# YELLOWSTONE SCIENCE

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# YELLOWSTONE GRIZZLY BEARS

Bears in Transition, 1959–1970s

From Garbage, Controversy, and Decline to Recovery

Delisting the Yellowstone Grizzly Bear

Management and Monitoring after Delisting

Human Habituated Bears: The Next Challenge

# Landmarks and Landscapes

"THE LIVIN' IS EASY," COURTESY OF MARSHA KARLE

## Twenty-five Years of the Interagency Grizzly Bear Committee

YELLOWSTONE IS BLESSED with many powerful symbols, both natural and cultural, but none of them resonate more richly in our collective imagination than the grizzly bear. We engage the grizzly bear in a relationship that is nothing less than symbiotic. Just as the grizzly bear has enriched the Yellowstone experience, so has Yellowstone enriched the very idea of the grizzly bear in world culture. We who love wildness now employ an amazing array of instruments of wonder, everything from cutting-edge science to spotting scopes to musical composition, in our efforts to do justice to this magnificent creature.

But it's a long way from such lofty sentiments to the day-to-day challenges of caring for the bear and ensuring its survival. This issue of *Yellowstone Science* is especially welcome for its thorough documentation of the development of modern grizzly bear conservation, including the formation of the all-important Interagency Grizzly Bear Committee (IGBC) twenty-five years ago. Those of us who have served on the Interagency Grizzly Bear Committee—and all of you who have had business with us as constituents, advocates, advisors, or staff—also remember difficult decisions and toilsome wranglings beyond counting. It has been a long trail.

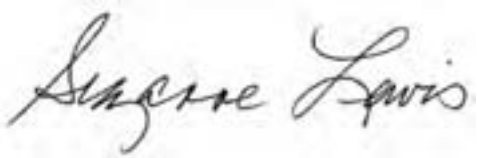
But that rather mundane behind-the-scenes reality just makes celebrating the first quarter century of the IGBC all the more important. We must never forget what is really behind each transcendently glorious view of a backlit grizzly bear on a high ridge. Since 1983, the IGBC has threaded the labyrinths of politics and procedure in fulfilling society's urgent quest to recover the grizzly bear. The nearly spectacular response of the grizzly bear population in greater Yellowstone is the only testament we should ever need to the ultimate value of the bureaucratic arts when they are well and sincerely practiced.

Commemoration of this important anniversary reminds us of earlier historic landmarks, some of which the IGBC was built upon. This year we celebrate the thirty-fifth anniversary of the Interagency Grizzly Bear Study Team, whose extraordinary scientific achievements were essential to our management decisions. The light and wisdom of their work has forever changed our relationship with the grizzly bear.

Just as significant, this year we also celebrate the 125th anniversary of a now-forgotten turning point in American conservation history. On January 15, 1883, Secretary of the Interior H. M. Teller instituted a ban on hunting—for sport or subsistence—in Yellowstone National Park. In that one stroke, he converted the park into a public wildlife preserve of unprecedented size and created the historic opportunity that would eventually lead us to modern ecosystem management.

So we celebrate the IGBC's twenty-fifth birthday and these other landmarks because they've kept this beautiful living symbol abundantly at large on our landscape. But we also celebrate them to remind ourselves of the arduous professional and public conversations that have gone into this success story, and to remind us of many challenging conversations to come. Recovery is a monumental step in the right direction, but there are many steps still to take.

Self congratulation is always a little risky; it should be most reluctantly practiced. But perhaps the next time each of us sees or even thinks about a grizzly bear, we owe ourselves a modest pat on our collective back. Then we should return our attention to the grizzly bear, the real hero of the story. It was, after all, the bear that brought out the best in us and got us this far.



Superintendent, Yellowstone National Park

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*on the cover:*
Grizzly sow and cubs.
NPS photo.

NPS/JIM PEACO

## FEATURES



## DEPARTMENTS

# News & Notes

## Endangered Species Program Recovery Champions Award

Yellowstone Superintendent Suzanne Lewis as well as four of the authors (Chris Servheen, Chuck Schwartz, Mark Haroldson, and Kerry Gunther) of papers in this issue of *Yellowstone Science* received the U.S. Fish and Wildlife Service's 2006 Endangered Species Recovery Champions Award. The award was given to all members of the Interagency Grizzly Bear Committee, the Yellowstone Ecosystem Subcommittee, the Interagency Grizzly Bear Study Team, and the U.S. Fish and Wildlife Service Grizzly Bear Recovery Coordinator for their contributions to the conservation and recovery of the grizzly bear in the Greater Yellowstone Area. The award recognizes U.S. Fish and Wildlife Service employees and partners who are a making a difference in promoting recovery of endangered or threatened species. These individuals have been instrumental in achieving milestones to help advance a species toward recovery. Recovery of this iconic species has required cooperation among numerous federal and state agencies, non-governmental organizations, local governments, and citizens. Collectively, these efforts represent one of the most compelling success stories since the inception of the Endangered Species Act.

NPS/JIM PEACO

NPS/DOUG SMITH

A Leopold pack wolf following a grizzly bear, 2007.

## Grizzly Bears in Yellowstone National Park Do Well First Year After Delisting

On April 30, 2007, the U.S. Fish and Wildlife Service removed grizzly bears in the Greater Yellowstone Ecosystem from threatened species status under the Endangered Species Act. Grizzly bears in Yellowstone National Park did well the first summer after delisting. Fourteen adult female grizzly bears with 33 cubs were observed inside the park. Litter sizes were 7 litters of triplets, 5 twin litters, and only 2 single-cub litters. Average litter size in the park was 2.4 cubs. The number of cubs produced significantly exceeded the number of grizzly bears that died due to human causes ($n$=1). In 2007, there were no grizzly bears killed in collisions with vehicles, and only one nuisance grizzly bear had to be removed in a management action in the park.

## Northern Rocky Mountain Wolves Removed from Endangered Species List

The gray wolf population in the Northern Rocky Mountains is thriving and no longer requires the protection of the Endangered Species Act. As a result, the U.S. Fish and Wildlife Service (USFWS) removed the species from the federal list of threatened and endangered species. The delisting of the Rocky Mountain population took effect on March 28, 2008. There are currently more than 1,500 wolves and at least 100 breeding pairs in Montana, Idaho, and Wyoming.

USFWS-approved state management plans will provide a secure future for the wolf population now that Endangered Species Act protections have been removed and the states have assumed management of wolf populations within their borders. The northern Rocky Mountain distinct population segment includes all of

Montana, Idaho and Wyoming, as well as the eastern one-third of Washington and Oregon, and a small part of north-central Utah.

The recovery goal for wolves in the northern Rocky Mountains was set at a minimum of 30 breeding pairs (a breeding pair represents a successfully reproducing wolf pack) and a minimum of 300 individual wolves for at least three consecutive years. This goal was achieved in 2002, and the wolf population has expanded in size and range every year since.


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The yearlings trapped on Stevenson Island in transit across Yellowstone Lake.

## Update on Yearling Grizzly Bears Rescued from Stevenson Island

In June 2005, Bear Management Office (BMO) staff successfully trapped and translocated two yearling grizzly bears that had been stranded on Stevenson Island. The BMO had received a report of an adult female grizzly bear with two yearlings there. BMO staff investigated the shore around the island and found tracks of an adult grizzly bear and at least two yearlings. Numerous bear scats were also found. The age and quantity of the tracks and scats indicated that the bears had likely been present on the island before the ice broke up on Yellowstone Lake in May.

BMO staff placed a bait station and made a track pit (raked the ground of a likely travel corridor smooth and clear of debris, to make subsequent tracks clearly visible) to determine if the bears were still present on the island. When the bait station was revisited, tracks of two yearlings but no adults were found, suggesting that the adult female may have swum for shore and abandoned the two yearlings. Because of their small size, the yearlings may have been afraid to swim the 1.4 miles to the nearest shore at the Gull Point/Sand Point area.

Although there was plenty of succulent vegetation for the bears to graze, the types and quantity of late summer and fall bear foods were rather scarce. Thus, it was likely that if the bears remained on the island they would have starved to death, as has happened in the past. Because grizzly bears were a threatened species, the decision was made to capture the bears and translocate them back to the mainland.

The two yearlings (both females) were captured, measured, tagged, and weighed (71 lbs. and 76 lbs.). They were underweight for their age but healthy. Their chances for survival were estimated at 50%, and as high as 80% if they rejoined their mother on the mainland. The cubs were allowed to fully recover, and then transported to the South Arm of Yellowstone Lake for release. They were monitored by telemetry for the rest of the summer and, based on their movements, were thought to have survived the summer and fall. By late fall 2005, both bears had lost their transmitters and could no longer be monitored.

On October 13, 2007, the Interagency Grizzly Bear Study Team captured one of the yearlings in a research trap in Flat Mountain Arm of Yellowstone Lake. The now three-year-old bear was identified from the lip tattoo applied when the bear was captured on Stevenson Island. She was slightly small for her age, but she had a layer of fat and was generally healthy, weighing 176 pounds. The fate of her sibling is unknown.


NPS/JIM PEACO

Orphaned and marooned yearling grizzly bear from Stevenson Island being released on the mainland, 2005.


BOB WESELMANN

## White-tailed Jackrabbits, Species of Interest

Recent newspaper accounts that white-tailed jackrabbits had been extirpated from Yellowstone National Park are unfounded. These accounts have generated a lot of interest in both the historical and contemporary abundance and distribution of white-tailed jackrabbits in the park. In 1926, park naturalist M. Skinner reported that white-tailed jackrabbits were "common between Gardiner and Mammoth Hot Springs, and may also be seen almost anywhere in the open northern sections of the Park." Today, white-tailed jackrabbits are still regularly observed from the park boundary at Reese Creek east to Gardiner, and south to the Mammoth Terraces. The distribution of white-tailed jackrabbits in the park appears to have changed very little since the 1920s. They occupy grassland-sagebrush communities below 6,500 feet that receive less than 16 inches of annual precipitation. White-tailed jackrabbits are also occasionally observed on the Blacktail Plateau, but appear to occur at much lower densities in that area. Park staff are still investigating the current and historical presence, abundance, and distribution of jackrabbits in the Lamar Valley.

## Grizzly Bear #539 Captured and Sent to Washington

A three-year-old female grizzly bear weighing approximately 140 pounds was captured on August 19, 2007, after frequenting two developed areas near Yellowstone Lake for the last two years. Grizzly #539 had entered the Lake Village and Fishing Bridge developments numerous times. She had been hazed away from those areas more than 40 times using beanbag rounds, cracker shells, and other techniques. This bear had previously been relocated by boat to the opposite side of Yellowstone Lake and by helicopter to the Gallatin Mountains in Yellowstone National Park. She returned to the Lake Village and Fishing Bridge developed areas after both relocations. She was responsible for at least eight instances of property damage, mostly by chewing hoses used for sewage hookups on employee trailer houses.

Because multiple hazing and relocation efforts were not effective, the decision was made to remove the bear. She was captured and driven to the Washington State University Bear Research, Education, and Conservation Program. For more than 20 years, the bear management program in Yellowstone has assisted with and benefited from the non-invasive ecology, nutrition, and physiology studies on bears performed there. More information on the program is available at http://www.naturalresources.wsu.edu/research/bear-center/index.html.

The Yellowstone National Park bear management policy strives to ensure a natural and free-ranging population of black and grizzly bears. This bear was habituated to people, had been involved in several instances of property damage, and had also received some minor food rewards. Bears that are both conditioned to human foods and habituated to human presence often become dangerous to people. Removal was considered the best course of action in this case to prevent human injury and further property damage.

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Grizzly bear #539.

# Bears in Transition, 1959–1970s

*Mary Meagher*

NPS/JOHN GOOD

Grizzly bears at the Trout Creek dump, 1964.

BY GOOD CHANCE, my time in Yellowstone spanned major additions to the park's knowledge of bears, both grizzly and black, as well as changes in management of both bears and people. Perhaps most importantly, the park's attitude toward bears shifted from tolerating (sometimes with amusement) a certain level of problems generated by bear access to human foods to one of what bears should be in a place managed as a natural area. I have been fortunate to observe, learn from, and sometimes, be involved with the changes because I came to work in Yellowstone in October 1959. Although the following discussion focuses on the park's grizzly bears, much of what is said applies also to the black bear population.

Almost since the establishment of the park, simply protecting bears had been deemed sufficient. Along the way, anecdotal information about bears accumulated, and some basic techniques developed for dealing with problems as they occurred. Some bear-caused human injuries—although unfortunate, certainly—were also a part of the bear scene. But the 1960s and the first half of the 1970s marked a fundamental transition period, especially for the grizzly bear, and more so than we recognized at the time. From the bears' perspective, this transition was biological, but concurrently, there were transitions of a human sort, in priorities, responsibilities, and attitudes. Schullery (1992) traced much of this in detail.

## Reactive Bear Management

Prior to the 1960s, our knowledge of Yellowstone bears consisted mostly of observational natural history (an often necessary foundation). In 1959, Yellowstone National Park had no research program of any kind nor were research biologists employed by the National Park Service. Research oversight was mainly carried out by naturalists in the interpretive division. They handled collecting permits and provided an office contact for interested scientists, be they from the academic world or from other government agencies, such as the U.S. Fish and Wildlife Service. Independent researchers, although few in number, were likewise welcome, but any collected specimens had to be deposited in a public institution. Depending on the research topic, there might be some coordination with the ranger division, and some oversight provided by rangers whose districts might be involved.

Bear management was the responsibility of the ranger division, charged then, as now, with law enforcement and resource protection. Although a management biologist position existed from about 1962 to 1968 to oversee the artificial regulation of ungulate numbers that was deemed necessary at the time, the position had little to do with bear management. Present-day resource management specialists, the successors of the management biologists, were unknown. At the time of the transition period discussed here, and before, bear management consisted mostly of reacting to problems as they occurred, and were usually handled by the rangers responsible for the locale involved. Oversight was provided by district and assistant chief rangers, with involvement by the chief or higher administrative levels as circumstances dictated.

Bear problems were those of bear–human conflicts in campgrounds and developed areas (both bear species) and along park roads (almost always black bears). Management

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Visitors were encouraged to view bears at dumps, ca. 1920s.


NPS, YNP, DANECKI, YELL 27353-7

Visitors at the Otter Creek bear feeding grounds, ca. 1930s.

techniques were basic: live-capture of problem bears with manually-operated culvert traps, coupled with relocation within the park to sites accessible by road. The ranger who was the most experienced person I knew at dealing with bear problems advocated blueberry pie as the best bait (G. Mernin, personal communication). Incorrigible returnees were dispatched, occasionally sent to zoos, otherwise shot. At the time, backcountry use was infrequent compared to the present and consisted mostly of outfitters with horse parties. Hikers were few, and backcountry problems were not an issue.

Well before the transition period addressed here, park files showed increasing concern about human injuries and property damage from both species of bears, especially after World War II as park visitor numbers and their attendant garbage and camp foods escalated. For example, ranger Jim Valder noted in a memorandum to the assistant chief ranger (JBV 1959) that although human injuries decreased from 74 to 37 from 1957 to 1959, property damage incidents increased from 32 to 66, and bears killed by park staff from 32 to 66. These numbers must have been partial only, as Schullery (1992:294) shows property damage for the same three years to have been 125, 117, and 269. With numbers such as these, complaints undoubtedly escalated. A park visitor (Andrews 1956) stated that he and his family counted 71 bears (probably mostly black bears, campground and roadside) during their 48-hour visit to the park, which included a stay at the Canyon campground. He mentioned the "free and frequent roaming of bears through this campground," and stated that his wife was appalled at their numbers and boldness and wished to leave immediately. He further criticized the sanitation involved.

Management of people entailed both human activities and their residue. To some extent, personnel from all park divisions had a role in addressing the where, when, and kinds of human activities, but garbage management, in whatever form and source, was a function of the maintenance division. The bulk of garbage was seasonal, derived from the hotels, restaurants, campgrounds, and other visitor-use facilities open in summer; this coincided with a highly visible level of bear activity. The summer season was much shorter then; peak operations extended through July into August, but declined rapidly about the last week of that month as travel decreased before schools opened. A winter operation did not exist, and the so-called shoulder seasons of the present were nearly non-existent.

At the beginning of the 1960s, open-pit garbage dumps were used for reasons of custom, cost, convenience, and lack of alternatives. Five or six dumps were distributed throughout the park, placed within reasonable transport distance from the various developments—roughly 8 miles or less (Cole 1970). Additionally, a large dump that served West Yellowstone was located a few miles north on Forest Service land adjacent to the park boundary, and a small dump was located at the east edge of Cooke City outside the park's northeast corner. The town of Gardiner used a dump inside the park a mile and a half west of the north entrance, just north of the Stephen's Creek road. The dumps "grew" from the park's beginnings, even as park visitation increased. There were no bear-proof garbage cans, dumpsters were non-existent, and incinerators did not appear until about the mid-1960s. The two unfenced incinerators that served Bridge Bay and Grant Village were located ¼ to 2 miles from those respective developments. A third incinerator was located just below the lower housing area of Mammoth, but was fenced (Cole 1970). Unfortunately, the quantity of garbage edible by bears, coupled with limited incinerator capability, resulted in cooked edibles rather than ash (G. Mernin, personal communication), ensuring that the incinerators, particularly the two interior ones, would attract bears even closer to developments.

A comment here is pertinent regarding the composition of garbage during much of the 1960s. Commercial suppliers of quality, prepared food as used now by concessionaire kitchens were non-existent. Hotels prepared food in their kitchens from basic supplies, resulting in a high level of waste, trimmings,

spoilage, etc., similar to that which occurs in home preparation, but the quantities involved from the hotel kitchens were enormous by comparison. This food preparation system vastly increased the amount of garbage that went to the open-pit dumps. Garbage consisted, therefore, of a great quantity of edibles and non-edibles, such as cans, bottles, and the occasional hotel spoon, lost from the flatware of a dining room, all mixed together. Large non-edible items to be disposed of, such as wood or metallic junk, went to so-called dry dumps, although it is possible that occasional edibles were included.

## Bear Research Begins

Except for Olaus Murie's 1944 study of Yellowstone bears, there was little systematic effort to gather what would now be termed ecological and population data. A long-term grizzly bear study, commonly referred to as the Craighead study, began in 1959 and lasted until 1971. It was led by John Craighead, of the Montana Cooperative Wildlife Research Unit-U.S. Fish and Wildlife Service at the University of Montana in Missoula, and his brother Frank, then a professor of ecology at the State University of New York, Albany. Their field work was based at the old concessionaire auto repair buildings south of the main Canyon development, which facilitated their primary focus on the Trout Creek dump in Hayden Valley.

According to information in park files, John Craighead's first overture to the National Park Service was made to the Washington office (Craighead 1958). He expressed concern for the apparently declining number of grizzly bears in Montana, but said that he could not locate a good study site with enough bears for research. Yellowstone National Park seemed to offer a suitable place to study ecological and population factors. He had visited the Trout Creek dump with the chief park naturalist, Dave Condon, in the summer of 1958 and had discussed the idea of a study with him and the assistant chief park naturalist, Dave (Merrill D.) Beal. Condon was most encouraging (Condon 1958), and the study was subsequently endorsed by the superintendent, Lon Garrison (Garrison 1958). Trout Creek dump, which served the large facilities at Canyon, Lake, and Fishing Bridge, offered an unmatched quantity and variety of edibles for bears and, accordingly, attracted the largest number of grizzly bears and other scavengers, including ravens, magpies, and dozens of seagulls. The suggestion to use dumps as study sites was understandable in the circumstances of the time.

During the earlier years of the Craighead study, the park service made efforts to protect marked study bears. Removal of problem bears from campgrounds and developed areas was delayed compared to the quick removal (relocation or killing) in the past. But marked bears were dump bears because that is where bears were marked. Based on data gathered by Maurice Hornocker (1962), a graduate student who assisted the Craigheads, Cole (1971) estimated that up to 100 different grizzly bears were using the Trout Creek dump, while Rabbit Creek and the West Yellowstone dumps each attracted an estimated 40 bears. Dump location, at a "reasonable" distance from developments, facilitated grizzly bear use of campgrounds as more bears learned about these sources of human food but

CRAIGHEAD COLLECTION

John and Frank Craighead at Trout Creek, where they began their grizzly bear study in 1959, photo circa 1966.

NPSD. A. BROWN

Weighing a grizzly for the Craighead study, 1961.

remained in the population. As visitor numbers increased, so did garbage and camp foods. Episodes such as the following became appallingly frequent. In a span of four hours at the 400-site Canyon campground in the mid-1960s, rangers saw seven different grizzly bears and five different black bears (G. Mernin, personal communication). This underscores the lack of food and garbage security then; there was none. A ranger's workday morning usually began with bear-caused property damage reports, but a rather amazing lack of personal injuries.

Eventually the park had breeding grizzly boars in the campgrounds. About 1971 or 1972, I was a fascinated observer of an attempted live capture at Canyon campground. Rotten fish were the bait for a culvert trap. A big black shape of a boar materialized in the darkness, got his fish, and disappeared soundlessly. Not surprisingly, bear visitation to campgrounds came to include mother grizzlies with cubs-of-the-year, and these mothers are particularly sensitive to the welfare of their cubs, making an especially bad mix for all concerned. Numbers of bears in the campgrounds escalated as young bears learned from their mothers. From 1966 through 1975, rangers spent their days on regular duties, and their nights trying to prevent havoc in their campgrounds, sometimes just disappearing to sleep where they could not be found when the day operation could be handed off to experienced personnel. Yellowstone developed some of the best field-experienced bear management rangers in the National Park Service. Fortunately for bears, rangers, and visitors, the training-ground has closed, recognizing the rare circumstance when that kind and level of bear expertise might be wanted.

Coincidentally, during the early years of the Craighead study, a National Academy of Science review (Robbins et al. 1963) expressed an appalled reaction to the state of natural history research conducted by the National Park Service throughout the park system. The authors advocated "mission-oriented research" in keeping with the unique management obligations of the agency to maintain park resources in a natural and "unimpaired" condition. This report, coupled with a very public and heated controversy that peaked during the mid-1960s over Yellowstone's elk reductions, unquestionably added impetus to the assignment of Glen Cole to the newly-created position of supervisory research biologist in Yellowstone in 1967.

That same year, the Craigheads (Craighead and Craighead 1967) submitted a number of management recommendations to the park superintendent, among which was one that advocated grizzly bears be "weaned" slowly from use of the garbage dumps. They believed that nutritionally, garbage was a necessary supplement for the bears, although this was not supported by data. Hornocker (1962:87), a graduate student working with the Craigheads, discounted garbage as much of an influence on grizzly bear population numbers, but John and Frank's perspective likely was based on their concern about

NPS

Grizzly bears congregated to feed at the Trout Creek dump, 1970.

the size of the Yellowstone grizzly bear population, which they estimated to average 174.

John and Frank also had other concerns for grizzly bear welfare. Their study data underscored the role of dumps as an influence on bear movements and concentrations, including grizzlies from beyond park boundaries. The Craigheads believed that maintaining an attractive food source roughly central to the park would help protect grizzly bears from conflicts with people, which sometimes resulted in bear mortality. They advocated a phase-out of the open-pit garbage dumps over some years, to give the bears a better opportunity to adjust to natural foods in summer rather than scattering into various developments in search of human foods (Craighead et al. 1995:364 were more specific, advocating 8 to 10 years or longer for a phase-out). Alternatively, as a substitute if the dumps had to be closed abruptly, their recommendation was to provide bison and elk carcasses as supplemental food.

## Garbage in Transition

Concession management changes in the park began to affect the garbage dumps. Instead of preparing meals from scratch, in about 1968 the hotel and restaurant kitchens began purchasing the prepared foods that were becoming much more available (B. Hape, personal communication). This decreased the quantity of garbage available to bears considerably, and abruptly. Even so, an estimated 7,000 tons of edible garbage was available to bears from June 1 to September 15 in 1968 and 1969 (Cole 1970). By then, only the Rabbit Creek dump north of Old Faithful, and the Trout Creek dump in Hayden Valley were still in use in the park.

Shortly after the change in food preparation methods, Executive Order #11507, dated February 4, 1970, required the closing of open-pit garbage dumps on federal lands. From a sanitation perspective, this was long overdue, as the dumps in places such as Yellowstone had become large and nasty as park visitation increased. At Trout Creek dump, the largest, seepage from rotting garbage and chemicals from non-edibles polluted the stream (Meagher, personal experience). Too, the dumps had become increasingly dangerous over the years as people, including employees, came to watch the bears. After the season of 1970, the last large open pit garbage dump in Yellowstone closed.

## Postscript on the Craigheads' Study

The various administrative changes coupled with much more emphasis on natural area management altered the milieu in which the Craigheads established and conducted their grizzly bear study. Simply put, the Craighead focus was on grizzly bears single-mindedly; that of park management was on Yellowstone as a whole, of which grizzly bears were only one element. The objective of the park service was to maintain as natural an area as possible. Not surprisingly, controversy developed between the Craigheads and park management, particularly over the open-pit garbage dumps and their role in the grizzly bear livelihood, but the focus here is primarily on the biology involved.

## Bear Survival without Human Foods

Consider that before Yellowstone was established, both species of bears apparently had survived quite well, and probably had since large mammals colonized the Yellowstone plateau after the Pleistocene ice vanished. It seems unlikely that the grizzly bear population would need nutritional supplements during summer, as recommended by the Craigheads. Springtime, after emergence from dens, and fall, when bears need to acquire extra body reserves for the long winter ahead, would appear to be more critical to their nutrition than was summer. And spring and fall were the times when supplemental food from garbage and campground foods were unavailable.

The bears, obviously, had to survive the critical early and late seasons on natural foods. For example, during the very late spring of 1970, Cole (1972) noted that from March 29 through May 30 there were 330 grizzly bear observations, of which 64% involved interactions with ungulates. He estimated 30 different grizzlies were involved. Among employees, the word was out that almost daily bears could be observed taking elk along the roads that transected the Firehole-Madison north to the Norris areas (Meagher, personal information).

Another point should be made concerning ungulates as food for bears. Management reductions, once thought necessary to regulate population numbers, ceased with the end of

WILLIAM CAMPBELL

Grizzlies returned to natural foods when the dumps closed.

winter in 1967 for bison, and 1968 for the elk. Bison numbers parkwide had been reduced to about 400 (Meagher 1973) and the northern Yellowstone elk to a winter count of 4,865 (Houston 1982:17). Left alone, these populations increased rapidly. By 1975, the winter count of bison was 1,049 (Meagher, unpublished), and the northern Yellowstone elk had increased to 12,607 (Houston 1982:17). Even as sources of human foods disappeared, the potential increased for "good" bears to scavenge winter-killed carcasses as an important natural food source. For spring 1981–1982, I estimated a biomass of 140,600 pounds of winter-killed bison available to scavengers (National Park Service 1984:94). This would be conservative, representing only documented carcasses.

> The park cannot guarantee a visitor will see a bear, but we should be able to guarantee that if a bear is seen it's living as a proper bear should.

Beyond the Craigheads' approach to management of grizzly bears, they also recommended a zoning and manipulative approach for other wildlife species. Concerning black bears, not a study subject for the Craigheads, they endorsed the enjoyment of the visiting public in observing black bears along park roads, while recognizing that feeding should cease (in reality, one was not possible without the other, as the then-ubiquitous black bear would not hang out along a road if it were not being fed). None of this reflected the management philosophy of a national park as a natural area. This philosophy had developed over some decades, but was articulated increasingly by the 1960s, and was accompanied by stronger emphasis on legal interpretations of the act that established the National Park Service in 1916.

Neither the park service nor the Craigheads could foretell what would be the outcome of their divergent views. Limited experience with a dump closure at Glacier National Park in the 1960s appeared to occur with minimal problems (Schullery 1980, 1986). In Yellowstone with the onset of World War II, lack of visitors ensured that garbage everywhere in the park was reduced, and the bear-feeding grounds that operated as shows for the public were closed. Problems escalated as garbage-conditioned bears sought human sources of food elsewhere, and bears were killed. But the habitats of the two parks differed, and so did the numbers and kinds of assorted scavenger populations, including bears, that used the dumps.

Yellowstone field personnel certainly had doubts, because as visitation tapered down rapidly at the end of August and garbage decreased, more bears entered the campgrounds (G. Mernin, personal communication). But in spite of doubts, the park service elected to try phasing out the dumps, in an effort to address the Craigheads' recommendation regarding "weaning." As a first step toward phase-out, the garbage was separated into edibles and non-edibles, with only edibles taken to the dumps. Partly, the decision to try a phasing-out program was made because the incinerators then in use could not cope with the quantity of mixed garbage, and separation might allow effective de-odorizing of the non-edibles (G. Mernin, personal communication). But because of the kitchens' shift to the use of prepared food, the separated edibles, which were still taken to the dumps, were considerably reduced. The apparent result was that dominant bears could possess the goodies, and there was a sharp increase in campground and developed area grizzly bear activity. When separation ceased, the conflicts settled down, relatively (Cole 1970, 1976).

## After the Dumps Closed

The garbage dump closures and the disengagement of their host of grizzly bears and other scavengers could not succeed without addressing all available sources of human foods parkwide. In particular, food could not be available to black bears along roads and in campgrounds with any hope of solving the grizzly bear problem. Deliberate feeding of bears along roads and elsewhere had been formally prohibited in 1902, but enforcement was feeble to non-existent. Partly this was a technological problem; despite efforts to secure garbage in campgrounds, the bears readily solved the access problem. When a widely-used, step-peddle lever affair with an underground pit was tried in the Canyon campground in the mid-1960s,

NPS

Black bear investigating a bear-proof garbage can, late 1960s–mid 1970s.

NPS/CANTER

Grizzly-damaged garbage can, 1970.

bears sometimes were in the garbage within five minutes (G. Mernin, personal communication). A bear-proof garbage can finally appeared in the late 1960s, the design similar to that used to secure mailboxes. These were in place on nearly all park garbage cans by the mid-1970s (Cole 1970). The design worked, although a few of the biggest, experienced grizzlies did gain access, simply by crushing the whole set-up. This may have been a problem mainly at the Fishing Bridge RV park, where the concession operator had installed cans of a lighter-weight metal (G. Mernin, personal communication).

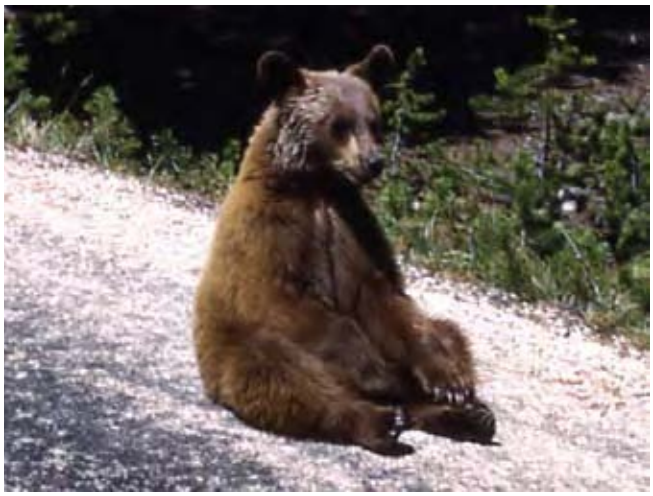
Additionally, there was a determined program of instructing the people in campgrounds to secure ice chests and camp foods where bears could not get at them, such as in car trunks or recreational vehicles, and otherwise informing campground users regarding food availability and bears. Citations followed for people who ignored the warnings. Experience had taught park personnel how readily bears learned about food: in cars with slightly-open windows, inside tents, ice chests, or wherever else odors were retained, bears would attempt to get at food. For experienced bears, sight was sometimes enough of a lure; ice chests were a prime example.

So as the last of the open-pit garbage dumps closed (Rabbit Creek in 1969, Trout Creek in 1970, West Yellowstone outside the park in early 1971) and human foods became mostly unavailable, what of the bears? During the first half of the 1970s, the park went through the unpleasant task of removing what were termed incorrigible bears, those that returned time and again to seek human foods and became habituated to human activities. Relocation was tried whenever possible, but in the end, most of the knowledgeable grizzly bears were dispatched, to be used as scientific specimens. The black bear clean-up mostly took care of itself once food sources became unavailable, and the roadside black bears began to vanish. Determined incorrigibles were relocated or removed. This broke the chain of learning that had been fostered by mother black bears bringing their cubs to roadsides and campgrounds.

In marked contrast to the present, in which control actions for bears are infrequent to rare, in 1970 park staff carried out 70 control actions involving 50 different grizzly bears (Cole 1976). Twenty bears were removed permanently, including 12 sent to zoos. Record keeping was difficult at the time and information sources don't always match, but because of the painstaking overhaul of numbers done in the late 1970s by biological technician Sue Fullerton for Paul Schullery (1992 and earlier editions), I have elected to use his removal numbers. Suffice to say that 1970 was the peak year for dealing with problem grizzly bears after the dumps were closed, bear-proof garbage cans were mostly installed, and intensive education and law-enforcement measures were instituted. By 1976, management emphasis had shifted to a program of mostly prevention.

Hindsight being what it is, and as we all came to understand more about bear behavior, intelligence, and capacity to learn, it became clear that only an abrupt closure of garbage dumps and attendant efforts to ensure secure storage of human foods would have been successful. The continuity of learning as bears passed along knowledge had to be terminated abruptly. The evolutionary heritage of bears seems to include the ability to remember for a lifetime where they got a good meal, even perhaps only once. This trait would have served the bears well, as natural food sources commonly are inconsistent over time. But this same trait dictated that the park could only "grit teeth and tough out" an unpleasant time and program.

My personal experience underscored that the bear situation could only have been cleaned up with an abrupt and thorough denial of human foods for bears. After the Trout Creek dump closed, I stopped by to look it over, usually several times every summer, for 12–15 years, as it was close to my most-used travel route up Hayden Valley while doing bison research. The surface of the dump had been covered over with earth fill, and there was no possibility of new edibles (the road was closed also), but every time I could see where "someone" had dug into the surface. Just checking.


NPS/R. ROBINSON

Roadside black bear on Dunraven Pass, 1962.

## Future Prospects for Yellowstone Bears

The bears have come a long way, biologically. That's important. But it happened only because many people, including the Assistant Secretary for Fish, Wildlife, and Parks and Yellowstone's superintendent and his staff, were willing to take on a tough and very contentious resource issue, with lots of unknowns. Fortunately for the bears, these people were successful. The park cannot guarantee a visitor will see a bear, but we should be able to guarantee that if a bear is seen it's living as a proper bear should.

Consider, however, that if bears again became as visible to the public as when sources of human foods were available, with the 3 million visitors that came to the park in 2007, the park would sort of congeal. Roads would be jammed far beyond the current scene caused by viewing of assorted wildlife. Bear-caused injuries, now fewer than those caused by the occasional human–bison encounter, would escalate, and it seems probable that the prevention of a host of other negative people–wildlife conflicts would become an operational impossibility. It's necessary to emphasize that bears will again be along the roadsides as *predictable* occurrences, as they once were, if they are fed. Same spot, same bear, no guesses necessary as to cause. The bears could be especially vulnerable to such a shift because some individuals are fairly habituated to human observers, and could be that much more easily fed while being watched. And a fed bear eventually is a dead bear.

A program of prevention becomes increasingly hard to maintain. People become euphoric, knowledge and experience decrease or vanish, and management priorities change. Present-day levels of visitation, coupled with increasing budget and staffing constraints, could again result in roadside bears becoming the bear equivalent of "the urban rat" (a 1969 report for Canadian and U.S. national parks, quoted in Schullery 1992:219).

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NPS/BRIAN HARRY

Grizzly bear cubs.


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*Grizzly Bears in the Greater Yellowstone Ecosystem*

# From Garbage, Controversy, and Decline to Recovery

Mark A. Haroldson, Charles C. Schwartz, and Kerry A. Gunther

NPS/AL NASH

IN THE 30 PLUS YEARS since dumps in Yellowstone were closed and loss of a large portion of the population precipitated listing under the Endangered Species Act, the grizzly bear has recovered in numbers and expanded its range in the Greater Yellowstone Ecosystem (GYE). Here we provide a brief account of the history and concerns for the future that have shaped its story.

Prior to European settlement of North America, grizzly bears could be found from northern Alaska south through Canada and the western United States and into northern Mexico (Rausch 1963). In the contiguous United States, habitat was altered or destroyed by farming, ranching, livestock grazing, logging, mining, and development of cities, towns, and homesteads. Important bear foods like salmon, elk, and bison were greatly reduced by dam building, market hunting, and competition with livestock. Primarily during the 1920s and 1930s (Servheen 1999), the grizzlies' historical range decreased nearly 98% (Mattson et al. 1995). Of the 37 grizzly bear populations known to exist in 1922, 31 were gone by 1975. In the West, grizzly bears were poisoned, shot, and trapped to reduce depredation on domestic cattle, sheep, and poultry. A stockman captured the prevailing attitude in the 1920s: "The destruction of these grizzlies is absolutely necessary before the stock business…could be maintained on a profitable basis" (Bailey 1931).

Yellowstone National Park (YNP) was established in 1872 to protect the area's geysers, thermal features, and scenic wonders. However, due to its remoteness and the protections afforded by national park status, it also became one of the last refuges for grizzlies in the lower 48 states (Craighead and Craighead 1967). Grizzly and black bears became one of the park's most popular attractions (Schullery 1992). By the 1880s park visitors enjoyed watching bears that gathered to feed at garbage dumped behind the hotels. As early as 1907, park staff were killing some black and grizzly bears because of conflicts with people (Craighead and Craighead 1967). By 1910, black bears

had learned to panhandle for food from tourists traveling in horse-pulled wagons (Schullery 1992). The first recorded bear-caused fatality occurred in 1916, when a grizzly bear killed a wagon teamster in a roadside camp (Schullery 1992).

When cars replaced horses and wagons, the number of park visitors and the amount of garbage they left behind increased. More garbage attracted more bears and park managers even encouraged bear viewing at some dumps by providing log bleachers and interpretive rangers (Schullery 1992). Unfortunately, this mix of people interacting with food-conditioned bears created problems. From 1931 through 1969, bears caused an annual average of 48 human injuries and 138 incidents of property damage (Gunther 1994). After a bear killed a woman in the Old Faithful Campground in 1942, Congress criticized park managers for failing to solve the bear problems (Schullery 1992).

In 1960, in response to public complaints of personal injury and property damage by black bears in many national parks, the National Park Service implemented a Bear Management Program and Guidelines (National Park Service 1960). This program included: (1) expanded visitor education about bear behavior, ways to reduce conflicts, and proper storage of food, garbage, and other attractants; (2) prompt and efficient garbage removal to make bears less dependent on garbage as a food source; (3) strict enforcement of regulations prohibiting bear feeding; (4) use of tip-proof garbage cans and development of better bear-proof garbage cans; and (5) removal of bears that were potentially dangerous, habitual beggars, or damaging property in search of human food. Although these guidelines reduced the availability of garbage, they did not eliminate it. Because bears were still attracted to roadsides and developments by human foods and garbage, the 1960s program did not significantly reduce human injuries or property damages.

## A New Bear Management Program

In 1963, an Advisory Committee to the National Park Service issued a report titled "Wildlife Management in the National Parks" that recommended maintaining park biotic communities in as near a primitive state as practical (Leopold et al. 1963) and nearly complete removal of human influence on wildlife populations to allow natural processes to work. In 1968, YNP closed two of its dumps, one at West Thumb and one at Tower. The Leopold report, in combination with the fatal mauling of two women by grizzly bears in separate incidents in Glacier National Park, the frequency of bear-caused injuries and property damages in YNP, and new environmental regulations for open-pit garbage dumps, led to the implementation of a more intensive Bear Management Program in YNP in 1970. Its goals were to: (1) maintain populations of grizzly and black bears as part of the native fauna at levels that were naturally sustainable; (2) eliminate human food and garbage from the bears' diet; (3) reduce bear-inflicted human injuries and bear-caused property damage; and (4) reduce the number of bears removed from the park in management actions (Cole

Table 1. Comparison of demographic and reproductive data between the pre-dump (1959–1970) and post-dump (1983–2002) closure grizzly bear population in the Greater Yellowstone Ecosystem.

| | Time Period | |
|---|---|---|
| **Reproductive and Demographic Parameters** | Pre-dump closure, 1959–1970 | Post-dump closure, 1983–2002 |
| Age of first pregnancy | 5.3 years[a] | 5.8 years[b] |
| Inter-litter interval | 3.29 years/litter[c] | 3.16 years/litter[d] |
| Average litter size | 2.10 cubs/litter[e] | 2.04 cubs/litter[f] |
| Average number of females producing cubs annually | 14 females/year[g] | 25 females/year[h] |
| Average total number of cubs produced annually | 31 cubs/year[i] | 51 cubs/year[j] |
| Reproductive rate | 0.61 cubs/year/female[k] | 0.636 cubs/year/female[l] |
| Ecosystem population estimate | 312[m] | 571[n] |
| Population density | 1 grizzly per 25 $mi^2$ [o] | 1 grizzly per 23–35 $mi^2$ [p] |
| Area occupied | 5 million acres[q] | 8.5 million acres[r] |

[a]Craighead et al. 1995:178
[b]Schwartz et al. 2006*b*:19
[c]Craighead et al. 1995:175
[d]Schwartz et al. 2006*b*:20
[e]Craighead et al. 1995:173
[f]Schwartz et al. 2006*b*:19
[g]Craighead et al. 1974:14
[h]Haroldson 2006:12
[i]Craighead et al. 1974:14
[j]Haroldson 2006:12
[k]Craighead et al. 1995:176
[l]Schwartz et al. 2006*b*:22
[m]Craighead et al. 1995:81
[n]Haroldson: in press
[o]Craighead et al. 1995:81
[p]Ruth et al. 2003:1152
[q]Craighead et al. 1995:81
[r]Schwartz et al. 2002:209

# John and Frank Craighead – Pioneers in Grizzly Bear Research

In 1959, brothers John and Frank Craighead and their dedicated team began their research of grizzly bears in the Yellowstone ecosystem. Their innovative approaches led to the development of methods to safely capture, immobilize, age, and mark grizzly bears. Nearly 50 years ago, they developed the first radio-transmitter collar and directional receiver used on wide-ranging animals and tracked two grizzlies to their winter dens. Today, radio telemetry is one of the most important tools used by wildlife biologists. It enabled the Craigheads and their graduate students at the University of Montana to learn about bear behavior and movements, and to document grizzly bear social structure, reproduction, survivorship, mortality, population dynamics, food habits, habitat use, and spatial requirements. They experimented with and eventually perfected the mapping of grizzly bear habitat using LANDSAT satellite imagery data. They studied grizzly bear intra-specific behavior in the large aggregations at the Trout Creek and Rabbit Creek garbage dumps. With the data that they collected, the Craighead brothers' team was able to calculate the age of first reproduction, inter-birth interval, average litter size, and reproductive rate for grizzly bears as well as how population age structure influenced population dynamics. This information would later enable biologists to make valuable demographic comparisons between the pre-dump closure (and pre-threatened species status) population and the population that was delisted in 2007 (Table 1).

In 1988, John and Frank received the National Geographic Centennial Award (along with Jane Goodall, Jacques Yves Cousteau, and Richard Leakey). In 2001, the brothers were presented with the U.S. Fish and Wildlife Service Great Bear Stewardship Award at the International Bear Biology Association meetings held in Jackson, Wyoming. They were also inducted into the Wyoming Outdoor Hall of Fame in 2006. Frank Craighead died October 21, 2001, in Jackson, Wyoming, at the age of 85. John is retired, in good health, and resides in Missoula, Montana.

CRAIGHEAD COLLECTION

John (left) and Frank Craighead, August 1966.

USGS/STEVE ARD

Ten of the 20 grizzly bears seen on a bison carcass *at the same time* on August 3, 2007, at Alum Creek in Hayden Valley.

1976). In addition to strict enforcement of regulations prohibiting the feeding of bears, the new program called for bear-proof garbage cans and dumpsters and the closure of all the park's garbage dumps (Cole 1976, Meagher and Phillips 1983).

Today most people would agree that the new Bear Management Program was a success. However, in 1970, the decision to close the park's last two garbage dumps was highly controversial and very unpopular. Park visitors expected to see and photograph panhandling black bears lining the roads and grizzly and black bears feeding at garbage dumps in and around park developments. Brothers John and Frank Craighead, pioneers of grizzly bear research, agreed that the dumps were inconsistent with National Park Service management philosophy, but believed they played a crucial role in reducing human-caused bear mortality. The highest proportion of grizzly bear mortality in the GYE occurred outside YNP (Craighead and Craighead 1967). Park dumps, especially the Trout Creek dump located in the center of bear range, attracted the largest concentration of bears, including many from outside the park (Craighead and Craighead 1967). When inside the park these bears were not exposed to hunting or killed due to depredations on livestock or conflicts with people and property on private land. The Craighead brothers recommended that the National Park Service leave the Trout Creek dump open indefinitely (Craighead and Craighead 1967). The Craigheads also recommended that if the dumps were to be closed, they be closed gradually over a period of 8–10 years or longer, and that the park provide elk and/or bison carcasses to the bears to ease their transition to a natural diet (Craighead and Craighead 1967, Craighead et al. 1995). They opposed a rapid phase-out of the dumps, especially the Trout Creek dump. They believed an immediate closure of all dumps would not allow bears adequate time to develop new feeding habits. They believed that rapid closure would increase conflicts, management removals, and mortality both inside and outside the park (Craighead and Craighead 1967, Craighead et al. 1995).

Today most people would agree that the new Bear Management Program was a success. However, in 1970, the decision to close the park's last two garbage dumps was highly controversial and very unpopular.

The National Park Service believed a gradual phasing out of dumps would result in several more generations of bears becoming dependent on human foods, leading to more bear–human conflicts over time (National Academy of Sciences 1974, Schullery 1992). Park managers wanted to shorten the adjustment period and reduce the time required for emergency measures to prevent injury to people and damage to property (National Academy of Sciences 1974). The current belief was that there were two populations of bears: garbage bears and "backcountry" bears. It was felt that backcountry bears would not be affected by dump closures. After obtaining the advice of the National Sciences Advisory Committee (Leopold et al. 1969), park authorities chose to close the park's remaining

two dumps quickly (Craighead et al. 1995) in 1970 and 1971 (Meagher and Phillips 1983). The state of Montana closed the three dumps in the park gateway communities of West Yellowstone, Gardiner, and Cooke City in 1970, 1978, and 1979, respectively (Meagher and Phillips 1983).

Within 12 years (1968–1979), all municipal dumps in the GYE that had aggregations of grizzly bears were closed and many bears that previously ate garbage dispersed in search of alternative foods (Craighead et al. 1995). Many of the bears that came into conflict with people at developed sites, campgrounds, private homes, and on cattle and sheep allotments were removed by the National Park Service and the state fish and game agencies from Wyoming, Montana, and Idaho, or were killed by private citizens (Craighead et al. 1988). At least 140 grizzly bear deaths were attributed to human causes during 1968–71 (Craighead et al. 1988). Bears that were trapped but not killed generally had their ear tags and/or radio collars removed. Due to the disagreement between the Craighead brothers and the park over the dump closures and restrictions placed on their research and publications that the brothers did not accept, their research permit in Yellowstone was not renewed after 1971 (Schullery 1992, Craighead et al. 1995).

As a consequence of the high grizzly bear mortality following the dump closures, the lack of current information about the population after the Craigheads' research ended, and increasing concerns about the future welfare of grizzly bears, Secretary of the Interior Rogers C. B. Morton established a Committee on the Yellowstone Grizzlies led by the National Academy of Sciences in February 1973. This committee was asked to "study and evaluate data on the population dynamics of the grizzly bears in Yellowstone National Park and to make recommendations concerning the scientific and technical implications of those data." Some key conclusions of the committee included: (1) the ecosystem supported one grizzly bear population and should be managed as such; (2) prior to dump closures the population was relatively stable, with a conservative estimate of 234 bears; (3) the population was reduced substantially during 1968–73; (4) it was necessary to mark an element of the population in order to estimate new biological parameters; (5) there was no convincing evidence that the population was in immediate danger of extinction; and (6) a conservative policy of removals should be pursued until better information on population parameters was available.

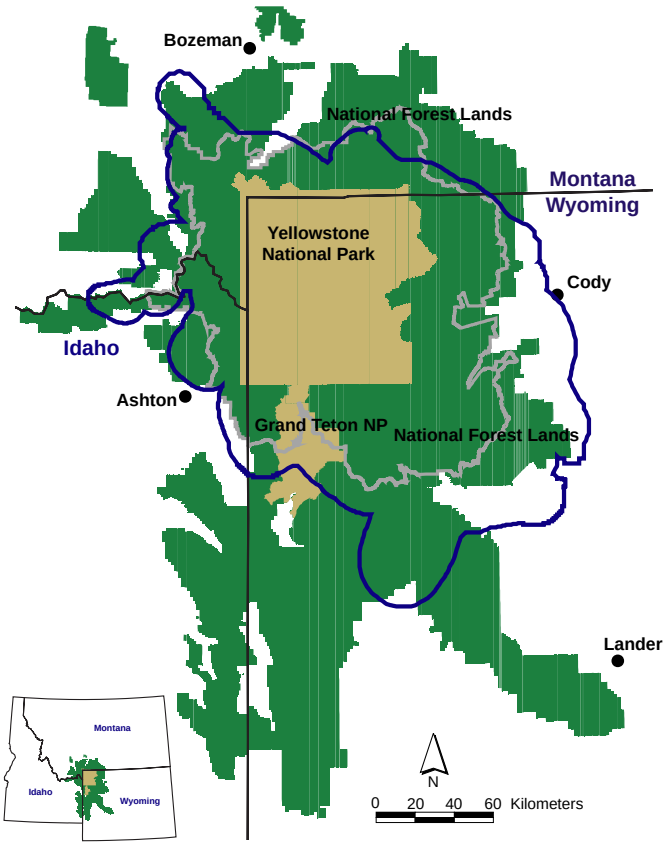



Figure 1. The current occupied range for grizzly bears in the Greater Yellowstone Ecosystem is shown in blue and encompasses approximately 37,000 km$^2$. The Primary Conservation Area (formerly the Yellowstone Grizzly Bear Recovery Zone) is shown in gray.

USGS/STEVE ARD

Female grizzly bear with cubs-of-the-year in tow, June 2006.

## Creation of the Interagency Grizzly Bear Study Team

The need for better information after the Craigheads' study was motivation for the creation of the Interagency Grizzly Bear Study Team (IGBST) in 1973. The study team initially had representatives from the National Park Service, the Forest Service, and the U.S. Fish and Wildlife Service; representatives from the states of Wyoming, Montana, and Idaho were added later. Dr. Richard Knight was named the study team leader

# Interagency Grizzly Bear Study Team Estimating Population Trend

When the Interagency Grizzly Bear Study Team was first created in 1973, its primary objective was to determine the status and trend of the grizzly bear population. At the time, methods for estimating population size for grizzly bears with reasonable confidence were extremely difficult and costly. Thus, the team concentrated their efforts on ways of determining population trend. Scientists estimate population change with some fairly complicated mathematical equations. A simple analogy may make this more understandable. We can think about the grizzly bear population in Yellowstone as a bank account. The population represents the amount of money in this account. Reproduction in the population is the same as interest paid on the principal.

NPS

Grizzly bear sow and three cubs.

New money added increases the size of the deposit and withdrawals reduce the account. Estimating population change is simply tracking new bears entering the population (reproduction) and bears leaving (mortality). The best expression of trend for a population is Lambda ($\lambda$) or "finite rate of change" (Caughley 1977). Estimates of $\lambda$ tell us whether, on average, numbers of births and recruitments for a population are greater than deaths or vice versa. Thus, $\lambda > 1$ indicates an increasing population, $\lambda = 1$ stable, and $\lambda < 1$ a decreasing population. A population that remains stable (neither grows nor declines), has a trajectory of 1.0. This would be equivalent to a bank account where withdrawals equal the interest paid to the account. A declining population has a trajectory of less than 1.0. A population with an estimated trajectory of 0.9 is declining at 10% per year; we've withdrawn the interest paid to the account plus 10% of the principal. However, population change is much more sensitive to the loss of an adult female than the loss of a cub because adult females are currently producing cubs, whereas a cub must remain in the population for at least five years before it can produce offspring. If we put this into dollar terms, the loss of an adult female is equivalent to withdrawing 73¢, whereas the loss of a cub is only about 13¢, or the loss of one adult female has the same potential impact on the population as the loss of five cubs. It's like getting interest paid on the account each year or waiting five years before any is paid. Obviously, the account with annual interest grows faster. Biologists estimate reproductive and mortality rates from radio-collared animals and can determine population trajectory, just like you do when you check your bank account statements.

by Assistant Secretary of the Interior Nathaniel Reed. The primary objectives of the team were to determine the status and trend of the grizzly bear population, the use of habitats by bears, and the relationship of land management activities to the welfare of the bear population.

Due in part to uncertainty about the status of Yellowstone bears and declines in other grizzly bear populations, the U.S. Fish and Wildlife Service listed grizzly bears in the lower 48 states as a threatened species under the Endangered Species Act in 1975. Indeed, early research conducted by the study team indicated that bear numbers in the GYE likely declined through the late 1970s and into the mid-1980s (Knight and Eberhardt 1984, Knight and Eberhardt 1985, Knight and Eberhardt 1987). Much of this early work pointed to a decline in litter size following the dump closures and lower survival rates for female bears. At the time, reducing adult female mortality by one or two bears per year would likely have been enough to stabilize the population. Action was needed to reverse the trend, and in 1983 the Interagency Grizzly Bear Committee (IGBC) was formed to address mortality and other issues facing the grizzly population in Yellowstone and other populations in the conterminous states.

The IGBC was comprised of high-level administrators from most federal and state agencies with authority and responsibility for management of bears or their habitat. To improve bear survival, they initiated better garbage management in communities throughout the GYE, removal of sheep grazing on Forest Service lands within the Yellowstone Grizzly Bear Recovery Zone (Figure 1), backcountry food storage requirements in grizzly habitat, and a reward system for those turning in poachers.

## Estimating Population Trend

**Females with Cubs.** For the first two years (1973–1974) after its formation, the IGBST was not permitted to

capture and/or mark bears in YNP (Knight et al. 1995). This early prohibition against marking individuals eventually led the study team to develop two methods for assessing population trend that the team continues to use today, only one of which requires marked bears. Dr. Knight and the study team observed that adult females with cubs were easy to see and that the number of cubs provided clues for distinguishing family groups. Summing the count of unique females over three successive years provided a conservative estimate of how many adult females were in the population. Counts were added over three years because, on average, adult female grizzlies produce a litter every three years (Craighead and Craighead 1967). Hence, this sum represented a reasonable estimate of adult females. Efforts were made to develop other methods, but Knight and Eberhardt (1984) considered this technique the best available index of grizzly abundance in the GYE.

To distinguish unique females from repeated sightings of the same female, the study team developed a rule set for observations (Knight et al. 1995). It was recognized that these rules were not perfect and if errors occurred, two different females were more likely called the same female as opposed to calling two sightings of the same female two different females. Thus, it was felt that employing the rule set returned conservative (or low) estimates for the number of females. This method was adopted as part of the Grizzly Bear Recovery Plan in 1993 (USFWS 1993). A running three-year average of females with cubs was used to establish a minimum population number and set allowable mortality limits (USFWS 1993). However, using counts of unique females with cubs was criticized by some scientists because (1) the rules to differentiate females had not been verified, (2) the technique did not account for variation in observer effort (number of people looking for females) or the sightability of bears in area and time (bears tend to be more easily seen in dry years), and (3) the estimate was a minimum count not an estimate of the total population (Craighead et al. 1995, Mattson 1997).

During the late 1990s, the study team and numerous collaborators began investigating methods to address these concerns. An evaluation of the rule set used to differentiate unique females with cubs confirmed that the method returned conservative (low) estimates and suggested that the negative bias increased as population size increased (Schwartz et al. 2008). Methods to estimate total numbers of females with cubs and account for variation in sightability of bears and observer efforts were also investigated (Boyce et al. 2001, Keating et al. 2002, Cherry et al. 2007). Employing the best of these methods, the estimated trend indicates an increase of about 5% per year during 1983–2007 (Figure 2; IGBST 2006, Harris et al. 2007). The requisite assumption for considering the trend in females with cubs as representative of the trend for the entire population is that the population's age distribution is relatively stable. This is a reasonable assumption considering demographic rates derived from monitoring radio-marked females in the GYE, which is the second and arguably more reliable method the study team employs to monitor population trend.

**Estimating Vital Rates from Radio-marked Bears.** The study team began capturing and radio-collaring grizzly bears in 1975. Early efforts were limited because of the time and expense required to capture, instrument, and monitor the bears. Aircraft were required to locate and monitor the status (i.e., alive or dead) of collared bears and to obtain observations of females for estimates of reproductive performance. The vital rates (i.e., survival and natality) derived from monitoring radioed bears through the early 1980s were not encouraging, and

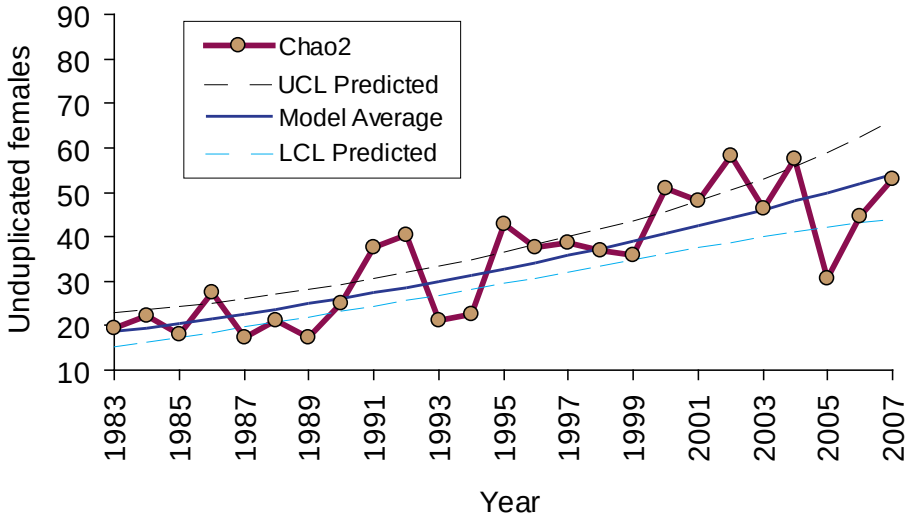
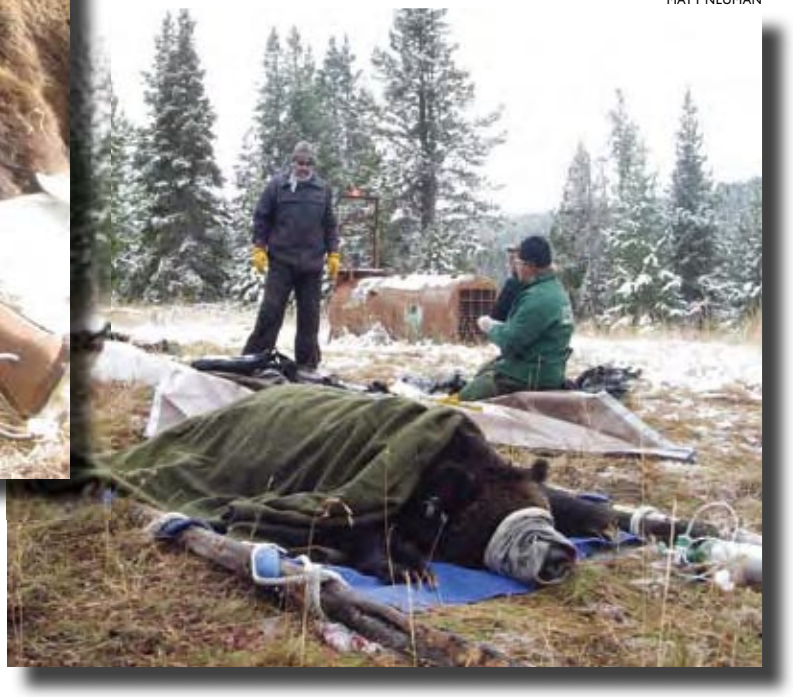



Figure 2. Model-averaged estimates (solid dark blue) for the number of unduplicated female grizzly bears with cubs-of-the-year in the Greater Yellowstone Ecosystem for the period 1983–2007, where the linear and quadratic models of $Ln(\hat{N}_{Chao2})$ were f tted. The dashed lines represent a 95% conf dence interval on the predicted population size. The linear model has about 75% of the model weights, with an estimated $\lambda$ of 1.0453.

JOHN MURNANE

*Left:* Standards of care for drugging and handling grizzly bears have improved. Standard procedures now routinely require providing oxygen and IV fluids, and continuous monitoring of heart rate, oxygen saturation, and temperature. Shown here is Jeremiah Smith and adult male grizzly bear #450.

MATT NEUMAN



*Right:* Chad Dickinson (standing), Jeremiah Smith (kneeling foreground), Craig Whitmen (kneeling background) and adult female grizzly bear #541.

suggested that the population was still declining (Knight and Eberhardt 1984, Knight and Eberhardt 1985). They pointed to the need for an increase in female survivorship (Knight and Eberhardt 1987) and highlighted the need for unambiguous estimates of survivorship from which the population trend could be estimated. The study team concluded that the best way to obtain this information was to increase the number of female bears monitored.

In 1986 the study team began collaring bears specifically for the purpose of monitoring population trend. The initial target was to monitor 10 adult females that were well-distributed throughout the ecosystem. However, because of their larger home ranges, male bears were captured about four times as often as females, providing additional information on topics including habitat use, movements, and cause of mortality. But it is female bears that drive the demographic vigor of the population.

In the mid-1990s, the target was raised to 25 monitored females to allow more precise estimates and increase confidence in the results. By then, estimates of adult female survival and population trend suggested that the population had stabilized (Eberhardt et al. 1994, Eberhardt 1995) but disagreement persisted over whether the population was likely increasing. An analysis published in 1999 that used data for vital rates obtained from 1975 through 1995 suggested that the population had changed little to none during that period (Pease and Mattson 1999, see also Eberhardt and Cherry 2000). Subsequent work published by the study team and collaborators (Schwartz et al. 2006*a*,) clearly demonstrates that GYE grizzly bear numbers increased at an average annual rate of about 4–7% during 1983–2001. This increase is likely a result of increased female survival and is similar to trend estimates derived from counts of females with cubs. The agreement between these two methods that used independent approaches provides confidence that the increase in the population was real (Harris et al. 2007).

## Current Status of Grizzly Bears in the Greater Yellowstone Ecosystem

Over the years, the study team has collected one of the longest running and largest datasets on any grizzly bear population in the world. That information has provided significant

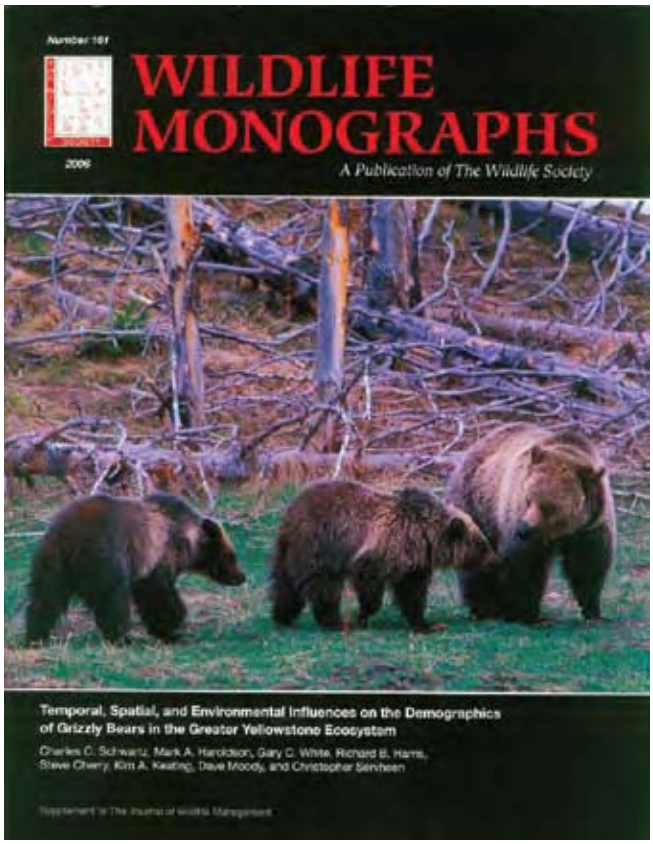
insight into the status and trend of the population, how grizzlies use the ecosystem, major food items, and human impacts on bears.

Additional analyses by the study team reveal that female survival is highest inside YNP and the surrounding Forest Service wilderness areas (Schwartz et al. in prep.), areas with a significant amount of secure habitat. As road density, the number of developed sites, and homes increase, bear survival declines. The study team has been able to establish a clear link between the health of the grizzly bear population and human activities on the landscape.

Another important finding is that bear distribution within the GYE has expanded during the last two decades as bears began to recolonize habitats outside YNP. Bears increased their range by 11% during the 1980s, and an additional 34% during the 1990s (Schwartz et al. 2002). Grizzly bears continue to expand their range and currently occupy more than 8.5 million acres (Schwartz et al. 2006*b*), significantly more than in the 1960s (Figure 1).

As the population of grizzly bears expanded in the ecosystem, bear density inside YNP also increased. Recent studies suggest that bears inside YNP are probably at carrying capacity, a term used to define the limits of available space, food, and other resources in the environment (Figure 3). As a population approaches this limit, juvenile mortality increases, females tend to initiate breeding later in life, and reproduction tends to decline (Eberhardt 2002). The study team has documented a decline in litter size as bear numbers increased, and a higher incidence of starvation and predation of cubs occurred inside YNP (Schwartz et al. 2006*c*).

The study team has also learned a great deal about how bears use the ecosystem. It is well documented that one of the first foods bears consume after emerging from their dens is




winter-killed elk and bison. In years following severe winters, more carcasses are available (Podruzny and Gunther 2005) and cub survival tends to improve (Schwartz et al. 2006*c*). This is likely due to less competition for each carcass and a reduced likelihood that females with new cubs will encounter big male bears that may prey on their offspring. In years with few carcasses, cub survival tends to be reduced.

Cutthroat trout were previously an important food for grizzly bears living around Yellowstone Lake (Mealey 1975), but their numbers have declined precipitously since the illegal introduction of lake trout there (Koel et al. 2005). Counts of spawning cutthroat trout at Clear Creek declined from more than 70,000 in 1978 to around 500 in 2007. Studies of fish use by bears in the late 1980s relied on detecting fish parts or determining the presence of fish remains in bear scats (Reinhart and Mattson 1990). In the late 1990s, the study team discovered that mercury in the effluent from thermal vents in Yellowstone Lake could be used as an indicator of fish consumption by bears. When a bear eats a fish that has eaten plankton containing this mercury, the mercury is deposited in its hair. Measuring the concentration of mercury in bear hair

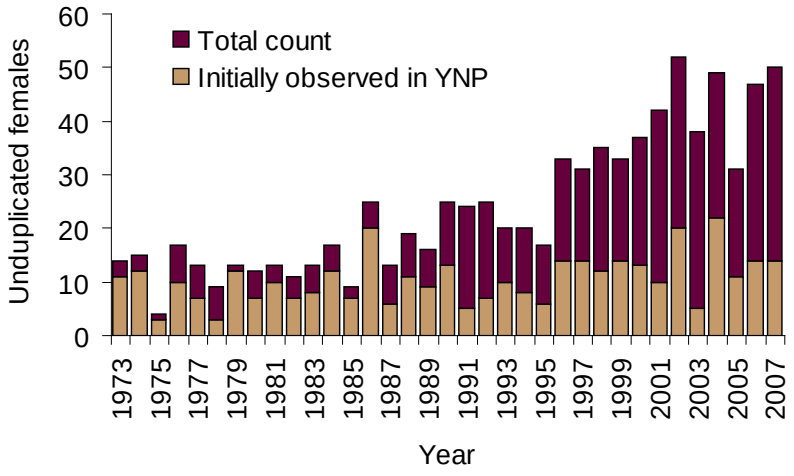



Figure 3. Total number of unduplicated female grizzly bears with cubs-of-the-year observed annually in the GYE during 1973–2007, and the number initially seen within the boundary of Yellowstone National Park. (Bears initially seen within park boundaries are counted as YNP bears.)

provides a direct measure of the number of fish consumed by that bear (Felicetti et al. 2004). Coupling mercury concentrations in bear hair with DNA analyses has allowed biologists to estimate how many bears consume fish (Haroldson et al. 2005), how many fish each bear eats, and the sex of the bears that eat fish. Results showed that in the late 1990s most fish were eaten by male bears (Felicetti et al. 2004). A three-year study, started in 2007, is documenting the extent to which bears have shifted from fish to other foods. Preliminary results confirm that very few bears still eat fish, and that most of the bears that previously ate fish are now focused on preying on elk calves adjacent to the lake (J. Fortin, Washington State University, personal communication). Elk are now calving in the post-fire blow-down resulting from the 1988 fires and studies suggest that the bears have shifted accordingly.

Whitebark pine, a high-elevation conifer, periodically produces abundant crops of high-quality seeds that are readily consumed by bears (Kendall 1983). In years following a good crop of seeds, grizzly bear females tend to produce more three-cub litters than one-cub litters (Schwartz et al. 2006*d*). The opposite is true following poor seed crops. In poor seed years, bears in YNP shift their diets and their survival rate remains high because the park is a secure environment. However, in years of poor seed production outside the park, particularly on the edge of the ecosystem, more bear conflicts occur (Gunther et al. 2004) and mortality rates tend to be higher (Mattson et al. 1992). Whitebark pine is currently under attack by native mountain pine beetles, previous outbreaks of which have resulted in high mortality rates in trees across the West. The study team, in cooperation with the National Park Service's Inventory and Monitoring Program, is tracking mortality rates in the GYE due to both pine beetles and blister rust infection, an exotic fungus that has killed many whitebark pine trees in the Pacific Northwest since it arrived in North America in the late 1920s. It has been less lethal in Yellowstone, but continues to spread. Surveys suggest that about 20% of the whitebark trees in the GYE are infected with rust. We do not yet have statistically rigorous estimates for whitebark pine mortality rates from either blister rust or mountain pine beetles, or for the extent of their impacts on whitebark communities for the entire GYE. However, the impact on some whitebark stands from pine beetles appears to be considerable in portions of the GYE. How the changes in whitebark abundance will affect grizzly bear numbers is not known, but in poor whitebark seed years grizzlies eat more meat (Felicetti et al. 2003). Bioelectrical impedance analysis, which the study team uses to estimate how fat each captured bear is (Schwartz et al. 2003), shows that the bears have been able to attain adequate fat levels for denning in both good and poor seed years.


NPS

Whitebark pine is an important fall food for bears.

## Removal from Threatened Species Status

In April 2007, the U.S. Fish and Wildlife Service officially removed the grizzly bear in the GYE from the Endangered Species list (USFWS 2007). As expected, several lawsuits were filed challenging this decision. Proponents for delisting point to the successes that have occurred since 1975, including the increase in bear numbers, the recolonization of previous habitats, high rates of female survival, and the current health of the population. Those opposed to delisting express concerns about the possible effects of climate change and declines in whitebark pine, and whether delisting the Yellowstone population separately from the other U.S. populations was appropriate. The agencies involved in the process prepared numerous documents detailing how the bears will be managed, including monitoring protocols, mortality limits, and habitat management programs. The courts will now determine if all these efforts meet the requirements of the Endangered Species Act. Regardless of that decision, the IGBST will continue to monitor grizzly bears in an effort to understand how the species adapts in a dynamic ecosystem in the face of natural and man-made change. The long-term survival of grizzlies in Yellowstone is intimately linked with humans, how we impact the ecosystem and how much space we leave for bears. To that end, the future of the bear is in our hands.

YS


## Acknowledgments

We thank the many people who contributed to the study team's data collection effort over the years, especially the f eld crews who captured and followed the bears, and the pilots who flew in search of them. They are too many to mention here by name, but their efforts contributed greatly to our understanding of grizzly bears in the GYE. We especially thank former study team leader R. R. Knight and team member B. M. Blanchard for their efforts in data collection and program direction from the study team's inception in 1973 through 1997. We thank P. J. White, F. L. Craighead, and P. Schullery for providing editorial suggestions as part of the U. S. Geological Survey Fundamental Science Practices.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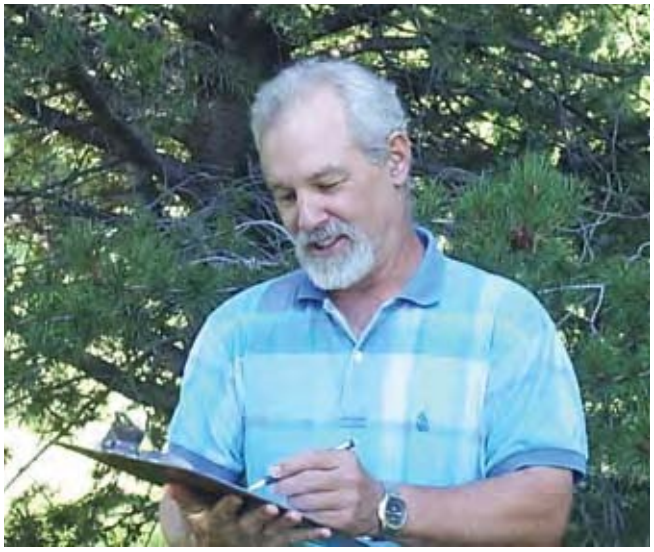
COURTESY MARK HAROLDSON



COURTESY CHUCK SCHWARTZ

**Mark A. Haroldson** is a supervisory wildlife biologist for the U.S. Geological Survey Interagency Grizzly Bear Study Team, based in Bozeman, Montana. He has been involved in bear research for 33 years, and has worked for the study team in the Yellowstone ecosystem since 1984. Most of his career has been spent as a field biologist capturing and collaring bears. Mark has authored or coauthored more than 30 peer-reviewed publications on grizzly bears. Recent works include several chapters in Wildlife Monographs 161 (2006), and co-authorship of the grizzly bear chapter in Wild Mammals of North America: Biology, Management, and Conservation (Feldhamer et al. 2003). Mark graduated from the University of Montana in 1979 with a BS in Wildlife Biology. Mark lives in Manhattan, Montana, with his wife Cecily (also pictured), and son Zane.

**Chuck Schwartz** works for the U.S. Geological Survey at the Northern Rocky Mountain Science Center in Bozeman, Montana. He is leader of the Interagency Grizzly Bear Study Team, an interdisciplinary group responsible for long-term research and monitoring of grizzly bears in the Greater Yellowstone Ecosystem. Chuck has worked on programs with grizzly bears in Alaska, Russia, Pakistan, and Japan. His research with large mammals has included moose and brown and black bears and focused on ecological issues of predator-prey dynamics, carrying capacity, nutrition, and physiology. Chuck earned his BS in agriculture from The Ohio State University, and an MS and PhD in Wildlife Biology from Colorado State University. Chuck currently resides in Bozeman, Montana, with his wife Melody.

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