# STATUS OF THE YELLOWSTONE GRIZZLY BEAR POPULATION: HAS IT RECOVERED, SHOULD IT BE DELISTED?

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*Abstract:* The number of grizzly bears *(Ursus arctos)* and the size of their former range within the western states (USA) have declined drastically over the previous 200 years. The downward trend has continued most sharply in the Greater Yellowstone Ecosystem, accelerated by the closing of open-pit garbage dumps in the late 1960s. The closure resulted in an estimated 50% reduction in population size. The immediate response by bears to the dump closures was significant movement into campgrounds and developed areas where many bears were captured and destroyed. Over a period of 15 years, the surviving bears moved out from aggregation centers (open-pit dumps, termed ecocenters) to exploit more fully the natural food base. The major detectable difference in resource use between pre- and post-closure periods was an especially heavy use of forbs. There was no evidence that the post-closure bear population found nutritional resources comparable to the ecocenters. Bears changed feeding habits and altered their distribution and use of space throughout the ecosystem. Recovery of a single grizzly bear population unit such as the Yellowstone population should be considered the first step in a multi-step recovery program for long-term persistence in the contiguous 48 states. Delisting of the Yellowstone population, if it occurs at all, must await population recovery throughout the Northern Rockies.

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**Key words**: brown bear, delisting, ecocenters, endangered species, Endangered Species Act, grizzly bear, threatened species, Yellowstone National Park.

Time can be a rigorous and unforgiving measure of ongoing events when we relate pertinent data of the past to a time scale that includes the present and projects into the future. With this in mind, I will attempt to put into perspective historic changes in the status of grizzly bears in the western states, examine more specifically their present status in the Yellowstone ecosystem, and comment on what this portends for the future of the bear.

Almost 400 years ago in 1602, Sebastian Vizcaino reported an aggregation of California grizzly bears (*U. a. californicus*) on the carcass of a beached whale (Cetacea) in Monterey harbor. About 250 years later (1849), J.W. Revere reported countless troops of grizzlies feeding on the remains of commercially rendered whales along the beaches of Monterey, California. Other observers from the same era reported large numbers of California grizzlies congregating at fields of clover (*Trifolium* spp.) and corn (Storer and Tevis 1955). About 150 years ago, the California grizzly apparently still thrived, at or near its original estimate of approximately 10,000 bears (Storer and Tevis 1955). One human life span later in 1923, the California grizzly was extinct and the subspecies inhabiting the Northern Rocky Mountains (*U. a. horribilis*) was in rapid decline.

When Lewis and Clark encountered the Northern Rockies in 1804, the area was wilderness. This condition extended to the Pacific Ocean, encompassing, overall, a pristine area of millions of hectares. The grizzly bear was found in the entire area, its numbers roughly estimated at 50,000–100,000 throughout the Mountain West. In less than 3 life spans, their numbers dwindled to what we find today in the contiguous 48 states—approximately 900–1,300 animals (Craighead et al. 1995). The precipitous decline toward extinction has slowed, but the trend continues downward, perhaps nowhere more sharply than in the Greater Yellowstone Ecosystem.

In 1958 I saw my first grizzly bear, and like Sebastian Vizcaino, I saw not one, but an aggregation, 30–40 congregated at a National Park Service open-pit refuse dump in Hayden Valley near the center of Yellowstone National Park. Grizzlies had been attracted to these human food wastes for nearly 100 years. That first sight of grizzly bears interacting socially and subsequent reflections on this striking phenomenon prompted me a year later (1959) to begin, in collaboration with my brother Frank Craighead Jr., a long-term study of the grizzly bear in the geographically isolated Yellowstone ecosystem. The biology of the grizzly bear was then virtually unknown, and there was absolutely no concern for its future in Western America, despite an estimated 98–99% decline in its numbers and a comparable decline in original range over 200 years (Craighead et al. 1995). However, interest in and information about the grizzly bear has grown rapidly since 1959. Grizzly bear population decline has been rapid and recent events clearly show that recovery will be slow—probably decades—if it can be achieved at all under the pressure of human population growth and accelerated use of the natural resources of our public lands (Craighead et al. 1995).

## HISTORICAL PERSPECTIVE ON THE YELLOWSTONE ECOSYSTEM POPULATION

In 1959, the grizzly bear population of the Yellowstone ecosystem was apparently healthy, judging by historical records (Craighead et al. 1995). After 10 years of research (1969), my data and that of my colleagues indicated that a mean population of 309 grizzly bears inhabited the 7.3 million hectare (18 million acres) Greater Yellowstone ecosystem (Craighead et al. 1974). This ecosystem population was growing at an annual average of 2.4% (Craighead et al. 1974, Craighead et al. 1995). Most of the grizzly bear population visited, at least occasionally, the long established National Park Service open-pit garbage dumps, aggregating annually at these sites to feed and breed. We termed these garbage sites ecocenters because the massive quantities of annually and predictably available food attracted aggregations of bears and held them there for 3 months of the year. Movement data and food habit studies showed that, though attracted to the ecocenters, the bears foraged throughout the ecosystem (Craighead 1976, Craighead 1982, Craighead et al. 1995). These man-made ecocenters were ecological equivalents to spawning runs for salmon *(Ononorhychus* spp.) and beached whales that similarly attract and hold bears for long periods of time, and which have functioned in this manner for thousands of years. Although unregulated killing of bears occurred within the Yellowstone ecosystem, the man-made ecocenters provided a high level of protection by holding the bears within the security of the Park. (Craighead et al. 1995)

### Closure of the Dumps

The National Park Service began phasing out open-pit dumps in Yellowstone during 1968 and 1969, with final closure in 1970. This action was recommended by an advisory committee, despite warnings by Frank Craighead and myself that a rapid phase-out would greatly disrupt the population (Craighead et al. 1995). The most immediate and obvious result of dump closures was increased bear mortality. A minimum of 158 grizzly bear deaths were recorded over the 4 years from 1969 to 1972 during and immediately after closure of the ecocenters (Craighead et al. 1974, 1988). These deaths represented approximately 51% of the ecosystem population mean of 309–312 bears as calculated from systematic counts for 1959–70 (Craighead et al. 1995). This catastrophic event not only elevated the ecosystem-wide mortality rate, but it drastically altered movement and behavioral patterns of the population. Five years after the last National Park Services dump was closed (1975), the Yellowstone grizzly bear was listed as a threatened species under the directives of the Endangered Species Act of 1973 (16 U.S.C. 1531–1544).

### Population Size and Behavior Following Dump Closure

For the 3 years following closure of the dumps, systematic data on bear numbers were not obtained, and estimates of the Yellowstone grizzly bear population for that period were of little scientific value. In 1980, 10 years after the closure of the last open-pit garbage dump, a federal research panel (the Ad Hoc Committee for Population Analysis), using a more rigorous database but unexplained census efficiency factors, estimated a grizzly population ranging between 183–207 (Knight et al. 1983). Because of unrecorded mortalities of marked bears, I believe the population may have been even smaller, ranging between 140–150 animals (Craighead et al. 1995).

A crucial question is how the ecocentered population responded to the abrupt reduction in the total food resource and the estimated 50% reduction in population size. Specifically, how did closure of the open-pit dumps affect bear movements, use of food resources, and reproductive parameters in the post-closure period (1971–95)? I will address these questions by briefly summarizing some of the conclusions that I and my colleagues, Jay Sumner and John Mitchell, have presented in *The Grizzly Bears of Yellowstone* (Craighead et al. 1995).

Closure of the Yellowstone ecocenters deprived most of the ecosystem's grizzly bear population of massive, localized food resources but left the broad natural foodbase intact. The immediate response by bears to the dump closures was significant movement into adjacent campgrounds and developed areas where many were captured and destroyed. Over the next few years, surviving bears moved out from these traditional aggregation centers. The population showed some indications of stabilizing at reduced densities as new home ranges evolved or old ones were enlarged. This required >15 years, during which time grizzlies adjusted to exploit more fully the natural food base. The major detectable difference in intensity of resource use between the pre- and post-closure periods was an increased use of the forb, vertebrate, and invertebrate food resources, with especially heavy use of forbs (Craighead et al. 1995). We found no evidence that the post-closure bear population found and exploited nutritional resources comparable to those lost when the ecocenters were destroyed. Bears changed their feeding habits, used resources more effectively, and altered their distribution and use of space throughout the ecosystem. But in spite of this, growth and weight data indicated the population was nutritionally stressed (Craighead et al. 1995).

### Comparison of Biological and Population Parameters

Analyses of grizzly bear weights within sex and age classes indicated declining growth rates after destruction of the ecocenters (Craighead and Mitchell 1982, Knight et al. 1983, Blanchard 1987, Stringham 1989, 1990). Evidence was equivocal that, by the mid-1980s, a new equilibrium had been established between bear numbers and food resources comparable to the pre-1970 levels. The results implied that, although total population size declined substantially after 1970, there was still less nutritional energy available/bear during the post-closure period (1971–90) than was the case before ecocenter closure. Growth rates had suffered accordingly (Craighead et al. 1995).

Comparison of 4 fundamental and 2 composite measures of reproduction among the pre- and post-closure populations showed no differences in age at first reproduction, fertility, litter size, or cub weaning age (fundamental reproductive parameters), but cycle length was shorter and production of cubs was higher (composite reproductive parameters) in the post-closure period. Average body weight was a good indicator of productivity (calculated as total cubs whelped by all females divided by the total of all female–years observed) during the preclosure period (1959–70). A review of the literature of brown bears, black bears (*U. americanus*), and polar bear (*U. maritimus*) revealed that this positive association between mean body weight and reproductive performance was a consistent pattern (Stirling et al. 1976, Rogers 1987, Pelton 1989, Mattson et al. 1991, Craighead et al. 1995).

Paradoxically, however, high post-closure productivity of the Yellowstone population was not associated with greater mean body weights. Because greater mean weight was a good predictor of productivity for the pre-closure Yellowstone population and for 4 other brown bear populations reported in the literature (Craighead et al. 1995), the productivity difference recorded between the pre- and post-closure Yellowstone populations presented a fundamental dilemma. Post-closure bears were smaller, but apparently more fecund. Our analyses suggested that the increase in post-closure productivity was probably apparent rather than real and was likely due to failures to detect preweaning cub mortality by the Interagency Grizzly Bear Study Team (Craighead et al. 1995). A composite measure of reproduction like productivity is especially sensitive to such a bias. For this reason, we caution against placing too much emphasis on the production of cubs in evaluating population status or trend. Even if we accept the post-closure productivity measures as accurate, we suggest that a population declining as a result of a series of abrupt reductions in the food base may equilibrate at comparable levels of per capita resource, and hence, comparable per capita reproductive performance. Reproductive parameters, therefore, reflect the current relationship between the size of a population and its total resource base, but they are not necessarily reliable indicators of size *per se* or the long-term trend of the population.

## ASSESSING POPULATION STATUS

A major objective of the IGBST field study, as recommended by the National Academy of Science Committee (NASC), was to determine the size and trend of the grizzly bear population inhabiting the Yellowstone ecosystem following the closure of the open-pit garbage dumps. To determine whether this primary research objective was accomplished, we examined the reports of the Federal Ad Hoc Committee for Population Analysis (of the Interagency Research Steering Committee). In 1983, the Committee reviewed the IGBST population data. They concluded that the minimum number of breeding females is the most reliable index available to estimate population size and recommended basing the index on 3-year sums of annual counts of unduplicated females with cubs (Knight et al. 1983). This essentially established by fiat an index to population size and trend of absolutely unproven validity. It is important to recognize that the annual count of *unduplicated* adult females with cubs is the basis for projection of population size and therefore *the* most crucial parameter among the 4 established in the Federal Grizzly Bear Recovery Plan (U.S. Fish and Wildl. Serv. 1993) as criteria for population recovery. The other 3 parameters, distribution of family units and allowable known mortality among adult females and among the population in total, derive from these counts, directly or indirectly (for greater detail see Chapter 19 in Craighead et al. 1995).

The IGBST employed 4 counting techniques to characterize the ecosystem-wide population from 1976 to 1990. These techniques ranged from the highly reliable annual identification of individually marked or radiocollared individuals to techniques of questionable reliability: identifying unmarked individuals from ground or air by few observations isolated in time and space.

Comparisons of numbers and percents of artificially marked to unmarked females identified annually in the unduplicated sample of females with cubs show that only 13% and 12% of the total females identified bore artificial markers (radiocollars) in 1976 and 1984, respectively, and that identification by means of artificial markers were at a maximum of 38% in 1977 and 1989 (Knight et al. 1978–1985; Craighead et al. 1995). The 164 females without artificial markers, reported as identified and included in the annual counts of adult females with cubs, represented 74% of the unduplicated sample over the 15-year period. Furthermore, analyses of the records of observation show that 58% of the 164 unmarked females recorded in the counts were identified (recognized) with but a single observation. Single identifications of unmarked or of naturally marked individuals are weak criteria on which to base a count. When over half of all the unmarked bears counted by the IGBST are so identified, the accuracy of the data can justifiably be questioned.

Less than half (46%) of the 164 IGBST identifications of unmarked females were made from the ground; 54% were from the air, further compromising the credibility of count accuracy. The margin for error in identifying unmarked bears from the air in the Yellowstone ecosystem is substantial because much of the terrain is heavily forested. Most aerial identifications are generally made from long distances, for short periods of time, and often without a spotting scope. Furthermore, the IGBST counting procedures were not standardized; neither the aerial nor the ground counts were conducted along predetermined routes, according to a grid pattern, or along transects, and the aerial counts were not conducted regularly, nor in any specific temporal sequence (Craighead et al. 1995). It seems reasonable that aerial identifications could be presented as unduplicated on occasions of simultaneous observations in space and time. But the uncertainties of time and space distinction are great, and as a rule, aerial identifications that rely on a single observation should not be represented as verified. When such identifications are included, they detract from, rather than add to, the credibility of count accuracy.

Interagency Grizzly Bear Study Team counting methods, from 1976 through 1990, were insufficiently rigorous to reliably index population size or trend. The likelihood of random and unaccountable errors in the unduplicated counts is too great. Yet these counts continue to serve as the fundamental metric for judging population recovery. I recognize that determining the size and trend of the Yellowstone grizzly bear population is technically challenging and will remain so into the future. It has been argued that the unduplicated count is not critical since it is used to calculate minimum numbers. However, these counts, as pointed out earlier, have been used to calculate allowable mortality as well as other criteria characterizing recovery. It should be noted that the criteria for distinguishing adult females with cubs were developed during the course of the study. After 1990 the criteria were improved (Knight et al. 1995). However using inappropriate data gathered over 15 years (1976–1990) to determine progress toward recovery makes the recovery plan suspect. It also tends to overestimate the counts, which then engenders an overly optimistic recovery outlook that endangers the population's prospects for long-term survival. The grizzly bear in the Yellowstone ecosystem will continually require special management if the population is to endure. I suspect that, under present management policy, continued efforts to count the population will not be acceptable to most bear biologists. To achieve recovery I suggest the development of population viability assessments along the lines outlined in Craighead et al. (1995) while making available more quality habitat primarily for use by the grizzly bears (See Chapter 20, Craighead et al. 1995).

## TIME FRAME AND CRITERIA FOR RECOVERY

What, then, should be the time frame for recovery of the Yellowstone grizzly bear population, and by what criteria should recovery be judged? According to IGBST statistics, all major recovery parameters (U.S. Fish and Wildl. Serv. 1993) have been met: (1) annual average unduplicated females with cubs = 19.8 (recovery target 15); (2) number of bear management units (BMUs) with family groups (1986–91 running sum) = 16 of 18 (recovery target 16 of 18 BMUs occupied); (3) annual average known human-caused bear deaths, females only = 1.8 (recovery target 3); (4) annual average known human-caused bear deaths = 4.0 (recovery target 9).

If we accept these statistics, the population inhabiting the Yellowstone Ecosystem has recovered. Why has the U.S. Fish and Wildlife Service not used these data and at least unofficially suggested that delisting would be in order? Is it possible that there is serious doubt concerning the data on which population trend and status are based? Others accept the data at face value and are not at all dubious. The Wyoming Fish and Game Department has requested immediate delisting, the IGBST is seriously considering such a move, and some private environmental organizations are leaning in that direction. I urge that no action be taken to revoke the population's threatened designation until appropriate measures of its status show the population to be healthy and viable over the long-term. Appropriate viability assessments are not likely in the near future simply because the current field methods for determining population status and trend are inadequate. They should be replaced with more rigorous methods for estimating abundance, productivity, and mortality; we also need quantitative estimates of habitat quality and distribution and cumulative human effects (Craighead et al. 1995). Long-term food stability, genetics, and the effects of natural catastrophes such as the 1988 fires (biological parameters that should be factored into viability assessments) are currently excluded from simulations because data are not available (for additional information see Craighead et al. 1995).

I suggest that the size and the sex and age structure of the pre-closure population should serve as recovery standards. Bears of the post-closure era are requiring significantly greater space for home and life ranges than did bears of the pre-closure era. Population size is a key factor in maintaining long-term persistence (100–300 years). Therefore, I recommend that critical habitat (recovery zone) be expanded to accommodate a population of at least pre-closure size (Craighead et al. 1995). To accept a recovery size of less than the pre-closure size of >300 animals will weaken the chance for long-term persistence.

## CONCLUSION

With a perspective from the past and information from the present, we can judge the current status of grizzly bear habitat and population size against previous conditions. If we relate current grizzly bear population estimates to those of the past, despite those of the past being very rough, we glimpse the future. That future is not promising for the threatened Yellowstone grizzly bear population or for the other 3 subpopulations, of which only 1 is currently considered viable. There is very strong evidence (Shaffer 1978, 1983; Metzgar and Bader 1992; Craighead et al. 1995) that long-term population persistence for grizzly bears in the Northern Rockies bioregion will require a series of independently secure subpopulations distributed over the geographic region. We are far from attaining that goal if, in fact, it is attainable under our current political and economic system. Currently, the excellent work in progress by state and federal biologists will provide future insight into the status of the Yellowstone grizzly. Why would we consider delisting the grizzly bear in the Yellowstone ecosystem, even if it could be unequivocally demonstrated that the population has recovered? Recovery of a single population unit such as the Yellowstone population would be only the first step in a multi-step recovery program for long-term persistence in the contiguous 48 states. With such long-term consequences, we don't have the option to delist. Delisting, if it occurs at all, must await population recovery throughout the Northern Rockies. Current delisting efforts may serve bureaucratic and political agendas, but a rational biological agenda should require no deadlines, no near-term declaration of accomplishment, and no change in protective status.

## LITERATURE CITED

BLANCHARD, B.M. 1987. Size and growth patterns of the Yellowstone grizzly bear. Int. Conf. Bear Res. and Manage. 7:99–107.

CRAIGHEAD, F.C., JR. 1976. Grizzly bear ranges and movement as determined by radiotracking. Int. Conf. Bear Res. and Manage. 3:97–109.

CRAIGHEAD, J.J., K.R. GREER, R.R. KNIGHT, AND H.I. PAC. 1988. Grizzly bear mortality in the Yellowstone ecosystem, 1959–1987. Mont. Dep. of Fish, Wildl. and Parks, Helena. 57pp.

———, AND J.A. MITCHELL. 1982. Grizzly bear. Pages 515–56 in J.A. Chapman and G.A. Feldhamer, eds. Wild mammals of North America—biology, management, economics. The Johns Hopkins Univ. Press, Baltimore, Md.

———, ———, AND J.A. MITCHELL. 1995. The grizzly bears of Yellowstone: Their ecology in the Yellowstone Ecosystem, 1959–1992. Island Press, Washington, D.C. 529pp.

———, J.S. SUMNER, AND G.B. SCAGGS. 1982. A definitive system for analysis of grizzly bear habitat and other wilderness resources. Wildlife–Wildlands Inst. Monogr. No. 1 Univ. Montana Foundation, Univ. Montana, Missoula. 279pp.

———, J.R. VARNEY, AND F.C. CRAIGHEAD, JR. 1974. A population analysis of the Yellowstone grizzly bears. Univ. Montana For. and Conserv. Exp. Stn. Bull. 40., Missoula. 20pp.

KNIGHT, R.R., J. BASILE, K.R. GREER, S. JUDD, L. OLDENBURG, AND L. ROOP. 1978. Yellowstone grizzly bear investigations: Annual report of the interagency study team, 1977. U.S. Dep. Inter. Nat. Park Serv., U.S. Gov. Printing Off., Washington, D.C. 107pp.

———, J. BEECHAM, F. BUNNELL, C. SERVHEEN, AND J. SWENSON. 1983. Memorandum—Interagency Grizzly Bear Steering Committee. From Chairman, ad hoc Committee for population analysis; subject: Committee findings. 4pp. unpublished.

———, B.M. BLANCHARD, AND L.L. EBERHARDT. 1995. Appraising status of the Yellowstone grizzly bear population by counting females with cubs-of-the-year. Wildl. Soc. Bull. 233:245–248.

———, ———, AND D.J. MATTSON. 1985. Yellowstone grizzly bear investigations: annual report of the interagency study team, 1983 and 1984. U.S. Dep. Inter. Nat. Park Serv. U.S.

Gov. Printing Off., Washington, D.C. 40pp.
MATTSON, D.J., B.M. BLANCHARD, AND R.R. KNIGHT. 1991. Food habits of Yellowstone grizzly bears, 1977–87. Can. J. Zool. 69:1619–29
METZGAR, L.H., AND M. BADER. 1992. Large mammal predators in the northern Rockies: Grizzly bears and their habitat. Northwest Environ. J. 8(1):231–233.
PELTON, M.R. 1989. The impacts of oak mast on black bears in the southern appalachians. Pages 7–11 *in* C.E. McGee, ed. Proceedings Workshop, Southern Appalachian Mast Management. U.S. Dep. Agric. For. Serv. and Univ. Tennessee, Knoxville.
ROGERS, L.L. 1987. Effects of food supply and kinship on social behavior, movements, and population growth of black bears in northeastern Minnesota. Wildlife Monogr. 97. 72pp.
SHAFFER, M.L. 1978. Determining minimum viable population sizes: a case study of the grizzly bear (*Ursus arctos* L.). Ph.D. Diss., Duke Univ., Durham, N.C. 192pp.
———. 1983. Determining minimum viable population sizes for the grizzly bear. Int. Conf. Bear Res. and Manage. 5:133–139.
STIRLING, I., A.M. PEARSON, AND F.L. BUNNELL. 1976. Population ecology studies of polar and grizzly bears in northern Canada. Trans. North Am. Wildl. and Nat. Resour. Conf. 41:421–430.
STORER, T.I., AND L.P. TEVIS. 1955. California grizzly. Univ. Nebraska Press, Lincoln. 335pp.
STRINGHAM, S.F. 1989. Demographic consequences of bears eating garbage at dumps: an overview. Pages 35–42 *in* M. Bromley, ed. Bear–People conflicts: Proceedings of a symposium on management strategies. Northwest Territories Dep. Renewable Resour., Yellowknife, Can.
———. 1990. Grizzly bear reproductive rate relative to body size. Int. Conf. Bear Res. and Manage. 8:433–443.
U.S. FISH AND WILDLIFE SERVICE 1993. Grizzly bear recovery plan, Final report. U.S. Fish and Wildl. Serv., Missoula, Mont. 18pp.