IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MONTANA
MISSOULA DIVISION

WILDEARTH GUARDIANS, a non-profit organization, Plaintiff, vs. RYAN ZINKE, as Secretary of the Department of the Interior; the UNITED STATES DEPARTMENT OF THE INTERIOR, a federal department; GREG SHEEHAN, as acting director of the U.S. Fish and Wildlife Service; and the UNITED STATES FISH AND WILDIFE SERVICE, a federal agency, Federal-Defendants.	No. 17-cv-00118-DLC DECLARATION OF DAVID J. MATTSON

I, DAVID J. MATTSON, hereby declare:

1. My name is David Mattson. I am a citizen of the United States and reside in Paradise Valley south of Livingston, Montana, inside Yellowstone's occupied grizzly bear habitat. The map immediately below (Fig. 1) shows the location of my residence relative to the 2010 distribution of Yellowstone grizzly bears, consistent with observations of grizzly bear tracks by my wife and me, as well as encounters with grizzly bears by neighbors within 2-4 miles of our residence.

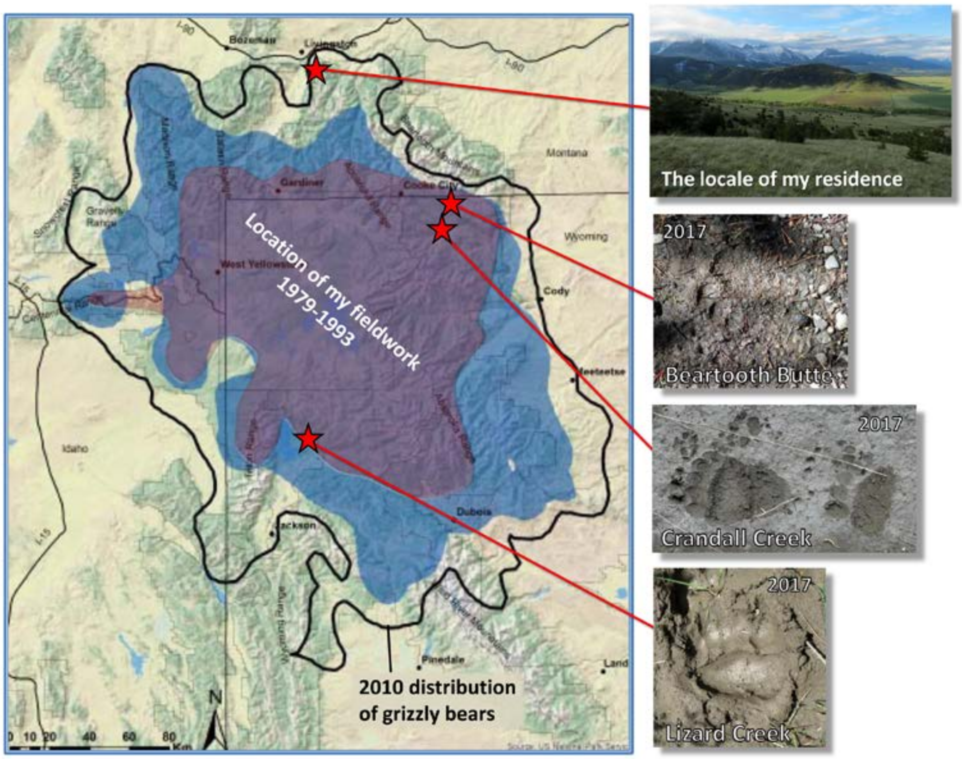


Figure 1. Map of the Yellowstone Ecosystem showing the approximate distribution of grizzly bears in 2010 (black line) and 2004 (blue-shading; from Bjornlie et al. 2014) as well as the locations of my grizzly bear-related fieldwork during 1979-1993 (purple), my residence, and a sampling of grizzly bear sign that I photo-documented during 2017. Other sightings and sign that I observed during 2017-18 are not shown.

2. My educational attainments include a B.S. in Forest Resource Management, an M.S. in Plant Ecology, and a Ph.D. in Wildlife Resource Management. My professional positions prior to retirement from the U.S. Geological Survey (USGS) in 2013 included Research Wildlife Biologist, Leader of the Colorado Plateau Research Station, and Acting Center Director for the Southwest Biological Science Center, all with the USGS, as well as Western Field Director of the MIT-USGS Science Impact Collaborative, Visiting Scholar at the Massachusetts Institute of Technology, and Lecturer and Visiting Senior Scientist at the Yale School of Forestry & Environmental Studies.

My dissertation focused on the ecology of grizzly bears in the Greater Yellowstone Ecosystem (GYE) during 1977-1996 (Mattson 2000). I intensively studied grizzly bears in the GYE during 1979-1993 as part of the Interagency Grizzly Bear Study Team (IGBST) and was charged with designing and supervising field investigations during 1985-1993. My field research focused on human-grizzly bear relations; grizzly bear foraging, habitat selection, diet, and energetics; and availability and ecology of grizzly bear foods. Among many projects, I led investigations of grizzly bear foraging on spawning cutthroat trout, whitebark pine seeds, and ungulate carrion, and was involved during the mid-1980s in discovering consumption of army cutworm moths by grizzly bears in the GYE. I have continued to observe grizzly bears and their habitats in the GYE since the end of my intensive field investigations in 1993, but even more so since my retirement in 2013. The map above (Fig. 1) shows the geographic extent of my grizzly bear-related field research relative to the current distribution of grizzly bears in the GYE, along with a sampling of locations where I photo-documented grizzly bear sign while hiking in grizzly bear habitat during 2017.

Although my field studies in the GYE ended during 1993, my involvement in grizzly bear-related research, management, and education, both regionally and internationally, has continued to the present. Among other topics, my published research has addressed demography of the GYE grizzly bear population, and suitability of currently unoccupied or under-occupied grizzly bear habitat in the Rocky Mountains of Canada and the United States. I have also been consulted by numerous brown/grizzly bear managers and researchers worldwide, including from Russia, Japan, France, Spain, Greece, Italy, and, most notably, Canada. I was deeply involved between 1980 and 2005 with Parks Canada grizzly bear research and management in Banff, Jasper, and Kluane National Parks. I have also given numerous public presentations on grizzly bear ecology and conservation, including talks, nationally, at the Smithsonian and American Museum of Natural History and, regionally, at the Denver Museum of Natural History, Museum of Wildlife Art (Jackson, Wyoming), and Museum of the Rockies (Bozeman, Montana).

Attachment 2 lists a selection of my grizzly bear-related publications.

3. Yellowstone's grizzly bear population is ecologically, evolutionarily, and historically significant, continentally and globally, and thereby of disproportionate importance to conservation and recovery of grizzly bears, not only in the contiguous United States, but worldwide. Grizzly bears in Yellowstone are the southernmost remnant of the 3% relic left after extirpations perpetrated by Europeans during 1800-1960 (see Fig. 2), and for that reason alone are of particular importance. As context, losses would almost certainly have been much greater without Endangered Species Act (ESA) protections (Mattson and Merrill 2002), although gains since listing have been sufficient to recoup only 1% of the totality lost during the 1800s and early 1900s (Mattson, 2017, 3% is not enough, https://www.grizzlytimes.org/single-post/2016/11/30/3-Is-Not-Enough-Towards-Restoring-Grizzly-Bears).

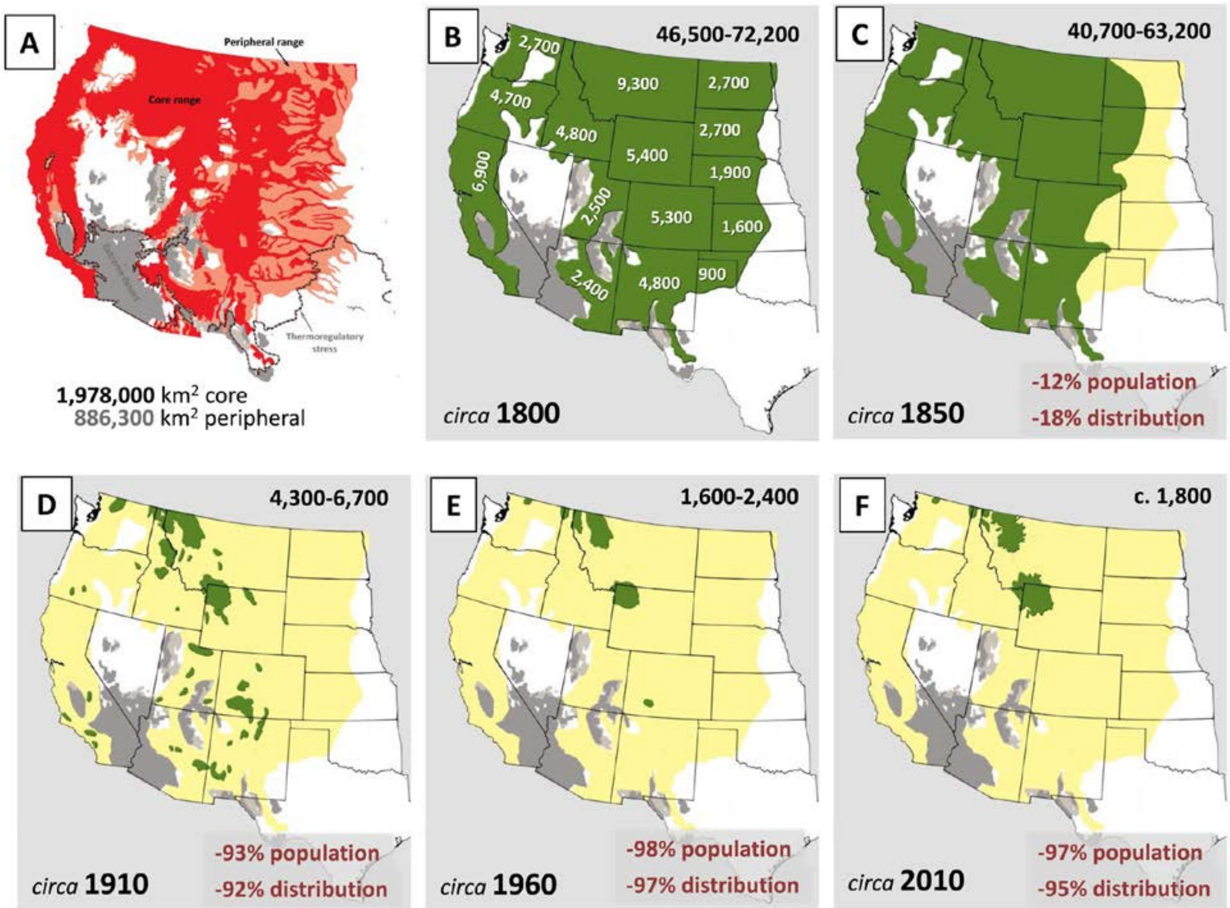


Figure 2. Losses of grizzly bear numbers and distributions in the western contiguous United States between 1800 and 1960 (B-E) along with the extent of gains since roughly 1970 (F), largely under ESA protection. The extent of grizzly bear distributions at each time step are shown in green and the extent of losses in yellow. Estimated total populations are shown in the upper right corner of each figure and estimated cumulative losses of populations and distributions in red in the lower right-hand corner. Panel A shows estimated core and peripheral historical range relative to the extent of extreme desert and hot climates that would have imposed thermoregulatory limits on the distributions of grizzly bears.

Yellowstone's grizzly bear population is also important from an evolutionary standpoint as part of a currently rare genetic lineage (Clade 4) of brown bears that was one of three clades or subclades first emigrating from Eurasia to North America during the Pleistocene. These bears spread from Beringia south to middle latitudes of North America sometime before 30,000 years ago, prior to when continental ice sheets of the Last Glacial Maximum isolated grizzly bears to the south from conspecifics to the north. Since then, most bears of the Clade 4 lineage have been extirpated, and now consist only of a small relic in Hokkaido, Japan, and grizzly bears residing south of central Alberta and southeast British Columbia (Waits et al. 1998, Miller et al. 2006, Davison et al. 2011). These Clade 4 bears once occupied all of the western contiguous United States, south into Mexico, and bore the brunt of European-caused extirpations, resulting in the loss of roughly 95% of all bears belonging to this genetic lineage in North America, if not the world (Mattson, 2017, What's in a grizzly name, https://www.grizzlytimes.org/single-post/2016/11/11/Whats-in-a-Grizzly-Name). Conservation and recovery of Yellowstone's grizzly bears are all the more important given that they are part of this rare and much diminished genetic lineage.

Finally, of ecological relevance, Yellowstone's grizzly bears exhibit foraging behaviors, diets, and habitat relations that are currently unique in North America, and possibly the world. Moreover, Yellowstone's bears continue to exhibit behaviors and diets that were probably once widespread in mid-latitudes of North America, but now largely extirpated. The Yellowstone ecosystem is thus a museum and the grizzly bears within a truly rare relic of much that has been lost behaviorally.

Nowhere else on the world do grizzly bears depend, as they do in Yellowstone, largely on energy and nutrients from army cutworm moths (*Euxoa auxliaris*), whitebark pine seeds (*Pinus albicaulis*), meat from elk (*Cervus elaphus*) and bison (*Bison bison*), and, prior to 2000, meat from spawning cutthroat trout (*Oncorhynchus clarki*; Mattson et al. 2004). Grizzly bears along the Rocky Mountain East Front in Montana are perhaps most closely related, dietarily, to

Yellowstone's bears. Even so, bears along the East Front obtain most of their meat from livestock and deer rather than elk and bison (Aune and Kasworm 1989), very few seeds any more from whitebark pine because of regional extirpations caused by disease and climate warming (Smith et al. 2008, Retzlaff et al. 2016), and unknown but probably only regionally minor amounts of army cutworm moths (White et al. 1998). Of lesser energetic importance, but emblematic of once widespread but largely lost behaviors, grizzly bears in the GYE are also the only to eat substantial amounts of fungal sporocarps (e.g., mushrooms and false truffles), biscuitroots (*Lomatium cous*), yampah (*Perideridia gairdneri*), and pocket gopher (*Thomomys talpoides*) root caches, plus non-trivial amounts of wasps, bees, earthworms, and sweet-cicely (*Osmorhiza* sp.) and pondweed (*Potamogeton* sp.) roots (Mattson 1997, 2000, 2002, 2004; Mattson et al. 2002a, 2002b, 2004, 2005). Yellowstone grizzly bears are truly unique ecologically, but with this uniqueness threatened by on-going environmental changes (see 6 below).

4. Grizzly bears are intrinsically vulnerable to human persecution partly because they are among the least productive terrestrial mammals in the world, certainly in North America. Figure 3, immediately below, contextualizes this seminal point by locating grizzly bears relative to other terrestrial placental mammals in terms of three signifiers of population productivity: annual reproductive rate, age at which females reach sexual maturity, and age at which a reproductive female replaces herself. Grizzly bears, along with polar bears, have the lowest reproductive rate and longest generation lengths of any terrestrial mammal in North America; only elephants and some primates are less productive

globally. On average, black bears in North America produce 10-20-times as many cubs per unit area and exist at 10-times the densities of sympatric grizzly bears (Mattson et al. 2005).

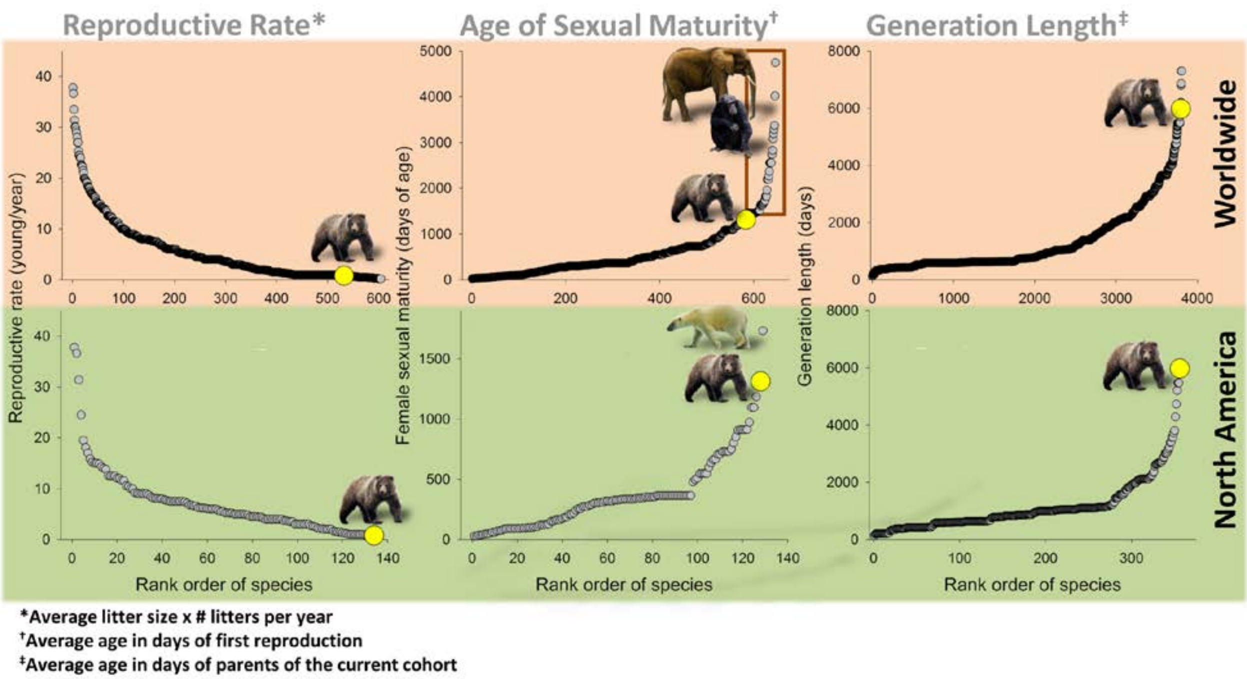


Figure 3. Signifiers of population productivity for grizzly bears (large yellow dots) relative to all other terrestrial mammals, worldwide (top) and in North America (bottom). Sources: Ernest, S. K. (2003). Life history characteristics of placental nonvolant mammals. Ecology, 84(12), 3402-3402. https://doi.org/10.6084/m9.figshare.c.3297992.v1; Pacifici, M., Santini, L., Di Marco, M., Baisero, D., Francucci, L., Marasini, G. G., ... & Rondinini, C. (2013). Generation length for mammals. Nature Conservation, 5, 87-94. http://datadryad.org/resource/doi:10.5061/dryad.gd0m3; Tacutu, R., Craig, T., Budovsky, A., Wuttke, D., Lehmann, G., Taranukha, D., Costa, J., Fraifeld, V. E., de Magalhaes, J. P. (2013). Human Ageing Genomic Resources: Integrated databases and tools for the biology and genetics of ageing. Nucleic Acids Research, 41(D1), D1027-D1033. http://genomics.senescence.info/species/query.php

As a consequence, grizzly bear populations are unable to accommodate appreciable human-caused mortality without declining, and even small rates of decline, if sustained, can result in catastrophic losses. Of relevance, even though annual rates of decline in grizzly bear populations averaged only -3-4% during

1850-1910 in the western contiguous U.S., cumulative losses were 90% (Mattson and Merrill 2002; Fig 2). This sensitivity of grizzly bear populations to even small added increments of mortality leaves managers with little margin of error.

Consistent with this thesis, Weaver et al. (1996) succinctly note in their overview of carnivore conservation in the northern U.S. Rocky Mountains, “Grizzly bears…possess much less resiliency [than other carnivores] because of their need for quality forage in spring and fall, their low triennial productivity, and the strong philopatry of female offspring to maternal home ranges.” I cover the implications of philopatry under 5 immediately below. The need for high-quality spring and fall forage, though, leads to a conclusion seemingly at odds with the fact that grizzly bears are omnivores. Grizzlies, do, in fact require high-quality forage, optimally with high concentrations of fat (Erlenbach et al. 2014), typically provided by only a few foods in environments that are otherwise paradoxically over-run with alternate but low-quality foods. Such is the case with Yellowstone grizzly bears, as I describe above (point 3), that have depended on just four main foods for most energy and nutrients. In contrast to the many other foods available to Yellowstone bears, the euphemistic “Big Four” provide much higher concentrations of net digested energy

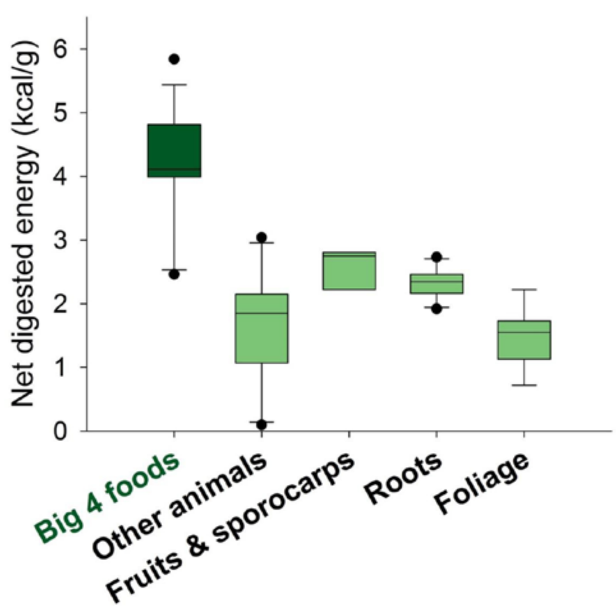


Figure 4. Median net digested energy available from the “Big 4” bears foods (whitebark pine seeds, army cutworm moths, meat from bison and elk, and cutthroat trout) versus all other known, alternate, foods in the GYE.

(Fig. 4; Mattson et al. 2004). As a consequence, grizzly bears such as those in Yellowstone—as well as elsewhere in the world (Hilderbrand et al. 1999; McLellan 2011, 2015; Nielsen et al. 2017; Hertel et al. 2018)—can be affected in potentially major ways by losses of a high-quality mainstay food despite compensatory subsistence for periods of time on low-quality alternate foods.

5. Isolation compounds the problems engendered by low productivity and small size for grizzly bear populations. The Yellowstone population is, in fact, isolated and has probably been so for roughly a century (Miller and Waits 2003; Haroldson et al. 2010). This isolation is intrinsically problematic, first, because genetic diversity of Yellowstone grizzly bears is lower than that of any other mainland North American grizzly bear population (Miller and Waits 2003) and, second, because the current population of roughly 700 bears is far fewer than the several thousand currently deemed necessary to insure long-term viability (e.g., 99% probability of persistence for 40 generations; Lande 1995; Brook et al. 2006; Traill et al. 2007, 2010). More to the point, Reed et al. (2003) estimated that minimum viable populations need to be near 9000 for species such as grizzly bears managed for little or no increase (see 8 below).

These viability considerations create a mandate for connectivity (e.g., Craighead and Vyse 1996; Servheen et al. 2001; Carroll et al. 2001, 2003, 2004; Proctor et al. 2005) that poses yet more problems given the limited ability of grizzly bears to colonize even nominally nearby areas. Averaged across relevant studies (Blanchard and Knight 1991, McLellan and Hovey 2001, Proctor et al. 2004, Støen et al. 2006, Zedrosser et al. 2007, Norman and Spong 2015), female brown/grizzly bears disperse only around 7 miles from their natal ranges, in contrast to 26 miles for male bears. Assuming that annual survival rates in current protected areas apply to bears colonizing connective habitat, it would take female grizzlies roughly 80 years and male bears roughly 50 years to colonize areas 100 miles distant. (The pace of colonization is slower than might be expected for males given that their advance is pegged to the advance of reproductive females, barring the next to last generational step.) Meaningful recovery is thus rendered nearly impossible if grizzly bears are subject to higher levels of mortality on the population periphery (see point 8 below).

6. Losses of important GYE bear foods since the mid-1990s to climate warming and non-native invasive species have entrained substantial long-lasting deleterious changes in the demography and diets of Yellowstone grizzly bears. As I describe in 3, above, grizzly bears in the GYE once obtained most energy and nutrients from just four foods or food groups: army cutworm moths, elk and bison, cutthroat trout, and whitebark pine seeds. But cutthroat trout were functionally extirpated as a grizzly bear food by around 2000 from predation by non-native lake trout, first detected in the mid-1990s, and by unfavorable climate-driven changes in the hydrology of spawning streams (Kaeding 2010, Gunther et al. 2011; Fig. 5e). Soon after, between 2000 and 2010, 40 to 70% of all mature whitebark pine in the GYE were killed by a climate-driven outbreak of mountain pine beetles (*Dendroctonus ponderosae*) (Macfarlane et al. 2010, Van Manen et al. 2016). On top of these losses, almost all GYE elk populations declined during 1995-2010 (Fig. 5a) as a result of predation, deteriorating summer forage conditions, and sport

hunting (Vucetich et al. 2005, Evans et al. 2006, Griffin et al. 2011, Brodie et al. 2013, Proffitt et al. 2014). As I elaborate in what follows, the losses of cutthroat trout and whitebark pine likely catalyzed dietary changes that resulted in increasing grizzly bear mortality and a stalling of population growth.

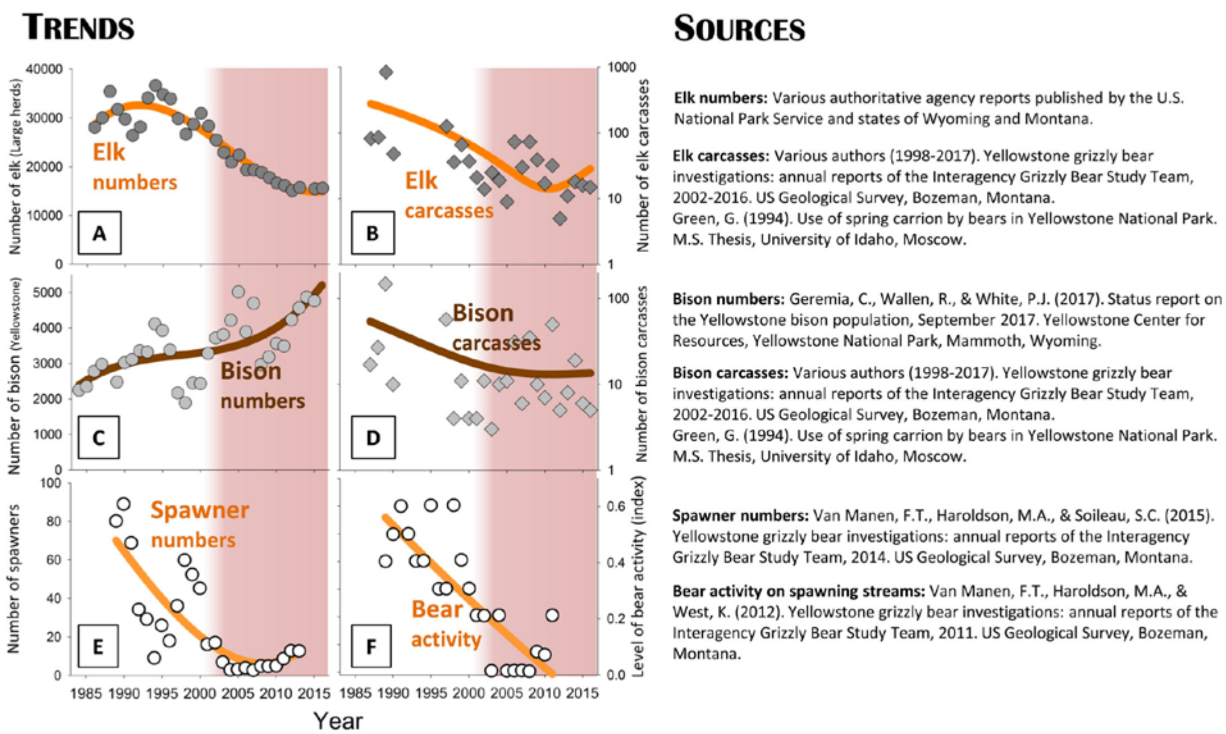


Figure 5. Summary of trends in availability of three important GYE bear foods, including (A) size of the Northern Yellowstone and Jackson elk herds; (B) numbers of elk carcasses counted along fixed transects in Yellowstone National Park; (C) size of the Northern and Central bison herds; (D) numbers of bison carcasses counted along transects in Yellowstone Park; (E) numbers of spawning cutthroat trout counted in front-country streams around Yellowstone Lake; and (F) levels of indexed bear activity (scats and tracks) along these same streams. Sources for time series data are given to the right of each pair of graphs.

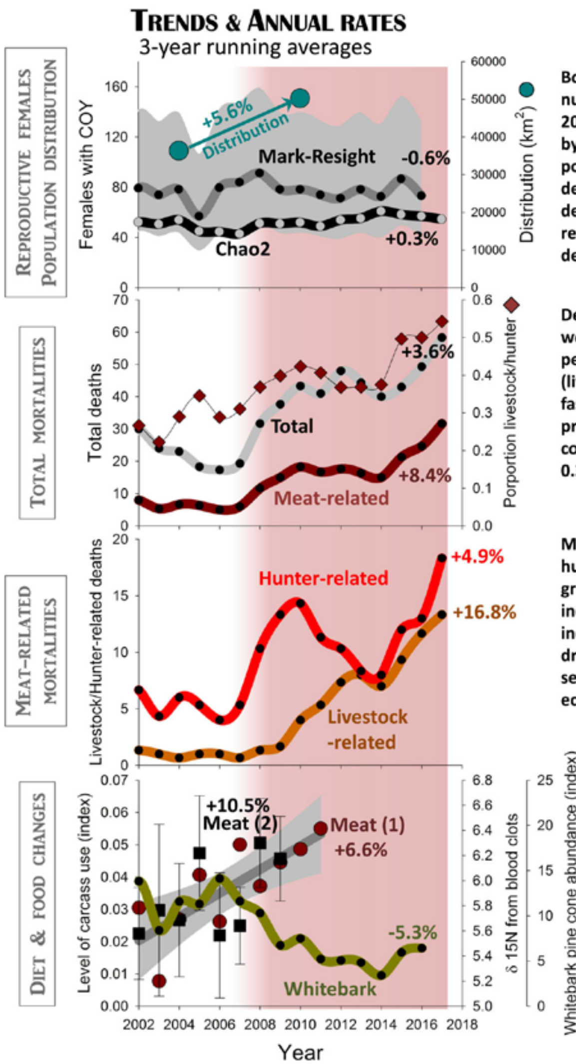
Key transitions in environments, diets, and demography of Yellowstone grizzly bears are summarized in Figures 5 (above) and 6 (below). Consumption of meat from large herbivores began to steadily climb around 2002 (Fig. 6d), soon after major declines in numbers of spawning cutthroat trout (Figs. 5e, 5f), and coincident with the onset of major losses of whitebark pine to bark beetles

(Macfarlane et al. 2013). Meat consumption continued to increase after the mid-2000s when, of relevance to grizzly bears subsisting on pine seeds, losses of mature whitebark pine trees to beetles were no longer offset by what had been a fortuitous series of large cone crops (Fig 6d).

Several researchers, including Middleton et al. (2013), Schwartz et al. (2013), and Ebinger et al. (2016), hypothesized that increased consumption of meat from large herbivores by Yellowstone grizzlies was in compensation for losses of cutthroat trout and whitebark pine seeds. The weight of available evidence certainly makes this the most plausible of any candidate explanation. If so, this begs the question of where grizzly bears obtained additional meat given that elk populations had declined substantially (Fig. 5a), and that spring availability of ungulate carcasses on ungulate winter ranges either declined or remained static (Figs. 5b, 5d) despite increases in bison numbers (Fig. 5c). Given these trends, grizzly bears plausibly obtained more meat from early-summer predation on elk calves, evident in a tripling of bear-specific calf mortality rates between the mid-1980s and mid-2000s (Middleton et al. 2013). Otherwise, bears likely obtained more meat during summer from livestock and, during fall, from remains of elk killed by big game hunters.

These latter two sources of meat are implicated in the exponential increases of grizzly bears dying because of conflicts over livestock depredation and encounters with big game hunters (Fig. 6c), coincident with the terminal decline in ecosystem-wide availability of whitebark pine seeds beginning in 2007 (Fig. 6d). These dramatic increases in hunter- and livestock-related grizzly bear deaths—signifying greater reliance by bears on meat—substantially contributed to sustained increases in total grizzly bear mortality in the GYE beginning, again, around 2007 (Fig. 6b). Death rates of cubs and yearlings also increased substantially during this same period (Van Manen et al. 2016), consistent with greater reliance on meat by reproductive females (see below). Not surprisingly, the steady increase in bear deaths during the last 11-12 years correlates with a static number of reproductive females in the ecosystem (Fig. 6a). Van Manen et al. (2016) claim that the associated drop in population growth rate was caused by increasing bear densities and related increases in bears killing bears. These authors point to increasing rates of cub and yearling deaths as evidence of their thesis.

However, their thesis fails for several reasons. First, at the same time that numbers of reproductive females remained static, the distribution of the population increased by over 40% (Fig. 6a). Axiomatically, population-wide densities dropped rather than increased given that essentially the same number of bears was spread over a much larger area. Second, the expansion of a static population over a larger area is consistent with a decline in carrying capacity, which is consistent, in turn, with losses of key foods that occurred during the last 15-20 years. Third, the modeling reported by Van Manen et al. (2016) is at odds with straight-forward data showing a 3.6% per annum increase in grizzly bear deaths in the GYE at the same time that population size remained more-or-less constant; hence, death rates for all bears likely increased (Fig. 6b). Finally, fourth, increased rates of cub and yearling deaths are plausibly attributed to a shift by reproductive females towards eating more meat, which, even with constant bear densities, predictably exposes dependent young more often, not only to predatory bears (Mattson et al. 1992b, Mattson 2000), but also to predatory wolves (Gunther & Smith 2004).



IMPLICATIONS

Both the Mark-resight and Chao2 methods show that numbers of reproductive females remained static during 2002-2017. Even so, population distribution increased by 38% between 2004 and 2010. Axiomatically, population-wide density of reproductive females declined, which debars an effect of increasing bear densities on birth or death rates. Dietary changes and resulting effects on death rates are the logical drivers of demographic changes during the last 15 years.

Despite the fact that numbers of reproductive females were static, total recorded mortality increased by 3.6% per annum during 2002-2017. Meat-related mortalities (livestock- and hunter-related) increased at an even faster 8.4% annual rate. As a consequence, the proportion of total grizzly bear mortality resulting from conflicts with humans over meat increased from roughly 0.35 to 0.55.

Mortalities resulting from meat-related conflicts with humans sky-rocketed as a presumed consequence of grizzly bears eating more meat. Hunter-caused deaths increased by 4.9% per annum. Livestock-related deaths increased by an astounding 16.8% annual rate. These dramatic increases probably arose, in part, from bears seeking human-associated meat as compensation for ecosystem-wide declines in elk populations.

Aerial extent of mature whitebark pine began to decline around 2002, but total availability of whitebark pine cones (the green trend line at left) didn't begin to appreciably decline until around 2007 primarily because losses of mature trees were offset by a series of large cone crops during 2002-2006. Whitebark pine seeds have remained relative scarce at an ecosystem level since 2007, as denoted by the pink background shading. Substantial increases in consumption of meat between 2002 and 2011 presumably occurred as compensation for losses of whitebark pine.

SOURCES

Mark-Resight & Chao2: Van Manen, F. T., Haroldson, M. A., & Karabensh, B. E. (2017). Yellowstone grizzly bear investigations: annual report of the Interagency Grizzly Bear Study Team, 2016. US Geological Survey, Bozeman, Montana.

2004 & 2010 distribution: Bjornlie, D. D., Thompson, D. J., Haroldson, M. A., Schwartz, C. C., Gunther, K. A., Cain, S. L., ... & Aber, B. C. (2014). Methods to estimate distribution and range extent of grizzly bears in the Greater Yellowstone Ecosystem. *Wildlife Society Bulletin*, *38*(1), 182-187.

2002-2016 mortalities: Various authors (2003-2017). Yellowstone grizzly bear investigations: annual reports of the Interagency Grizzly Bear Study Team, 2002-2016. US Geological Survey, Bozeman, Montana.

2017 mortalities: Haroldson, M. A. (2017-2018). 2017 Known and probable grizzly bear mortalities in the Greater Yellowstone Ecosystem. Interagency Grizzly Bear Study Team, US Geological Survey, Bozeman, Montana. https://www.usgs.gov/data-tools/2017-known-and-probable-grizzly-bear-mortalities-greater-yellowstone-ecosystem

2002-2016 mortalities: Various authors (2003-2017). Yellowstone grizzly bear investigations: annual reports of the Interagency Grizzly Bear Study Team, 2002-2016. US Geological Survey, Bozeman, Montana.

2017 mortalities: Haroldson, M. A. (2017-2018). 2017 Known and probable grizzly bear mortalities in the Greater Yellowstone Ecosystem. Interagency Grizzly Bear Study Team, US Geological Survey, Bozeman, Montana. https://www.usgs.gov/data-tools/2017-known-and-probable-grizzly-bear-mortalities-greater-yellowstone-ecosystem

Meat (1): Ebinger, M. R., Haroldson, M. A., Manen, F. T., Costello, C. M., Bjornlie, D. D., Thompson, D. J., ... & White, P. J. (2016). Detecting grizzly bear use of ungulate carcasses using global positioning system telemetry and activity data. Oecologia, 181(3), 695-708.

Meat (2): Schwartz, C. C., Fortin, J. K., Teisberg, J. E., Haroldson, M. A., Servheen, C., Robbins, C. T., & Van Manen, F. T. (2014). Body and diet composition of sympatric black and grizzly bears in the Greater Yellowstone Ecosystem. The Journal of wildlife management, 78(1), 68-78.

Whitebark pine cone crops: Various authors (2003-2017). Yellowstone grizzly bear investigations: annual report s of the Interagency Grizzly Bear Study Team, 2002-2016. US Geological Survey, Bozeman, Montana.

Whitebark pine aerial extent: Van Manen, F. T., Haroldson, M. A., Bjornlie, D. D., Ebinger, M. R., Thompson, D. J., Costello, C. M., & White, G. C. (2016). Density dependence, whitebark pine, and vital rates of grizzly bears. The Journal of Wildlife Management, 80(2), 300-313.

Figure 6. Synopsis of population, mortality, and dietary trends of GYE grizzly bears relevant to dynamics unfolding during 2002-2017. Sources for each data time series are provided farthest right with a brief discussion of implications provided in the middle column. The pink-shaded background spanning all time series denotes the onset and subsequent persistence of whitebark pine losses caused by mountain pine beetles.

This collective evidence renders implausible central claims made by the FWS about GYE grizzly bears and their habitat, largely based on complicated flawed models (see comments by Mattson submitted to the FWS dated 10 May and 7 October, 2016). The FWS argues that the population has grown, reached a static invariate carrying capacity, and thus spread out commensurate to increases in population size, fully compensating for losses of key foods by eating other largely unspecified foods, without any explicit demographic consequences. By contrast, weight of evidence more defensibly suggests that losses of cutthroat trout and whitebark pine precipitated shifts to more hazardous diets comprised increasingly of human-associated meat, resulting in more dead bears, stalled growth in numbers of reproductive females, and burgeoning conflicts between people and bears on an ever-expanding population periphery (e.g., Van Manen et al. 2012, 2013). Moreover, theoretical (Doak 1995) and empirical (McLellan 2015) evidence of lagged responses by bear populations to deteriorating environmental conditions suggests that negative demographic trends will continue, especially given declines in future recruitment caused by the recent increases in mortality rates of young bears (Van Manen et al. 2016).

The picture painted by a clear-eyed comprehensive look at all of the available evidence is of a population in trouble, largely as a consequence of deleterious habitat changes caused directly or indirectly by humans, compounded by lethal human responses to emerging arenas of conflict.

7. Given the magnitude of historical losses, comparatively small subsequent gains, and current signs of trouble, management of GYE grizzly bears

would logically facilitate expansion of this population into adjacent as-yet-unoccupied suitable habitat as well as other movement by bears among ecosystems. Such outcomes would achieve multiple desirable even necessary outcomes. GYE bears would have access to more foods in more areas to compensate for unfolding losses; long-term genetic health would be assured; the population would be more resilient to future environmental changes simply because of larger size; colonization of currently unoccupied potential habitat in the

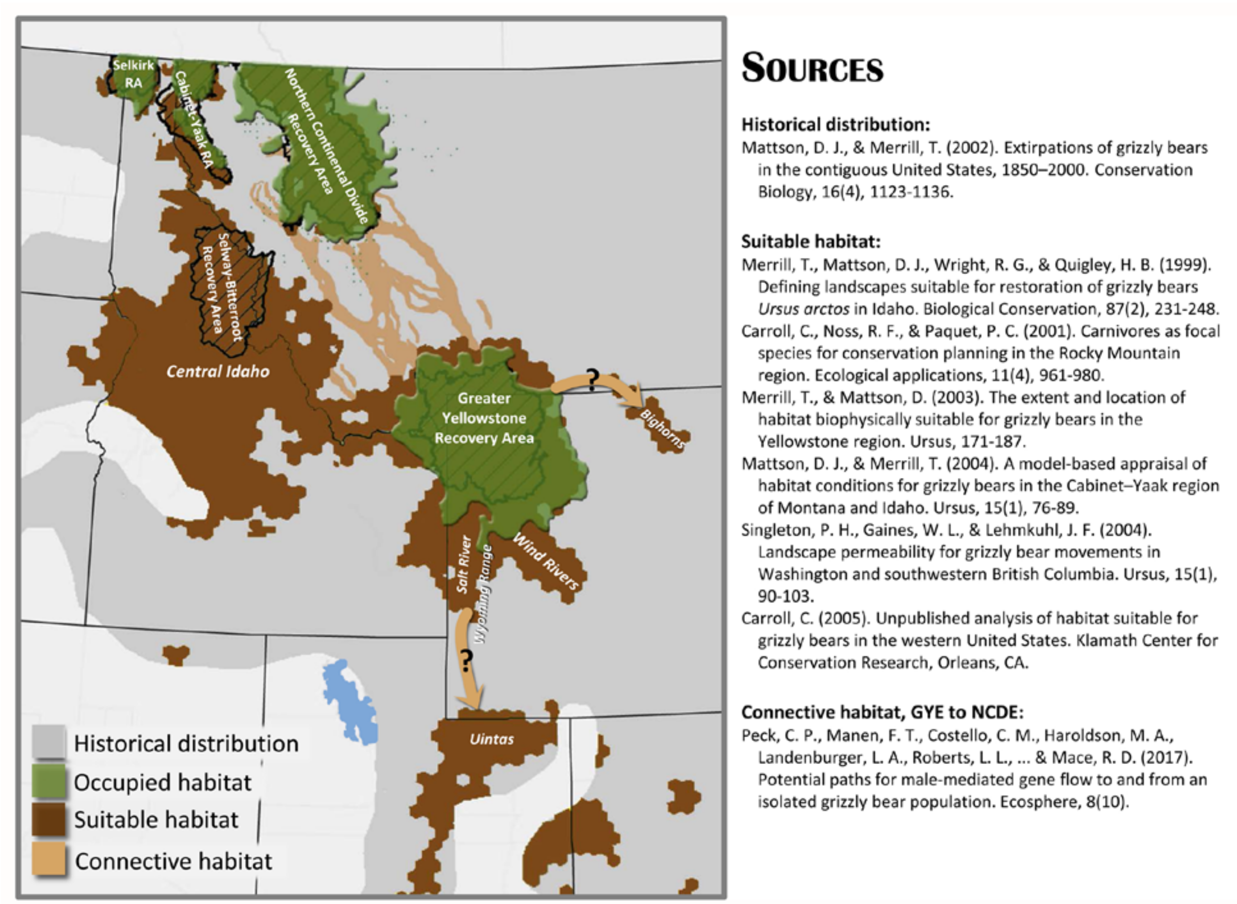


Figure 7. Currently occupied grizzly bear habitat in the northern U.S. Rocky Mountains (green) in relation to suitable but unoccupied habitat (dark brown) and potential dispersal routes between the Greater Yellowstone and Northern Continental Divide ecosystems (tan). Probable dispersal routes to the Bighorn Mountains and Uinta Mountains are also identified.

Selway-Bitterroot Recovery Area of central Idaho would be facilitated; and colonization of other suitable areas farther south, in expanses depopulated during the heyday of human lethality, would be more likely.

Achieving such goals is contingent on the location and extent of suitable habitat and connective corridors relative to occupied grizzly bear habitat. Figure 7, above, summarizes the results of research conducted by numerous researchers designed to identify potential corridors and other habitat suitable for long-term occupancy by grizzly bears in the U.S. Rocky Mountains, including areas farther south. There is clearly ample contiguous habitat with potential to sustain resident grizzly bears to the west of the GYE into central Idaho, thence north through the Selway-Bitterroot Recovery Area (RA), and, further north yet, connecting with the Cabinet-Yaak RA. Substantial potential habitat also extends south in Wyoming into the Wind River, Wyoming, and Salt River Ranges. Additional but disjunct potential habitat occurs in the Uinta and Bighorn Mountains to the south and east of habitat contiguous with current grizzly bear distribution in the GYE. As research by Peck et al. (2017) and others have shown, independent of capacity to sustain resident bears, corridors sufficient to host transient grizzly bears also exist between the GYE and NCDE, suggestive of additional corridors south and east of the GYE able to support colonizing dispersers.

However, all of this research makes a critical assumption: that human lethality is constant, and that the only features varying from one location to another are habitat productivity and remoteness from humans. Lethality can be understood as the probability that, given an encounter with a human, the involved bear will end up dead (Mattson et al. 1996a, 1996b). Human lethality was extraordinarily high during 1800-1950, when most grizzly bears were extirpated, and much lower with ESA protections (Mattson and Merrill 2002). In other words, lethality can vary independent of remoteness from humans, with landscapes becoming more or less deadly for grizzly bears depending on how lethality is managed, most notably, whether killing of grizzly bears is licensed or otherwise encouraged by those with authority over bear management. If management regimes become more lethal, even the most remote and productive wilderness can become inhospitable for grizzly bears. If, as in National Parks, priority is placed on conservation, grizzly bears can thrive even in the midst of human multitudes (Gunther et al. 2004, Haroldson & Gunther 2013).

8. Following removal of ESA protections, management of Yellowstone's grizzly bear population within the Demographic Monitoring Area (DMA) has been configured by a Memorandum of Agreement (MOA) adopted by Wildlife Commissions in Wyoming, Montana, and Idaho. The FWS gave the MOA authoritative weight under the ESA by codifying its objectives, protocols, and guidelines in the final delisting rule, including explicit provision for implementation of a sport hunt by all three involved states. Even though each state's Commission has expressly reserved the right to deviate from the MOA, this agreement nonetheless will likely govern—if not dictate—grizzly bear management until at least the end of the FWS's 5-year post-delisting oversight of state management in June 2022.

Of particular relevance here, the MOA's protocols are expressly designed to prevent growth of the grizzly bear population within the DMA (as estimated by the so-called Chao2 method) above levels observed during 2002-2014 (Fig. 6a). If, as during 2017, estimated population size exceeds the 2002-2014 average, prescribed mortality rates will be increased to reduce bear numbers (e.g., “adjustable mortality rates”), with prospectively much of the differential between so-called discretionary and non-discretionary mortality allocated to sport hunting. As described in the FWS’s Final Rule, the MOA’s “…adjustable mortality rates were calculated as those necessary to manage the population to the modeled average Chao2 population estimate of 674 bears...” and “…total mortality is limited…when the population is at or below 674, with higher mortality limits when the population is higher than 674.” I emphasize “to” in the quote above because this single word is critical. In essence, it encapsulates the central post-delisting objective of managing to prevent growth of the Yellowstone DMA grizzly bear population above 674 animals, which is particularly relevant given that current estimated population size is around 700.

The Final Rule describes provisions putatively designed to guard against post-delisting population declines within the Yellowstone DMA, including statements averring that state managers will adaptively decrease mortality rates as population estimates drop below triggering thresholds, and disallowing sport hunting if estimated bear numbers drop below 600. However, neither provision is binding on the States; both are discretionary. The only substantive population-related trigger for authoritative FWS intervention occurs when estimated bear numbers drop below 500. As stated in the Final Rule, “The Service will initiate a formal status review and could emergency re-list the GYE grizzly bear population…If the population falls below 500 in any year...”

However, all these provisions, discretionary or otherwise, are compromised by uncertainties, lags, and deficient assumptions built into the MOA's methods. These methods assume that males can be killed at roughly twice the rate as females (e.g., 15% versus 7.6% annually at a population of 674), even though males and females are born in roughly equal numbers (Schwartz et al. 2006; Van Manen et al. 2016). This alone guarantees declines in numbers of males, even if females are being managed sustainably. Yet numbers of males are not directly monitored. Adolescent and adult males are numerically added to total population estimates proportional to retrospective estimates of their fractions in the population, based, in turn, on assumption-ridden model-contingent estimates of comparative mortality rates using data collected during the previous 5-10 years. In other words, even if estimates of comparative mortality rates are unbiased, male population dynamics will be viewed through a rearview mirror, with relevant estimates lagging well behind unfolding real-time conditions.

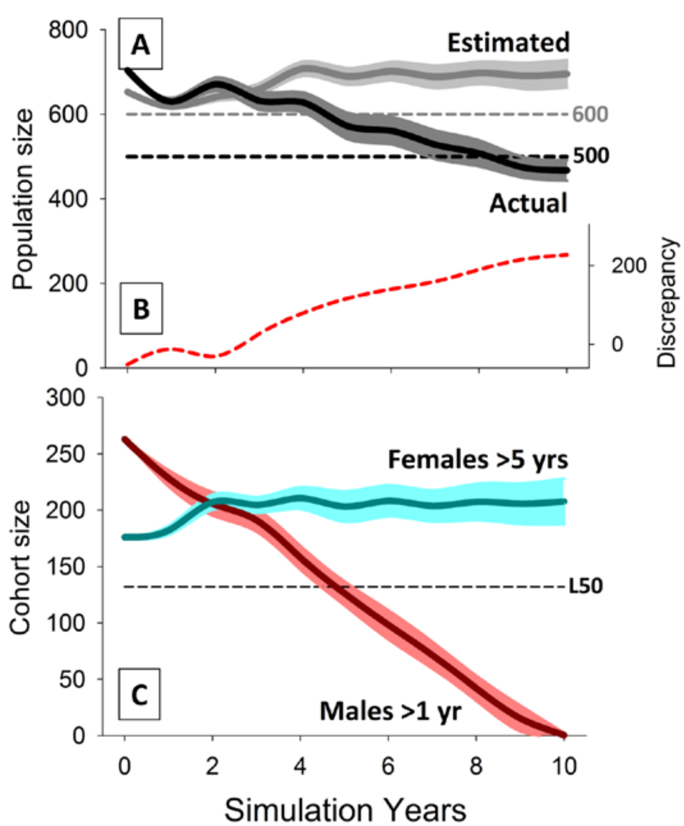


Figure 8. 10-year population projections simulating implementation of MOA protocols for management of grizzly bears inside the Yellowstone DMA. Estimated population size increasingly exceeds real population size over time (A), with over-estimates reaching near 200 bears by 10 years out (B), largely because the male segment >1-year-old crashes outside of National Park jurisdictions. Roughly 50% of adult males are killed within 5 years, corresponding to L50.

Figure 8, above, visually summarizes projections simulating the implementation of protocols specified by the Tri-state MOA. These projections take the protocols at face value and, in the absence of any enforceable specifics, do not credit assurances by wildlife managers that untoward trends will somehow be detected and corrected. Succinctly, if fully implemented, the MOA protocols will likely lead to an undetected crash in the DMA's male population segment outside National Park jurisdictions (Fig. 8c), at the same time that estimated population size increasingly exceeds true population size (Fig. 8a). By 10 years out, the population could be over-estimated by >200 animals (Fig. 8b). As a consequence, managers would not detect a population decline below 600 and then 500 (Fig. 8a), the putative trigger for a formal status review by the FWS. Instead, state managers would be erroneously applying mortality rates designed to further depress a population assumed to be near 700, but actually nearer 500.

Importantly, the FWS has not undertaken its own analysis projecting the consequences of faithfully applying the protocols codified in its 2017 Final Rule. Instead, the agency's response to simulations such as the one presented in figure 8 has been dismissive in apparent service of political expedience. But, as a trustee, the FWS is obliged to address any issue of potentially critical importance brought to its attention by the concerned public, and do so in good faith. The FWS's response to date lacks both sincerity and seeming cognizance of its trust responsibilities.

9. State plans for managing grizzly bears outside the DMA compound the deficiencies in protocols for managing grizzly bears within. These plans matter

because the FWS explicitly states in the Final Rule that "Mortalities outside the DMA are the responsibility of each State and do not count against total mortality limits," which functionally gives state managers *carte blanche*. Of relevance here, the three involved states either intend to limit or even prevent occupancy of areas outside the DMA by grizzly bears—as in the case of Wyoming—or, at best, allow for expansion in highly ambiguous and qualified terms—as in the case of Montana.

To quote the Wyoming Grizzly Bear Management Plan: "Habitats that are biologically and socially suitable for grizzly bear occupancy are the portions of northwestern Wyoming within the DMA that contain large tracts of undisturbed habitat, minimal road densities, and minimal human presence" and "Although grizzly bears will not be actively discouraged from occupying all areas outside the DMA, management decisions will focus on minimizing conflicts and may proactively limit occupancy where potential for conflicts or public safety issues are very high" (my emphasis added).

As direct evidence of its intent, the state of Wyoming plans to sport hunt as many as 12 grizzly bears in areas outside the DMA during its fall 2018 hunting season. Two of these bears will prospectively be adult females. Given that there are almost certainly no more than 90-100 bears outside the DMA, the sport hunt alone will prospectively kill 12-13% of all extralimital grizzly bears in Wyoming, and this on top of other mortality that will likely be of equal magnitude (see Point 20.1 in my May 10, 2016, comments on the FWS's Draft Rule). No research has ever shown that an annual mortality rate near 25% can be sustained by any interior North American grizzly bear population (see also point 4, above). More commonly, as posited by the MOA, sustainable mortality rates are less than half such a rate, nearer 5-10%.

With reference to key linkages in Montana (see point 7, above), the Final Rule merely states: “To increase the likelihood of occasional genetic interchange between the GYE grizzly bear population and the NCDE grizzly bear population, the State of Montana has indicated they will manage discretionary mortality in this area in order to retain the opportunity for natural movements of bears between ecosystems” (again, my emphasis added). The Grizzly Bear Management Plan for Southwestern Montana (Montana Fish, Wildlife & Parks, 2013) states throughout that “non-conflict” grizzlies will be accommodated in potential linkage zones, but then specifies measures for dealing with “conflict” grizzly bears, all of which history has shown lead to a high likelihood of death for the involved bear. As a consequence, and as the Plan itself acknowledges, connectivity between the GYE and other grizzly bear populations will depend on widespread effective efforts to prevent conflict and curb detrimental private land development, all of which require ample funding.

10. Despite laudable language in various planning documents, the U.S. Forest Service and States of Wyoming, Montana, and Idaho are demonstrably ill-equipped to prevent or non-lethally mitigate escalating human-grizzly bear conflicts concentrated on the periphery of the Greater Yellowstone Ecosystem. As I note under point 6, above, grizzly bear deaths have been increasingly linked since the mid-2000s to human-associated meat, notably livestock and the remains of hunter-killed big game, together accounting for near 55% of known and probable bear fatalities. The fact that meat-associated grizzly bear deaths have been

increasing at rates of 5% (hunter-related) and 17% (livestock-related) per annum (Fig. 6a) during a period of stalled population growth is a self-evident verdict on the deficiency of measures taken by managers to non-lethally address these burgeoning causes of human-grizzly bear conflict.

The current Conservation Strategy along with state grizzly bear management plans furthermore explicitly call for maintenance of the status quo, which will likely institutionalize an inadequate conflict prevention regime. A pointed example can be found in the Upper Green River Area Rangeland Project Final EIS completed by the Bridger-Teton National Forest during October 2017. This project area contains the highest concentrations of grizzly bear depredations on livestock—mostly cattle—in the entire GYE. Figure 9 shows the Upper Green River grazing allotments along with the ecosystem-wide locations of grizzly bear depredations during two emblematic years (2012 and 2013; mapped locations for more recent years are not publicly available). Despite the fact that these

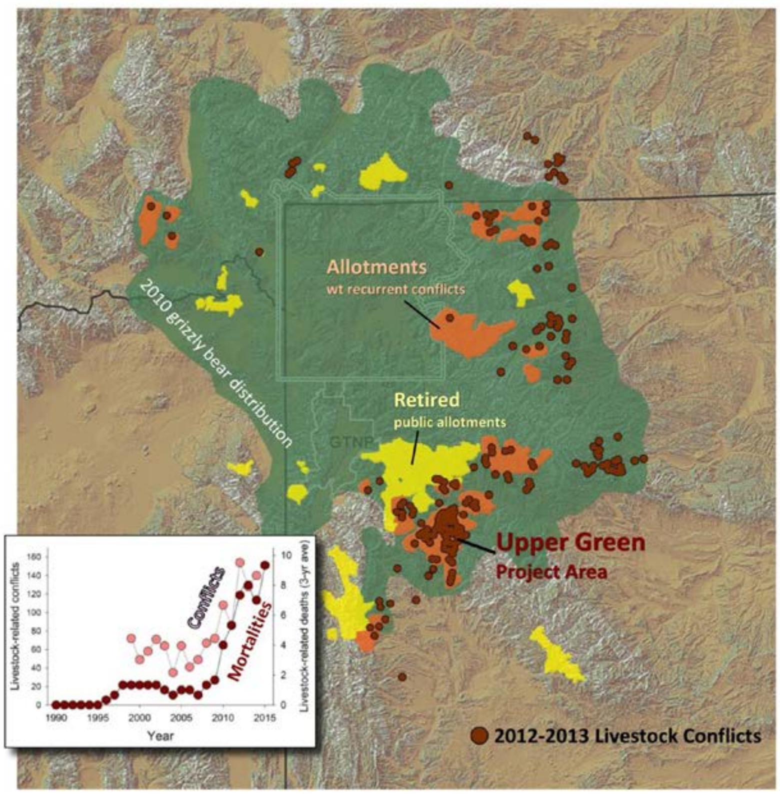


Figure 9. Distribution of grizzly bear depredation on livestock and related conflicts in the GYE during 2012-2013 (dark red dots) along with *circa* 2010 grizzly bear distribution (green), recently retired public land grazing allotments (yellow) and active allotments identified as having chronic conflicts. The inset graph shows trends in grizzly bear-livestock conflicts (pink) and related grizzly bear mortalities (dark red).

allotments continue to account for much of the livestock-related conflict in the GYE, the Final EIS essentially enshrines the status quo. There is no provision for substantive changes in husbandry practices, stocking rates, or allotment delineations and infrastructure. Unmitigated conflict and resulting bear deaths will likely continue here and elsewhere.

This prognosis is rendered even more plausible by the fact that state grizzly bear conflict specialists will likely be further under-resourced in the near future. Appendix F of the penultimate GYE Conservation Strategy summarizes the prospective annual costs of implementing mandated human/grizzly bear conflict management, estimated to be $650,000 for the US Forest Service, $735,000 for the state of Wyoming, and $246,000 for the state of Montana. On top of this, the Montana state plan also asserts the importance of "Securing important linkage habitats through purchase or easement…" Few of the requisite operating funds are currently available, much less funds for purchasing easements or fee simple titles. Out-year budgets for the Forest Service and state wildlife management bureaus suggest a worsening rather than improving fiscal situation.

Funding deficiencies are fully acknowledged in state grizzly bear management plans. The 2013 Montana plan states "…a funding mechanism to support Montana's responsibilities for Yellowstone grizzly bear management is necessary." Since then, the agency's wildlife-related budget has been essentially static after accounting for inflation, with no increased allocations to support grizzly bear conflict prevention. Likewise, the 2016 Wyoming plan states "…costs associated with data collection and conflict management will vastly exceed any revenue generated by the grizzly bear program." The Wyoming Game and Fish

Department's budget has concurrently declined by a net $6 million since 2016 (Wyoming Game & Fish Department 2017). There is little prospect that short-falls will be covered by grants from the federal government given that proposed 2018-2019 budgets for the FWS and Forest Service call for major cuts in programs supporting recovery of endangered and threatened species.

11. Inadequacies of the current conflict prevention regime in the GYE are not mere speculation. One need look no further for evidence than in grizzly bear mortality trends in the GYE during the last three years, which have, if anything, amplified during 2018. Figure 10, below, illustrates the pace at which known and probable grizzly bear mortalities accrued each year in the GYE during 2013-2018. Year-end totals broke records during 2015-2017, representing a dramatic jump from totals for 2013-2014. As suggested by population trends in Figure 6, this increase cannot be explained by either the non-existent increase in population size or modest increase in population distribution. And, of import here, the pace at which

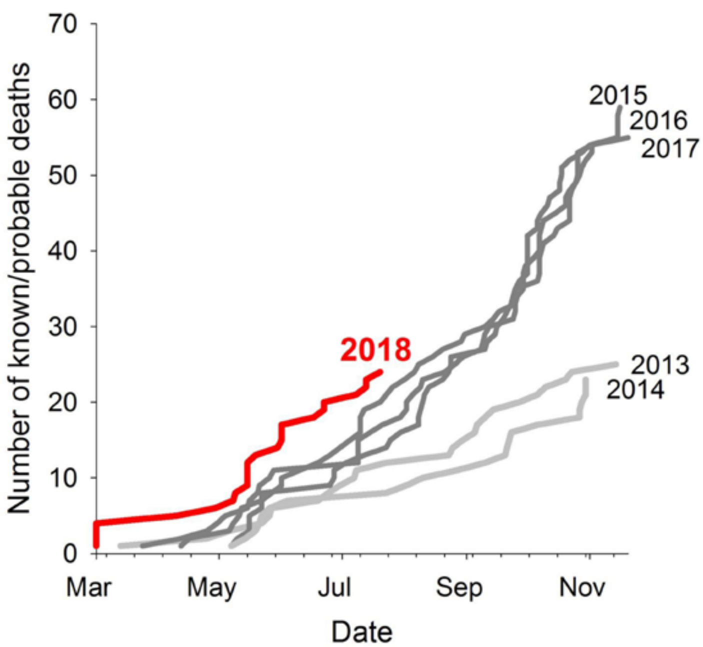


Figure 10. Annual accumulation curves for known and probable grizzly bear deaths in the GYE during 2013-2018. Deaths are attributable to all causes both inside and out of the DMA. In keeping with how the states of Wyoming, Montana, and Idaho are implementing the MOA, the accumulation curve for 2018 includes four deaths that occurred late in 2017 but were not detected until spring 2018. State wildlife managers plan to account for these deaths during 2017 in calculating allowable mortality for 2019.

grizzly bears are dying in the GYE during 2018 exceeds that of 2015-2017, a period during which state wildlife managers were *de facto* in charge of conflict management. At a minimum, data from 2018 (see: https://www.usgs.gov/data-tools/2018-known-and-probable-grizzly-bear-mortalities-greater-yellowstone-ecosystem) demonstrate that exceedingly high levels of mortality this year are, in part, a continuation of trends in livestock-related deaths that drove high levels of mortality during 2015-2017. These trends are a tacit verdict on the inadequacy of conflict prevention measures in the ecosystem and the current lethality of state-administered management of grizzly bears. Moreover, the trend unfolding during 2018 is alarming, even prior to advent of the planned September 2018 sport hunt in Wyoming and Idaho.

12. Hunting will harm Yellowstone grizzly bears, if for no other reason than by magnifying and compounding dynamics heretofore described that already sorely compromise future prospects of this isolated population. But, even more problematic, this harm is likely to be irreparable, not only for the directly affected bears, but also for surviving bears through a cascade of subsequent indirect effects.

Most obviously—perhaps tautologically—the grizzly bears killed by sport hunters will be irreparably harmed. These bears' lives will be irreversibly ended in ways definitively linked to hunting. They will, moreover, be unambiguously removed from the pool of potential reproductive individuals.

But beyond the obvious, there is the question of whether bears that will be killed by hunters would have likely died for other reasons during the subsequent year. If yes, then these hunting-related mortalities would have 'compensated' for other causes of death. If no, then hunting-related mortalities would be in addition to any that would have otherwise occurred. This is the distinction in technical ecological literature between ‘compensatory’ and ‘additive’ mortality. If hunting-related mortality is fully compensatory then, at a population level, there are no direct numeric effects incurred during a seasonal cycle. However, if mortality is additive, then population numbers will axiomatically be reduced below levels that would have otherwise been sustained. This is a key consideration because it sets the stage for determining whether, aside from irrefutable harm to individual bears, hunting could cause irreparable harm to the population and its long-term prospects.

In fact, there is little doubt that most hunting-caused mortality will be additive, not compensatory. Deductively, heavily-armed humans that deliberately seek out bears to kill them (i.e., sport hunters) will be, as a modality, far more lethal than humans under virtually any other circumstances. Absent hunting, a certain number of independent-aged grizzly bears in the Yellowstone ecosystem would survive the existing relatively lethal environments that they are exposed to largely because of choices they make, for example, by seeking out gut piles that bring them into close contact with elk hunters or by seeking out and either killing or scavenging livestock on public lands grazing allotments.

But these endemic scenarios do not translate into the near-certain death of the involved bears upon encountering the involved humans—which would be the case with a grizzly bear sport hunt. The point here is that sport hunting by its very nature is, deductively, *per capita* much more lethal to grizzly bears. By first principles, many deaths from sport hunting will be additive—that is, would not have otherwise occurred.

The weight of empirical evidence supports this conclusion. Without being exhaustive, research by Bishof et al. (2009) and Frank et al. (2017) has definitively shown additive effects of hunting in *Ursus arctos* populations, consistent with additive effects shown for wolves by Creel & Rottella (2010), for American black bears by Obbard & Howe (2008), and for cougars by Weilgus et al. (2013), Robbinson et al. (2014), and Wolfe et al. (2015). By contrast, no credible investigation of any species of large carnivore has shown that hunting-related mortality wholly or even largely compensates for other causes of mortality.

Importantly, tallies of grizzly bear mortalities predating a fall sport hunt, as is planned in Wyoming and Idaho during 2018, will not account for the additive effects introduced by hunting-related deaths. Nor, under current management protocols, will the additive effects manifest during the 12 months following a hunt be accounted for in calculations of mortalities allowed for the following year.

13. But the toll of sport hunting will not be limited to direct numeric effects on the Yellowstone grizzly bear population. Other indirect effects, manifest in decreased production, survival, and recruitment of cubs, will likely transpire during subsequent months.

Some mammalian populations have been shown to increase reproduction and recruitment in the aftermath of elevated human-caused mortality. These responses have the potential to indirectly compensate for mortality caused by sport hunting. However, in other instances, human-caused mortality depresses reproduction during subsequent months, which amplifies and exacerbates direct numeric effects. These sorts of depensatory effects have been most consistently shown for carnivore species in which males kill offspring of reproductive females to enhance their own reproductive opportunities—a phenomenon known as sexually-selected infanticide, or SSI (Ebensperger, 1998, Milner et al. 2007).

A priori, SSI is likely to be common in brown and grizzly bear populations given the large average difference in size of male and female bears (i.e., sexual dimorphism) and the fact that females, as in the Yellowstone ecosystem, have 3-year reproductive cycles (Schwartz et al. 2006). Synthetic analyses by researchers such as Harano & Kutsukake (2018) have shown the SSI correlates with the same intense competition among males that leads to selection for increasingly large comparative size. Moreover, rough parity between numbers of adult males and females slaved to a 3-year reproductive cycle—as with Yellowstone grizzly bears (Schwartz et al. 2006)—means that there are approximately three reproductive males for every breeding female. Such a skew by itself predictably leads to intense competition among males; a substantial portion of cubs unrelated to the males battling to reproduce; and significant incentive for males to kill cubs as means of inducing premature estrus in the targeted female (Bunnell & Tait 1981). Even a lesser ratio of reproductive males to breeding females predictably generates such a dynamic.

Amplification of SSI by sport hunting that disproportionately targets adult males would entrain several deleterious consequences. Cub and yearling death rates would likely increase with an influx of non-sire males triggered by the disruption of a social structure otherwise maintained by mature resident males. Longer-term, reproductive females would likely abandon productive habitats to seek refuge in more spartan environs (for example; Mattson et al. [1987, 1992];

Ben-David et al. [2004]; Gardner et al. [2014]), with resulting depression of fecundity. All of this could exacerbate, longer-term, the direct and additive numeric effects caused by hunter-caused deaths.

But, in addition to a strong deductive case, there is overwhelming empirical support for the existence of SSI and related dynamics among grizzly bears, and for the amplification of these phenomena by human persecution. Without being exhaustive, there are more than 20 publications reporting evidence from investigations of brown and grizzly bears that: SSI is amplified by sport hunting (Bellemain et al. 2006; Gosselin et al. 2015, 2017; Bischof et al. 2018), including depensatory effects on birth and death rates (Stringham 1980, Swenson et al. 1997, Wielgus et al. 2013, Gosselin et al. 2015, Frank et al. 2017, Bishof et al. 2018); that deleterious social restructuring occurs, including an influx of potentially infanticidal males (Swenson et al. 1997; Wielgus et al. 2001; Ordiz et al. 2011, 2012; Gosselin et al. 2017; Leclerc et al. 2017; Bishof et al. 2018; Frank et al. 2018); and that foraging efficiencies of adult females decrease (Wielgus & Bunnell 2000; Ordiz et al. 2011, 2012; Hertel et al. 2016; Bishof et al. 2018) in tandem with increased physiological stress (Bourbonnais et al. 2013, Støen et al. 2015).

These results specific to *Ursus arctos* are in context of compendious research showing the same spectrum of results for large carnivores more broadly (e.g.; Milner et al. 2007, Packer et al. 2009, Harano & Kutsukake 2018), as well as more specifically for American black bears (Czetwertynski et al. 2007, Stillfried et al. 2015, Treves et al. 2010), mountain lions (Robinson et al. 2008, Peebles et al. 2013, Wielgus et al. 2013, Maletzke et al. 2014, Keehner et al. 2015, Teichman et al. 2016), and wolves (e.g.; Murray et al. 2010, Wielgus et al. 2014).

By contrast, research specific to *Ursus arctos* that calls into question the potential amplification of SSI and other depensatory effects by hunting amounts to essentially two publications (Miller et al. 2003, McLellan 2005). Even so, Miller et al. do not cover conditions of particular relevance to Yellowstone's grizzly bear population, where, unlike what they considered, hunting would perturb social dynamics of a population near a dynamic carrying capacity, and McLellan premises a regime where "some" adult males might be killed, which does not concur with the regime being proposed by Wyoming and Idaho entailing the hunting of 21 males in addition to congeners that will have died from other human causes. Moreover, this paucity of relevant findings is consistent with a continent-wide deficit pertaining to other large carnivores. Only a handful of authors, notably Czetwertynski et al. (2007) and Murray et al. (2010), call into question depensatory effects of sport hunting on black bears and wolves, respectively, and, even so, with significant qualifications.

Deductive logic and the available evidence leaves little doubt that male-biased sport hunting will entrain longer-term depensatory effects that amplify the more immediate negative effects of elevated mortality among grizzly bears occupying hunting units managed by the states of Wyoming and Idaho. Any arguments to the contrary will necessarily be based on ignoring the weight of evidence, inflating uncertainties, and over-stating research in ways convenient to the purpose.

14. The post-delisting regime for managing Yellowstone's grizzly bear population is designed to prevent numeric increases within the heart of the

ecosystem (i.e., the DMA); discourage, if not prevent, dispersal to and colonization of most of the adjacent or farther distant suitable habitat; and promulgate inadequate conflict prevention programs. Moreover, this insufficient if not punitive management is being implemented using methods that not only engender considerable uncertainty, but also stand a good chance of leading to unintended undetected population declines.

This inauspicious regime is being imposed at a time when long-term conservation goals and on-the-ground conditions create an imperative to encourage—not discourage—occupancy of all adjacent suitable habitat; connectivity with central Idaho and the Northern Continental Divide Ecosystem; and colonization of novel yet suitable habitats to the south and east by grizzly bears in the Yellowstone ecosystem.

Compounding these manifold stressors and problems, the states of Idaho and Wyoming have moved aggressively forward with instituting a sport hunt designed to kill the maximum number of bears allotted for this purpose. And these hunting-caused deaths will almost certainly be additive to the toll taken by humans for other reasons, likely compounded by longer-term indirect but depensatory effects on female reproduction and recruitment.

In toto, these problematic environmental dynamics coupled with uncertain monitoring methods and purposefully lethal post-delisting management promise irreparable harm to, not only the Yellowstone grizzly bear population, but also other extant or potential grizzly bear populations in the Northern US Rocky Mountains. As a consequence, prospects for meaningful recovery and restoration will be potentially fatally compromised, which is of all the greater consequence given that grizzly bears in this region represent a globally unique genetic and behavioral lineage, as well as an imperiled remnant of bears that once occupied most of the western contiguous United States.

Pursuant to 28 U.S.C. § 1746, I declare under penalty of perjury that the foregoing is true and correct.

Executed on this 1st day of August, 2018.

David J. Mattson

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