Yellowstone Grizzly Bear Investigations 2003

The Greater Yellowstone Ecosystem

Annual Report of the Interagency Grizzly Bear Study Team

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2003

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

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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 2003 field season. The report also contains a summary of nuisance grizzly bear (*Ursus arctos horribilis*) management actions.

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 summer 2004.

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 Wildlife Monograph has been drafted and submitted for consideration as a publication. We anticipate final word sometime during winter 2005.

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. Our manuscript on consumption rates of whitebark pine has been published (Canadian Journal of Zoology 81:763-770). A copy can be found on the Interagency Grizzly Bear Study Team (IGBST) website http://www.nrmsc.usgs.gov/research/igbst-home.htm. The manuscript on fish consumption is in final review and should be published in 2004.

We began a new study in Grand Teton National Park evaluating habitat use both temporally and spatially between grizzly and black (*Ursus americanus*) bears. We will employ a new form of Global Positioning System (GPS) technology that incorporates a spread spectrum communication system. Spread spectrum allows for transfer of stored GPS locations from the collar to a remote receiving station. We tested 2 collars during the fall of 2003 and provide a summary of the results. We will attempt to deploy several of these collars during the 2004 field season.

The annual reports of the 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 Greater Yellowstone Ecosystem (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, 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, Merrill 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; Dan Bjornlie, Wyoming Game and Fish Department)*

During the 2003 field season, 44 individual grizzly bears were captured on 54 occasions (Table 1), including 11 females (9 adult) and 33 males (22 adult). Thirty individuals were new bears not previously marked.

We conducted research trapping efforts for 660 trap days (1 trap day = 1 trap set for 1 day) in 11 Bear Management Units (BMUs) within the Grizzly Bear Recovery Zone (USFWS 1993) and adjacent 10-mile perimeter area. We also conducted research trapping efforts outside the 10-mile perimeter in Montana and Wyoming. We captured 32 individual grizzly bears 40 times for a research trapping success rate of 1 capture every 16.5 trap days.

There were 14 management captures of 14 individual bears in the GYE during 2003 (Tables 1 and 2), including 2 females (1 adult) and 12 males (7 adults). Eleven bears (1 female, 10 males), were relocated due to conflict situations (Table 1). One adult female capture at a conflict trap site with 2 COY was not the target bear and was released on site. Two other grizzly bears were captured and removed from the population as a result of conflicts with humans.

We radio-monitored 80 individual grizzly bears during the 2003 field season, including 25 adult females (Tables 2 and 3). Forty-five grizzly bears entered their winter dens wearing active transmitters in the GYE. Since 1975, 446 individual grizzly bears have been radio-marked.

Table 1. Grizzly bears captured in the Greater Yellowstone Ecosystem during 2003.

Bear	Sex	Age	Date	General location[a]	Capture type	Release site	Trapper/handler[b]
G86	male	subadult	5/12	N Fork Shoshone, Pr-WY	management	removed	WYGF
G87	male	adult	5/16	Pilgrim Cr, GTNP	research	on site	IGBST
399	female	adult	5/20	Snake River, GTNP	research	on site	IGBST
			6/28	Cygnet Cr, GTNP	research	on site	IGBST
G88	male	subadult	6/1	Cygnet Cr, GTNP	research	on site	IGBST
G89	male	adult	6/17	Flat Mountain Cr, YNP	research	on site	IGBST
427	male	subadult	6/16	Bridge Cr, YNP	management	Lewis River, YNP	YNP/IGBST
			9/22	Arnica Cr, YNP	research	on site	IGBST
428	female	subadult	6/18	Franks Fork, SNF	research	on site	WYGF
429	male	adult	6/27	Pelican Cr, YNP	research	on site	IGBST
430	male	subadult	7/1	S Fork Shoshone, Pr-WY	management	Blackrock Cr, BTNF	WYGF
431	male	subadult	7/4	Brooks Lake Cr, SNF	management	Sunlight Cr, SNF	WYGF
432	male	adult	7/10	S. Fk. Shoshone, Pr-WY	management	Burnt Cr, SNF	WYGF
433	male	adult	7/12	Green River, BTNF	management	N Fork Shoshone, SNF	WYGF
G82	male	subadult	7/13	Line Cr, Pr-WY	management	removed	WYGF
434	male	yearling	7/21	Conant Cr, TNF	research	on site	WYGF
			8/7	Badger Cr, TNF	research	on site	WYGF
418	male	adult	7/25	Conant Cr, TNF	research	on site	WYGF
435	male	yearling	7/25	Conant Cr, TNF	research	on site	WYGF
			8/1	Coyote Cr, TNF	research	on site	WYGF
			8/8	Badger Cr, TNF	research	on site	WYGF
			8/10	Badger Cr, TNF	research	on site	WYGF
436	male	subadult	7/25	Coyote Cr, TNF	research	on site	WYGF
323	male	adult	7/26	Gibbon River, YNP	research	on site	IGBST
			9/11	Gibbon River, YNP	research	on site	IGBST
193	female	adult	7/27	Gibbon River, YNP	research	on site	IGBST
437	male	adult	7/27	Wagon Cr, BTNF	management	Sunlight Cr, SNF	WYGF
438	male	adult	7/29	Boulder River, GNF	management	Tepee Cr, GNF	WS/MTFWP
412	female	adult	7/31	Hominy Cr, TNF	research	on site	WYGF
439	female	adult	8/3	Fish Cr, BTNF	management	on site	WYGF
440	male	adult	8/5	Fish Cr, BTNF	management	Mormon Cr, SNF	WYGF
G90	female	yearling	8/7	Jack Pine Cr, TNF	research	on site	WYGF
			11/20	Leigh Cr, Pr-ID	management	Mormon Cr, SNF	WYGF
441	male	subadult	8/9	Coyote Cr, YNP	research	on site	IGBST
442	male	adult	8/10	Dunoir River, Pr-WY	management	Sunlight Cr, SNF	WYGF
443	male	adult	8/10	Coyote Cr, YNP	research	on site	IGBST
444	male	adult	8/12	Coyote Cr, YNP	research	on site	IGBST

Table 1. Continued.

Bear	Sex	Age	Date	General location[a]	Capture type	Release site	Trapper/handler[b]
445	male	adult	8/19	Jack Pine Cr, TNF	research	on site	WYGF
446	male	adult	8/19	S Fork Shoshone, Pr-WY	management	Wood River, SNF	WYGF
349	female	adult	9/4	Solfatara Cr, YNP	research	on site	IGBST
			9/16	Gibbon River, YNP	research	on site	IGBST
287	male	adult	9/5	Cascade Cr, YNP	research	on site	IGBST
			9/16	Cascade Cr, YNP	research	on site	IGBST
318	male	adult	9/8	Antelope Cr, YNP	research	on site	IGBST
281	male	adult	9/9	Cascade Cr, YNP	research	on site	IGBST
219	male	adult	9/10	Solfatara Cr, YNP	research	on site	IGBST
211	male	adult	9/11	Cascade Cr, YNP	research	on site	IGBST
196	female	adult	9/18	Cascade Cr, YNP	research	on site	IGBST
295	female	adult	9/18	Gibbon River, YNP	research	on site	IGBST
G91	male	cub	9/18	Gibbon River, YNP	research	on site	IGBST
447	female	adult	9/19	Arnica Cr, YNP	research	on site	IGBST
448	female	yearling	9/19	Arnica Cr, YNP	research	on site	IGBST
449	male	adult	9/21	Cascade Cr, YNP	research	on site	IGBST

[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.
[b] IGBST = Interagency Grizzly Bear Study Team, U.S. Geological Survey; MTFWP = Montana Fish, Wildlife and Parks; WS = Wildlife Services/Animal and Plant Health Inspection Service (APHIS); WYGF = Wyoming Game and Fish Department.

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
2003	80	44	40	14	11

Table 3. Grizzly bears radio monitored in the Greater Yellowstone Ecosystem during 2003.

Bear	Sex	Age	Offspring[a]	Monitored: Out of den	Monitored: Into den	Current status
132	F	Adult	1 Yearling	Yes	No	Cast
179	F	Adult	3 2-year-olds	Yes	No	Cast
188	F	Adult	2 Yearlings, lost 1	Yes	Yes	Active
193	F	Adult	1 Yearling, lost	Yes	Yes	Active
196	F	Adult	3 COY, lost 1	Yes	Yes	Active
211	M	Adult		Yes	No	Cast
213	F	Adult	None	Yes	Yes	Active
214	F	Adult	None	Yes	Yes	Active
219	M	Adult		No	No	Unresolved[b]
228	M	Adult		Yes	No	Cast
260	M	Adult		Yes	No	Cast
267	F	Adult	None	Yes	Yes	Active
281	M	Adult		Yes	No	Cast
295	F	Adult	1 COY	Yes	Yes	Active
303	F	Adult	1 2-year-old	Yes	No	Cast
305	F	Adult	2 COY	Yes	Yes	Active
318	M	Adult		No	No	Cast
323	M	Adult		Yes	No	Cast
344	M	Adult		Yes	No	Cast
349	F	Adult	None	No	Yes	Active
351	F	Adult	Unknown	Yes	No	Probable battery failure
352	M	Adult		Yes	No	Probable battery failure
355	M	Subadult		Yes	No	Cast
356	M	Adult		Yes	Yes	Active
365	F	Adult	Unknown	Yes	No	Probable battery failure
367	F	Adult	None	Yes	Yes	Active
369	M	Adult		Yes	No	Probable battery failure
372	M	Adult		Yes	Yes	Active
373	M	Subadult		Yes	No	Cast
374	M	Adult		Yes	No	Cast
383	F	Adult	2 COY	Yes	No	Probable battery failure
384	F	Adult	1 Yearling	Yes	No	Probable battery failure
394	M	Adult		Yes	No	Cast
399	F	Adult	None	Yes	Yes	Active
401	M	Adult		Yes	No	Cast
402	F	Adult	None	Yes	Yes	Active
405	M	Adult		Yes	No	Cast
406	M	Adult		Yes	Yes	Active

Table 3. Continued.

Bear	Sex	Age	Offspring[a]	Monitored Out of den	Monitored Into den	Current status
407	M	Subadult		Yes	Yes	Active
408	M	Subadult		Yes	Yes	Active
410	M	Adult		Yes	No	Cast
412	F	Adult	2 COY, lost both	Yes	Yes	Active
413	M	Subadult		Yes	No	Cast
415	M	Subadult		Yes	Yes	Active
416	F	Adult	None	Yes	No	Cast
417	M	Adult		Yes	No	Cast
418	M	Adult		Yes	No	Missing
419	M	Subadult		Yes	No	Probable battery failure
420	M	Subadult		Yes	No	Dead
421	M	Subadult		Yes	Yes	Active
422	M	Subadult		Yes	No	Dead
423	F	Adult	None	Yes	Yes	Active
424	M	Subadult		Yes	No	Cast
425	F	Adult	None	Yes	No	Cast
426	M	Subadult		Yes	No	Missing
427	M	Subadult		No	Yes	Active
428	F	Subadult		No	Yes	Active
429	M	Adult		No	Yes	Active
430	M	Subadult		No	Yes	Active
431	M	Subadult		No	Yes	Active
432	M	Adult		No	Yes	Active
433	M	Adult		No	Yes	Active
434	M	Subadult		No	Yes	Active
435	M	Subadult		No	No	Cast
436	M	Subadult		No	Yes	Active
437	M	Adult		No	Yes	Active
438	M	Adult		No	No	Cast
439	F	Adult	2 COY	No	Yes	Active
440	M	Adult		No	Yes	Active
441	M	Subadult		No	Yes	Active
442	M	Adult		No	Yes	Active
443	M	Adult		No	Yes	Active
444	M	Adult		No	No	Cast
445	M	Adult		No	Yes	Active
446	M	Adult		No	No	Dead

Table 3. Continued.

Bear	Sex	Age	Offspring[a]	Monitored: Out of den	Monitored: Into den	Cast Current status
447	F	Adult	2 Yearlings	No	Yes	Active
448	F	Subadult		No	No	Cast
449	M	Adult		No	Yes	Active
450	M	Adult		No	Yes	Active
451	M	Subadult		No	Yes	Active

[a] COY = cub-of-the-year.
[b] Transmitter was not retrieved in 2003, site will be visited as soon as possible in 2004 to determine status.

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

Thirty-eight unduplicated females accompanied by 75 COY were identified using the method described by Knight et al. (1995) in the GYE during 2003 (Table 4). Litter sizes observed during initial observations were 6 single cub litters, 27 litters of twins, and 5 litters of triplets. Average litter size was 2.0. Most unique females observed during 2003 were located in the southeastern portion of the GYE (Fig. 1). Three of the 38 females were initially observed farther than 10 miles from the Recovery Zone in Wyoming (Fig. 1). 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." Thus, 35 unique females will be used in calculating the minimum population estimates and mortality thresholds in the Yellowstone Grizzly Bear Recovery Zone for the year 2003. 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 4). The 6-year average for total number of COY and average litter size observed at initial sighting were 74 and 1.9, respectively (Table 4).

There is a strong positive correlation (Pearson's r = 0.93) between the number of sightings obtained and the number of unduplicated females with COY identified annually (Fig. 2). The decline in the number of unique females with COY identified during 2003 compared to 52 in 2002 was due primarily to the low number of sightings obtained. By 1 September, only 60 sightings were documented, compared with 153 during 2002. This result represents a 61% decline in the number of sightings. A likely explanation for the decline in sighting is that most reproductive-aged females in the population were accompanied by COY or yearlings during 2002 and were unavailable for breeding. This is supported by the finding that bears/hour observed during observation flights was high during 2003 when compared to previous years, but females with COY observed/hour declined (Fig. 3). Most observations (56.7%) were made during agency observation flights (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 7 methods to estimate the total numbers of females with COY annually using sighting frequencies of randomly observed bears and recommended the second order sample coverage estimator ($\hat{N}_{SC2}$) of Lee and Chao (1994). The Conservation Strategy for the grizzly bear in the GYE (USFWS 2003) proposes to estimate total grizzly bear population size and set mortality thresholds using estimates of total number of females with COY produced by this methodology. During 2003, we estimated 53 unduplicated females with COY in the GYE using $\hat{N}_{SC2}$ (Table 6). Although we met the minimum sample size ($n/\hat{N}_{SC2} \geq 1$, Table 6) recommended by Keating et al. (2003), our 2003 estimate is likely biased about 10% high because the estimated coefficient of variation ($\hat{\gamma}$) among sighting probabilities for individual animals was 0 (Table 6). In the future, we recommend conducting additional survey flights to increase $n/\hat{N}_{SC2}$ to $\geq$ 2, contingent on availability of funds. This will reduce bias in the estimate.

Table 4. Number of unduplicated females with cubs-of-the-year (COY), number of COY, and average litter size at initial observation for the years 1973-2003 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
2003[d]	38	75	2.0	38	74	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.
[d] Three females with COY were observed outside the 10-mile perimeter.

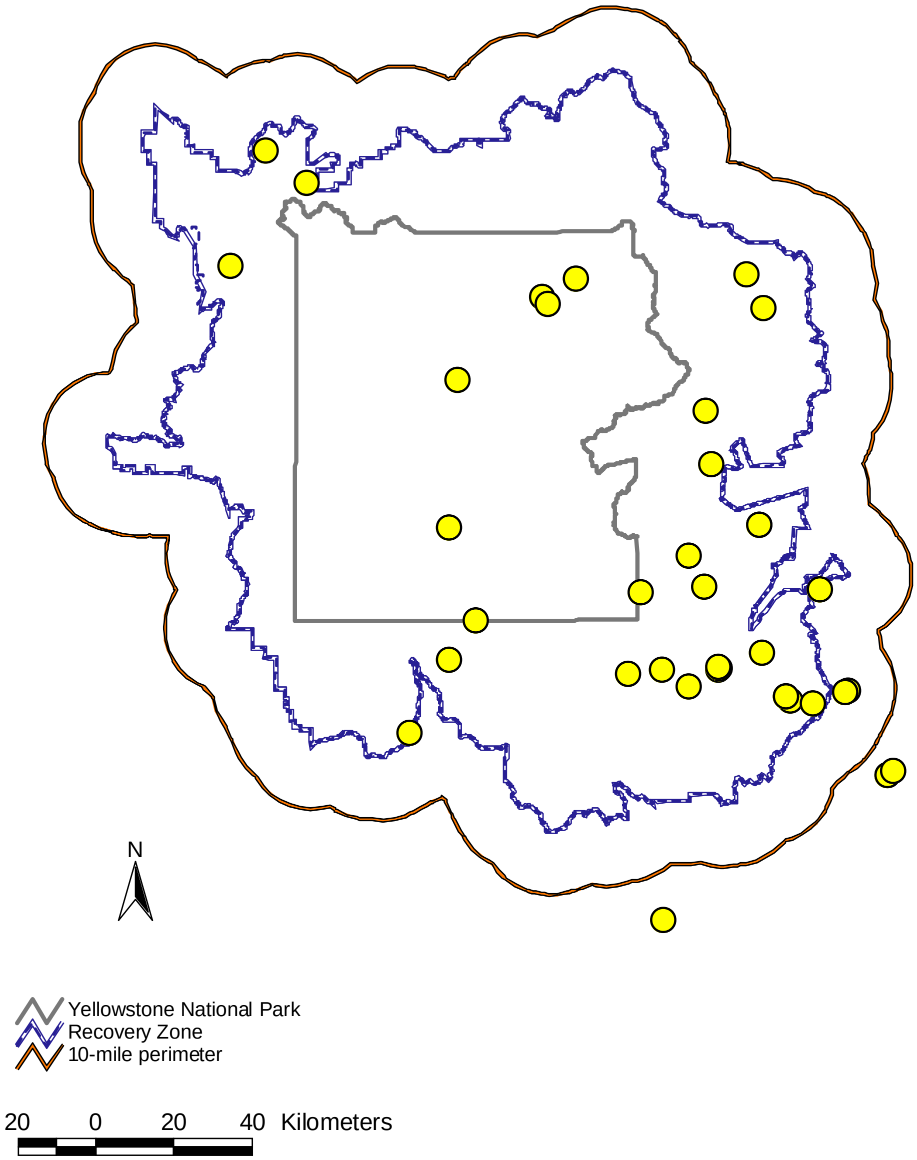

Fig. 1. Distribution of initial observations of unduplicated female grizzly bears with cubs-of-the-year in the Greater Yellowstone Ecosystem during 2003.

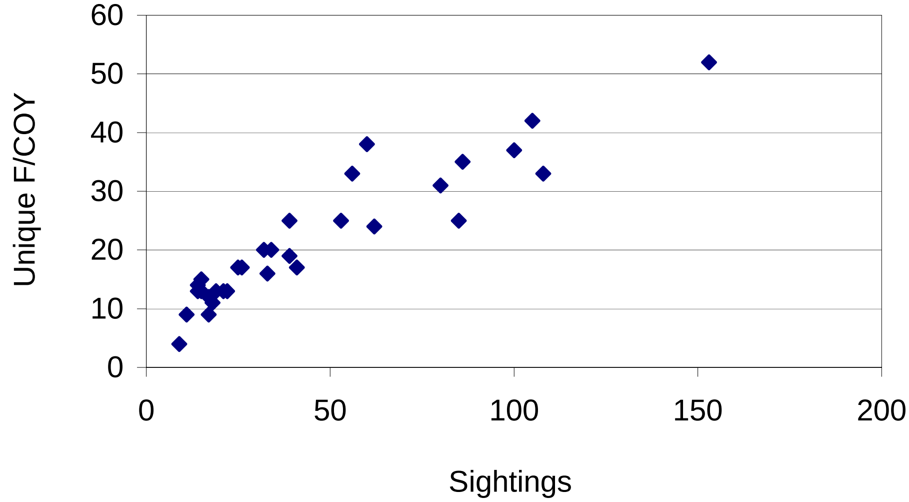

Fig. 2. Relationship between number of sightings of females with cubs-of-the-year (COY) and number of unique females (F/COY) identified annually.

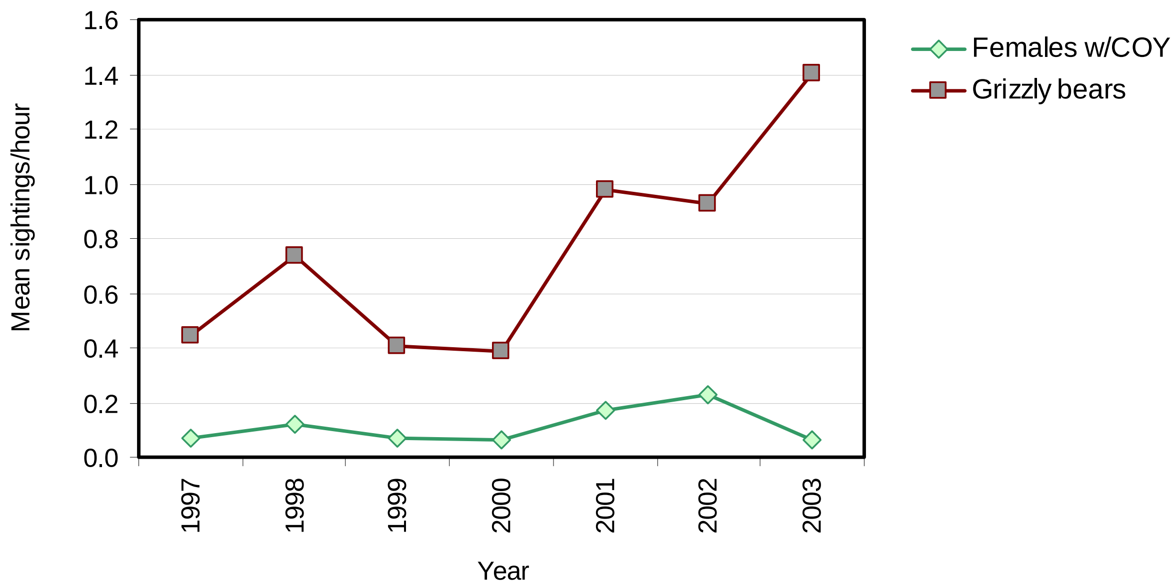

Fig. 3. Average observations/hour for unmarked grizzly bears and unmarked females with cubs-of-the-year (COY) in non-moth Bear Management Units within the recovery zone during 1997-2003.

Table 5. Method of observation for sightings of unduplicated females with cubs-of-the-year during 2003.

Method of observation	Frequency	Percent	Cumulative percent
Fixed wing – other researcher	3	5.0	5.0
Fixed wing – observation	34	56.7	61.7
Fixed wing - radio flight	13	21.7	83.3
Ground sighting	7	11.7	95.0
Helicopter – other research	2	3.3	98.3
Trap	1	1.7	100.0
Total	60	100.0	

Table 6. Estimates of annual numbers ($\hat{N}_{Obs}$) of females with cubs-of-the-year (F_{Cub}) in the Greater Yellowstone Ecosystem grizzly bear population, 1986–2003. $\hat{N}_{Obs}$ gives the number of unique F_{Cub} differentiated, 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 ($\hat{\gamma}$, Eq. 5). 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
2003	38	35	53.2	49.9	47.1	44.1	41.5	1.0	0.0

Occupancy of Bear Management Units 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. Sixteen of 18 BMUs had verified observations of female grizzly bears with young during 2003 (Table 7). Bear management units that did not contain verified documentation of females with young were Madison and Henry's Lake. 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, 1998-2003.

Bear Management Unit	1998	1999	2000	2001	2002	2003	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	6
7) Shoshone	X	X	X	X	X	X	6
8) Pelican/Clear	X	X	X	X	X	X	6
9) Washburn	X	X	X	X	X	X	6
10) Firehole/Hayden	X	X	X	X	X	X	6
11) Madison	X	X	X	X	X		5
12) Henry's Lake	X		X	X	X		4
13) Plateau		X	X	X	X	X	5
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	14	17	18	18	18	16	

__Observation Flights__ (Karrie West, Interagency Grizzly Bear Study Team)

Two rounds of observation flights were conducted during 2003. 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 73.8 hours of observation. The average duration of flights for both rounds was 2.1 hours (Table 8). Two hundred two bear sightings, excluding dependent young, were recorded during observation flights. This included 3 solitary radio-marked bears, 1 marked female with young, 147 solitary unmarked bears, and 51 unmarked females with young (Table 8). Observation rates were 1.33 bears/hour for all bears or 0.34 females with young/hour. Ninety-nine young (53 COY, 32 yearlings, and 14 of unknown age) were observed (Table 9). Observation rate was 0.17 females with COY/hour.

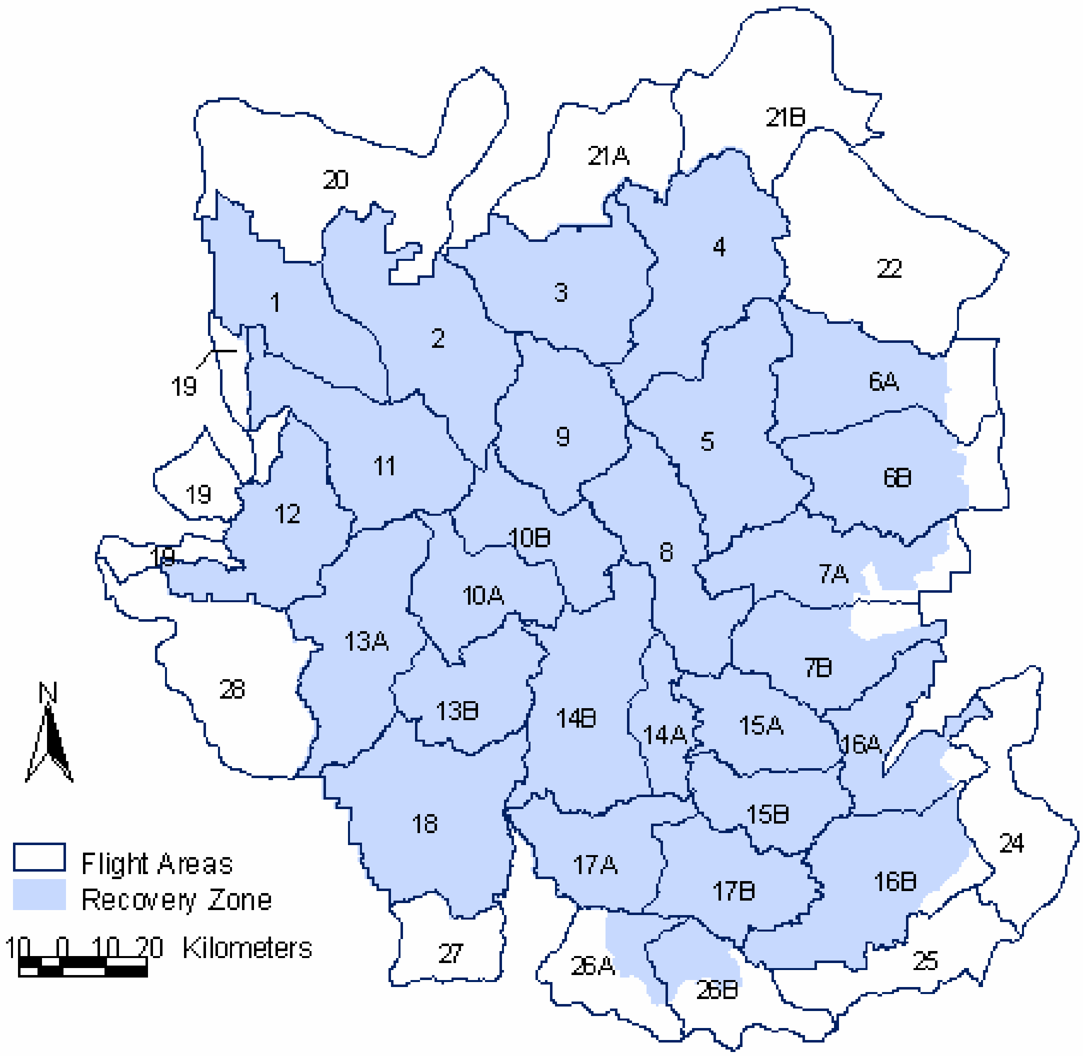

Fig. 4. Observation flight areas within the Greater Yellowstone Ecosystem, 2003. The numbers represent the 27 bear observation areas. Those units too large to search during a single flight were further subdivided into 2 units. Consequently, there were 37 search areas.

Table 8. Annual summary statistics for observation flights conducted in the Greater Yellowstone Ecosystem, 1987-2003.

					Bears seen							
					Marked		Unmarked			Observation rate (bears/hour)		
Date	Observation period	Total hours	Number of flights	Average hours/flight	Lone	With young	Lone	With young	Total number of groups	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
2003[d]	Round 1	78.2	36	2.2	2	0	75	32	109	1.39		
	Round 2[e]	73.8	35	2.1	1	1	72	19	93	1.26		
	Total	152.0	71	2.1	3	1	147	51	202	1.33	0.34	0.17

[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); 2003 (12 June-28 July, 11July-13 September).

[e] One flight was excluded from the 2003 data because it was flown after the cut-off date for considering observations of females with COY (1 September).

Table 9. Size and age composition of family groups seen during observation flights in the Greater Yellowstone Ecosystem, 1998-2003.

	Females with cubs-of-the-year (number of cubs)			Females with yearlings (number of yearlings)			Females with young of unknown age (number of young)		
Date	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
2003[a]									
Round 1	2	12	2	2	6	2	3	3	0
Round 2	2	5	3	2	5	0	2	0	1
Total	4	17	5	4	11	2	5	3	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); 2003 (12 June-28 July, 11 July-13 September).

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

Eighty-one telemetry relocation flights were conducted during 2003, resulting in 336.6 hours of search time (ferry time to and from airports excluded) (Table 10). Flights were conducted at least once during all months except February, but over 90% occurred May-November. During telemetry flights, 722 locations of bears equipped with radio transmitters were collected, 85 (11.8%) of which included a visual sighting. Thirty-eight sightings of unmarked bears were also obtained during telemetry flights, including 28 solitary bears, 7 females with COY, 2 females with yearlings, and 1 female with 2-year-olds. Rate of observation for all unmarked bears during telemetry flights was 0.11 bears/hour. Rate of observing females with COY was 0.02/hour, which was considerably less than during observation flights (0.17/hour) in 2003.

Table 10. Summary statistics for radio-telemetry relocation flights in the Greater Yellowstone Ecosystem, 2003.

				Radioed bears			Unmarked bears observed					
								Females			Observation rate (groups/hour)	
Month	Hours	Number of flights	Mean hours per flight	Number of locations	Number seen	Observation rate (groups/hour)	Lone bears	With COY[a]	With yearlings	With young	All groups	Females with COY
January	7.56	3	2.52	12	0	0.00	0	0	0	0	----	-----
February	0.00	0	-----	0	0	-----	0	0	0	0	-----	-----
March	7.32	2	3.66	8	0	0.00	0	0	0	0	-----	-----
April	31.15	7	4.45	65	7	0.22	0	0	1	0	0.03	0.00
May	45.96	10	4.6	104	32	0.70	9	0	0	0	0.20	0.00
June	32.41	7	4.63	68	7	0.22	3	1	0	0	0.12	0.03
July	35.93	9	3.99	67	9	0.25	7	4	0	1	0.33	0.11
August	41.62	10	4.16	104	11	0.26	7	1	0	0	0.19	0.02
September	42.80	10	4.28	82	7[b]	0.16	2	1	1	0	0.09	0.02
October	45.68	11	4.15	109	7	0.15	0	0	0	0	0.00	0.00
November	18.69	5	3.74	48	1	0.05	0	0	0	0	0.00	0.00
December	27.49	7	3.93	55	4	0.15	0	0	0	0	0.00	0.00
Total	336.61	81	4.16	722	85	0.25	28	7	2	1	0.11	0.02

[a] COY = cub-of-the-year.
[b] A family group was observed which included a radiomarked yearling (#434)

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. Appendix F of the Grizzly Bear Recovery Plan (USFWS 1993) intended that mortalities occurring within the Yellowstone Grizzly Bear Recovery Zone **and** a 10-mile perimeter area be counted against mortality quotas. The U.S. Fish and Wildlife Service clarified this 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 18 grizzly bear mortalities during 2003 (Table 11). Twelve were known human-caused bear deaths; 1 was a possible human-caused mortality. One of the known human-caused grizzly bear mortalities occurred >10 miles outside the Recovery Zone in Wyoming (Tables 11 and 12). This instance was a case of mistaken identity by a black bear hunter. There were 2 management removals, both occurred in Wyoming and were due to site conflicts where the nuisance individual obtained a food reward (Table 11). In addition to the mistaken identity kill outside the 10-mile perimeter, we documented 3 known and 1 possible hunting-related mortalities (Table 11). The 3 known hunting-related mortalities were incidents of self-defense. The 6 remaining human-caused mortalities were from 1 defense-of-life kill in which the person sustained injury from a female with young, 1 accidental mortality of a yearling female by Wildlife Services during a wolf (*Canis lupus*) control action, 1 road kill, and 3 mortalities that remain under investigation.

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, 11 known human-caused grizzly bear mortalities, including 3 adult females and 6 total females, were applied to the calculation of mortality threshold (USFWS 1993) for 2003. Using these results, both total human-caused and female mortalities were under annual mortality thresholds (Table 13).

Three natural mortalities were documented during 2003 (Table 11). All were probable COY losses from 2 radiomarked females. One female lost 2 COY between late May and the end of July. The second female lost a COY between late July and mid-September.

Cause of death could not be determined for 2 mortalities documented during 2003 (Table 11). The carcass of bear #422 exhibited significant fight wounds, but was found within 100 m of the highway just north of Jackson Lake Dam. The necropsy could not rule out vehicle impact as a possible cause of death. The second instance involved a hunting guide who found the skull of an adult bear during the fall of 2003. This bear, for which sex was unknown, likely died during 2002.

Table 11. Grizzly bear mortalities documented in the Greater Yellowstone Ecosystem during 2003.

Bear[a]	Sex	Age[a]	Date	Location[c]	Certainty	Cause
mkd	M	subadult	2003	BTNF	Known	Human-caused, under investigation.
422	M	adult	4/26-27	Snake River, GTNP	Known	Undetermined cause. Fight with another bear, or vehicle impact.
G86	M	subadult	5/12	N Fork Shoshone, Pr-WY	Known	Human-caused, management removal.
unm	M	adult	5/26	Owl Cr, SNF[d]	Known	Human-caused, mistaken identity kill by black bear hunter.
264	F	adult	6/14	Solfatara Cr, YNP	Known	Human-caused, road kill.
unm	F	adult	6/25	Tom Miner Basin, GNF	Known	Human-caused, self-defense, female with young of unknown age charged and injured hiker, hiker shot and killed bear.
unm	F	subadult	7/13	Sunlight Cr, SNF	Known	Human-caused, yearling female accidentally killed during wolf capture operation.
G82	M	subadult	7/13	Line Cr, Pr-WY	Known	Human-caused, management removal.
unm	Unk	cub	5/23-7/31	Moose Cr, GTNP	Probable	Natural, COY of Bear #412 lost 1 of 2 COY.
unm	Unk	cub	5/23-7/31	Moose Cr, GTNP	Probable	Natural, COY of Bear #412 lost 1 of 2 COY.
unm	F	subadult	2003	BTNF	Known	Human-caused, under investigation.
unm	Unk	cub	7/20-9/18	Alum Cr, YNP	Probable	Natural, COY of Bear #196 lost 1 of 3 COY.
unm	F	adult	9/24	Tough Cr, SNF	Known	Human-caused, self-defense, hunting related, under investigation.
unm	F	subadult	10/4	Squaw Cr, SNF	Known	Human-caused, self-defense, hunting related, under investigation.
unm	M	subadult	10/18	Piney Cr, SNF	Known	Human-caused, self-defense, hunting related, under investigation.
mkd	M	adult	2003	SNF	Known	Human-caused, under investigation.
unm	Unk	Unk	11/7-9	Taylor's Fork, GNF	Possible	Human-caused, under investigation. Reports of grizzly bear shot near hunter's camp.
unm	Unk	adult	Fall 2002	N Fork Butte Cr, SNF	Known	Undetermined cause. Skull in possession of hunting guide, bear likely died during 2002, under investigation

[a] mkd = marked bear, 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, SNF = Shoshone National Forest, YNP = Yellowstone National Park, GTNP = Grand Teton 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, 1973-2003.

	All bears				Adult females			
	Human-caused		Other[a]		Human-caused		Other	
Year	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	8[h]	0	4	0	3[g]	0
2003	11	1	4	0	3	0	0	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 (Appendix A in Schwartz and Haroldson 2001).
[g] Includes 1 known mortality from fall of 2001 discovered in 2002.
[h] Includes 1 known mortality from 2002 discovered in 2003.

Table 13. Annual count of unduplicated females with cubs-of-the-year (COY), known and probable human-caused grizzly bear mortalities within the Recovery Zone and the 10-mile perimeter, 1993-2003. 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
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
2003	35	11	6	3	11.2	4.8	3.0	416	16.6	Under	5.0	Under

[a] Beginning in 2000, probable human-caused mortalities are used in calculation of annual mortality thresholds.

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 use ungulates as carrion (Mealey 1980, Henry and Mattson 1988, Green 1994, Blanchard and Knight 1996, Mattson 1997) in Yellowstone National Park. Competition with recently reintroduced wolves for carrion and changes in bison (*Bison bison*) and elk (*Cervus elaphus*) 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 2003, we surveyed routes in ungulate winter ranges to monitor the relative abundance of spring ungulate carcasses (Fig. 5).

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 animals 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. Winter Severity Index 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 11 routes on Yellowstone's Northern Range totaling 149.4 km traveled. In 2003, we used a GPS to more accurately measure the actual distance traveled on most of the routes. We counted 24 carcasses, including 1 bison, 1 mule deer (*Odocoileus hemionus*), and 22 elk, which equated to 0.16 carcasses/km (Table 14). Sex and age of carcasses found are shown in Table 15. All carcasses were almost completely consumed by scavengers, evidence of use by bears could be determined at 1 mule deer, 1 elk, and 1 bison carcass. Three of the elk were probably killed by wolves. Grizzly bear sign (e.g., tracks, scats, feeding activity) was observed along 5 of the routes.

Firehole River Area

We surveyed 8 routes in the Firehole drainage totaling 72.9 km. We found the remains of 2 bison and 3 elk, which equated to 0.07 carcasses/km traveled (Table 14). Evidence of use by wolves was found at both bison carcasses. Definitive evidence of use by grizzly bears was found at 1 bison and 1 elk carcass. Grizzly bear sign was found along 6 of the routes, and black bear

tracks were found on 1 route. One bison and 1 elk were probably winter-killed, cause of death could not be determined for the carcasses.

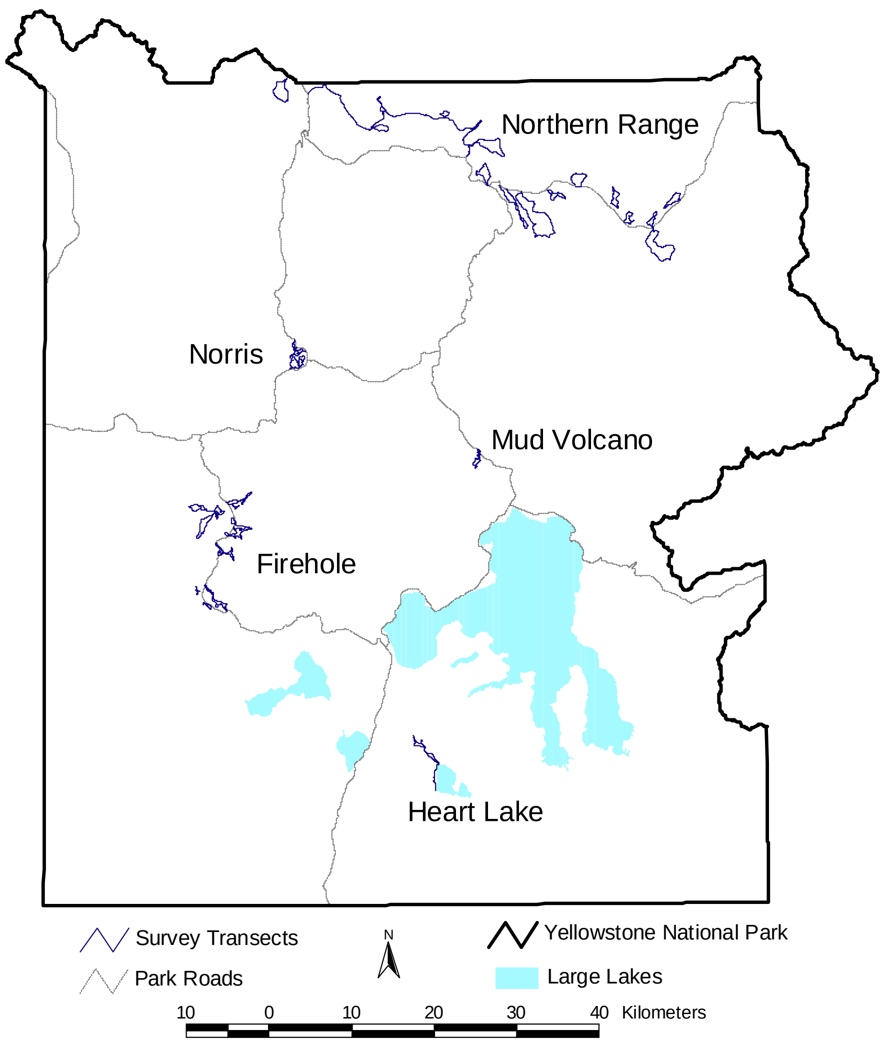

Fig. 5. Spring ungulate carcass survey transects in 5 areas of Yellowstone National Park.

Table 14. Carcasses found and visitation of carcasses by bears, wolves, and unknown large scavengers along surveyed routes in Yellowstone National Park during spring 2003.

Survey area (# routes)	Elk				Bison				Total Carcasses/km
	Number of carcasses	# Visited by species			Number of carcasses	# Visited by species			
		Bear	Wolf	Unknown		Bear	Wolf	Unknown	
Northern Range (11)	22	1	3	18	1	1	0	0	0.16[a]
Firehole (8)	3	1	0	1	2	1	2	0	0.07
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

[a] Includes 1 mule deer carcass that was visited by an unidentified bear species.

Table 15. Age classes and sex of elk and bison carcasses found, by area, along surveyed routes in Yellowstone National Park during spring 2003. One adult female mule deer carcass was also found.

	Elk (n = 25)						Bison (n = 3)					
	Northern Range	Firehole	Norris	Heart Lake	Mud Volcano	Total	Northern Range	Firehole	Norris	Heart Lake	Mud Volcano	Total
<u>Age</u>												
Adult	8	2	0	0	0	10	1	2	0	0	0	3
Yearling	0	0	0	0	0	0	0	0	0	0	0	0
Calf	4	0	0	0	0	4	0	0	0	0	0	0
Unknown	10	1	0	0	0	11	0	0	0	0	0	0
<u>Sex</u>												
Male	2	0	0	0	0	2	1	0	0	0	0	1
Female	7	2	0	0	0	9	0	2	0	0	0	2
Unknown	13	0	0	0	0	13	0	0	0	0	0	0

Norris Geyser Basin

We surveyed 4 routes in the Norris Geyser Basin totaling 24.1 km traveled. We observed no carcasses but grizzly bear tracks were found along all 4 routes.

Heart Lake

We surveyed 3 routes in the Heart Lake thermal basin covering 23.2 km. We observed no carcasses. Grizzly bear sign, including tracks, rub trees, and other feeding activities, was observed along all routes. Five grizzly bears were seen in the survey area.

Mud Volcano

We surveyed the new route in the Mud Volcano area covering 8.7 km. No carcasses were observed this spring, but grizzly bear tracks were abundant.

According to the WSI, the winter of 2002-2003 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 2002-2003 compared to the relatively severe winter of 1996-1997 (Fig. 7).

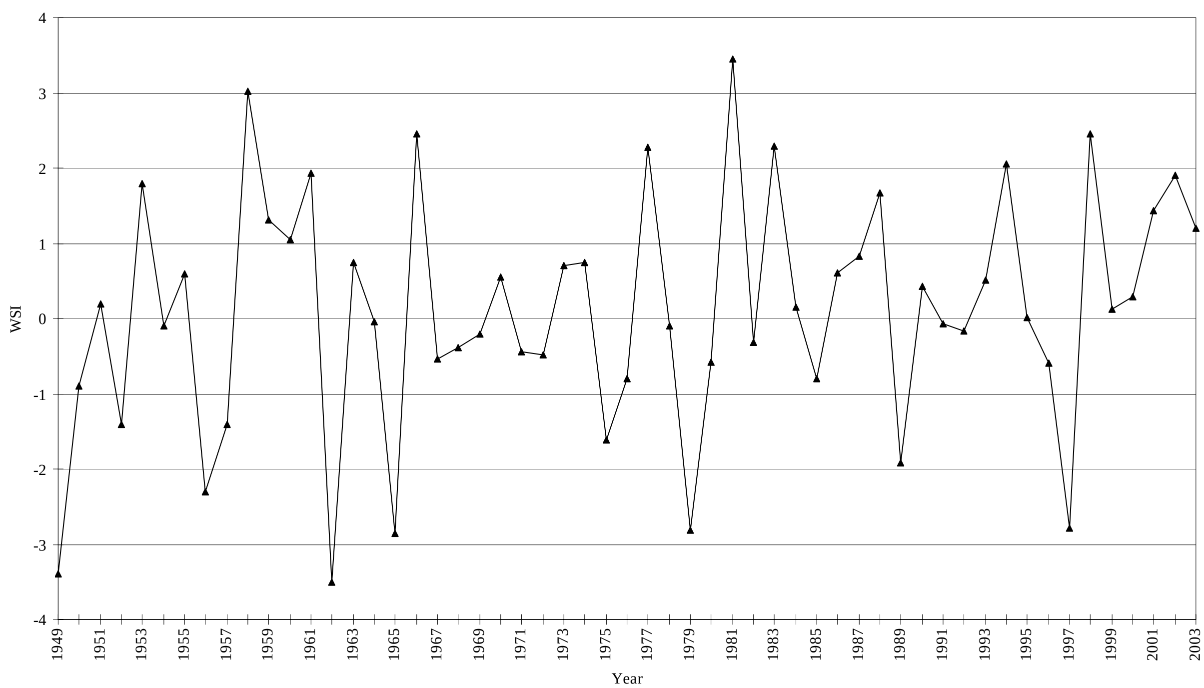

Fig. 6. Winter Severity Index (WSI) for the Northern Range of Yellowstone National Park, 1949-2003.

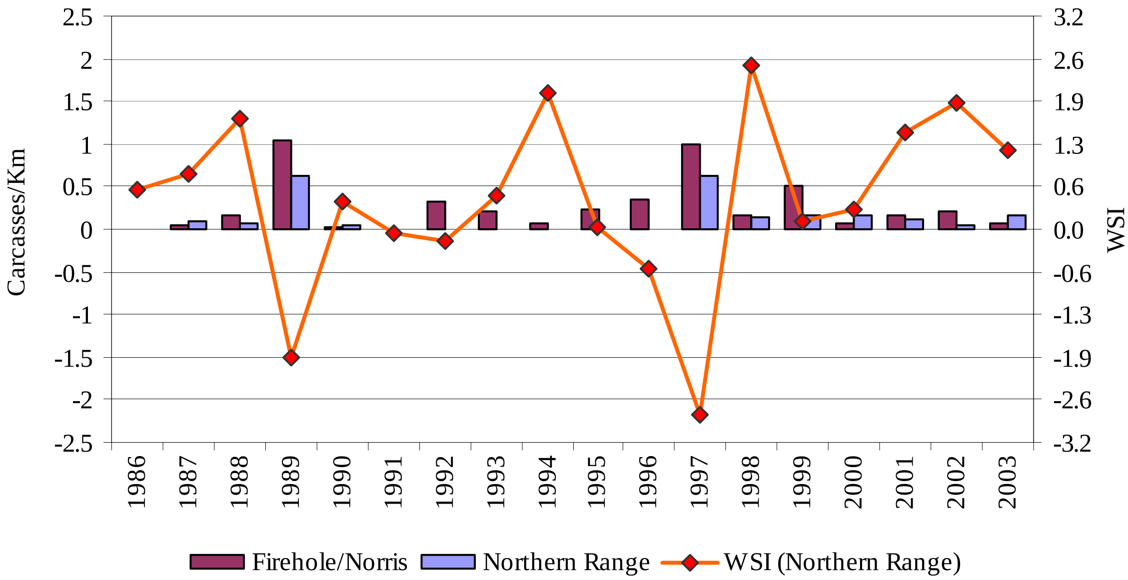

Fig. 7. Winter Severity Index (WSI) for elk on the Northern Range of Yellowstone National Park and ungulate carcasses per kilometer surveyed, 1986-2003.

Spawning Cutthroat Trout *(Kerry A. Gunther, C. Travis Wyman, and Susan Chin, Yellowstone National Park)*

Spawning cutthroat trout are one of the highest sources of energy available to grizzly bears in Yellowstone National Park (YNP) (Mealey 1975, Pritchard and Robbins 1990), and influence the distribution of bears over a large geographic area (Mattson and Reinhart 1995). Grizzly bears are known to prey on cutthroat trout in at least 36 different streams tributary to Yellowstone Lake (Hoskins 1975, Reinhart and Mattson 1990). Haroldson et al. (in review) estimated that approximately 60 grizzly bears likely fished Yellowstone Lake tributary streams annually. Bears also occasionally prey on cutthroat trout in the Trout Lake inlet in the northeast section of the park.

The cutthroat trout population in Yellowstone Lake is now threatened by the introduction of exotic lake trout (*Salvelinus namaycush*) and whirling disease (*Myxobolus cerebralis*) (Koel et al. 2003). Lake trout and whirling disease could depress the native cutthroat trout population and associated bear fishing activity (Haroldson et al. in review). There is evidence that the number of spawning cutthroat trout in Yellowstone Lake is declining. Reinhart et al. (1995) reported a decline in the number of spawning cutthroat trout in North Shore and West Thumb spawning streams during the period 1989-1995, as compared to the period 1985-1987. The downward trend has generally continued in all monitored streams during the period 1996-2003. Non-native lake trout were discovered in Yellowstone Lake in 1994 and have probably been reproducing in the lake since 1986 (Koel et al. 2003). Lake trout are highly predatory on cutthroat trout and have significantly reduced native trout populations in other lakes where they have been introduced (Gerstung 1988, Donald and Alger 1993). Younger age classes of lake trout compete with cutthroat trout for macroinvertebrates consumed by both species (Elrod and O'Gorman 1991). Older lake trout may consume from 50 to 90 cutthroat trout/year (Yellowstone Center for Resources 2002). Without control, lake trout could reduce the cutthroat trout population in Yellowstone Lake by as much as 90% (McIntyre 1996).

Whirling disease was discovered in Yellowstone Lake in 1998 (Koel et al. 2003). Whirling disease primarily affects young cutthroat trout by destroying head cartilage, resulting in loss of equilibrium, skeletal deformities, and inability to feed normally and avoid predators (Yellowstone Center or Resources 2002). Whirling disease has devastated wild trout populations in other waters of the Intermountain West (Nickum 1999). Due to the importance of cutthroat trout to grizzly bears and the potential threats from lake trout and whirling disease, monitoring of the cutthroat trout population is specified under the Yellowstone grizzly bear Conservation Strategy (USFWS 2003). The cutthroat trout population is currently monitored annually using counts at fish traps and during stream surveys (Koel 2001, USFWS 2003).

Yellowstone Lake

***Fish trap surveys*.—**The number of spawning cutthroat trout migrating upstream are counted annually from weirs with fish traps at the mouths of Clear Creek and Bridge Creek on the east and north sides of Yellowstone Lake, respectively (Koel 2001). The fish traps are generally installed in May, the exact date depending on winter snow accumulation, weather conditions, and spring snow melt (Koel 2001). Fish are counted by dip-netting trout that enter the upstream trap box and/or visually counting trout as they swim through wooden chutes

attached to the traps (Koel 2001). An electronic fish counter is also periodically used (Koel 2001).

In 2003, 3,432 upstream migrants were counted in Clear Creek (Koel et al. in press), this represents a 48% decrease from the total of 6,613 trout counted in 2002, and the lowest count since 1994 (Koel et al. 2003). Lake trout are thought to have been illegally introduced into Yellowstone Lake in the mid-1980s (Munro et al. 2001). The number of cutthroat trout counted at Clear Creek has generally declined (Fig. 8) since the mid-1980s (Koel et al. 2003). The number of spawning cutthroat trout migrating up Bridge Creek has also declined in recent years (Koel et al. 2003). In 2003, 86 cutthroat trout were counted migrating up Bridge Creek (Koel et al. in press). This represents a 76% decrease from the 2002 total of 375, and a 96% decrease since monitoring began in 1999 (Fig. 9).

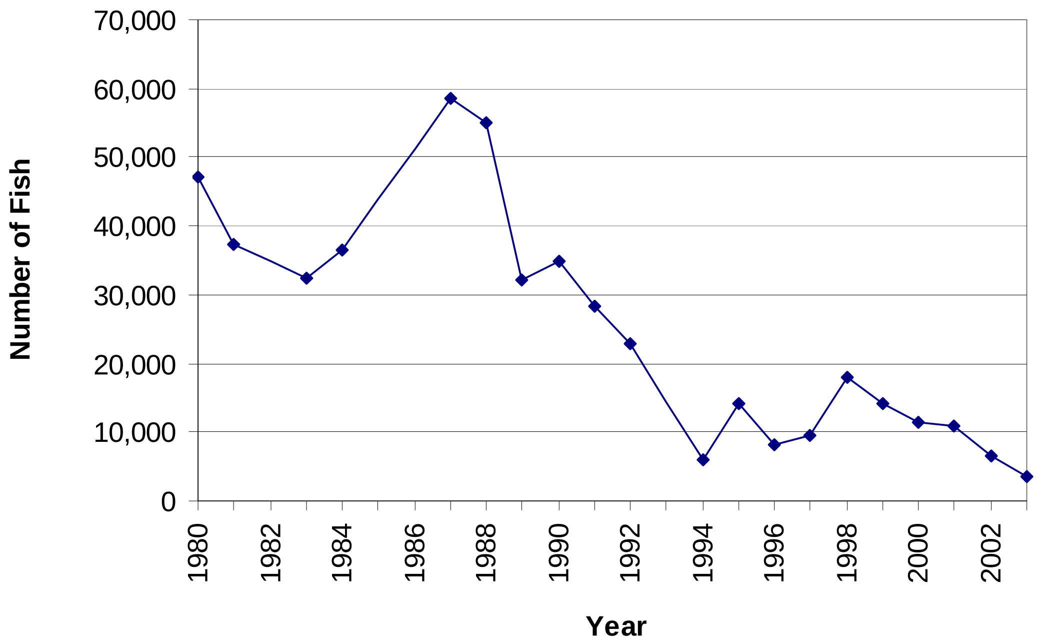

Fig. 8. Number of spawning cutthroat trout counted at the Clear Creek fish trap on the east shore of Yellowstone Lake, Yellowstone National Park, 1980-2003.

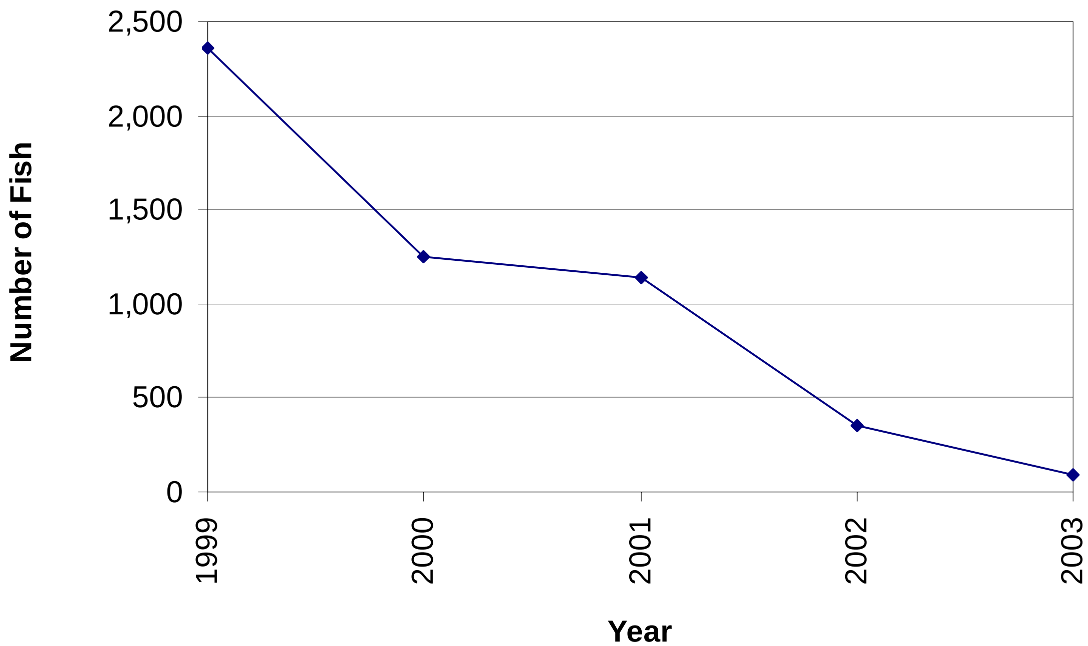

Fig. 9. Number of spawning cutthroat trout counted at the Bridge Creek fish trap on the north shore of Yellowstone Lake, Yellowstone National Park, 1999-2003.

Spawning stream surveys.—Beginning 1 May each year, several streams including Lodge, Hatchery, Incinerator, Wells, and Bridge Creeks on the north shore of Yellowstone Lake, and Sandy, Sewer, Little Thumb, Arnica, and 1167 Creeks in the West Thumb area are checked daily to detect the presence of adult cutthroat trout (Andrascik 1992, Olliff 1992). Once adult trout are found (i.e., onset of spawning), weekly surveys of cutthroat trout in these streams are conducted. Sample methods follow Reinhart (1990), as modified by Andrascik (1992) and Olliff (1992). In each stream on each sample day, 2 people walk upstream from the stream mouth and record the number of adult trout observed. Sampling continues 1 day/week until most adult trout return to the lake (i.e., end of spawning). The peak spawner count (the number of fish counted during the peak week) is used to identify annual trends in the number of cutthroat trout spawning.

Data collected in 2003 continued to show low numbers of spawning cutthroat trout on North Shore (P. Perrotti, National Park Service, personal communication) and West Thumb (E. Reinertson, National Park Service, personal communication) streams. The number of spawners counted in the North Shore and West Thumb streams have decreased noticeably since 1989 (Figs. 10 and 11).

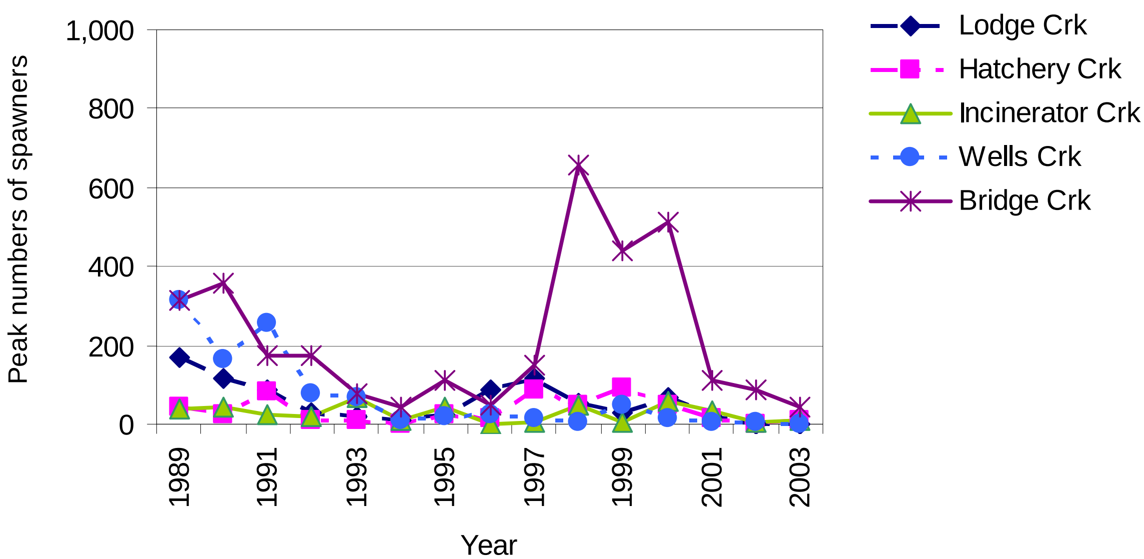

Fig. 10. Number of spawning cutthroat trout counted during the peak week in North Shore spawning streams (Lodge, Hatchery, Incinerator, Wells, and Bridge Creeks) tributary to Yellowstone Lake, Yellowstone National Park, 1989-2002.

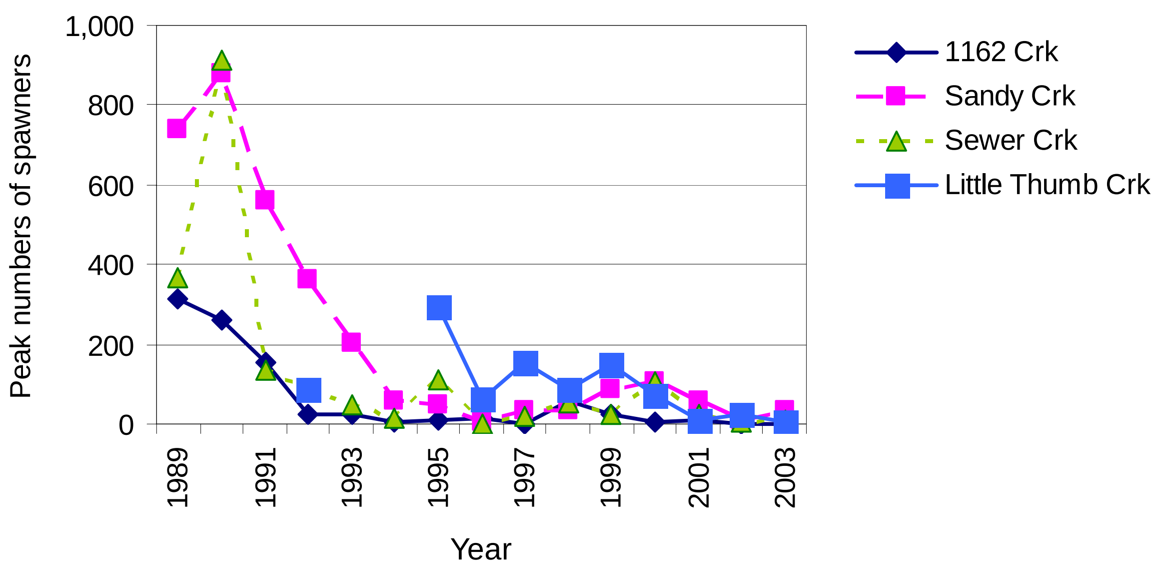

Fig. 11. Number of spawning cutthroat trout counted during the peak week in West Thumb spawning streams (1162, Sandy, Sewer, and Little Thumb Creeks) tributary to Yellowstone Lake, Yellowstone National Park, 1989-2002.

Trout Lake

Spawning stream surveys.—Beginning the first week of June each year, the number of spawning cutthroat trout migrating up the Trout Lake inlet are counted once per week. On each sample day, 2 people walk upstream from the stream mouth and record the number of adult trout observed. Sampling continues 1 day/week until most adult trout return to Trout Lake (i.e., end of spawning). The peak spawner count (the number of fish counted during the peak week) is used to identify annual trends in the number of cutthroat trout spawning.

In 2003, 45 cutthroat trout were counted during the peak week of spawning activity at the Trout Lake inlet. This represents an 82% decrease from the 2002 total of 255, and 90% decrease since monitoring began in 1999 (Fig. 12).

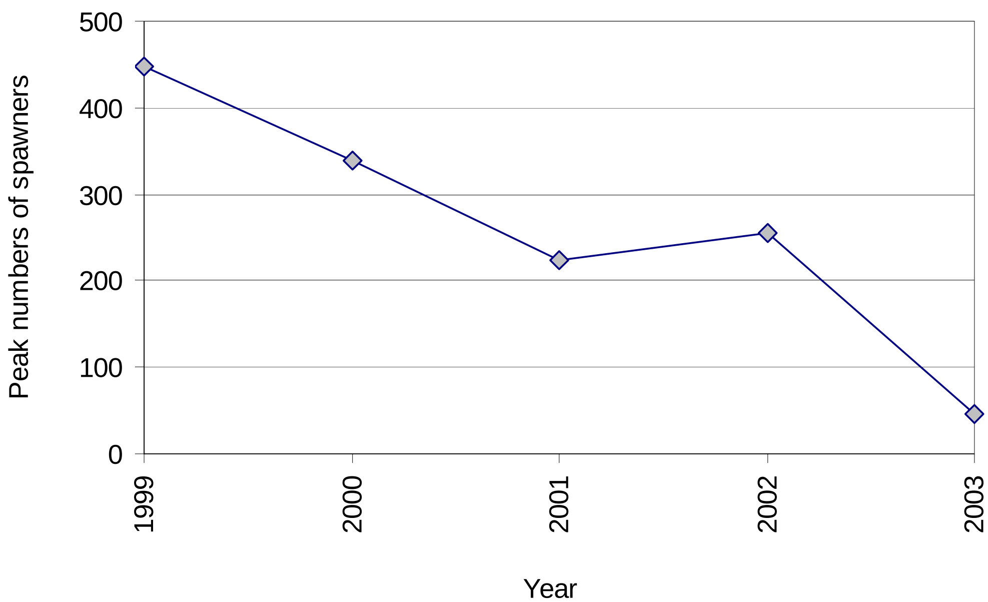

Fig. 12. Number of spawning cutthroat trout counted during the peak week in the Trout Lake inlet, Yellowstone National Park, 1989-2003.

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

Army cutworm moths (*Euxoa auxiliaris*) were first recognized as an important food source for grizzly bears in the GYE during the mid 1980s (Mattson et al. 1991*b*, French et al. 1994). Early observations indicated that moths, and subsequently bears, showed specific site fidelity. These sites are generally high alpine areas dominated by talus and scree adjacent to areas with abundant alpine flowers. 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. Only a few sites have been investigated by ground reconnaissance and the boundaries of sites are not clearly known. In addition, it is likely that the size and location of insect aggregation sites fluctuate from year to year with moth abundance and variation in environmental factors such as snow cover.

Since 1986, when insect aggregation sites were initially included in aerial observation surveys, our knowledge of these sites has increased annually. Our techniques for monitoring grizzly bear use of these sites have changed in response to this increase in knowledge. 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 due to the inability to create polygons around sites with 2 or fewer locations. From 1997-1999, the method for defining insect aggregation sites was to inscribe a 1-km circle around the center of clusters of observations in which bears were seen feeding on insects in talus/scree habitats (Ternent and Haroldson 2000). This method allowed trend in bear use of sites to be monitored annually by recording the number of bears documented in each circle (i.e., site).

A new technique was developed in 2000 (D. Bjornlie, Wyoming Game and Fish Department, personal communication). Using this technique, sites were delineated by buffering only the locations of bears observed actively feeding at insect aggregation sites by 500 m. 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 in the grizzly bear location database from 1 July through 30 September of each year were then overlaid on these polygons and enumerated. 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, annual analysis for this report is completed for all years using this technique. Areas suspected as insect aggregation sites but dropped from the confirmed sites list using this technique, as well as sites with only 1 observation of an actively feeding bear or multiple observations in a single year, are termed "possible" sites and will be monitored in subsequent years for additional observations of actively feeding bears. These sites may then be added to the confirmed sites list. When 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 insect aggregation sites in past years may change as new sites are added, and data from this annual report may not match that of past reports. In addition, as new actively feeding bear observations 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.

Observation of bears actively feeding in 4 new areas resulted in the classification of 4 new possible insect aggregation sites in 2003. No possible sites were reclassified as confirmed sites in 2003 due to a lack of additional active feeding observations at those sites. Some previously known sites were also combined into 1 site because locations from 2003 demonstrated that they were 1 large site without topographical isolation between them. Therefore, a combination of new possible sites and grouping some sites into 1 produced 28 confirmed sites and 24 possible sites for 2003.

The percentage of confirmed sites with documented use by bears varies from year to year, suggesting that some years have higher moth activity than others (Fig. 13). For example, the years 1993-1995 were probably poor moth years because the percentage of confirmed sites used by bears (Fig. 13) and the number of observations recorded at insect sites (Table 16) were low. The number of insect aggregation sites used by bears in 2003 remained constant at 26 (Table 16) and was above the 5-year average of 20 sites/year from 1998-2002. While the percent use of insect aggregation sites remained high in 2003 (Fig. 13), the total number of observations or telemetry relocations at sites decreased by 42% from the record number in 2002 (Table 16). Part of this decrease may be due to flight restrictions in portions of some insect aggregation site areas due to forest fires. However, bear observations on insect aggregation sites were down in all areas with sites, not just in fire-restricted areas.

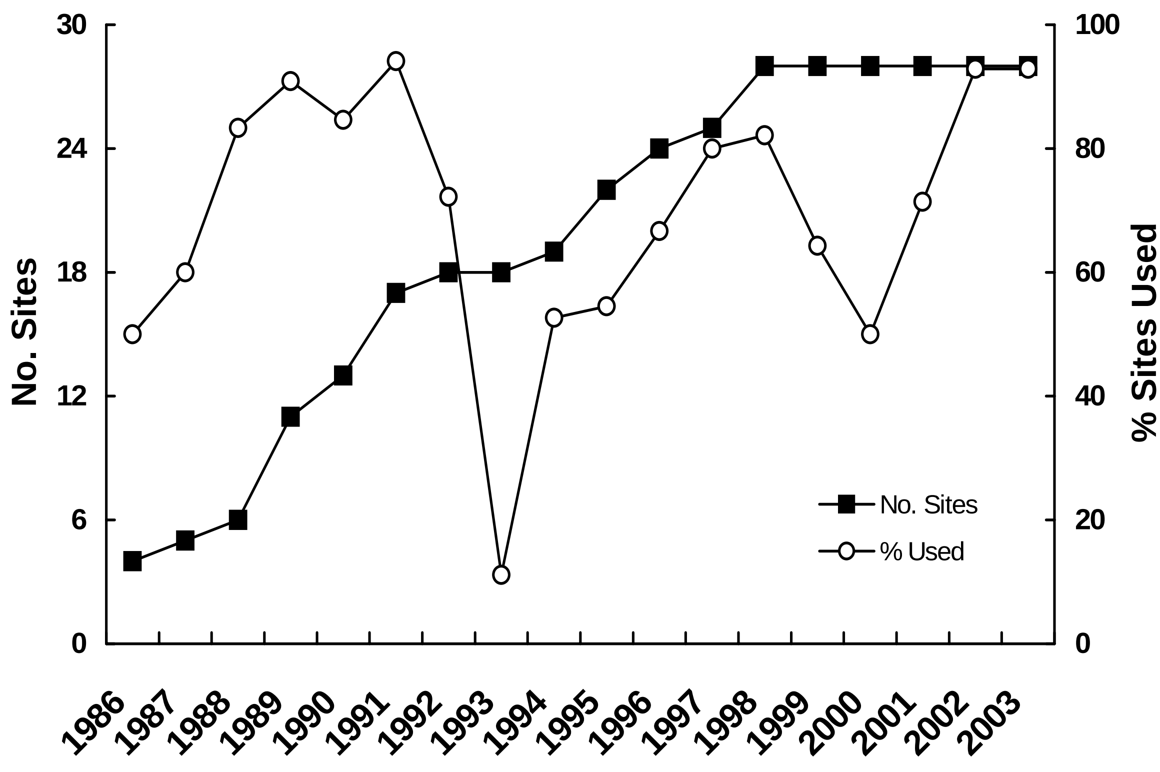

Fig. 13. Annual number of confirmed insect aggregation sites and percent of those sites at which either telemetry relocations of marked bears or visual observations of unmarked bears were recorded, Greater Yellowstone Ecosystem, 1986-2003.

Table 16. The number of confirmed insect aggregation 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 1986-2003.

Year	Number of confirmed moth sites[a]	Number of sites used[b]	Number of locations or observations[c]
1986	4	2	10
1987	5	3	14
1988	6	5	42
1989	11	10	50
1990	13	11	79
1991	17	16	172
1992	18	13	96
1993	18	2	2
1994	19	10	24
1995	22	12	32
1996	24	16	72
1997	25	20	85
1998	28	23	164
1999	28	18	166
2000	28	14	110
2001	28	20	136
2002	28	26	266
2003	28	26	154
Total			1,674

[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, 505 initial sightings of unduplicated females with COY have been recorded, of which 120 (24%) have occurred at (within 500 m, n = 93) or near (within 1,500 m, n = 27) insect aggregation sites (Table 17). Notably, peaks in the number of initial sightings recorded at sites correspond with annual trends in the total number of observations at sites (Table 16) and the percent of insect aggregation sites with documented use (Fig. 13). In 2003, there were 16 unduplicated females with COY observed at insect aggregation sites, an increase of 1 from 2002 (Table 17). Forty-two percent (16 of 38) of the total observations of unduplicated

females with COY were recorded at insect aggregation sites in 2003, a substantial increase from the 5-year average of 18% from 1998-2002. This increase is due not to an increase in the number of females observed on insect aggregation sites, but to a decrease in the total number of unduplicated females with COY observed in the GYE in 2003 (Table 17).

Table 17. Number of initial sightings of unduplicated females with cubs-of-the-year (COY) that occurred on or near insect aggregation sites, number of sites where such sightings were documented, and the mean number of sightings per site in the Greater Yellowstone Ecosystem, 1986-2003.

Year	Unduplicated females with COY[a]	Number of moth sites with an initial sighting[b]	Initial sightings: Within 500 m[b] *N*	Within 500 m[b] %	Within 1,500 m[c] *N*	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
2003	38	9	16	42.1	17	44.7
Total	505		93		120	
Mean	28.1	3.8	5.2	16.4	6.7	21.4

[a] Initial sightings of unduplicated females with COY; see Table 4.
[b] Insect aggregation 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 insect aggregation site for this analysis, since some observations could be made of bears traveling to and from insect aggregation sites.

Survey flights at insect aggregation sites contribute to the count of unduplicated females with COY; however, it is typically 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 (Fig. 14). This suggests that some other factor besides observation effort at insect aggregation sites is responsible for the increase in sightings of female with COY.

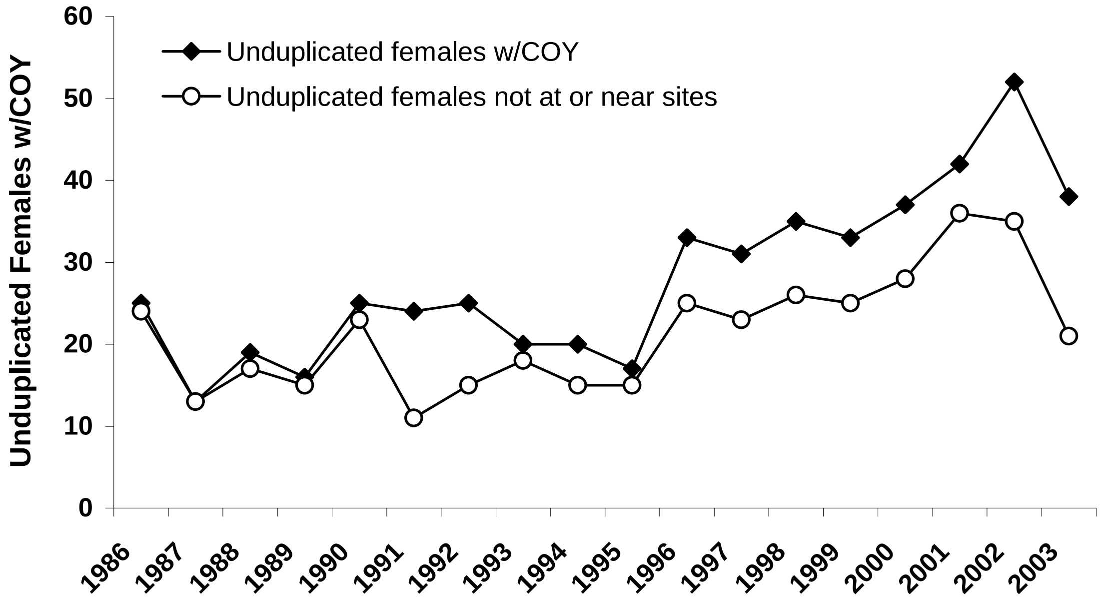

Fig. 14. Numbers of unduplicated females with cubs-of-the-year (COY) observed annually in the Greater Yellowstone Ecosystem and the number of unduplicated females with COY not found within 1,500 m of known insect aggregation sites, 1986-2003.

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).

Army cutworm moths 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.

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.

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 U.S. Geological Survey's 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 microsatellite DNA library was developed for the ACM in January 2001. Eight microsatellite loci (hereafter loci) have been isolated from this library, and polymerase chain reactions (PCRs) are being optimized to amplify these loci. Analyses of the variability at these loci are performed using an Applied Biosystems (ABI) 3730 microsatellite fragment analysis machine and GeneMapper software. Preliminary analyses indicate these loci are variable within and among populations. Because the genetic data will be influenced by when and where ACMs mate, female ACMs are inspected 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, Wyoming Game and Fish Department and the Interagency Grizzly Bear Study Team, U.S. Geological Survey, Northern Rocky Mountain Science Center. Donations from the Turner Foundation, Camp Fire Conservation Fund, Bernice Barbour Foundation, Earth Friends, and National Park Foundation were contributed through the Yellowstone Park Foundation.

Cooperators

Interagency Grizzly Bear Study Team, Yellowstone National Park Bear Management Office; U.S. Forest Service Region 1; Montana State University, Bozeman Agricultural Extension Agents; and the Wyoming Game and Fish Department.

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 28.5 cones/tree on 19 transects read during 2003 (Table 18). Cones were abundant throughout the ecosystem (Fig. 15). Transect results were consistent with qualitative reports by observers throughout the ecosystem (i.e., good cone production overall). Mean cone production per year during 1980-2003 is presented in Fig. 16.

Near 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). Typically, there is a corresponding reduction in numbers of management actions during years of abundant cone availability (Fig. 16). During August-October of 2003, 4 management captures involving 4 bears 2-years of age or older (independent) resulted in 3 transports.

High levels of mountain pine beetle (*Dendroctonus ponderosae*) activity continue in Yellowstone National Park (YNP) and environs. There was 6.3% (12/190) mortality in transect trees between 2002 and 2003. Evidence indicated all of this mortality was due to mountain pine beetle. Approximately 4,452 acres (5%) of whitebark pine stands in YNP have been affected.

Table 18. Summary statistics for the 2003 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
5,079	178	19	28.5	43.6	0	380	267.3	303.5	9	1,443

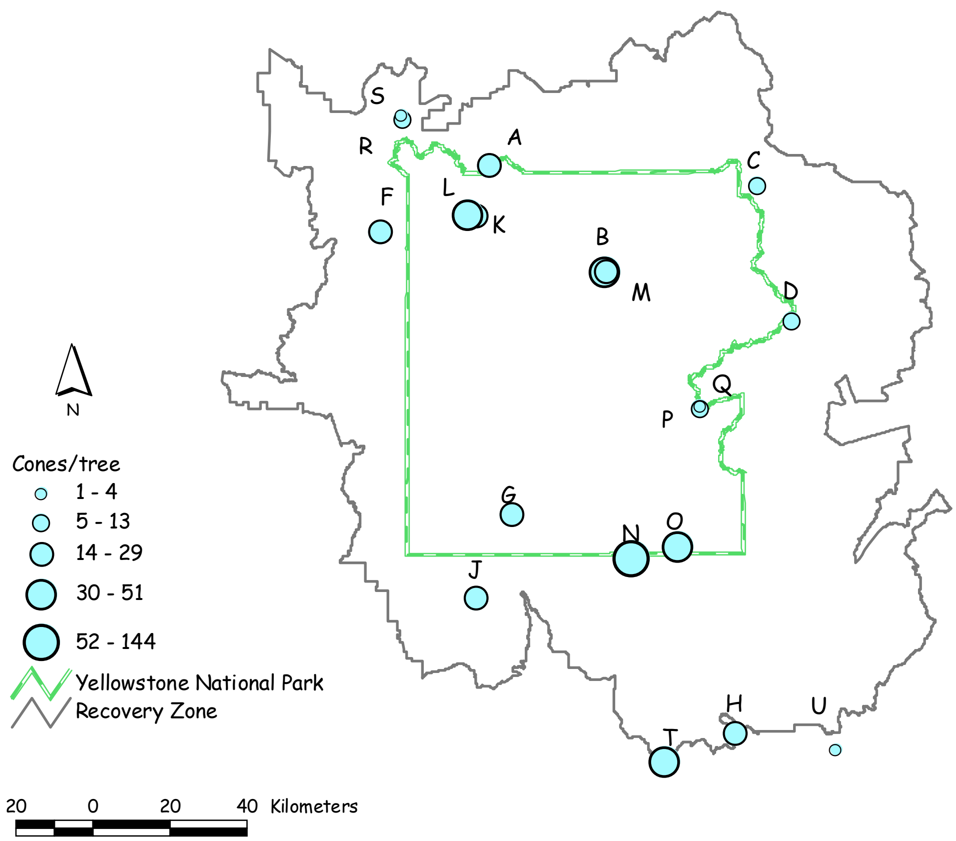

Fig. 15. Average cones per tree for 19 whitebark pine cone production transects surveyed during 2003 in the Greater Yellowstone Ecosystem.

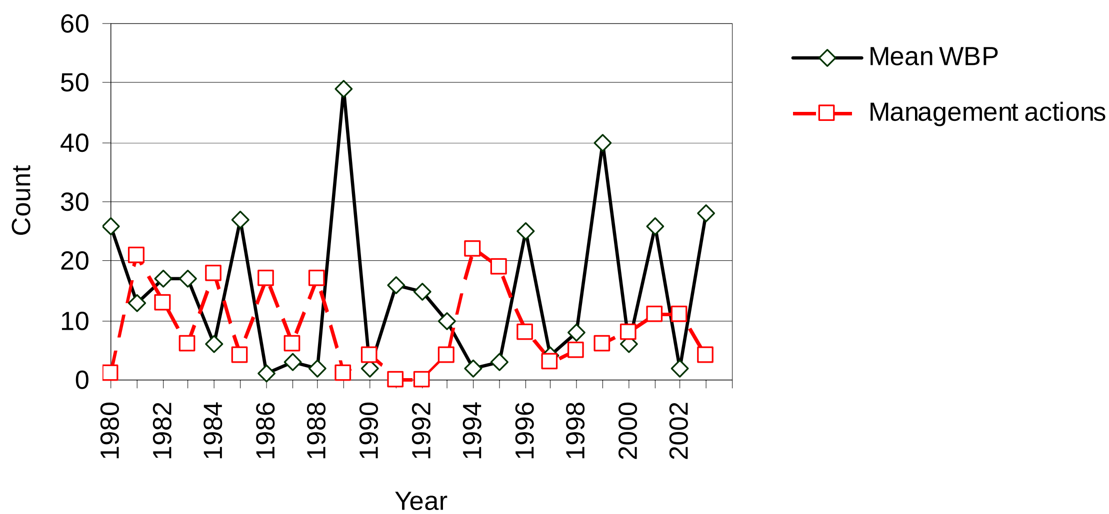

Fig. 16. Mean whitebark pine (WBP) cone production and the number of management actions of grizzly bears older than yearlings during August through October in the Greater Yellowstone Ecosystem, 1980-2003.

Application of Spread Spectrum GPS Telemetry to Assess Grizzly Bear Habitat Use: a Test.
(Shannon Podruzny and Chuck Schwartz, Interagency Grizzly Bear Study Team)

While traditional Very High Frequency (VHF) telemetry has greatly advanced the ability of researchers to study the ways individual bears use their habitat, the technology does have some limitations. Because bears are far-ranging and tend to use very remote habitat, the use of aerial telemetry is often required. Use of aircraft for this application is restricted to times when it is safe to fly, typically during daylight hours on calm, clear days. Depending upon terrain, vegetation, winds, the error associated with estimating radiolocations in this way can average as large as a 300-m radius (Podruzny and Schwartz 2003). The advent of GPS technology has allowed the collection of more precise bear locations during all hours and all weather conditions, but retrieving the location data in time to follow up with field reconnaissance has been problematic. Argos satellite uplink allows for retransmission of GPS fixes to an orbiting satellite and retrieval via computer modem (Schwartz and Arthur 1999). However, the system is limited in the number of locations that can be transmitted. In 2003, the IGBST tested new technology that may solve these problems.

In September, the IGBST deployed the first GPS collars equipped with spread spectrum technology (SST) on grizzly bears in the GYE. Spread spectrum technology allows for interrogation of the collars to collect stored GPS fixes on demand. Two bears, a young adult male and a yearling female, were caught and collared in the interior of Yellowstone National Park. The collars were also equipped with a VHF telemetry beacon and a pre-programmed collar release mechanism. Each collar attempted to acquire GPS fixes on the hour. The collars were located by fixed-wing aircraft and the GPS location data were remotely downloaded to a laptop computer approximately weekly until 15 October, when the programmed release-mechanisms opened and the collars fell off.

Collar Interrogation

Using a wireless receiving unit with an external antenna, contacting each collar and downloading the entire data set usually took about 3-5 minutes. Downloading the data remotely required line-of-sight between the collar and the airplane. Data were successfully downloaded from a distance of up to 4.5 km horizontally from the collared bears and to at least 1,300 m above ground level. If a download attempt failed, gaining elevation usually allowed the next attempt to be successful. Downloads were successful when initiated within 3.2 km of the bear's location, regardless of whether the airplane was approaching, leaving, or passing by the bear.

GPS Fix Success

The SST collars were deployed for 34 days on the male and 26 days on the female. A summary of the counts of GPS fixes acquired by the collars while on the bears is presented in Table 19. Acquisition attempts are coded in the data set as "3D" (3 dimensional calculation), "2D" (horizontal position calculated and vertical position estimated based on previous locations, <3 satellites used), or "Unavailable" (too few satellites available to calculate position). Both 2D and 3D locations were considered successful. Both collars had high successful fix rates, 85.5% for the male and 89.7% for the female. For both collars, 53.7% of the successful fixes were 3D.

Table 19. Numbers of GPS locations acquired by 2 Spread Spectrum Technology-equipped radio collars, Yellowstone National Park, 2003.

		n GPS fixes (%)			
Bear	Dates deployed	Attempted	Unsuccessful	Successful	3D (of successful)
Male	9/11/03 – 10/15/03	785	114 (14.5)	671 (85.5)	360 (53.7)
Female	9/19/03 – 10/15/03	612	63 (10.3)	549 (89.7)	295 (53.7)

Habitat Use Investigations Using GPS Locations

The collars recorded GPS fixes in decimal degrees. We used ArcView 3.3 (Environmental Systems Research Institute 1999) to project them into Universal Transverse Mercator coordinates and transferred the locations as waypoints into a commercially available personal GPS receiver. Using this hand-held receiver to navigate to waypoints, we opportunistically visited 36 of the downloaded locations within a few days of the bears being there. We found evidence of bear activity at 32 (89%) of the locations. Whitebark pine feeding activity comprised most of the activities (26 locations), daybeds (9 locations) and scats (12 locations) were the other predominant signs found. In contrast, we found evidence of bear activity at only 32.1% of 81 VHF telemetry locations investigated during 2002 (Podruzny and Schwartz 2003).

Using the more frequently collected GPS locations also yields a different picture of how bears move across the landscape (Fig. 17). Based on the GPS locations, the male moved a total of 417 km (532 m/hr) whereas the female moved 234 km (383 m/hr). Comparatively, using the VHF locations collected during the same time period would indicate that the male moved only 76.2 km (7 locations, 93.4 m/hr) and the female moved only 36.1 km (6 locations, 57.8 m/hr).

Precision of GPS Fixes

We estimated 95% confidence ellipses by constructing Jennrich-Turner (1969) bivariate normal home ranges (Hooge and Eichenlaub 1997) around locations of stationary collars to obtain estimates of the precision of recorded GPS fixes. Two situations were available for this examination of the 2 collars: (1) after the collars dropped off the bears, the collars remained in place in the field for a day and a half until we retrieved them, and once retrieved (2) we placed them in the open in a suburban/agricultural setting for 4 days. The male's collar dropped off in a flat meadow, whereas the female's collar dropped off in a daybed in whitebark pine/lodgepole pine (*Pinus contorta*) forest on a 25° slope. We calculated confidence ellipses using all acquired fixes (2D + 3D) as well as using only 3D fixes (Table 20). The female's dropped collar had a much lower proportion of 3D fixes than the other situation where the collar was located in the open on flatter ground. The confidence ellipses around that collar were the largest of the group, and had the greatest difference when calculated with all the fixes versus only the 3D fixes. The confidence ellipses ranged from 369 m^2 to 1,957 m^2. This represents a significant improvement over the average 282,600 m^2 error for standard aerial VHF telemetry that we previously reported (Podruzny and Schwartz 2003). While our test of precision here does not directly measure the accuracy of the GPS locations, it is interesting to note that we retrieved both collars by navigating directly to them with a handheld GPS unit and without using a VHF receiver.

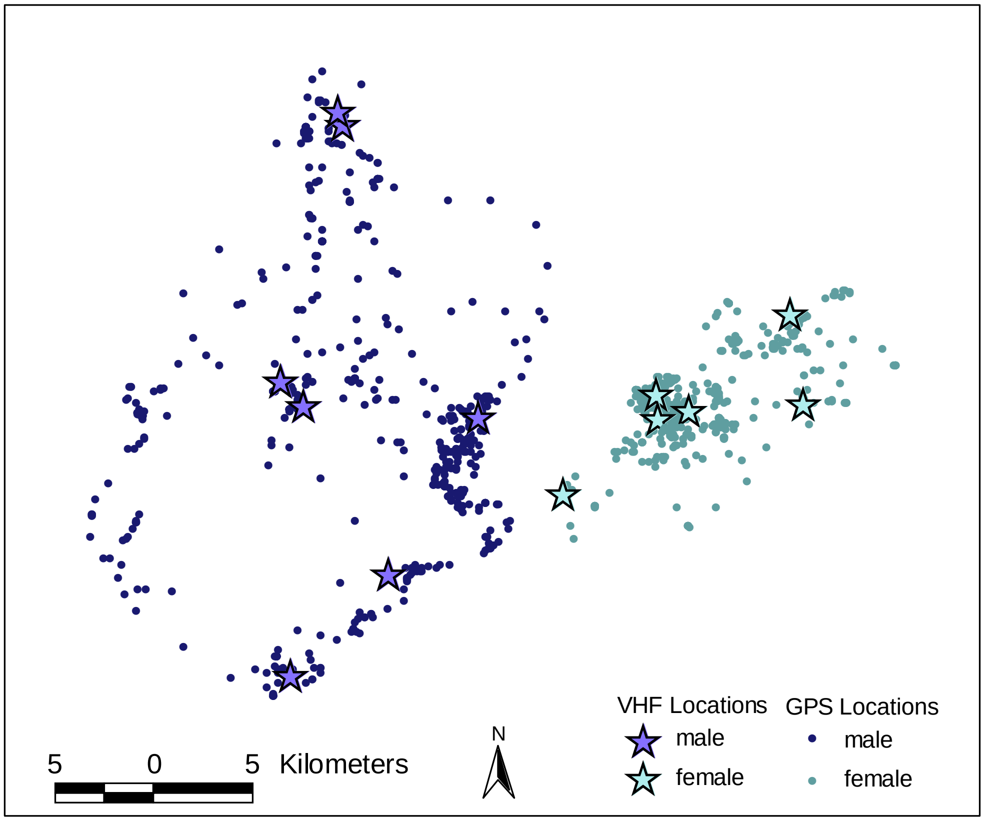

Fig. 17. Global Position System (GPS) and Very High Frequency (VHF) telemetry locations for 2 grizzly bears instrumented with Spread Spectrum Technology-equipped radio collars, Yellowstone National Park, 2003.

Table 20. Ninety-five percent confidence ellipses calculated for 2 stationary GPS collars in 2 testing situations, Greater Yellowstone Ecosystem, 2003.

Bear	Situation	Fix type	*n*	Area (m^2)	Primary axis (m)	Secondary axis (m)	Angle (°)
Male	Dropped	2D + 3D	36	369.4	30.5	15.4	48.0
Male	Dropped	3D only	34	386.9	31.3	15.7	47.9
Female	Dropped	2D + 3D	36	1,957.3	55.1	45.2	-49.2
Female	Dropped	3D only	13	732.2	40.2	23.2	-40.4
Male	Placed	2D + 3D	97	874.4	40.5	27.5	-53.1
Male	Placed	3D only	96	882.7	40.7	27.6	-53.1
Female	Placed	2D + 3D	97	612.8	34.8	22.4	-84.9
Female	Placed	3D only	96	615.7	34.9	22.4	-85.2

Habitat Monitoring

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

In 2003, total visitation in Grand Teton National Park was 4,065,185 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 2,355,693. Backcountry user nights totaled 23,079. Long-term trends of total visitation and backcountry user nights by decade are shown in Table 21.

Table 21. Average annual visitation and average annual backcountry use nights in Grand Teton National Park by decade from 1951 through 2003.

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]	2,523,384	32,459

[a] In 1983 a change in the method of calculation for parkwide visitation resulted in decreased numbers. Another change in 1992 increased numbers. Thus, parkwide visitation data for the 1980s and 1990s are not strictly comparable.
[b] Data for 2000-2003 only.

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

In 2003, 3,019,376 people visited Yellowstone National Park. These visitors spent 661,297 person use nights camping in developed area roadside campgrounds and 45,505 person 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 3,018,624 visitors/year in the 1990s (Table 22). Average annual park visitation has decreased slightly the first 4 years (2000-2003) of the current decade, to an average of 2,909,550 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 22). The number of backcountry use nights is limited by both the number and capacity of designated backcountry campsites in the park.

Table 22. Average annual visitation, auto campground use nights, and backcountry use nights in Yellowstone National Park by decade from 1930 through 2003.

Decade	Average annual parkwide visitation	Average annual auto campground use nights	Average annual backcountry use nights
1930s	333,835[a]	82,331[b]	Data not available
1940s	552,227	139,659[c]	Data not available
1950s	1,355,559	331,360	Data not available
1960s	1,958,924	681,303[d]	Data not available
1970s	2,243,737	686,594[e]	47,395[f]
1980s	2,381,258	656,093	39,280
1990s	3,018,624	690,044	43,702
2000s[g]	2,909,550	663,316	42,967

[a] Data from 1931-1939.
[b] Data from 1930-1934.
[c] Average does not include data from 1940 and 1942.
[d] Data from 1960-1964.
[e] Data from 1975-1979.
[f] Backcountry use data available for the years 1973-1979.
[g] Data for the years 2000-2003 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 Kevin Frey, Montana Department of Fish, Wildlife and Parks)*

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 the 10-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 hunters of sheep (*Ovis canadensis*), moose (*Alces alces*), and deer (*Odocoileus* spp.) use the Recovery Zone and 10-mile perimeter area, their numbers are fairly 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 data set from all states from 1993 to 2003 (Table 23). Complete data only exists from 1993-1996, 1999, and 2001-2002. Elk hunter numbers did not fluctuate significantly during that time frame. Data was not available from Montana during 1997, 1998, and 2003. Due to the hunter/harvest survey program in Montana (survey, analysis, and final reporting), year specific findings will not available until July in the following year. Elk seasons were liberalized, especially in Wyoming in the late 1980s through most of the 1990s. In the late 1990s, as elk populations began to stabilize, the number of elk hunters decreased to reduce total harvest. Hunter numbers in Idaho have not fluctuated significantly over the last 10 years. The increase in Idaho hunters, starting in 2002, is the result of a new method of calculating hunter numbers. Ecosystem wide, complete data is not available for a definitive trend analysis. However, it appears there is a downward trend in hunter numbers from the mid 1990s to the early 2000s.

Table 23. Estimated numbers of elk hunters within the Grizzly Bear Recovery Zone plus a 10-mile perimeter in Idaho, Montana, and Wyoming, for the years 1993-2003.

	Year										
State	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Idaho[a]	2,962	2,682	2,366	3,102	2,869	2,785	2,883	[b]	2,914	3,262	3,285
Montana	18,238	20,942	18,783	18,044	[b]	[b]	16,254	17,329	15,407	17,908	[b]
Wyoming	17,105	17,053	17,464	16,283	17,458	15,439	15,727	12,812	13,591	13,709	11,771
Total	38,305	39,777	38,613	37,429			34,864		31,912	34,879	

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

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

Conservation of grizzly bears in the GYE requires protecting sufficient habitat and maintaining sustainable levels of human-caused mortality. Most human-caused grizzly bear mortalities are directly related to grizzly bear-human conflicts (Gunther et al. 2004; see Appendix A). Grizzly bear-human conflicts also erode public support for grizzly bear conservation. To effectively allocate resources for implementing management actions designed to prevent grizzly bear-human conflicts from occurring, land and wildlife managers need baseline information as to the types, causes, locations, and trends of conflict incidents. To address this need, we record all grizzly bear-human conflicts reported in the GYE annually. We group conflicts into 6 broad categories using standard definitions described by Gunther et al. (2000, 2001). To identify areas with concentrations of conflicts, we calculated the 80% isopleth for the distribution of conflicts using the fixed kernel estimator in the Animal Movements (Hooge and Eichenlaub 1997) extension for ArcView GIS (Environmental Systems Research Institute 1999).

The frequency of grizzly bear-human conflicts is inversely associated with the abundance of natural bear foods (Gunther et al. 2004). In 2003, the availability of high-quality concentrated bear foods was poor during spring, estrus, and early hyperphagia, but good during late hyperphagia. The availability of winter-killed ungulate carcasses was below average in thermally influenced ungulate winter ranges during spring (see *Spring Ungulate Availability*) and the numbers of spawning cutthroat trout were below average during estrus. Early hyperphagia was characterized by drought conditions that caused vegetal bear foods to desiccate early. However, the abundance of whitebark pine seeds during late hyperphagia was significantly higher than average (see *Whitebark Pine Cone Production*) and likely influenced bears foraging at high elevations, and away from human developments.

There were 136 grizzly bear-human conflicts reported in the GYE in 2003 (Table 24, Fig. 18). These incidents included bears killing livestock (47%, n = 64), obtaining anthropogenic foods (38%, n = 52), damaging property (13%, n = 18), and injuring people (2%, n = 2). Most (62%, n = 85) of the conflicts occurred on public land administered by the U.S. Forest Service (53%, n = 72), National Park Service (7%, n = 10), and the State of Wyoming (2%, n = 3). Thirty-eight percent (n = 51) of the conflicts occurred on private land in the states of Wyoming (32%, n = 43), Montana (3%, n = 4), and Idaho (3%, n = 4). Fifty-eight percent (n = 79) of the conflicts occurred outside and 42% (n = 57) inside of the Grizzly Bear Recovery Zone (USFWS 1993). The conflict distribution map constructed using the 80% isopleth identified 3 areas where most grizzly bear-human conflicts in the GYE occurred in 2003 (Fig. 18). These 3 areas contained 97 of the136 (71%) conflicts. The 3 areas where most conflicts occurred included: (1) the headwaters region of the Green, Snake, and Wind Rivers (n = 58) where bears killed cattle and sheep, and ate garbage, human foods, and livestock and pet foods; (2) the Crandall Creek/Sunlight Basin area (n = 22) where bears killed cattle, ate human foods, and damaged buildings, equipment, and vehicles; and, (3) the north and south forks of the Shoshone River (n = 17) where bears ate garbage, human foods, livestock and pet foods, and killed cattle.

The below average abundance of most concentrated high-quality bear foods during the spring, estrus, and early hyperphagia seasons in 2003, was likely off-set by the good abundance of whitebark pine seeds during late hyperphagia. Overall, the numbers of all types of grizzly bear-human conflicts reported in 2003 were similar to the long-term averages recorded from 1992-2002 (Table 25).

Table 24. Number of incidents of grizzly bear-human conflicts reported within different land ownership areas in the Greater Yellowstone Ecosystem, 2003.

Land owner[a]	Total conflicts	Human injuries	Property damages	Anthropogenic foods	Gardens/ orchards	Beehives	Livestock depredations
BLM	0	0	0	0	0	0	0
BDNF	0	0	0	0	0	0	0
BTNF	31	0	0	0	0	0	31
CNF	0	0	0	0	0	0	0
CTNF	0	0	0	0	0	0	0
GNF	4	1	0	0	0	0	3
GTNP/JDR	0	0	0	0	0	0	0
ID-private	4	0	1	3	0	0	0
ID-state	0	0	0	0	0	0	0
MT-private	4	0	0	3	0	0	1
MT-state	0	0	0	0	0	0	0
SNF	37	0	2	14	0	0	21
WY-private	43	0	7	28	0	0	8
WY-state	3	0	1	2	0	0	0
YNP	10	1	7	2	0	0	0
Total	136	2	18	52	0	0	64

[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.

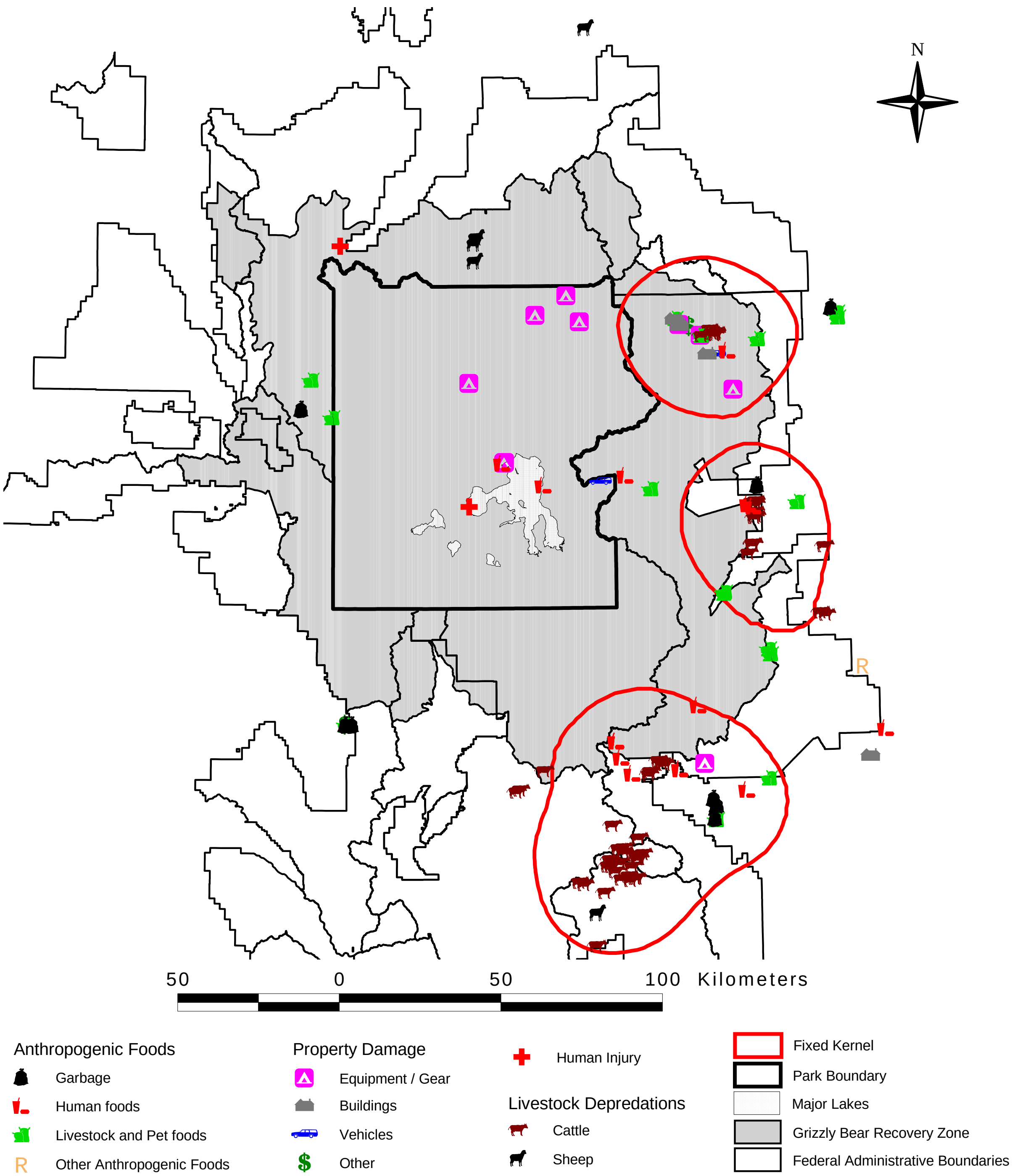

Fig. 18. Locations of different types of grizzly bear-human conflicts reported in the Greater Yellowstone Ecosystem in 2003. Polygons represent concentrations of conflicts identified using the 80% fixed kernel isopleth. The shaded area represents the Yellowstone Grizzly Bear Recovery Zone.

Table 25. Comparison between the number of incidents of different types of grizzly bear-human conflicts in 2003 and the annual average number of conflicts recorded from 1992-2002 in the Greater Yellowstone Ecosystem.

Type of conflict	1992-2002 Average	2003
Human injury	4 ± 3	2
Property damage	16 ± 10	18
Anthropogenic foods	54 ± 46	52
Gardens/orchards	5 ± 3	0
Beehives	3 ± 4	0
Livestock depredations	51 ± 21	64
Total conflicts	134 ± 65	136

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Appendix A.

Grizzly bear–human conflicts in the Greater Yellowstone Ecosystem, 1992–2000

Kerry A. Gunther, Mark A. Haroldson, Kevin Frey, Steven L. Cain,
Jeff Copeland, and Charles C. Schwartz

Abstract: For many years, the primary strategy for managing grizzly bears (*Ursus arctos*) that came into conflict with humans in the Greater Yellowstone Ecosystem (GYE) was to capture and translocate the offending bears away from conflict sites. Translocation usually only temporarily alleviated the problems and most often did not result in long-term solutions. Wildlife managers needed to be able to predict the causes, types, locations, and trends of conflicts to more efficiently allocate resources for pro-active rather than reactive management actions. To address this need, we recorded all grizzly bear–human conflicts reported in the GYE during 1992–2000. We analyzed trends in conflicts over time (increasing or decreasing), geographic location on macro- (inside or outside of the designated Yellowstone Grizzly Bear Recovery Zone [YGBRZ]) and micro- (geographic location) scales, land ownership (public or private), and relationship to the seasonal availability of bear foods. We recorded 995 grizzly bear–human conflicts in the GYE. Fifty-three percent of the conflicts occurred outside and 47% inside the YGBRZ boundary. Fifty-nine percent of the conflicts occurred on public and 41% on private land. Incidents of bears damaging property and obtaining anthropogenic foods were inversely correlated to the abundance of naturally occurring bear foods. Livestock depredations occurred independent of the availability of bear foods. To further aid in prioritizing management strategies to reduce conflicts, we also analyzed conflicts in relation to subsequent human-caused grizzly bear mortality. There were 74 human-caused grizzly bear mortalities during the study, primarily from killing bears in defense of life and property (43%) and management removal of bears involved in bear–human conflicts (28%). Other sources of human-caused mortality included illegal kills, electrocution by downed power-lines, mistaken identification by American black bear (*Ursus americanus*) hunters, and vehicle strikes. This analysis will help provide wildlife managers the information necessary to develop strategies designed to prevent conflicts from occurring rather than reacting to conflicts after they occur.

Gunther, K.A., M.A. Haroldson, K. Frey, S.L. Cain, J. Copeland, and C.C. Schwartz. 2004. Grizzly bear-human conflicts in the Greater Yellowstone Ecosystem, 1992-2000. Ursus 15(1):10-22.