Yellowstone Grizzly Bear Investigations
2002

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

2002

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
Montana State University

Charles C. Schwartz and Mark A. Haroldson, Editors

U.S. Department of the Interior
U.S. Geological Survey
2003

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INTRODUCTION *(Charles C. Schwartz, Interagency Grizzly Bear Study Team, and David Moody, Wyoming Game and Fish Department)*

This Report

The contents of this Annual Report summarize results of monitoring and research from the 2002 field season. The report also contains a summary of nuisance grizzly bear (*Ursus arctos horribilis*) management actions.

In addition to our normal monitoring, we completed an array of studies addressing grizzly bear demographics in the Greater Yellowstone Ecosystem (GYE). Four manuscripts were submitted to the Journal of Wildlife Management and are currently under review. We will make the abstracts available in our next report once we receive notice of acceptance following peer review. We have reassessed reproductive rates, survival of dependent young and independent bears using a suite of models with the best selected using Akaike's Information Criterion.

The study team continues to work on issues associated with counts of unduplicated females with cubs-of-the-year (COY). These counts are used to establish a minimum population size, which is then used to establish mortality thresholds for the Recovery Plan (U.S. Fish and Wildlife Service [USFWS] 1993). A computer program that defines the rule set used by Knight et al. (1995) to differentiate unique family groups is currently under development. Once complete, we intend to use it to verify the accuracy of the rules using known bears and their telemetry locations in test runs. We hope to have this work complete by Winter 2003.

The grizzly bear recovery plan (USFWS 1993) established mortality quotas at 4% of the minimum population estimate derived from female with COY data and no more than 30% of the 4% (1.2%) could be female bears. Simulation modeling (Harris 1984) established sustainable mortality at around 6% of the population. We used the latest information on reproduction and survival to estimate population trajectory in the same simulation model originally used by Harris. A manuscript on these results has also been submitted to the Journal of Wildlife Management and we will post it after we receive formal peer review and acceptance.

Our project addressing the potential application of stable isotopes and trace elements to quantify consumption rates of whitebark pine (*Pinus albicaulis*) and cutthroat trout (*Oncorhynchus clarki*) by grizzly bears was completed. Two manuscripts were submitted to the Canadian Journal of Zoology. One is officially accepted and the abstract is appended to this report (Appendix A), the other is still out for review. We will post it once officially reviewed and accepted.

We continued measuring body composition of captured bears. Body composition is a technique that is easy to apply and only takes about 5 minutes to perform, including obtaining the weight of the animal. Body fat is determined using bioelectrical impedance analysis (BIA), a technique that passes a small electrical current through the body. Resistance to the current flow is measured and correlated to the amount of water in the animal's body. Since body water is inversely related to body fat, it is possible to determine with some degree of precision the amount of body fat for each bear captured. We have made BIA a routine part of our data collection for each bear captured. These long-term records, particularly when combined with isotope and trace element analyses, will provide insight into the energetics of bears during years of good and bad food conditions. We continue to detect lower body fat measurements in problem bears trapped for management control when compared to random bears captured in the ecosystem. Although it is too early to do a rigorous analysis of these data, we provide a section in this annual report detailing what we have learned to date.

The annual reports of the Interagency Grizzly Bear Study Team (IGBST) summarize annual data collection. Because additional information can be obtained after publication, data summaries are subject to change. For that reason, data analyses and summaries presented in this report supersede all previously published data. The study area and sampling techniques are reported by Blanchard (1985), Mattson et al. (1991*a*), and Haroldson et al. (1998).

History and Purpose of the Study Team

It was recognized as early as 1973, that in order to understand the dynamics of grizzly bears throughout the GYE, there was a need for 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 (USGS), National Park Service, U.S. Forest Service, USFWS, and the States of Idaho, Montana, and Wyoming. The responsibilities of the IGBST are to: (1) conduct both 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.nrmsc.usgs.gov/research/igbst-home.htm).

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 overlap of effort, and pools limited economic and personnel resources.

Previous Research

Some of the earliest research on grizzlies within Yellowstone National Park was conducted by John and Frank Craighead. The book, "The Grizzly Bears of Yellowstone" provides a detailed summary of this early research (Craighead et al. 1995). With the closing of open-pit garbage dumps and cessation of the ungulate reduction program in Yellowstone National Park in 1967, bear demographics (Knight and Eberhardt 1985), food habits (Mattson et al. 1991*a*), and growth patterns (Blanchard 1987) for grizzly bears changed. Since 1975, the IGBST has produced annual reports and numerous scientific publications (for a complete list visit our web page http://www.nrmsc.usgs.gov/research/igbst-home.htm) summarizing monitoring and research efforts within the GYE. As a result, we know much about the historic distribution of grizzly bears within the GYE (Basile 1982, Blanchard et al. 1992), movement patterns (Blanchard and Knight 1991), food habits (Mattson et al. 1991*a*), habitat use (Knight et al. 1984), and population dynamics (Knight and Eberhardt 1985, Eberhardt et al. 1994, Eberhardt 1995). Nevertheless, monitoring and updating continues so that status can be reevaluated annually.

This report truly represents a "study team" approach. Many individuals contributed either directly or indirectly to its preparation. To that end, we have identified author(s). We also wish to thank Craig Whitman, Chris McQueary, Jeremiah Smith, Doug Blanton, Mark Biel, Travis Wyman, Dan Reinhart, Rick Swanker, Keith Aune, Neil Anderson, Mark Bruscino, Brian DeBolt, Craig Sax, Gary Brown, Max Black, John Emmerich, Larry Roop, Tim Fagan, Jerry

Longobardi, Duke Early, Dennis Almquist, Doug McWhirter, Cole Thompson, Bill Long, Doug Crawford, Bonnie Gafney, Kerry Murphy, Tom Olliff, Pat Perrotti, Doug Smith, Kim Barber, Mark Hinschberger, Brian Aber, Adrian Villaruz, Connie King, Wendy Clark, Sue Consolo Murphy, Bill Chapman, Doug Chapman, Rich Hyatt, Gary Lust, Claude Tyrrel, Jerry Spencer, Dave Stradley, Roger Stradley, Steve Ard, Sheldon Rasmussen, Peter Gogan, Kim Keating, Casey Hunter, Merril Nelson, Jed Edwards, and Steve Cherry for their contributions to data collection, analysis, and other phases of the study. Without the collection efforts of many, the information contained within this report would not be available.

RESULTS AND DISCUSSION

Grizzly Bear Capturing, Collaring, and Monitoring

Marked Animals *(Mark A. Haroldson and Chad Dickinson, Interagency Grizzly Bear Study Team, and Ron Grogan, Wyoming Game and Fish Department)*

During the 2002 field season, 54 individual grizzly bears were captured on 72 occasions (Table 1), including 18 females (16 adult) and 34 males (15 adult). Twenty-eight individuals were new bears not previously marked. Gender was not determined for 2 cubs captured and transported with their mother (#188, Table 1), and released without handling.

We conducted research trapping efforts for 888 trap days (1 trap day = 1 trap set for 1 day) in 7 Bear Management Units (BMUs) within the Grizzly Bear Recovery Zone (USFWS 1993) and 2 adjacent 10-mile perimeter areas. We captured 33 individual grizzly bears 49 times for a trapping success rate of 1 capture every 18.1 trap days.

There were 22 management captures of 21 individual bears in the GYE during 2002 (Tables 1 and 2), including 6 females (5 adult) and 13 males (5 adults). Gender for 2 cubs (see above) was not determined. Fifteen bears (4 female, 9 male, 2 unknown gender), including 2 family groups (#403 with yearlings G81 and G82, #188 and 2 unmarked cubs, Table 1) were relocated due to conflict situations during 2002 (Table 1). One of these bears (#404, Table 1) became involved in subsequent conflicts and was removed from the population. In addition, 6 other grizzly bears were captured and removed from the population because of conflicts with humans.

We radio-monitored 81 individual grizzly bears during the 2002 field season, including 30 adult females (Tables 2 and 3). Fifty-two grizzly bears entered their winter dens wearing active transmitters in the GYE. Since 1975, 423 individual grizzly bears have been radio-marked.

Table 1. Grizzly bears captured in the Greater Yellowstone Ecosystem during 2002.

Bear	Sex	Age	Date	General location[a]	Capture type	Release site	Trapper/Handler[b]
380	M	Adult	4/2	N Fork Shoshone, Pr-WY	Management	Removed	WGFD
404	M	Subadult	5/9	Timber Cr, Pr-WY	Management	Sheffield Cr, BTNF	WGFD
			8/9	Lime Cr, BTNF	Management	Removed	WGFD
405	M	Adult	5/9	S Fork Shoshone, Pr-WY	Management	Wiggins Fork, WY	WGFD
406	M	Adult	5/20	Brent Cr, SNF	Research	On site	WGFD
			5/21	Burroughs Cr, SNF	Research	On site	WGFD
			6/1	Charlie Cr, SNF	Research	On site	WGFD
379	M	Subadult	5/31	Pacific Cr, GTNP	Research	On site	IGBST
213	F	Adult	6/1	Wapiti Cr, GNF	Research	On site	IGBST
304	M	Adult	6/4	Cartridge Cr, SNF	Research	On site	WGFD
407	M	Subadult	6/8	Cartridge Cr, SNF	Research	On site	WGFD
408	M	Subadult	6/12	Long Cr, SNF	Research	On site	WGFD
409	F	Subadult	6/15	E Fork Long Cr, SNF	Research	On site	WGFD
410	M	Adult	6/19	Deadhorse Cr, GNF	Research	On site	IGBST
			8/10	Eldridge Cr, GNF	Research	On site	IGBST
411	M	Adult	6/21	Brent Cr, SNF	Research	On site	WGFD
303	F	Adult	6/23	Long Cr, SNF	Research	On site	WGFD
412	F	Adult	7/13	Berry Cr, GTNP	Research	On site	IGBST
413	M	Subadult	7/17	Berry Cr, GTNP	Research	On site	IGBST
			7/30	Berry Cr, GTNP	Research	On site	IGBST
414	M	Subadult	7/17	Spalding Bay, GTNP	Research	On site	IGBST
415	M	Subadult	7/23	Spread Cr, BTNF	Research	On site	WGFD
			8/3	Blackrock Cr, BTNF	Research	On site	WGFD
			8/9	Grizzly Cr, BTNF	Research	On site	WGFD
			8/29	Buffalo Fork, Pr-WY	Management	Spread Cr, BTNF	WGFD
344	M	Adult	8/3	Game Cr, BTNF	Research	On site	WGFD
416	F	Adult	8/7	Wapiti Cr, GNF	Research	On site	IGBST
417	M	Adult	8/9	Lime Cr, BTNF	Management	Mormon Cr, SNF	WGFD
355	M	Subadult	8/11	Cache Cr, GNF	Research	On site	IGBST
403	F	Adult	8/13	Jakeys Fork Wind, Pr-WY	Management	Sunlight Cr, SNF	WGFD
G81	F	Yearling	8/14	Jakeys Fork Wind, Pr-WY	Management	Sunlight Cr, SNF	WGFD
G82	M	Yearling	8/14	Jakeys Fork Wind, Pr-WY	Management	Sunlight Cr, SNF	WGFD
196	F	Adult	8/15	Cascade Cr, YNP	Research	On site	IGBST
			9/20	Cascade Cr, YNP	Research	On site	IGBST
			9/22	Cascade Cr, YNP	Research	On site	IGBST
101	F	Adult	8/31	Hebgen Lake, Pr-MT	Management	Removed	MTFWP
G83	M	Cub	8/31	Hebgen Lake, Pr-MT	Management	Removed	MTFWP
G84	M	Cub	8/31	Hebgen Lake, Pr-MT	Management	Removed	MTFWP

Table 1. Continued.

Bear	Sex	Age	Date	General location[a]	Capture type	Release site	Trapper/Handler[b]
418	M	Adult	9/1	Hoodoo Cr, Pr-WY	Management	Calf Cr, TNF	WGFD
419	M	Yearling	9/5	Yellowstone River, Pr-MT	Management	Trapper Cr, GNF	MTFWP
G85	M	Subadult	9/6	S Fork Madison, Pr-MT	Management	Removed	MTFWP
295	F	Adult	9/7	Gibbon River, YNP	Research	On site	IGBST
			9/9	Gibbon River, YNP	Research	On site	IGBST
			9/11	Gibbon River, YNP	Research	On site	IGBST
323	M	Adult	9/7	Gibbon River, YNP	Research	On site	IGBST
420	M	Subadult	9/7	N Fork Shoshone	Management	Blackrock Cr, BTNF	WGFD
402	F	Adult	9/9	Gibbon River, YNP	Research	On site	IGBST
211	M	Adult	9/9	Gibbon River, YNP	Research	On site	IGBST
401	M	Adult	9/11	Berry Cr, GTNP	Research	On site	IGBST
			10/9	Arizona Cr, GTNP	Research	On site	IGBST
421	M	Subadult	9/18	Carter Cr, Pr-WY	Management	Burnt Timber Cr, SNF	WGFD
132	F	Adult	9/18	Lamar River, YNP	Research	On site	IGBST
			9/21	Lamar River, YNP	Research	On site	IGBST
260	M	Adult	9/20	Antelope Cr, YNP	Research	On site	IGBST
281	M	Adult	9/23	Gibbon River, YNP	Research	On site	IGBST
422	M	Subadult	9/23	Pilgrim Cr, GTNP	Research	On site	IGBST
			10/6	Pilgrim Cr, GTNP	Research	On site	IGBST
			10/8	Pilgrim Cr, GTNP	Research	On site	IGBST
399	F	Adult	9/23	Snake River, GTNP	Research	On site	IGBST
			10/7	Pilgrim Cr, GTNP	Research	On site	IGBST
423	F	Adult	9/24	Sunlight Cr, Pr-WY	Management	E Fork Wind, ST-WY	WGFD
188	F	Adult	9/24	Sunlight Cr, Pr-WY	Management	E Fork Wind, ST-WY	WGFD
unm	unk	Cub	9/24	Sunlight Cr, Pr-WY	Management	E Fork Wind, ST-WY	WGFD
unm	unk	Cub	9/24	Sunlight Cr, Pr-WY	Management	E Fork Wind, ST-WY	WGFD
424	M	Subadult	9/25	Indian Cr, YNP	Research	On site	IGBST
392	M	Subadult	10/6	Pilgrim Cr, GTNP	Research	On site	IGBST
425	F	Adult	10/8	Jasper Cr, YNP	Research	On site	IGBST
214	F	Adult	10/17	Stephens Cr, YNP	Research	On site	IGBST
			10/19	Stephens Cr, YNP	Research	On site	IGBST
228	M	Adult	10/20	Indian Cr, YNP	Research	On site	IGBST
426	M	Subadult	10/28	Dogshead Cr, YNP	Research	On site	IGBST/YNP
311	F	Adult	11/8	Crandall Cr, Pr-WY	Management	Removed	WGFD

[a] BTNF = Bridger-Teton National Forest, GNF = Gallatin National Forest, GTNP = Grand Teton National Park, SNF = Shoshone National Forest, TNF = Targhee National Forest, YNP = Yellowstone National Park, Pr = private, ST = State.
[b] IGBST = Interagency Grizzly Bear Study Team, USGS; MTFWP = Montana Fish, Wildlife and Parks; WS = Wildlife Services/Animal and Plant Health Inspection Service (APHIS); WGFD = Wyoming Game and Fish.

Table 2. Annual record of grizzly bears monitored, captured, and transported in the Greater Yellowstone Ecosystem since 1980.

Year	Number monitored	Individuals trapped	Total captures		
			Research	Management	Transports
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

Table 3. Grizzly bears radio monitored in the Greater Yellowstone Ecosystem during 2002.

Bear	Sex	Age	Offspring[a]	Monitored: Out of den	Monitored: Into den	Current status
125	F	Adult	2 COY	Yes	No	Cast
132	F	Adult	3 COY	No	Yes	Active
166	F	Adult	3 COY	Yes	No	Cast
179	F	Adult	3 Yearlings	Yes	Yes	Active
188	F	Adult	2 COY	No	Yes	Active
193	F	Adult	2 COY, lost 1	Yes	Yes	Active
196	F	Adult	None	Yes	Yes	Active
211	M	Adult		No	Yes	Active
213	F	Adult	None	Yes	Yes	Active
214	F	Adult	None	No	Yes	Active
228	M	Adult		No	Yes	Active
260	M	Adult		No	Yes	Active
267	F	Adult	2 Yearlings	Yes	Yes	Active
281	M	Adult		No	Yes	Active
295	F	Adult	2 2-yr-olds	Yes	Yes	Active
303	F	Adult	1 Yearling	Yes	Yes	Active
304	M	Adult		No	No	Cast
305	F	Adult	Unknown	Yes	Yes	Active
311	F	Adult	None	Yes	No	Removed
323	M	Adult		No	Yes	Active
338	M	Adult		Yes	No	Cast
339	M	Adult		Yes	No	Missing
344	M	Adult		No	Yes	Active
346	F	Adult	1 Yearling	Yes	No	Dead
349	F	Adult	1 COY	Yes	No	Cast
350	F	Subadult		Yes	Yes	Active
351	F	Adult	None	Yes	Yes	Active
352	M	Adult		Yes	Yes	Active
355	M	Subadult		Yes	Yes	Active
356	M	Adult		Yes	Yes	Active
359	M	Adult		Yes	No	Unresolved
360	F	Adult	2 COY	Yes	No	Cast
365	F	Adult	None	Yes	Yes	Active
367	F	Adult	None	Yes	Yes	Active
369	M	Adult		Yes	No	Unresolved[b]
370	F	Adult	Unknown	Yes	No	Battery failure
372	M	Adult		Yes	Yes	Active
373	M	Subadult		Yes	Yes	Active

Table 3. Continued.

Bear	Sex	Age	Offspring[a]	Monitored: Out of den	Monitored: Into den	Current status
374	M	Adult		Yes	Yes	Active
379	M	Subadult		Yes	No	Cast
381	M	Adult		Yes	No	Unresolved[b]
383	F	Subadult	None	Yes	Yes	Active
384	F	Adult	1 COY	Yes	Yes	Active
386	F	Adult	3 Yearlings	Yes	No	Cast
387	M	Adult		Yes	No	Cast
388	M	Adult		Yes	No	Cast
390	M	Adult		Yes	No	Cast
392	M	Subadult		No	No	Unresolved[b]
393	M	Adult		Yes	No	Unresolved[b]
394	M	Adult		Yes	Yes	Active
395	F	Subadult		Yes	No	Cast
397	M	Adult		Yes	No	Cast
398	M	Adult		Yes	No	Cast
399	F	Adult	None	Yes	Yes	Active
400	M	Adult		Yes	No	Cast
401	M	Adult		Yes	Yes	Active
402	F	Adult	None	Yes	Yes	Active
403	F	Adult	2 Yearlings	Yes	No	Dead
404	M	Subadult		No	No	Removed
405	M	Adult		No	Yes	Active
406	M	Adult		No	Yes	Active
407	M	Subadult		No	Yes	Active
408	M	Subadult		No	Yes	Active
409	F	Subadult		No	No	Cast
410	M	Adult		No	Yes	Active
411	M	Adult		No	Yes	Active
412	F	Adult	None	No	Yes	Active
413	M	Subadult		No	Yes	Active
414	M	Subadult		No	No	Dead
415	M	Subadult		No	Yes	Active
416	F	Adult	None	No	Yes	Active
417	M	Adult		No	Yes	Active
418	M	Adult		No	Yes	Active
419	M	Subadult		No	Yes	Active

Table 3. Continued.

Bear	Sex	Age	Offspring[a]	Monitored: Out of den	Monitored: Into den	Current status
420	M	Subadult		No	Yes	Active
421	M	Subadult		No	Yes	Active
422	M	Subadult		No	Yes	Active
423	F	Adult	None	No	Yes	Active
424	M	Subadult		No	Yes	Active
425	F	Adult	None	No	Yes	Active
426	M	Subadult		No	Yes	Active

[a] COY = cub-of-the-year.

[b] These transmitters were not retrieved in 2002; the sites will be visited as soon as possible in 2003 to determine status.

Unduplicated Females *(Mark A. Haroldson, Interagency Grizzly Bear Study Team)*

Knight et al. (1995) detailed procedures used to distinguish "unduplicated" or "unique" females with COY. During 2002, we identified 52 unduplicated females accompanied by 102 COY in the GYE (Fig. 1). Litter sizes observed during initial observations were 14 single cub litters, 26 litters of twins, and 12 litters of triplets. Average litter size was 2.0. Distribution of initial sightings during 2000-2002 is shown in Fig. 2. Of the 52 female with COY classified as unduplicated, 24% (12) were initially sighted by ground observers; 58% (30) were sighted during IGBST observation flights (Table 4).

The increase in unique females with COY estimated during 2002 was due primarily to the high number of verified sightings obtained. By 1 September, 153 sightings were documented. This result represents a 46% increase over the number of sightings obtained during 2001 (n = 105). There is a strong positive correlation (Pearsons r = 0.95) between the number of sightings obtained and the number of unduplicated females with COY identified annually (Fig. 3). Thirteen females with COY were observed during 3 observation flights flown concurrently on 16 July. This result also contributed to the high count, as these 13 females were unequivocally different family groups in close proximity to each other. The increase in number of sightings was likely due to a combination of 3 factors: (1) more females with COY, (2) an increase in sightability, and (3) changes in timing of observations flights. Both rounds of observation flights in BMUs containing army cutworm moth (*Euxoa auxiliaris*) aggregation sites were conducted after mid-July when moths were available and bears were on sites. Flights in non-moth BMUs were flown prior to mid-July when observability was better in these BMUs.

Appendix F of the Grizzly Bear Recovery Plan (USFWS 1993) provides "Revised reporting rules for Recovery Plan Targets, July 12, 1992." Rule 1 states "unduplicated females with cubs will be counted inside or within 10 miles of the Recovery Zone line." Fifty unduplicated females were initially observed within 10-miles of Recovery Zone during 2002. The current 6-year average (1997-2002) for counts of unduplicated females with COY within the Recovery Zone and the 10-mile perimeter is 38 (Table 5). The 6-year average for total number of COY and average litter size observed at initial sighting were 73 and 1.9, respectively (Table 5).

Current methodology to determine number of unduplicated females with COY provides a minimum count (Knight et al. 1995). Keating et al. (2003) investigated methods to estimate total numbers of females with COY annually using sighting frequencies of randomly observed bears and recommended the second-order sample coverage estimator of Lee and Chao (1994). The Conservation Strategy for the Grizzly Bear in the Greater Yellowstone Area (USFWS 2003) proposes to use this methodology to estimate total numbers of female with cubs observed in the entire Greater Yellowstone Area (Table 6). The Conservation Strategy also proposes to estimate total grizzly bear population size and set mortality thresholds using estimates of total number of females with cubs produced by the second-order sample coverage method (Appendix C in USFWS 2003).

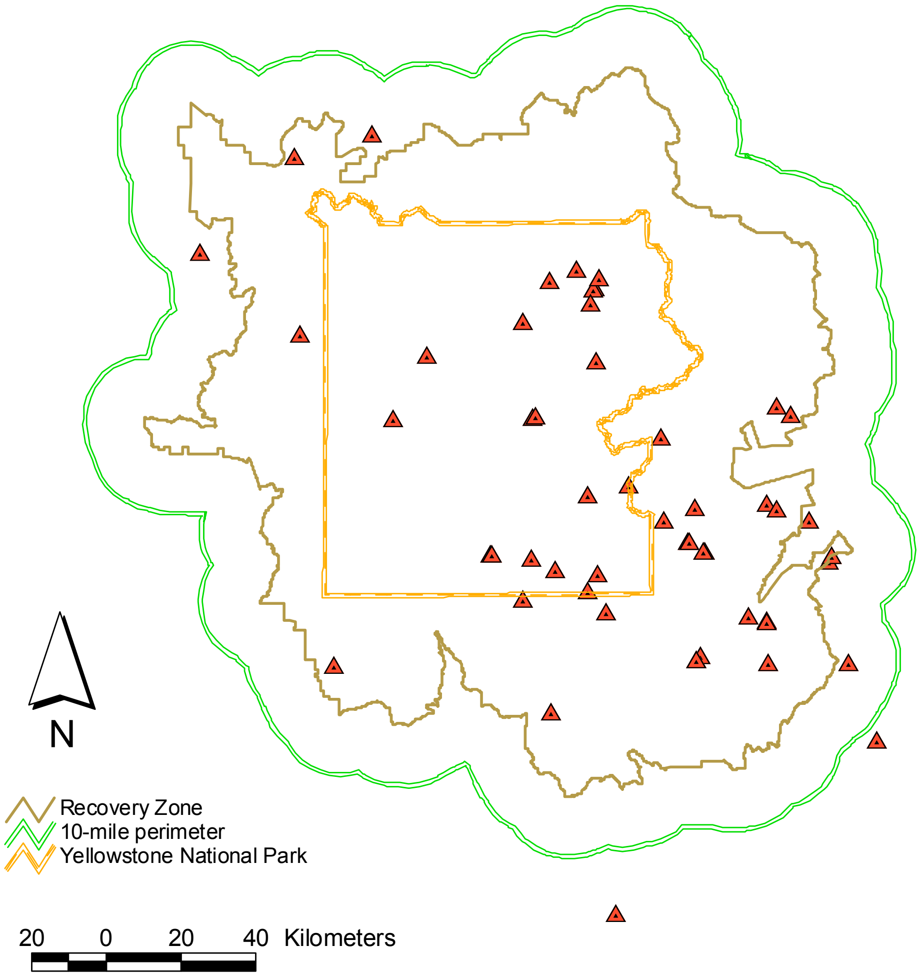

Fig. 1. Distribution of initial observations of unduplicated female grizzly bears with cubs-of-the-year in the Greater Yellowstone Ecosystem during 2002. The Yellowstone Grizzly Bear Recovery Zone (USFWS 1993) and 10-mile perimeter, Bear Management Units within the Recovery Zone, and Yellowstone National Park boundaries are delineated.

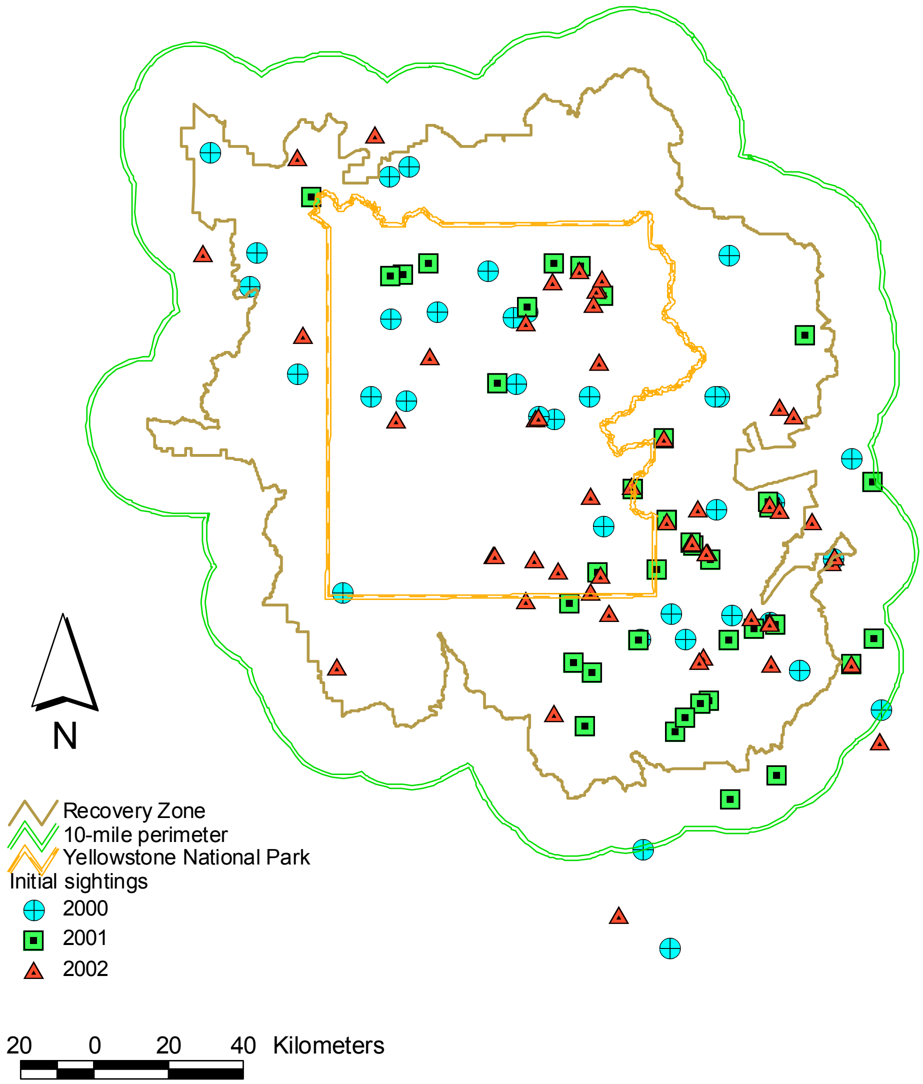

Fig. 2. Distribution of initial observations of unduplicated females with cubs-of-the-year in the Greater Yellowstone Ecosystem, 2000-2002. The Yellowstone Grizzly Bear Recovery Zone (USFWS 1993) and 10-mile perimeter, Bear Management Units within the Recovery Zone, and Yellowstone National Park boundaries are delineated.

Table 4. Method of initial observation of unduplicated female grizzly bears with cubs-of-the-year in the Greater Yellowstone Ecosystem, 1986-2002.

	Aerial observations				
	IGBST[a]				
Year	Observation	Radio-tracking	Other	Ground sightings/trap	Total
1986	7	5	3	10	25
1987	4	1	0	8	13
1988	4	4	1	10	19
1989	4	4	2	6	16
1990	4	6	0	15	25
1991	15	4	2	3	24
1992	9	3	4	9	25
1993	1	5	3	11	20
1994	9	5	3	3	20
1995	3	1	1	12	17
1996	9	12	1	11	33
1997	9	10	3	9	31
1998	15	7	1	12	35
1999	7	4	5	17	33
2000	7	7	5	18	37
2001	20	8	4	10	42
2002	30	8	1	13	52

[a] IGBST = Interagency Grizzly Bear Study Team.
[b] Females with cubs-of-the-year seen during non-IGBST research flights by qualified observers.

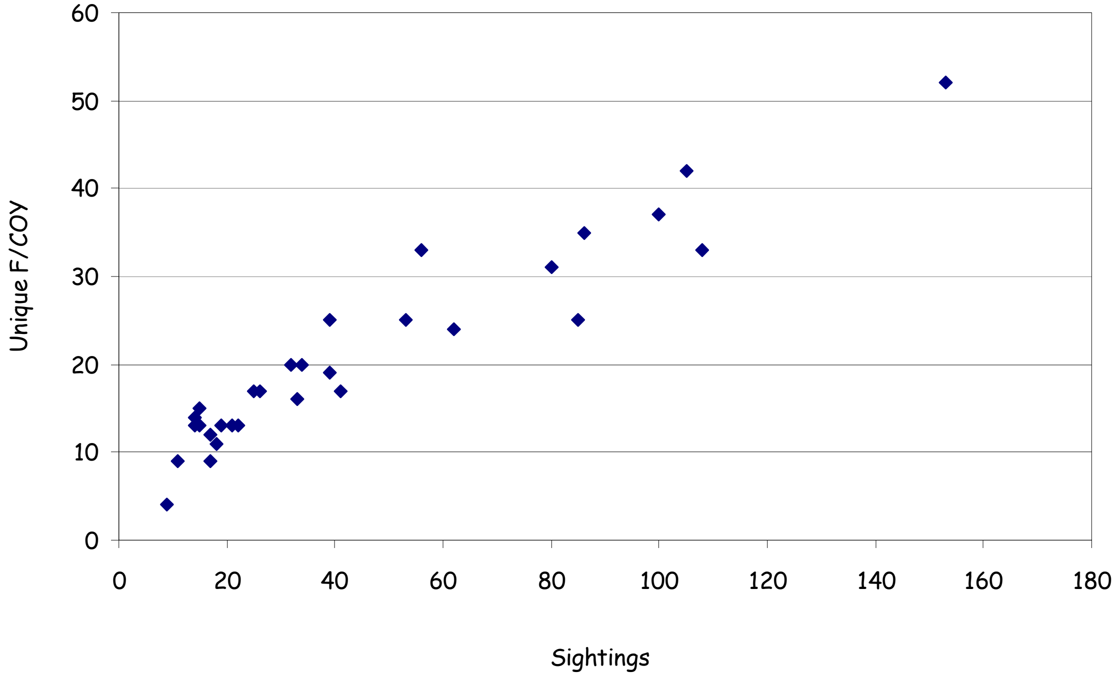

Fig. 3. Relationship between number of sightings and number of unique females identified annually.

Table 5. Number of unduplicated females with cubs-of-the-year (COY), number of COY, and average litter size at initial observation for the years 1973-2002 in the Greater Yellowstone Ecosystem (GYE). Six-year running averages were calculated using only unduplicated females with COY observed in the Recovery Zone and 10-mile perimeter.

	GYE			Recovery Zone and 10-mile perimeter 6-year running averages		
Year	Females	COY	Mean litter size	Females	COY	Litter size
1973	14	26	1.9			
1974	15	26	1.7			
1975	4	6	1.5			
1976	17	32	1.9			
1977	13	25	1.9			
1978	9	19	2.1	12	22	1.8
1979	13	29	2.2	12	23	1.9
1980	12	23	1.9	11	22	1.9
1981	13	24	1.8	13	25	2.0
1982	11	20	1.8	12	23	2.0
1983	13	22	1.7	12	23	1.9
1984	17	31	1.8	13	25	1.9
1985	9	16	1.8	13	23	1.8
1986	25	48	1.9	15	27	1.8
1987	13	29	2.2	15	28	1.9
1988	19	41	2.2	16	31	1.9
1989[a]	16	29	1.8	16	32	1.9
1990	25	58	2.3	18	36	2.0
1991[b]	24	43	1.9	20	41	2.0
1992	25	60	2.4	20	43	2.1
1993[a]	20	41	2.1	21	45	2.1
1994	20	47	2.4	21	46	2.1
1995	17	37	2.2	22	47	2.2
1996	33	72	2.2	23	50	2.2
1997	31	62	2.0	24	53	2.2
1998	35	70	2.0	26	55	2.1
1999[a]	33	63	1.9	28	58	2.1
2000[c]	37	72	2.0	31	62	2.0
2001	42	78	1.9	35	69	2.0
2002[c]	52	102	2.0	38	73	1.9

[a] One female with COY was observed outside the 10-mile perimeter.
[b] One female with unknown number of COY. Average litter size was calculated using 23 females.
[c] Two females with COY were observed outside the 10-mile perimeter.

Table 6. Estimates of annual numbers ($\hat{N}_{Obs}$) of females with cubs-of-the-year (F_{Cub}) in the Greater Yellowstone Ecosystem (GYE) grizzly bear population, 1986–2002. $\hat{N}_{Obs}$ gives the number of unique F_{Cub} seen, including those located using radiotelemetry; m gives the number of unique F_{Cub} observed using random sightings only; and $\hat{N}_{SC2}$ gives the second-order sample coverage estimates, per Lee and Chao (1994:Eqs. 3–5). Lower, 1-tailed confidence bounds are for $\hat{N}_{SC2}$ and were calculated using Efron and Tibshirani's (1993) percentile bootstrap method. Also included are annual estimates of relative sample size ($n / \hat{N}_{SC2}$, where n is the total number of observations of F_{Cub}) and of the coefficient of variation among sighting probabilities for individual animals ($\hat{\gamma}$). Estimates differ in some years from those in Table 5 of Keating et al. (2003) because values presented here are for the entire GYE, not the just the Recovery Zone plus 10-mile perimeter.

				Lower 1-tailed confidence bounds					
Year	$\hat{N}_{Obs}$	m	$\hat{N}_{SC2}$	70%	80%	90%	95%	$n / \hat{N}_{SC2}$	$\hat{\gamma}$
1986	25	24	31.9	28.3	26.9	25.3	23.7	2.6	0.9
1987	13	12	19.5	17.0	15.4	13.6	11.8	1.0	0.4
1988	19	17	21.5	20.1	19.1	17.7	16.7	1.7	0.3
1989	16	14	23.4	19.3	17.3	15.4	14.0	1.2	0.7
1990	25	22	25.5	24.4	23.6	22.2	21.3	1.9	0.0
1991	24	24	34.5	31.2	29.2	26.6	25.1	1.8	0.6
1992	25	23	47.6	39.9	36.3	32.5	29.2	0.8	0.6
1993	20	18	23.9	22.0	20.8	19.6	18.0	1.3	0.0
1994	20	18	25.5	23.2	22.1	19.9	18.8	1.1	0.0
1995	17	17	54.9	40.6	35.3	28.6	24.5	0.5	0.9
1996	33	28	41.4	38.6	36.4	33.9	31.5	1.1	0.0
1997	31	29	41.3	37.4	35.5	33.2	31.2	1.6	0.6
1998	35	33	40.9	38.4	37.0	35.1	33.7	1.8	0.4
1999	33	30	36.7	34.3	33.0	31.2	29.9	2.6	0.6
2000	37	34	62.6	54.5	50.9	45.9	42.9	1.2	0.9
2001	42	39	54.6	49.7	47.7	44.6	42.7	1.5	0.6
2002	52	49	72.4	66.1	63.4	59.3	56.3	2.0	0.9

Occupancy of BMUs by Females with Young *(Shannon Podruzny, Interagency Grizzly Bear Study Team)*

Dispersion of reproductive females throughout the ecosystem is represented by verified reports of female grizzly bears with young (COY, yearlings, 2-year-olds, and/or young of unknown age) by BMU. The population recovery requirements (USFWS 1993) include occupancy of 16 of the 18 BMUs by females with young on a running 6-year sum with no 2 adjacent BMUs unoccupied. Eighteen of 18 BMUs had verified observations of female grizzly bears with young during 2002 (Table 7). Eighteen of 18 BMUs contained verified observations of females with young in at least 4 years of the last 6-year period.

Table 7. Bear Management Units in the Greater Yellowstone Ecosystem occupied by females with young (cubs-of-the-year, yearlings, 2-year-olds, or young of unknown age), as determined by verified reports, 1997-2002.

Bear Management Unit	1997	1998	1999	2000	2001	2002	Years occupied
1) Hilgard	X		X	X	X	X	5
2) Gallatin	X	X	X	X	X	X	6
3) Hellroaring/Bear	X		X	X	X	X	5
4) Boulder/Slough	X		X	X	X	X	5
5) Lamar	X	X	X	X	X	X	6
6) Crandall/Sunlight	X	X	X	X	X	X	5
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	5
13) Plateau			X	X	X	X	4
14) Two Ocean/Lake	X	X	X	X	X	X	6
15) Thorofare	X	X	X	X	X	X	6
16) South Absaroka	X	X	X	X	X	X	6
17) Buffalo/Spread Creek	X	X	X	X	X	X	6
18) Bechler/Teton	X	X	X	X	X	X	6
Totals	17	14	17	18	18	18	

Observation Flights *(Karrie West, Interagency Grizzly Bear Study Team)*

Two rounds of observation flights were conducted during 2002. Thirty-six of the 37 Bear Observation Areas (BOA; Figure 4) were surveyed during Round 1 (12 June-22 July), resulting in 84 hours of observation time. During Round 2 (13 July–28 August), 35 of the 37 BOAs were surveyed for 79.3 hours of observation. The average duration of flights for both rounds was 2.3 hours (Table 8). Two hundred ninety-four bear sightings, excluding dependent young, were recorded during observation flights. This included 9 solitary radio-marked bears, 205 solitary unmarked bears, and 80 unmarked females with young (Table 8). Observation rates were 1.80 bears/hour for all bears or 0.49 females with young/hour. One hundred fifty-five young (127 COY, 23 yearlings, and 5 of unknown age) were observed (Table 9). Observation rates were 0.40 females with COY/hour and 0.08 females with yearlings/hour.

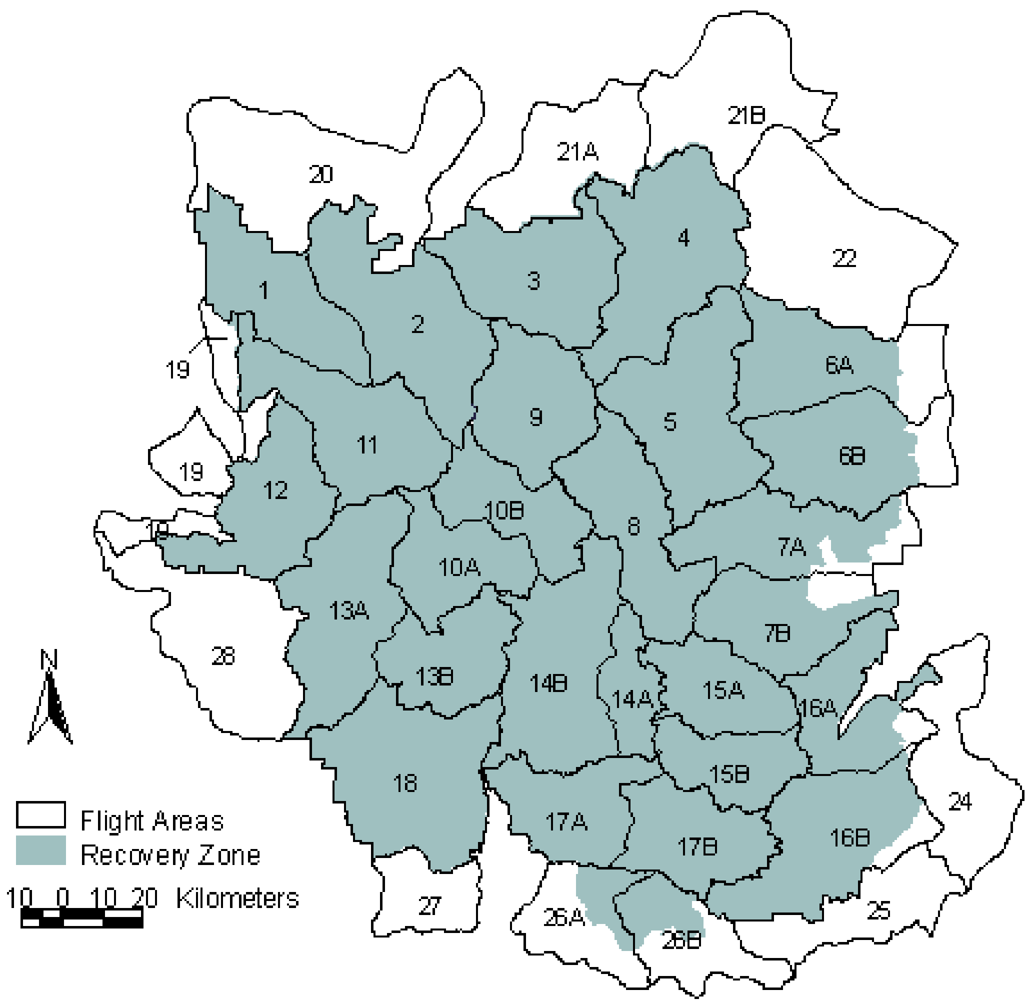

Fig. 4. Observation flight areas within the Greater Yellowstone Ecosystem, 2002. The numbers represent the 27 bear observation areas. Those units too large to search during a single flight were further subdivided into 2 units. Consequently, there were 37 search areas.

Table 8. Annual summary statistics for observation flights conducted in the Greater Yellowstone Ecosystem, 1987-2002.

Date	Observation period	Total hours	Number of flights	Average hours/flight	Bears seen: Marked, Lone	Marked, With young	Unmarked, Lone	Unmarked, With young	Total number of groups	Observation rate (bears/hour): All groups	With young	With COY[a]
1987	Total	50.6	21	2.4					26[b]	0.51	0.16	0.12
1988	Total	34.8	17	2.0					30[b]	0.86	0.43	0.23
1989	Total	91.9	39	2.4					60[b]	0.65	0.16	0.09
1990	Total	88.1	41	2.1					48[b]	0.54	0.19	0.15
1991	Total	101.3	46	2.2					134[b]	1.32	0.52	0.34
1992	Total	61.1	30	2.0					113[b]	1.85	0.54	0.29
1993[c]	Total	56.4	28	2.0					32[b]	0.57	0.10	0.05
1994	Total	80.1	37	2.2					67[b]	0.84	0.30	0.19
1995	Total	70.3	33	2.1					62[b]	0.88	0.14	0.09
1996	Total	88.6	40	2.2					71[b]	0.80	0.27	0.23
1997[d]	Round 1	55.5	26	2.1	1	1	38	19	59	1.08		
	Round 2	59.3	24	2.5	1	1	30	17	49	0.83		
	Total	114.8	50	2.3	2	2	68	36	108	0.94	0.33	0.16
1998[d]	Round 1	73.6	37	2.0	1	2	54	26	83	1.13		
	Round 2	75.4	37	2.0	2	0	68	18	88	1.17		
	Total	149.0	74	2.0	3	2	122	44	171	1.15	0.31	0.19
1999[d]	Round 1	79.7	37	2.2	0	0	13	8	21	0.26		
	Round 2	74.1	37	2.0	0	1	21	8	30	0.39		
	Total	153.8	74	2.1	0	1	34	16	51	0.33	0.11	0.05
2000[d]	Round 1	48.7	23	2.1	0	0	8	2	10	0.21		
	Round 2	83.6	36	2.3	3	0	51	20	74	0.89		
	Total	132.3	59	2.2	3	0	59	22	84	0.63	0.17	0.12
2001[d]	Round 1	72.3	32	2.3	0	0	37	12	49	0.68		
	Round 2	72.4	32	2.3	2	4	85	29	120	1.66		
	Total	144.7	64	2.3	2	4	122	41	169	1.17	0.31	0.25
2002[d]	Round 1	84.0	36	2.3	3	0	88	34	125	1.49		
	Round 2	79.3	35	2.3	6	0	117	46	169	2.13		
	Total	163.3	71	2.3	9	0	205	80	294	1.80	0.49	0.40

[a] COY = Cub-of-the-year.

[b] Only includes unmarked bears. Checking for radio-marks on observed bears was added to the protocol starting in 1997.

[c] Three flights were excluded from the 1993 data because they were not flown as part of the 16 observation flight areas.

[d] Dates of flights (Round 1, Round 2): 1997 (24 July–17 August, 25 August-13 September); 1998 (15 July-6 August, 3-27 August); 1999 (7-28 June, 8 July–4 August); 2000 (5-26 June, 17 July–4 August); 2001 (19 June–11 July, 16 July–5 August); 2002 (12 June–22 July, 13 July–28 August).

Table 9. Size and age composition of family groups seen during observation flights in the Greater Yellowstone Ecosystem, 1998-2002.

Date	Females with cubs-of-the-year (number of cubs)			Females with yearlings (number of yearlings)			Females with young of unknown age (number of young)		
	1	2	3	1	2	3	1	2	3
1998[a]									
Round 1	4	10	4	0	4	2	1	2	1
Round 2	0	7	3	2	4	1	0	1	0
Total	4	17	7	2	8	3	1	3	1
1999[a]									
Round 1	2	1	1	0	1	2	1	0	0
Round 2	1	2	0	0	3	1	0	1	0
Total	3	3	1	0	4	3	1	1	0
2000[a]									
Round 1	1	0	0	0	0	0	0	1	0
Round 2	3	11	1	1	2	0	0	2	0
Total	4	11	1	1	2	0	0	3	0
2001[a]									
Round 1	1	8	1	1	0	0	0	0	1
Round 2	14	10	2	4	2	1	0	0	0
Total	15	18	3	5	2	1	0	0	1
2002[a]									
Round 1	8	15	5	3	2	0	0	0	1
Round 2	9	19	9	2	4	2	0	1	0
Total	17	34	14	5	6	2	0	1	1

[a] Dates of flights (Round 1, Round 2): 1997 (24 July–17 August, 25 August-13 September); 1998 (15 July-6 August, 3-27 August); 1999 (7-28 June, 8 July–4 August); 2000 (5-26 June, 17 July–4 August); 2001 (19 June–11 July, 16 July–5 August); 2002 (12 June–22 July, 13 July–28 August).

Telemetry Relocation Flights *(Karrie West, Interagency Grizzly Bear Study Team)*

One hundred eight telemetry relocation flights were conducted during 2002, resulting in 413.4 hours of search time (ferry time to and from airports excluded; Table 10). Flights were conducted at least once during all months except February and March, but over 90% occurred May-November. During telemetry flights, 909 locations of bears equipped with radiotransmitters were collected, 77 (8.5%) of which included a visual sighting. Eight-three sightings of unmarked bears were also obtained during telemetry flights, including 72 solitary bears, 6 females with COY, 3 females with yearlings, and 2 females with 2-year-olds. Rate of observation for all unmarked bears during telemetry flights was 0.20 bears/hour. Rate of observing females with COY was 0.015/hour, which was considerably less than during observation flights (0.40/hour) in 2002.

Table 10. Summary statistics for radio-telemetry relocation flights in the Greater Yellowstone Ecosystem, 2002.

Month	Hours	Number of flights	Mean hours per flight	Radioed bears: Number of locations	Radioed bears: Number seen	Radioed bears: Observation rate (bears/hour)	Unmarked bears observed: Lone bears	Unmarked bears observed: Females With COY[a]	Unmarked bears observed: Females With yearlings	Unmarked bears observed: Females With young	Unmarked bears observed: Observation rate (bears/hour) All bears	Unmarked bears observed: Observation rate (bears/hour) Females with COY
January	4.90	1	4.90	1	0	0.000	0	0	0	0	0.00	0.00
February	0.00	0	-----	0	0	-----	0	0	0	0	-----	-----
March	0.00	0	-----	0	0	-----	0	0	0	0	-----	-----
April	18.81	4	4.70	27	1	0.053	0	0	0	0	0.000	0.000
May	57.26	17	3.37	115	15	0.262	18	1	1	0	0.349	0.017
June	44.24	14	3.16	93	6	0.136	4	0	0	0	0.090	0.000
July	57.39	17	3.38	122	17	0.296	8	4	1	1	0.244	0.070
August	55.48	14	3.96	130	14	0.252	32	1	1	0	0.613	0.018
September	66.25	13	5.10	136	16	0.242	7	0	0	1	0.121	0.000
October	47.07	11	4.28	132	4	0.085	2	0	0	0	0.042	0.000
November	47.84	10	4.78	122	2	0.042	0	0	0	0	0.000	0.000
December	14.15	3	4.72	31	2	0.141	0	0	0	0	0.000	0.000
Total	413.39	108	3.83	909	77	0.186	72	6	3	2	0.200	0.015

[a] COY = cub-of-the-year.

Grizzly Bear Mortalities *(Mark A. Haroldson, Interagency Grizzly Bear Study Team, and Kevin Frey, Montana Fish, Wildlife and Parks)*

We continue to 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. Those cases in which a carcass is physically inspected or when a management removal occurs are classified as "known" mortalities. Those instances where evidence strongly suggests a mortality has occurred but no carcass is recovered are classified as "probable" mortalities. When evidence is circumstantial, with no prospect for additional information, a "possible" mortality is designated. The Grizzly Bear Recovery Plan (USFWS 1993:41-44) provides criteria for determining if known human-caused grizzly bear mortalities have exceeded annual thresholds. Although not clearly stated, Appendix F of the Grizzly Bear Recovery Plan (USFWS 1993) intended that only known human-caused grizzly bear mortalities occurring within the Yellowstone Grizzly Bear Recovery Zone and a 10-mile perimeter area count against mortality quotas. The U.S. Fish and Wildlife Service clarified this oversight with an amendment to the Recovery Plan. In addition, beginning in 2000, probable mortalities were included in the calculation of mortality thresholds, and COY orphaned as a result of human causes will be designated as probable mortalities (see Appendix A in Schwartz and Haroldson 2001). Prior to these changes, COY orphaned after 1 July were designated possible mortalities (Craighead et al. 1988). Sex of probable mortalities will be randomly assigned as described in Appendix A in Schwartz and Haroldson (2001).

We documented 27 grizzly bear mortalities during 2002. Seventeen were known human-caused bears deaths, and 2 were possible human-caused mortalities. Two of the known human-caused grizzly bear mortalities occurred >10 miles outside the Recovery Zone in Wyoming (Tables 11 and 12). Both of these instances were livestock related management actions. There were 6 other management removals, 4 in Montana (including female #101 and 2 male cubs) and 2 in Wyoming (Table 11). We documented 4 known and 2 possible hunting related mortalities (Table 11). The 2 possible mortalities both involved females with young. Both females were wounded in the encounters (1 with an arrow, the other was shot), but evidence at the site suggested neither died. Possible human-caused mortalities and known or probable human-caused mortalities occurring >10 miles outside the Recovery Zone are not included in the calculation of mortality thresholds (see Appendix A in Schwartz and Haroldson 2001). Thus, 15 known human-caused grizzly bear mortalities, including 4 adult females and 7 total females, were applied to the calculation of mortality threshold (USFWS 1993) for 2002. Using these results, both total human-caused and female mortalities were under annual mortality thresholds (Table 13).

Four natural mortalities were documented during 2002 (Table 11). Two were COY that likely died from predation. One probable cub loss from a radio-collared female occurred between mid-July and early October. The remaining natural mortality was a 16-year-old female discovered in Porcupine Creek, Gallatin National Forest, during May. Necropsy of this bear found no evidence of human involvement and indicated malnutrition was the likely cause of death.

Cause of death could not be determined for 4 mortalities documented during 2002 (Table 11). One of these bears (#308, Table 11) died during the fall of 2001 at the site of a hunter-killed elk (*Cervus elaphus*). She was accompanied by 2 COY when she died. Another radio-collared female (#403, Table 11) died during mid-August shortly after beginning transported to Sunlight Creek, Shoshone National Forest, from near Dubios, Wyoming. Her carcass was discovered within 100 meters of the main road, and within 3.8 km of the release site. The fate of her 2 yearlings transported with her is unknown. A subadult male (#414, Table 11) died during the Summer or Fall of 2002, also from undetermined cause. This bear was discovered 6 km from the capture site at the mouth of a den. The remains of a grizzly bear of undetermined sex was discovered in the Rock Creek drainage, Targhee National Forest, during the Fall of 2002.

Table 11. Grizzly bear mortalities documented in the Greater Yellowstone Ecosystem during 2002.

Bear[a]	Sex	Age[a]	Date	Location[c]	Certainty	Cause
308	Female	Adult	Fall 2001	Five Pockets, SNF	Known	Undetermined cause of death.
Unm	Unk	Unk	Spring 2002	Rock Creek, TNF	Known	Undetermined cause of death.
380	Male	Adult	4/2	N Fork Shoshone, Pr-WY	Known	Human-caused: management removal due to nuisance activity and property damage.
Unm	Female	Adult	5/15	Porcupine Creek, GNF	Known	Natural: specific cause unknown.
Unm	Female	Subadult	6/11	Leidy Creek, BTNF	Known	Human-caused: hunting related, mistaken identity.
Unm	Male	COY	6/21	Mary Bay, YNP	Known	Human-caused: hit by vehicle.
Unm	Unk	COY	7/13-10/3	Lower Geyser Basin	Probable	Natural: specific cause unknown, COY of #193.
Unm	Unk	COY	7/22	Pelican Creek, YNP	Known	Natural: specific cause unknown.
Unm	Female	Adult	8/2	Gallatin River, YNP	Known	Human-caused: hit by vehicle.
404[d]	Male	Adult	8/9	Lime Creek, BTNF	Known	Human-caused: management removal for repeated livestock depredation.
340[d]	Male	Adult	8/11	Little Blind Bull Creek, BTNF	Known	Human-caused: livestock related.
403	Female	Adult	8/13-9/11	Sunlight Creek, SNF	Known	Undetermined cause of death.
101	Female	Adult	8/31	Horse Butte, Pr-MT	Known	Human-caused: management removal (to zoo) due to numerous food rewards and property damage.
G83	Male	COY	8/31	Horse Butte, Pr-MT	Known	Human-caused: management removal (zoo), COY of #101.
G84	Male	COY	8/31	Horse Butte, Pr-MT	Known	Human-caused: management removal (zoo), COY of #101.
G85	Male	Subadult	9/6	S Fork Madison, Pr-MT	Known	Human-caused: management removal due to property damage and food reward.
375	Male	Adult	9/10	Crandall Creek, Pr-WY	Known	Human-caused: defense of life.
Unm	Unk	COY	9/21	Sunlight Creek, SNF	Known	Natural: specific cause unknown.
346	Female	Adult	9/20	Sawtelle Peak, CTNF	Known	Human-caused: under investigation.
Unm	Female	Yearling	9/20	Sawtelle Peak, CTNF	Known	Human-caused: under investigation.
Unm	Male	Adult	9/23	S Fork Buffalo, BTNF	Known	Human-caused: hunting related.
Unm	Female	Adult	9/28	Cooney Creek, CTNF	Possible	Human-caused: hunting related.
Unm	Unk	Adult	10/9	Papoose Creek, SNF	Known	Human-caused: hunting related.
Unm	Female	Subadult	10/19	Woody Creek, BTNF	Known	Human-caused: hunting related.
Unm	Female	Adult	11/6	Ishawooa Creek, SNF	Possible	Human-caused: hunting related.
311	Female	Adult	11/8	Crandall Creek, Pr-WY	Known	Human-caused: management removal due to property damage and repeated nuisance activity.
414	Male	Subadult	Fall 2002	Leigh Canyon, GTNP	Known	Undetermined cause of death

[a] Unm = unmarked bear; number indicates bear number.
[b] COY = cub-of-the-year. Unk = unknown age
[c] BTNF = Bridger-Teton National Forest, CTNF = Caribou-Targhee National Forest, GNF = Gallatin National Forest, GTNP = Grand Teton National Park, SNF = Shoshone National Forest, YNP = Yellowstone National Park, Pr = private.
[d] Occurred >10 miles outside the Recovery Zone.

Table 12. Known and probable grizzly bear deaths in the Greater Yellowstone Ecosystem, 1973-2002.

	All bears				Adult females			
	Human-caused		Other[a]		Human-caused		Other	
	In[b]	Out[b]	In	Out	In	Out	In	Out
1973	14	0	3	0	4	0	0	0
1974	15	0	1	0	4	0	0	0
1975	3	0	0	0	1	0	0	0
1976	6	0	1	0	1	0	0	0
1977	14	0	3	0	6	0	0	0
1978	7	0	0	0	1	0	0	0
1979	7	1	0	0	1	0	0	0
1980	6	0	4	0	1	0	0	0
1981	10	0	3	0	3	0	2	0
1982	14	0	3	0	4	0	0	0
1983	6	0	1	0	2	0	0	0
1984	9	0	2	0	2	0	0	0
1985	5	1	7	0	2	0	0	0
1986	5	4	2	0	1	1	0	0
1987	3	0	0	0	2	0	0	0
1988	5	0	7	0	0	0	2	0
1989	2	0	1	0	0	0	0	0
1990	9	0	0	0	4	0	0	0
1991	0	0	0	0	0	0	0	0
1992	4	0	4	0	0	0	0	0
1993	3	0	2	0	2	0	1	0
1994	11	1	1	0	4	0	0	0
1995	17	0	1	0	3	0	0	0
1996	10[c]	0	4	1	3	0	0	0
1997	8	2	10[d]	0	3	0	0	0
1998	1	2	3	0	1	0	0	0
1999	7[e]	1	7	0	1	0	0	0
2000[f]	16	6	10	0	3	1	0	0
2001	19	1	12[g]	0	6	0	1	0
2002	15	2	7	0	4	0	3[g]	0

[a] Includes deaths from natural and unknown causes.
[b] In refers to inside the Recovery Zone or within a 10-mile perimeter of the Recovery Zone. Out refers to >10 miles outside the Recovery Zone.
[c] Includes 1 known human-caused mortality from 1996 discovered during 1999.
[d] Includes 1 mortality from the fall of 1997 discovered in 1998.
[e] Includes 1 probable human-caused mortality from 1999 discovered in 2000.
[f] Starting in 2000, includes human-caused orphaned cubs-of-the-year (see Appendix A in Schwartz and Haroldson 2001).
[g] Includes 1 known mortality from fall of 2001 discovered in 2002.

Table 13. Annual count of unduplicated females with cubs-of-the-year (COY), and known and probable[a] human-caused grizzly bear mortalities within the Recovery Zone and the 10-mile perimeter, 1992-2002. Calculations of mortality thresholds (USFWS 1993) do not include mortalities or unduplicated females with COY documented outside the 10-mile perimeter.

								U.S. Fish and Wildlife Service Grizzly Bear Recovery Plan mortality thresholds				
									Total human-caused mortality		Total female mortality	
		Human-caused mortality			Human-caused mortality 6-year running averages							
Year	Unduplicated females with COY	Total	Female	Adult female	Total	Female	Adult female	Minimum population estimate	4% of minimum population	Year result	30% of total mortality	Year result
1992	25	4	1	0	3.8	1.8	1.0	255	10.2		3.1	
1993	19	3	2	2	3.8	1.8	1.0	241	9.6	Under	2.9	Under
1994	20	10	3	3	4.7	2.0	1.5	215	8.6	Under	2.6	Under
1995	17	17	7	3	7.2	3.2	2.0	175	7.0	Exceeded	2.1	Exceeded
1996	33	10	4	3	7.3	2.8	1.8	223	8.9	Under	2.7	Exceeded
1997	31	7	3	2	8.5	3.3	2.2	266	10.7	Under	3.2	Exceeded
1998	35	1	1	1	8.0	3.3	2.3	339	13.6	Under	4.1	Under
1999	32	5	1	1	8.3	3.2	2.2	343	13.7	Under	4.1	Under
2000	35	16	6	3	9.3	3.7	2.2	354	14.2	Under	4.2	Under
2001	42	19	8	6	9.7	3.8	2.7	361	14.5	Under	4.3	Under
2002	50	15	7	4	10.5	4.3	2.8	416	16.6	Under	5.0	Under

[a] Beginning in 2000, probable human-caused mortalities are used in calculation of annual mortality thresholds (see Appendix A in Schwartz and Haroldson 2001).

Key Foods Monitoring

Spring Ungulate Availability and Use by Grizzly Bears in Yellowstone National Park.
(Shannon Podruzny, Interagency Grizzly Bear Study Team, and Kerry Gunther, Yellowstone National Park)

It is well documented that grizzly bears consume the carrion of ungulates (Mealey 1980, Henry and Mattson 1988, Green 1994, Blanchard and Knight 1996, Mattson 1997) in Yellowstone National Park. Competition with recently reintroduced wolves (*Canis lupus*) for carrion and changes in bison (*Bison bison*) and elk management policies in the GYE have the potential to affect carcass availability and use by grizzly bears. For these and other reasons, we continue to survey historic carcass transects in Yellowstone National Park. In 2002, we surveyed routes in ungulate winter ranges to monitor the relative abundance of spring ungulate carcasses (Fig. 5).

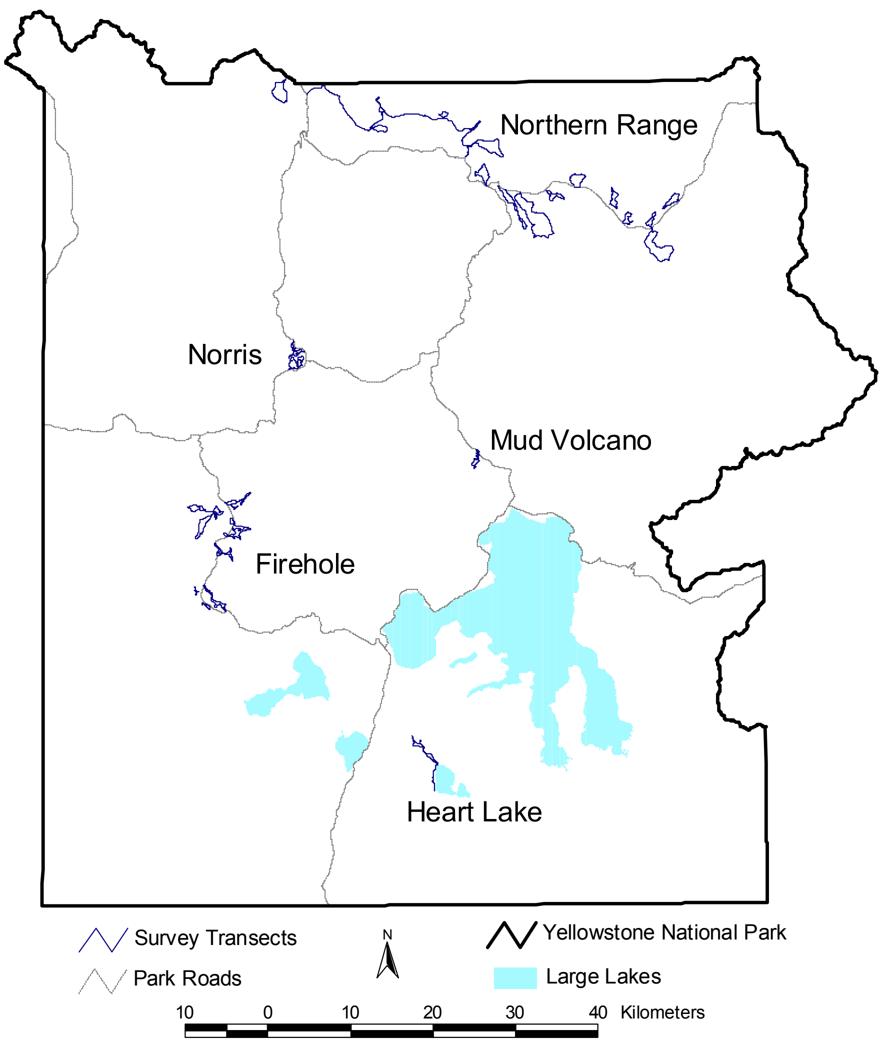

Fig. 5. Spring ungulate carcass survey transects in 5 areas of Yellowstone National Park.

We surveyed each route once for carcasses between April and early-May. At each carcass, we collected a site description (i.e., location, aspect, slope, elevation, distance to road, distance to forest edge), carcass data (i.e., species, age, sex, cause of death), and information about species using the carcasses (i.e., species, percent of carcass consumed, scats present). We were unable to calculate the biomass consumed by bears, wolves, or other unknown large scavengers with our survey methodology.

We are interested in relating the changes in ungulate carcass numbers to potential independent measures of winter die-off. Such measures include weather, winter severity, and forage availability. All are considered limiting factors to ungulate survival during winter (Cole 1971, Houston 1982). Long-term changes in weather and winter severity monitoring may be useful in predicting potential carcass availability. The Winter Severity Index (WSI) developed for elk (Farnes 1991), tracks winter severity, monthly, within a winter and is useful to compare among years. WSI uses a weight of 40% of minimum daily winter temperature below 0° F, 40% of current winter's snow pack (in snow water equivalent), and 20% of June and July precipitation as surrogate for forage production (Farnes 1991).

Northern Range

We surveyed 12 routes on Yellowstone's Northern Range totaling 150.8 km traveled. In 2002, we used a GPS to more accurately measure the actual distance traveled on most of the routes. We counted 7 carcasses, including 1 bison and 6 elk, which equated to 0.05 carcasses/km (Table 14). Sex and age of carcasses found are shown in Table 15. All carcasses were almost completely consumed by scavengers; no direct evidence of use by bears could be determined. One of the elk was probably killed by wolves. Bear sign (e.g., tracks, scats, or feeding activity) was observed along 5 of the routes.

Table 14. Carcasses found and visitation of carcasses by bears, wolves, and unknown large scavengers along surveyed routes in Yellowstone National Park during spring 2002.

	Elk				Bison				
	Number of carcasses	# Visited by species			Number of carcasses	# Visited by species			
Survey area (# routes)		Bear	Wolf	Unknown		Bear	Wolf	Unknown	Total Carcasses/km
Northern Range (12)	6	0	1	4	1	0	0	1	0.05
Firehole (8)	8	1	1	4	10	2	3	2	0.21
Norris (4)	0	0	0	0	0	0	0	0	0
Heart Lake (3)	0	0	0	0	0	0	0	0	0
Mud Volcano (1)	0	0	0	0	0	0	0	0	0

Table 15. Age classes and sex of elk and bison carcasses found, by area, along surveyed routes in Yellowstone National Park during Spring 2002.

	Elk (n = 14)						Bison (n = 11)					
	Northern Range	Firehole	Norris	Heart Lake	Mud Volcano	Total	Northern Range	Firehole	Norris	Heart Lake	Mud Volcano	Total
<u>Age</u>												
Adult	4	5	0	0	0	9	1	6	0	0	0	7
Yearling	1	1	0	0	0	2	0	2	0	0	0	2
Calf	1	2	0	0	0	3	0	2	0	0	0	2
Unknown	0	0	0	0	0	0	0	0	0	0	0	0
<u>Sex</u>												
Male	0	1	0	0	0	1	1	1	0	0	0	2
Female	4	3	0	0	0	7	0	6	0	0	0	6
Unknown	2	4	0	0	0	6	0	3	0	0	0	3

<u>Firehole River Area</u>

We surveyed 8 routes in the Firehole drainage totaling 86.6 km. We found the remains of 10 bison and 8 elk, which equated to 0.21 carcasses/km traveled (Table 14). The carcasses include 2 bison that died as a result of predation, and 1 stillborn bison calf. Grizzly bear tracks were observed along 4 of the routes. Two carcasses were visited by grizzly bears and 1 by black bears (*Ursus americanus*). Five carcasses had evidence of use by wolves.

<u>Norris Geyser Basin</u>

We surveyed 4 routes in the Norris Geyser Basin totaling 21.7 km traveled. We observed no carcasses or bear sign this spring.

<u>Heart Lake</u>

We surveyed 3 routes in the Heart Lake thermal basin covering 16.8 km. We observed no carcasses. Grizzly bear sign, including 2 sightings, was observed on 2 routes.

<u>Mud Volcano</u>

We established a new route in the Mud Volcano area covering 7.4 km. No carcasses or grizzly bear sign were observed this spring.

According to the WSI, the winter of 2001-2002 presented milder-than-average conditions (Fig. 6). There were fewer carcasses observed than in previous years, and our index of carcass abundance was lower in 2001-2002 compared to the relatively severe winter of 1996-1997 (Fig. 7). We found a significant correlation between the WSI and numbers of carcasses observed on the Northern Range (R^2 = 0.68, n = 15, F = 27.4, P < 0.0001), and in the Firehole/Norris basins (R^2 = 0.81, n = 10, F = 33.7, P < 0.001).

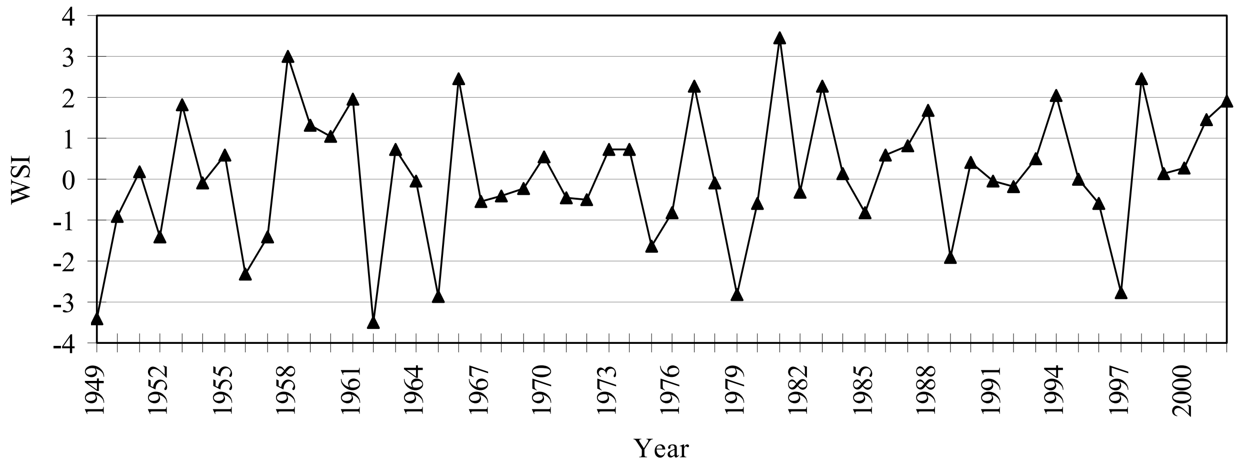

Fig. 6. Winter Severity Index (WSI) for elk on the Northern Range, Yellowstone National Park, 1949-2002. WSI values of 3 to 4 indicate very mild winters, 0 average, and –3 to –4 very severe winters.

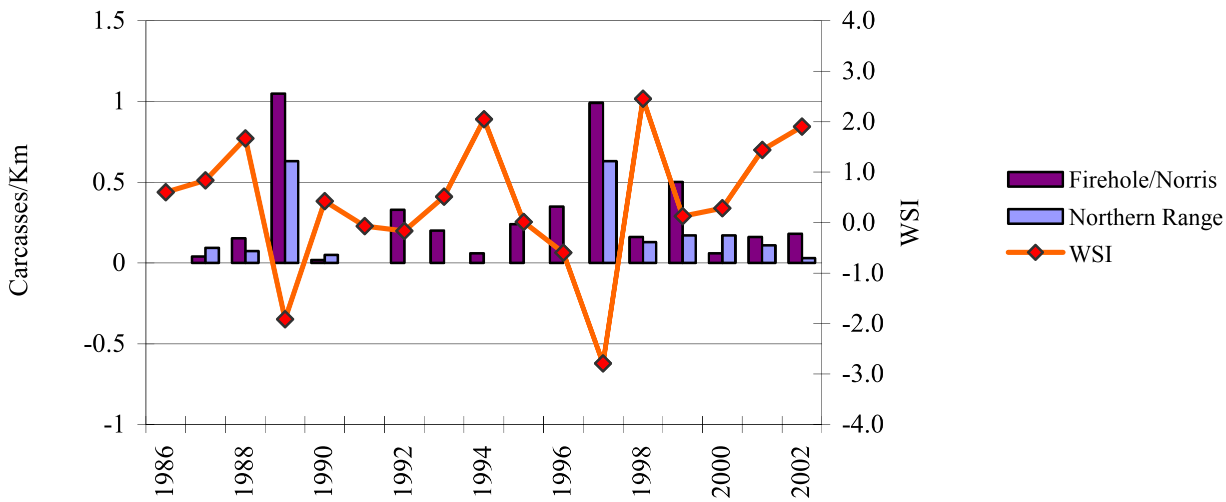

Fig. 7. Winter Severity Index (WSI) derived for elk on the Northern Range and ungulate carcasses/km along transects in 2 survey areas, Yellowstone National Park, 1986-2002.

Grizzly Bear Use of Insect Aggregation Sites Documented from Aerial Telemetry and Observations *(Dan Bjornlie, Wyoming Game and Fish Department; and Mark A. Haroldson, Interagency Grizzly Bear Study Team)*

Army cutworm moths were first recognized as an important food source for grizzly bears in the GYE during the mid 1980s (Mattson et al. 1991*b*, French et al. 1994). Early observations indicated 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. Such areas are referred to as "insect aggregation sites." Since their discovery, numerous bears have been counted on or near these aggregation sites due to excellent sightability from a lack of trees and simultaneous use by multiple bears.

Complete tabulation of grizzly presence at insect sites is nearly impossible. Not all observations of bears feeding at insect aggregation sites are specifically recorded as such, and the boundaries of sites are not clearly defined. It may be possible that size and location of insect aggregation sites fluctuate from year to year with moth abundance.

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. The problem with this technique was that small sites were overlooked. From 1997-1999 the method for defining insect aggregation sites was to inscribe a 1-km circle around clusters of observations in which bears were seen feeding on insects in talus/scree habitats (Ternent and Haroldson 1999, 2000; Bjornlie and Haroldson 2001). This method allowed trend in bear use of moth sites to be annually monitored by recording the number of bears documented in each circle (i.e., site). A new technique was developed in 2000 based on analysis from Ternent et al. (in preparation). Using this technique, sites were delineated by buffering by 500 m only the locations of bears observed actively feeding at insect aggregation sites. The borders of the overlapping buffers at individual insect sites were dissolved to produce a single polygon for each site. These sites are identified as "confirmed" sites. Locations from the entire grizzly bear location database from 1 July through 31 October were then overlaid on these polygons and analysis was conducted. The new technique to delineate confirmed sites in 2000 substantially decreased the number of sites described compared to past years in which locations from both feeding and non-feeding bears were used. Therefore, analysis for this report is completed for all years using this new technique. Areas suspected as insect aggregation sites but dropped from the confirmed sites list using this technique, as well as sites with only 1 location of an actively feeding bear in a single year, are termed "possible" sites and will be monitored in upcoming years for locations of actively feeding bears. These sites may then be added to the confirmed sites list. When possible sites are changed to confirmed sites, analysis is done on all data back to 1986 to determine the historic use of that site. Therefore, the number of bears using moth sites in past years may change as new sites are added, and data from this annual report may not match that of past reports. In addition, as new actively feeding bear locations are added to 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.

Monitoring bear presence within the unique boundary of each insect site would be more desirable than defining a site by a buffer based on bear locations, but it is not possible because the location of each unique boundary is presently unknown. In fact, only a few sites have been investigated by ground reconnaissance. Besides monitoring trend in use each year, ongoing research is also attempting to answer other questions, such as where do migrating moths originate and what are the implications for bears from agricultural moth control efforts (see pages 37-40 of this report).

Six possible sites were reclassified as confirmed sites in 2002 due to additional active feeding locations at those sites. In addition, 2 new confirmed sites were delineated from multiple locations of actively feeding bears. Single locations of feeding bears on 2 other sites resulted in the classification of 2 new possible sites in 2002. Some previously known sites were also combined into 1 site because locations from 2002 demonstrated that they were 1 large site without topographical isolation between them. Therefore, a combination of new possible sites, new confirmed sites, changes from possible to confirmed, and grouping some sites into 1, produced 32 confirmed sites and 18 possible sites for 2002. The percentage of confirmed sites with documented use by bears changes from year to year, suggesting that some years are better moth years than others (Fig. 8). For example, the years 1993-1994 were probably poor moth years because the percentage of confirmed sites used by bears (Fig. 8) and the number of observations recorded at insect sites (Table 16) were low. These years also had more nuisance management activity than other years (Gunther et al. 2001). The number of insect aggregation sites used by bears in 2002 compared to 2001 increased from 20 to 28 and was above the 5-year average of 19 sites/year from 1997-2001. The percentage of total confirmed sites used also increased markedly in 2002 (Fig. 8), suggesting that grizzly bear use of insect aggregation sites in 2002 was above average. There were 3 locations recorded on 3 possible sites in 2002.

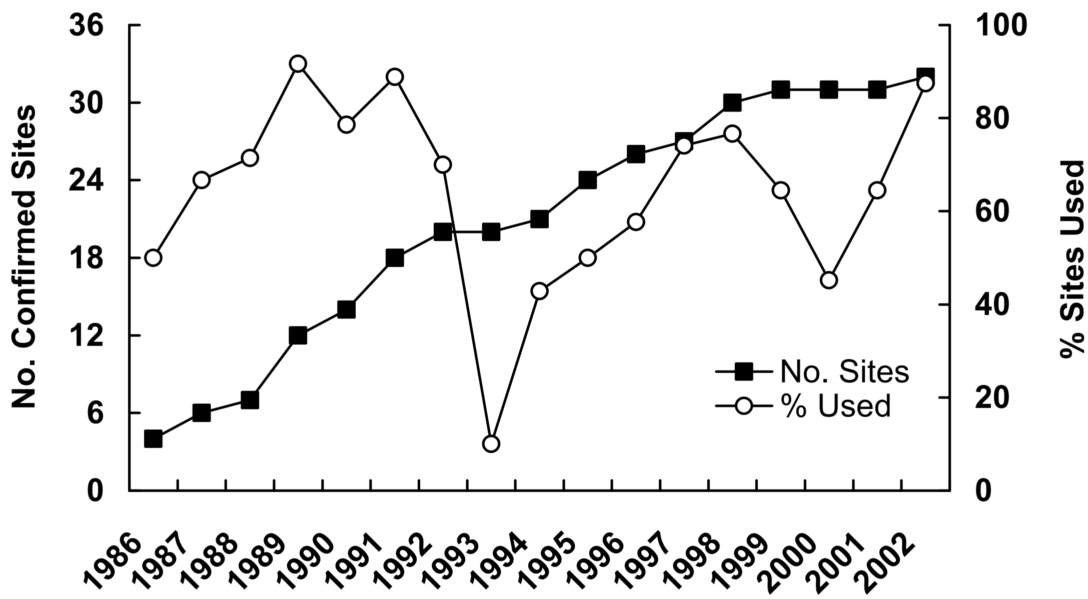

Fig. 8. Annual number of confirmed moth sites and percent of those sites at which either telemetry relocations of marked bears or visual observations of unmarked bears were recorded, Greater Yellowstone Ecosystem, 1986-2002.

Table 16. The number of confirmed moth sites in the Greater Yellowstone Ecosystem annually, the number actually used by bears, and the total number of telemetry relocations or aerial observations of bears recorded at each site during 1986-2002.

Year	Number of confirmed moth sites[a]	Number of sites used[b]	Number of locations or observations[c]
1986	4	2	10
1987	6	4	15
1988	7	5	43
1989	12	11	48
1990	14	11	77
1991	18	16	171
1992	20	14	98
1993	20	2	2
1994	21	9	22
1995	24	12	30
1996	26	15	70
1997	27	20	80
1998	30	23	164
1999	31	20	165
2000	31	14	105
2001	31	20	131
2002	32	28	253
Total			1,484

[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 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 that year.

[c] May include replicate sightings or telemetry relocations.

The IGBST maintains an annual list of unduplicated females observed with COY (see Table 4). Since 1986, when moth sites were initially included in aerial observation surveys, 467 initial sightings of unduplicated females with COY have been recorded, of which 103 (22%) have occurred at (within 500 m, n = 75) or near (within 1,500 m, n = 28) moth sites (Table 17). Notably, peaks in the number of initial sightings recorded at moth sites correspond with annual trends in the total number of locations (Table 17) and the percent of moth sites with documented use (Fig. 8). In 2002, 25.0% (13 of 52) of sightings of unduplicated females with COY were recorded at moth sites. This was higher than the 5-year average of 17.2% from 1997-2001.

Survey flights at insect aggregation sites obviously contribute to the count of unduplicated females with COY; however, it typically is low, ranging from 0 to 17 initial sightings/year since 1986 (Table 17). If these sightings are excluded, an increasing trend in the annual number of unduplicated sightings of female with COY is still evident, suggesting that factors other than observation effort at moth aggregation sites are responsible for increased sightings of females with cubs.

Table 17. Number of initial sightings of unduplicated females with cubs-of-the-year (COY) that occurred on or near moth sites, number of sites where such sightings were documented, and the mean number of sightings per site in the Greater Yellowstone Ecosystem (GYE), 1986-2002.

Year	Total GYE count of unduplicated females with COY[a]	Number of moth sites with an initial sighting[b]	Initial sightings: Within 500 m[b] *N*	Initial sightings: Within 500 m[b] %	Initial sightings: Within 1,500 m[c] *N*	Initial sightings: Within 1,500 m[c] %
1986	25	0	0	0.0	1	4.0
1987	13	0	0	0.0	0	0.0
1988	19	1	2	10.5	2	10.5
1989	16	1	1	6.3	1	6.3
1990	25	2	2	8.0	2	8.0
1991	24	8	9	37.5	13	54.2
1992	25	6	7	28.0	10	40.0
1993	20	2	2	10.0	2	10.0
1994	20	2	4	20.0	5	25.0
1995	17	1	1	5.9	2	11.8
1996	33	4	4	12.1	8	24.2
1997	31	4	7	22.6	8	25.8
1998	35	4	5	14.3	9	25.7
1999	33	4	7	21.2	8	24.2
2000	37	5	5	13.5	9	24.3
2001	42	4	6	14.3	6	14.3
2002	52	11	15	28.8	17	32.7
Total	467		77		103	
Mean	27.5	3.5	4.5	14.9	6.1	20.1

[a] Initial sightings of unduplicated females with COY; see Table 4.
[b] Moth site is defined as a 500-m buffer drawn around a cluster of observations of bears actively feeding. Thirty-two sites have been identified as of 2002.
[c] This distance is 3 times what is defined as a moth site for this analysis, since some observations could be made of bears traveling to and from moth sites.

The Ecological Relationship between a Rocky Mountain Threatened Species and a Great Plains Agricultural Pest *(Hillary Robison, Ph.D. candidate, University of Nevada, Reno)*

Project Summary

Army cutworm moth (ACMs) adults migrate from Great Plains agricultural areas to the Rocky Mountains and aggregate in high elevation talus slopes. These ACM aggregations provide an important food resource for grizzly bears. Much is known about the agricultural aspect of the life history of ACMs. However, relatively little is known about their alpine and migratory ecology and their population genetics.

This study was designed to understand how ACM ecology and population genetics might impact grizzly bear conservation in the GYE. Fieldwork was conducted in high elevation areas from late June through September and in low elevation areas from August through October in 1999, 2000, and 2001.

This study addresses the following: the scale at which ACMs migrate to high elevation areas; whether ACMs harbor pesticides which could biomagnify in bears; and determining sites where moths may aggregate and bears may feed on moths based on characteristics of known sites. The results of this study will provide groundwork for further investigations of the affects of moth variability and abundance on grizzly bear fecundity and mortality, as well as, provide insights to biologists that may help them make management decisions.

Background and Significance

A link between army cutworm moth migration and grizzly bear conservation – Grizzly bears were first found feeding on ACMs aggregated in talus slopes in the Mission Mountains in 1952 (Chapman et al. 1955). Since this discovery, grizzly bears have been observed feeding on ACMs at several high elevation sites in Montana and Wyoming (Craighead et al. 1982, Servheen 1983, Mattson et al. 1991*b*, French et al. 1994, O'Brien and Lindzey 1994, White 1996).

ACMs are an important summer and fall food source for grizzly bears. Grizzly bears excavate the moths from the talus and consume them by the thousands from July through September (Pruess 1967, Chapman et al. 1955, Mattson et al. 1991*b*, French et al. 1994, White 1996). When compared to other food sources in the GYE, ACMs are the highest source of digestible energy available to grizzly bears (Mealey 1975, Pritchard and Robbins 1990, French et al. 1994, Craighead et al. 1995, White 1996). Over a 30-day period, a grizzly bear feeding extensively on ACMs can consume 47% of its annual energy budget (White 1996).

When ACMs and whitebark pine nuts (WBPNs) are abundant in the fall, grizzly bears move to high elevations to forage on these rich food sources and in doing so the bears geographically separate themselves from areas of human activity. Due to this geographic separation, fewer grizzly bear management situations and grizzly bear mortalities are recorded during years when WBPNs and ACMs are abundant or present than during years when they are scarce or absent (Gunther et al. 1993, 1994, 1995, 1996, 1997). WBPN abundance positively correlates with increased grizzly bear fecundity (Mattson et al. 1992). Cyclic crashes in the WBPN crop and damage to whitebark pine from white pine blister rust (*Cronartium ribicola*) increase the importance of understanding the factors influencing ACM presence and abundance at grizzly bear foraging sites.

In 1991 and 1992, researchers estimated that an average of 44% of GYE grizzly bears foraged at ACM aggregation sites in the Absaroka Mountains and that female grizzly bears comprised 40% of these bears (O'Brien and Lindzey 1994).

Female grizzly bear survivorship and reproduction is important to grizzly bear population persistence (Bunnell and Tait 1981, Eberhardt 1990, Craighead and Vyse 1996). Female reproduction depends on adequate pre-hibernation weight gain and fat deposition (Rogers 1987) and is influenced by the quantity and quality of available food (Stringham 1990, McLellan 1994).

The goal of the Endangered Species Act is to recover species and ensure their persistence through time. ACMs and WBPNs are likely important to grizzly bear recovery in the GYE because presence and abundance of these foods influences grizzly bear survival, reproduction and, in turn, persistence.

Biology of the army cutworm moth – The ACM is native to North America and ranges from California to Kansas and from Alberta, Canada to New Mexico. When agriculture began to dominate ACM habitat at the turn of the 20th century, the ACM became an agricultural pest. Adult moths lay their eggs in loose soil in the fall (Strickland 1916, Burton et al. 1980), and the larvae feed on emergent plants (e.g., small grains, alfalfa, and sugar beets) until early winter. During winter, the larvae develop underground. The adult moths emerge in May and migrate to high-elevation talus slopes in the Rocky Mountains (Pruess 1967). Once ACMs reach the mountains, they remain there from July through September and forage on alpine flower nectar at night (Pruess 1967, French et al. 1994) and hide in talus during the day (Pruess 1967, French et al. 1994, O'Brien and Lindzey 1994, White 1996). From late August through the beginning of October, the moths migrate back to the Great Plains and oviposit into soil (Pruess 1967, Burton et al. 1980).

Project Objectives

The main objectives of this study are to determine the scale of ACM origins and, hence, the scale at which factors may influence ACM migration to high elevation areas where they are fed on by bears; to determine whether ACMs harbor pesticides which could biomagnify in bears; and to identify sites where moths may aggregate and bears may feed on moths based on characteristics of known sites.

Determining the scale of ACM origins and if ACMs exhibit site fidelity is important because pressures on ACMs in natal areas, whether natural (e.g., weather patterns) or human-caused (e.g., pesticides or habitat loss), may affect moth recruitment and the numbers of adults reaching high-elevation sites used by bears.

Genetic techniques can be used to determine the origins of species and to differentiate populations (Queller et al. 1993, Estoup et al. 1995, Garcìa-Moreno et al. 1996, Rankin-Baransky et al. 1997, Bolten et al. 1997, Palsboll et al. 1997, Eldridge et al. 2001). Because ACMs are small, extremely wide-ranging insects that are not amenable to physical tagging, genetic techniques are well-suited to determining the scale of their origins.

The results of this study will provide groundwork for further investigations of the affects of moth variability and abundance on grizzly bear fecundity and mortality, as well as, provide insights to biologists that may help them make management decisions.

Work in Progress

Field sampling – high elevation – From mid-July through September 1999-2001 crews used black-light traps at moth aggregation sites to collect ACMs for genetic and pesticide analyses.

ACMs were collected from 6, 9, and 5 sites in 1999, 2000, and 2001, respectively. In total, ACMs were collected from 11 different high-elevation sites, including 9 sites in Wyoming, 1 site in Washington, and 1 site in New Mexico.

Field sampling – low elevation – In the late summer and early fall, field crews trapped ACMs with pheromone traps in agricultural lands in Wyoming and Idaho. These efforts were coordinated with the ACM trapping programs of university agricultural extension services in Nebraska, Montana, and South Dakota who sent ACM samples.

Fifteen sites were sampled in 1999 and were re-sampled along with 24 new sites in 2000. All 39 sites were re-sampled in 2001 along with 2 new sites. The sampling effort was expanded in 2000 and 2001 in order to sample a 360-degree radius around the high-elevation study areas.

Laboratory procedures

All ACM samples collected for pesticide residue analysis in 1999 were sent to the USGS-Columbia Environmental Research Center laboratory in Missouri. The lab found only non-significant traces of pesticides in the samples. ACMs were not collected for pesticide residue analysis during the 2000 field season. In Winter 2000, a question arose as to whether the method used in 1999 was sensitive enough to detect traces of certain pesticides in the ACMs. In 2001, I submitted a sample of ACMs to the Montana State University-Bozeman Analytical Laboratory for a different type of pesticide screening process; this sample came back negative for traces of pesticides.

The genetic data are being analyzed in the Laboratory for Ecological and Evolutionary Genetics and the Nevada Genomics Center at the University of Nevada, Reno. Each of the several thousand moths that have been collected must be individually keyed to species, and the DNA of moths identified as ACMs is extracted. Small-scale DNA extractions began when funds became available in May 2000, and larger-scale extractions began after lab help became available in March 2001. A genomic DNA library was developed for the ACM in January 2001. To date, 310 sequences have been screened from this library; 4 of these sequences are microsatellite loci. Polymerase chain reactions (PCRs) have been perfected for 1 of the 4 loci and PCRs are currently being perfected for the remaining 3 loci. Sixteen new loci have been recently identified and PCR primers have been designed to amplify them. Analysis of the variability at the loci is performed using an Applied Biosystems (ABI) 3700 and an ABI 3730 microsatellite fragment analysis machine and GeneScan and GeneMapper software. Because the genetic data will be influenced by when and where ACMs mate, I am inspecting female ACMs to determine their reproductive status.

Project products

The results of this research will be written in manuscript form and submitted to several peer-reviewed journals. A Ph.D. dissertation will be submitted to the University of Nevada, Reno and research results will be presented in a public defense.

Funding sources

Rob and Bessie Welder Wildlife Foundation, Yellowstone Park Foundation, International Bear Association – Bevins Fund, The Wyoming Chapter of the Wildlife Society Memorial Bear Fund, Sigma Xi, American Museum of Natural History, U.S. Forest Service Region 1, Yellowstone National Park Bear Management Office (YNP-BMO), Interagency Grizzly Bear Study Team (IGBST), and the Wyoming Game and Fish Department (WGFD).

Cooperators

IGBST, YNP-BMO; U.S. Forest Service Region 1; Montana State University, Bozeman Agricultural Extension Agents; and the WGFD.

Whitebark Pine Cone Production *(Mark A. Haroldson and Shannon Podruzny, Interagency Grizzly Bear Study Team, Roy Renkin, Yellowstone National Park)*

Whitebark pine cone production averaged 2.4 cones/tree on 19 transects during 2002 (Table 18). Cone production was poor throughout most of the ecosystem (Fig. 9). Exceptions were transects F and R on the Gallatin National Forest in the northwestern portion of the ecosystem (Fig. 9). Transect results were consistent with qualitative reports by observers throughout the ecosystem, i.e. poor cone production overall. Mean annual cone production during 1980-2002 is presented in Fig. 10.

Table 18. Summary statistics for the 2002 whitebark pine cone production transects in the Greater Yellowstone Ecosystem.

Total			Trees				Transect			
Cones	Trees	Transects	Mean cones	SD	Min	Max	Mean cones	SD	Min	Max
465	190	19	2.4	12	0	142	24.5	58.8	0	252

Nearly exclusive use of whitebark pine seeds occurs during years in which mean cone production on transects exceeds 20 cones/tree (Blanchard 1990, Mattson et al. 1992). During years of low whitebark pine seed availability, grizzly bears range wider and seek alternate foods, which often brings them in close proximity to human activities during the fall. This may result in an increase in the number of management captures and transports and human-caused mortality. During August-October of 2002, 11 management captures involving bears 2-years of age or older (independent) resulted in 8 transports and 3 removals of nuisance individuals (Fig. 10).

Whitebark pine stands in portions of the GYE, especially Yellowstone National Park, are infected with mountain pine beetle (*Dendroctonus ponderosae).* The last recorded beetle irruption in the GYE was during the 1930s. Except for the Pitchstone Plateau, all of the high-elevation mountain ranges and plateaus supporting an overstory of whitebark pine show some level of mountain pine beetle activity. Intensities are greatest in the southeast quadrant of the park, where large continuous tracts of red-needled whitebark pine were repeatedly observed on the Two Ocean Plateau and in the Absaroka Range along the park boundary. Similar intensities of pine beetle activity are evident to the south and east of the park boundary (L. Koch, Wyoming State Division of Forestry, personal communication). Cumulative drought stress on whitebark pine trees may be the responsible for the increased susceptibility to beetle activity (D. Six, University of Montana, personal communication). Mountain pine beetle activity represents an immediate and serious threat to whitebark pine stand in the GYE because tree mortality is very high. We will continue to monitor mountain pine beetle activity.

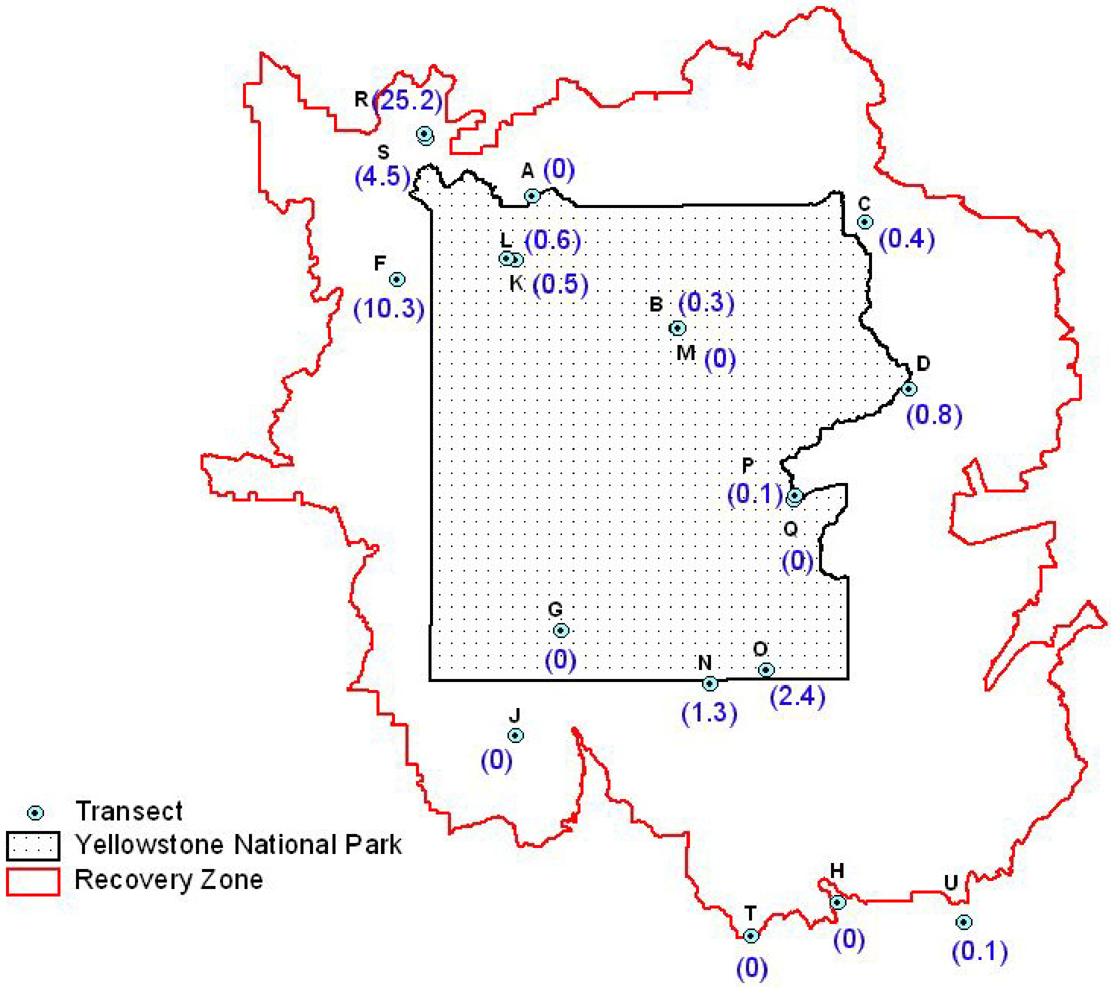

Fig. 9. Average whitebark pine cones/tree (in parentheses) on 19 transects monitored during 2002 in the Greater Yellowstone Ecosystem. Each transect consists of 10 trees.

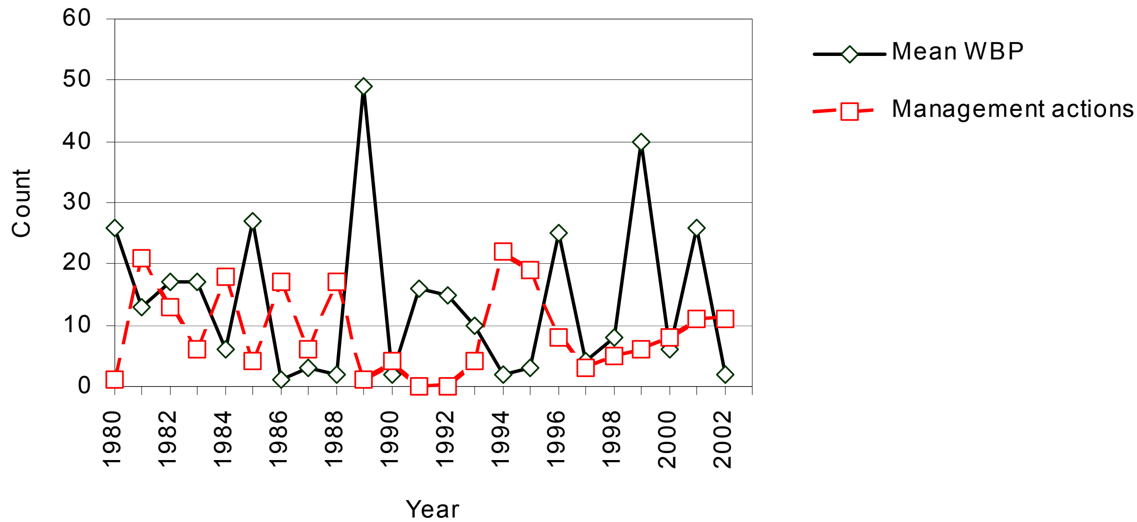

Fig. 10. Mean whitebark pine cone production and the number of August through October management actions of grizzly bears older than yearlings in the Greater Yellowstone Ecosystem, 1980-2002.

Grizzly Bear Body Composition *(Charles C. Schwartz, Mark A. Haroldson, and Chad Dickinson, Interagency Grizzly Bear Study Team)*

Studies of the nutritional ecology of the Yellowstone grizzly bear have focused mainly on food habits (Mattson et al 1991*a*, Mattson and Reinhart 1995, Mattson 1997). However, because certain foods like meat and fish are highly digestible, identification of undigested food items from scats can be biased. Poorly digested foods like plants are over represented in the feces whereas highly digestible foods are underrepresented. Fecal correction factors can improve upon quantification of forage items (Hewitt and Robbins 1996), but one cannot determine the contributions of dietary components to the energetics of individuals.

Body mass and composition are good indicators of reproductive potential in bears (Rogers 1976, Blanchard 1987, Hilderbrand et al. 1999). In habitats with abundant food resources, age at first reproduction and reproductive interval are reduced, and litter size is large relative to poor habitats (Stringham 1990). Information detailing the body composition of bears can thus provide important ecological insight into the nutritional ecology of individuals and ultimately the population.

Farley and Robbins (1994) developed the method of utilizing bioelectrical impedance analysis (BIA) to accurately predict body composition of bears. The technique is simple, and provides relatively accurate results. We used the BIA technique as detailed by Hilderbrand et al. (1998) to measure body composition in grizzly bears in the GYE.

We began collecting body composition data for captured grizzly bears in May 2000. We purchased additional equipment for the state of Wyoming in 2001 to increase sample sizes. During the past 3 years, we have obtained 80 body condition measurements, with 72 from bears randomly captured at research trap sites and 8 from targeted problem bears at management trap sites. We illustrate change in body condition for a sample of female bears (Fig. 11). Results clearly show increased body condition with time. We will continue to collect additional samples from captured bears and build our database for future analyses.

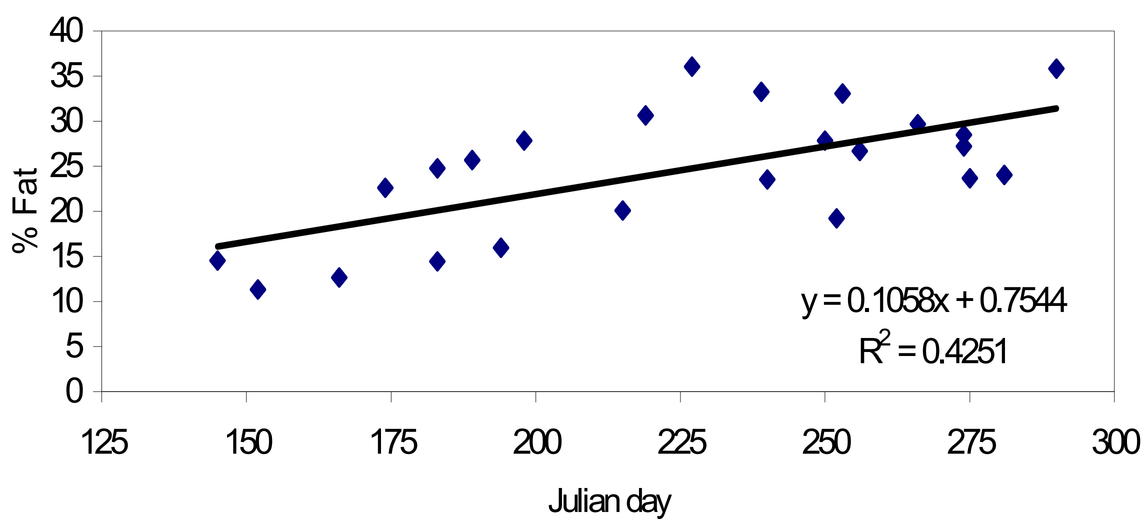

Fig. 11. Body fat determinations for 24 female grizzly bears from the Greater Yellowstone Ecosystem, 2000-2002. Julian date (jday) 121 = 1 May, whereas jday 280 = 7 October.

Habitat Monitoring

Grand Teton National Park Recreational Use *(Steve Cain, Grand Teton National Park)*

In 2002, total visitation in Grand Teton National Park was 3,987,584 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 2,612,109. Backcountry user nights totaled 32,723. Long-term trends of total visitation and backcountry user nights by decade are shown in Table 19.

Table 19. Average annual visitation and average annual backcountry use nights in Grand Teton National Park by decade from 1951 through 2002.

Decade	Average annual parkwide 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[b]	2,579,279	32,585

[a] In 1983 a change in the method of calculation for parkwide visitation resulted in decreased numbers. Another such change in 1992 increased numbers. Thus, parkwide visitation data for the 1980s and 1990s are not strictly comparable.
[b] Data for 2000-2002 only.

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

In 2002, 2,983,051 people visited Yellowstone National Park. These visitors spent 564,132 use nights camping in developed area roadside campgrounds and 43,590 use nights camping in backcountry campsites. Average annual park visitation increased each decade from an average of 333,835 visitors/year in the 1930s to an average of 3,023,916 visitors/year in the 1990s (Table 20). Average annual park visitation has decreased slightly the first 3 years (2000-2002) of the current decade, to an average of 2,859,937 visitors/year. Average annual backcountry use nights have been less variable between decades than total park visitation, ranging from 39,280 to 47,395 use nights/year (Table 20). The number of backcountry use nights is limited by both the number and capacity of designated backcountry campsites in the park.

Table 20. Average annual visitation, auto campground use nights, and backcountry use nights in Yellowstone National Park by decade from 1931 through 2002.

Decade	Average annual parkwide visitation	Average annual auto campground use nights	Average annual backcountry use nights
1931-39	333,835	82,331[a]	Data not available
1940s	552,227	139,659[b]	Data not available
1950s	1,355,559	331,360	Data not available
1960s	1,958,924	681,303[c]	Data not available
1970s	2,243,737	686,594[d]	47,395[e]
1980s	2,381,258	656,093	39,280
1990s	3,023,916	690,044	43,702
2000s[f]	2,859,937	626,901	42,120

[a] Data from 1930-1934.
[b] Average does not include data from 1940 and 1942.
[c] Data from 1960-1964.
[d] Data from 1975-1979.
[e] Backcountry use data available for the years 1973-1979.
[f] Data for the years 2000-2002 only.

Trends in Elk Hunter Numbers within the Grizzly Bear Recovery Zone plus the 10-mile Perimeter Area *(Dave Moody, Wyoming Game and Fish Department; Lauri Hanauska-Brown, Idaho Department of Fish and Game; and Kurt Alt, Montana Department of Fish, Wildlife and Parks)*

The State wildlife agencies in Idaho, Montana, and Wyoming annually estimate the number of people hunting most major game species. We used state estimates for the number of elk hunters by hunt area as an index of hunter numbers for the Grizzly Bear Recovery Zone plus the10-mile perimeter area. Because some hunt area boundaries did not conform exactly to the Recovery Zone and 10-mile perimeter area, field personnel familiar with each area were queried to estimate hunter numbers within the Recovery Zone plus the 10-mile perimeter area. Elk hunters were used because they represent the largest cohort of hunters for individual species. While there are sheep, moose, and deer hunters using the Recovery Zone and 10-mile perimeter area, their numbers are small and many hunt in conjunction with elk, especially in Wyoming, where seasons overlap. Elk hunter numbers represent a reasonably accurate index of total hunter numbers within areas occupied by grizzly bears in the GYE.

We generated a complete data set from Idaho and Wyoming from 1992 to 2002 (Table 21); statistics for Montana were not available. Elk hunter numbers decreased from a low of 39,048 in 1992 to 37,429 in 1996, a fluctuation of less than 5%. This trend primarily reflects reduced seasons beginning in the mid 1990s as elk populations stabilized following several years of high harvest in the late 1980s and early 1990s. Hunter numbers in Idaho have fluctuated less than 20% over the last ten years. Hunter numbers in Wyoming have decreased approximately 4,000 over the same time period. Hunter numbers in Montana fluctuated slightly from 1992 through 1996; no data have been available for Montana since 1996.

Table 21. Estimated numbers of elk hunters within the Grizzly Bear Recovery Zone plus a 10-mile perimeter in Idaho, Montana, and Wyoming for the years 1992-2002.

	Year										
State	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Idaho[a]	2,573	2,962	2,682	2,366	3,102	2,869	2,785	2,883	[b]	2,914	3,262
Montana	19,321	18,238	20,042	18,783	18,044	[b]	[b]	[b]	[b]	[b]	[b]
Wyoming	17,154	17,105	17,053	17,464	16,283	17,458	15,439	15,727	12,812	13,591	13,709
Total	39,048	38,305	39,777	38,613	37,429						

[a] Idaho has recalculated hunter numbers. As such, they differ from previous reports.
[b] Hunter number estimates not currently available.

Effects of Wildfire on Vegetal Grizzly Bear Foods in the Greater Yellowstone Ecosystem
(*Shannon R. Podruzny, Interagency Grizzly Bear Study Team; Kerry Gunther and Darren Ireland, Yellowstone National Park; and Charles C. Schwartz, Interagency Grizzly Bear Study Team*)

<u>Background</u>

Wildfire is a complex and active component of the GYE (Houston 1973, Romme 1982, Greater Yellowstone Coordinating Committee [GYCC] 1988, Romme and Despain 1989, Despain 1990, Marston and Anderson 1991, Turner et al. 1997, Turner et al. 1999). Fire frequency and severity affect landscape pattern and diversity by influencing postfire variation in forest structure and in the relative abundances of forbs, graminoids, and shrubs (Romme 1982, Despain 1990, Turner et al. 1999). Natural, historical fire return intervals in Yellowstone range from 20-25 years for shrub and grasslands in the Northern Range (Houston 1973) to 300 years or more for lodgepole pine (*Pinus contorta*) forests on the central plateau (Romme 1982, Romme and Despain 1989) and subalpine whitebark pine stands. Widespread fires occurred in 1988, burning approximately 12% of the 4.8 million-ha GYE (Schullery 1989).

Individual plant species in the ecosystem have specific relationships with fire (Despain 1990, Tomback et al. 1993, Wamboldt et al. 2001). Serotinous lodgepole pine cones require the heat of fire to open and release their seeds (Clements 1910, Habeck and Mutch 1973). Patches of dense lodgepole pine may persist within Yellowstone's burned landscape for decades (Turner et al. 1999). The persistence of whitebark pine across its range may depend upon stand replacement fires (Morgan and Bunting 1990). These fires create forest openings that are used by Clark's nutcracker (*Nucifraga columbiana*) for caching whitebark pine seeds (Tomback et al. 1993). Less-severe fires in the whitebark pine zone reduce competition from climax species such as subalpine fir (*Abies lasiocarpa*; Kendall and Arno 1990, Morgan and Bunting 1990). Because whitebark pine matures very slowly, stand replacement fires also remove significant amounts of seed available for wildlife for 100 years or more (Kendall and Arno 1990). The effects of fire on meadow, shrub, and forest understory communities are less well-understood (Houston 1973, Turner et al. 1999).

The IGBST began collecting information on Yellowstone grizzly bear habitat use and feeding activities in 1974 (Knight et al. 1984, Mattson et al. 1991*a*). Primary methods for collecting these data included site visits to radio-relocations of collared bears and analysis of scat samples collected en route to radio-relocations (Knight et al. 1984, Blanchard 1985, Mattson et al. 1991*a*).

The widespread fires of 1988 occurred within the core of grizzly bear habitat; canopy burns covered approximately 17% of the Yellowstone Grizzly Bear Recovery Zone (USFWS 1993). Fires may affect food items in a variety of ways. Forbs and grasses may respond immediately after fires with a flush of production (Houston 1973, Turner et al. 1999, Wamboldt et al. 2001). Growing tree and shrub seedlings may later shade these plants out. Root crops (*Lomatium* spp. and *Perideridia gairderni*) may be enhanced or harmed by fire. Berry-producing shrubs in western Montana may flourish with the removal of canopy cover (Martin 1983, Zager et al. 1983, Holland 1986,), however Turner et al. (1999) suggested that shrubs in Yellowstone, primarily *Vaccinium scoparium*, might recover slowly following severe burns. While whitebark pine populations may benefit from the fires in the long-term, 28% of the mature, seed-producing trees in Yellowstone National Park were burned in 1988 and therefore removed both as seed source for regeneration and as a food source for bears into the next century (Kendall and Arno 1990, Renkin and Despain 1992).

During the field season immediately following the 1988 fires, IGBST field crews attempted to revisit 501 aerial radio-relocations of female grizzly bears originally field-sampled during 1978-1988 (Fig. 12). Crews documented site characteristics including distance to forest edge and burn intensity, as well as information regarding the abundance, cover, and growth stages of vegetal bear foods at the site. Fifty-six percent of the revisited locations were unburned, 206 sites were burned, and 22 sites could not be located. The sampled sites included the range of forested and non-forested habitat types used by bears in the core of the ecosystem. It is important to note that these revisits monitored the immediate effects of fire.

Data collected through multiple visits to bear-used locations postfire can be used to model changes in food abundance against time since disturbance. Abundance curves should be developed relative to habitat types, successional changes, and fire cycles in the ecosystem. These models can be used in decision support systems to provide estimates of abundance of bear foods following various management prescriptions. Because of the effects of invasive species on whitebark pine (Kendall and Arno 1990) and cutthroat trout (Schullery and Varley 1996) and of human and other large predators on ungulate populations, the future availabilities of these foods are not guaranteed. In the absence of any of these major food sources, vegetal foods would become even more important to the survival of the grizzly bear. As fire is the primary source of disturbance for most bear food plants in the GYE, knowledge of the responses of these species over time to fire will help land managers to understand how fire management activities may affect grizzly bears.

Objective

The objective of this study was to evaluate the potential of developing measures of change in bear foods post-succession by revisiting a sample of the original sites sampled following the 1988 fires.

2002 Field Season

Crews re-visited a random sample of 55 of the original 479 points and repeated the original sampling methods as detailed in Blanchard (1985) and Mattson et al. (1991*a*). Investigators recorded comprehensive information including physical site characteristics, climax habitat type, successional stage, heights of shrub and herbaceous plants, abundance of bear foods, and evidence of bear feeding activity. Field data have been entered into a database, are currently being analyzed.

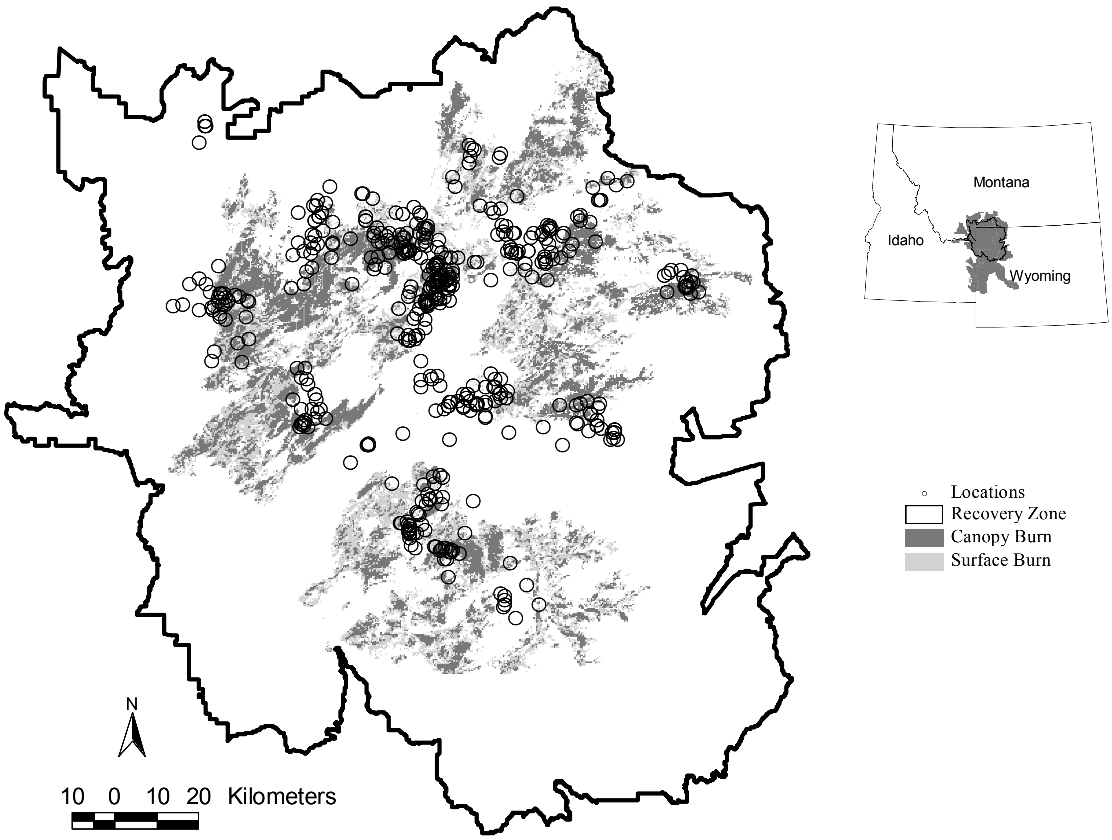

Fig. 12. Radio-relocations of female grizzly bears re-visited by Interagency Grizzly Bear Study Team personnel in the year following extensive wildfires in 1988. The 479 sites were initially examined during 1978-1988 for analysis of feeding activities. The locator map in the upper right shows the location of the study area including public land of the Greater Yellowstone Ecosystem in gray with the Yellowstone Grizzly Bear Recovery Zone outlined in black.

Habitat Partitioning by Grizzly and Black Bears in Yellowstone and Grand Teton National Parks (*Shannon Podruzny and Chuck Schwartz, Interagency Grizzly Bear Study Team*)

We used field visits in combination with VHF telemetry locations to obtain detailed information about habitat use by grizzly and black bears. The beneficial aspect of this type of approach is that it allows for determination of what a bear was actually doing at a specific radiolocation. Simple coordinates (from GPS or VHF collar locations) placed on a map tell us where a bear was present, but they yield little information about how the bear was using the landscape at that location. Site visits allow us to determine if the bear was using that particular habitat for feeding, resting, traveling, or some other activity. From this we can gain insight into the relative importance of measurable habitat variables to the life history of grizzly and black bears in the study area, and to compare spatial and temporal patterns between the species at a finer scale. Further insight into specific food resources used by bears can be gained by analyzing scats collected during field activities. While visual identification of bear species from scat is not always possible, analysis of mitochondrial DNA (mtDNA) is highly reliable for species identification.

As part of a pilot project investigating ecological relationships between grizzly and black bears, habitat crews visited radiolocations of both species in Grand Teton National Park (GTNP), May-October 2002. We investigated 81 radiolocations of 11 grizzlies and 16 black bears in GTNP and the adjacent Bridger-Teton National Forest (BTNF). We collected 50 scats for mtDNA and food habits analysis. We surveyed 42 plots at random locations to allow comparisons with "available" habitat and to determine if we were detecting activity at radiolocations at a rate different from what we would find at randomly selected sites.

Following recommendations from the previous field season (Podruzny and Schwartz 2002), we used a GPS to navigate to randomly selected radiolocations. Sites were visited within a maximum of 2 weeks after the flight. At the location coordinates, we searched thoroughly for any evidence of feeding or other activity. If activity was found, we centered a sample plot of approximately 30 m diameter where the activity was most concentrated. If no evidence of activity was found, we centered the plot on the radiolocation. Plots were inventoried using methods adapted from Mattson et al. (1991*a*). The habitat plots provided detailed ecological information about places where bears were located. We recorded physical site characteristics (e.g., slope, aspect, elevation, topographical position [e.g., ridge or mid-slope], GPS location of plot center). We recorded general habitat characteristics including: climax habitat type (Steele et al. 1983), successional stage (Despain 1990), estimates of vegetal cover (i.e., graminoids, forbs, shrubs, and woody material) using point-line transects, a standard variable radius timber plot, percent forest cover using concave spherical densiometers, average heights of foliage and shrubs, recent wildfire history, and distance to forest edge. The methodology for point line transects was as follows: percent cover for each vegetation class determined as percentage of types recorded at 1-m intervals along 4 10-m tapes laid out in the cardinal directions from plot center. On plots with evidence of use by bears we used 10 100-cm^2 Daubenmire quadrats (Daubenmire 1959) placed a regular intervals along the point-line transects to estimate percent cover, abundance category, and phenology of individual vegetal food items. We recorded types of feeding activity and intensity of use. Non-feeding sign including day beds, rub trees, dens, and scats were also measured and recorded. We collected all bear scats that appeared to be <1 week old. Scats were collected at plot locations as well as when en route to and from locations. Approximately 10 ml of each scat was stored in ethanol for later mtDNA analysis.

We found evidence of feeding activity at 23.5% of the radiolocations visited. Four grizzly bear locations had evidence of feeding on insects, 1 of those locations was also associated with feeding on a moose carcass. Of the 15 black bear locations with evidence of feeding activity: 12 included feeding on insects, 4 feeding on berries (*Vaccinium* spp., *Shepherdia canadensis*), and 1 elk calf predation. Nine of the 42 (21.4%) random locations had recent evidence of bears' feeding on insects. Non-feeding sign found at locations included tracks, scats, day beds, rub-trees, and dropped radio-collars. Three grizzly bear and 8 black bear locations had non-feeding sign present. We found no non-feeding sign at the random locations. Food habits analysis has been performed on all scats collected, but we are still awaiting the results of the mtDNA species determination.

Difficulties with our methods during the field season of 2002 were again mainly related to lack of success in finding sign at radiolocations. We found evidence of any activity on only 32.1% of radiolocations. We also found sign at 21.4% of random locations. One plausible explanation for this lies in the precision of VHF telemetry locations. Our estimated telemetry error (IGBST unpublished data) for aerial VHF locations was approximately 300 m. Crews cannot effectively search an area of that radius (282,600 m^2 or 56 football fields) around each location. While most bears were collared with store-on-board type GPS receivers, this technology does not allow us to visit GPS-acquired locations in a real-time manner. Small sample size posed additional problems. When compared with the potential acquisition rate of roughly 5 GPS locations/bear/day, standard VHF telemetry yielded a poor location frequency of 1 location/bear/7-10 days. Utilization of GPS collars that could be remotely queried for locations would allow ground crews to visit the more accurate GPS-acquired coordinates in a reasonable timeframe. Crews may also more readily identify highly visible types of feeding activity, and less visible activities such as grazing may be underreported.

We did improve our field methods over those used in the 2001 field season (Podruzny and Schwartz 2002) in several ways. We randomized selection of sites to visit and we visited randomly located sites for comparison. Random numbers were assigned to locations as flight reports came in, and sites were visited in numeric order. This random order of visitation may have reduce our sample size due to less efficient travel patterns, but it helped to assure that distant locations were as likely to be sampled as those near access points. We increased our efficiency by not collecting the full complement of data on sites without evidence of bear use, reducing the amount of time needed to complete the plot. We also used more objective methods for determining phenology, cover, and abundance classifications of food species by using Daubenmire plots rather than ocular estimates.

We strongly recommend that future efforts include using radiocollars that would allow field crews to investigate GPS-acquired locations within a reasonable time period. Other tools that may be useful in examining habitat use include scat analysis and GIS applications. Like site visits, scat analysis may be biased towards more detectable food items. However, combining food habits analysis with site visits should provide a more complete picture of how grizzly and black bears are using the landscape. Additionally, combining information from a small sample of site visits to remotely sensed information (e.g., VHF telemetry location data, GPS location data, various map data layers) may be the most productive use of both types of data.

Grizzly Bear-Human Conflicts in the Greater Yellowstone Ecosystem

Summary of Grizzly Bear-Human Conflicts in the Greater Yellowstone Ecosystem *(Kerry A. Gunther, Yellowstone National Park; Mark T. Bruscino, Wyoming Game and Fish Department; Steve Cain, Grand Teton National Park; Lauri Hanauska-Brown, Idaho Department of Fish and Game; Kevin Frey, Montana Fish, Wildlife and Parks; Mark A. Haroldson and Charles C. Schwartz, Interagency Grizzly Bear Study Team)*

Grizzly bear-human conflicts often lead to bear mortality and also erode public support for grizzly bear conservation. By preventing grizzly bear-human conflicts, bear mortality can be reduced and public support for bears enhanced.

<u>Methods</u>

Grizzly bear management in the GYE is under the jurisdiction of 3 state agencies (Wyoming Game and Fish Department; Montana Fish, Wildlife and Parks; and Idaho Department of Fish and Game) and 2 national parks (Yellowstone and Grand Teton National Parks), each with their own unique terminology for recording bear-human conflicts. Here, we use the conflict summaries from the 3 states and 2 national parks and re-categorize the types of conflicts using standard definitions described by Gunther et al. (2000) with the minor modifications (Gunther et al. 2001). Due to the differences in terminology, the number of different types of conflicts reported in the individual agency summaries may differ from the numbers reported here in the GYE summary. By using standard definitions, causes, types, and trends of conflicts are comparable throughout the GYE, regardless of agency jurisdiction.

<u>Grizzly Bear-Human Conflicts</u>

There were 249 grizzly bear-human conflicts reported in the GYE in 2002 (Table 22, Fig. 13). These incidents included bears obtaining anthropogenic foods (52%, n = 130), killing livestock (29%, n = 71), damaging property (13%, n = 32), obtaining fruits and vegetables from gardens and orchards (4%, n = 10), and injuring people (2%, n = 6). Fifty-three percent of the conflicts occurred on public land administered by the U.S. Forest Service (47%, n = 118), National Park Service (6%, n = 14), and Bureau of Land Management (<1%, n = 1). Forty-seven percent of the conflicts occurred on private land in the states of Wyoming (37%, n = 92), Montana (10%, n = 24), and Idaho (<1%, n = 1). Fifty-five percent (n = 136) of the conflicts occurred outside and 45% (n = 113) inside of the designated Yellowstone Grizzly Bear Recovery Zone.

<u>Year 2002 Overview</u>

In 2002, there was a below-average abundance of most high-quality grizzly bear foods in the GYE. The availability of winter-killed ungulate carcasses in spring, spawning cutthroat trout during estrus, and whitebark pine seeds during late hyperphagia were all poor. Both early and late hyperphagia were characterized by severe drought conditions causing vegetal foods to desiccate early. Overall, likely due to the severe drought and poor whitebark pine seed production, the number of incidents where grizzly bears damaged property, gardens, orchards and beehives, and obtained anthropogenic foods were higher than the long-term averages recorded from 1992-2001 (Table 23). The 249 conflicts reported in 2002 was the highest number recorded since we began keeping records of conflicts in the GYE in 1992.

Table 22. Number of incidents of grizzly bear-human conflicts reported within different land ownership areas in the Greater Yellowstone Ecosystem, 2002.

Land owner[a]	Total conflicts	Human injuries	Property damages	Anthropogenic foods	Gardens/ orchards	Beehives	Livestock depredations
BLM	1	0	0	1	0	0	0
BDNF	1	0	1	0	0	0	0
BTNF	47	2	2	6	0	0	37
CNF	0	0	0	0	0	0	0
CTNF	0	0	0	0	0	0	0
GNF	18	1	5	4	0	0	8
GTNP/JDR	0	0	0	0	0	0	0
ID-private	1	0	0	1	0	0	0
ID-state	0	0	0	0	0	0	0
MT-private	24	0	4	11	9	0	0
MT-state	0	0	0	0	0	0	0
SNF	51	1	9	31	0	0	10
WY-private	92	0	7	68	1	0	16
WY-state	0	0	0	0	0	0	0
YNP	14	2	4	8	0	0	0
Total	249	6	32	130	10	0	71

[a] BLM = Bureau of Land Management, BDNF = Beaverhead-Deerlodge National Forest, BTNF = Bridger-Teton National Forest, CNF = Custer National Forest, CTNF = Caribou-Targhee National Forest, GNF = Gallatin National Forest, GTNP/JDR = Grand Teton National Park/John D. Rockefeller, Jr. Memorial Parkway, ID = Idaho, MT = Montana, SNF = Shoshone National Forest, WY = Wyoming, YNP = Yellowstone National Park.

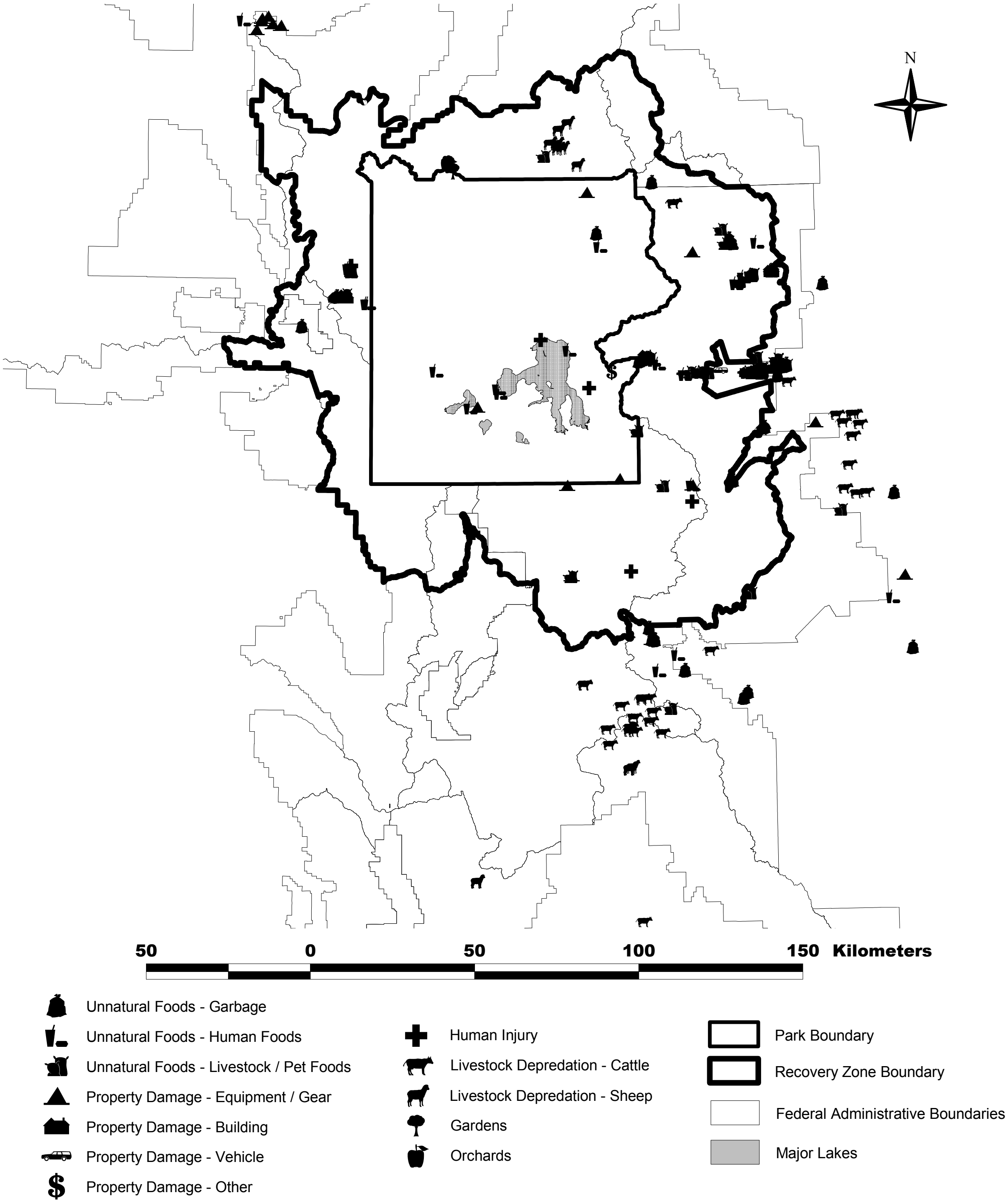

Fig. 13. Locations where incidents of grizzly bear-human conflicts were reported in the Greater Yellowstone Ecosystem, 2002.

Table 23. Number of incidents of different types of grizzly bear-human conflicts in 2002 and average number of conflicts recorded from 1992-2001 in the Greater Yellowstone Ecosystem.

Type of conflict	1992-2001 Average	2002
Human injury	4 ± 3	6
Property damage	14 ± 9	32
Anthropogenic foods	46 ± 40	130
Gardens/orchards	5 ± 3	10
Beehives	4 ± 4	0
Livestock depredations	49 ± 21	71
Total conflicts	122 ± 55	249

Geographic Areas with High Numbers of Conflicts

Most of the grizzly bear-human conflicts that occurred in 2002 occurred in 7 distinct areas of the ecosystem (Fig. 13). The 7 areas where most conflicts occurred included: 1) the North Fork of the Shoshone River where bears obtained garbage, human foods, and livestock and pet foods; 2) the Lime Creek/Fish Creek area where bears killed cattle and sheep; 3) the Meeteetse Creek/Greybull River area where bears killed cattle; 4) the upper Hellroaring area where bears killed sheep; 5) the Sunlight Creek area where bears damaged buildings and property and obtained garbage, human foods, and livestock and pet foods; 6) the South Fork of the Madison River/Horse Butte area where bears obtained garbage, human foods, and livestock and pet foods; and 7) the Cherry Creek area where bears damaged property and obtained human foods.

Grizzly Bear-Human Conflicts in Wyoming Outside of the National Park System *(Mark T. Bruscino, Wyoming Game and Fish Department)*

There were 203 human-grizzly bear conflicts in Wyoming during 2002, an increase of 8% from the number of conflicts in 2001 (n = 188), and an increase of 75% from the 1997-2001 average of 116 incidents/year. The short-term increase is attributable to dry conditions during the summer and fall, resulting in bears searching widely for foods. The long-term trend is largely attributable to an increase in bear numbers and distribution. Bears have repopulated federal lands managed for multiple uses and private lands well outside of Yellowstone National Park and the surrounding wilderness areas during the past decade. This expansion potentially increases the number of conflicts with people or their property. Encounters between people and bears are numerous each year in Wyoming. The Wyoming Game and Fish Department (WGFD) does not systematically investigate or record ordinary encounters that do not result in conflict.

Agriculture Damage

Forty-three cattle were killed or injured by grizzly bears in Wyoming during 2002, a 48% increase from losses (n = 29) in 2001, and a 5% increase from the 1997-2001 average of 41 cattle/year. Ten cattle depredations occurred on grazing allotments on the Shoshone National Forest (SNF), 16 in Bridger-Teton National Forest (BTNF), and 17 on private lands in the Cody and Dubois areas. Three male bears were captured and relocated for killing cattle on private lands and 1 was subsequently killed by management authorities after killing domestic sheep on an allotment in BTNF.

Forty-six sheep were killed in 21 incidents during 2002, which is a 29% decrease in the number of incidents (n = 27) and a 21% increase in the number of sheep killed (n = 38) during 2001. The 1997-2001 average is 21 incidents/year. All sheep were killed on grazing allotments in BTNF. One adult male grizzly bear was captured and relocated and 2 male bears were removed because of sheep depredations during the summer grazing season. No additional losses were reported after the management of these 3 bears.

No incidents of apiary damage occurred during 2002. The number of apiary damage problems has varied from 0 to 6/year during the previous 5-years. Many apiaries have been protected by electric fencing in Wyoming during the past 10 years.

Property Damage

Property damage incidents changed 0% in 2002 (n = 75) from the number of incidents in 2001 (n = 73), and increased 326% from the previous 5-year average of 23 incidents/year. Types of incidents included damage to camps, vehicles, bird feeders, fruit trees, gardens, and buildings. Thirty-eight incidents occurred on private lands, 28 in SNF, 2 on WGFD-owned lands, 1 on State lands, and 6 in BTNF. The WGFD provided assistance with materials and technical advice, and managed bears when needed to prevent further property damage. One bear was killed by management authorities in 2002 after repeated property damage incidents, and 1 bear was relocated after damaging property.

Anthropogenic Food Rewards

Bears were able to access non-natural foods in 109 incidents during 2002, a decrease of 15% from the number of food rewards in 2001 (n = 125) and a 294% increase from the previous 5-year average of 36 incidents/year. In 55 (51%) of the incidents, bears caused property damage while attempting to obtain human food, garbage, and/or pet or livestock feeds. Six food reward incidents occurred in BTNF, 31 in SNF, 1 on Bureau of Land Management lands, 2 on WGFD-owned lands, and 69 on private lands. Eight bears were captured and relocated after being rewarded with human food.

Harvested Game Animals

The WGFD received numerous reports of bears consuming harvested game animals that had been left in the field or improperly stored. Wild ungulates are natural foods for Yellowstone area grizzly bears, so incidents of bears consuming carcasses are not considered a conflict and are not detailed in this report.

Human Injuries

Two human injury incidents occurred in Wyoming outside of the national parks in 2002. Both incidents were associated with hunting-related activities. Each incident required professional medical attention.

Human-Caused Bear Deaths

Nine human-caused bear mortalities and 1 injury occurred in Wyoming in 2002. Four of the 9 bears were removed in agency management actions after repeated conflicts with people ($n = 2$) or livestock depredations ($n = 2$). The remaining 5 human-caused deaths are currently under investigation as to the circumstances that resulted in the death of the bears.

Bear Management Activities

Human-bear conflicts occurred throughout the non-denning period in Wyoming. Three years of dry conditions in northwest Wyoming and an increasing bear population has resulted in numerous human-bear conflicts. Conflicts began in March, increased in April and May, decreased in June, then peaked in July-September. A few conflicts continued throughout October and ended in mid-November. Management personnel captured 14 bears a total of 15 times in actions to prevent or manage conflicts.

Personnel worked with Teton and Park county governments to distribute information on bear behavior and preventing conflicts. "Living in Bear and Lion Country" workshops were taught in communities throughout the State. Numerous contacts were made with recreationalists, businesses, and property owners to provide assistance in preventing or managing conflicts with bears. Informational mailings containing conflict prevention tips were sent to Moran and Cody areas residents. Numerous media releases and interviews were conducted to disseminate information on preventing and avoiding conflicts with bears. Bear-proof barrels were provided to Cody, Jackson, and Dubois area residents for storing garbage and livestock feeds. Bear conflict prevention techniques were taught at all hunter safety classes conducted in northwestern Wyoming. Assistance with bear interpretive signing was provided to the city of Cody. Bear conflict management techniques were taught to thousands of children who attended the "Wyoming Hunting and Fishing Heritage Expo." Bear conflict information was mailed to all limited quota big game license holders hunting in occupied grizzly bear habitat. Personnel filmed bear conflict prevention techniques for future public service announcements. Numerous public presentations on preventing bear conflicts and recreating in bear habitat were conducted during the year.

Grizzly Bear-Human Conflicts in Southwestern Montana *(Kevin Frey, Montana Fish, Wildlife and Parks)*

Conflicts

There were 71 reported grizzly bear-human conflicts investigated in Montana within the GYE during 2002. This was a decrease of 10% from the 79 conflicts in 2001, which had increased by 21% from the 63 conflicts in 2000. For the preceding 10 years (1992-2001), the average number of bear-human conflicts in Montana was 45. Approximately 46% of the bear-human conflicts occurred on pubic land and 54% occurred on private land in 2001. Unnatural food attractants (unsecured and secured) accounted for 62% of all bear-human conflicts in Montana during 2002. This was an increase from 2000 and 2001, where unnatural food related conflicts accounted for 48% and 54% of all bear-human conflicts, respectively.

Extreme drought conditions began in early spring and continued through the fall season with marginal availability of quality bear foods during the spring and summer. Numerous grizzly bear conflicts occurred near areas of human development which were partially attributable to drought conditions. Whitebark pine cone availability was poor to fair in the northern portions of the GYE, use of cones by bears likely reduced the potential conflicts during late September and October. As documented during previous years of low cone production, grizzly bears in some areas keyed into activities of hunters during September and October. Numerous reports of grizzly bears following hunters or claiming elk carcasses were investigated. Natural food abundance and availability also has a direct correlation on the level of bear-human conflicts associated with unnatural foods at developed areas or backcountry camps.

On average, situations caused by non-secured unnatural foods continue to be the major cause of bear-human conflicts in Montana. During 2002, 5 bears (2 subadult males and a female with 2 COY) were responsible for 22 of the unnatural food related conflicts. Most of these could have been avoided if people would have made an effort to secure all unnatural food attractants. Except for 3 livestock depredations, all management captures of grizzly bears in southwest Montana during the past 12 years have been a result of unnatural foods. Euthanization or live removal of bears due to unnatural foods during this period has resulted in 21 bears being eliminated from the GYE in Montana. This type of conflict is more easily addressed than confrontational conflicts and should be possible to minimize. Managing agencies should continue to make extensive efforts to solve the non-secured unnatural food problem.

Confrontations between bears and humans are a continuing problem in Montana, comprising an average of 24% of the total bear-human conflicts during the last 10 years. Confrontations are not rare events and numerous incidents go unreported each year. There were 11 reported confrontations in 2002, all of which occurred in the backcountry on public land. During 2001, 24% or 19 of the total bear-human conflicts were confrontations; 16 occurred in the backcountry and 17 were on public land. Confrontations can escalate and lead to human injuries and/or grizzly bear mortalities. During 2002, 1 person was injured by a female grizzly bear with 2 COY. No grizzly bears were killed or humans injured in backcountry conflict situations associated with big game hunting in 2002.

Human Injuries

Late afternoon on 25 August, a man was injured by a female grizzly bear in the West Yellowstone area. The injured man was hiking with several companions in the Horse Butte/Rainbow Point area. The group was following grizzly bear tracks into a heavy lodgepole pine/willow (*Salix* spp.) area, when they found what was making the bear tracks. They walked into the family group (female with 2 cubs) while the bears were day-bedded. The man was injured after he started running and came into contact with 1 of the cubs, prompting the female bear to turn and hit the man, mauling his head and face. After the man was subdued, the female bear and cubs left the immediate area. The injured man was flown to a hospital in Idaho, where he recovered. The general area (U.S. Forest Service land) where the incident occurred was closed to all human activities for 4 to 5 days (varied with locale).

From 1992 through 2002, 13 people were injured in 10 grizzly bear attacks in the GYE in Montana. Of these 10 bear attacks, 4 of the grizzly bears were killed in self-defense. Nine of the 10 attacks (injuring 12 people) involved chance encounters with female grizzly bears and cubs. Ten of the total 13 people injured were big game hunting at the time of the mauling. During this same time period, there were an additional 5 grizzly bears killed by hunters in self-defense situations, where no people were injured.

Managing agencies and the public have to accept that confrontational conflicts between bears and people, along with associated human injuries and bear mortalities will be a very difficult problem to minimize. These serious confrontational conflicts require persistent management efforts to maintain a degree of human acceptance and tolerance of bears. In reality, certain human activities (i.e., summer camping, hiking, fall hunting season, unsecured food storage) will always bring humans and bears together in confrontational situations. The need continues for long-term education and information regarding proper actions to reduce all types of bear-human conflicts while recreating or living in bear country.

Management Captures

During 2002, 5 grizzly bears were captured in Montana due to conflict situations. All of the bear captures were due to unsecured food attractants and increasingly bold behavior by the bears.

On 30 August, a female grizzly bear (#101) and her 2 COY were captured in the West Yellowstone area, near Hebgen Lake. See Bear Mortalities section for more information.

On 5 September, a male subadult grizzly bear was captured along the Yellowstone River near Gardiner. This bear (#419) was relocated in the Henry Lake Mountains west of West Yellowstone.

On 6 September, a male subadult grizzly bear was captured in the West Yellowstone area near the South Fork of the Madison River. See Bear Mortalities section for more information.

From 1991 through 2002, 37 individual grizzly bears were captured 46 times due to conflict-caused management actions. Of these management captures, 43 were the result of non-secured unnatural foods and the sometimes associated property damage. On average, 4 grizzly bears have been captured each year due to management situations in southwest Montana (range: 0-12).

Bear Mortalities

In southern Montana during 2002, 5 grizzly bears were either removed (live to zoo) or died from known causes within the GYE.

On 15 May, an adult female grizzly bear was found dead in Porcupine Creek, Gallatin National Forest. The bear was recovered and investigation/necropsy revealed the bear had died of natural causes.

On 30 August, an adult female bear (#101) and her 2 male COY were captured and removed live to a zoo due to unnatural food rewards and bold behavior. In 1994, Bear #101 and her 2 yearlings were captured/relocated due to numerous conflict situations in the same area as in 2002.

An adult male bear was euthanized on 8 September after being captured due to unnatural food conflicts, severe property damage, and exhibiting bold behavior in the West Yellowstone area. There were no zoos available for this male bear and an interagency decision deemed him unsuitable for relocation.

From 1992 through 2002, there were 34 known grizzly bear deaths and 11 live removals (to zoos) out of the GYE within Montana. Of these 45 grizzly bear losses, 47% were related to unnatural food conflicts, 20% to hunting/self-defense conflicts, and 13% to illegal activities. Natural (4) and unknown (3) caused deaths resulted in 16% of the known grizzly bear mortalities. Livestock depredation resulted in 4% of the total loss of grizzly bears.

Of this total (45) bear mortality, 25 or 55% have been assumed residents of Montana, 7 or 15% of the bears had moved into Montana after being translocated from Wyoming to YNP, 5 or 11% of the bears had naturally moved into Montana from YNP or Wyoming, 6 or 13% had used the border lands of Montana/YNP, and 6% of the bears had been translocated into Montana from Wyoming. This information helps document the grizzly bears behavior and ability to move over a large geographic area which results in great difficulty in successfully relocating management situation bears. Over time, habituated bears can easily find another unnatural food source (usually unsecured) regardless of where the relocation site is.

There has been an increase in grizzly bear sightings (verified and non-verified), bear-human conflicts, and grizzly bear mortalities occurring in areas that are increasingly farther away from the Recovery Zone boundary of the GYE. As the grizzly bear population recovers, as evident in Montana, Wyoming, and YNP, bears will use all available habitat within the GYE. The need for grizzly bear management efforts will become ever-demanding in the future. Assumptions can no longer be made that these areas are not occupied by grizzly bears or are only black bear habitat. In Montana, during 1998, a grizzly bear that caused livestock depredation 40 miles west of the Recovery Zone was an example of this change. This occurred again during 2001, with a livestock depredation 25 miles west of the Recovery Zone and a sighting of a female grizzly with 1 cub 35 miles north of the Recovery Zone. During 2002, several grizzly bear sightings were reported and investigated far north and west of the GYE recovery line. These sightings were up to 162 linear air miles from the GYE recovery line. Grizzly bears have been regularly observed within 10 miles of Livingston, Bozeman, and Ennis, where these sightings were once rare or occasional.

Grizzly Bear-Human Conflicts in Eastern Idaho *(Lauri Hanauska-Brown, Idaho Department of Fish and Game)*

Two female grizzly bears with cubs were involved in human conflicts during the fall of 2002 in southeast Idaho. One of these conflicts resulted in the mortality of a marked adult female. Three unconfirmed grizzly bears were reported in early September in or near subdivisions or campgrounds. A grizzly bear skull was found and collected by a bow hunter in late September on Rock Creek within yards of the southwest corner of Yellowstone National Park. Investigation into several of these cases is ongoing.

The carcasses of adult female #346 and her female yearling were found by a hunter in the Sawtelle Peak area on 30 September. The right ear appeared to have been cut off and a distinct ring around the neck indicated a collar had also been removed. Both carcasses were taken to Ashland, Oregon, for forensic necropsy.

An adult female with 2 COY was wounded in self-defense by bow hunters on the evening of 28 September. The 3 bow hunters were returning to an elk kill in Cooney Canyon, north of Bishop Mountain when the female charged and chased the hunters until she was wounded in the left front shoulder/leg area with an arrow. The hunters left the area immediately after the incident and returned the next day with 2 Idaho conservation officers. The hanging elk meat was untouched, but the gut pile had been buried by the bear. The officers felt the wound was not life threatening as the bear had buried the gut pile since being wounded, was traveling with her cubs, and had traveled close to a mile since the incident.

Island Park residents reported a grizzly bear in the Boot Jack Creek neighborhood on 8 September. Several residents reported the bear had raided garbage cans. Conservation officers removed unsecured food sources and educated area residents on sanitation issues. Officers also set a culvert trap on the 10 September, but closed the trap 4 days later after receiving no further reports or observing any additional sign.

The numbers of bear-human conflicts continue to increase each fall in the Island Park area. Increased education and sanitation regulations are needed. Hunter education is also needed to prevent further human injury or bear mortality within Idaho.

Grizzly Bear-Human Conflicts in Yellowstone National Park *(Kerry A. Gunther, Yellowstone National Park)*

There were 14 grizzly bear-human conflicts reported in Yellowstone National Park (YNP) in 2002. These included 4 incidents where grizzly bears damaged property, 8 incidents in which grizzly bears obtained anthropogenic foods, and 2 incidents where people were injured by grizzly bears.

Property Damage

There were 4 incidents where grizzly bears damaged property without obtaining a food reward. These incidents included damage to a vehicle on the East Entrance Road, a crushed tent in a backcountry campsite, damage to angler's backpacks that had been left on the ground in the Slough Creek drainage, and damage to a towel that had been hung outside of a backcountry patrol cabin.

Anthropogenic Food Rewards

In 8 incidents, grizzly bears obtained anthropogenic foods. These included 2 incidents where grizzly bears obtained food from campsites in the Grant Village Campground and 2 incidents where food was obtained in backcountry campsites. Other incidents included food obtained from a pack thrown aside during an encounter with a bear, grain from a storage box left open at a backcountry patrol cabin, food thrown to a bear that was grazing along the East Entrance Road, and a bag of garbage that had been left next to a bear-proof garbage can by a park visitor.

Human Injuries

There were 2 grizzly bear-inflicted human injuries. On 26 May at approximately 0715 hours, a U.S. Post Office employee was jogging alone around the Lake Lodge cabin loop when she encountered a subadult grizzly bear about 15 m to her right. She was wearing a small bear-bell necklace. She spotted the bear out of the corner of her eye and immediately stopped and stood perfectly still. She did not make eye contact with the bear fearing it would be considered an aggressive act. She also verbally reassured the bear that she was not a threat. The bear took a few steps towards her and briefly stood up on its back legs. It appeared to her that the bear was trying to identify her; its nose reached for the sky, attempting to get a scent. It then dropped to the ground and slowly approached her. When it reached her, it began sniffing her. As the bear began to sniff her fingers she made a fist thinking her fingers would be bitten. The bear sniffed her pants then opened its mouth and very gently clamped its teeth down on her right upper thigh. The bear applied increasing pressure with its mouth. At that point she began yelling "go away bear" and grabbed her water bottle from her hip and squirted the bear in the face. This caused the bear to release her leg and walk away. She received contusions to her thigh from the bear's canines; her skin was not broken from the bite.

On 2 September, at approximately 1100 hours, 2 men were hiking off-trail up the Alluvium Creek drainage approximately 3 miles northeast of backcountry campsite 5E4 near Columbine Creek. When they topped a ridge, they surprised a female grizzly bear with 3 COY. The 2 hikers immediately turned around and were starting back down the ridge when the bear charged. The men dropped to the ground and remained still. The bear bit 1 man's lower left leg, picked him up and shook him for a few seconds before releasing him. He received 2 large puncture lacerations to his leg and a fractured fibula. The bear approached the second hiker, who was able to deploy pepper spray to the bear's face. The bear immediately turned away and left the area with her cubs. After the incident, the backcountry campsites in the area were temporarily closed and off-trail hiking was temporarily prohibited.

Grizzly Bear Management Actions

Due to the relatively few grizzly bear-human conflicts that occurred in YNP, no grizzly bears were captured in management actions and there were no management removals of nuisance bears from the park in 2002.

Human-Caused Grizzly Bear Mortalities

There were 2 human-caused grizzly bear mortalities in YNP in 2002. The first mortality occurred on 21 June when a 14 pound, male grizzly bear COY was struck and killed by a vehicle at Mary Bay on the East Entrance Road. The second mortality occurred on 2 August, when a 210-pound, adult female grizzly bear was struck and killed by a vehicle between mileposts 18 and 19 on U.S. Highway 191 in the park.

Concerns for the Future

Management of habituated grizzly bears that are tolerant of people but do not obtain anthropogenic foods remains the biggest bear management challenge in YNP. In 2002, YNP staff responded to 279 bear-jams where grizzly bears feeding on natural foods along park road corridors had attracted large numbers of park visitors that had stopped to view, photograph, and appreciate the bears. Park rangers provided visitors with interpretive information and traffic control, and monitored park visitor's behavior in order to prevent them from approaching and/or feeding bears at bear-jams.

Grizzly Bear-Human Conflicts in Grand Teton National Park *(Steve Cain, Grand Teton National Park)*

There were no grizzly bear-human conflicts and no management actions taken on grizzly bears in Grand Teton National Park in 2002.

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APPENDIX A

Use of sulfur and nitrogen stable isotopes to determine the importance of whitebark pine nuts to Yellowstone grizzly bears *(Laura A. Felicetti, Charles C. Schwartz, Robert O. Rye, Mark A. Haroldson, Kerry A. Gunther, Donald L. Phillips, and Charles T. Robbins)*

Abstract: Whitebark pine (*Pinus albicaulis)* is a masting species that produces relatively large, fat and protein-rich nuts that are consumed by grizzly bears (*Ursus arctos horribilis*). Trees produce abundant nut crops in some years and poor crops in other years. Grizzly bear survival in the Greater Yellowstone Ecosystem is strongly linked to variation in pine nut availability. Because whitebark pine trees are infected with blister rust (*Cronartium ribicola*), an exotic fungus that has killed the species throughout much of its range in the northern Rocky Mountains, we used stable isotopes to quantify the importance of this food resource to Yellowstone grizzly bears while healthy populations of the trees still exist. Whitebark pine nuts have a sulfur isotope signature (9.2 ± 1.3‰) (mean ± 1SD) that is distinctly different from all other grizzly bear foods that range from 1.9 ± 1.7‰ for all other plants to 3.1 ± 2.6‰ for ungulates. Feeding trials with captive grizzly bears were used to develop relationships between dietary sulfur, carbon, and nitrogen isotope signatures and those of bear plasma. The sulfur and nitrogen relationships were used to estimate the importance of pine nuts to free-ranging grizzly bears from blood and hair samples collected between 1994 and 2001. During years of poor pine nut availability, 72% of the bears made minimal use of pine nuts. During years of abundant cone availability, 8 ± 10% of the bears made minimal use of pine nuts while 67 ± 19% derived over 51% of their assimilated sulfur and nitrogen (i.e., protein) from pine nuts. Pine nuts and meat are two critically important food resources for Yellowstone grizzly bears.

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