Yellowstone Grizzly Bear Investigations 2018

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

2018

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

2019

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

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

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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 2018. 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 manuscript publications, and the peer review process.

New Section: Occupied Range

Starting with this annual report, we will include a new section every other year to provide an update on occupied range. The IGBST estimates occupied range every 2 years, using techniques described in Bjornlie et al. (2014). Estimates of occupied range over time provide important insights into the dynamics of the population. For example, grizzly bears now occupy areas well beyond the Demographic Monitoring Area (DMA), including areas where they have not been present for decades or longer. On the periphery of occupied range, this increasingly includes areas with lower habitat suitability and greater human use of the landscape. Human-bear conflicts are more likely in such areas, presenting a substantial challenge to management agencies, landowners, residents, and recreationists. Documenting occupied range and outlier observations (verified observations of grizzly bears that are outside of occupied range) provides an important indication of where future range expansion may occur and thus helps managers to be proactive with outreach programs and landowner assistance.

The latest iteration of the occupied range analysis is presented on page 25. Occupied range estimates have more than quadrupled since the 1970s. Fig. 5 in this report shows occupied range for 4 different years within the period 1990–2018. An animated map with annual time steps for this entire time period can be viewed on the IGBST website. An important message from these analyses is that land ownership and landscape characteristics associated with newly occupied range is different from occupied areas in the core. This provides a useful context for interpretation of human-bear conflict data. Human-bear conflicts within Yellowstone National Park and the Recovery Zone were relatively high in the 1970s and 1980s but generally declined over time as more management efforts were directed to address human-bear conflicts; access to anthropogenic foods and livestock depredation were the primary conflict types that were reduced through food storage regulations and the retirement of livestock allotments on federal lands. As the population expanded beyond the Recovery Zone, where the human footprint is greater, conflicts concurrently increased. This also led to shifts in the type of conflicts that bears are most often involved in, transitioning from the acquisition of anthropogenic food sources to livestock depredations, the latter being a much more challenging conflict type to address. This pattern is repeating itself today, with almost 30% of occupied range now extending beyond the boundaries of the DMA and increasingly onto private lands (currently ~18%).

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 2018, the model-averaged Chao2 estimate was 56 females with cubs within the DMA, from which we derived a total population estimate of 714 (see "***Estimating Number of Females with Cubs***"). These estimates are similar to those from previous years.

Referencing the total population estimate of 714 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 2002–2018 was 7.0% for independent females and 9.8% 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. The small number of ungulate carcasses observed in recent survey years were insufficient for trend analysis. We refer to the 2017 annual report for the final summary of the spring ungulate carcass surveys.

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 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 Recovery Zone (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 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 of 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).

Development and enhancement of data collection and analysis techniques continues. As our summaries of recent longitudinal studies underscore, through long-term research and monitoring we continue to collect detailed data to support a variety of analyses, providing researchers and managers with a comprehensive assessment of population dynamics. We are currently in the process of 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.

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 contributions to data collection, analysis, and other phases of IGBST research. **IDFG**: C. Anderson, P. Atwood, J. Beer, C. Bleke, J. Brower, L. Cepenzski, D. Cureton, J. Farr, K. Garrett, K. Guy, C. Hendricks, R. Howe, C. Johnson, L. Lane, G. Losinski, A. McKarley, J. Nicholson, T. Nicholson, M. Pieron, R. Poole, M. Proett, J. Rydalch, J. White: **MSU**: M. Higgs; **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** N. Adams, G. Angelo, B. Apel, K. Atkins, B. Bennett, J. Bennett, D. Bergum, N. Bowersock, E. Boyd, C. Butler, M.K. Clark, R. Coscarelli, S. Dewey, C. Donovan, J. Erwin, R. Evans, C. Flaherty, C. Greenbaum, S. Greenbaum, G. Grieco, K. Gunther, D. Gustine, C. Hayden, T. Hayden, A. Hanna, K. Harrigan,
D. Harris, S. Hegg, B. Helms, D. Houck, J. Jakicic, B. Johns, E. Johnston, P. Kirchner, M. Landry, C. Liesen, J. Lodge, E. Maki, T.J. Mascia, R. Mascia, S. Mayberry, J. Mills, J. Mohr, J. Moul, L. Muir, P. Navaille, S. Nestler, E. Reinertson, M. Renteria, T. Ritter, A. Rodriguez, J. Roper, W. Scherer, D. Schneider, C. Schoner, P. Schoner, J. Schwabedissen, M. Scott, D. Stahler, P. Stalker, J. Stephenson, L. Stevenson, B. Swift, B. Tatu, T. Tatu, S. Stewart, L. Templin, C. Valdez, J. Warren, G. White, A. Willemain, C. Willemain, J. Willemain, K. Wilmot, G. Wilson, L. Wofford, R. Wofford, M. Wrigley, T. Wyman, A. Zuckerman; **Pilots and Observers**: S. Ard, N. Cadwell, J. Ortman, M. Packila, K. Robinson, J. Romero, T. Schell; **Shoshone and Arapaho Tribes**: J. Friday, A. Lawson, B. Snyder; **USFS**: J. Brandl, S. Derusseau, L. Dickerson, S. Halman, A. Pils, S. Pils, C. Pultz, D. Tyers, L. Raadt; **USFWS**: H. Cooley, L. Connell, J. Fortin-Noreus, P. Hnilicka, M. Mazur, C. Servheen, S. Stoinski; **USGS**: D. Dickinson, M. Ebinger, M. Kurzen, V. Villalobos, C. Whitman; **WS**: K. Glazier, T.J. Dorvall, C. Hoover, J. Meitdke, G. McDougal, J. Rost, D. Tidwell; **WGFD:** G. Anderson, C. Atkinson, B. Baker, D. Bjornlie, M. Boyce, J. Clapp, D. Clause, A. Courtemanch, B. Debolt, L. Ellsbury, T. Fieseler, G. Fralick, R. Fuda, M. Gocke, Z. Gregory, H. Haley, A. Johnson, R. Kindermann, J. Kraft, B. Kroger, K. Lash, D. Lasseter, T. Mong, P. Quick, S. Ryder, J. Stephens, D. Thompson, Z. Turnbull, B. Wise, L. Wood. Without the collection efforts, contributions, and dedication of all these people, the information contained within this report would not be available. Finally, we thank S. Becker (U.S. Fish and Wildlife Service) and S. Consolo-Murphy (National Park Service) for their reviews of this report as part of the USGS Fundamental Science Practices.

BEAR MONITORING AND POPULATION TREND

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

During the 2018 field season, we captured 112 individual grizzly bears on 129 occasions (Table 1), including 36 females (22 adult), 73 males (47 adult) and 3 bears (2 yearlings, 1 adult) of unknown sex (Table 1). The yearlings of unknown sex were captured at a research trap site and a cattle depredation site and were released without handling. The third bear of unknown sex was a probable mortality from a management action on the Beaverhead-Deerlodge National Forest. This bear was shot and presumed mortally wounded at a cattle depredation site, but the carcass was not recovered (Table 1, mort# 201831).

Seventy-eight (69.4%) of the 112 individual bears were not previously marked. The percent of previously unmarked individual grizzly bears captured annually has remained relatively constant during the period 1998–2018, averaging 62%, with no evidence ($F = 0.008$, 1 *df*, $P = 0.928$) of a change in trend (Fig. 1). As we have noted in previous reports, this finding continues to support the notion that in this closed population bears are recruiting into the population at a relatively constant rate. We would expect the number of new bears encountered annually to decline if individuals were not recruiting into the population.

We conducted research trapping efforts for a total of 473 trap days (1 trap day = 1 trap set for 1 day). During research trapping operations we had 57 captures of 50 individual grizzly bears for a trapping success rate of 1 grizzly capture every 8.3 trap days. All research captures were within the Demographic Monitoring Area (DMA).

There were 72 management captures of 64 individual bears during 2018 (Tables 1 and 2), including 22 females (12 adults), and 40 males (20 adults). Twenty-five management captures of 21 individual bears (8 females, 13 males) occurred outside the DMA. As mentioned previously, sex was unknown for 2 bears involved in management actions. Twenty-seven individual bears (11 females, 16 males) were relocated because of conflict situations (Table 1). One subadult female (#954, Table 1) was transported twice. The initial capture and transport for bear #954 was for increasingly bold behavior near ranch buildings; the second was related to a non-target capture at a cattle depredation site. One subadult male (#946, Table 1) was initially captured at a research trap site and was later captured and transported for cattle depredation. Another subadult male (#943, Table 1) was initially captured at a research traps site and was later captured and relocated because it was deemed responsible for nearby conflicts. This bear subsequently returned and was removed (live removal to zoo) after additional conflicts. In total, there were 40 management captures that resulted in removals (11 females, 28 males, 1 unknown sex) during 2018 (Table 1). Eight bears (3 females, 5 males) were removed after previous capture and relocations attempts (Table 1).

We radiomonitored 106 individual grizzly bears during the 2018 field season, including 53 females, 43 of which were adults (Tables 2 and 3). Sixty-three grizzly bears entered their winter dens wearing active transmitters. Since 1975, 944 individual grizzly bears have been radiomarked in the GYE.

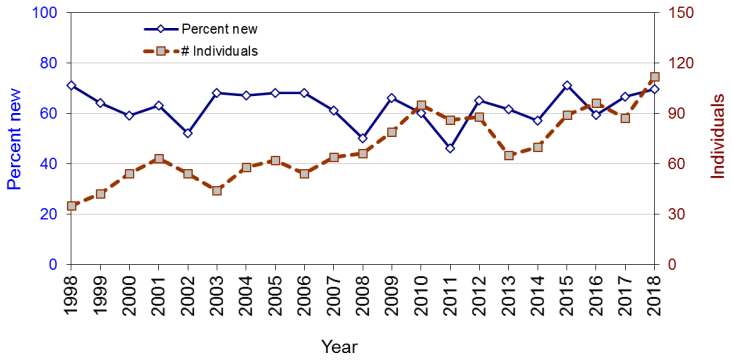


Fig. 1. Percent of previously unmarked and total number of grizzly bears captured annually in the Greater Yellowstone Ecosystem, 1998–2018.

Table 1. Grizzly bears captured in the Greater Yellowstone Ecosystem during 2018.							
Bear	Sex	Age	Date	General location[a]	Capture type	Release site[b]	Handler[c]
649	Male	Adult	04/10/18	Rawhide Crk, PR-WY	Management	Removed (#201801)	WGFD
921	Male	Subadult	04/24/18	Bull Crk, PR-WY	Management	Transport	WGFD
921	Male	Subadult	09/01/18	South Fork Shoshone, PR-WY	Management	Removed (#201836)	WGFD
Unm1	Male	Adult	04/29/18	Pat O'Hara, PR-WY	Management	Removed (#201802)	WGFD
Unm2	Male	Adult	05/08/18	Clarks Fork Yellowstone, SNF	Management	Removed (#201803)	WGFD
Unm3	Male	Adult	05/09/18	Green Crk, PR-WY	Management	Removed (#201804)	WGFD
922	Male	Adult	05/25/18	Pacific Crk, GTNP	Research	On site	IGBST/GTNP
G234	Male	Subadult	05/29/18	Pacific Crk, GTNP	Research	On site	IGBST
Unm4	Female	Subadult	05/30/18	Blaine Crk, BLM-WY	Management	Removed (#201813)	WGFD
G235	Male	Subadult	05/30/18	Cottonwood Crk, PR-WY	Management	Transport	WGFD
363	Male	Adult	06/07/18	Pacific Crk, GTNP	Research	On site	IGBST/GTNP
810	Male	Adult	06/07/18	Snake River, GTNP	Research	On site	IGBST/GTNP
810	Male	Adult	06/09/18	Spread Crk, GTNP	Research	On site	IGBST/GTNP
810	Male	Adult	06/15/18	Pacific Crk, GTNP	Research	On site	IGBST/GTNP
923	Male	Adult	06/10/18	Pacific Crk, GTNP	Research	On site	IGBST/GTNP
924	Female	Subadult	06/13/18	Pacific Crk, GTNP	Research	On site	IGBST/GTNP
925	Male	Adult	06/13/18	Reef Crk, SNF	Research	On site	WGFD
Unm5	Unk	Yearling	06/13/18	Ghost Crk, SNF	Research	On site	WGFD
926	Female	Subadult	06/15/18	Snake River, GTNP	Research	On site	IGBST/GTNP
927	Male	Adult	06/15/18	Ghost Crk, SNF	Research	On site	WGFD
928	Male	Adult	06/16/18	Sunlight Crk, SNF	Research	On site	WGFD
928	Male	Adult	06/20/18	Gravelbar Crk, SNF	Research	On site	WGFD
929	Male	Subadult	06/18/18	Wigwam Crk, BDNF	Research	On site	IGBST
930	Female	Adult	06/18/18	Deadman Crk, SNF	Research	On site	WGFD
931	Male	Adult	06/19/18	Wigwam Crk, BDNF	Research	On site	IGBST
G236	Male	Subadult	06/20/18	Deadman Crk, SNF	Research	On site	WGFD
932	Male	Adult	06/20/18	Reef Crk, SNF	Research	On site	WGFD
786	Female	Adult	06/21/18	Deadman Crk, PR-MT	Research	On site	IGBST
Unm6	Male	Adult	06/22/18	Bull Crk, BLM-WY	Management	Removed (#201818)	WGFD
Unm7	Male	Adult	06/22/18	Foster Gulch, PR-MT	Management	Removed (#201819)	WS
933	Female	Adult	06/22/18	Ghost Crk, SNF	Research	On site	WGFD
G237	Male	Adult	06/23/18	Gravelbar Crk, SNF	Research	On site	WGFD
G196	Male	Adult	06/23/18	Deadman Crk, SNF	Research	On site	WGFD
712	Male	Adult	06/26/18	Beem Gulch, SNF	Research	On site	WGFD
G238	Male	Adult	06/27/18	Gravelbar Crk, SNF	Research	On site	WGFD
384	Female	Adult	06/28/18	Reef Crk, SNF	Research	On site	WGFD

Table 1. Continued							
Bear	Sex	Age	Date	General location[a]	Capture type	Release site[b]	Handler[c]
934	Male	Adult	07/01/18	Pilgrim Crk, GTNP	Research	On site	IGBST/GTNP
934	Male	Adult	07/06/18	Pilgrim Crk, GTNP	Research	On site	IGBST/GTNP
934	Male	Adult	07/09/18	Pacific Crk, GTNP	Research	On site	IGBST/GTNP
935	Male	Subadult	07/05/18	Henrys Fork, CTNF	Research	On site	IDFG
G239	Male	Subadult	07/05/18	Henrys Fork, CTNF	Research	On site	IDFG
936	Male	Subadult	07/03/18	Wagon Crk, BTNF	Management	Transport	WGFD
841	Male	Adult	07/08/18	Crow Crk, BTNF	Management	Removed (#201820)	WGFD
899	Female	Adult	07/09/18	Warm River, CTNF	Research	On site	IDFG
937	Male	Subadult	07/11/18	Mill Crk, CTNF	Management	Transport	IDFG
937	Male	Subadult	07/20/18	Mill Crk, CTNF	Management	Removed (#201823)	IDFG
938	Male	Adult	07/13/18	Jesse Crk, CTNF	Research	On site	WGFD/WRIR
344	Male	Adult	07/13/18	Wagon Crk, BTNF	Management	Removed (#201821)	WGFD
592	Male	Adult	07/13/18	Mosquito Lake, BTNF	Management	Removed (#201822)	WGFD
Unm 8	Unk	Yearling	07/13/18	Wagon Crk, BTNF	Management	On site	WGFD
G240	Male	Subadult	07/16/18	South Fork Fish Crk, BTNF	Management	On site	WGFD
939	Male	Adult	07/19/18	Bull Lake Crk, WRIR	Research	On site	WGFD
940	Male	Adult	07/21/18	East Dry Crk, CTNF	Management	Transport	IDFG
941	Male	Adult	07/25/18	Bob Crk, WRIR	Research	On site	WGFD/WRIR
G241	Male	Subadult	07/24/18	Wagonfeur Crk, PR-WY	Management	Transport	WGFD
G242	Female	Yearling	07/24/18	Gypsum Crk, BTNF	Management	Transport	WGFD
G243	Male	Yearling	07/25/18	Gypsum Crk, BTNF	Management	Transport	WGFD
G244	Female	Yearling	07/25/18	Gypsum Crk, BTNF	Management	Transport	WGFD
439	Female	Adult	07/25/18	Gypsum Crk, BTNF	Management	Removed (#201825)	WGFD
942	Female	Adult	07/29/18	East Dry Crk, CTNF	Research	On site	IDFG
G245	Male	Subadult	07/31/18	Jesse Crk, CTNF	Research	On site	IDFG
Unm 9	Male	Adult	08/01/18	Gypsum Crk, BTNF	Management	Removed (#201827)	WGFD
G246	Female	Subadult	08/02/18	Henrys Fork, CTNF	Research	On site	IDFG
723	Male	Adult	08/05/18	Gypsum Crk, BTNF	Management	Removed (#201828)	WGFD
808	Male	Adult	08/04/18	Paint Crk, PR-WY	Management	Removed (#201829)	WGFD
906	Female	Adult	08/06/18	Henrys Fork, CTNF	Research	On site	IDFG
G247	Male	Subadult	08/07/18	Wagon Crk, BTNF	Management	Transport	WGFD
943	Male	Yearling	08/08/18	Henrys Fork, CTNF	Research	Transport	IDFG
943	Male	Yearling	08/14/18	Henrys Fork, PR-ID	Management	Removed (#201827)	IDFG
859	Male	Subadult	08/08/18	Wagon Crk, BTNF	Management	Transport	WGFD
859	Male	Subadult	09/06/18	Fish Crk, BTNF	Management	Removed (#201840)	WGFD
872	Male	Adult	08/11/18	Blind Crk, CTNF	Research	On site	IDFG

Table 1. Continued

Bear	Sex	Age	Date	General location[a]	Capture type	Release site[b]	Handler[c]
Unm10	Unk	Adult	08/11/18	Freezeout Crk, BDNF	Management	Removed (#201831)	WS
913	Female	Adult	08/13/18	Bear Crk, CTNF	Research	On site	IDFG
740	Male	Adult	08/13/18	Wagon Crk, BTNF	Management	Removed (#201832)	WGFD
Unm11	Female	Adult	08/09/18	JK Crk, WRIR	Management	Removed (#201833)	WRIR
944	Male	Subadult	08/17/18	South Fork Shoshone, PR-WY	Management	Transport	WGFD
945	Male	Adult	08/18/18	Tosi Crk, PR-WY	Management	Transport	WGFD
946	Male	Subadult	08/19/18	Middle Soda Crk, BTNF	Research	On site	WGFD
946	Male	Adult	09/10/18	Tepee Crk, BTNF	Management	Transport	WGFD
947	Female	Adult	08/23/18	Crow Crk, BTNF	Management	Transport	WGFD
948	Female	Adult	08/24/18	Buffalo Crk, YNP	Research	On site	IGBST
949	Female	Subadult	08/25/18	Henrys Fork, CTNF	Research	On site	IDFG
860	Male	Adult	08/30/18	Reader Crk, PR-MT	Management	Removed (#201835)	WS/MTFWP
738	Male	Adult	09/04/18	North Fork Shoshone, PR-WY	Management	Removed (#201838)	WGFD
Unm12	Male	Adult	09/04/18	South Fork Owl Crk, PR-WY	Management	Removed (#201839)	WGFD
771	Female	Adult	09/06/18	Paint Crk, PR-WY	Management	Transport	WGFD
771	Female	Adult	10/25/18	Shoshone River, PR-WY	Management	Removed (#201867)	WGFD
G248	Male	Cub	09/06/18	Paint Crk, PR-WY	Management	Transport	WGFD
G248	Male	Cub	10/25/18	Shoshone River, PR-WY	Management	Removed (#201868)	WGFD
G249	Female	Cub	09/06/18	Paint Crk, PR-WY	Management	Transport	WGFD
G249	Female	Cub	10/25/18	Shoshone River, PR-WY	Management	Removed (#201869)	WGFD
Unm13	Female	Cub	09/06/18	Paint Crk, PR-WY	Management	Mortality (#201841)	WGFD
950	Female	Subadult	09/07/18	Slab Crk, PR-WY	Management	Transport	WGFD
951	Male	Subadult	09/12/18	South Fork Owl Crk, ST-WY	Management	Transport	WGFD
Unm14	Female	Adult	09/16/18	Soda Fork, BTNF	Management	Removed (#201843)	WGFD
Unm15	Male	Yearling	09/16/18	Soda Fork, BTNF	Management	Removed (#201844)	WGFD
480	Male	Adult	09/20/18	Antelope Crk, YNP	Research	On site	IGBST
480	Male	Adult	10/04/18	Cascade Crk, YNP	Research	On site	IGBST
813	Male	Adult	09/20/18	Stephens Crk, YNP	Research	On site	IGBST
Unm11	Unk	Adult	08/11/18	Freezeout Crk, BDNF	Management	Removed (#201831)	WS
567	Female	Adult	08/13/18	Bear Crk, CTNF	Research	On site	IDFG

Table 1. Continued

Bear	Sex	Age	Date	General location[a]	Capture type	Release site[b]	Handler[c]
791	Male	Adult	09/22/18	Flat Mountain Crk, YNP	Research	On site	IGBST
952	Female	Adult	09/22/18	Stephens Crk, YNP	Research	On site	IGBST
887	Male	Adult	09/22/18	Stephens Crk, YNP	Research	On site	IGBST
651	Male	Adult	09/25/18	Corral Crk, SNF	Management	Removed (#201849)	WGFD
953	Male	Adult	09/29/18	Flat Mountain Crk, YNP	Research	On site	IGBST
954	Female	Subadult	09/29/18	South Fork Shoshone, PR-WY	Management	Transport	WGFD
954	Female	Subadult	10/16/18	South Fork Shoshone, PR-WY	Management	Transport	WGFD
Unm18	Male	Subadult	09/30/18	Clarks Fork Yellowstone, PR-WY	Management	Removed (#201851)	WGFD
955	Female	Subadult	09/30/18	Yellowstone River, PR-MT	Management	Transport	MTFWP
955	Female	Subadult	10/16/18	Yellowstone River, PR-MT	Management	Removed (#201864)	MTFWP
589	Male	Adult	10/01/18	Arnica Crk, YNP	Research	On site	IGBST
589	Male	Adult	10/10/18	Arnica Crk, YNP	Research	On site	IGBST
688	Male	Adult	10/02/18	Arnica Crk, YNP	Research	On site	IGBST
Unm19	Male	Subadult	10/02/18	Clarks Fork Yellowstone, PR-WY	Management	Removed (#201853)	WGFD
Unm20	Female	Adult	10/03/18	Whit Crk, PR-WY	Management	Removed (#201856)	WGFD
Unm21	Male	Yearling	10/03/18	Whit Crk, PR-WY	Management	Removed (#201857)	WGFD
Unm22	Male	Yearling	10/03/18	Whit Crk, PR-WY	Management	Removed (#201858)	WGFD
Unm23	Female	Yearling	10/04/18	Yellowstone River, PR-MT	Management	Removed (#201862)	MTFWP
394	Male	Adult	10/05/18	Cascade Crk, YNP	Research	On site	IGBST
Unm24	Male	Adult	10/07/18	Flat Mountain Crk, YNP	Research	On site	IGBST
956	Female	Adult	10/07/18	Hunter Crk, PR-WY	Management	Transport	WGFD
896	Female	Adult	10/15/18	Green River, BTNF	Management	Transport	WGFD
G250	Male	Subadult	10/16/18	Green River, BTNF	Management	Transport	WGFD
957	Female	Adult	10/16/18	Elbow Crk, PR-MT	Management	Transport	MTFWP
734	Female	Adult	10/16/18	South Fork Shoshone, PR-WY	Management	On site	WGFD
G065	Female	Adult	10/19/18	Corral Crk, SNF	Management	Removed (#201865)	WGFD
G251	Female	Yearling	10/20/18	Corral Crk, SNF	Management	On site	WGFD

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

[b] Numbers in parentheses are assigned mortality numbers

[c] IDFG = Idaho Fish and Game; IGBST = Interagency Grizzly Bear Study Team, USGS; 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, 1980–2018.

Year	Number monitored	Individuals trapped	Total captures		Transports
			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

Table 3. Grizzly bears radiomonitored in the Greater Yellowstone Ecosystem during 2018.						
				Monitored		
Bear	Sex	Age	Offspring	Out of den	Into den	Current status
363	M	Adult		No	No	Cast
384	F	Adult	None	No	No	Cast
394	M	Adult		Yes	Yes	Active
399	F	Adult	2 yearlings	Yes	No	Cast
480	M	Adult		No	No	Cast
506	M	Adult		Yes	No	Cast
516	M	Adult		Yes	No	Cast
589	M	Adult		No	Yes	Active
653	M	Adult		Yes	No	Cast
676	F	Adult	2 cubs	Yes	No	Killed
678	F	Adult	2 yearlings, 2 lost?	Yes	No	Cast
679	M	Adult		Yes	No	Cast
688	M	Adult		No	Yes	Active
695	M	Adult		Yes	No	Cast
712	M	Adult		No	Yes	Active
734	F	Adult	1 cub	No	Yes	Active
743	F	Adult	2 cubs	Yes	Yes	Active
749	F	Adult	1 cub	Yes	No	Cast
762	F	Adult	1 cub, lost?	Yes	Yes	Active
763	M	Adult		Yes	No	Cast
771	F	Adult	3 cubs, removed	No	No	Removed
772	M	Adult		Yes	No	Missing
773	F	Adult	None	Yes	Yes	Active
782	M	Adult		No	No	Cast
786	F	Adult	None	Yes	Yes	Active
789	M	Adult		Yes	No	Cast
791	M	Adult		No	Yes	Active
810	M	Adult		Yes	No	Cast
815	F	Adult	1 2-year old, weaned	Yes	No	Cast
833	F	Adult	1 yearling	Yes	Yes	Active
848	F	Adult	None	Yes	No	Cast
851	F	Adult	1 yearling	Yes	No	Cast
853	M	Adult		Yes	Yes	Active
859	M	Subadult		No	No	Removed
863	F	Adult	None	Yes	Yes	Active
867	F	Adult	None	Yes	Yes	Active
868	F	Adult	None	Yes	Yes	Active
869	F	Adult	2 cubs	Yes	Yes	Active
875	F	Adult	2 yearlings, lost 1?	Yes	No	Cast/dead?
876	F	Adult	None	Yes	Yes	Active
878	M	Adult		Yes	No	Missing
879	M	Subadult		No	No	Cast

Table 3. Continued.

Bear	Sex	Age	Offspring	Monitored		Current status
				Out of den	Into den	
880	M	Adult		Yes	Yes	Active
883	F	Adult	None	Yes	No	Cast
886	F	Subadult	None	Yes	Yes	Active
887	M	Adult		No	Yes	Active
888	M	Adult		Yes	No	Cast
890	M	Subadult		Yes	No	Cast
893	F	Adult	None	Yes	Yes	Active
895	F	Adult	3 cubs	Yes	Yes	Active
896	F	Adult	2 cubs, lost 1?	Yes	Yes	Active
898	F	Adult	2 2-year olds, weaned	Yes	No	Cast
899	F	Adult	1 cub, lost	Yes	Yes	Active
900	F	Subadult	None	Yes	No	Missing
902	M	Adult		Yes	No	Cast
905	F	Adult	3 2-year olds, weaned	Yes	Yes	Active
906	F	Adult	1 2-year old, weaned	Yes	Yes	Active
907	F	Adult	None	Yes	Yes	Active
908	M	Subadult		Yes	No	Cast
909	F	Adult	None	Yes	No	Cast
911	F	Adult	2 cubs	Yes	Yes	Active
912	F	Subadult	None	Yes	No	Cast
913	F	Adult	2 cubs	Yes	Yes	Active
914	F	Adult	2 yearlings, lost 2?	Yes	Yes	Active
915	F	Adult	None	Yes	No	Dead
916	M	Adult		Yes	Yes	Active
917	M	Adult		Yes	Yes	Active
918	M	Subadult		Yes	No	Den/cast?
919	F	Subadult	None	Yes	No	Dead
921	M	Subadult		No	No	Removed
922	M	Adult		No	Yes	Active
923	M	Adult		No	No	Cast
924	F	Subadult	None	No	Yes	Active
925	M	Adult		No	No	Cast
926	F	Subadult	None	No	Yes	Active
927	M	Adult		No	No	Killed
928	M	Adult		No	Yes	Active
929	M	Subadult		No	Yes	Active
930	F	Adult	None	No	Yes	Active
931	M	Adult		No	No	Cast
932	M	Adult		No	No	Dead
933	F	Adult	None	No	Yes	Active
934	M	Adult		No	Yes	Active

Table 3. Continued.

Bear	Sex	Age	Offspring	Monitored		Current status
				Out of den	Into den	
935	M	Subadult		No	Yes	Active
936	M	Subadult		No	Yes	Active
937	M	Subadult		No	No	Removed
938	M	Adult		No	Yes	Active
939	M	Adult		No	Yes	Active
940	M	Adult		No	No	Cast
941	M	Adult		No	Yes	Active
942	F	Adult	2 cubs, lost 1?	No	Yes	Active
943	M	Subadult		No	No	Live removal
944	M	Subadult		No	Yes	Active
945	M	Adult		No	Yes	Active
946	M	Subadult		No	Yes	Active
947	F	Adult	None	No	Yes	Active
948	F	Adult	2 cubs	No	Yes	Active
949	F	Subadult	None	No	Yes	Active
950	F	Subadult	None	No	No	Missing
951	M	Subadult		No	Yes	Active
952	F	Adult	None	No	Yes	Active
953	M	Adult		No	Yes	Active
954	F	Subadult	None	No	Yes	Active
955	F	Subadult	None	No	No	Removed
956	F	Adult	None	No	Yes	Active
957	F	Adult	None	No	Yes	Active

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

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

Background

Under 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 2018 findings for counts of unique females with cubs, and the total population estimate derived from numbers of females with cubs observed within the Demographic Monitoring Area (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 number of unique females with cubs estimated using the Knight et al. (1995) method is biased low and becomes more biased 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 the DMA.

2018 Sightings of Females with Cubs

We documented 172 verified sightings of females with cubs during 2018 in the GYE. Nearly twice as many observations of females with cubs were obtained from aerial sources (67.4%) than from ground observers (32.6%, Table 4). We differentiated 58 unique females with cubs from the 172 sightings using the rule of Knight et al. (1995). Eighteen sightings (10.5%) of 8 unique females occurred outside the DMA (Fig. 2). Two of the 58 unique females were only observed (each with 1 sighting) outside the DMA. Thirty-eight (22.1%) observations from an estimated 8 unique females with cubs occurred within the boundary of Yellowstone National Park (YNP).

The total number of cubs observed during initial sightings of the 58 unique females with cubs was 119 and mean litter size was 2.05 (Table 5). There were 11 single cub litters, 33 litters of twins, and 14 litters of triplets (Table 5). Using the initial sightings of all females with cubs observed within the DMA total cubs was 114 and mean litter size was 2.04.

2018 DMA Chao2 and Population Estimate

Excluding the 18 sightings (2 females) observed outside the DMA and sightings of 6 family groups based on telemetry only, which are not independent observations, we obtained 116 observations of 50 unique families. Using the sighting frequencies, our estimate of the number of unique females with cubs within the DMA was $\hat{N}_{DMAChao2} = 55$. Applying the linear and quadratic regressions produced a model-averaged estimate of $\hat{N}_{DMAChao2} = 56$ (95% CI = 45–70). The 2017 Revised Demographic Criteria specify a minimum of 48 females with cubs (USFWS 2017). Applying the

updated 2002–2011 vital rates to $\hat{N}_{DMAChao2}$ produced a total population estimate for the DMA of 714 (Table 7).

We used the annual $\hat{N}_{Chao2}$ for the DMA during the period 1983–2018 (Table 6) to evaluate trend for the female with cubs segment of the population (Fig. 3). With the 2018 addition, AIC_c weights (Table 8) continue to support the quadratic (92.9%) over the linear (7.1%) model, with a strong quadratic effect ($\beta = -0.00100$, $P = 0.008$; Table 8). These data are similar to previous years and show a leveling off of population growth for the geographically restricted area of the DMA; this was not unexpected and is consistent with other data and analyses. The linear regression of $\hat{N}_{Chao2}$ values with year for the period 2002–2018 shows no support for either a positive or negative trend ($F = 1.621$, 1 df, $P = 0.222$).

Table 4. Method of observation for female grizzly bears with cubs sighted in the Greater Yellowstone Ecosystem, 2018.

Method of observation	Frequency	%	Cumulative %
Fixed wing aircraft – incidental	7	4.1	4.1
Fixed wing aircraft – observation flight	58	33.7	37.8
Fixed wing aircraft – telemetry flight	48	27.9	65.7
Fixed wing aircraft – ferry time	3	1.7	67.4
Helicopter – other researcher	0	0	67.4
Ground sighting	55	32	99.4
Trap	1	0.6	100
Total	172	100	

A grizzly bear cub hiding under mom (photo courtesy of Jake Davis)

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, 1983–2018.

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

[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, 1983–2018. Estimates in parenthesis for 2012–2018 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)

[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, 2018.

Segment	Estimate[a]	95% CI	
		Lower[b]	Upper[b]
Independent females (≥2 years old)	248	197	298
Independent males (≥2 years old)	248	193	302
Dependent young (cubs and yearlings)	219	197	240
Total	714	637	792

[a]Total estimate is different from total of the 3 population segments due to rounding error.
[b]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 1983–2018. During 2012–2018, Chao2 estimates were restricted to the Demographic Monitoring Area.

Model	Parameter	Estimate	Standard error	*t* value	*P*
Linear					
	β_0	3.02104	0.07666	39.41	<0.0001
	β_1	0.03303	0.00361	9.14	<0.0001
	SSE	1.7246			
	AIC_c	-102.637			
	AIC_c weight	0.08			
Quadratic					
	β_0	2.7912	0.10909	25.59	<0.0001
	β_1	0.06932	0.0136	5.1	<0.0001
	β_2	-0.00098	0.00036	-2.75	0.009
	SSE	1.40269			
	AIC_c	-107.534			
	AIC_c weight	0.92			

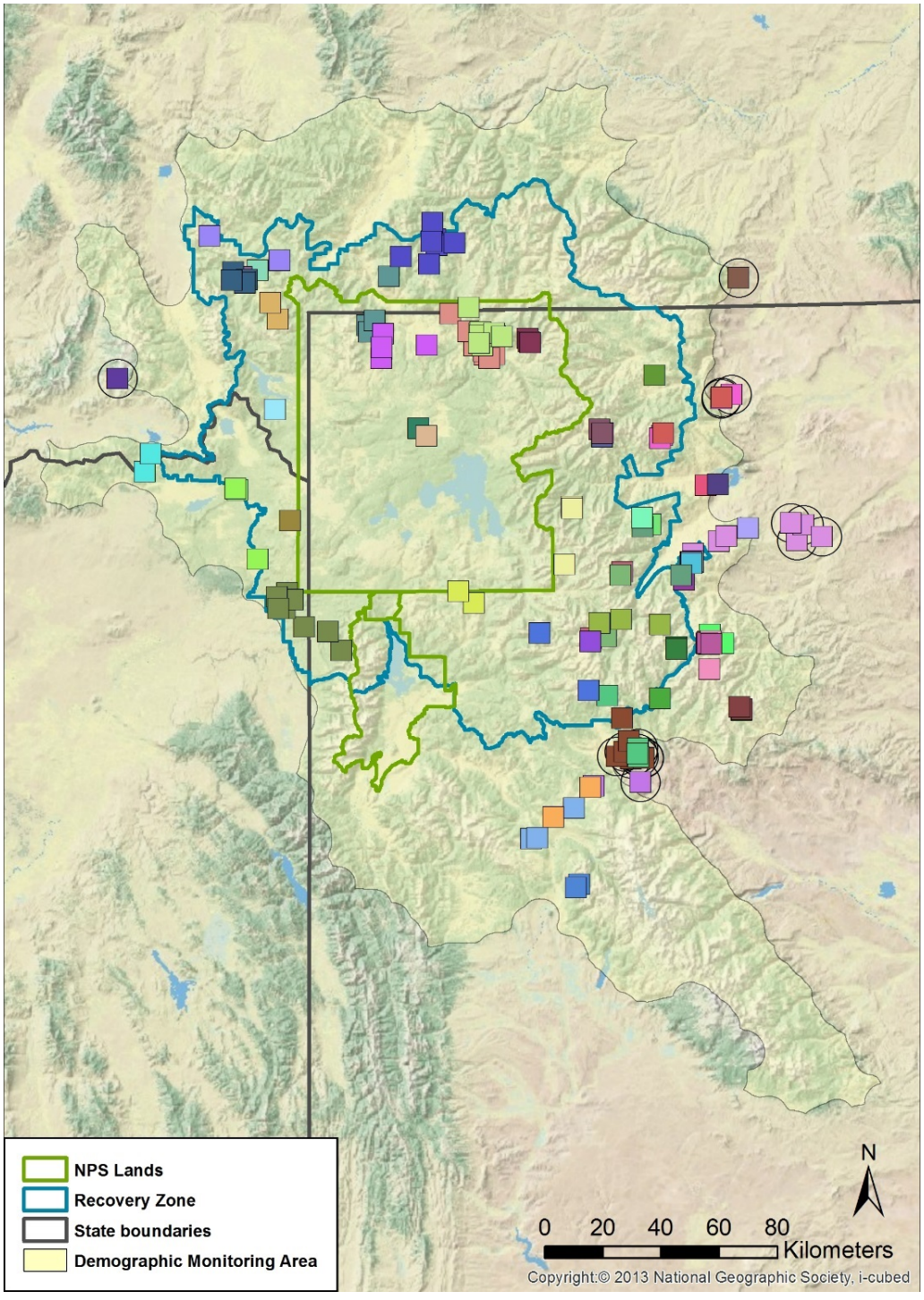


Fig. 2. Distribution of 172 sightings of 58 (indicated by unique colors) unduplicated female grizzly bears with cubs observed in the Greater Yellowstone Ecosystem, 2018. Only sightings from females with cubs occurring within the Demographic Monitoring Area (DMA) are used for population estimation. During 2018, 18 sightings (black circles around symbols) from 8 unique females with cubs occurred outside the DMA. Two of these females (1 observation each) were only observed outside the DMA.

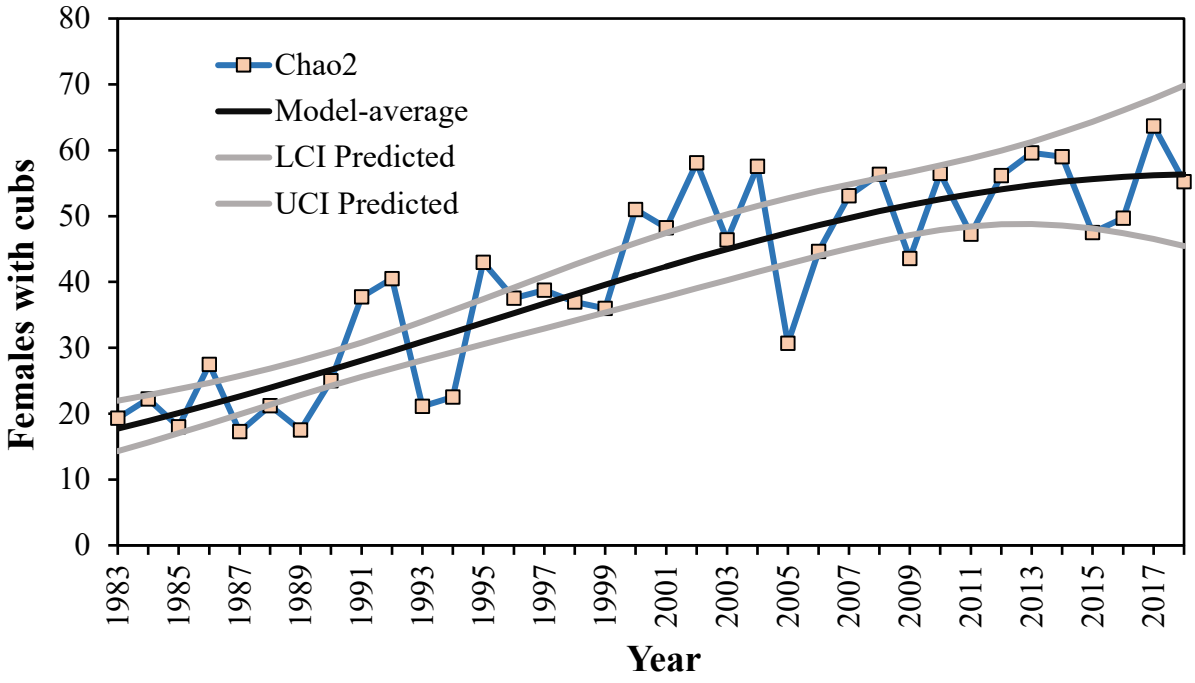


Fig. 3. Model-averaged estimates for the number of unique female grizzly bears with cubs, 1983–2018, where the linear and quadratic models of $Ln(\hat{N}_{Chao2})$ *were fitted. Estimates for 2012–2018 were restricted to the Demographic Monitoring Area (DMA). The inner set of gray solid lines represents a 95% confidence interval on the predicted population size.*

Female grizzly bear with cubs crossing a river (photo courtesy of Jake Davis)

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.

2018 Mark-Resight Results

Seven female grizzly bears with cub(s) wore functioning radio-transmitters during June-August 2018 when aerial observation flights were conducted and were available for sighting. One of these 7 families was observed once during observation flights >500 m from a moth site. The 6 other radio-marked females with cubs were not sighted during observation fights. All 7 females were included in the mark-resight analysis. We observed

19 unmarked females with cubs >500 m from moth sites (Table 9). Using the method of Higgs et al. (2013) with updated 1997–2018 data, and excluding observations at army cutworm moth aggregation sites, our 2018 mark-resight estimate for unique females with cubs was 81 (95% inter-quartile range = 45–137) with a low probability of ≤48 females with cubs ($P < 0.040$; Table 10). The mark-resight 3-year-moving average for 2017 (i.e., using 2016–2018 results) was 80 unique females with cubs (95% inter-quartile range = 52–123), with a $P = 0.010$ 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 2018.

Table 9. Data used in mark-resight analysis on female grizzly bears with cubs, Greater Yellowstone Ecosystem, 1997–2018, 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

[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, 1997–2018. 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

Table 11. Three-year moving average for mark-resight estimates of female grizzly bears with cubs, Greater Yellowstone Ecosystem, 1998–2017. 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

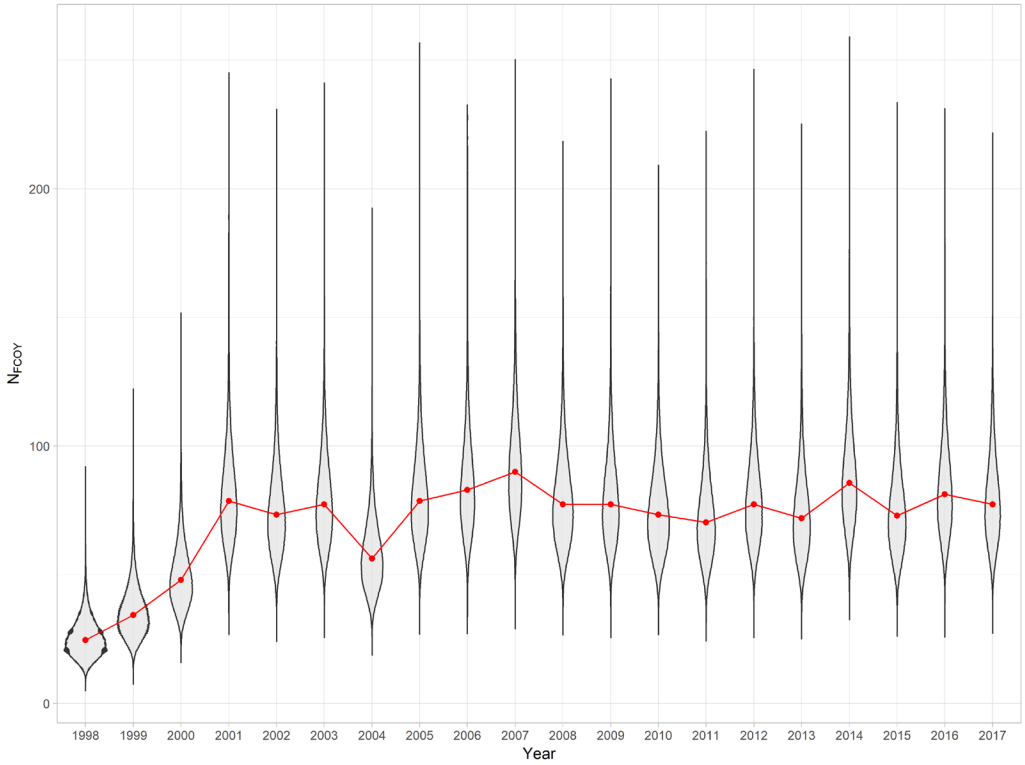


Fig. 4. Annual mark-resight estimates (3-year moving average [red dots], 95 % inter quartile [gray area]) of the number of female grizzly bears with cubs, Greater Yellowstone Ecosystem, 1998–2018. Estimates exclude females with cubs observed <500 m of army cutworm moth aggregation sites.

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

Dispersion of reproductive females throughout the ecosystem is assessed by verified observations of female grizzly bears with young (cubs, yearlings, 2-year-olds, or young of unknown age) by 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 2018 (Table 12). Eighteen of 18 BMUs contained verified observations of females with young in at least 4 years of the last 6-year (2013–2018) 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, 2013–2018.

Bear Management Unit	2013	2014	2015	2016	2017	2018	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	18	17	18	17	18	

Grizzly Bear Occupied Range in the Greater Yellowstone Ecosystem, 1990–2018 *(Daniel D. Bjornlie, Wyoming Game and Fish Department; and Mark A. Haroldson, U.S. Geological Survey, Interagency Grizzly Bear Study Team)*

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

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

Because grizzly bears are a long-lived species and the collection of confirmed locations over the entire GYE is not feasible on an annual basis, Bjornlie et al. (2014) recommended that location data be pooled over a 15–20 year period to ensure the data provide an accurate representation of grizzly bear occupied range. Therefore, we used a 15-year period of location data in a moving window analysis to provide annual estimates of occupied range. Thus, an annual estimate contains location data from that year and the previous 14 years (e.g., 2004–2018 for the year 2018).

Using this technique, analysis of grizzly bear locations from 1976 through 1990 produced an estimate of GYE grizzly bear occupied range almost entirely contained within the Grizzly Bear Recovery Zone established in the 1993 Grizzly Bear Recovery Plan (USFWS 1993) (Fig. 5). By the late 1990s, occupied range had grown slightly to the south and east, but was still mostly contained within the Recovery Zone (Fig. 5). However, in the 2000s, range expansion seemed to gain momentum and larger increases were seen, especially to the northwest and southeast (Fig. 5). The addition of 2018 location data resulted in nearly all of the Absaroka and Beartooth Ranges falling within grizzly bear occupied range, as well as the entire Wind River Range. To the west, the entirety of the Centennial and Gravelly Ranges are included, along with the previously occupied Madison and Gallatin Ranges (Fig. 5). To provide a spatial perspective, the portion of 2018 occupied range at the southeastern tip of the Wind River Range is closer to the town of Fort Collins, Colorado (366 km) than it is to Bozeman, Montana (403 km) at the northern extent of GYE grizzly bear range.

Perhaps even more striking than the expansion of occupied range is the continued progression of confirmed grizzly bear locations outside occupied range, particularly on the eastern side of the GYE. Indeed, in 2018 we documented two of the most-easterly confirmed locations since grizzly bears were listed under the ESA. Grizzly tracks were confirmed near Ocean Lake, approximately 25 km northwest of Riverton, Wyoming (Fig. 6). To the north, a female grizzly bear with 2 cubs was captured along the Shoshone River near the town of Byron, Wyoming, a heavily agricultural area approximately 50 km northeast of Cody, Wyoming. This location is 60 km east of the historically occupied Absaroka Mountains, but only 40 km west of the currently unoccupied Bighorn Mountains in north-central Wyoming (Fig 6), where grizzly bears have not been documented for nearly 100 years. In the northern GYE, grizzly bear locations have been confirmed as far north as Interstate 90 near Livingston and Big Timber, Montana (Fig. 6) and to the west, recent confirmed locations have been documented in the Blacktail Mountains just east of Interstate 15, south of the town of Dillon, Montana (Fig. 6).

Verified locations of grizzly bears in places novel in recent history have become relatively common in many areas of the GYE and beyond. Confirmed 2018 locations west of Interstate 15 in the Pioneer Mountains and Big Hole Valley near Wisdom, Montana are located outside the Yellowstone Distinct Population Segment and could be bears originating from either the Greater Yellowstone population or the Northern Continental Divide population in northwestern Montana. These outlying locations do not necessarily constitute occupied range, but reveal the leading edges of grizzly bear expansion within and between ecosystems.

From 1990 through 2018, the area of occupied range has increased steadily at a rate of 4% per year

from just over 23,000 km^2 to over 68,000 km^2 (Fig. 7). Grizzly bear occupied range now includes 97.5% of the Demographic Monitoring Area (DMA), and has expanded 20–30 km beyond the DMA boundary to the east and west and by as much as 59 km in the Wyoming Range in the southwestern portion of the GYE (Fig. 6). The 2018 data show that nearly 30% of GYE grizzly bear range is now outside the DMA boundary (Fig. 7). As grizzly bears advance into these areas, they are encountering more human-dominated landscapes, many of which are private lands dominated by agricultural uses (Fig. 8). By 1990, just over 600 km^2 of private lands were encompassed within grizzly bear occupied range, an area half the size of Grand Teton National Park. By 2018, nearly 12,000 km^2 of private lands occurred within occupied range, an area larger than Yellowstone and Grand Teton National Parks combined (Fig. 8). A consequence of this increased expansion into private lands is the increased potential for human-bear conflicts. The recovery of grizzly bears in the GYE is a remarkable wildlife conservation success story, but this success presents formidable new challenges for wildlife managers and people living, working, and recreating in these areas, particularly in recently occupied areas.

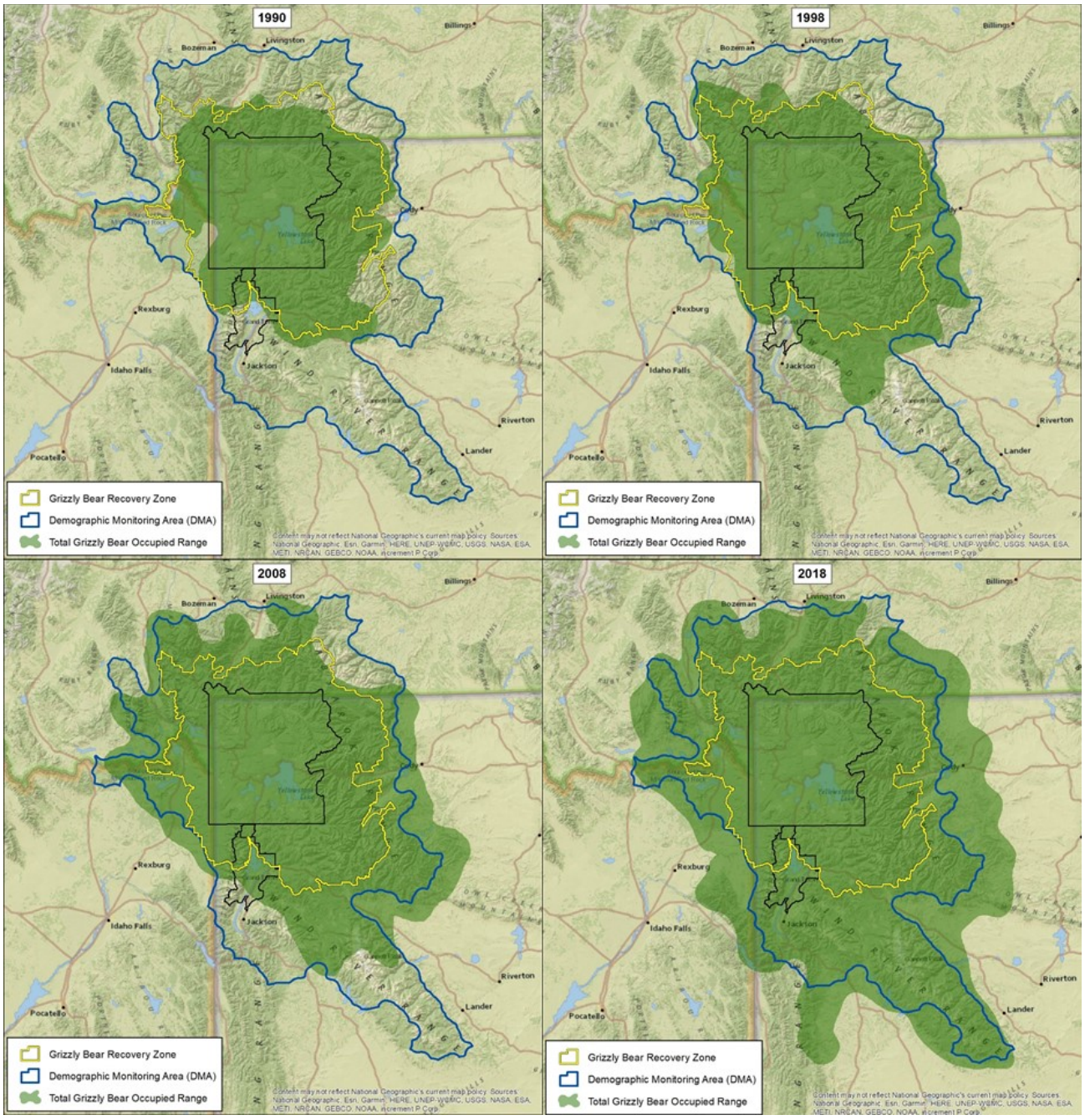


Fig. 5. Grizzly bear occupied range (green shaded area) in the Greater Yellowstone Ecosystem, 1990, 1998, 2008, and 2018.

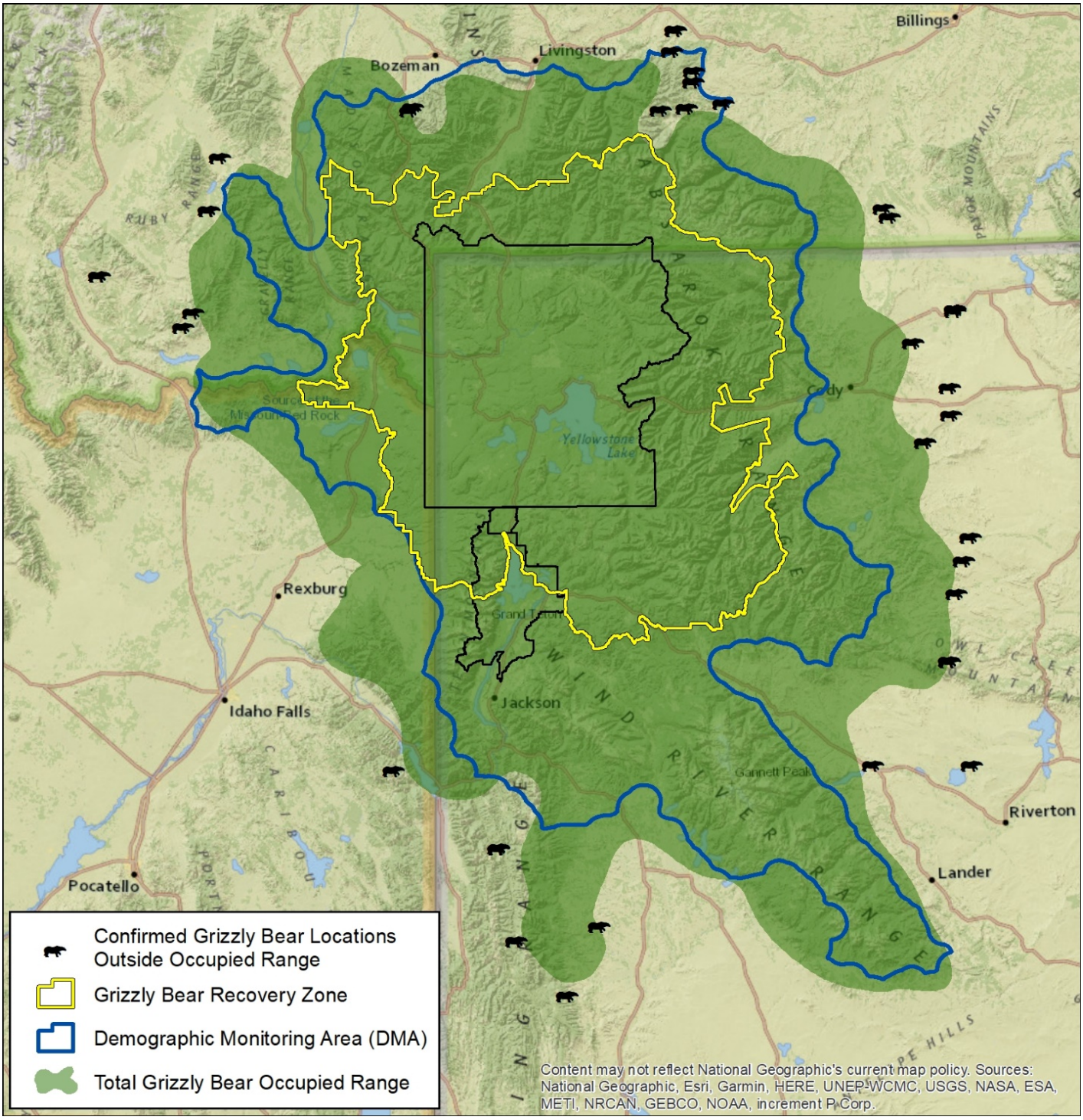


Fig. 6. Grizzly bear occupied range (green shaded area) in the Greater Yellowstone Ecosystem, 2018. Bear icons represent confirmed grizzly bear locations outside occupied range.

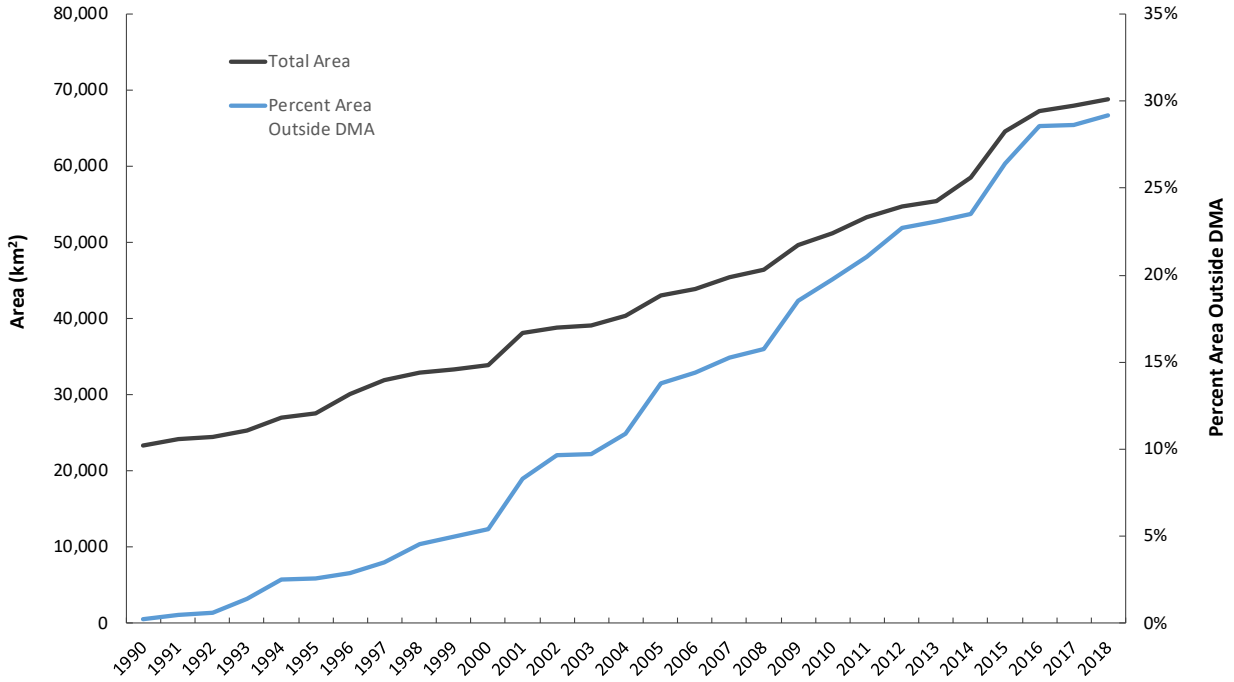


Fig. 7. Total area of grizzly bear occupied range and percent of area of occupied range outside the Demographic Monitoring Area (DMA) in the Greater Yellowstone Ecosystem, 1990–2018.

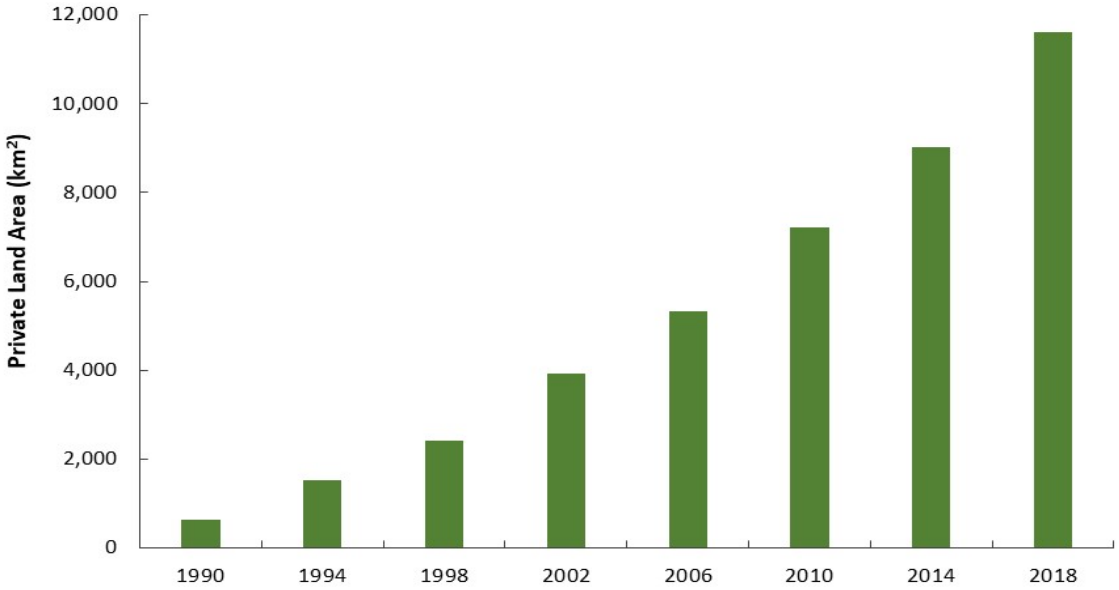


Fig. 8. Area of private land within grizzly bear occupied range in the Greater Yellowstone Ecosystem in 4-year intervals, 1990–2018.

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

Fifty-four Bear Observation Areas (BOAs, Fig. 9) were established in 2014. In 2018, two rounds of observation flights were conducted: 54 BOAs were surveyed during Round 1 (12 Jun–13 Aug) and 40 during Round 2 (10 Jul–29 Aug). Total duration of observation flight time was 105.76 hours for Round 1 and 73.58 hours for Round 2; average duration of individual flights was 1.91 hours (Table 13). Excluding dependent young, 394 bear sightings were recorded during observation flights. This included 11 radio-marked bears (4 females with young, 3 females without young, and 4 males), 290 solitary unmarked bears, and 93 unmarked females with young (Table 13). Our observation rate was 2.2 bears/hour for all bears. A total of 187 young (118 cubs, 60 yearlings, and 9 2-year-olds) were observed (Table 14). Observation rates for females with dependent young were 0.54 females with young/hour and 0.32 females with cubs/hour (Table 13).

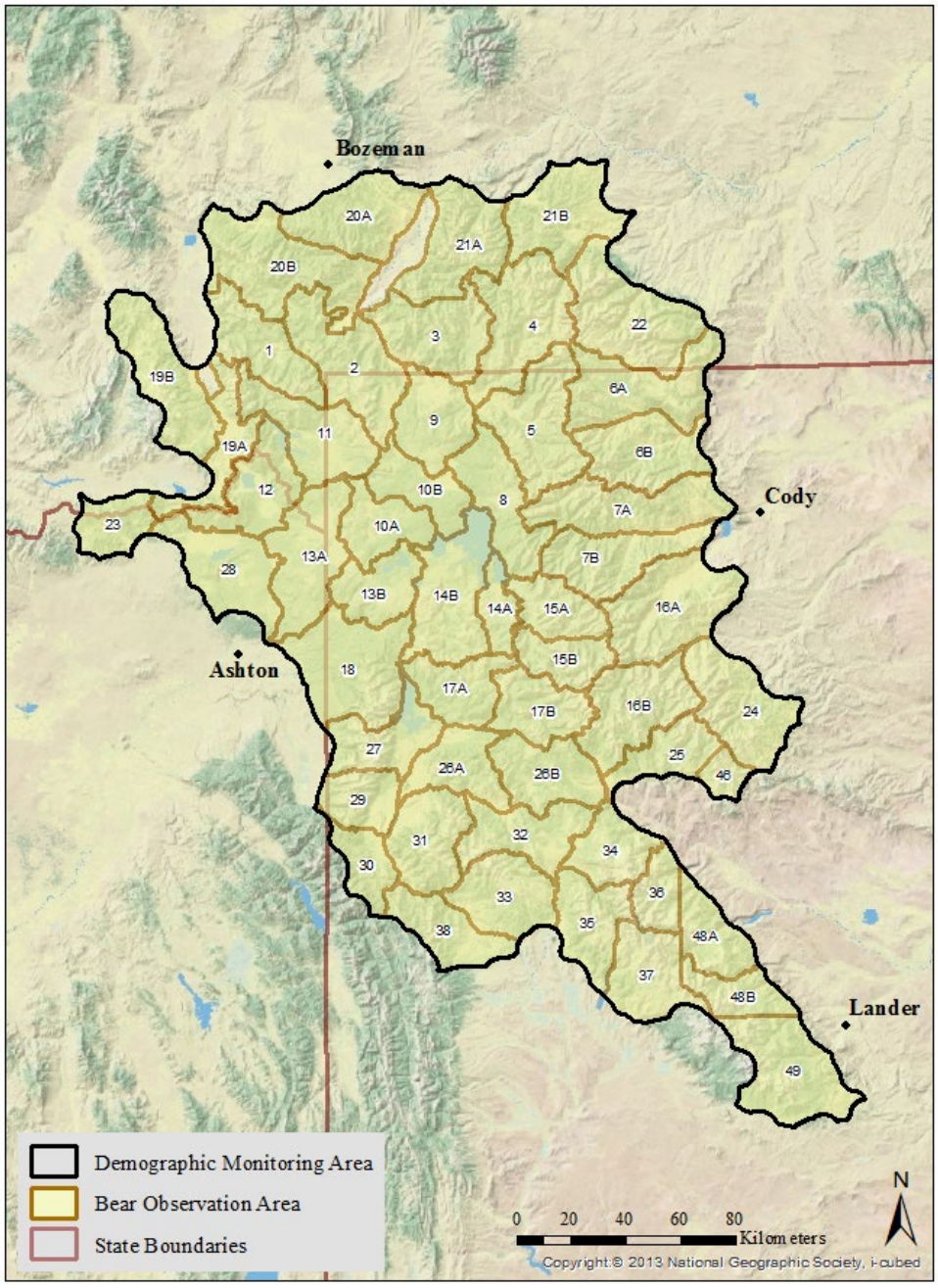


Fig. 9. Grizzly bear observation areas for aerial surveys, Greater Yellowstone Ecosystem, 2018. Numbers represent the 54 Bear Observation Areas, with several larger areas split into 2 sections (A and B).

Table 13. Annual summary statistics for grizzly bear observation flights, Greater Yellowstone Ecosystem, 2004–2018.

Date	Observation period	Total hours	Number of flights	Average hours/flight	Bears seen					Observation rate (bears/hour)		
					Marked		Unmarked		Total number of groups			
					Lone	With young	Lone	With young		All groups	With young	With cubs
2004[a]	Round 1	84.1	37	2.3	0	0	43	12	55	0.65		
	Round 2	76.6	37	2.1	1	2	94	38	135	1.76		
	Total	160.8	74	2.2	1	2	137	50	190	1.18	0.32	0.23
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	1.6		
	Total	174.1	74	2.4	2	5	221	73	301	1.73	0.45	0.29
2008[a]	Round 1	97.6	46	2.1	2	1	87	36	126	1.29		
	Round 2	101.5	45	2.3	2	3	185	53	243	2.39		
	Total	199.1	91	2.2	4	4	272	89	369	1.85	0.47	0.23
2009[a]	Round 1	90.3	47	1.9	1	0	85	21	107	1.18		
	Round 2	93.6	47	2	2	0	157	34	193	2.06		
	Total	183.9	94	2	3	0	242	55	300	1.63	0.30	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	0.20
2011[a]	Round 1	88.9	47	1.9	2	1	153	31	187	2.1		
	Round 2	71	35	2	4	0	109	23	136	1.92		
	Total	159.8	82	1.9	6	1	262	54	323	2.02	0.34	0.18
2012[a]	Round 1	95.4	48	2	4	2	178	35	219	2.3		
	Round 2	73.7	35	2.1	2	1	117	30	150	2.04		
	Total	169.1	83	2	6	3	295	65	369	2.18	0.4	0.23
2013[a]	Round 1	97	48	2	2	1	152	44	199	2.05		
	Round 2	72.8	35	2.1	4	1	171	48	224	3.08		
	Total	169.8	83	2.1	6	2	323	92	423	2.49	0.55	0.39
2014[a]	Round 1	104	52	2	2	2	170	47	221	2.13		
	Round 2	88.6	43	2.1	3	1	188	60	252	2.84		
	Total	192.6	95	2	5	3	358	107	473	2.46	0.57	0.27
2015[a]	Round 1	104	52	2	4	1	126	34	165	1.59		
	Round 2	88.6	44	2	1	2	142	41	186	2.1		
	Total	192.7	96	2	5	3	268	75	351	1.82	0.40	0.23
2016[a]	Round 1	106.8	53	2	5	3	133	36	177	1.66		
	Round 2	86.5	42	2.1	1	2	95	32	130	1.5		
	Total	193.3	95	2	6	8	228	68	307	1.59	0.40	0.24
2017[a]	Round 1	105.5	54	1.95	7	2	153	36	198	1.88		
	Round 2	79	40	1.98	8	2	127	36	173	2.19		
	Total	184.5	94	1.97	15	4	280	72	371	2	0.40	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

[a] Dates of flights (Round 1, Round 2): 2004 (12 Jun–26 Jul, 3 Jul–31 Aug); 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).

Table 14. Size and age composition of grizzly bear family groups seen during observation flights, Greater Yellowstone Ecosystem, 2004–2018.

		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
2004[a]	Round 1	4	1	3	1	1	0	2	0	0
	Round 2	6	16	7	4	7	0	0	0	0
	Total	10	17	10	5	8	0	2	0	0
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

[a] Dates of flights (Round 1, Round 2): 2004 (12 Jun–26 Jul, 3 Jul–31 Aug); 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).

[b] Includes 1 female with 4 yearlings.

[c] Includes 1 female with 4 cubs.

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

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

One hundred and one telemetry location flights were conducted during 2018, resulting in 273 hours of search time (excluding ferry time to and from airports; Table 15). Flights were conducted at least once during all months, with 73% of telemetry flights in May–November. During telemetry flights, 919 locations of bears equipped with radio transmitters were collected, 324 (35%) of which included a visual sighting. Fifty-eight sightings of unmarked bears were also obtained during telemetry flights, including 53 solitary bears, 2 females with cubs, 1 female with yearlings, and 2 females with 2-year-olds. Rate of observation for all unmarked bears during telemetry flights was 0.21 bears/hour; and 1.19 bears/hour for marked bears. The observation rate during telemetry flights for unmarked females with cubs was 0.007 females with cubs/hour.

In an effort 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 2018. We deployed 27 Iridium GPS collars in 2018, obtaining over 118,000 GPS locations from 49 grizzly bears (newly and previously deployed GPS collars).

Table 15. Summary statistics for radio-telemetry flights to locate grizzly bears, Greater Yellowstone Ecosystem, 2018.

	Radioed bears						Unmarked bears observed					
								Number of females			Observation rate (no. of groups/hour)	
Month	No. of hours	No. of flights	Mean no. of hours/flight	No. of locations	No. seen	Observation rate (no. of groups/hr)	Lone bears	With cubs	With yearlings	With young	All groups	Females with cubs
Jan	1.0	1	2.20	9	0	---	0	0	0	0	---	---
Feb	8.8	2	4.40	54	0	---	0	0	0	0	---	---
Mar	8.6	3	2.87	46	1	0.12	0	0	0	0	---	---
Apr	26.9	11	2.45	112	25	0.93	1	0	0	0	0.04	---
May	30.2	11	2.75	104	57	1.88	14	0	0	1	0.50	---
June	28.0	13	2.15	93	62	2.21	20	1	1	1	0.82	0.04
July	28.3	14	2.02	100	51	1.80	8	0	0	0	0.28	---
Aug	31.2	11	2.84	91	60	1.92	0	0	0	0	---	---
Sept	34.0	9	3.78	88	32	0.94	7	1	0	0	0.24	0.03
Oct	34.4	10	3.44	83	22	0.64	2	0	0	0	0.06	---
Nov	30.4	9	3.38	92	14	0.46	1	0	0	0	0.03	---
Dec	10.0	7	1.43	47	0	---	0	0	0	0	---	---
Total	273	101	2.7	919	324	1.19	53	2	1	2	0.21	0.007

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 occurring in the Demographic Monitoring Area (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, which include 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.

2018 Mortality Results

We documented 74 known and probable mortalities in the GYE during 2018, of which 4 likely occurred during 2017 (#201805, #201806, #201807, and #201812; Table 16), with 1 additional mortality that likely occurred during 2016 (#201830; Table 16). All 5 mortalities from years prior to 2018 were within the DMA. Three mortalities that occurred during the fall of 2017 (#201805, #201806, and #201807; Table 16) remain under investigation.

Of the 69 known and probable mortalities that occurred during 2018, 59 (85.5%) were attributable to human causes (Table 16, Fig. 10). Eleven of the 69 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 11 mortalities are included in the following summaries.

Nine (15.3 %) of the 59 human-caused losses were hunting related, including 1 mistaken identity kill by a black bear hunter and 6 losses from reported self-defense kills. One of these self-defense kills involved a female accompanied by 2 cubs. Additionally, an adult female and yearling were captured and removed at the site of a human fatality where a guide and hunter were attacked while processing an elk they had harvested.

Nineteen (32.2 %) of the 59 human-caused losses involved management removals due to livestock depredations, whereas 26 (44.1%) were related to anthropogenic site conflicts. Other human-caused losses included 2 vehicle strikes (3.4%), 1 (1.7%) bear found drowned in the Heart Mountain Canal, and 1 cub (1.7%) that died during handling associated with a management capture for cattle depredation by its mother. Lastly, an old adult male found in poor condition and unable to lift its hind legs was removed for humane reasons.

We documented 9 natural mortalities (Table 16). Four of the natural mortalities were cubs lost from 4 different radio-marked females. Evidence suggested another 3 bears (1 female adult, 1 female subadult, and 1 subadult of unknown sex) were likely killed and consumed by other bears. We suspect another adult male died from an infected injury in the groin area. The origin of the injury was not thought to be human-caused. Lastly, the remains of an adult male were found by NPS staff at a remote location in Yellowstone National Park during late November. The carcass had been mostly consumed by scavengers. We classified this as a natural mortality given the location and the late season although the specific cause of death was unknown.

We have 1 reported mortality from an undetermined cause during 2018. This mortality is also currently under investigation.

We documented 2 incidents considered possible mortalities during 2018 (Table 16). Both events involved a charging bear and shots fired in self-defense; one by elk hunters, and the second by a range rider. In both instances no evidence was found that a mortality had occurred.

We evaluated known and probable mortalities relative to population estimates only for the Demographic Monitoring Area (DMA). Of the 69 known and probable documented mortalities occurring in 2018, 51 occurred within the boundaries of the DMA (Table 17, Fig. 10). Sex determination for 3 reported mortalities of independent-age bears from 2018 is pending DNA results (n = 1), or will remain unknown (n = 2) unless carcasses are found. We used a random generator to attribute sex to these 3 incidents with results indicating 1 female (#201831; Table 16) and 2 males (#201826 and #201850; Table 16). Among independent-age bears and including randomly generated sex, we documented 11 female mortalities within the DMA during 2018 (Table 17). There were 6 management removals, 3 radio-marked losses, and 2 reported losses of independent-age females (Table 18). Estimated total mortality for independent-age females was 6.1 % of the 2018 estimate for this segment of the population (Table 18). Twenty-two known and probable mortalities for independent-age males occurred within the DMA (Table 17). We documented 14 management removals, 1 radio-marked loss, and 7 reported losses of independent-age males within the DMA (Table 17). Estimated total mortality for independent males was 15.3 % of the 2018 estimate for this segment of the population (Table 18). There were 11 known and probable human-caused losses of dependent young documented in the DMA during 2018 (Table 18). Estimated human-caused loss for dependent young was 5.0 % within the DMA (Table 18).

One documented mortality from 2012 remains under investigation, as do 3 from 2013, 3 from 2014, 6 from 2015, 8 from 2016, and 3 from 2017. No mortalities documented during 2009, 2010, or 2011 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.

A lone bear, presumed male, approaches a female grizzly bear with cubs (photo courtesy of Jake Davis)

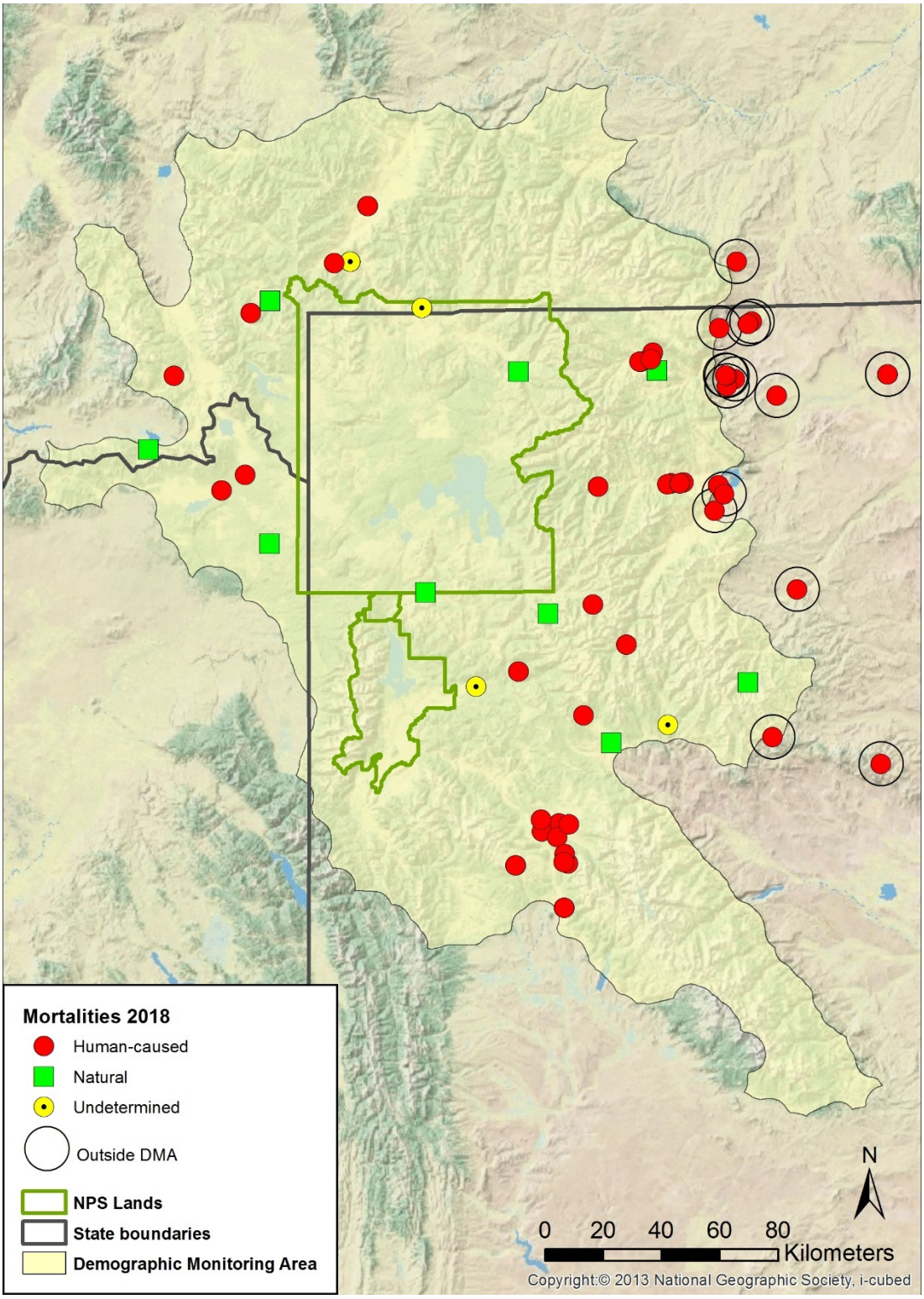


Fig. 10. Distribution of 74 known and probable grizzly bear mortalities documented in the Greater Yellowstone Ecosystem during 2018, including 4 mortalities that likely occurred during 2017, and 1 from 2016. Fifty-one of documented mortalities occurring in 2018 were within the Demographic Monitoring Area (DMA), of which 41 were attributed to human causes. Eighteen mortalities in 2018 were documented 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 74 locations are visible on this map.

Table 16. Grizzly bear mortalities documented in the Greater Yellowstone Ecosystem, 2018.								
Unique #	Bear [a]	Sex [b]	Age [c]	Date	Location [d]	Monitoring Area [e]	Certainty	Loss
201801	649	M	Adult	4/10/2018	Rawhide Crk, PR-WY	Outside DMA	Known	Human-caused, management capture and removal for frequenting calving area and previous conflict history. Was not collared at time of removal.
201802	Unm	M	Adult	4/29/2018	Pat O'Hara Crk, PR-WY	Outside DMA	Known	Human-caused, management capture and removal for frequenting calving area and bold behavior towards humans.
201803	Unm	M	Adult	5/8/2018	Clarks Fork Yellowstone, SNF-WY	Inside DMA	Known	Human-caused, humane removal of old bear in very poor condition and unable to lift hind legs.
201804	Unm	M	Subadult	5/9/2018	Green Crk, PR-WY	Inside DMA	Known	Human-caused, management capture and removal for breaking into a building and obtaining a food reward.
201805			Adult	2017	MT	Inside DMA	Known	UNDER INVESTIGATION.
201806			Cub	2017	MT	Inside DMA	Probable	UNDER INVESTIGATION.
201807			Cub	2017	MT	Inside DMA	Probable	UNDER INVESTIGATION.
201808			Adult	2018	WY	Inside DMA	Known	UNDER INVESTIGATION.
201809			Cub	2018	WY	Inside DMA	Known	UNDER INVESTIGATION.
201810			Cub	2018	WY	Inside DMA	Probable	UNDER INVESTIGATION.
201811			Cub	2018	WY	Inside DMA	Probable	UNDER INVESTIGATION.
201812	Unm	Unk	Adult	2017	Crevice Crk, YNP	Inside DMA	Known	Undetermined cause, grizzly bear remains found, cast collar. Likely died fall of 2017. Puncture wound on skull suggest killed by another bear.
201813	Unm	F	Subadult	5/30/2018	Blaine Crk, BLM-WY	Outside DMA	Known	Human-caused, management capture and removal for association with multiple livestock conflicts.
201814			Adult	2018	WY	Inside DMA	Known	UNDER INVESTIGATION.
201815			Cub	2018	WY	Inside DMA	Probable	UNDER INVESTIGATION.

Table 16. Continued								
Unique #	Bear [a]	Sex [b]	Age [c]	Date	Location [d]	Monitoring Area [e]	Certainty	Loss
201816			Cub	2018	WY	Inside DMA	Probable	UNDER INVESTIGATION.
201817	G198	M	Adult	6/17/2018	Alkali Crk, PR-WY	Outside DMA	Known	Human-caused, drowned in fast-flowing water of cement-sided Heart Mountain Canal.
201818	Unm	M	Adult	6/22/2018	Bull Crk, BLM-WY	Outside DMA	Known	Human-caused, management capture for cattle damage, removed because of poor condition and extensive injuries from unknown cause.
201819	Unm	M	Adult	6/22/2018	Foster Gulch, PR-MT	Outside DMA	Known	Human-caused, management capture and removal for cattle depredations.
201820	841	M	Adult	7/8/2018	Crow Crk, BTNF-WY	Inside DMA	Known	Human-caused, management capture and removal for cattle depredations.
201821	592	M	Adult	7/13/2018	Mosquito Lake, BTNF-WY	Inside DMA	Known	Human-caused, management capture and removal for cattle depredations.
201822	344	M	Adult	7/13/2018	Wagon Crk, BTNF-WY	Inside DMA	Known	Human-caused, management capture and removal for cattle depredations.
201823	937	M	Subadult	7/20/2018	Mill Crk, CTNF-ID	Inside DMA	Known	Human-caused, management removal of bear #937 for bold behavior and obtaining unsecured anthropogenic foods.
201824	919	F	Subadult	4/19/2018	Coulter Crk, BTNF-WY	Inside DMA	Known	Known, natural, appeared to have been killed by another bear. Skull was fractured and carcass had been fed on by bear(s).
201825	439	F	Adult	7/25/2018	Gypsum Crk, BTNF-WY	Inside DMA	Known	Human-caused, management capture and removal for cattle depredations. Three yearlings present were tagged and transported.
201826	Unm	Unk	Subadult	7/19/2018	Yellowstone River, BTNF-WY	Inside DMA	Known	Known, natural, killed and consumed by another bear(s). Samples collected for DNA determination of sex.
201827	Unm	M	Adult	8/1/2018	Gypsum Crk, BTNF-WY	Inside DMA	Known	Human-caused, management capture and removal for cattle depredations.
201828	723	M	Adult	8/5/2018	Gypsum Crk, BTNF-WY	Inside DMA	Known	Human-caused, management capture and removal for cattle depredations.
201829	808	M	Adult	8/4/2018	Paint Crk, PR-WY	Outside DMA	Known	Human-caused, management capture and removal for cattle depredations.
201830	Unm	M	Adult	2016	Buffalo Fork, BTNF	Inside DMA	Known	Undetermined cause, skeletal remains found including skull. Skull characteristics indicated likely an adult male grizzly bear. Samples collected for DNA analysis. Estimated year of death 2016.
201831			Unk	2018	BDNF-MT	Inside DMA	Probable	UNDER INVESTIGATION.

Table 16. Continued								
Unique #	Bear [a]	Sex [b]	Age [c]	Date	Location [d]	Monitoring Area [e]	Certainty	Loss
201832	740	M	Adult	8/13/2018	Wagon Crk, BTNF-WY	Inside DMA	Known	Human-caused, management capture and removal for cattle depredations.
201833	Unm	F	Adult	8/9/2018	JK Crk, WRIR	Outside DMA	Known	Human-caused, management capture and removal for cattle depredations.
201834	943	M	Yearling	8/14/2018	Henrys Fork, PR-ID	Inside DMA	Known	Human-caused, management capture and removal for obtaining anthropogenic food rewards at numerous residences.
201835	860	M	Adult	8/30/2018	Reader Crk, PR-MT	Inside DMA	Known	Human-caused, management capture and removal for cattle depredations.
201836	921	M	Subadult	9/1/2018	South Fork Shoshone, PR-WY	Outside DMA	Known	Human-caused, management capture and removal for repeated nuisance activity at residences and property damage (apples).
201837			Adult	2018	WY	Outside DMA	Known	UNDER INVESTIGATION
201838	738	M	Adult	9/3/2018	North Fork Shoshone, PR-WY	Inside DMA	Known	Human-caused, management capture and removal for conflict history, property damage, chicken depredations, and poor condition.
201839	Unm	M	Subadult	9/4/2018	South Fork Owl Crk, PR-WY	Outside DMA	Known	Human-caused, management capture and removal for multiple cattle depredations
201840	859	M	Subadult	9/6/2018	Fish Crk, BTNF	Inside DMA	Known	Human-caused, management capture and removal of #859 for multiple cattle depredations.
201841	Unm	F	Cub	9/6/2018	Paint Crk, PR-WY	Outside DMA	Known	Human-caused, handling mortality during management capture of mother for cattle depredations, 1of 3 cubs.
201842	920	M	Subadult	9/6/2018	North Fork Shoshone, SNF	Inside DMA	Known	Human-caused, road kill.
201843	Unm	F	Adult	9/16/2018	Soda Fork, BTNF	Inside DMA	Known	Human-caused, management removal of adult female accompanied by yearling male involved in human fatality.
201844	Unm	M	Yearling	9/16/2018	Soda Fork, BTNF	Inside DMA	Known	Human-caused, management removal of yearling male involved in human fatality.
201845	932	M	Adult	9/10/2018	Russell Crk, SNF	Inside DMA	Known	Known, natural, suspected natural mortality of radio-marked male. Specific mechanism was infected injury not thought to be human-caused. No evidence of foul play.
201846	915	F	Adult	9/6/2018	South Fork Wood River, SNF	Inside DMA	Known	Known, natural, evidence suggest radio-marked female was killed and consumed by another bear at site of a deer carcasses.
201847	Unm	F	Adult	9/20/2018	Clarks Fork Yellowstone, PR-WY	Outside DMA	Known	Human-caused, management capture and removal of old bear in poor condition for frequenting agricultural areas and a public corn maze.
201848	Unm	M	Adult	9/21/2018	North Fork Shoshone, PR-WY	Inside DMA	Known	Human-caused, management capture and removal for obtaining anthropogenic food rewards at numerous residences and breaking into coup and killing a turkey.

Table 16. Continued								
Unique #	Bear [a]	Sex [b]	Age [c]	Date	Location [d]	Monitoring Area [e]	Certainty	Loss
201849	651	M	Adult	9/25/2018	Corral Crk, SNF	Inside DMA	Known	Human-caused, management capture and removal for obtaining anthropogenic food rewards and prior conflict history.
201850			Unk	2018	MT	Inside DMA	Probable	UNDER INVESTIGATION.
201851	Unm	M	Yearling	9/30/2018	Clarks Fork Yellowstone, PR-WY	Outside DMA	Known	Human-caused, management capture and removal for frequenting agricultural areas and a public corn maze.
201852	G228	M	Adult	10/1/2018	West DuNoir Crk, SNF	Inside DMA	Known	Human-caused, reported self-defense kill by elk hunters while processing harvested elk.
201853	Unm	M	Subadult	10/2/2018	Clarks Fork Yellowstone, PR-WY	Outside DMA	Known	Human-caused, management capture and removal for frequenting agricultural areas and a public corn maze.
201854	Unm	M	Adult	10/2/2018	Gention Crk, SNF	Inside DMA	Known	Human-caused, self-defense kill by elk hunter at site of harvested elk.
201855	Unm	M	Subadult	10/2/2018	Thorofare Crk, BTNF	Inside DMA	Known	Human-caused, self-defense kill in hunting camp.
201856	Unm	F	Adult	10/3/2018	Whit Crk, PR-WY	Inside DMA	Known	Human-caused, management capture and removal of female with 2 yearlings for obtaining anthropogenic foods and increasingly habituated and bold behavior
201857	Unm	M	Yearling	10/3/2018	Whit Crk, PR-WY	Inside DMA	Known	Human-caused, management capture and removal of yearlings for obtaining anthropogenic foods, and increasingly bold behavior
201858	Unm	M	Yearling	10/3/2018	Whit Crk, PR-WY	Inside DMA	Known	Human-caused, management capture and removal of yearlings for obtaining anthropogenic foods, and increasingly bold behavior
201859	Unm	F	Adult	10/3/2018	Rock Crk, BTNF	Inside DMA	Known	Human-caused, reported self-defense kill by hunter of an unmarked female with 2 cubs.
201860	Unm	Unk	Cub	10/3/2018	Rock Crk, BTNF	Inside DMA	Probable	Human-caused, 1st of 2 cubs of unmarked female killed in self-defense by hunter.
201861	Unm	Unk	Cub	10/3/2018	Rock Crk, BTNF	Inside DMA	Probable	Human-caused, 2nd of 2 cubs of unmarked female killed in self-defense by hunter.
201862	Unm	F	Subadult	10/4/2018	Yellowstone River, PR-MT	Inside DMA	Known	Human-caused, management capture and removal for frequenting residences, habituated behavior, and public safety concerns.
201863			Adult	2018	WY	Inside DMA	Known	UNDER INVESTIGATION.
201864	955	F	Subadult	10/16/2018	Yellowstone River, PR-MT	Inside DMA	Known	Human-caused, management capture and removal for frequenting residences, habituated behavior, and public safety concerns.
201865	G065	F	Adult	10/19/2018	Corral Crk, SNF	Inside DMA	Known	Human-caused, management capture and removal for property damage, obtaining food rewards and frequenting developed areas.

Table 16. Continued

Unique #	Bear [a]	Sex [b]	Age [c]	Date	Location [d]	Monitoring Area [e]	Certainty	Loss
201866	Unm	M	Adult	10/19/2018	Reef Crk, SNF	Inside DMA	Known	Human-caused, road kill.
201867	771	F	Adult	10/25/2018	Shoshone River, PR-WY	Outside DMA	Known	Human-caused, management capture and removal with 2 cubs (G248 and G249) for public safety concerns.
201868	G248	M	Cub	10/25/2018	Shoshone River, PR-WY	Outside DMA	Known	Human-caused, management capture and removal with mother and sibling for public safety concerns.
201869	G249	F	Cub	10/25/2018	Shoshone River, PR-WY	Outside DMA	Known	Human-caused, management capture and removal with mother and sibling for public safety concerns.
201870	Unm	M	Adult	11/22/2018	Lamar River, YNP	Inside DMA	Known	Likely natural, remains of an adult male (based on skull) grizzly found by wolf researchers, carcass had been consumed, wolves were clustered on the site 11/22. Remote location, no indication of human involvement.
201871	Unm	Unk	Cub	4/29/2018	Survey Draw, CTNF-ID	Inside DMA	Probable	Likely natural, cub radio-marked female lost between 4/20 and 5/19. Mortality date is midpoint between dates, location was estimated from average of locations for the period.
201872	Unm	Unk	Cub	6/9/2018	Sage Crk, CGNF-MT	Inside DMA	Probable	Likely natural, cub radio-marked female lost between 5/25 and 6/25. Mortality date is midpoint between dates, location was estimated from average of locations for the period.
201873	Unm	Unk	Cub	9/10/2018	Bench Crk, ST-WY	Inside DMA	Probable	Likely natural, cub radio-marked female lost between 9/4 and 9/16. Mortality date is midpoint between dates, location was estimated from average of locations for the period.
201874	Unm	Unk	Cub	10/2/2018	Upper Red Rock Lake, BLM-MT	Inside DMA	Probable	Likely natural, cub radio-marked female lost between 9/7 and 10/28. Mortality date is midpoint between dates, location was estimated from average of locations for the period.

[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 2018 by sex, age class, and location relative to the Demographic Monitoring Area (DMA), Greater Yellowstone Ecosystem.

		Age class		
		Dependent (<2 years old)	Independent (≥2 years old)	
Area	Sex			Total
Inside DMA	Female	0	11	11
	Male	5	22	27
	Unknown	10	3	13
	Total	15	36	51
Outside DMA	Female	2	4	6
	Male	1	11	12
	Unknown	0	0	0
	Total	3	15	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 2018. 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	219	11						5.0
Females 2+	248	9	7	3	2[b]	5[b]	15[b]	6.1
Males 2+	248	19	14	1	9[b]	23[b]	38[b]	15.3[b]

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

[b] Numbers may change pending DNA determination of sex for 3 reported mortality from 2018.

MONITORING OF GRIZZLY BEAR FOODS

Spawning Cutthroat Trout Availability and Use by Grizzly Bears in Yellowstone National Park *(Kerry A. Gunther, Eric 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). The combined effect of all these factors has reduced the Yellowstone Lake 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 decline and past use of YCT as a food source by some grizzly bears, monitoring of the YCT population is a component of the habitat monitoring program of the 2016 Conservation Strategy for the Grizzly Bear 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. 11). 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 water 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. 12; Koel et al. 2005). The fish trap was typically 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 and visually as they swam through wooden chutes attached to the trap or 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 station is installed in mid to late-April and runs through mid-July. Fish counts were obtained in 2015 and 2016, however, the sonar fish counter malfunctioned in 2017 so an accurate count was not available for that year. The sonar fish count data for 2018 had not yet been analyzed at the time this report was written, but will be reported in the 2019 IGBST annual report.

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 recorded 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 20, 2018. Data collected in 2018 continued to show low numbers of spawning YCT in north shore and most West Thumb tributary streams (Table 24). In north shore streams, only 52 spawning YCT were counted. Forty-five spawning YCT were counted in Bridge Creek, 6 in Hatchery Creek, and 1 in Lodge Creek. No spawning YCT were observed in Incinerator Creek or Wells Creek. Grizzly bear tracks were observed along Hatchery Creek and tracks from an unknown species of bear were observed along Bridge Creek. 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 2018.

On West Thumb streams, 72 spawning YCT were counted, including 58 in Little Thumb Creek, 13 in Sandy Creek, and 1 in Sewer Creek. No spawning YCT were observed in stream #1167. Grizzly bear tracks were observed along Little Thumb Creek, Sandy Creek, and Sewer Creek. Black bear tracks were observed along Little Thumb Creek, Sandy Creek, and stream #1167. Bear scats consisting of vegetation were found on Little Thumb Creek; no bear scats containing fish were found. A trail camera we set up on Little Thumb Creek captured video of an adult brown colored black bear fishing in the creek; the bear was not successful. Evidence (fish parts and bear tracks) found on Sewer Creek indicate that a grizzly bear was likely fishing there.

The number of spawning YCT counted in the north shore (Fig. 13) and West Thumb (Fig. 14) streams has decreased significantly since 1989. Although the increased spawning activity 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 2018, 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, 11 spawning YCT were counted. Nine spawning YCT were counted in stream #1138 and 2 in Flat Mountain Creek. No spawning YCT were observed in stream #1141. Grizzly bear tracks were observed along Flat Mountain Creek and stream #1138; no black bear tracks were observed. Evidence of grizzly bear predation on YCT was found along Flat Mountain Creek and stream #1138. No evidence of bear fishing activity was observed along stream #1141.

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). Once spawning trout are detected (i.e., onset of spawning), weekly surveys of adult trout in the inlet creek are conducted. On each sample day, two people walk from the stream mouth to the upstream extent that fish have been observed in past years, and record the number of adult trout counted. Sampling continues one day per week until two consecutive weeks when no trout are observed in the creek. 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 mean number of spawning trout observed per visit is calculated by dividing the total number of adult trout counted by the number of surveys conducted during the spawning season.

The first movement of spawning trout from Trout Lake into the inlet creek was observed on June 18. The spawn lasted approximately 38 days with the last spawning trout observed in the inlet creek on July 25. During the once per week visual surveys, 518 spawning cutthroat (and cutthroat trout × rainbow trout hybrids) were counted, an average of 86 per visit during the spawning season (Table 24). No evidence of grizzly bear or black bear fishing activity was observed along Trout Lake or the inlet creek during the surveys in 2018. The number of fish observed per survey has ranged from a low of 31 in 2004, to a high of 306 in 2010 (Fig. 15).

Outlook for Cutthroat Trout

The number of spawning YCT counted in all surveyed tributary streams of Yellowstone Lake reached a nadir in approximately 2004 (Figs. 11–13). A Native Fish Conservation Plan/Environmental Assessment was completed in 2011 (Koel et al. 2010). The plan outlines a program of management efforts 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 297,110 lake trout from Yellowstone Lake in 2018. 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). 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. In 2018, we found evidence of grizzly bears fishing for YCT in Sewer Creek, Flat Mountain Creek and stream #1138. In addition, we documented through video a black bear fishing in Little Thumb Creek. Documentation of bear fishing activity indicates that the YCT population may be increasing at least in some streams and suggests that the lake trout removal program may be beginning to show signs of success.

Table 24. Summary statistics for spawning cutthroat trout surveys, Yellowstone National Park, 2018.

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	5/29/2018	5/29/2018	1	1	1	1
Hatchery Creek	05/22/2018	06/06/2018	9	3	6	2.0
Incinerator Creek			No spawn			
Wells Creek			No spawn			
Bridge Creek	5/22/2018	5/28/2018	7	2	45	22.5
#1090			Not surveyed			
West Thumb						
1167 Creek			No spawn			
Sandy Creek	5/14/2018	5/21/2018	8	2	13	6.5
Sewer Creek	5/21/2018	5/21/2018	1	1	1	1
Little Thumb Creek	6/5/2018	6/12/2018	8	2	58	29
Total frontcountry[a]				11	124	11.3
Backcountry						
Flat Mountain Creek	5/28/2018	5/28/2018	1	1	2	2
#1141 Creek			No spawn			
#1138 Creek	5/24/2018	6/4/2018	12	3	9	3
Columbine Creek			Not surveyed			
Total backcountry				4	11	2.8
Northern Range						
Trout Lake Inlet	6/18/2018	7/25/2018	38	6	518	86.3

[a] Total for north shore and West Thumb streams that had a spawn.

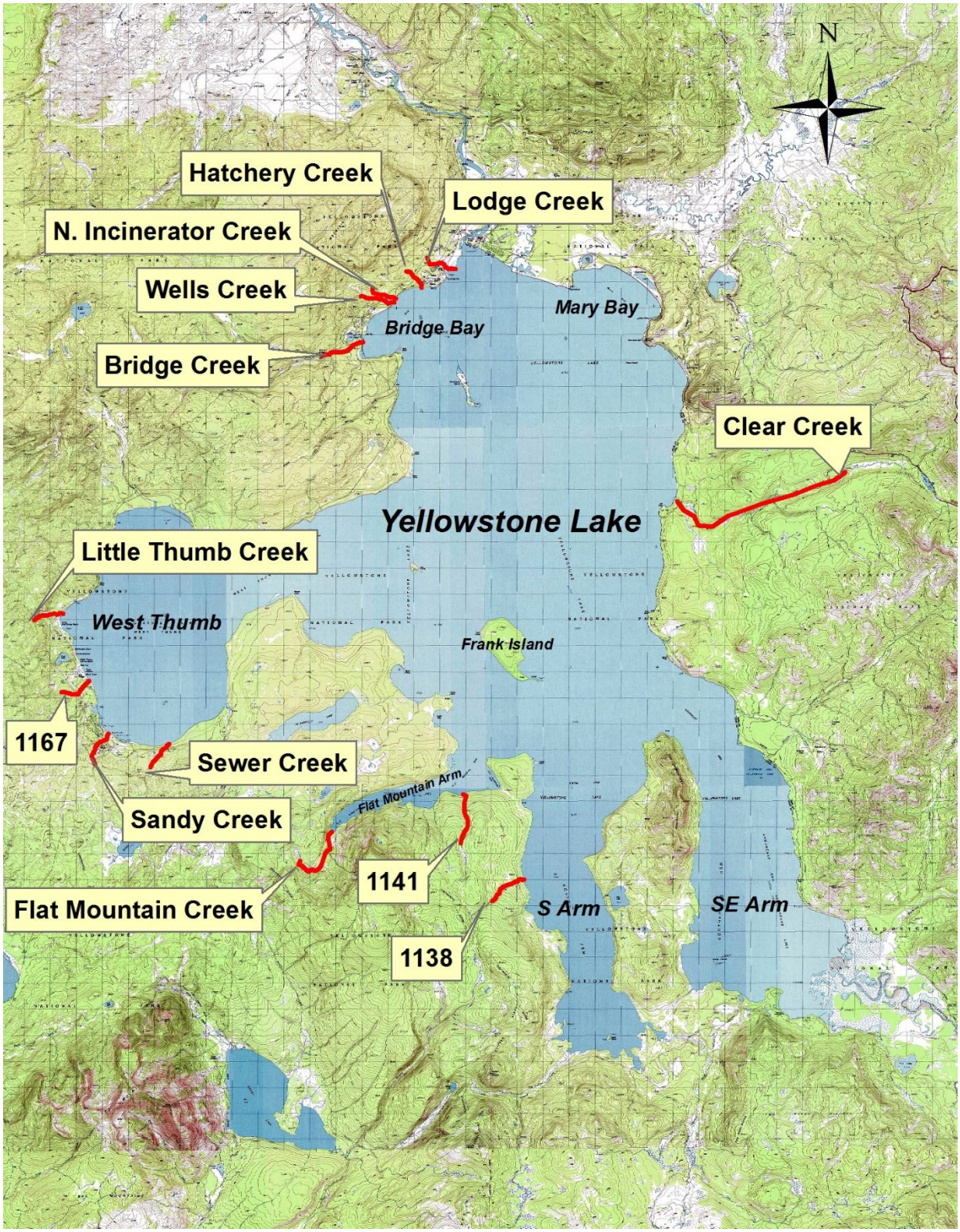


Fig. 11. Locations of Yellowstone Lake cutthroat trout spawning streams surveyed in 2018.

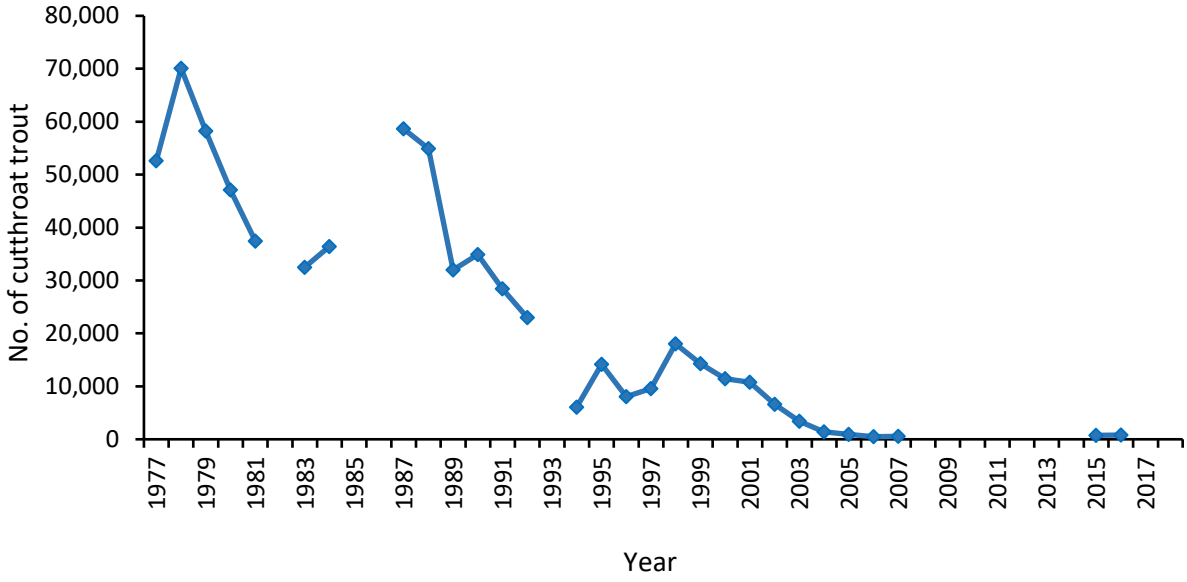


Fig. 12. Number of spawning Yellowstone cutthroat trout counted at the Clear Creek fish weir on the east shore of Yellowstone Lake, Yellowstone National Park, 1977–2016.

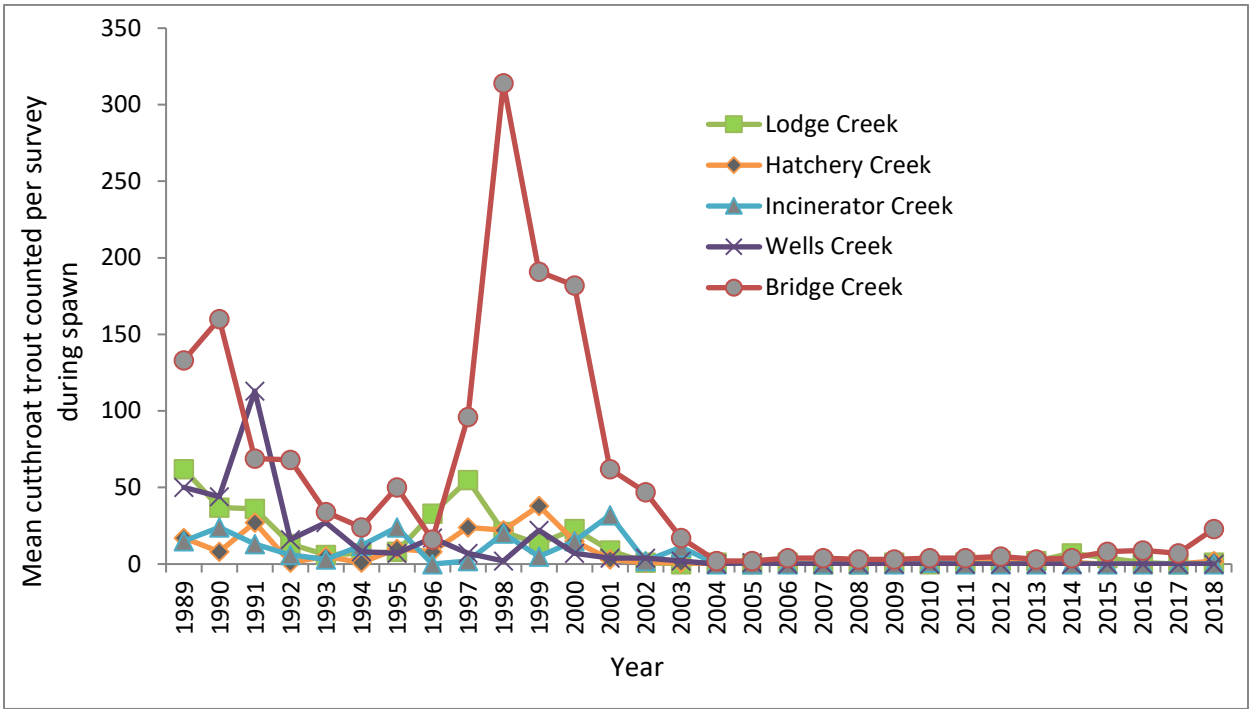


Fig. 13. Mean number of spawning cutthroat trout observed during weekly visual surveys of 5 north shore spawning stream tributaries to Yellowstone Lake, Yellowstone National Park, 1989–2018.

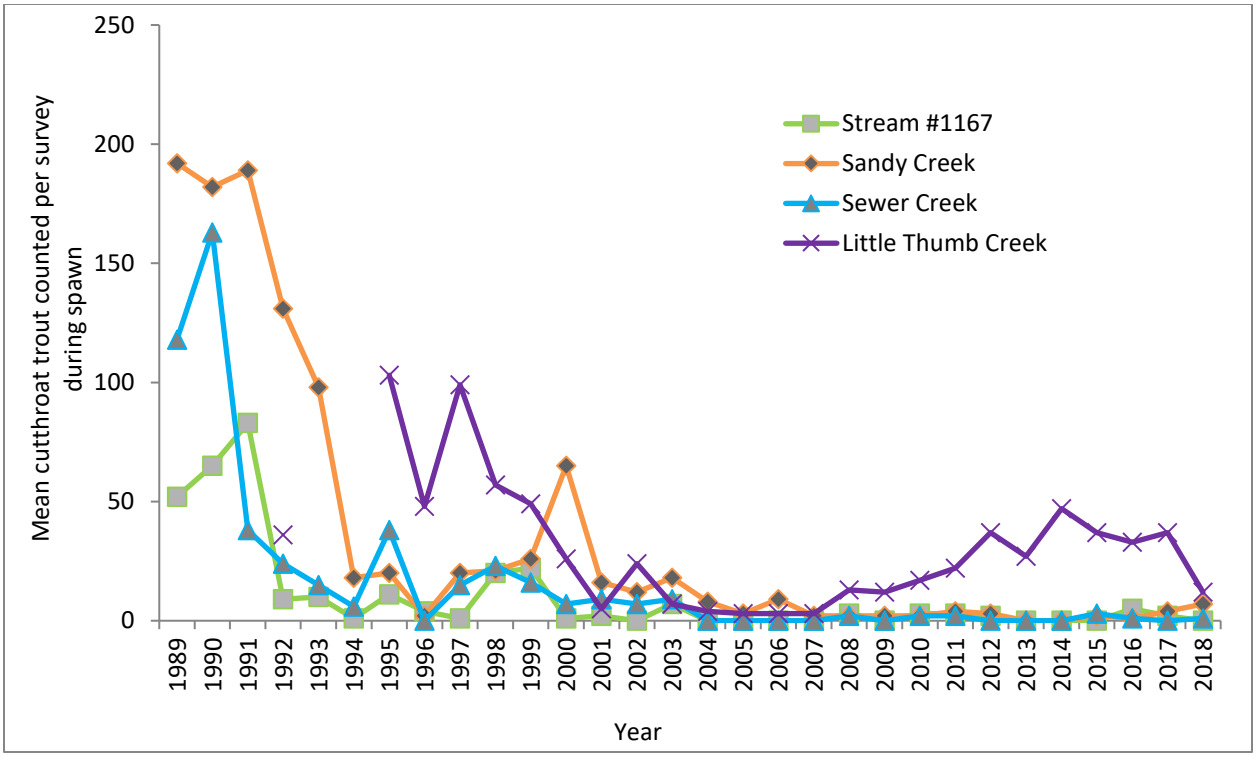


Fig. 14. Mean number of spawning cutthroat trout observed during weekly visual surveys of 4 West Thumb spawning stream tributaries to Yellowstone Lake, Yellowstone National Park, 1989–2018.

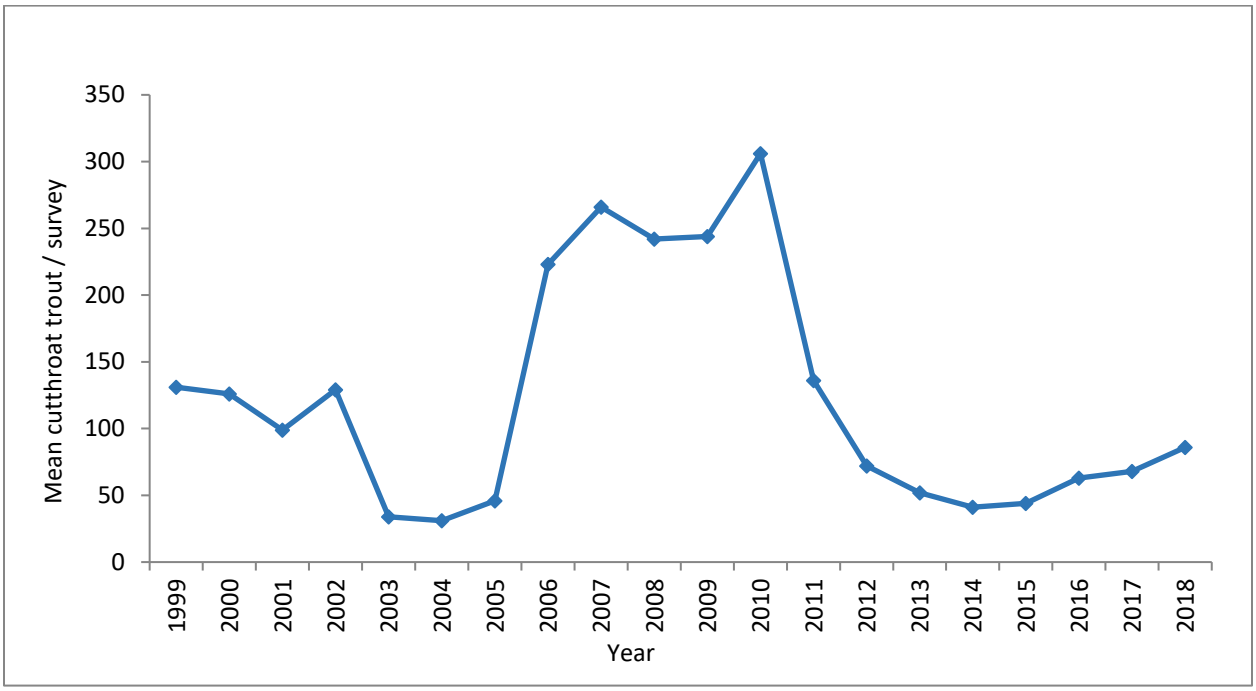


Fig. 15. Mean number of spawning cutthroat trout (including cutthroat × rainbow trout hybrids) observed during weekly visual surveys of the Trout Lake inlet creek, Yellowstone National Park, 1999–2018.

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

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 site in the early 1980s, 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. Prior to 1997, we delineated insect aggregation sites with convex polygons drawn around locations of bears seen feeding on moths and buffered these polygons by 500 m. However, this technique overlooked small sites due to the inability to create polygons around sites with fewer than 3 locations. During1997–1999, the method for defining insect aggregation sites was to inscribe a 1-km circle around the center of clusters of observations in which bears were seen feeding on insects in talus and scree habitats (Ternent and Haroldson 2000). This method allowed trend in bear use of sites to be annually monitored by recording the number of bears documented in each circle (i.e., site).

We developed a new technique in 2000 (D. Bjornlie, Wyoming Game and Fish Department, unpublished data) 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. Application of the new technique decreased the number of sites described in prior years, in which locations from both feeding and non-feeding bears were used. We now use this technique for the annual analysis completed for all years. 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 historic 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 2018 resulted in an additional 200 observations of actively feeding grizzly bears on previously identified confirmed sites. In addition, there were observations of actively feeding grizzly bears at 2 previously undocumented sites so 2 possible new sites were added in 2018. Thus, there were 31 confirmed sites and 21 possible sites through 2018.

Overall insect aggregation site use by grizzly bears in 2018 (n = 281) was slightly lower than 2017 (n = 297; Table 25). 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. 16), 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. 16) and the number of observations recorded at insect sites were very low (Table 25). In all other years, the percentage of insect aggregation sites used by grizzly bears varied between 50% and 84% (Fig. 16).

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 2017 (n = 228 observations, 6.9 locations/hour flown) to 2018 (n = 246 observations, 8.6 observations/hour flown) (Fig. 17). 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. 17). 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 25 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, 1,227 initial sightings of unique females with cubs have been recorded, of which 347 (28.3%) have occurred at (<500 m, n = 323) or near (<1,500 m, n = 24) insect aggregation sites (Table 26). In 2018, 18 of the 58 (31.0%) initial sightings of unique females with cubs were observed at insect aggregation sites; slightly higher than the mean of 27.3% for the previous five years (2013–2017, Table 26).

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 12.4 initial sightings/year since 2009 (Table 26). If these sightings are excluded, a similar trend in the annual number of unique sightings of females with cubs is still evident (Fig. 18), suggesting that other factors besides observation effort at insect aggregation sites are responsible for the increase in sightings of females with cubs over time.

Table 25. Summary statistics for grizzly bear use of confirmed insect aggregation sites, Greater Yellowstone Ecosystem, 1986–2018.

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	17	11	6	107
1993	18	3	1	2
1994	18	9	1	31
1995	20	11	7	39
1996	21	14	21	67
1997	22	15	17	83
1998	25	21	10	182
1999	25	14	26	156
2000	25	13	48	95
2001	26	18	23	127
2002	27	20	30	251
2003	27	20	9	163
2004	27	16	2	134
2005	29	19	16	197
2006	29	16	15	146
2007	29	19	19	161
2008	29	22	17	179
2009	31	23	9	170
2010	31	18	4	132
2011	31	19	9	162
2012	31	22	16	252
2013	31	22	25	295
2014	31	24	11	343
2015	31	21	13	210
2016	31	19	10	207
2017	31	21	20	277
2018	31	19	18	263
Total			454	4,768

[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 26. Initial sightings of unique females with cubs on or near insect aggregation sites, Greater Yellowstone Ecosystem, 1986–2018.

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
1987	13	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
Total	1,227		323		347	
Mean	37.2	6.1	9.8	24.4	10.5	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.

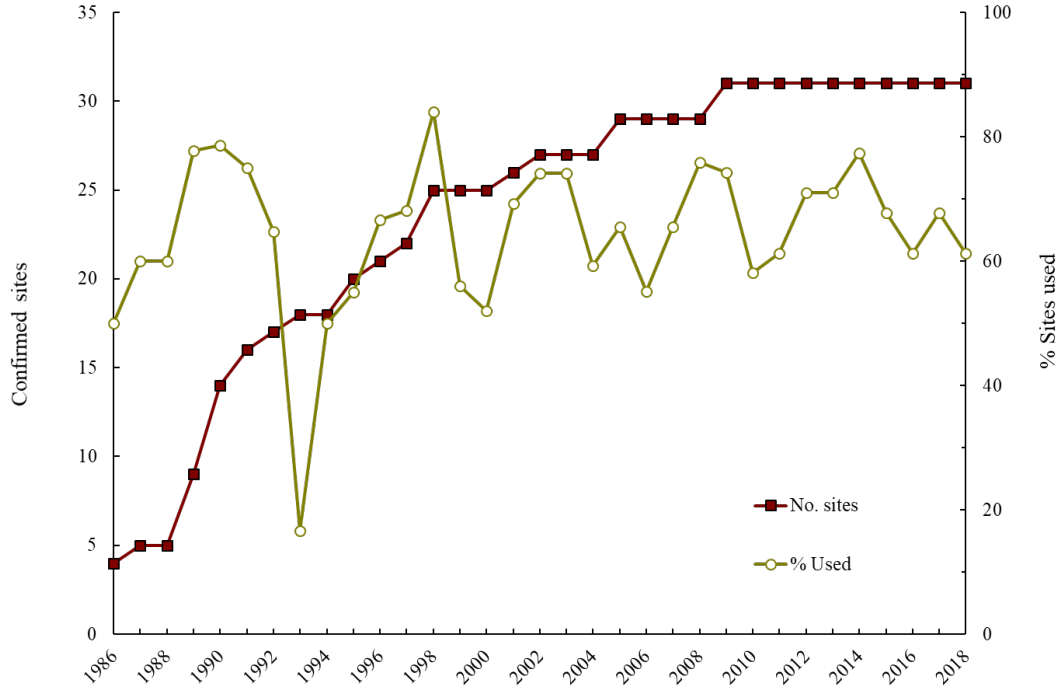


Fig. 16. Annual number of confirmed insect aggregation sites and percent of those sites at which telemetry relocations of marked bears or visual observations of unmarked bears were recorded, Greater Yellowstone Ecosystem, 1986–2018.

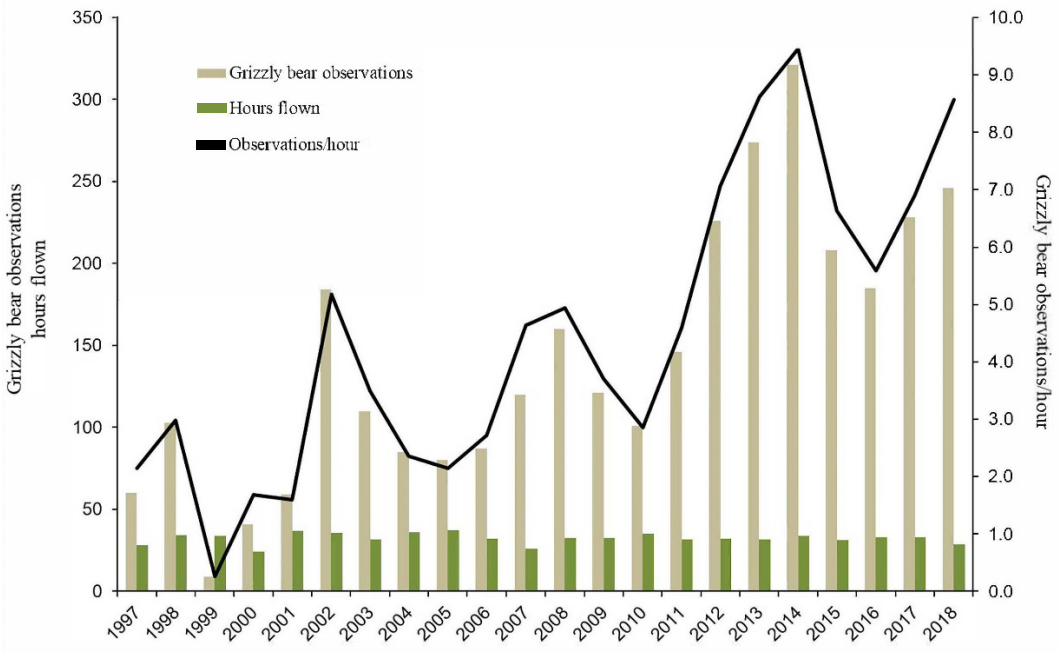


Fig. 17. Number of grizzly bears observed (tan bars) on insect aggregation sites during observation flights only, hours flown (green bars) for these bear management units (BMU), and grizzly bear observations per hour (black line) during observation flights of BMUs containing all known insect aggregation sites, Greater Yellowstone Ecosystem, 1997–2018.

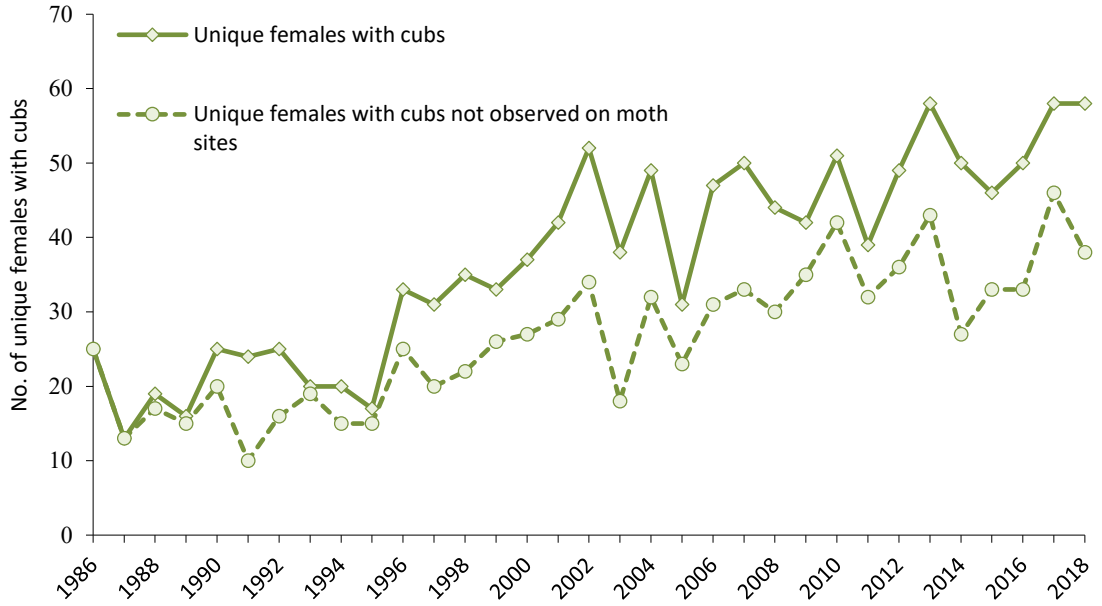


Fig. 18. Total number of unique females with cubs observed annually in the Greater Yellowstone Ecosystem and the number of unique females with cubs not found within 1,500 m of known insect aggregation sites, 1986–2018.

Bears feeding on army cutworm moths, August 2019 (photo courtesy of Josh Westerhold).

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

Whitebark pine (*Pinus albicaulis*) surveys on 21 established transects indicated above-average cone production during 2018 (Fig. 19). Overall, the mean number of observed cones/tree was 26.0 (Table 27), which was above the overall average of 16 for the period 1980–2018 (Fig. 20). Cone production was above average on 12 transects and below average on 9 (Table 28).

We continue to monitor tree mortality caused by mountain pine beetle (*Dendroctonus ponderosae*) in stands that contain our cone production transects. During 2018 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. 21). These findings 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 27. Summary statistics for whitebark pine cone production surveys, Greater Yellowstone Ecosystem, 2018.

Total			Trees				Transect			
Cones	Trees	Transects	Mean cones	SD	Min	Max	Mean cones	SD	Min	Max
4,862	187	21	26	35	0	217	231.5	225	3	1,007

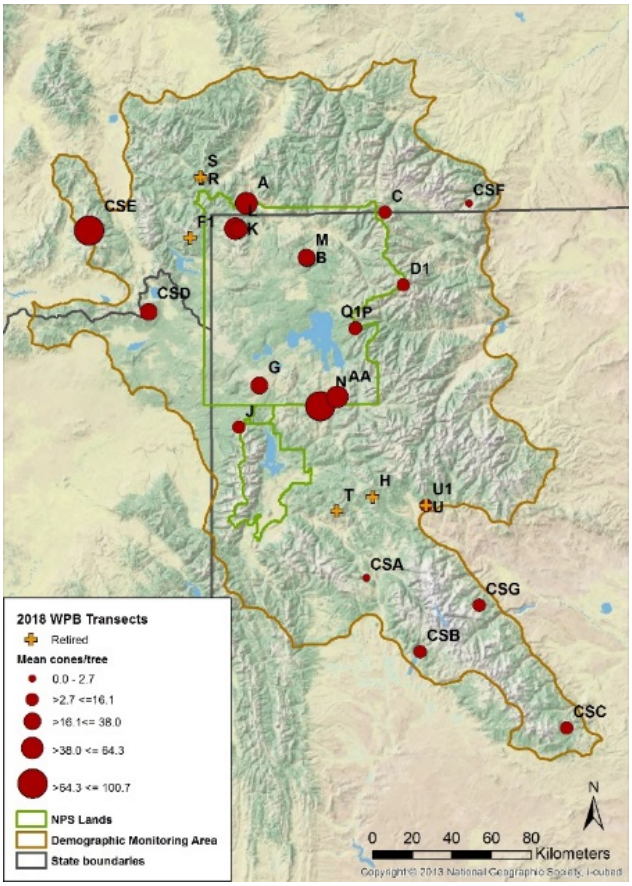


Fig. 19. Locations and mean number of cones/tree for 21 whitebark pine cone production transects, Greater Yellowstone Ecosystem, 2018. Labels reflect transect identifiers (see Table 27).

Table 28. Results of whitebark pine cone production surveys, Greater Yellowstone Ecosystem, 2018.

Transect	Number of cones	Number of trees	Mean number of cones/tree	SD
A	245	4	61.3	103.9
B	313	10	31.3	14.7
C	90	10	9	6.5
D1	159	10	15.9	8.2
F1		-----Transect retired in 2008-----		
G	217	10	21.7	21.2
H		-----Transect retired in 2008-----		
J	161	10	16.1	16
K	450	7	64.3	24.7
L	380	10	38	26.3
M	315	10	31.5	21.5
N	1007	10	100.7	42.7
P	61	10	6.1	5.8
Q1	78	10	7.8	10.1
R		-----Transect retired in 2009-----		
S		-----Transect retired in 2010-----		
T		-----Transect retired in 2008-----		
U		-----Transect retired in 2016-----		
U1	77	10	7.7	5
AA	573	10	47.3	42.3
CSA	27	10	2.7	3.4
CSB	113	10	11.3	10.4
CSC	90	10	9	12.1
CSD	252	10	25.2	18.6
CSE	177	2	88.5	102.5
CSF	3	4	0.8	1.5
CSG	74	10	7.4	7.3

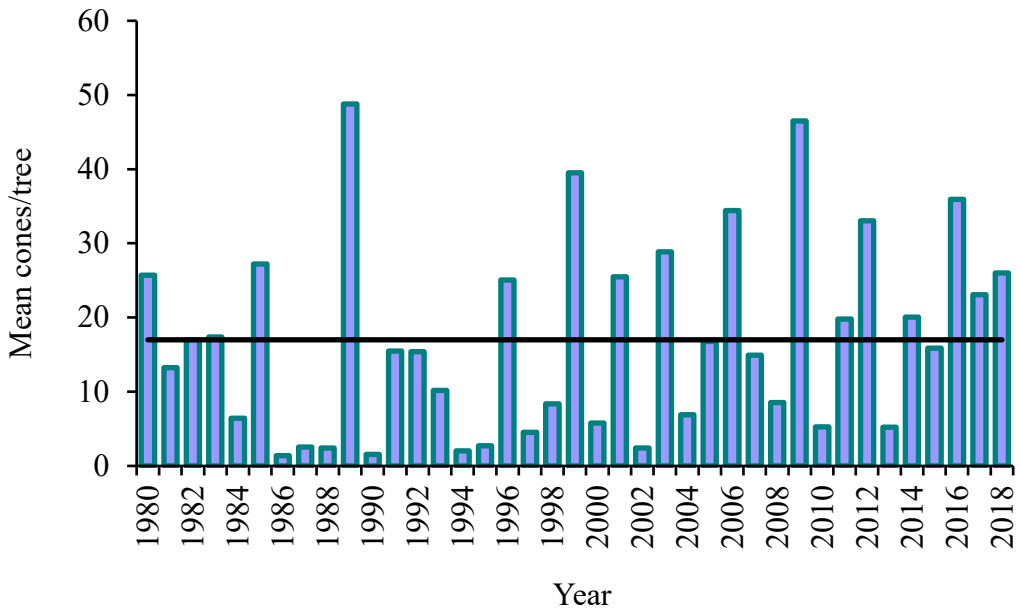


Fig. 20. Annual mean number of cones/tree observed along whitebark pine cone production transects, Greater Yellowstone Ecosystem, 1980–2018. The overall average for the time period (16 cones/tree) is shown as a solid line.

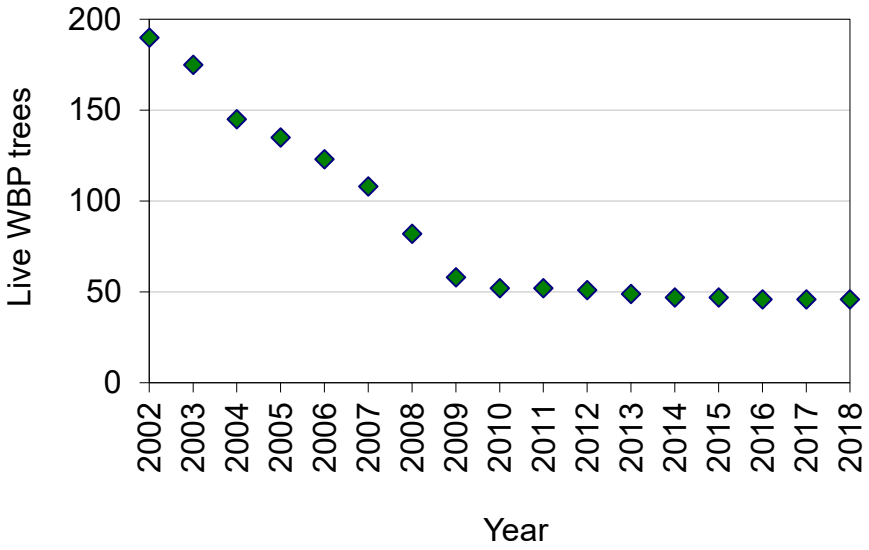


Fig. 21. Number of live whitebark pine (WBP) trees on cone production transects among 190 individual trees monitored since 2002, Greater Yellowstone Ecosystem, 2002–2018.

RECREATION MONITORING

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

In 2018, total visitation in Grand Teton National Park was 5,109,024 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 3,491,151. Backcountry user nights totaled 38,803. Long and short-term trends of recreational visitation and backcountry user nights are shown in Table 29 and Fig. 22.

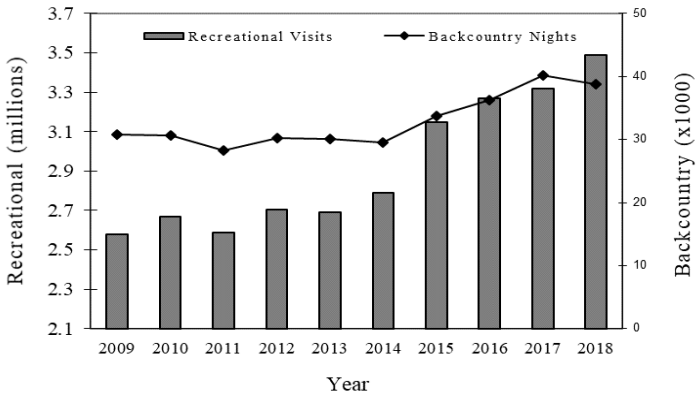


Fig. 22. Trends in recreational visitation and backcountry user nights in Grand Teton National Park during 2009–2018 (https://irma.nps.gov/Stats).

Table 29. Average annual recreational visitation and average annual backcountry use nights in Grand Teton National Park by decade from 1951 through 2009, and the most recent 10-year average.

Decade	Average annual recreational visitation[a]	Average annual backcountry use nights
1950s	1,104,357	Data not available
1960s	2,326,584	Data not available
1970s	3,357,718	25,267
1980s	2,659,852	23,420
1990s	2,662,940	20,663
2000s	2,497,847	30,049
2009–2018	2,925,049	31,716

[a] In 1983 a change in the method of calculation for park-wide visitation resulted in decreased numbers. Another change in 1992 increased numbers. Thus, park-wide visitation data for the 1980s and 1990s are not strictly comparable.

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 Greater Yellowstone Ecosystem. 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 30). 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 5,338,438 visits in 2018 (https://irma.nps.gov/Stats/SSRSReports/Yell/Yellowstone) including recreational and non-recreational use. Recreational visits in 2018 totaled 4,115,000, the third busiest year on record and the fourth straight year that recreational visitation has topped the 4 million mark (Table 31). 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 2018, there were 3,954,822 recreational visits (96%) during those peak months, an average of 21,494 recreational visits per day. Park visitors spent 791,238 overnight stays in roadside campgrounds, and 41,759 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 32, Fig. 23). 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 beginning in 2010 is on pace to set a new park record high for visitation, with the first 9 years of the decade all ranking among the top 10 highest years for visitation (Table 31). The average number of overnight stays in roadside campgrounds in the park has also increased considerably in recent years (Table 32, Fig. 24). 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/year (Table 32, Fig. 25). The number of overnight stays in the backcountry is limited by both the number and capacity of designated backcountry campsites in the park.

Table 30. 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
Wilderness and undeveloped lands	886,552 ha (2,190,718 acres) (~ 99% of park)	• Managed primarily for bears and other wildlife • Overnight visitation is capped by a limited number of designated backcountry campsites • Most recreational day use is <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 31. Ten highest years for visitation to Yellowstone National Park, 1895–2018.		
Rank	Year	Visitation
1	2016	4,257,177
2	2017	4,116,525
3	2018	4,115,000
4	2015	4,097,710
5	2010	3,640,184
6	2014	3,513,484
7	2012	3,447,727
8	2011	3,394,321
9	2009	3,295,187
10	2013	3,188,030

Table 32. Average annual recreational visitation, auto campground overnight stays, and backcountry campsite overnight stays by decade, Yellowstone National Park, 1895–2018.			
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	3,752,241[g]	730,097[g]	42,060[g]

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

[b] Data from 1930–1934.

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

[d] Data from 1960–1964.

[e] Data from 1975–1979.

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

[g] Data for the years 2010–2018.

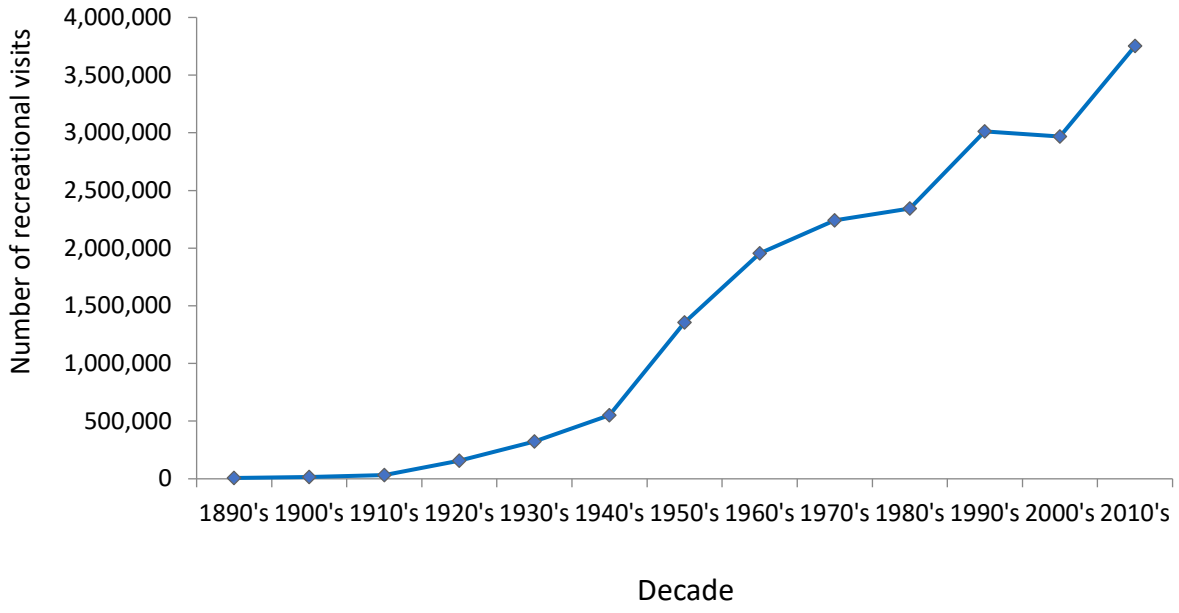


Fig. 23. Average annual number of recreational visits by decade, Yellowstone National Park, 1895–2018.

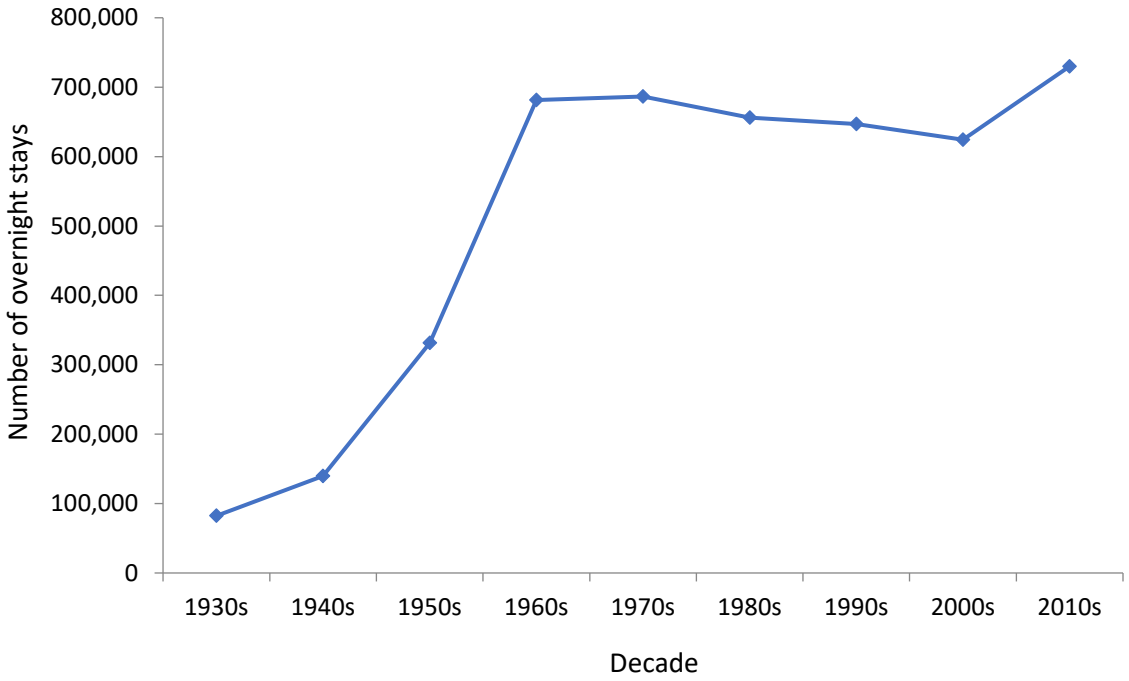


Fig. 24. Average annual number of overnight stays in roadside campgrounds by decade, Yellowstone National Park, 1930–2018.

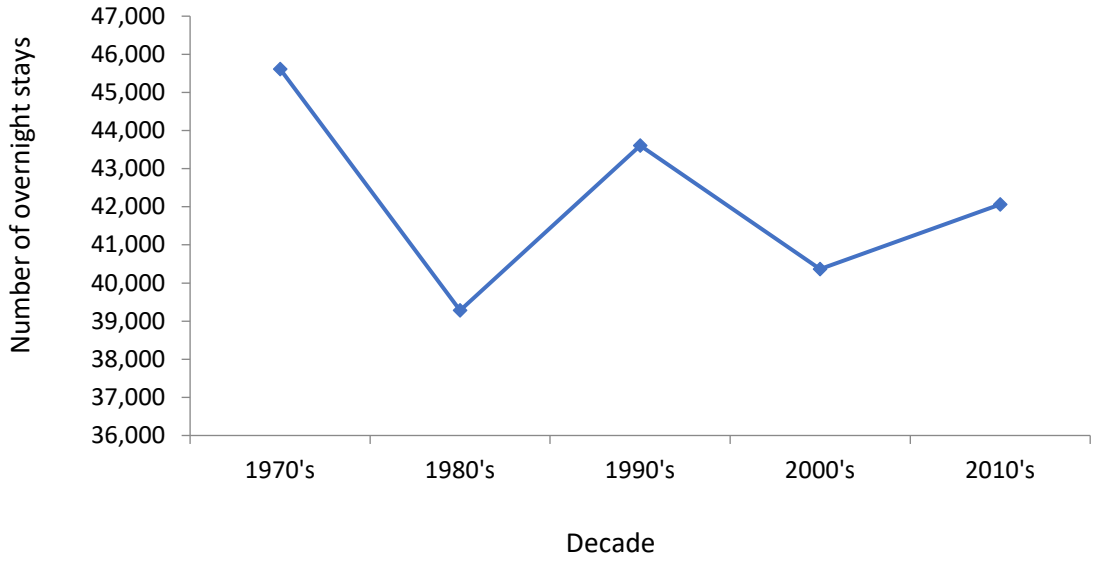


Fig. 25. Average annual number of overnight stays in backcountry campsites by decade, Yellowstone National Park, 1972–2018.

Yellowstone National Park visitors view grizzly bears in a roadside meadow. In 2018 there were over 4.1 million recreational visits to Yellowstone National Park, the third busiest year on record and the fourth straight year visitation topped the 4 million mark.

HUMAN-GRIZZLY BEAR CONFLICTS IN THE GREATER YELLOWSTONE ECOSYSTEM

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

No management actions were taken on grizzly bears in Grand Teton National Park in 2018, however, one human-grizzly bear conflict was recorded. On April 16, 2018, a grizzly bear chewed on several plastic water line markers in the Flagg Ranch area of the John D. Rockefeller, Jr. Memorial Parkway, which is managed by Grand Teton National Park staff.

Management of nonfood-conditioned, human-habituated bears required considerable effort to prevent conflicts from occurring. Grizzly bears were hazed out of a developed area 1 time and off of park roads 17 times. Grand Teton National Park recorded a minimum of 431 bear jams (169 grizzly, 231 black, 31 species not recorded), created when habituated bears frequented roadsides and the outskirts of other developments and drew crowds of onlookers. Grizzly bear jams peaked in May 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 7,500 hours towards this important bear conservation and public education program.

Grand Teton National Park hosted 132 bear safety programs park-wide. These presentations highlighted safety in bear country and concluded with a (inert) bear spray demonstration. The program was well received, with 2,826 visitors attending over the summer. Grand Teton National Park continued its partnership with the Grand Teton National Park Foundation to cost-share expenses for the purchase and installation of bear-resistant food storage lockers. One-hundred and four bear boxes (30 ft^3) were installed in 2018, bringing the total number of bear boxes in campgrounds and other developed sites to 755. Four of the park's 6 roadside campgrounds, including Jenny Lake, Signal Mountain, Colter Bay, and Lizard Creek Campgrounds, have a food storage locker in each site.

Plastic water line chewed on by grizzly bear in Grand Teton National Park (photo courtesy of Eli Kind/NPS employee)

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

To effectively allocate resources for implementing management actions designed 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).

There were 3 human-grizzly bear conflicts reported in Yellowstone National Park in 2018 (Table 33, Fig. 26). On July 2 at approximately 6:30 p.m., a female grizzly bear accompanied by 1 cub pulled aluminum beverage cans and plastic bottles from recycling bins located at the Indian Creek Campground. The bears may have consumed small amounts of food and beverage residue from the insides of the cans and bottles. The bears were hazed away from the area and the aluminum and plastic recycling bins were removed from the campground. No further incidents occurred at the Indian Creek Campground in 2018. The second conflict occurred around 10 a.m. on August 23, when a 10-year-old boy was injured by a female grizzly accompanied by a cub or yearling. The boy and his mother, father, and teenage brother were hiking on the Divide Trail when an adult grizzly bear charged out of the brush on the side of the trail. As the bear charged, the father reached for his bear spray, the mother and teenage boy got behind trees, and the 10-year-old turned and ran back down the trail. The bear ran past the rest of the family, and pulled the running boy down from behind, breaking his arm and causing a deep laceration in the muscles of his back. As the bear was standing on top of the child, the parents ran to within 3–5 feet and sprayed it with bear spray, causing the bear to run off. Complete tracks of an adult grizzly bear and partial tracks of at least 1 cub or yearling were found at the scene. Some fresh bear digging (current year) and numerous old diggings (previous year) in red squirrel middens containing whitebark pine seeds were found in the forest within 10 yards of the trail. The trail was closed for 16 days, then reopened after trail cameras set up at the site indicated the bears had left the area. No management action was taken against the bears. The third conflict occurred at the Bacon Rind Trailhead on August 24, when an unmarked adult grizzly bear (based on tracks) obtained human food (wildland fire fighter lunch scraps including a peach, peanut butter sandwich, and residue from an empty Red Bull can) from a non-bear proof garbage can (intended for paper towels) that had been set up at a hand wash station associated with a temporary pit toilet at a staging area for crews working on the Bacon Rind Fire. The non-bear proof garbage can was removed from the wildland fire staging area and Bear Management Technicians with hazing equipment monitored the trailhead for several days. However, the bear did not return and no further incidents occurred at the trailhead.

The annual number of human-bear conflicts occurring in Yellowstone National Park can vary widely from year to year and depends on many factors, including the availability of natural bear foods, grizzly bear population numbers, park visitation, and park staffing levels. The annual number of conflicts in Yellowstone National Park has decreased substantially after efforts to prevent bears from obtaining anthropogenic foods were implemented in the late 1960s and early 1970s (Fig. 27).

During 2018, there was 1 known grizzly bear mortality in the Yellowstone National Park portion of the GYE. The mortality was due to natural causes. On November 26, the skeletal remains of a 15- to 18-year-old grizzly bear was discovered in Lamar Valley. The carcass was nearly entirely consumed by wolves and other scavengers, so the exact cause of death could not be determined. The Junction Butte wolf pack consisting of 11 wolves was known (via GPS Iridium collar locations and feeding site examination) to have fed on the carcass and may have killed the bear. There was no evidence that the mortality was human-caused. 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. 28), primarily management removals of bears involved in human-bear conflicts. In recent decades (1980–2018), 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 2018, considerable management effort was dedicated to preventing conflicts (Table 34). Because of grizzly bear activity in visitor use areas, bear warning signs were posted at 15 locations and temporary trail or area closures were posted at 21 locations. In addition, 87 large mammal wildlife carcasses likely to attract grizzly bears were removed from visitor use areas. In an effort to prevent the need to capture and relocate or remove bears, grizzly bears were hazed out of human use areas 36 times. Grizzly bears were hazed out of park developments 5 times and off of primary roads 31 times. In addition, as part of the park's strategy for preventing bears from obtaining human foods, 162 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 158 food storage lockers in roadside campgrounds in 2018, 825 (43%) of the park's 1,907 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 (44% of sites), Madison (38% of sites), Bridge Bay (26% of sites), and Grant (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, 3 food storage lockers were installed in backcountry campsites in 2018 to replace broken food 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). One additional food storage locker was installed in the Youth Conservation Corps work crew campsite located at Lake Village.

Although there were few conflicts in Yellowstone National Park, management of non-food conditioned, human-habituated 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 2018, 240 roadside traffic-jams caused by visitors stopping to view habituated grizzly bears along roadsides were reported in Yellowstone National Park. Thousands of visitors viewed bears at these bear jams. Park staff responded to 180 (75%) of the grizzly bear jams and spent 1,066 personnel hours managing habituated grizzly bears, the traffic associated with the traffic jams, and the visitors that stopped to view and photograph the habituated grizzly bears. On average, 5.9 hours of park staff time were spent managing each grizzly bear jam in 2018. In addition, 481 traffic jams caused by black bears were reported. Park staff responded to 411 (85%) of the black bear jams and spent 1,287 personnel hours managing them. On average, 3.1 hours of park staff time were spent managing each black bear jam in 2018. After the 2nd week of August, there was a noticeable decrease in the number of both grizzly and black bear jams (Fig. 29) as bears moved up in elevation to feed on whitebark pine seeds. Counts of whitebark pine cones on transects were higher than the long-term average in 2018 (see "***Whitebark Pine Cone Production***"). The number of late summer and fall bear-jams are lower during years with good whitebark pine cone production, because bears are foraging for pine seeds (in red squirrel middens) in forested areas where they are not readily visible and because fewer park roads occur at the higher elevations of whitebark pine habitat (Haroldson and Gunther 2013).

Visitation to Yellowstone National Park exceeded 4 million visits for the first time in 2015, has exceeded that number each year thereafter, and is expected to continue to increase into the foreseeable future (see "***Yellowstone National Park Recreational Use***"). Since 2008, annual visitation to Yellowstone has increased by almost 40 percent. 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. Therefore, concurrent with increasing visitation, park managers should anticipate the need for increased staff time and infrastructure (e.g., housing, vehicles, and equipment) dedicated to the management of visitors at bear jams.

Table 33. Number of incidents of human-grizzly bear conflict reported in Yellowstone National Park, 2018.

Conflict type	Number of conflicts
Property damage – without food reward	0
Property damage – with food reward	2
Human injury	1
Human fatality	0
Livestock depredation[a]	0
Total conflict incidents	3

[a]There are no cattle or sheep grazing allotments inside of Yellowstone National Park. Horses, mules, and llama's 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.

Table 34. Number of management actions taken to reduce the potential for conflicts with grizzly bears in Yellowstone National Park, 2018.

Management action	Number of incidents
Bear warnings posted	15
Temporary area closures	21
Wildlife carcass removal from visitor use areas	87
Bear-jam management	180
Management hazing	36
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	339

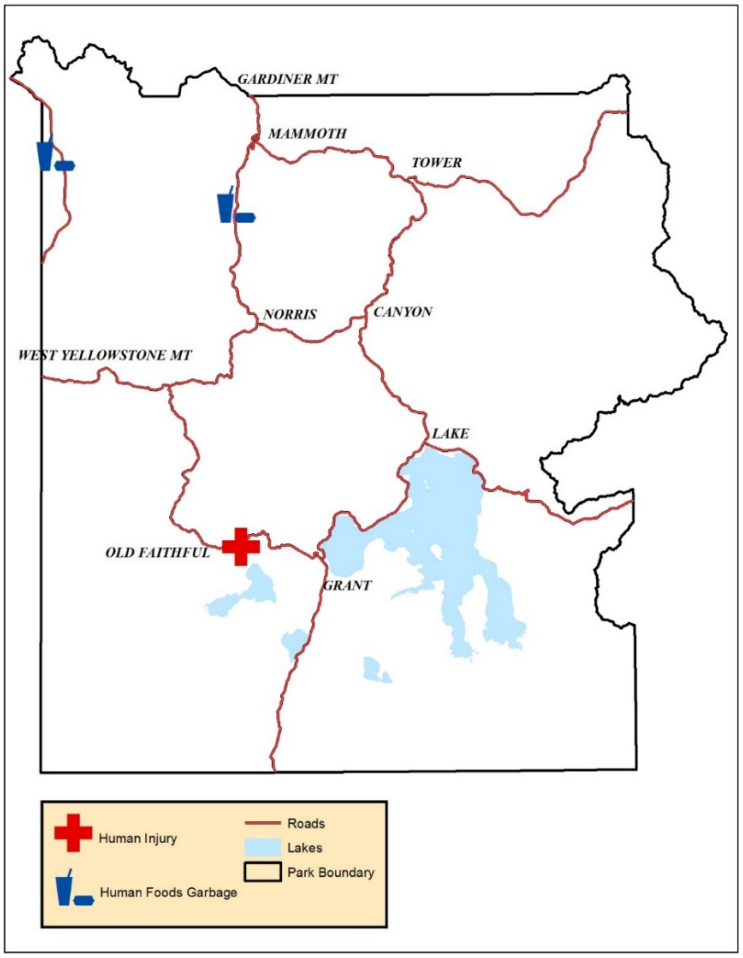


Fig. 26. Locations of human-grizzly bear conflicts, Yellowstone National Park, 2018.

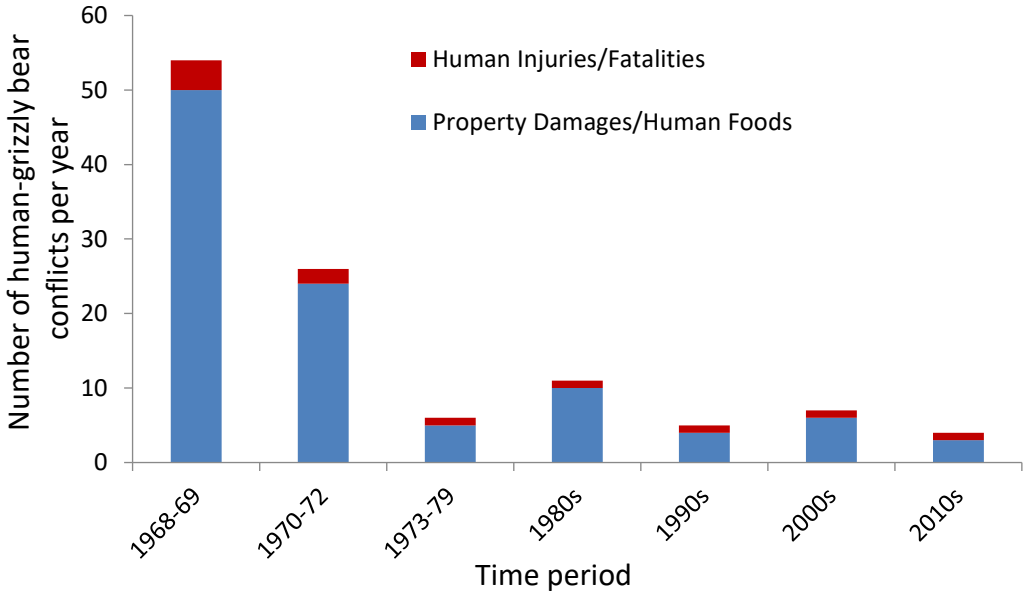


Fig. 27. Number of human-grizzly bear conflicts, Yellowstone National Park, 1968–2018.

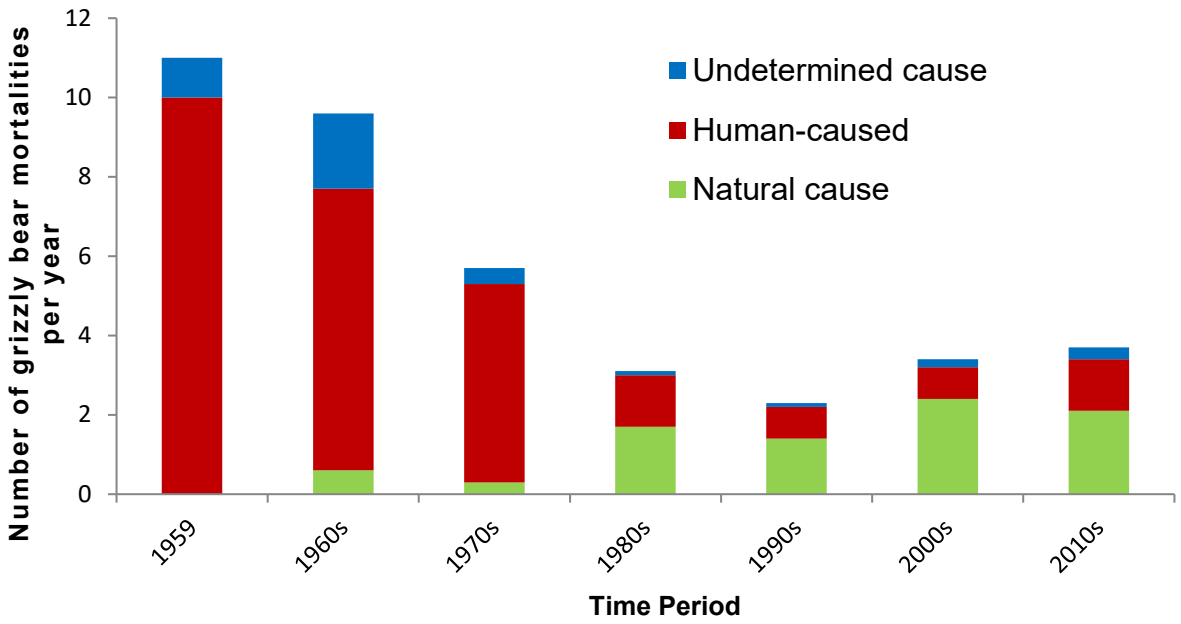


Fig. 28. Number of known and probable grizzly bear mortalities, Yellowstone National Park, 1959–2018.

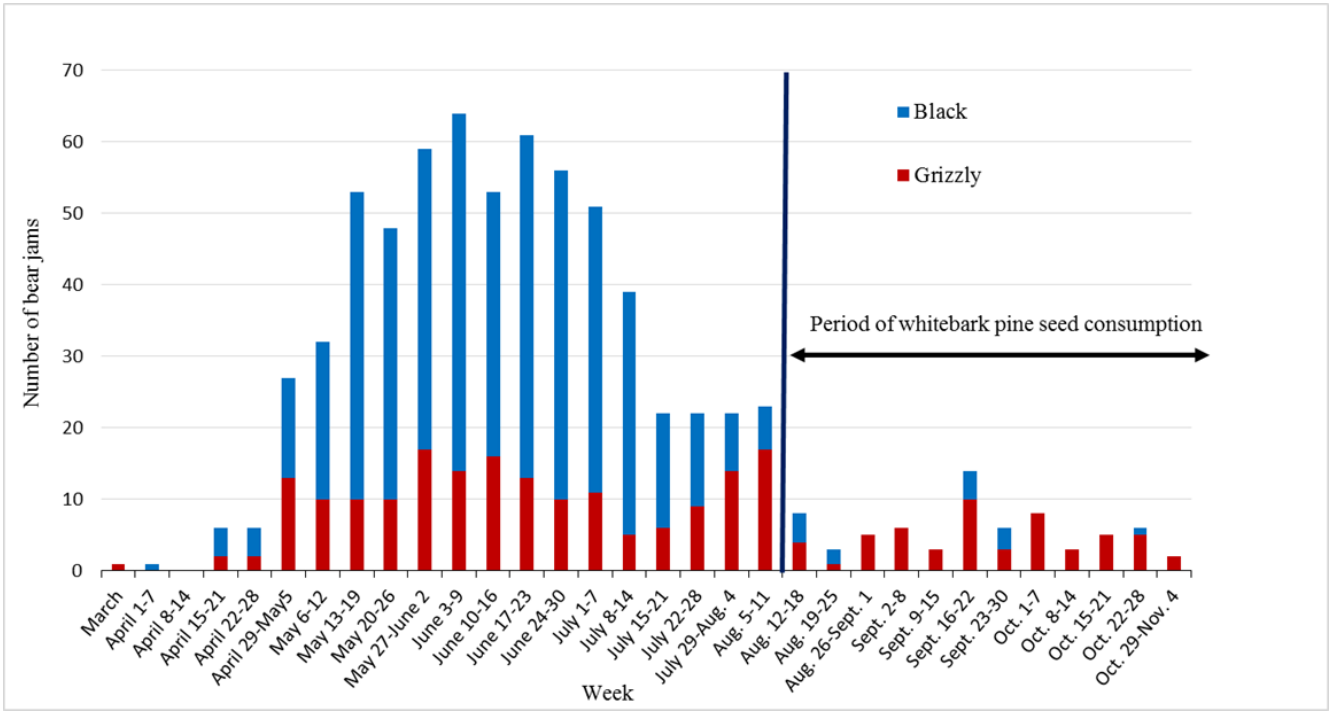


Fig. 29. Number of grizzly and black bear caused traffic jams by week in Yellowstone National Park, 2018. Note the reduction in the number of bear jams after the 2nd week in August, when bears forage for whitebark pine seeds which are found in forested areas where bears are not highly visible from roads. In 2018, whitebark pine cone production in the Greater Yellowstone Ecosystem was higher than the long-term average.

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 32 human –grizzly bear conflicts in 2018 (Table 35, Fig. 30) 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 been occurring consistently in Idaho's portion of the Greater Yellowstone Ecosystem (GYE) since 2005 (Fig. 31). All of the conflicts in 2018 were inside the Demographic Monitoring Area (DMA). Since 1992, 90% of the conflicts that have occurred in Idaho were within the DMA (Fig. 32). The mean 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 2018 (n = 32) exceeded those in 2016 (n = 2) and 2017 (n = 6). The increase in conflicts in 2018 was mostly attributed to a small number of bears being involved in multiple incidents. Three bears were responsible for 25 of the conflicts that occurred. One of those bears was a subadult and the other a yearling that exhibited signs of habituation early in the season. Despite our efforts, the bears' behavior progressively worsened, becoming more habituated and food conditioned, which led to their removal from the population. Another bear involved in multiple conflicts was a female with cubs that found an entrance into the county landfill. After we secured the landfill, the bears visited a campground two nights in a row. We increased patrolling and information and education efforts in the campground and surrounding areas and did not have any additional incidents with that family of bears.

The majority of conflicts in 2018 involved bears exhibiting signs of habituation and spending time near developed areas (Table 35). There were 6 close encounter situations, 5 of which resulted in people being charged. Two encounters resulted in the deployment of bear spray. One of those incidents involved a hiker that was charged by a bear on a trail. Another individual sprayed a bear that approached at a campsite. The bear spray deterred the bear in both events. Three hunters were charged by grizzly bears in 2018. One of those events occurred in the spring and involved a female defending her young. The other two incidents occurred in the fall. Both events were in the same drainage and likely involved a bear defending a food source. Despite the increase in encounters, no human injuries occurred in 2018. There were 8 reports of bears obtaining anthropogenic foods. These incidents ranged from bears finding bird feeders at residential areas, to bears getting food in campgrounds, to a female with cubs of the year gaining access into the county landfill multiple times. There was one confirmed incident of a grizzly bear killing a domestic calf in 2018.

Three bears were captured for their involvement in conflicts. A large, male grizzly bear was captured and relocated for killing a domestic calf. A subadult male was captured because it was exhibiting signs of habituation and frequenting developed areas. The bear was relocated but returned to his original capture location. Its habituation worsened, and it began to seek human food. The bear was recaptured and euthanized due to its behavior and potential threat to public safety. A male yearling bear was observed numerous times in multiple campgrounds and in neighborhoods. The bear eventually started seeking and finding human food. It was captured in a research trap, collared, and relocated. It quickly returned to the same area and continued to seek human food. The bear was captured again and taken to an animal sanctuary in Texas. The two bears removed from the population for their involvement in conflicts were the only known mortalities in the Idaho portion of the GYE.

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. In 2018, we had an increase in bear activity in campgrounds on the Caribou-Targhee National Forest. Generally, bears would visit but were not able to gain a food reward in designated campgrounds that were closely monitored by campground hosts, volunteers, and U.S. Forest Service and IDFG personnel. In dispersed campsites, particularly in group camping areas, there were confirmed incidents of bears obtaining food, and likely, other unconfirmed incidents. Dispersed campsites are not monitored as closely and do not have campground hosts. In 2019, monitoring efforts at dispersed campsites will increase, particularly where conflicts occurred in 2018.

The IDFG tries to reduce conflicts through outreach and education efforts and securing attractants on public and private land. The IDFG works closely with the U.S. Forest Service and campground hosts in patrolling campgrounds, looking for improperly stored attractants, and providing education materials to campers. The IDFG also routinely removes carcasses from roadsides and other public use areas that could attract bears and other wildlife. On private land, the Department works with homeowners to secure

attractants and provide education materials about living in bear country. Unsecured garbage left at rental properties is an issue that has continued to worsen and will be a focus in the future. Efforts have been made with homeowners-associations to increase bear awareness and to reduce attractants available to bears. Substantial improvements are needed, but one neighborhood that consistently experienced conflicts has made tremendous progress in securing attractants and is no longer experiencing conflicts.

The IDFG continues to build relationships with local business owners in an effort to increase the use of bear resistant dumpsters by 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. We have found that many business owners are willing to purchase a bear-resistant dumpster if we help them find a provider that has reasonably priced equipment and provides good service. In particular, new businesses are generally open to purchasing bear-resistant dumpster if approached in the early stages of their operation.

Table 35. Human-grizzly bear conflicts in the Idaho portion of the Greater Yellowstone Ecosystem, 2018.

Conflict type	Number of Conflicts
Encounter situations	6 (5 charging incidents)
Public safety threat (e.g., habituated, near developed site)	17
Anthropogenic foods	8
Property damage – without food reward	0
Property damage – with food reward	0
Livestock – cattle	1
Livestock – poultry	0
Livestock – sheep	0
Beehives/orchards	0
Total	32

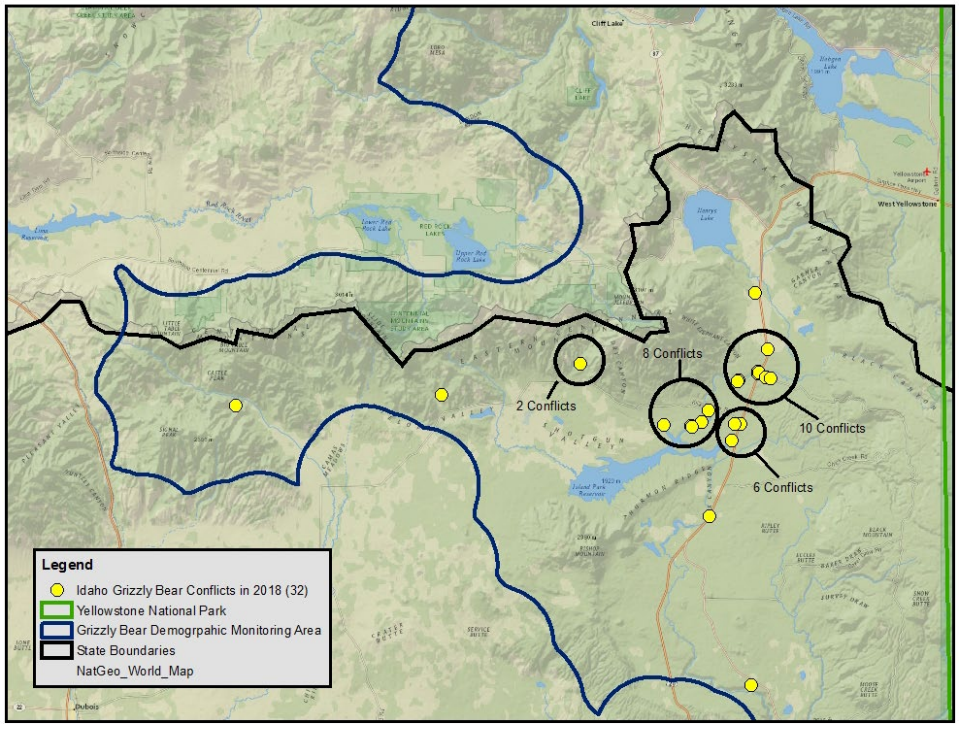


Fig. 30. Locations of human-grizzly bear conflicts in the Idaho portion of the Greater Yellowstone Ecosystem, 2018.

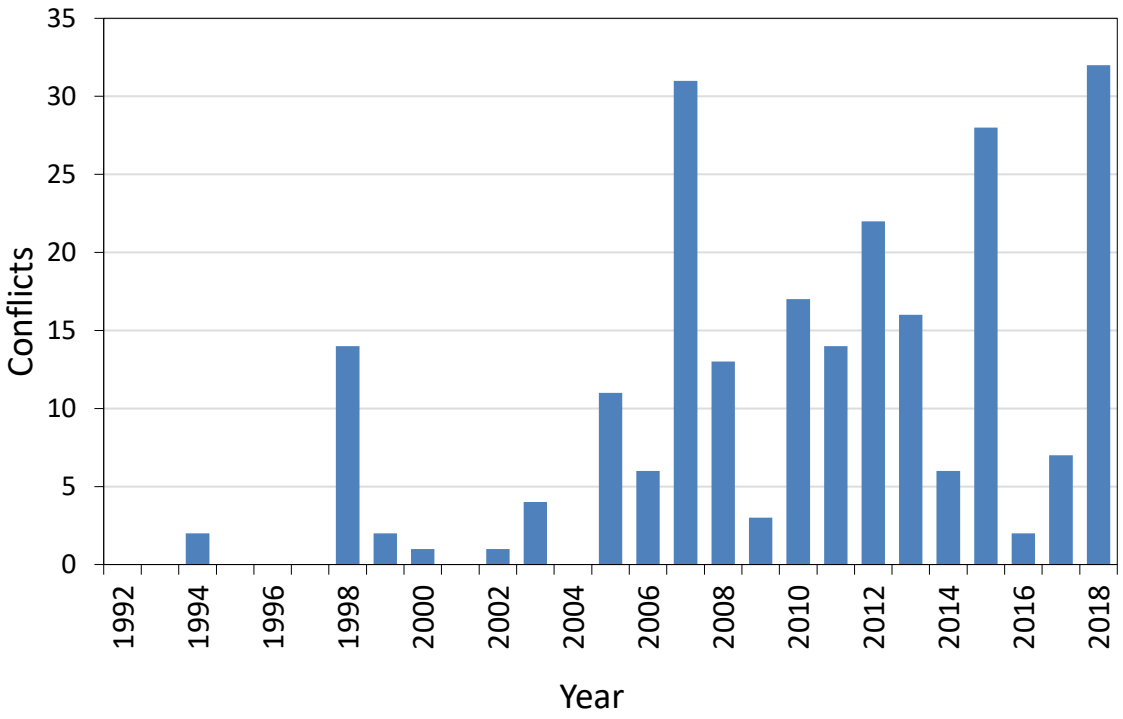


Fig. 31. Number of documented human-grizzly bear conflicts in the Idaho portion of the Greater Yellowstone Ecosystem, 1992–2018.

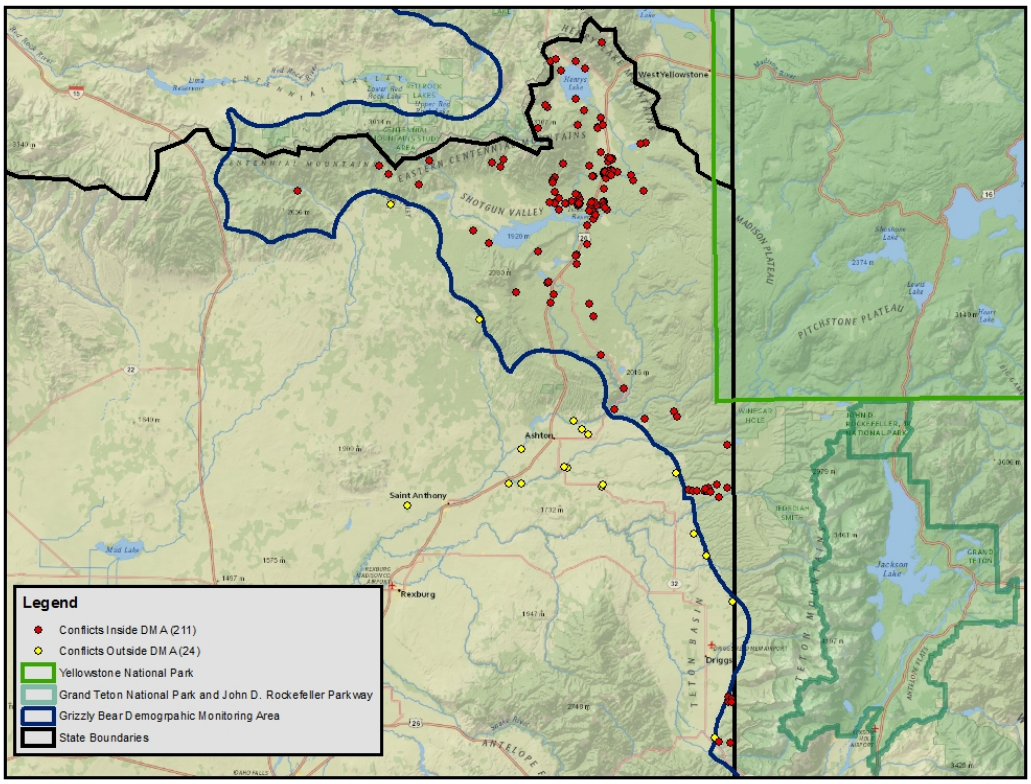


Fig. 32. Number of documented human-grizzly bear conflicts inside and outside the Demographic Monitoring Area (DMA) in the Idaho portion of the Greater Yellowstone Ecosystem, 1992–2018.

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

During 2018, Montana Fish, Wildlife and Parks (MFWP) personnel investigated 111 human-grizzly bear conflicts in Montana's portion of the Greater Yellowstone Ecosystem (GYE). Incidents in which grizzly bears cause public safety concerns, property damage, livestock depredations, human injuries, obtain anthropogenic foods, or grizzly bear mortalities, are all considered conflicts that require agency response and may require management action. These conflicts vary from a bear being involved in a single incident to multiple incidents involving one or more bears over an extended time period before the conflicts can be resolved. The mean annual number of conflicts over the previous 10 years is 76. There were 111 reported and investigated human-grizzly bear conflicts in 2018 (Table 36). Most conflicts (59%) occurred on private land (Table 36). Annually, Montana Fish, Wildlife and Parks continues efforts to reduce conflicts, increase public safety, and reduce bear mortalities in areas of historic high conflicts, in new geographic areas, and at individual sites.

With the grizzly bear population expanding in occupied range and numbers beyond the Demographic Monitoring Area (DMA), conflicts are occurring in a larger geographic area on public and private land in MFWP Region 3 (Fig. 33) and MFWP Region 5 (Fig. 34). Additionally, grizzly bear conflicts and confirmed grizzly bear sightings or tracks are now occurring annually in the geographic area between the GYE and the Northern Continental Divide Ecosystem (NCDE).

During 2018, one person was injured during an encounter with a female grizzly bear in Montana's portion of the GYE. The encounter and injury were related to archery elk hunting and occurred in mid-October.

As in 2017, the most common conflict type in 2018 was livestock depredation on public and private land. Livestock depredations were the second most common conflict type in 2016 and the most common conflict type in 2015. Historically, the most common conflicts occurred at or near developed sites with bears searching for or obtaining unnatural (anthropogenic) foods, with some having associated property damage. These anthropogenic food-related conflicts were the most common type of human-bear conflict, which was also the main cause for bear captures, relocations, and mortalities. For more than twenty years, extensive effort has been made on private and public land to secure attractants and reduce these conflicts. Early in the recovery program this was a primary management emphasis for the Yellowstone grizzly bear population. Bears near developed sites are often investigating the possibility of obtaining anthropogenic foods. In Montana and throughout the GYE, information and education programs, sanitation efforts, and experience have helped reduce the number of bears obtaining anthropogenic foods, thereby reducing the need for management actions involving capture, relocation, or sometimes removal. These efforts will need to continue to maintain social tolerance of grizzly bears.

There has been a 20% increase in conflicts during the most recent 10-year period over the previous 10-year period. During 1999–2008, 608 human-grizzly bear conflicts were investigated. From 2009 through 2018, there were 761 reported and investigated human-grizzly bear conflicts in the Montana portion of the GYE (Fig. 35). This increase is attributed to the increase in grizzly bear population numbers, the expansion of occupied grizzly bear range, and the increase in human population and activity. However, considering substantial human population growth and continuing grizzly bear range expansion in Montana's portion of the GYE, it is apparent that conflict reduction efforts have been beneficial on public and private lands.

Historically, livestock depredations by grizzly bears have been relatively low in southwest and southcentral Montana. However, as bears expanded their distribution farther away from the core of biological suitable habitat, livestock depredations have greatly increased on private and public lands in these areas. The relatively recent (since 2011) increase in livestock depredations have been on the outer edge of the DMA or beyond the DMA boundary on the northeast and west side of the GYE in Montana. During 2018, most of the livestock depredations occurred on public land in the Gravelly Mountains and on private land in the greater Red Lodge area. These areas now experience yearly depredations due to the northerly and westerly expansion of grizzly bears in Montana's portion of the ecosystem and it is anticipated that livestock depredations will continue in these areas and in new and historical areas. Overall, the majority (54%) of 2018 livestock depredations occurred on private lands.

In the Red Lodge area, 91% of the livestock depredations occurred on private land beyond the DMA. These and other conflicts will remain a management challenge. More evidence that the GYE and NCDE grizzly bear populations are geographically expanding was emphasized during 2018 by a calf depredation that occurred on the southside of the Little Belt Mountains, north of Two Dot on private land and a calf depredation

Table 36. Human-grizzly bear conflicts in Montana portion of the Greater Yellowstone Ecosystem, 2018.

Conflict type	Number of conflicts
Encounter situations	12 (1 human injury)
Livestock – cattle	60 (62 cattle killed or injured)
Livestock – sheep	1 (2 sheep killed)
Livestock – swine	0
Property damage	1
Anthropogenic foods	16
Anthropogenic foods with property damage	3
Near developed sites-safety concerns	12
Mortalities	6 (+1 possible)
Total	111

in the West Pioneer Mountains, northeast of Jackson on public land. The calf depredation north of Two Dot is the farthest east confirmed grizzly bear presence in NCDE or GYE in modern times. Livestock depredations were at the highest recorded level (n = 62) during 2018 in Montana's portion of the GYE. During 1999–2008, there were 25 livestock-related conflicts investigated in southwest/southcentral Montana. This conflict type increased to 235 investigated livestock related conflicts during the recent 10-year time period of 2009–2018.

During 2018, there were 6 management captures involving 5 grizzly bears, with all 6 of the captures occurring on private land (Fig. 36). The long-term average over the previous 20 years is 4.5 management captures per year. Three of the 2018 grizzly bear captures were due to livestock (cattle) depredations, which involved 2 adult males and 1 adult female bear. One adult female bear was captured on private land outside the DMA and relocated after being captured at a livestock depredation site.

Table 37. Private and public land grizzly bear conflicts in Montana portion of the Greater Yellowstone Ecosystem, 2018.

Jurisdiction	Number of conflicts
Private	66 (59%)
State	2
County or local jurisdiction	2
Federal jurisdiction	0
Bureau of Land Management	2
Custer-Gallatin National Forest	9
Beaverhead-Deerlodge National Forest	30
USFWS-National Wildlife Refuge	0
Total	111

A grizzly bear investigates bait in management trap (photo courtesy of Kevin Frey)

During 2018, there were 4 known and 2 probable grizzly bear mortalities in the Montana portion of the GYE (Fig. 37), which was a significant decrease from the 16 known and probable mortalities in 2017. There was an additional possible mortality during 2018 that occurred in a defense of life and property situation on public land. The bear involved in this incident was chasing cattle and running towards a ranch worker, who fired several carbine rounds at the bear. The bear was not found injured or dead and after searching no evidence was discovered that the bear had been injured. Possible mortalities do not count towards the annual mortality limits but are documented in the annual GYE mortalities. All four of the known mortalities occurred on private land and the two probable mortalities occurred on public land. Of the four known mortalities, one was an adult male bear captured on private land outside the DMA and removed for multiple cattle depredations in the area prior to its capture. A second adult male was also captured on private land, but within the DMA and was removed for multiple cattle depredations. This male bear had been previously captured at a multiple-cattle depredation site in 2016. At that time, the bear had been collared and released on site. The other two known mortalities were subadult females that were removed from private land for conflicts at multiple residences, habituation, and human safety concerns. Of the two probable grizzly bear mortalities, one may have been killed in a backcountry self-defense situation within the DMA on public land with archery hunters in late September. The bear had charged two hunters who were sitting by a tree. Several pistol shots were fired to deter the bear and when the bear continued its charge, several shots were fired at the bear. It was reported that the bear had been hit at least once. The other probable mortality occurred during an agency management investigation situation at a livestock depredation within the DMA on public land. When investigators approached the reported livestock kill, the bear was discovered on a freshly killed bovine and an authorized attempt was made to remove the bear on site. Reportedly, the bear was struck multiple times and went into heavy timber. Repeated searches of the area did not result in the bear carcass being found. All 2018 grizzly bear mortalities are shown in Table 16 and in Fig. 10.

Even as the Yellowstone grizzly bear population has been expanding throughout the entire ecosystem, Montana's long-term mortality trend has remained relatively constant since 1992, averaging 5.4 bear mortalities per year. Comparing time periods of 1999─2008 to 2009─2018, bear mortalities associated with anthropogenic foods have decreased from 43% to 9% of the total annual mortality in Montana, indicating that sanitation and education efforts have been successful in reducing bear mortalities and increasing public safety. Front and backcountry grizzly bear encounters resulting in documented defense of life-related bear mortalities have increased from 26% of the average annual bear mortality during 1999─2008 to 41% during 2009─2018. Management removals of bears due to livestock depredations have increased from 0% to 15% of the average annual mortalities during these same time periods. The trend of grizzly bear mortalities due to management actions compared with all other mortality causes is shown in Fig. 38. The expectation is that grizzly bears will continue to expand their range into areas beyond the DMA, likely resulting in an increase of total conflicts and bear mortalities. Evidence of grizzly bear expansion was again documented during 2018, with confirmed locations east, west and northeast of the Yellowstone Ecosystem DMA.

The 2018 summer climatic conditions recorded high precipitation during the spring and early summer months and relatively cooler temperatures. Ample moisture and relatively average spring/early summer temperatures allowed for early-stage plant growth and blossoms or setting fruit buds. This resulted in the availability of berry fruits persisting for late summer and fall foraging. As in 2017, whitebark pine cone production was slightly above average in the GYE during 2018 (see "***Whitebark Pine Cone Production"*** in last year's annual report). Bears were also feeding on vegetative roots, grazing, and scavenging animal carcasses during the summer and fall months.

Grizzly bear conflict numbers (n = 111) during 2018 were above the 10-year average (n = 76). There is always great variation in yearly conflict numbers. During the last 10 years, the range of yearly conflicts has varied from 46 to 113. The number of 2018 conflicts did not correlate to food stress for bears but was related to a high number of livestock depredation conflicts on private and public land inside and outside the DMA, which involved all age and sex groups of bears. Grizzly bear conflicts in late summer and fall involving anthropogenic foods or being near developed sites were higher in 2018. These types of conflicts are related to the availability of natural, higher-quality (fats, carbohydrates, proteins, sugars) foods and generally the production of unnatural fruits (apples). Apples were abundant near residences in 2018. However, the main factor now contributing to high conflict numbers is a high density of bears in relatively small geographic areas, resulting in conflict clusters. Bears in these areas are also habituated to the ever-increasing human presence and activities, which lead to investigating food sources near people. Occasional management removal of

conflict bears reduces conflict clusters; even though there are multiple bears in these areas, the percentage of bears involved in human conflicts is usually low. Field investigations indicated grizzly bears were using all habitat types (heavy shaded timber, wet areas, and open areas) during the summer months allowing bears to find adequate vegetative and protein food sources. Bears were also paralleling cattle habitat use on public and private land, depredating and scavenging cattle carcasses.

Again, grizzly bears caused a relative high number of livestock depredations*, which occurred on private land in marginal habitat and public land in quality habitat during 2018.

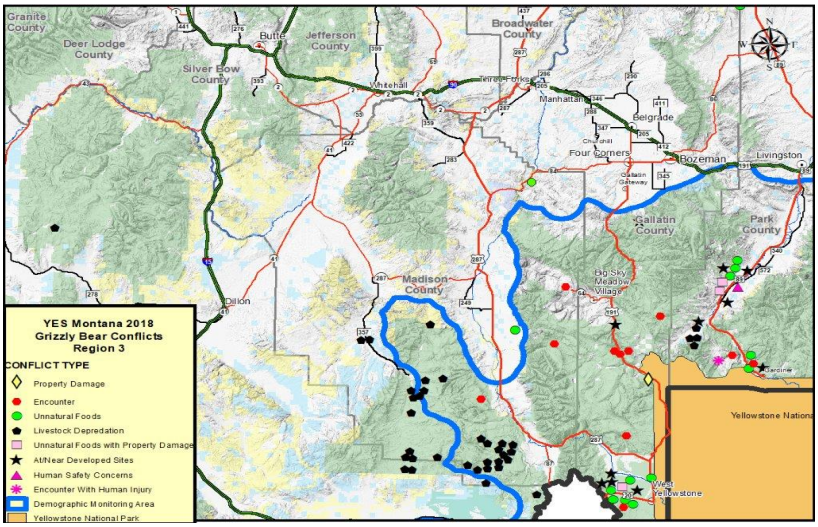


Fig. 33. Locations of human-grizzly bear conflicts in Montana FWP Region 3 portion of Greater Yellowstone Ecosystem, 2018.

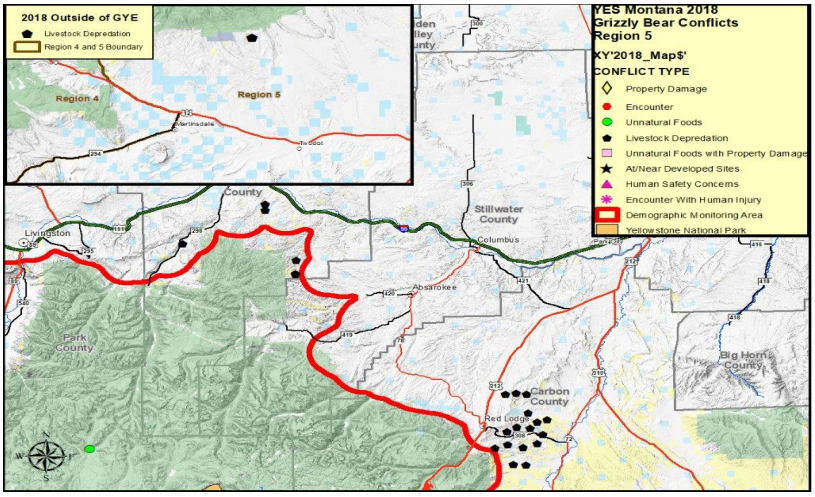


Fig. 34. Locations of human-grizzly bear conflicts in Montana FWP Region 5 portion of the Greater Yellowstone Ecosystem, 2018.

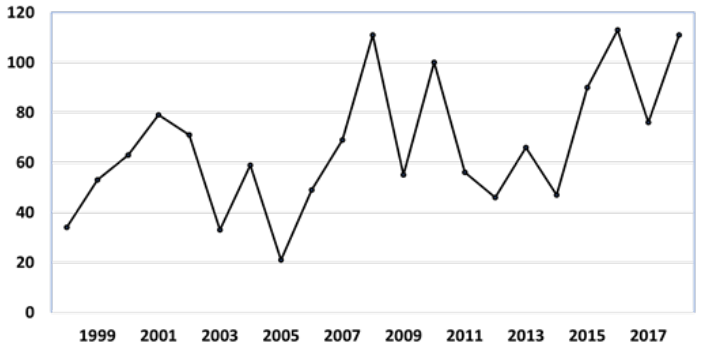


Fig. 35. Annual variation in total human-grizzly bear conflicts in Montana portion of the Greater Yellowstone Ecosystem, 1998–2018.

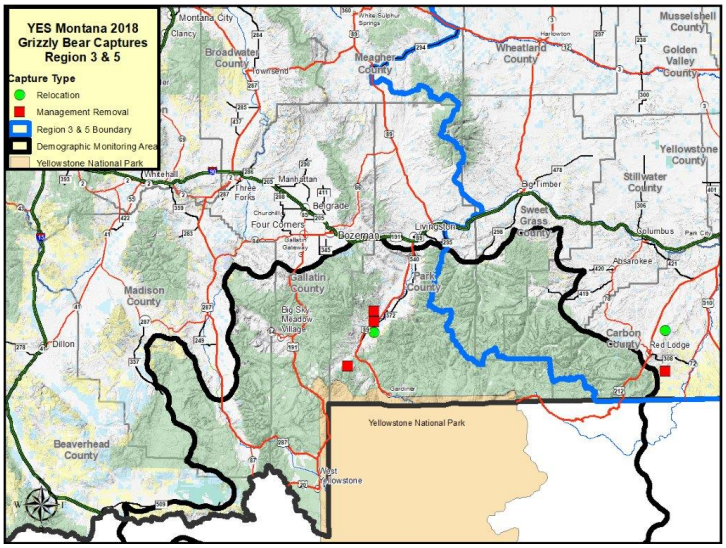


Fig. 36. Locations of grizzly bear management captures in Montana portion of Greater Yellowstone Ecosystem, 2018.

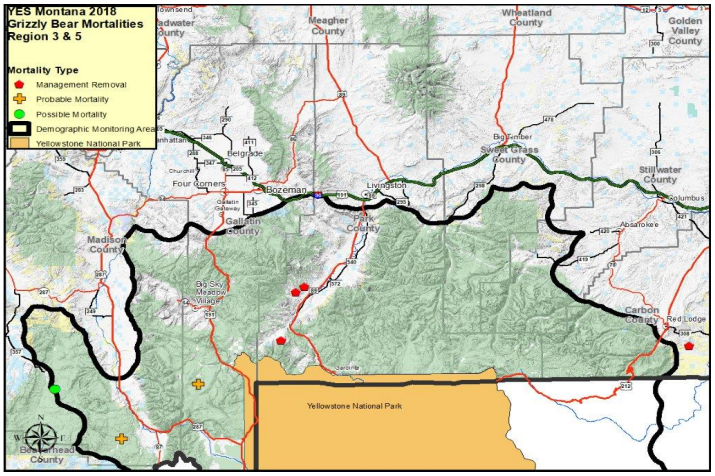


Fig. 37. Locations and causes of grizzly bear mortalities in Montana portion of Greater Yellowstone Ecosystem, 2018.

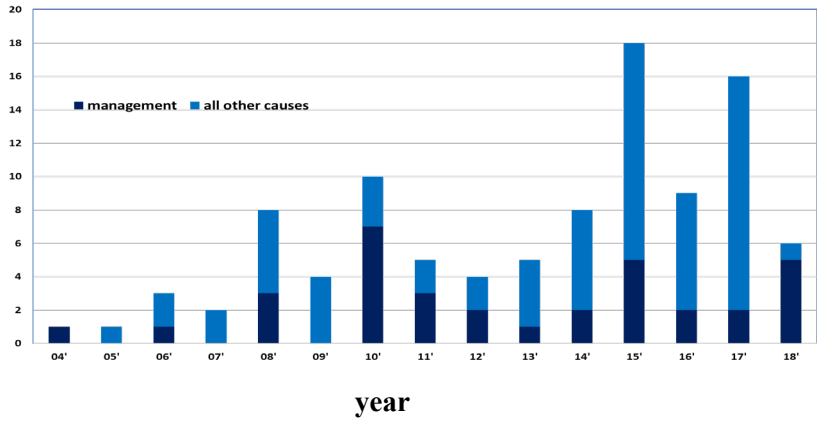


Fig. 38. Number of management removals and other mortalities in Montana portion of Greater Yellowstone Ecosystem, 2004–2018.

Summer vegetative foods were adequate in these shaded and mesic areas, as high-quality fall foods (e.g., berries, roots, seeds, carcasses) were in good quantity. No single factor can be attributed to low or high conflicts during a given year and it is always a combination of multiple factors. Natural food availability, climate conditions, bear numbers, individual bear behavior, dispersing sub-adult bears, previous bear removals, management efforts and human activities all factor into the annual variation of human-bear conflicts. Extensive efforts are made to reduce all types of conflicts and we have observed a measured success in the reduction of sanitation and anthropogenic food-related conflicts and associated bear mortalities.

During 2018, only two conflicts were related to garbage, with the remaining anthropogenic conflicts mostly involving fall scavenging of apples. Since 2006, Montana Fish, Wildlife and Parks and local community efforts have distributed and placed nearly 400 bear-resistant garbage containers which have greatly reduced garbage related conflicts in the upper Yellowstone River-Gardiner area, Cooke City, and upper Boulder River area, south of Big Timber. Conservation Strategy funding from the USFWS provided since the first delisting (2007) of the Yellowstone grizzly bear population allowed the acquisition of 346 bear-resistant refuse containers for placement on private and public land within the Grizzly Bear Recovery Zone/Primary Conservation Area. Defenders of Wildlife also donated the purchase of 17 bear-resistant garbage containers during 2018 to be distributed in these areas. Efforts continue by the Bear Aware Council in Big Sky, which represents private businesses, community developments, and agencies. Through the cooperative efforts of the Bear Aware Council, nearly 70% of the home-owner associations (HOA) require bear-resistant garbage containers. In the remaining 30% of the HOAs, there are many residents volunteering to use bear-resistant containers. Republic Services and L&L Site Services are providing the bear-resistant garbage containers in the Big Sky area. Additionally, there are numerous campaigns being implemented to raise bear awareness for residents and vacationers. This committed education and sanitation effort will help reduce black bear and grizzly bear conflicts in this portion of Gallatin and Madison Counties. The most difficult conflict type to prevent is a surprise encounter. Such encounters can lead to human injuries and are currently trending to be the leading cause of bear mortalities in Montana's portion of the GYE. During 2018, there was one human injury due to a surprise encounter with a bear. The person was injured while archery elk hunting and required medical treatment. Montana Fish, Wildlife and Parks continues to distribute bear conflict information to hunters through hunter (archery and rifle) education classes, license holders, postcards, letters, personal contacts, newspapers, websites, and televised news. In general, most of the public is aware of grizzly bear presence and potential encounter situations, but due to the unpredictable and random occurrence of surprise encounters, it is impossible to prevent most of these types of conflicts. The largest future challenge will be to effectively address bear management situations on lands beyond recognized suitable habitat and the DMA.

The Southwest Bear Education Working Group, led by Danielle Oyler (Education Coordinator) is now in its third year of operation through the funding and cooperative efforts of Montana Fish Wildlife and Parks, U.S. Forest Service (Beaverhead-Deerlodge, Custer-Gallatin, Helena-Lewis and Clark), Wildlife Management Institute, Wildlife Conservation Society, People and Carnivores and the U.S. Fish and Wildlife Service. During 2018, Danielle Oyler and U.S. Forest Service bear education technicians presented

information to numerous publics regarding overall bear safety, bear biology, preventing bear conflicts, reducing attractants, bear encounters and bear spray in a variety of formats.

The collective working group members connected with people at organized events, while on field patrols, during bear-specific training sessions and at schools and youth programs. During 2018, the working group contacted 14,607 people, of which 10,141 were adults and 4,466 were children. As this working group program has evolved, a directional emphasis is being made to reach people most likely to encounter bears, based on where they live or during work and recreational activities. This priority has led the on the ground members of the working group to speak at many hunting and fishing specific events and participate at community gatherings such as watershed councils and farmers markets. The purchase and implementation of a new remote-controlled charging bear in the presentations is greatly helping teach participants about how to respond to and use bear spray in serious bear encounters. This aspect will hopefully gain the attention of new people and help the messaging and education reach more audiences. The use of this educational tool required the use of 220 cans of inert bear spray and 25 cans of bear spray were also given away. The interactive mechanical charging bear and the overall bear information efforts will increase human safety and reduce conflicts between bears and people.

Livestock Depredation Investigations:

**MFWP has a statewide legal memorandum of understanding (MOU) with USDA/Aphis - Wildlife Services (WS) that makes WS the lead investigators on wildlife-caused livestock depredations and predator control. When possible, MFWP will coinvestigate on site grizzly bear caused livestock depredations. For livestock producers incurring depredation losses due to grizzly bears, WS field specialists must verify the loss as a confirmed or probable depredation for the producer to be reimbursed for the livestock loss by the state Livestock Loss Board. In consultation with MFWP and the United States Fish & Wildlife Service (USFWS), WS may attempt capture or removal of an offending bear(s). If WS captures a grizzly bear and as the bear is currently listed, MFWP and the USFWS determines the fate of the bear whether to release, translocate or remove the animal and MFWP conducts those management actions.*

Livestock depredation from a grizzly bear (photo courtesy of Kevin Frey)

Human-Grizzly Bear Conflicts in Wyoming *(Brian DeBolt, Becky Fuda, Zach Turnbull, Luke Ellsbury, Michael Boyce, Dustin Lasseter, Phil Quick, Zach Gregory, 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 2018, the WGFD captured 53 individual grizzly bears in 59 capture events in an attempt to prevent or resolve conflicts (i.e., 6 bears were captured twice) (Fig. 39 and Tables 38 and 39). Most captures were adult and subadult (3–5 years old) males.

Of the 59 capture events, 35 captures were a result of bears killing livestock (primarily cattle), 13 were captured for obtaining pet, livestock food, garbage, or damaging fruit trees. Nine bears were captured for frequenting developed sites or populated areas unsuitable for grizzly bear occupancy. Two bears were captured for killing a person. Of the 59 capture events, 29 (49%) were in Park County, 20 (34%) were in Sublette County, 4 (7%) were in Teton County, 3 (5%) were in Hot Springs County, and 3 (5%) were in Big Horn County (Table 38 and Fig. 39).

Of the 59 capture events, there were 23 relocation events. Four bears were released on site because they were non-target captures or part of a family group. Thirty-two bears were removed from the population. All relocated grizzly bears were released on U.S. Forest Service lands in or adjacent to the Primary Conservation Area (Fig. 40). Of the 23 relocation events, 11 (48%) bears were released in Teton County, 11 in Park County (48%), and 1 (4%) was released in Fremont County (Fig. 40 and Table 38).

Bears were removed 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 32 bears that were removed from the population, 17 were outside of the Demographic Monitoring Area. Removals occur after much deliberation and ultimate decisions take into account multiple factors unique to each conflict situation.

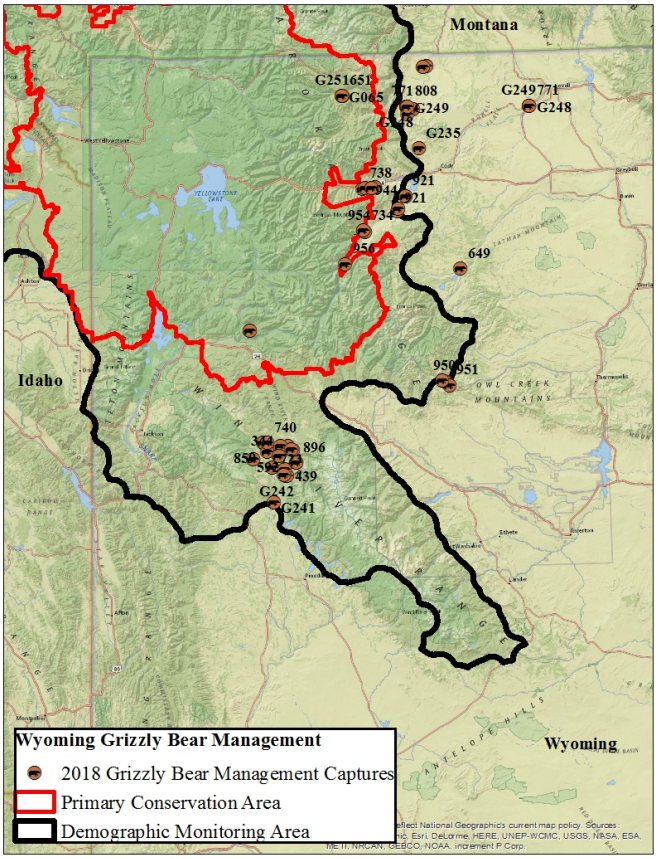


Fig. 39. Capture locations (n = 59) for grizzly bears captured in conflict management efforts in Wyoming portion of the Greater Yellowstone Ecosystem, 2018. Grizzly bears with "G" in front of their number were marked but not fitted with radio collars typically because they were too young to be collared. Because of the mapping scale, some locations are combined at one symbol. A complete list is provided in Table 38.

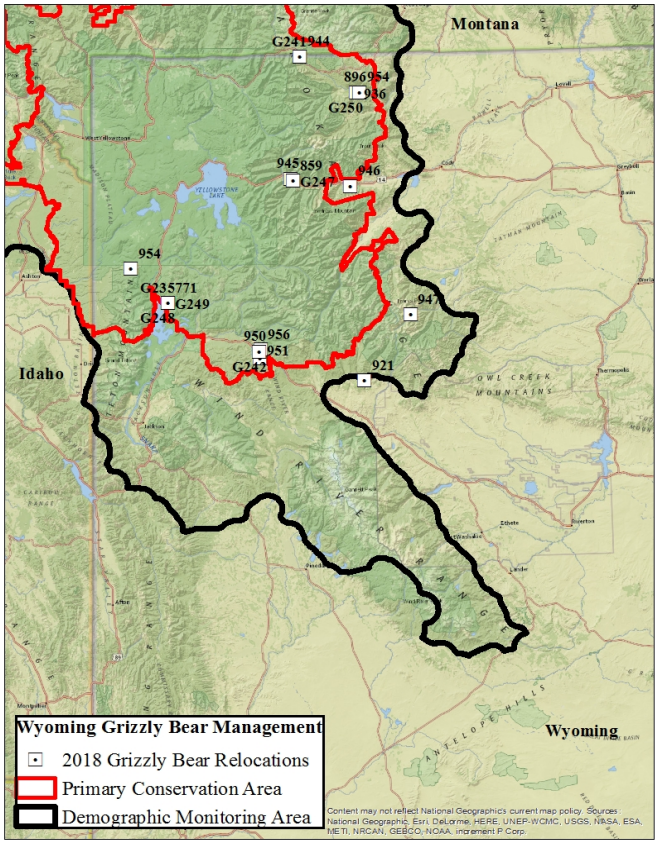


Fig. 40. Release locations (n = 23) for grizzly bears captured, relocated, or released on site in conflict management efforts in Wyoming portion of the Greater Yellowstone Ecosystem, 2018. Grizzly bears with "G" in front of their number were ear-marked but not fitted with a radio collar upon release, 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 38.

Table 38. Summary of grizzly bear conflict management captures in Wyoming portion of the Greater Yellowstone Ecosystem, 2018. Grizzly bears identified with "N/A" were removed from the population without receiving an identification number.

Date	ID	Capture county	Relocation site	Release county	Reason for capture
4/24/2018	921	Park	Bear Creek	Fremont	Captured for frequenting calving pastures
4/29/2018	N/A	Park			Removed for very bold behavior and frequenting calving pasture/ranch area
5/9/2018	N/A	Park			Removed for breaking into building and getting pet food
5/30/2018	N/A	Park			Removed for being habituated and associated with multiple cattle depredations
5/30/2018	G235	Park	Bailey Creek	Teton	Captured for frequenting a residence with chickens
6/22/2018	N/A	Park			Captured for cattle depredation; removed due to very poor condition
7/3/2018	936	Sublette	Sunlight Basin	Park	Cattle depredation
7/8/2018	841	Sublette			Removed for repeated cattle depredations
7/13/2018		Sublette	On site		Non-target capture; released without handling
7/13/2018	344	Sublette			Removed for repeated cattle depredations
7/13/2018	592	Sublette			Removed for repeated cattle depredations
7/16/2018	G240	Sublette	On site		Released on site
7/24/2018	G241	Sublette	Fox Creek	Park	Cattle depredation
7/24/2018	G242	Sublette	Blackrock	Teton	Cattle depredation
7/25/2018	439	Sublette			Removed for chronic cattle depredation; G242, G243, G244 relocated
7/25/2018	G243	Sublette	Blackrock	Teton	Cattle depredation
7/25/2018	G244	Sublette	Blackrock	Teton	Cattle depredation
8/1/2018	N/A	Sublette			Removed for livestock depredations and missing foot
8/4/2018	808	Park			Captured and removed for livestock depredations
8/5/2018	723	Sublette			Removed for chronic cattle depredation
8/7/2018	G247	Teton	Mormon Creek	Park	Non target at cattle depredation
8/8/2018	859	Teton	Mormon Creek	Park	Cattle depredation
8/13/2018	740	Sublette			Removed due to repeated cattle depredations
8/17/2018	944	Park	Fox Creek	Park	Captured for damaging apple trees at a residence
8/18/2018	945	Sublette	Fivemile Creek	Park	Cattle depredation
8/23/2018	947	Sublette	Wood River	Park	Cattle depredation
9/1/2018	921	Park			Removed for apple tree damage and frequenting residential areas
9/3/2018	738	Park			Removed for getting into chicken coops and poor condition
9/4/2018		Hot Springs			Removed for multiple cattle depredations
9/6/2018		Park			Cattle depredation; died during capture
9/6/2018	771	Park	Bailey Creek	Teton	Cattle depredation; relocated with 2 cubs G248 and G249
9/6/2018	859	Sublette			Removed for repeated cattle depredations

Table 38. Continued.

Date	ID	Capture county	Relocation site	Release county	Reason for capture
9/6/2018	G248	Park	Bailey Creek	Teton	Captured and transported with mother (771) and sibling (G249) for cattle depredation
9/6/2018	G249	Park	Bailey Creek	Teton	Transported with mother (771) and sibling (G248) for cattle depredation
9/7/2018	950	Hot Springs	Lost Lake	Teton	Cattle depredation
9/10/2018	946	Sublette	Clocktower Creek	Park	Cattle depredation
9/12/2018	951	Hot Springs	Squaw Basin	Teton	Cattle depredation
9/16/2018	N/A	Teton			Removed for human death
9/16/2018	N/A	Teton			Removed for human death
9/19/2018	N/A	Park			Removed for frequenting agricultural areas, including a public corn maze, poor condition and public safety
9/21/2018	N/A	Park			Removed for several trash conflicts and breaking into turkey coop and killing a turkey
9/25/2018	651	Park			Removed for obtaining garbage from bear resistant trash can and prior conflict history
9/29/2018	954	Park	Fall River	Teton	Frequenting yards and around ranch buildings, exhibiting bold behaviors during daylight hours
9/30/2018	N/A	Park			Removed for frequenting agricultural areas, including a public corn maze, and public safety
10/2/2018	N/A	Park			Removed for frequenting public corn maze and for public safety
10/3/2018	N/A	Park			Removed for habituated behavior, food rewards and frequenting developed areas
10/3/2018	N/A	Park			Removed for habituated behavior and frequenting developed areas
10/3/2018	N/A	Park			Removed for habituated behavior and frequenting developed areas
10/7/2018	956	Park	Lost Lake	Teton	Property damage to a root cellar to obtain elk quarters
10/15/2018	896	Sublette	Deadman Creek	Park	Damaging property at outfitter camp
10/16/2018	734	Park	On site		Cattle depredation - released on site with GPS collar
10/16/2018	954	Park	Deadman Creek	Park	Non-target capture; moved for previous capture on same area on 9/29; not handled - relocated
10/16/2018	G250	Sublette	Deadman Creek	Park	Damaging property at outfitter camp
10/19/2018	G065	Park			Removed for obtaining food rewards from bear resistant containers and associated with several depredations
10/20/2018	G251	Park	On site		Into trash and climbing on vehicles at ranch
10/25/2018	G249	Big horn			Removed with mother 771 and sibling G248 for public safety concerns and recent capture history
10/25/2018	771	Big horn			Removed with 2 cubs G248 and G249 for public safety concerns and recent capture history
10/25/2018	G248	Big horn			Removed with mother 771 and sibling G249 for public safety concerns and recent capture history

WGFD personnel investigated and recorded 244 human-grizzly bear conflicts in 2018 (Table 38, Fig. 41). As a result of numerous and diligent education and conflict prevention efforts, the general pattern of conflicts is relatively steady within currently occupied habitat (Fig. 42). However, as occupied grizzly bear range has expanded, conflicts continue to occur in areas further from the Primary Conservation Area 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 Wyoming Game and Fish Department, 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 number of grizzly bear conflicts in Wyoming for 2018 was high. 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 2018. 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 further 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 enable multiple options to reduce grizzly bear-livestock conflicts.

The majority of conflicts in Wyoming occurred on public lands outside of the Primary Conservation Area (Figs. 42 and 43). The increasing distribution of grizzly bears is reflected in the annual documentation of conflicts further 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 39. Type and number of human-grizzly bear conflicts in Wyoming portion of the Greater Yellowstone Ecosystem, 2018.

Conflict type	Number	Percent (%)
Cattle	150	61
Garbage	19	8
Property Damage	16	7
Animal Death	10	4
Pet-livestock-birdfeed	8	3
Fruit Trees	8	3
Unsecured attractant	7	3
Aggression toward humans	7	3
Sheep	6	2
Other	5	<1
Poultry	4	<1
Human Injury	2[a]	<1
Beehive	1	<1
Human Death	1	<1
Total	244	100

[a]Four total people were injured by grizzly bears in Wyoming in 2018 in 2 incidents involving an animal death conflict and a human fatality conflict.

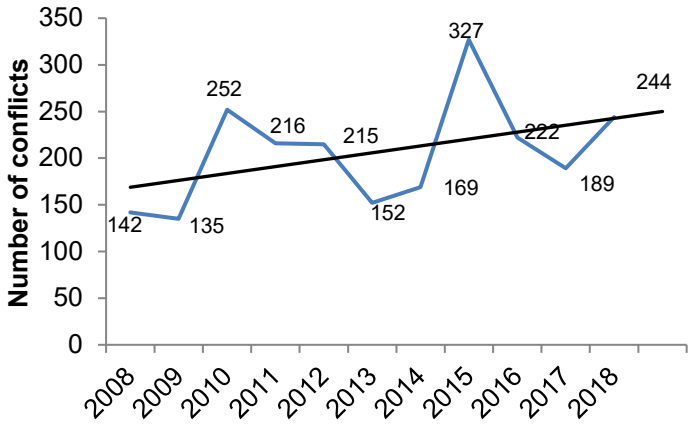


Fig. 41. Number of human-grizzly bear conflicts in Wyoming portion of the Greater Yellowstone Ecosystem, 2008–2018.

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. 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 myriad 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. In general, there is an inverse relationship between social tolerance and biological suitability for bear occupancy in areas further from the Primary Conservation Area 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 used for long-term conflict resolution.

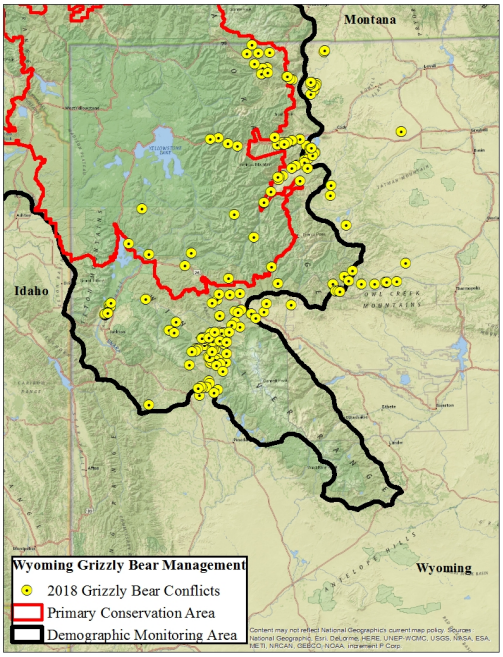


Fig. 42. Location of human-grizzly bear conflicts in Wyoming portion of the Greater Yellowstone Ecosystem outside of National Parks (n = 244) in relation to the Grizzly Bear Recovery Zone/Primary Conservation Area and the Demographic Monitoring Area, 2018.

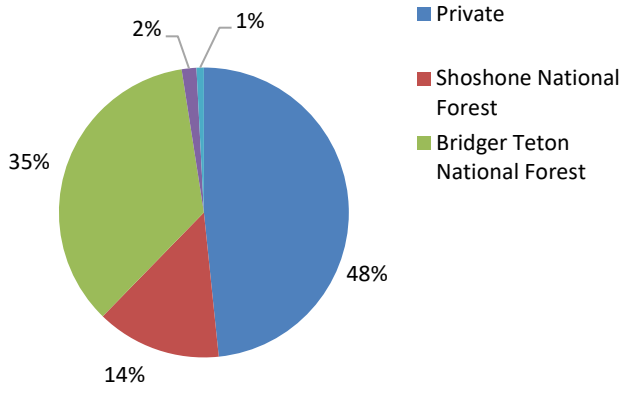


Fig. 43. Percent of human-grizzly bear conflicts on private and public lands in Wyoming portion of the Greater Yellowstone Ecosystem, 2018.

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*)

One adult female was lethally removed due to extensive cattle depredations and human safety concerns in the JK Creek area of the Owl Creek Mountains. This bear was responsible for 1 confirmed calf loss and 14 probable calf losses. The bear visited a large encampment on several occasions, displaying little avoidance of humans. No other depredations or conflicts were reported on the Wind River Reservation in 2018.

A radio-collared grizzly bear in the snow (photo courtesy of Jake Davis)

Human-Grizzly Bear Interactions in Yellowstone National Park *(Kerry A. Gunther, Travis C. Wyman, and Eric 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 2018, there were 21 reported incidents where grizzly bears were known to enter park developments (Table 40). The activity of the bear was reported in 17 of the incidents. In 71% (n = 12) it appeared that the bears were just traveling through the development, and in 18% (n = 3) of the incidents the bears foraged for natural foods within developments. In 1 incident, bears investigated and obtained minor food rewards from empty cans and bottles pulled from recycle bins. In the remaining incident a grizzly bear investigated and bit traffic cones within a development.

Reactions of Bears to the Presence of People in Frontcountry Developments

Grizzly bears were known to have encountered people in 15 of the 21 incidents where they entered developments and the bears' reaction was recorded in all of these incidents (Table 41). Bears reacted with a flight response in 67% (n = 10) of the incidents and in a neutral manner in 33% (n = 5). Bears did not display warning signals, aggressive behavior, or attack people in any of the 15 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 for recreational purposes 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 2018, 240 reports of grizzly bears using habitat adjacent to park roads were recorded (Table 42). The primary activity of roadside bears was recorded in 235 of these reports. In the majority of these incidents, the roadside bears' primary activity was foraging for natural foods (62%, n = 146) or traveling (27%, n = 63). Other activities reported included swimming (5%, n = 12), bedded/sleeping (3%, n = 8), courtship (1%, n = 3), investigating vehicles (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 195 of the 240 reports of bear activity along roads. The reaction of bears to people was reported for 192 of these 195 roadside encounters (Table 41) and were classified as neutral in 70% (n = 136) and as a flight response in 27% (n = 52) of the incidents. Grizzly bears displayed curious behavior and investigated vehicles in <1% (n = 1) and walked towards people in <1% (n = 1) of the roadside encounters. In 2 incidents grizzly bears charged toward people during roadside encounters.

Human-Bear Interactions in Backcountry Areas

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

Activity of Bears in Occupied Backcountry Campsites

Bears occasionally enter designated backcountry campsites while the campsites are occupied by recreational users. In 2018, there were 11 incidents reported where grizzly bears entered occupied backcountry campsites (Table 43). The bears' primary activity in the core camp was reported for 9 of the incidents. Reported activities of bears in occupied campsites included walking through the core campsite (n = 5), foraging on native foods (n = 2), investigating the tent without causing damage or getting a food reward (n = 1), and investigating the bear food storage locker without causing damage or getting a food reward (n = 1).

Bear Reactions to the Presence of People in Backcountry Campsites

In 10 of the 11 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 10 of these incidents. Grizzlies had no overt response in 5 incidents, a flight response in 1 of the encounters, and were curious and approached people during 1 encounter (Table 41). Grizzly bears charged toward the campers in the campsites without making contact in 3 of the incidents.

Bear Reactions to Encounters with People on Backcountry Trails

In 2018, there were 24 reported incidents where people encountered grizzly bears on backcountry trails (Table 41). Reactions of bears to the encounters were reported for all 24 of these incidents. Grizzly bears reacted to encounters with people along backcountry trails with flight behaviors in 33% (n = 8), neutral behaviors in 29% (n = 7), charging without making contact in 17% (n = 4), standing and staring in 8% (n = 2), and curiously approaching in 8% (n = 2). In 1 incident a grizzly bear charged and made contact inflicting minor injuries on a 10-year old boy.

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

In 2018, there were 13 reported incidents where people encountered grizzly bears while traveling off-trail in backcountry areas (Table 41). The reaction of the bears to the encounters were reported in all 13 of the incidents and included fleeing (54%; n = 7), charging without making contact in 31% (n = 4), neutral behaviors (8%; n = 1), and curiously approach (8%, n = 1). Grizzly bears did not attack people in any of the off-trail encounters in Yellowstone National Park in 2018.

Summary

Grizzly bears instill fear in many Yellowstone National Park visitors and when they attack people in the park, it generates world-wide news further spreading their ferocious reputation. However, grizzly bears rarely reacted aggressively toward people during encounters in Yellowstone National Park in 2018 (Table 44). Results in 2018 are similar to overall results from the entire period we have monitored human-bear interactions in the park (1991–2018, Table 45). In the 6,264 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 = 3,608), by fleeing in 34% (n = 2,159), curious behaviors in 3% (n = 207), and with stress, bluster, or warning behaviors in 1% (n = 36) of the incidents. Grizzly bears reacted with

aggression without contact in 4% (n = 232) of the encounters. Less than 1% (n = 22) of the 6,264 reported encounters between people and grizzly bears in Yellowstone National Park 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 420 reported encounters) than during on-trail interactions (1%, 15 attacks in 1,431 encounters). During the study period, there were no bear attacks during interactions in areas where human presence was expected and predictable, such as along primary roads (0 attacks in 3,569 encounters), within developments (0 attacks in 641 encounters), and in designated backcountry campsites (0 attacks in 203 encounters). Despite their ferocious reputations, 28 years of human-bear interactions data from Yellowstone National Park suggest that grizzly bears are tolerant of people in most encounters. Grizzly bears made contact and 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 40. Activity of bears that entered frontcountry developments, Yellowstone National Park, 2018.

Activity of bear while inside development	Number of incidents
Not reported or unknown	4
Travel through	12
Forage for natural foods	3
Investigate anthropogenic foods but no food reward and no property damage	0
Investigate and damage property but no food reward	0
Investigate and obtain anthropogenic foods	1
Attack people	0
Other	1
Total	21

Table 41. Reactions of grizzly bears to encounters with people, Yellowstone National Park, 2018.

Reaction of bear	Development	Along roadside	Backcountry campsite	On trail	Off trail	Total
Not reported/not known	0	3	0	0	0	3
Flight response						
Run away	3	8	0	3	6	20
Walk away	7	44	1	5	1	58
Adult climb tree	0	0	0	0	0	0
Cubs climb tree/adult remain	0	0	0	0	0	0
Flight behavior subtotal	10	52	1	8	7	78
Neutral behaviors						
No overt reaction	5	136	5	5	1	152
Stand up on hind legs	0	0	0	2	0	2
Circle down wind	0	0	0	0	0	0
Neutral behavior subtotal	5	136	5	7	1	154
Curious behaviors						
Walk towards-curious	0	1	1	2	1	5
Follow mobile person	0	0	0	0	0	0
Investigate vehicle	0	1	0	0	0	1
Curious behavior subtotal	0	2	1	2	1	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	0	0
Pop jaws/teeth clacking noises	0	0	0	0	0	0
Stood ground watched/stared	0	0	0	2	0	2
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	0	0	2	0	2
Aggressive behaviors						
Growl	0	0	0	0	0	0
Aggressive approach	0	0	0	0	0	0
Stalk	0	0	0	0	0	0
Run towards/aggressive charge	0	2	3	4	4	13
Aggressive behavior subtotal	0	2	3	4	4	13
Attack behaviors						
Defensive attack	0	0	0	1	0	1
Predatory attack	0	0	0	0	0	0
Attack unknown cause	0	0	0	0	0	0
Attack behavior subtotal	0	0	0	1	0	1
Total	15	195	10	24	13	257

Table 42. Primary activity of grizzly bears along roadsides, Yellowstone National Park, 2018.

Activity of bear	Number of incidents
Not reported/unknown	5
Traveling	63
Foraging natural foods	146
Courtship	3
Swimming	12
Nursing young	0
Playing	0
Bedded/sleeping	8
Investigating vehicles/seeking anthropogenic foods; no food reward	2
Obtain anthropogenic foods	0
Damage property	0
Aggressive approach/posture towards people	1
Attack people	0
Total	240

Table 43. Primary activity of grizzly bears that entered occupied backcountry campsites, Yellowstone National Park, 2018.

Activity of bear	Number of incidents
Not reported/unknown	2
Walked past edge of campsite	0
Walked through core camp	5
Forage native foods	2
Investigate tent without damage/no food reward	1
Investigate food pole without food reward	0
Investigate food storage locker without food reward	1
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	11

Table 44. Grizzly bear reactions to interactions with people (*n* = 254) in different location settings, Yellowstone National Park, 2018.

Location of encounter	Reaction of bear											
	Flee		Neutral behavior		Curious		Stress/agitation		Aggression without contact		Attack	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Park development	10	67	5	33	0	0	0	0	0	0	0	0
Roadside corridor	52	27	136	71	2	1	0	0	2	1	0	0
Backcountry campsite	1	10	5	50	1	10	0	0	3	30	0	0
Backcountry trail	8	33	7	29	2	8	2	8	4	17	1	4
Backcountry off-trail	7	54	1	8	1	8	0	0	4	31	0	0
Total	78	31	154	61	6	2	2	<1	13	5	1	<1

Table 45. Grizzly bear reactions to interactions with people (*n* = 6,264) in different location settings, Yellowstone National Park, 1991–2018.

Location of encounter	Reaction of bear											
	Flee		Neutral behavior		Curious		Stress/agitation		Aggression without contact		Attack	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Park development	312	49	301	47	17	3	3	<1	8	1	0	0
Roadside corridor	816	23	2,633	74	52	1	9	<1	59	2	0	0
Backcountry campsite	83	41	93	46	17	8	1	<1	9	4	0	0
Backcountry trail	715	50	447	31	107	7	22	2	125	9	15	1
Backcountry off-trail	233	55	134	32	14	3	1	<1	31	7	7	2
Total	2,159	34	3,608	58	207	3	36	1	232	4	22	<1

Bear on the run… (Photo courtesy of Jake Davis)

Visitor Compliance with Bear Spray and Hiking Group Size Bear Safety Recommendations in Yellowstone National Park *(Kerry A. Gunther, Eric 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, much less effort is expended to teach people how 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 Yellowstone National Park, concurrent with grizzly bear recovery in the Greater Yellowstone Ecosystem.

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

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

In 2018, we surveyed 4,005 people in 1,283 groups at 39 different backcountry trails and 4 boardwalk trails. Our surveys included 1,940 backcountry day hikers, 1,734 people using boardwalk trails, 300 overnight backpackers, 16 overnight stock-riders, 14 stock day-riders, and 1 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 1,940 day hikers traveling in 657 groups on 30 different trails. Average party size was 3.0 people (Table 46). The most common group size (mode) and the median group size were 2 people per party. Fifty-six percent (n = 365) of day hiking parties had less than the recommended party size of 3 people and 11% (n = 74) hiked by themselves. Of the 1,940 day hikers, 409 (21%) carried bear spray, 37 (2%) had bear bells, and 7 (<1%) carried firearms (Table 47). Of the 657 groups of day hikers, 301 (46%) had at least 1 member that carried bear spray, 33 groups (5%) had at least 1 person wearing bear bells, and 5 groups (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 300 backpackers in 72 groups on 20 different trails. Average party size was 4 people (Table 46). The most common group size (mode) was 2 people; the median group size was 3 people. Forty-seven percent (n = 34) of the backpacking groups had less than the recommended party size of 3 people and 11% (n = 8) hiked alone. Of the 300 backpackers, 141 (47%) carried bear spray, 5 (2%) had bear bells, and 3 (1%) carried firearms (Table 47). Of the 72 groups of backpackers, 58 (81%) had at least 1 person in the party that carried bear spray, 4 groups (6%) had at least 1 person wearing bear bells, and 3 groups (4%) had at least one person carrying a firearm.

Stock Day-Riders

We surveyed 14 stock day-riders in 3 groups (Table 46) on the 2 different trails. One (7%) of the day-riders openly carried a firearm. None of the day-riders carried bear spray or bear bells (Table 47).

Stock Overnight-Riders

We surveyed 16 people in 2 groups that were riding stock and camping overnight (Table 46) on 2 different trails. Four (25%) of the overnight stock riders carried bear spray. None of the overnight stock riders carried bear bells or firearms (Table 47).

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 1 person riding a bicycle on a day trip (Table 46) on the Fountain Flat trail. The bicyclist had bear spray but was not carrying bear bells or a firearm (Table 47).

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 are constructed to 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 backcountry hiking experience. Stock animals and overnight camping are not allowed on boardwalk trails. We surveyed 1,734 people in 548 groups on 4 different boardwalk trails. Average party size was 3 (Table 46). The most common group size (mode) and the median group size were both 2 people. Fifty-six percent (n = 305) of the groups of boardwalk users had fewer than the recommended party size of 3 and 13% (n = 72) hiked alone. Only 1% (n = 18) of the individuals surveyed carried bear spray (Table 47). Three percent of the groups (n = 17) surveyed had at least one person in the party that carried bear spray. Two (<1%) people in 2 parties hiking on boardwalks carried bear bells. None of the people or groups observed on boardwalk trails carried firearms.

Use of Bear Spray

In 2018, 4 incidents where people deployed bear spray during encounters with grizzly bears were reported inside of Yellowstone National Park. On July 29 at approximately 3 p.m., a solo day-hiker had a surprise encounter with an adult female grizzly and 2 cubs at a distance of 20 yards. The adult bear (the only one initially visible) charged but veered off, turned and charged again, the hiker yelled at the bear and it stopped. Two cubs then came walking over a nearby hill and the adult bear charged a 3rd time, the hiker sprayed his bear spray into the adult bears face causing it to turn away and fall to the ground. The adult bear then got up and ran off with her 2 cubs. On August 17 a solo backpacker hiked in to backcountry campsite 4B1 in the Broad Creek drainage. While lighting his campfire he heard a noise and an adult female grizzly accompanied by 2 yearlings ran down hill straight at him from approximately 400 yards away. He grabbed his bear spray and sprayed the adult bear when it was about 10 feet away. The adult bear circled around and charged again, he sprayed the bear again, this time when it was about 5 feet away. After being sprayed the second time the adult bear and her 2 yearlings ran off. After the incident, the backpacker saw a bison carcass about 100 yards from the core camp so he packed up his gear and moved to another campsite. On August 18 at approximately 4:30 p.m. a group of 4 backpackers were napping in backcountry campsite 8C6 in the Snake River drainage. One person woke up and got out of the tent and saw an adult grizzly bear with 3 cubs about 100 yards away eating berries. The rest of the party got up and quietly began watching the bears, which continued foraging to about 70 yards from the edge of the campsite. The adult bear looked up, saw the people, huffed and charged. The group gathered together with their bear spray and sprayed the adult bear when it charged to within 5 feet. Upon being hit by the spray the bear veered off, gathered up her cubs and left. On August 23, at approximately 10 a.m. a family of 4 people hiking on the Divide trail had a surprise encounter with an adult female grizzly and one cub or yearling that were likely digging for whitebark pine seeds in a red squirrel midden next to the hiking trail. The adult bear charged, the father reached for his bear spray, the mother jumped behind a nearby tree, the teenager stood near his parents, and the 10 year-old boy turned and ran back down the trail. The adult bear ran past the father, mother, and teenage boy and chased down the 10 year-old inflicting minor injuries, then stood on top of the prone boy. The father and mother ran up to within 3–5 feet of the bear and sprayed it in the face with bear spray. The bear shook its head then ran off back in the direction it had come from.

Discussion

In 2018, overnight backpackers had the highest level of compliance with the park's bear spray recommendation (excluding bicycle day-riders which had a sample size of only 1); 47% of individual backpackers carried bear spray; 81% 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 8 years surveys have been conducted (Table 48 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 Yellowstone National Park, permits are required for camping in the backcountry. During the permitting process, backpackers are given face-to-face verbal information about bears and bear

spray from the ranger issuing the permit, and are also required to watch a safety video containing information on hiking and camping in bear country and how to use bear spray. Backpackers are also given the "Beyond Roads End" safety booklet containing information on bear spray and hiking and camping in bear country. Surveys indicate that Yellowstone National Park visitors retain verbal information from uniformed park staff better than written information from signs or brochures (Taylor et al. 2014). 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 8 years of the study has been 2 people per party (Table 50).

Only 21% of day hikers carried bear spray, however, 46% 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 8 years surveys have been conducted (Table 48). 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 Yellowstone National Park can seek and obtain bear safety information from the Yellowstone National Park web page, park newspaper, day hike trip planners, safety cards and brochures, and from rangers at visitor centers. However, the only bear safety information day hikers are exposed to 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 Yellowstone National Park 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 grizzly bear attacks in Yellowstone National Park 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 2018, the most common group size encountered on boardwalk trails was 2 people per party and only 1% 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 48 years have occurred on or near boardwalk trails, therefore the risk of attack during this type of recreational activity is very low.

None of the day-use and only 4 of the overnight stock riders surveyed in 2018 carried bear spray. Bear spray is not very useful while in the saddle, as deploying it from horseback may result in the rider being thrown from 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. 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.

The 1 bicyclist we encountered on our surveys was carrying bear spray. Bicyclists incur greater risk of surprise encounters because bicycles are fast and relatively quiet.

Although some backcountry recreationists in Yellowstone National Park carry firearms, and it is legal to do so, it is illegal to discharge them within the park, so they are not considered a viable bear deterrent. Firearms were openly carried by only a small proportion of all types of recreationists in the 8 years we conducted our survey. Firearms were openly carried by <1% of the recreationists we observed in 2018. Horse day-riders (7%) 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 approximately 1% of all recreationists surveyed in Yellowstone National Park in 2018. Backpackers (2%) and day hikers (2%) had the highest frequency of bear bell use. The low use of bear bells likely reflects the lack of demonstrated effectiveness as an auditory warning device (Herero 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).

Four incidents where people sprayed charging grizzly bears with bear spray were reported in 2018. Two of the 4 incidents involved females with cubs-of-the-year, 1 incident involved a female with yearlings near a bison carcass, and 1 incident involved a female with either a cub or yearling. Bear spray was successful at causing the bears to turn and flee in all 4 incidents. One of the incidents resulted in minor injuries, but in that incident bear spray was not deployed until after the bear had made contact and injured the person. In that incident, the bear spray may have prevented injury to other family members and may have reduce the length and severity of attack on the person that was injured.

Table 46. Group size characteristics for different types of recreational activities in Yellowstone National Park, 2018.

Type of recreational activity	Total people	Total groups	Average group Size	Median group size	Mode group size
Boardwalk trail (foot travel walking)	1,734	548	3.1	2	2
Day hiker (e.g., day use foot travel-hiker, angler, photographer)	1,940	657	3	2	2
Overnight backpacker (foot travel camping overnight)	300	72	4.2	3	2
Stock – day use	14	3	4.7	5	1, 5, 8
Stock – overnight use	16	2	8	4, 12	4,12
Day bicycle trip	1	1	1	1	1
Total	4,005	1,283	3.1	2	2

Table 47. Number and percent (%) of people and groups of recreationists surveyed that carried bear spray, firearms, or bear bells, Yellowstone National Park, 2018.

	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	1,734	1,940	1	300	14	16	4,005
(# of parties surveyed)	548	657	1	72	3	2	1,283
People with bear spray							
Total	18	409	1	141	0	4	572
Percent	1.0	21.1	100	47.0	0	25.0	14.3
Parties with bear spray							
Total	17	301	1	58	0	1	377
Percent	3.1	45.8	100	80.6	0	50.0	29.4
People with firearms							
Total	0	7	0	3	1	0	11
Percent	0	0.4	0	1.0	7.1	0	0.3
Parties with firearms							
Total	0	5	0	3	1	0	9
Percent	0	0.8	0	4.2	33.3	0	0.7
People with bear bells							
Total	2	37	0	5	0	0	44
Percent	0.1	1.9	0	1.7	0	0	1.1
Parties with bear bells							
Total	2	33	0	4	0	0	39
Percent	0.4	5.0	0	5.6	0	0	3.0

Table 48. Percent (%) of people engaged in different types of backcountry recreational activities that carried bear spray, Yellowstone National Park, 2011–2018.

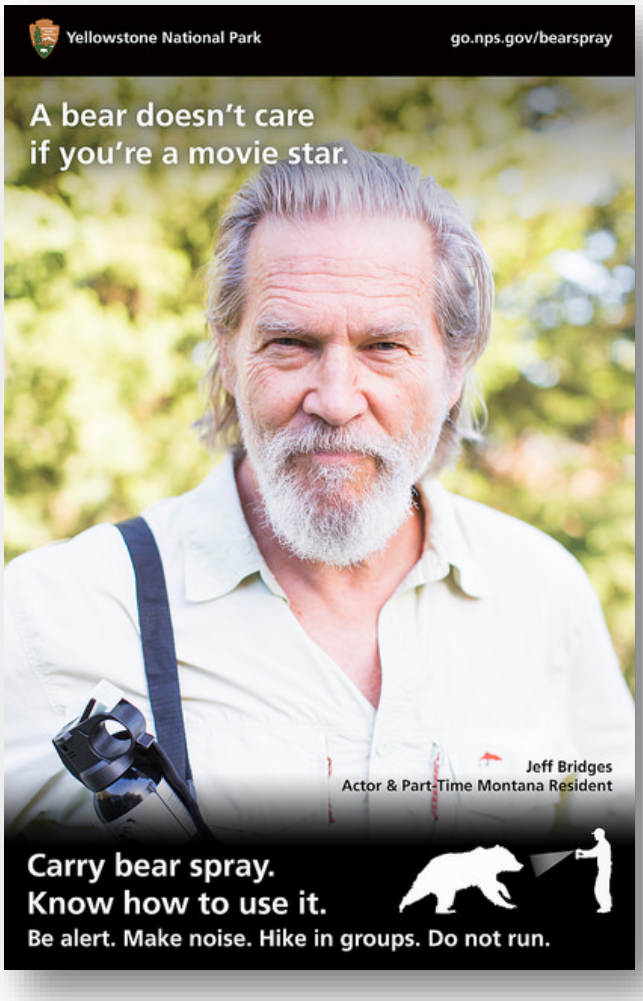
Year	Overnight backpackers	Day hiker	Boardwalk	Stock day-use	Stock-overnight use	Day-use bicycle
2011	53	15	Not surveyed	0	60	Not surveyed
2012	47	11	0	9	44	0
2013	60	16	0	11	22	0
2014	48	13	<1	0	35	33
2015	50	14	<1	Not surveyed	14	0
2016	52	19	<1	0	100	0
2017	62	21	1	0	0	43
2018	47	21	1	0	25	100
2011–2018 combined data	52	17	1	4	34	16

Table 49. Percent (%) of groups engaged in different types of backcountry recreational activities that had at least one member that carried bear spray, Yellowstone National Park, 2011–2018.

Year	Overnight backpackers	Day hiker	Boardwalk	Stock day-use	Stock-overnight use	Day-use bicycle
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
2011–2018 combined data	81	37	2	19	58	21

Table 50. Group size characteristics for different types of recreational activities, Yellowstone National Park, 2011–2018.

Type of recreational activity	Total people	Total groups	Average group size	Median group size	Mode group size
Boardwalk	7,567	2,735	3.0	2	2
Day hiker (e.g., day foot travel-hiker, angler, photographer)	13,782	4,687	2.9	2	2
Overnight backpacker (overnight-foot travel)	1,035	340	3.0	2	2
Horse – day use	91	16	5.7	5	3
Horse – overnight use	97	19	5.1	5	2
Day bicycle trip	51	24	2.1	2	2
Total	22,623	7,821	2.9	2	2



Poster displayed in Yellowstone National Park and surrounding communities as part of the 2018 bear safety messaging campaign to increase the proportion of day hikers and backpackers that carry bear deterrent spray when hiking in the Greater Yellowstone Ecosystem

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Appendix A

2018 Grizzly Bear Habitat Monitoring Report

Grizzly Bear Habitat Modeling Team, Greater Yellowstone Ecosystem
Compiled by: Lisa Landenburger, U.S. Forest Service and U.S. Geological Survey

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). Habitat standards and monitoring protocols identified in the Conservation Strategy went into effect in 2007 when federal protections for the Yellowstone population were first removed after grizzly bears in the lower 48 states were listed in 1975 as threatened under the ESA (Federal Register, 2007). However, the legal status of the Yellowstone grizzly bear remains a contentious issue. The 2007 de-listing rule was challenged and overturned in a Montana District Court in 2009. The 2009 ruling was upheld by the 9th Circuit Court of Appeals in 2011, and federal protections were restored to the Yellowstone population. In response to concerns raised by the courts, the Interagency Grizzly Bear Study Team (IGBST) conducted a series of comprehensive studies to evaluate the adaptive response of Yellowstone grizzly bears to changing food resources (IGBST 2013; Bjornlie et al. 2014; Costello et al. 2014, 2016; Gunther et al. 2014; Schwartz et al. 2014*a*, *b*; Ebinger et al. 2016; van Manen et al. 2016). Based on the IGBST findings, the USFWS determined that the research provided sufficient evidence to support the claim that the GYE population of grizzly bears has indeed recovered and no longer meets the definition of a Threatened or Endangered species. Consequently, in June 2017, the USFWS again removed the Yellowstone population from the federal list of endangered and threatened wildlife (Federal Register 2017). In August 2018, a coalition of nonprofits and Native American tribes challenged the delisting rule in court. In September 2018, a U.S. District Court of Montana ruled in the plaintiffs' favor and vacated the delisting rule, which restored federal protections for the GYE grizzly bear population. In December 2018 the USFWS, along with the states of Idaho, Montana, and Wyoming, each filed for an appeal of the September court decision, thus the future legal status of the population may remain uncertain for some time. 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 Grizzly Bear Recovery Zone (GBRZ)[1] located at the core of the GYE (Fig. A1).

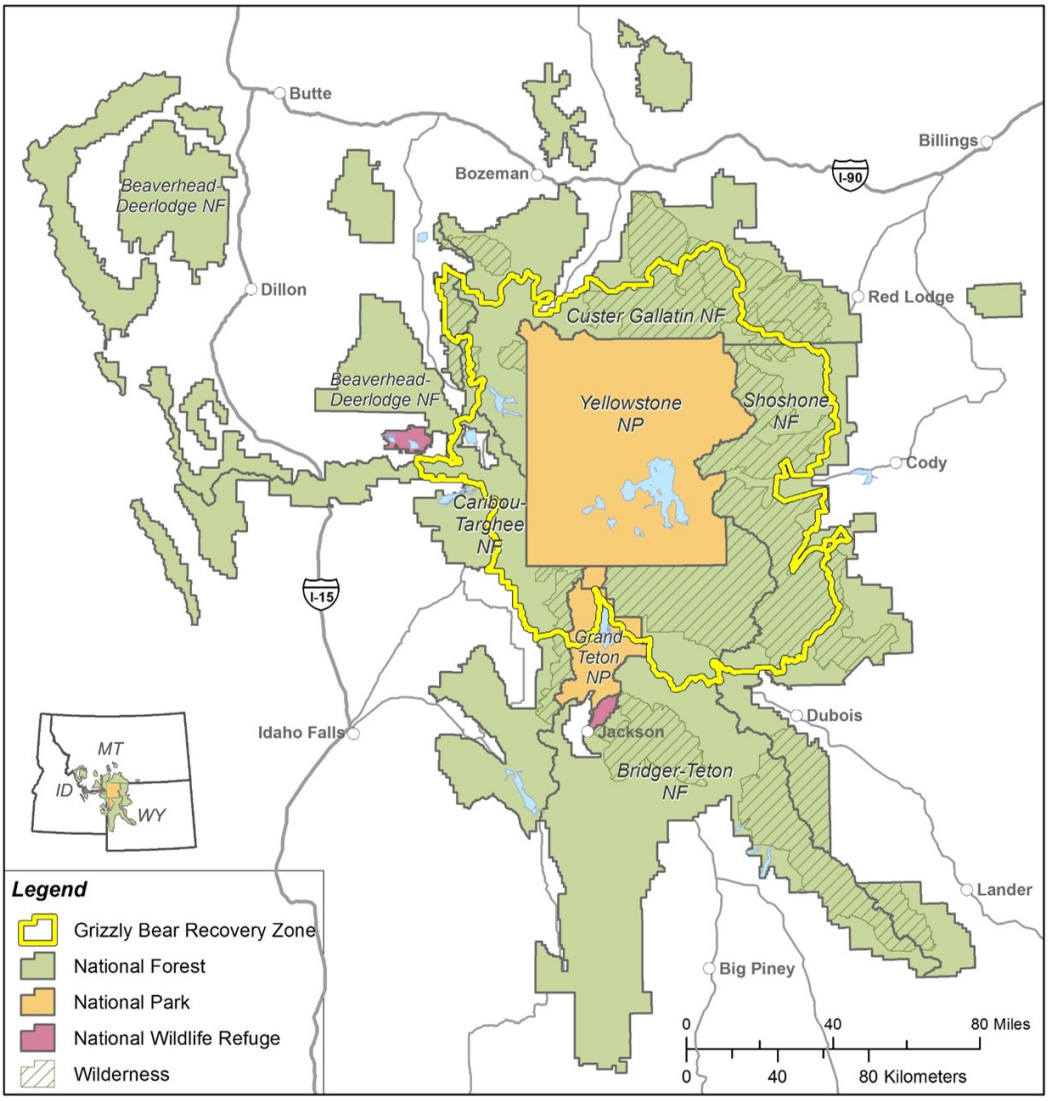


Fig. A1. Federal lands comprising the Greater Yellowstone Ecosystem and the Grizzly Bear Recovery Zone (GBRZ).

Annual Monitoring Requirements inside the GBRZ

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

[1] The Grizzly Bear Recovery Zone (GBRZ) is a term used when the Yellowstone grizzly bear population is protected as a threatened species under the ESA. The same area is referred to as the Primary Conservation Area (PCA) when the bear is de-listed or removed from federal protection. The GBRZ term is used in this 2018 report to reflect the current protected status of the Yellowstone grizzly bear population.

GBRZ during 1998. Forest and park personnel continue to improve the quality of their information to more accurately reflect what was on the landscape in 1998.

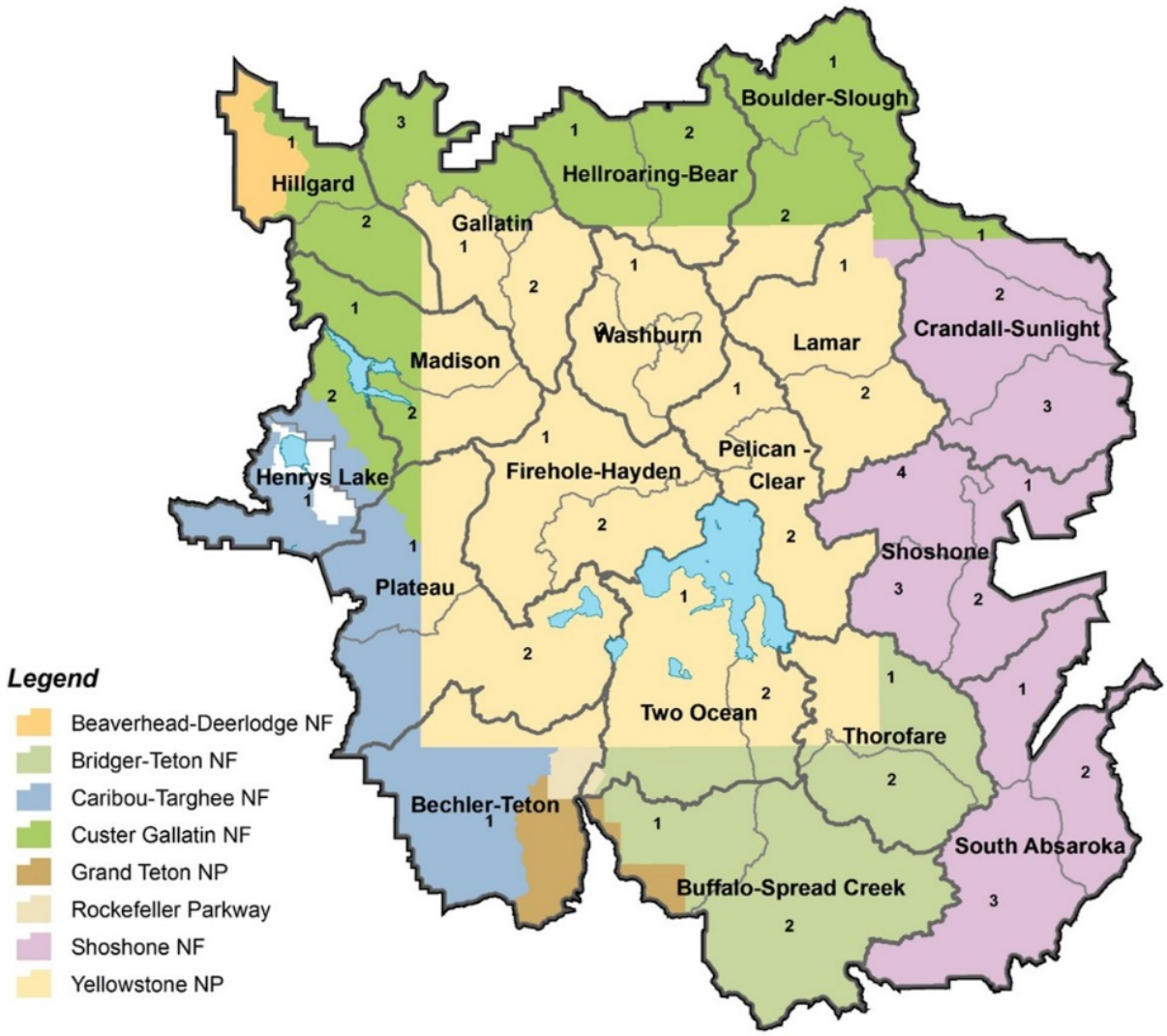


Fig. A2. Bear Management Units and subunits comprising the Grizzly Bear Recovery Zone in the Greater Yellowstone Ecosystem.

Biennial Monitoring Requirements outside the GBRZ

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

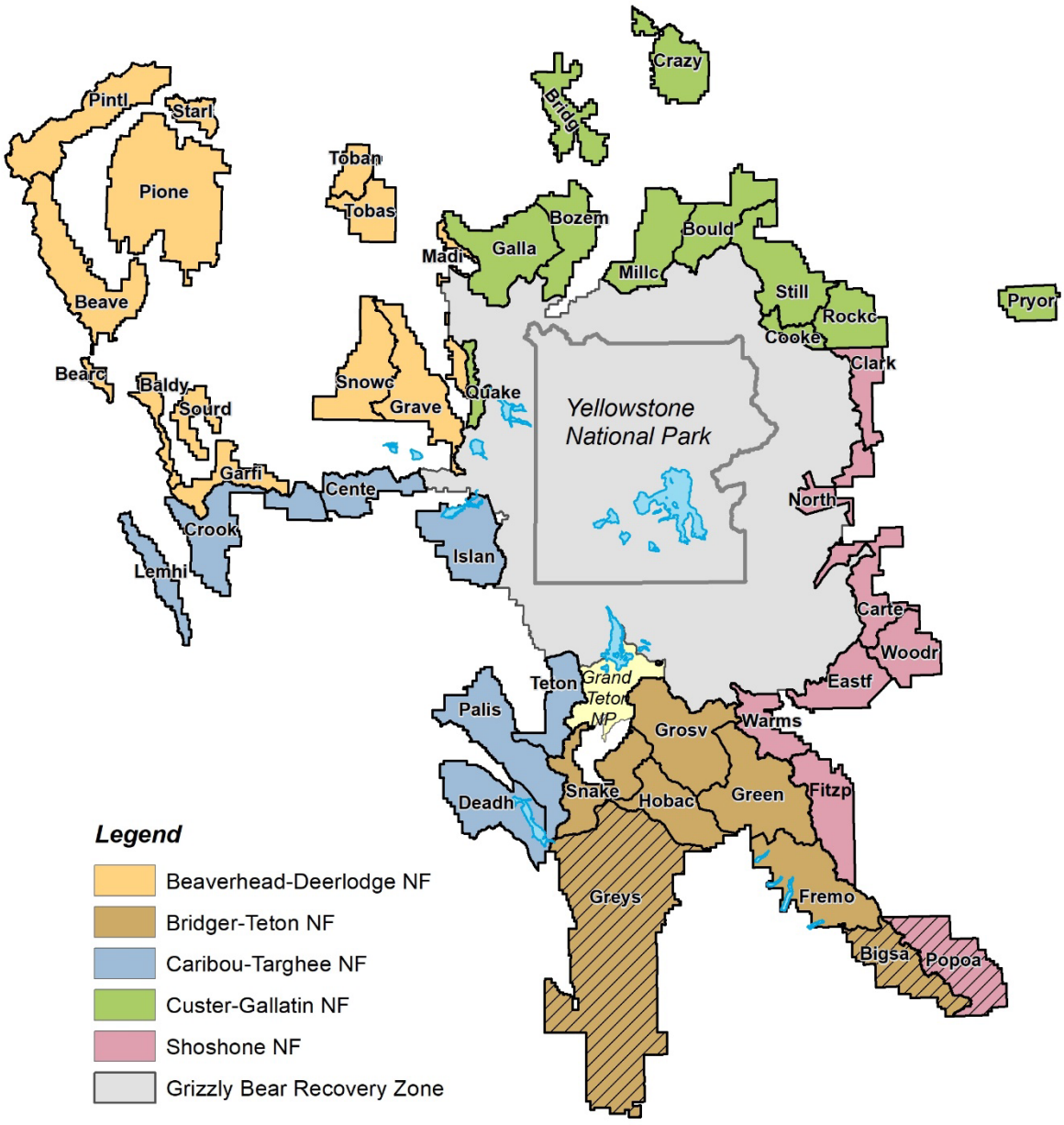


Fig. A3. Bear Analysis Units outside the Grizzly Bear Recovery Zone on the 5 National Forests in the Greater Yellowstone Ecosystem. Hatched areas are currently not reported as they are determined socially unacceptable for grizzly bear occupancy.

Monitoring of Livestock Grazing

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

Commercial grazing allotments on public lands inside the GBRZ are tracked through time to evaluate adherence to the habitat standard at 1998 levels or lower. The number of commercial livestock allotments, by itself, is not a meaningful metric of change because individual allotments can be combined or divided without affecting the overall footprint of commercially grazed land. Likewise, allotment boundaries can be reconfigured or modified over time to enclose smaller or larger areas. Thus, the total acreage of grazed lands constitutes a more meaningful metric of overall change on the landscape. See Table A1 for 2018 status of livestock allotments compared against the 1998 baseline.

Change in cattle allotments since 1998

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

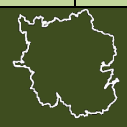
Change in sheep allotments since 1998

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

Change in livestock allotments during 2018

During 2018 there were no reported changes in livestock grazing allotments on federal lands inside the GBRZ.

Table A1. Number of commercial livestock grazing allotments and sheep animal months (AMs) inside the Primary Conservation Area in 1998 and 2018.

Administrative unit	Cattle allotments				Sheep allotments				Sheep animal months	
	Active		Vacant		Active		Vacant			
	1998	2018	1998	2018	1998	2018	1998	2018	1998	2018
Beaverhead-Deerlodge National Forest	3	3	2	0	0	0	0	0	0	0
Bridger-Teton National Forest	9	6	0	1	0	0	0	0	0	0
Caribou-Targhee National Forest [a]	11	7	1	1	7	1	4	0	14,163	1,970[a]
Custer-Gallatin National Forest	23	14	10	5	2	0	4	0	3,540	0
Shoshone National Forest	25	25	0	0	2	0	2	0	5,387	0
Grand Teton National Park	1	0	0	0	0	0	0	0	0	0
Total count in GBRZ	72	55	13	7	11	1	10	0	23,090	1.970
Total acres in GBRZ	661,770	456,040	67,846	31,679	148,368	3,504	77,066	0		
Total area in GBRZ (km^2)	2,678	1,846	275	128	600	14	312	0		

[a] The Meyers Creek allotment, the only active sheep grazing unit remaining inside the GBRZ, did not request a permit in 2018.

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 2018

In 2018, a total of 128 grizzly bear conflicts associated with livestock depredation on U.S. Forest Service lands were reported inside the GYE (Fig. A4). These conflicts occurred on 21 distinct commercial grazing allotments distributed throughout the ecosystem. All 128 incidents in 2018 involved cattle depredations and accounted for the injury or mortality of at least 5 cows, 1 steer, and 119 calves or yearlings. Conflicts were reported on 4 national forests in the GYE including the: Beaverhead-Deerlodge (n = 29), Bridger-Teton (n = 80), Caribou-Targhee (n = 1), and the Shoshone (n = 18). Approximately 98% (n = 125) of the conflicts occurred outside the GBRZ. Of the 128 livestock-related conflicts, 56% (n = 72) occurred on the Upper Green River cattle allotment located outside the GBRZ on the north portion of the Bridger-Teton National Forest. During 2018, management actions in direct response to livestock depredations on public lands led to the removal of 9 grizzly bears (1 adult female, 6 adult males, 1 subadult male, and 1 adult of unknown gender). Eight of the nine grizzly bear management removals were

due to persistent cattle depredations on the Upper Green River allotment. One removal was due to calf depredations on the West Fork allotment on the Beaverhead-Deerlodge National Forest.

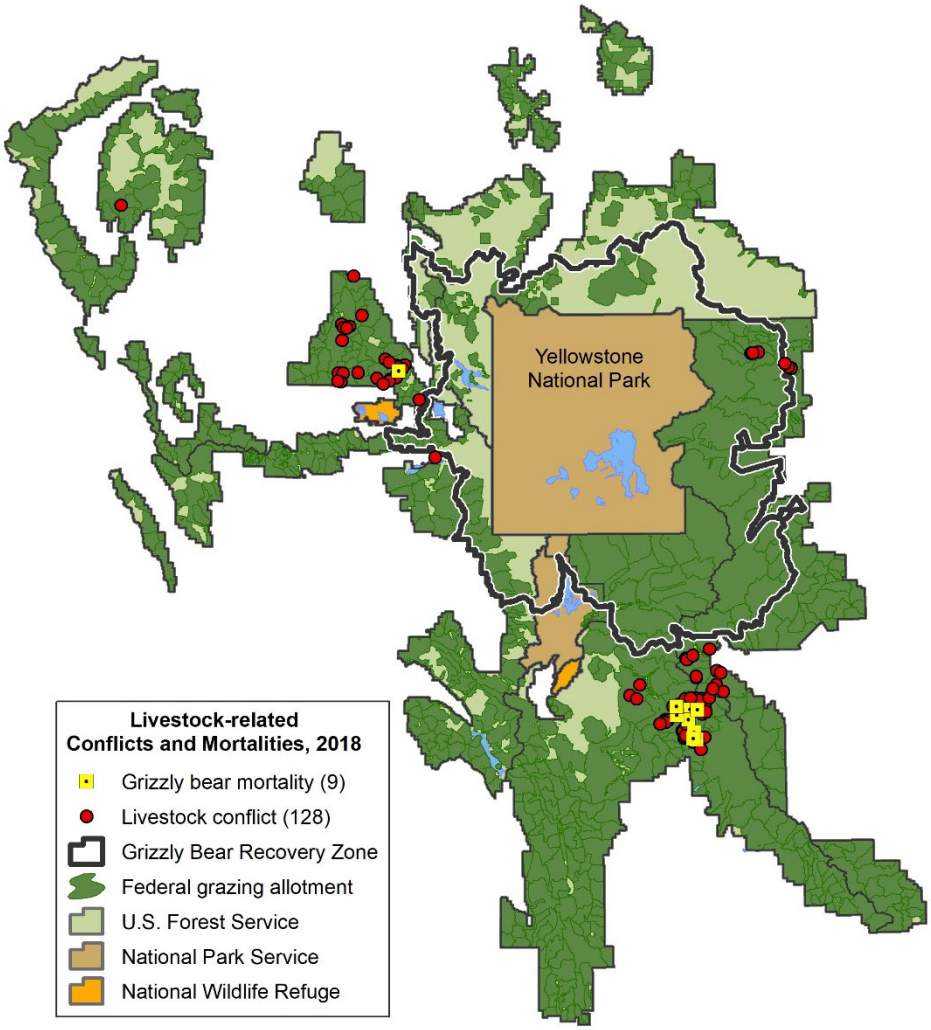


Fig. A4. Grizzly bear conflicts and mortalities related to commercial livestock grazing on federal lands in the Greater Yellowstone Ecosytem during 2018.

Recurring livestock conflicts 2014–2018

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 2014–2018, 545 livestock depredation incidents were reported on grazing allotments on national forest lands inside the GYE (Table A2). Approximately 95% (n = 519) of these conflicts occurred outside the GBRZ. Of the 545 conflicts, 62% (n = 339) occurred on the Upper Green River cattle allotment located outside the GBRZ on the Bridger-Teton National Forest. Eleven allotments experienced recurring conflicts: 2 on the Beaverhead-Deerlodge, 3 on the Bridger-Teton, and 6 on the Shoshone National Forest (Table A2). Over the past 5 years, 29 grizzly bears were removed from the population due to persistent livestock depredation on U.S. Forest Service allotments. These 29 management removals included 3 females (2 adult, 1 subadult) and 25 males (19 adult, 5 subadult, 1 cub) and 1 adult of unknown gender. Twenty-one (72%) of the 29 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 (2014–2018)	Recurring conflicts
		2014	2015	2016	2017	2018		
Beaverhead–Deerlodge National Forest								
Anderson/Cox	29,826	0	0	0	1	0	1	No
Antelope Basin	4,430	0	2	0	0	0	2	No
Bufiox	13,077	0	0	0	3	1	4	No
Clover Meadows	10,398	0	1	0	0	1	2	No
Conklin	3,654	0	0	0	1	0	1	No
Eureka Basin	11,617	0	0	0	1	5	6	No
Hidden Lake Bench	6,609	0	0	0	1	0	1	No
Lobo Cascade	11,941	0	0	0	0	1	1	No
Lyon Wolverine	16,188	0	0	0	0	1	1	No
North Saddle	3,454	0	0	1	2	1	4	Yes
Poison Basin	6,863	0	0	1	0	0	1	No
Upper Ruby	44,395	0	0	0	2	5	7	No
Warm Springs	22,518	0	0	0	1	0	1	No
West Fork	53,096	0	4	2	9	13	28	Yes
Wigwam Trail	12,742	0	0	0	0	1	1	No
Bridger-Teton National Forest								
Fish Creek [a]	76,217	0	0	1	0	0	1	No
Green River (Drift)	1,003	0	0	0	1	0	1	No
Lime Creek	4,973	0	5	1	0	0	6	No
Noble Pasture	762	0	1	0	0	4	5	No
North Cottonwood	28,177	0	2	0	0	2	2	No
Roaring Fork	8,416	0	0	0	1	0	1	No
Rock Creek	5,148	2	0	0	0	0	2	No
Salt Creek	10,005	0	0	0	1	0	1	No
Sherman C&H	8,287	1	0	1	1	0	3	Yes
Tosi Creek	14,090	0	0	1	0	0	1	No
Upper Green River	131,94	66	78	54	69	72	339	Yes
Upper Gros Ventre	67,497	1	5	0	4	3	13	Yes
Wagon Creek	182	0	1	0	0	0	1	No
Caribou-Targhee National Forest								
Ching Creek	3,911	0	0	1	0	0	1	No
High Five	21,943	0	0	0	0	1	0	No
Grandview	43,478	0	2	0	0	0	2	No
Squirrel Meadows	28,797	0	0	1	1	0	2	No
Custer-Gallatin National Forest								
Wigwam	2,762	0	0	1	2	0	3	No
Shoshone National Forest								
Basin	73,119	0	1	0	0	0	1	No
Bear Creek	33,672	0	1	0	1	0	2	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 (2014–2018)	Recurring conflicts
		2014	2015	2016	2017	2018		
Beartooth	30,317	3	1	0	0	0	4	No
Bench (Clarks Fork)	28,751	8	3	4	0	4	19	Yes
Deep Lake	6,486	1	0	0	0	0	1	No
Dick Creek	9,569	0	1	0	0	0	1	No
Dunn Creek	4,520	0	0	1	0	0	1	No
Dunoir	52,875	0	0	0	0	1	1	No
Fish Lake	12,743	0	0	0	2	3	5	No
Ghost Creek	11,579	0	0	3	0	0	3	No
Horse Creek	29,980	1	0	2	1	0	4	Yes
Parque Creek	13,528	2	4	0	0	0	6	No
Piney	14,287	0	0	1	0	0	1	No
Ramshorn	16,005	0	1	0	0	0	1	No
Reef Creek	11,449	0	0	3	0	0	3	No
Rock Creek	16,833	1	0	0	0	0	1	No
Salt Creek	8,263	0	0	5	1	0	6	No
Sunshine	2,152	0	1	0	0	0	1	No
Table Mountain	13,895	0	0	4	1	3	8	Yes
Trout Creek	12,799	0	0	1	0	0	1	No
Union Pass	39,497	0	0	0	1	4	5	No
Warm Springs	16,875	1	2	3	3	2	11	Yes
Wiggins Fork	37,653	1	2	1	0	0	4	Yes
Wind River	44,158	3	4	1	0	1	9	Yes
Total conflicts		**91**	**122**	**94**	**110**	**128**	**545**	

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

Monitoring of Developed Sites inside the GBRZ

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

Changes in developed sites since 1998

The number of distinct developed sites known to exist in 1998 is 593. In the intervening years, a number of sites have been condemned or permanently closed and dismantled. New sites that were built have been mitigated for by

closing one or more sites of equivalent human use within the same subunit. Today, the number of known developed sites on public lands inside the GBRZ is 576, accounting for a net decrease of 17 sites between 1998 and 2018. From 1998 to the present, the number of developed sites have remained at or below 1998 counts for all subunits inside the GBRZ except for the Hilgard #2 subunit, which increased by a count of one. This increase occurred in 2005 when the Taylor Falls/Lightning trailhead, originally located in subunit #1 of the Hilgard BMU, was moved from one side of a road to the other, placing it in subunit #2 of the Hilgard BMU. In this case, the loss in one subunit yielded a gain in the other. Although this transfer technically accounted for an increase in developed sites on Hilgard #2, it was determined to have no detrimental effect on grizzly bears and did not violate the intent of the developed site standard. Table A3 shows a comparison of developed site counts between 1998 and 2018.

Changes in developed sites in 2018:

During 2018 there were no changes in the number of developed sites on federal lands inside the GBRZ. However, one correction to the 1998 baseline for developed sites was submitted by the Caribou-Targhee National Forest. The Big Springs boat takeout site in the Henry Lake #1 subunit had been erroneously omitted and was appended to the baseline in 2018. This site was known to be existing prior to 1998 as verified in 1994 photo imagery. This correction accounts for an increase of one in the total count of developed sites inside the GBRZ; 592 to 593 (1998) and 575 to 576 (2018). Refer to Table A3 for 1998 and current counts of developed sites per bear management subunit.

Future review of developed sites

Since 2007, when the grizzly bear habitat standards were first implemented, the number of visitors on public lands throughout the GYE has increased significantly. In Yellowstone National Park alone, annual visitation increased by more than 40% during the period 2008–2018, surpassing 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 Developed Sites Technical Team will be presenting an overview of their recommendations in the 2019 spring meeting of the Yellowstone Ecosystem Subcommittee (YES). Upon final approval by the YES committee, the proposed revisions will be released for public comment.

Table A3. Number of developed sites in 1998 and 2018 on public lands per bear management subunit in the Greater Yellowstone Ecosystem.

Bear management subunit	Admin unit [1]	Summer home complexes		Developed campgrounds		Trailheads		Major developed sites [2]		Administrative or maintenance sites		Other		Plans of operation [3]		Total count developed sites in PCA	
		1998	2018	1998	2018	1998	2018	1998	2018	1998	2018	1998	2018	1998	2018	1998	2018
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 2018 on public lands per bear management subunit in the Greater Yellowstone Ecosystem.

Bear management subunit	Admin unit [1]	Summer home complexes		Developed campgrounds		Trailheads		Major developed sites [2]		Administrative or maintenance sites		Other		Plans of operation [3]		Total count developed sites in PCA	
		1998	2018	1998	2018	1998	2018	1998	2018	1998	2018	1998	2018	1998	2018	1998	2018
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 2018 on public lands per bear management subunit in the Greater Yellowstone Ecosystem.

Bear management subunit	Admin unit [1]	Summer home complexes		Developed campgrounds		Trailheads		Major developed sites [2]		Administrative or maintenance sites		Other		Plans of operation [3]		Total count developed sites in PCA	
		1998	2018	1998	2018	1998	2018	1998	2018	1998	2018	1998	2018	1998	2018	1998	2018
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 GBRZ

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

Calculations of secure habitat are based entirely on proximity to motorized routes (roads and trails) and serve as a metric of human presence in grizzly bear habitat. Secure habitat is defined as any contiguous area ≥10 acres in size and more than 500 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 GBRZ. OMARD is a measure of the density of routes open to public motorized use at least one or more days during the non-denning portion of the year when grizzly bears are considered active (March 1–November 30). TMARD is a measure of the density of roads and trails that are open to the public and/or administrative personnel for motorized use on one or more days during the active season. Route densities are reported as the percent area of each subunit where OMARD >1 mi/mi^2 (>0.62 km/km^2) and TMARD >2 mi/mi^2 (>1.2 km/km^2). Thus, although TMARD is a measure of total route density, values are typically lower than OMARD because the threshold density is at a higher level. Table A4 shows historic and current values of secure habitat and motorized route density. Routes that are gated closed to the public yearlong but accessible to administrative personnel detract from secure habitat and contribute to TMARD only.

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

Permanent changes in secure habitat since 1998 (inside GBRZ)

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

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

Permanent changes in secure habitat during 2018 (inside GBRZ)

During 2018 several changes in the status of motorized access on public land yielded minor changes to secure habitat.

- *Buffalo Spread Creek #1*: A total of 2.1 mi (3.3 km) of open motorized roads in the Pilgrim Creek area of Grand Teton National Park were permanently decommissioned. In the same area, the Grandview water tank access road (0.8 mi, 1.3 km) was permanently gated year-round. Motorized access to this utility road is now available only for administrative maintenance and will remain closed to the public. Collectively, these changes in motorized status resulted in a measured increase of 0.2% in secure habitat for the Buffalo Spread Creek #1 subunit.
- *Buffalo Spread Creek #2*: Approximately 1.9 mi (3 km) of motorized roads located south of Rosies Ridge on the Blackrock Ranger District in the Bridger-Teton National Forest were decommissioned. Because these road closures were in an area of relatively high motorized route density, the closures led to no measurable increase in secure habitat.

Table A4. *1998 and 2018 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	2018	% chg	1998	2018	% chg	1998	2018	% chg		1998	2018
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	16.0	0.4	12.7	16.0	3.3	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 2018 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	2018	% chg	1998	2018	% chg	1998	2018	% chg		1998	2018
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, 2018 (inside GBRZ)

Reductions in secure habitat below baseline levels are allowed on a temporary basis inside the GBRZ when associated with authorized federal projects. In these cases, adherence to the "one percent" application rule and other provisions must be met. The one percent rule states that any temporary loss of secure habitat below baseline values within a given BMU cannot exceed 1% of the total acreage of the largest subunit within that BMU. Application rules allow only one temporary project to be active in a particular subunit at any given time. During 2018 two projects involving temporary reductions in secure habitat were operational inside the GBRZ (Table A5). Below is a brief summary of these two Forest Service projects.

Meadow Creek Timber Sale: The Meadow Creek Timber Sale was authorized as part of the Northern Island Park Wildland Urban Interface (NIPWUI) project to reduce hazardous fuels on public lands interfacing with private lands near Henrys Lake Reservoir in the north portion of the Ashton-Island Park Ranger District on the Caribou-Targhee National Forest. The NIPWUI project authorized two separate timber sales (Meadow Creek and Bighorn) in the two Henry Lakes bear management subunits. Harvest operations were initiated for the Meadow Creek Timber Sale in 2017 and involved the construction of approximately 0.4 mi (0.6 km) of temporary roads. During 2018, a new temporary project road, 0.7 mi (1.1 km) in length, was constructed in the southern end of the project area located south of Reas Creek in the Henrys Lake #1 subunit. Access originated on private property under an agreement with the Old Faithful Church. Due to the configuration of project roads with respect to existing roads, there was no measurable reduction in secure habitat in either subunit and the level of secure habitat remained above baseline thresholds. Logging operations associated with the Meadow Creek sale were completed in the fall of 2018 and all project roads and skid trails were decommissioned and rehabilitated. Project activities associated with the Bighorn Timber Sale have not yet been initiated.

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. The 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 a 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. All new temporary roads will be decommissioned and rehabilitated upon sale completion.

Table A5. *Secure habitat affected by temporary projects inside the Grizzly Bear Recovery Zone, 2018*

Project Name and National Forest	BMU Subunit	Secure Habitat ($miles^2$)					Project Status
		Allowed reduction below Baseline [a]	Baseline	2018 (without project)	2018 (with project)	Reduction in Secure Habitat	
Meadow Creek Timber Sale Caribou-Targhee NF	Henrys Lake #1	1.9	86.8	88.0	88.0	0	Closed
	Henrys Lake #2		72.5 [b]	72.6	72.6		
Sugarloaf Timber Sale Bridger-Teton NF	Crandall-Sunlight #2	3.2	260.3	261.5	261.3	0.2	Closed

[a] The maximum allowed temporary reduction in secure habitat below baseline is 1% of the area of the largest subunit within the BMU.
[b] Secure habitat baseline value for Henrys Lake #2 is based on 2006 Gallatin Travel Plan conditions rather than 1998 conditions.

Monitoring Secure Habitat outside the GBRZ

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

Changes in secure habitat outside the GBRZ (2016–2018)

Several changes in motorized routes yielded changes in secure habitat on Forest Service lands outside the GBRZ (Table A6). Below is a listed of changes to motorized routes and secure habitat that have occurred outside the GBRZ since last reported in 2016:

East Fork BAU: A small segment of motorized trail (0.2 mi, 0.3 km) was permanently closed near the Double Cabin area in the East Fork BAU of Shoshone National Forest. No measurable gain in secure habitat was procured.

Gros Ventre BAU: Approximately 4.8 mi (7.7 km) of motorized access was decommissioned in the northern portion of the Gros Ventre BAU on the Bridger-Teton National Forest. Closures were in the Dry Lake and Rock Creek area of the Blackrock Ranger District and included some system and user-created routes. These decommissions accounted for an increase of 1% (5.1 mi^2, 13.2 km^2) in secure habitat inside this BAU.

Snake River BAU: A single route (0.8 mi, 1.3 km) of motorized route was decommissioned in the northwest portion of the Snake River BAU located on the Jackson Ranger District of the Bridger-Teton National Forest. No measurable gain in secure resulted from this closure.

Warm Springs BAU: A total of 6.3 mi (10.1 km) of motorized routes were decommissioned in the Warm Springs BAU located on the Wind River Ranger District of the Shoshone National Forest. These decommissions accounted for an increase of 0.7 % (12.8 mi^2, 33.2 km^2) in secure habitat inside this BAU.

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

Bear Analysis Unit (BAU)	Percent Secure Habitat			BAU Area * ($miles^2$)
	2016	2018	Change (2016 – 2018)	
Beaverhead-Deerlodge National Forest				
Baldy Mountain	55.0	55.0	0.0	96.9
Bear Creek	62.6	62.6	0.0	36.4
Beaver Creek	57.3	57.3	0.0	478.9
Garfield	71.6	71.6	0.0	182.0
Gravelies	58.5	58.5	0.0	384.4
Madison Range	99.4	99.4	0.0	89.2
Pintler Mountains	57.6	57.6	0.0	410.3
Pioneer Mountains	55.1	55.1	0.0	912.2
Snowcrest Range	74.8	74.8	0.0	357.2

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

Bear Analysis Unit (BAU)	Percent Secure Habitat			BAU Area * (miles^2)
	2016	2018	Change (2016 – 2018)	
Sourdough	46.9	46.9	0.0	111.2
Starlight	34.8	34.8	0.0	79.0
Tobacco Roots North	53.4	53.4	0.0	106.7
Tobacco Roots South	47.5	47.5	0.0	186.3
Mean Secure / Total Area	**59.6**	**59.6**	**0.0**	**3,431**
Bridger-Teton National Forest				
Fremont	88.2	88.2	0.0	440.0
Green River	65.7	65.7	0.0	527.9
Gros Ventre	63.9	64.0	0.1	507.7
Hoback Range	58.9	58.9	0.0	292.9
Snake River	64.2	64.2	0.0	348.9
Mean Secure / Total Area	**68.2**	**68.2**	**0.0**	**2,117**
Caribou-Targhee National Forest				
Centennials	50.9	50.9	0.0	199.1
Crooked Creek	59.5	59.5	0.0	403.0
Dead Horse Ridge	50.2	50.2	0.0	364.8
Island Park	36.7	36.7	0.0	333.9
Lemhi Mountains	70.0	70.0	0.0	143.1
Palisades Reservoir	59.8	59.8	0.0	472.5
Teton	75.8	75.8	0.0	209.5
Mean Secure / Total Area	**57.6**	**57.5**	**0.0**	**2,126**
Custer-Gallatin National Forest				
Boulder	69.7	69.7	0.0	277.9
Bozeman	59.3	59.3	0.0	270.5
Bridger	38.4	38.4	0.0	236.3
Cooke City	99.6	99.6	0.0	68.7
Crazy	66.9	67.9	0.0	254.8
Gallatin	59.6	59.6	0.0	415.0
Mill Creek	83.8	83.8	0.0	312.2
Pryor Mountains	38.8	38.8	0.0	121.8
Quake	92.1	92.1	0.0	66.2
Rock Creek	83.8	83.8	0.0	237.2
Stillwater	85.5	85.5	0.0	404.7
Mean Secure / Total Area	**70.7**	**70.8**	**0.0**	**2,023**
Shoshone National Forest				
Carter	77.9	77.9	0.0	261.1
Clarks Fork	70.1	70.1	0.0	160.5
East Fork	73.2	73.2	0.0	251.0
Fitzpatrick	98.4	98.4	0.0	317.8
North Fork	78.0	78.0	0.0	143.2

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

Bear Analysis Unit (BAU)	Percent Secure Habitat			BAU Area * (miles^2)
	2016	2018	Change (2016 – 2018)	
Warm Springs	29.4	30.1	0.7	183.0
Wood River	85.3	85.3	0.0	228.5
Mean Secure / Total Area	**73.2**	**73.3**	**0.1**	**1,545**

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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

Natural Resource Stewardship and Science

Monitoring Whitebark Pine in the Greater Yellowstone Ecosystem

2018 Annual Report

Natural Resource Data Series NPS/GRYN/NRDS—2019/1225

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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.

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Appendix C

2018 Wyoming Bear Wise Wyoming Project Update

Introduction

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

This report provides a summary of program accomplishments in 2018. Past accomplishments are reported in the 2006–2017 annual reports of the Interagency Grizzly Bear Study Team (IGBST) and in the 2011–2017 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 Ecosystem 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 Greater Yellowstone Ecosystem. The North Fork of the Shoshone River west of Cody was then chosen as the first area composed primarily of private land to have a multi-agency/public approach to reducing conflicts at developed sites.

In 2005, the Department began implementation of the Bear Wise Community Program. Although the program's efforts were focused primarily in the Wapiti area, the Department initiated a smaller scale project in Teton County to address the increasing number of black and grizzly bear conflicts in the Jackson, Wyoming area. For the last 12 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.

Wapiti Project Update

The Wapiti Bear Wise Community Program continues to use radio, television and print media, mass mailings, and the use of signing on private and public land to convey the educational messages surrounding human-bear conflict prevention. Conflict prevention information is also disseminated through public workshops and presentations and by contact with local community groups, governments, the public school system, and various youth organizations. To complement 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 2018 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, 1,088 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 22 new developments within Park County.

3. In the Cody Region, Large Carnivore Section personnel erected 6 temporary electric fences around bee apiaries to minimize conflicts. There were also several electric fences temporarily placed around apple orchards to deter bears.

4. Recorded an interview for Wilderness Attitude podcast discussing how to behave in bear country and management of bears in Wyoming. The episode aired in August and had large viewership on iTunes.

5. In the spring, Large Carnivore Section personnel put on 9 “Living in Large Carnivore Country” workshops across Wyoming. The objective of these workshops is to reach out to the public and give them the opportunity to learn how to live with bears, mountain lions, and wolves. In 2018, we gave presentations and hands-on demonstrations to 216 attendees.

6. With grants from the Wyoming Outdoorsmen, Rocky Mountain Elk Foundation, and Western Bear Foundation the Department was able to purchase 200 cans of bear spray to be distributed to sportsmen. A 100 cans of bear spray were handed out at the Cody Wyoming Game and Fish Check Station and 100 cans were handed out at Jackson Hole and Greater Yellowstone Visitor Center. Sportsmen were asked to voluntarily fill out a short survey to gather a better understanding how the Bear Wise program can better meet constituent needs.

7. 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 2018 on the Bighorn Basin Radio Network. Large Carnivore Section personnel also took part in several radio interviews.

8. A permanent electric fence was erected around the Park County Landfill. Funding came from Wyoming Outdoorsmen, BLM, Park County Commissioners, and Greater Yellowstone Coalition. Volunteers from the BLM and Western Bear Foundation removed the existing fence. A private contractor installed the permanent electric fence.

9. Funding was secured, from the Memorial Bear Fund, to purchase 10 temporary 150' electric fences and 10 solar fence chargers. These fences will be used by wildlife managers to secure attractants in order to minimize human-bear conflicts.

10. Educational black bear-grizzly bear identification materials were distributed to individuals and to local sporting goods stores in the Cody, Pinedale, and Lander areas and mailed to black bear hunters who registered bait sites with the Department in areas surrounding the Greater Yellowstone Ecosystem.

11. 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. Frequent in-person contacts were made during the 2018 conflict season in areas where the occurrence of human-bear conflicts has historically been high.

12. 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.

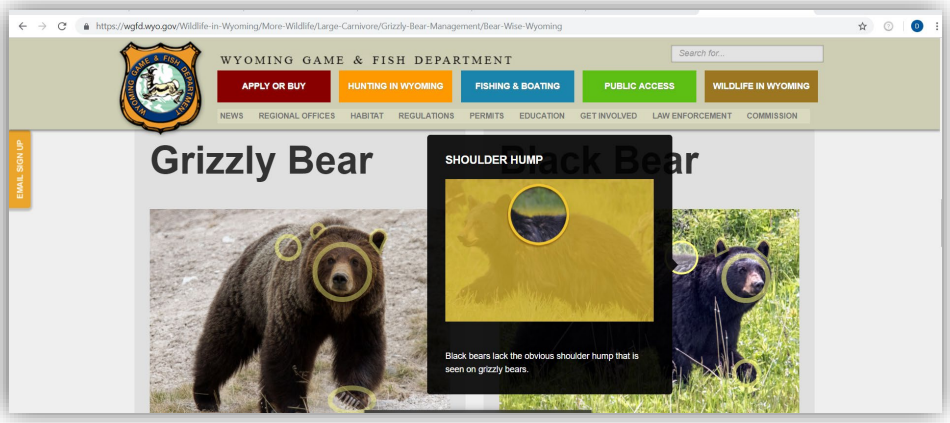
13. A booth containing information on bear identification, attractant storage, hunting and recreating safely in bear country, and the proper use of bear spray was staffed at the Lander Winter Fair, Cody Outdoor Expo, Casper Expo, Dubois Museum Days, Powell Outdoor Safety Day, and Wyoming Outdoorsmen Banquet.

14. By using the bear trailer, booths, workshops, and giving 45 presentations upon request, the Bear Wise program directly reached approximately 3,500 people in Northwest Wyoming. Although, the level of interaction differed from person to person, the added level of awareness to bears lessened conflicts.

15. Grizzly bear hunter orientation was provided to residents and non-residents who drew grizzly bear licenses. This training was aimed at keeping hunters safe in the field, teaching them the physical characteristics differences of the sexes, and potential uses of bear meat.

16. The new 2018 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.

17. With help from the Department web-designer the Bear Wise page was updated and revamped to be more interactive. The Bear Wise page had a total of 16,979 unique views over the course of the year.



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 2018 are as follows:

1. The Department hosted a "Living in Lion, Bear, and Wolf Country" workshop in Big Piney. Approximately 15 people attended the workshop.

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

3. Hunting in Bear Country presentations were given to hunter safety classes throughout the region.

4. A bear safety presentation was given to staff members of the Sublette County Chamber of Commerce and Sublette County Visitor's Center.

5. A bear safety presentation was given to the Pinedale and Big Piney Ranger Districts of the United States Forest Service and the Rock Springs office of the Bureau of Land Management.

6. A bear safety presentation was given to Sublette County Weed and Pest employees and volunteers.

7. The Department 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 Department employees contact an estimated 1,000 constituents. This year's booth featured a new "bear charger" that helps visitors practice using bear spray under more realistic conditions.

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

9. Presented bear safety information, and entertained guests with the "bear charger" at the Jackson Hole Land Trust's annual banquet at the Murdock Ranch west of Pinedale.

10. Large Carnivore Section personnel manned a bear booth at the Sublette County Conservation District's "Spring Expo" and reached approximately 200 people.

Objectives for 2019 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 2018, 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 Department, Grand Teton National Park, Bridger Teton National Forest, and Jackson Hole Wildlife Foundation. Two bear mounts (1 grizzly bear and 1 black bear) have been placed in the trailer along with other educational materials. The bear mounts were donated to the Department through a partnership with the United States Taxidermist Association and the Center for Wildlife Information. The trailer was displayed and staffed at various events and locations including 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.

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 occur.

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

6. 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. Assisted hunting outfitters and with the installation and maintenance of electric fence systems around their field camps and located in the Bridger-Teton National Forest.

10. Assisted Teton County Transfer Station staff with an electric fence design for their new facility.

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 Land Development Regulations.

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

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

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

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

Objectives for the Bear Wise Jackson Hole program in 2019 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 Land Development Regulations. In addition, more work will be done to identify areas within the city limits of Jackson and Star Valley communities where better attractant management and sanitation infrastructure is needed.

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

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Information and Education

2018 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 2018, 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 to provide timely information to the public regarding grizzly bear management activities conducted by the department. The web page contents include various interagency annual reports and updates and links to other grizzly bear recovery web sites.

3) Hunter Education
   a) Every hunter education class in Wyoming is required to discuss how to hunt safely in bear country. To assist instructors, most have been provided inert bear spray canisters for demonstration purposes and DVDs 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

The primary link to other publications, annual reports, and peer reviewed literature for the Yellowstone population of grizzly bears is summarized on the Interagency Grizzly Bear Study Team web site at: 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 plan visit: https://wgfd.wyo.gov/wildlife-in-wyoming/more-wildlife/large-carnivore/grizzly-bear-management

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