Grizzly Bears in the Greater Yellowstone Ecosystem

From Garbage, Controversy, and Decline to Recovery

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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.

Reproductive and Demographic Parameters	**Time Period** 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).

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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.

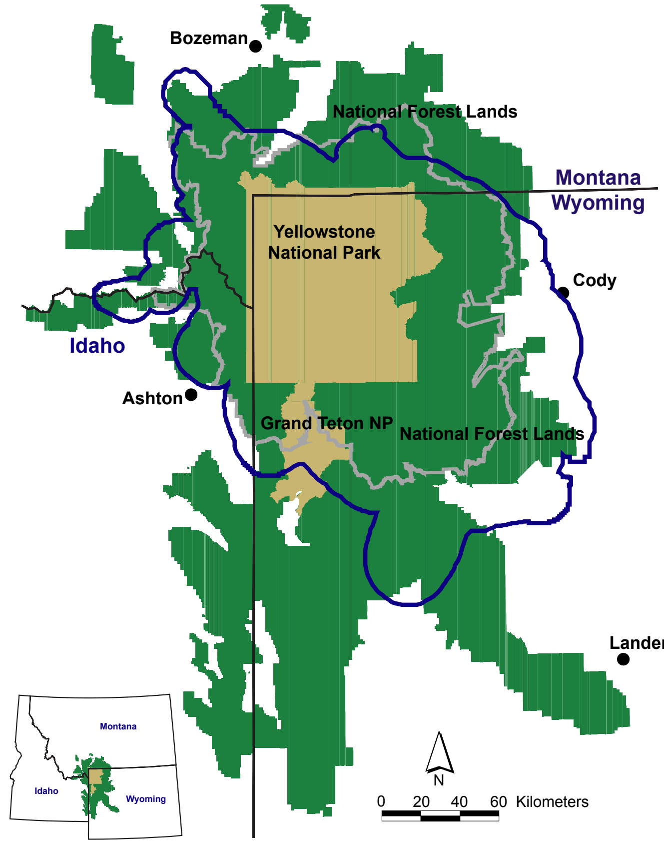

Figure 1. The current occupied range for grizzly bears in the Greater Yellowstone Ecosystem is shown in blue and encompasses approximately 37,000 km^2. The Primary Conservation Area (formerly the Yellowstone Grizzly Bear Recovery Zone) is shown in gray.

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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.

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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 (λ) or "finite rate of change" (Caughley 1977). Estimates of λ 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

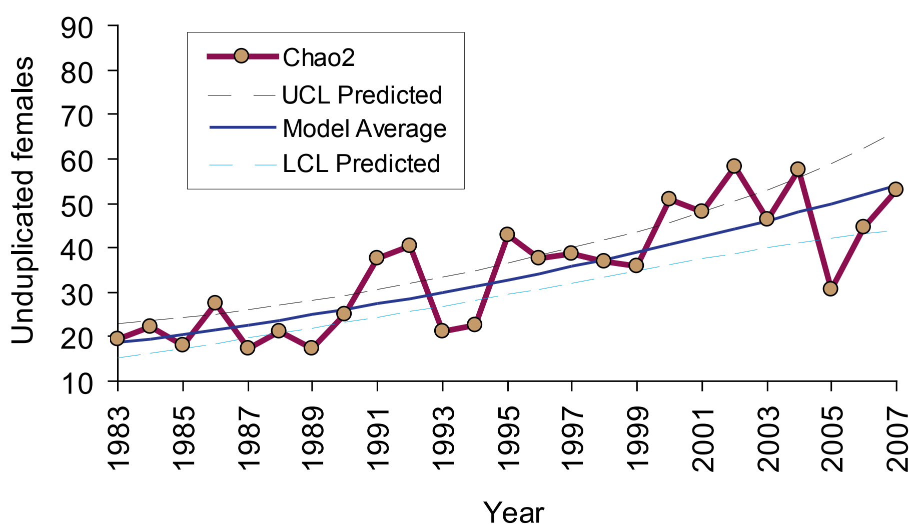


Figure 2. Model-averaged estimates (solid dark blue) for the number of unduplicated female grizzly bears with cubs-of-the-year in the Greater Yellowstone Ecosystem for the period 1983–2007, where the linear and quadratic models of $Ln(\hat{N}_{Chao2})$ were fitted. The dashed lines represent a 95% confidence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

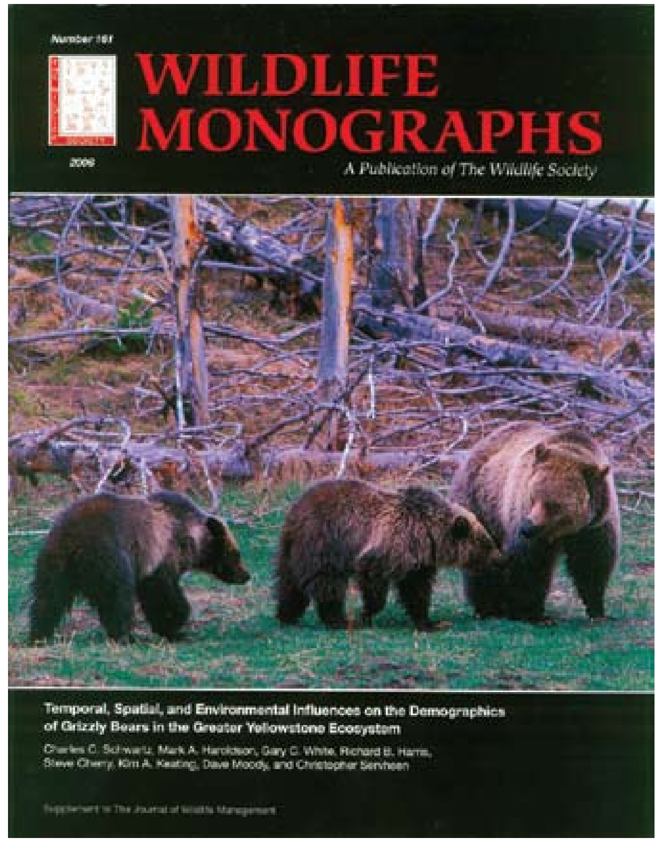
Over the years, the study team has collected one of the longest running and largest datasets on any grizzly bear population in the world. That information has provided significant insight into the status and trend of the population, how grizzlies use the ecosystem, major food items, and human impacts 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

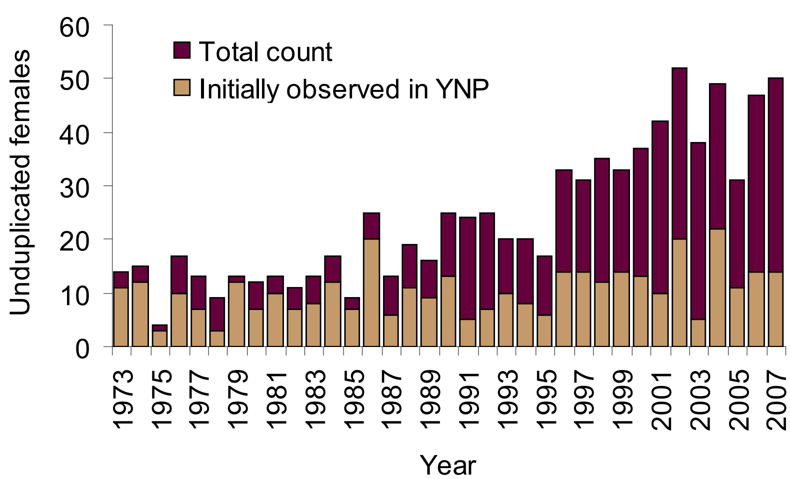


Figure 3. Total number of unduplicated female grizzly bears with cubs-of-the-year observed annually in the GYE during 1973–2007, and the number initially seen within the boundary of Yellowstone National Park. (Bears initially seen within park boundaries are counted as YNP bears.)

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.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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.

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Acknowledgments

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For more information:
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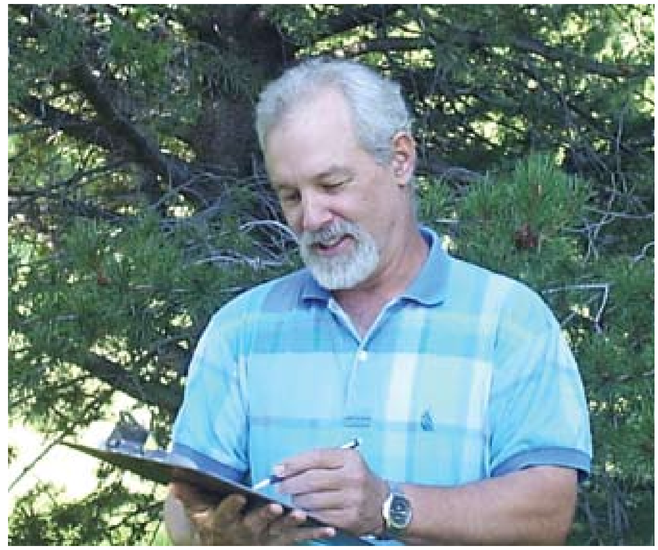
COURTESY MARK HAROLDSON



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