

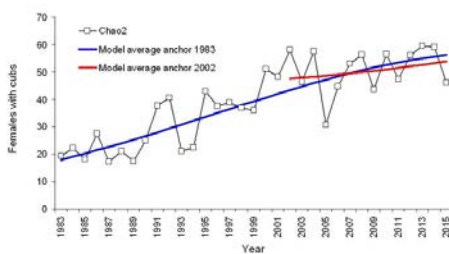
Bulleted summary of peer review and public comments, organized into issues

Green = public comment

Blue = peer review

Purple = both public comment and peer review

- **ISSUE 14:** Concerns about how we measured and interpreted population trend (Jennifer):
 - Concerns about measurement/methods
 - Annual uncertainty in the population estimate should be compared to long-term averages to give more insight into the population trend. It is unclear what this comment refers to.
 - Negative trend may not be detected with current statistical rigor until too late. IGBST is currently investigating the power of the current population estimation protocol to detect a declining trend. Primary findings will be submitted to a peer-reviewed journal during fall 2016.
 - The model-averaged approach to estimate population size and trend is insensitive to rapidly changing conditions. The “smoothing” approach should not include data from before 2000 when drastic changes occurred in the GYE. The results, both population size and trend, are highly dependent on the time period being modeled. The more data included, the more optimistically the result is biased. Since 2007, the population trend has declined significantly to 0.8%. IGBST investigated the influence of “anchoring” the time series in 1983 versus 2002. The difference in model-averaged Chao2 estimates was negligible. For example, the 2014 estimate of females with cubs-of-the-year using the time series of 1983-2014 was 60, whereas the 2002-2014 time series resulted in an estimate of 57 for 2014. Similarly, the 2015 estimate of females with cubs-of-the-year based on the 1983-2015 time series was 56, whereas the 2002-2015 time series produced an estimate of 54 (see figure below). It should be noted that the graph below also shows no statistical trend based on the 2002-2015 data, supporting the interpretation of population being stable during this time period.



- “The Service employs linear and quadratic models, without statistical or theoretical justification.” A detailed explanation and justification was provided in a peer-reviewed publication: Harris et al. (2007).
- The population growth rate has been over-estimated because it does not account for senescence in both birth and death rates of female grizzly bears (Doak & Cutler

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2014a, 2014b). In a rebuttal to this critique, van Manen et al. (2014) showed that Doak and Cutler's choice of extreme mortality risk beyond age 20 and their incompatible estimate of baseline fecundity led to erroneous conclusions.

- **Population size is inflated by inflation of survival rates male and female bears 2+ years old and is insensitive to rapidly changing conditions.** We are not aware of a scientific basis for this assertion. Survival rates of independent males and independent females are estimated based on known-fate data, as detailed in Haroldson et al. (2006). The survival estimates are not inflated and, in fact, may be underestimates because IGBST assigns the month of death as the last month an individual bear was known to be active when a bear was lost from monitoring and the date of death was unknown. If some of these individuals were lost the following month, the overall estimate of survival would be higher (Haroldson et al. 2006). Regarding insensitivity to rapidly changing conditions, IGBST is currently investigating the power of the current population estimation protocol to detect a declining trend (see response above).
- **Van Manen et al. (2016) and Bjornlie et al. (2014), the papers cited in the rule, use trapping-effort data instead but should use the more reliable capture-recapture population count method.** It is unclear what this comment specifically refers to. van Manen et al. (2016) used radio-monitored bears in their analysis of known-fate data to estimate vital rates; no population estimation was involved. Bjornlie et al. (2014; assuming this is the paper addressing home range size, whitebark pine decline, and population density) was based on home-range data of grizzly bears; no population estimation was involved in this study either.
- **Doak (1995) published that there's an 8-13 year lag between habitat decline and population decline, McLellan (2015) recently demonstrated lag effects for grizzly bears in the North Fork of the Flathead River drainage of BC and MT.** For large vertebrate populations, lag effects can occur, if there is indeed habitat decline and animals are affected by that decline. With 2016 being approximately 10 years after the peak years of whitebark pine decline and about 20 years since the decline of cutthroat trout, there is currently little evidence of a lag effect either at the population level (population remains stable) or at the individual level (lack of evidence of changes in survival, litter size, fecundity, etc. during the last 10-15 years). It should be noted that observed changes in vital rates (i.e., lower cub and yearling survival, slight suppression of reproduction) occurred during the late 1990s and early 2000s. Even without a lag effect, these changes in vital rates occurred prior to, or close to, the onset of whitebark pine decline; thus, there is little support for a lag effect due to changes in food resources.
- **Use of an independent measure to verify model trends, including independent sampling for this purpose, would strengthen interpretation of any model employed.** Although not specifically presented in the Proposed Rule, the IGBST uses 4 independent methods to estimate population size and/or trend: 1) Chao2 method (IGBST annual reports), 2) mark-resight estimator (IGBST annual reports); 3) population projections from known-fate analysis (Schwartz et al. 2006; IGBST 2012), and 4) population reconstruction (IGBST, unpublished data). These 4 methods support the interpretation that the Yellowstone grizzly bear population experienced

Comment [FTvM1]: Chapter in Schwartz et al. 2006; Wildlife Monograph.

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robust population growth from the mid to late 1980s through the late 1990s, followed by a slowing of population growth since the early 2000s.

- The IGBST workshops concluded that it is not possible to rely on FCOY observations as a trend indicator at the current high densities (IGBST 2012). This comment seems to reference the following statement in the IGBST (2012) report: “We believe that obtaining an unbiased estimate of the true number of animals from unduplicated counts is difficult because it becomes increasingly challenging to distinguish unique animals from duplicates as density increases.” This statement in the 2012 report remains true; however, it would be incorrect to conclude that “it is not possible to rely on FCOY observations as a trend indicator at the current high densities”. Although changes in the estimate of females with cubs-of-the-year may be more difficult to detect as density increases, the current protocol represents a conservative monitoring approach. We have previously used the analogy of a thermometer that does not register temperatures above 102 degrees; as long as the value of interest is below 102, it still registers when it drops to that point. Additionally, IGBST is currently investigating the power of the current population estimation protocol to detect a declining trend. Primary findings will be submitted to a peer-reviewed journal during fall 2016.
- Alternative interpretations
 - 2015 population estimate was down 6% from the 2014 estimate. Decline due to increased mortalities as a result of conflicts with hunters and livestock and lower cub survival For a long-lived vertebrate, such as grizzly bears, inference of trend based on model-averaged Chao2 estimates from one year to the next is inappropriate. Trends should be investigated over longer time periods; based on unpublished IGBST analyses of 2000-2015 data, analyses do not indicate a population decline.
 - The population has not increased since the early 2000s. Trend analyses and population projections based on known-fate data indicate the population has indeed remained stable to slightly increasing. So far, no analyses have indicated evidence of a population decline.
 - More older bears and fewer cubs and young bears is not a good trend to maintain a healthy population. This is a valid point, and supports the notion that GYE grizzly bears may be nearing carrying capacity in portions of the ecosystem. As van Manen et al. (2016) point out, observations of more older bears and suppression of recruitment support the notion of density-dependence in the GYE grizzly bear population. One consequence of density dependence indeed is that trends stabilize or possibly even decline.

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Proposed Rule Language

Population and Demographic Recovery Criteria

Below, we summarize relevant portions of the demographic analyses contained in the IGBST's 2012 report (IGBST 2012, entire) and compare them with the previous results of Schwartz *et al.* (2006b, entire) to draw conclusions concerning the grizzly bear population in the GYE DMA using these collective results. These analyses inform the scientific basis for our proposed revisions. While Schwartz *et al.* (2006b, p. 11) used data from 1983 through 2001; the 2012 IGBST report examined a more recent time period, 2002 through 2011 (IGBST 2012, p. 33). The IGBST found that population growth had slowed since the previous time period, but was still stable to slightly increasing, meaning the population had not declined. Because the fates of some radio-collared bears are unknown, Schwartz *et al.* (2006b, p. 48) and the IGBST (2012, p. 34) calculated two separate estimates of population growth rate: one based on the assumption that every bear with an unknown fate had died (i.e., a conservative estimate); and the other simply removing bears with an unknown fate from the sample. The true population growth rate is assumed to be somewhere in between these two estimates because we know from 30 years of tracking grizzly bears with radio-collars that every lost collar does not indicate a dead bear. While Schwartz *et al.* (2006b, p. 48) found the GYE grizzly bear DMA population increased at a rate between 4.2 and 7.6 percent per year between 1983 and 2002, the IGBST (2012, p. 34) found this growth had slowed and leveled off and was between 0.3 percent and 2.2 percent per year during 2002–2011.

Demographic Recovery Criteria 1

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The model-averaged Chao2 method is currently the best available science to estimate the total population size in the GYE. The IGBST has been calculating population size on an annual basis using the model-averaged Chao2 (see glossary) estimate since ~~2002~~2007, and this method has been published in the peer-reviewed scientific literature. The model-averaged Chao2 method is the population estimate method that has the lowest amount of annual variation, and it is the most sensitive method to detect increasing or decreasing population trends over time. As the grizzly bear population has increased, model-averaged Chao2 estimates have become increasingly conservative (i.e., prone to underestimation). As a conservative approach to population estimation, the model-averaged Chao2 method will continue to be the method used to assess Criterion 1 (see U.S. Fish and Wildlife Service 2016, Appendix C, for the application protocol for annual population estimation using the Chao2 method) until a new population estimator is approved. If new methods become available, these will be considered for application in the GYE as long as they represent the best available science. However, until possible new methods are developed, the model-averaged Chao2 method will continue to be used. *Status:* This recovery criterion has been met since 2003 (see IGBST annual reports available at <http://www.nrmc.usgs.gov/products/IGBST>).

Comment [FTvM2]: For this section, see suggested edits we made in PR in our response to Issue 13.

Cumulative effects of Factors A through E

While these numerous stressors on grizzly bear persistence are challenging to conservation, our experience demonstrates that it is possible for large carnivore conservation to be compatible with them (Linnell *et al.* 2001, p. 48). Despite these risks, the best available ~~information data~~ indicates the GYE grizzly bear population's trend has been relatively constant with no evidence to date of a decline, -and range extent has ~~been increasing~~ continued to expand.

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We consider estimates of population trend (i.e., “lambda”) to be the ultimate metric to assess cumulative impacts to the population. It reflects all of the various stressors on the population ~~and provides a scientific basis to correct a negative trend~~. This calculation reflects total mortality, changes in habitat quality, changes in population density, change in range, displacement effects, and so forth. In other words, there will always be threats to the GYE grizzly bear population that lead to human-caused mortality or displacement, but if these are not causing the population to decline, we cannot consider them substantial.

Post-delisting monitoring

Within the DMA, the IGBST will continue to document population trends, distribution, survival and birth rates, and the presence of alleles from grizzly bear populations outside the GYE grizzly bear DPS boundaries to document gene flow into the population. Throughout the DPS boundaries, locations of grizzly bear mortalities on private lands will be provided to the IGBST for incorporation into their annual report. To examine reproductive rates, survival rates, causes of death, and overall population trends, the IGBST will radio collar and monitor a minimum of 25 adult female grizzly bears every year and a similar representative sample of adult males. ~~These objective will be to maintain radio-marked sample of~~ -bears ~~will be that are~~ spatially distributed throughout the ecosystem so they provide a representative sample of the entire population inside the DMA. Mortalities throughout the Yellowstone DPS will be monitored and reported annually and ~~maintained-evaluated~~ in accordance with the DMA total mortality limits and population objectives in table 2, above.

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Draft Conservation Strategy Language

Population Trend

Background

The population of grizzly bears was increasing at approximately 4% to 7% annually between 1983 and 2001 (~~Eberhardt *et al.* 1994, Boyce 1995, Boyce *et al.* 2001b, Harris *et al.* 2006~~).

While there is some debate related to the actual level of increase since the bear was listed in 1975, all information, including numbers of ~~unduplicated-unique~~ females with cubs-of-the-year (Figure 3), distribution of reproducing females (Figure 4), and the distribution of verified grizzly bear occurrences ~~bears, informal sightings by agency personnel, and areas where nuisance bears are being managed indicate~~ support the position that this population has increased in both numbers of bears (Figure 5) and the geographic area they occupy (~~Schwartz *et al.* 2002~~).

Comment [FTvM3]: This (Wildl. Monogr. Chapter) is the only valid citation for this statement; the references we deleted are not.

Schwartz *et al.* (2006b) used data from 1983 through 2001, while the 2012 IGBST report examined a more recent time period, 2002 through 2011 (IGBST 2012). The 2012 report (IGBST 2012) reported that population growth had slowed since the previous time period, but was still stable to slightly increasing, and had not declined. Because the fates of some radio-collared bears are unknown, Schwartz *et al.* (2006b) and the IGBST (2012) calculated two separate estimates of population growth rate: one based on the assumption that every bear with an unknown fate had died (a conservative estimate); and the other simply removing bears with an unknown fate from the sample. The true population growth rate is assumed to be somewhere in between these two estimates because we know from 30 years of tracking grizzly bears with radio-collars that every lost collar does not indicate a dead bear. While Schwartz *et al.* (2006b) found the GYE grizzly bear population increased at a rate between 4.2 and 7.6 percent per year between 1983 and 2002, the IGBST (2012) found this growth had slowed and is stable to slightly increasing and was between 0.3 percent and 2.2 percent per year during 2002–2011.

Schwartz *et al.* (2006b) analyzed survivorship of cubs-of-the-year, yearlings, and independent bears based on whether they lived inside Yellowstone National Park, outside the Park but inside

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the Recovery Zone or Primary Conservation Area (PCA), or outside the PCA entirely. The PCA boundaries (containing 23,853 sq km (9,210 sq mi) correspond to those of the Yellowstone Recovery Zone (U.S. Fish and Wildlife Service 1993) and will replace the Recovery Zone boundary (Figure 1). They concluded that grizzly bears were approaching carrying capacity inside Yellowstone National Park. Consistent with this conclusion, the IGBST (2012) documented lower cub and yearling survival than in the previous time period. Importantly, annual survival of independent females (the most influential age-sex cohort on population trend) remained the same while independent male survival increased (IGBST 2012). Collectively, these two studies indicate that the growth rate of the grizzly bear population inside the DMA had slowed as bear densities ~~have approached~~ may be nearing carrying capacity, particularly in the core area of occupied range. Recent work by van Manen *et al.* (~~2015~~2016) confirms that population growth has slowed and ~~the population data are~~ is showing evidence of density-dependent population regulation in portions of the DMA where bear densities are high. as the population occupies almost all suitable habitat in the DMA.

Monitoring Protocol

Comment [FTvM4]: There are some major issues with this section.....

This Strategy recognizes that any one factor cannot provide the needed information to assess population size and trend. Ultimately, population assessments will require multiple sources of information.

Population trend, using the Lotka equation as calculated from adult female survivorship and reproductive rate data for the appropriate period (Eberhardt *et al.* 1994, Eberhardt and Knight 1996), will be used as supportive information to evaluate population trend. This method will be applied to the population inside the DMA.

Comment [FTvM5]: Huh?

Comment [HMA6]: I agree, Huh??

~~The agencies will strive to~~ IGBST's goal -will be to maintain a minimum of 25 adult female grizzly bears fitted with ~~mortality sensing~~ radio collars and ~~monitored at all times~~ a similar representative sample of males. To adequately sample survival, these 25 adult females will be spatially distributed throughout the ecosystem. The target distribution of these 25 radio-collared adult females will be determined by the IGBST; the expected distribution of collared females by

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agency will be assigned. Each female will be monitored using aerial telemetry flights every 10-14 days during the active season and approximately once every month during the denning season~~during the non-denning period.~~ These data will be collected in conjunction with other regularly scheduled relocation flights. When a radio collar indicates via a mortality signal that a bear may have died, a field crew will evaluate the bear's actual~~status of the female~~ and, if a mortality is observed, determine cause of death. The IGBST will coordinate ~~field crew~~ collection of mortality data on each bear.

Comment [FTvM7]: ? can be deleted I think...

Comment [HMA8]: I agree

Data to ~~calculate~~estimate reproductive parameters, such as litter size, and survival of cubs-of-the-year and yearlings ~~on and survival~~ are collected ~~annually~~in conjunction with telemetry flights in all areas occupied by grizzly bears throughout the DMA. These data sets will be maintained by the IGBST and used periodically for population projections and ~~to~~evaluation of population trend.