Grizzly Bear Recovery Plan

Supplement: Revised Demographic Recovery Criteria for the Yellowstone Ecosystem

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Date

Revised criteria to calculate population size and sustainable mortality limits for the Greater Yellowstone Area

APPENDED TO THE 1993 GRIZZLY BEAR RECOVERY PLAN

In 1995, the U.S. District Court for the District of Columbia issued an order that remanded to the U.S. Fish and Wildlife Service for further study and clarification four issues that are relevant to the Greater Yellowstone Area (GYA): (1) The method used to measure the status of bear populations; (2) the impacts of genetic isolation; (3) how mortalities related to livestock are monitored; and (4) the monitoring of disease (Fund for Animals v. Babbitt, 903 F. Supp. 96 (D. D.C. 1995); 967 F. Supp. 6 (D. D.C. 1997)).

In response to item (1) of the court remand, in 2000 we began a process to reevaluate and update methods to determine the status of the bear population, reevaluate and update methods used to estimate population size, and reevaluate and update methods to determine the sustainable level of mortality in the GYA. The development and application of this updated scientific information was also prescribed by Task Y11 of the 1993 Grizzly Bear Recovery Plan (U.S. Fish and Wildlife Service 1993, p. 44): "Reevaluate and refine population criteria as new information becomes available". The Wildlife Monograph: "Temporal, Spatial, and Environmental Influences on The Demographics of Grizzly Bears in The Greater Yellowstone Ecosystem" (Schwartz et al. 2006d); the report: "Reassessing Methods to Estimate Population Size and Sustainable Mortality Limits for the Yellowstone Grizzly Bear" (hereafter referred to as the Reassessing Methods Document) (Interagency Grizzly Bear Study Team 2005); and the report: "Reassessing Methods to Estimate Population Size and Sustainable Mortality Limits for the Yellowstone Grizzly Bear Workshop Document Supplement 19-21 June, 2006" (hereafter referred to as the Supplement to the Reassessing Methods Document) (Interagency Grizzly Bear Study Team 2006) were produced as a result of this reevaluation and updating effort.

This Wildlife Monograph is divided into chapters (Haroldson et al. 2006, pp. 33-42; Harris et al. 2006, pp. 44-55; Schwartz et al. 2006a, pp. 18-23; Schwartz et al. 2006b, pp. 25-31; Schwartz et al. 2006c, pp. 9-16; Schwartz et al. 2006e, pp. 57-63) and we reference these chapters individually as applicable.

There were formerly 3 demographic criteria in the 1993 Grizzly Bear Recovery Plan (U.S. Fish and Wildlife Service 1993, p. 44). The second criterion pertaining to the distribution of females with offspring remains unchanged. However, the first and third criteria pertaining to the minimum allowable number of females with cubs of the year and sustainable mortality limits are hereby revised and updated to reflect current methods based on the best available science. The current demographic recovery criteria to be appended to the 1993 Recovery Plan are:

- Demographic Recovery Criterion 1 — Maintain a minimum of 48 females with cubs of the year in the GYA (Figure 1), as indicated by the model-averaged Chao2 estimate for that year. The number of females with cubs of the year cannot drop below 48 for any 2 consecutive years.
- Demographic Recovery Criterion 2 — Sixteen of 18 bear management units within the Recovery Zone (Figure 2) must be occupied by females with young, with no 2 adjacent bear management units unoccupied, during a 6-year sum of observations. This criterion is important as it ensures that reproductive females occupy the majority of the Recovery Zone and are not concentrated in one portion of the ecosystem.
- Demographic Recovery Criterion 3 — For independent females (at least 2 years old), the current annual mortality limit, not to be exceeded in 2 consecutive years and including all sources of mortality, is 9 percent of the total number of independent females. For independent males (at least 2 years old), the current annual mortality limit not to be exceeded in 3 consecutive years and including all sources of mortality, is 15 percent of the total number of independent males. For dependent young (less than 2 years old), the current annual mortality limit, not to be exceeded in 3 consecutive years and including only known and probable human-caused mortalities, is 9 percent of the total number of dependent young.

The first and third criteria were changed because we no longer considered 1993 Demographic Recovery Criterion 1 and 3 to represent the best scientific and commercial data available nor the best technique to assess recovery of the Yellowstone grizzly bear population because – (1) There is now a method called the Chao2 estimator to calculate the total number of independent females from sightings and resightings of females with cubs (Keating et al. 2002, p. 173) and this then allows calculation of total population size (Interagency Grizzly Bear Study Team 2005, pp. 5-9) instead of the minimum population size as used in the old method (U.S. Fish and Wildlife Service 1993, pp. 41-44); (2) There is now a method to calculate the unknown and unreported mortalities (Cherry et al. 2002, pp. 176-181) and application of this method allows more conservative mortality management based on annually updated information rather than the estimate of unknown and unreported mortality used in the 1993 Recovery Plan (U.S. Fish and Wildlife Service 1993, p. 20, 43); and (3) There are now improved and updated data on reproductive performance of Yellowstone grizzly bears (Schwartz et al. 2006a, pp. 19-22), survival rates of cub and yearling Yellowstone grizzly bears (Schwartz et al. 2006b, pp. 27-28), survival rates of independent Yellowstone grizzly bears (Haroldson et al. 2006, pp. 34-36), the trajectory of the Yellowstone grizzly bear population under alternate survival rates (Harris et al. 2006, pp. 48-51), and the impacts of spatial and environmental heterogeneity on Yellowstone grizzly bear demographics (Schwartz et al. 2006e, pp. 58-61). These improved data and analyses, since the development of the 1993 Demographic Recovery Criterion 3 (U.S. Fish and Wildlife Service 1993, pp. 41-44), allow much improved mortality management based on more accurate calculations of total population size and biologically sustainable mortality limits for independent females, independent males, and dependent young.

Unlike the 1993 method which only counted human-caused mortalities against the sustainable mortality limit, the updated method counts deaths of grizzly bears from all sources against the limits for independent females and males and known and probable human-caused mortalities for dependent young. For independent females and males, this includes: (1) known and probable human-caused mortalities; (2) reported deaths due to natural and undetermined causes; and (3) calculated unreported human-caused mortalities. The current method is a much more comprehensive mortality management approach. Between 1980 and 2002, approximately 21 percent of all known grizzly bear deaths were from undetermined causes (Servheen et al. 2004, p. 15). These deaths could not be counted against the 4 percent human-caused mortality limit using the previous method because the cause of death could not be confirmed. The previous method also assumed a 2-to-1 known-to-unknown mortality ratio. Many researchers hypothesize that the ratio of known-to-unknown mortality is much higher than 2-to-1 (Knight and Eberhardt 1985, pp. 332-333; McLellan et al. 1999, p. 916). After careful consideration and using the best available science, the Study Team adopted a known-to-unknown mortalities ratio of approximately 1-to-2 that is recalculated each year based on the number of known, reported deaths (Cherry et al. 2002, p. 179; Interagency Grizzly Bear Study Team 2005, pp. 39-41).

The following paragraphs describe the revised demographic criteria in detail. These demographic criteria apply within the grey area in Figure 1 and are hereby appended to the Yellowstone chapter of the Grizzly Bear Recovery Plan Task Y11 (U.S. Fish and Wildlife Service 1993, p. 44) and will replace 1993 Demographic Criterion 1 and 3.

- Because 48 adult females with cubs of the year is equivalent to a population of approximately 500 total individuals (Interagency Grizzly Bear Study Team 2005, p. 43), we are establishing a target number of 48 adult females with cubs of the year for the GYA. This target number shall not go below 48 for any two consecutive years. For genetic reasons (Miller and Waits 2003, p. 4338) it is desirable that the total population of grizzly bears in the GYA be maintained above 400 bears. To assure that this goal is met and in order to adopt a conservative approach, the total population will be maintained at or above 500 grizzly bears in the GYA. The estimate of 48 adult females with cubs of the year will be calculated by the Interagency Grizzly Bear Study Team based on model averaging as described in the Supplement to the Reassessing Methods Document (Interagency Grizzly Bear Study Team 2006, pp. 2-10).

- For independent females (at least 2 years old), the current annual mortality limit, not to be exceeded in 2 consecutive years and including all sources of mortality, is 9 percent of the total number of independent females. Simulations have shown that a 9 percent adult female mortality rate allows a stable to increasing population 95 percent of the time (Harris et al. 2006, p. 50).

- For independent males (at least 2 years old), the current annual mortality limit, not to be exceeded in 3 consecutive years and including all sources of mortality, is 15 percent of the total number of independent males. The Study Team chose this limit because it approximates the level of male mortality in the GYA from 1983 to 2001 (Haroldson et al. 2006, p. 38), a period when the mean growth rate of the population was estimated at 4 to 7 percent per year (Harris et al. 2006, p. 48). Independent males can endure a higher rate of mortality compared to females without affecting the overall stability or trajectory of the population because they contribute little to overall population growth (Mace and Waller 1998, pp. 1009-1013; Interagency Grizzly Bear Study Team 2005, p. 39).

- For dependent young (less than 2 years old), the mortality limit, not to be exceeded in 3 consecutive years and including only known and probable human-caused mortalities, is 9 percent of the total number of dependent young (Interagency Grizzly Bear Study Team 2005, pp. 36-38). This limit is less than the 15 percent human-caused mortality documented for each sex from 1983 to 2001, a period of population growth and expansion (Interagency Grizzly Bear Study Team 2005, pp. 36-38). Although it is known that dependent bears experience far higher natural mortality rates than independent bears (Schwartz et al. 2006b, p. 30), there is no known way to sample these mortalities directly in the field. Instead, these rates are calculated from consecutive years of observing radio-collared females with offspring..

Figure 1. The grey shaded area denotes the area within which the revised demographic criteria apply in the Yellowstone area. This is Figure 3 in the Final Conservation Strategy for the Grizzly Bear in the Greater Yellowstone Area (U.S. Fish and Wildlife Service 2007).

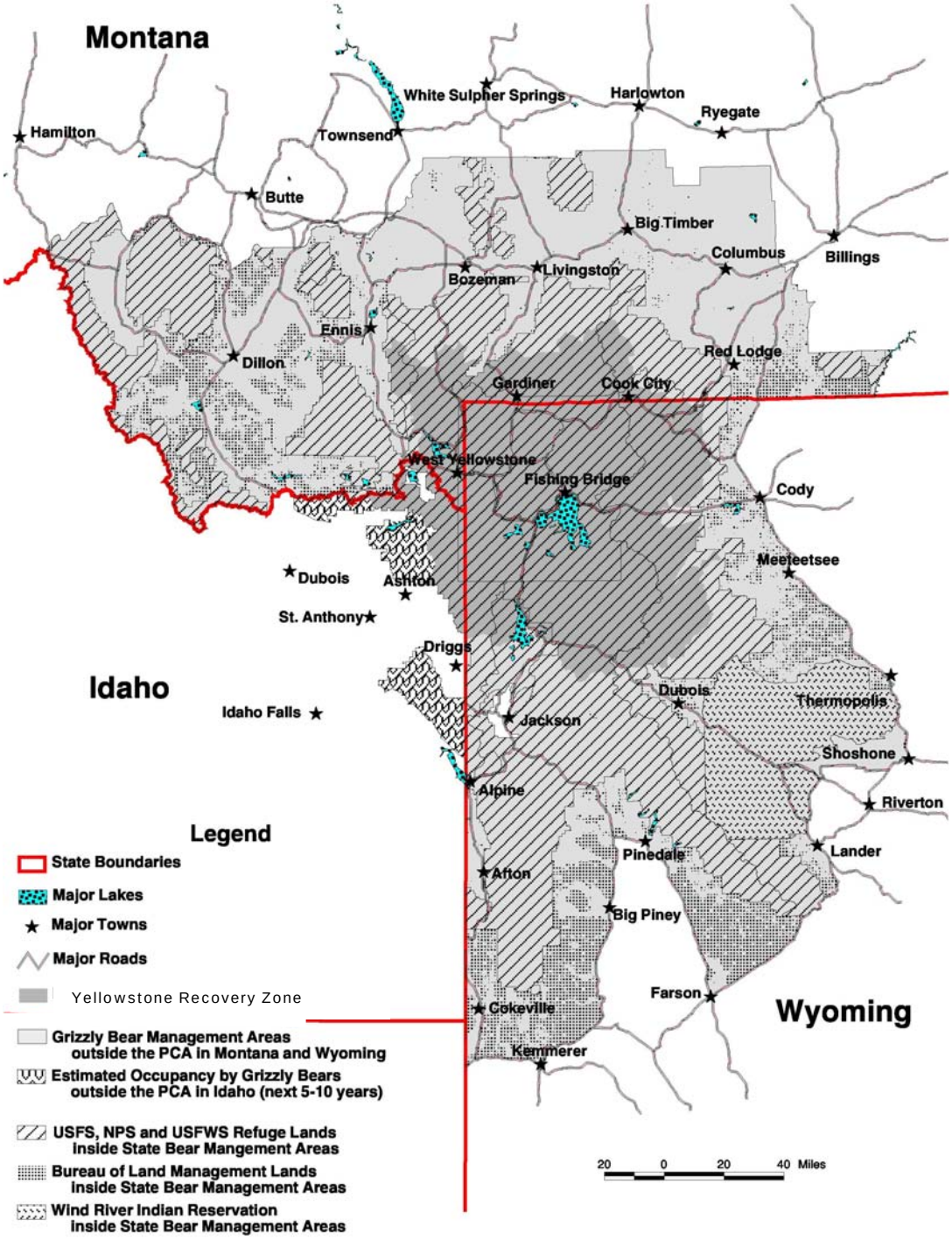

Figure 2. Yellowstone recovery zone boundary showing bear management unit (BMU) and subunit boundaries.

Application of the revised demographic criteria

Annual allowable mortality limits for each bear class (independent female, independent male, dependent young), are calculated based on total population estimates of each bear class for the current year (Interagency Grizzly Bear Study Team 2006, pp. 16-17). The estimate of 48 adult females will be calculated by the Interagency Grizzly Bear Study Team based on the model averaging technique described in the Supplement to the Reassessing Methods Document (Interagency Grizzly Bear Study Team 2006, pp. 2-10).

The Interagency Grizzly Bear Study Team will use the following procedures to establish and track sustainable mortality and calculate the number of adult female grizzly bears in the Greater Yellowstone Area:

1. Raw observations of sightings of females with cubs of the year will be separated into observations of unique females and repeat observations of the same female using the methods of Knight et al. (1995, p. 246).
2. The Chao2 estimator (Keating et al. 2002, p. 173) will be applied to sighting frequencies of unique females with cubs of the year to estimate the number of females with cubs of the year in the population.
3. The number of unique females with cubs of the year obtained from the Chao2 estimator each year will be added to the dataset and the model averaging process described in the Supplement to the Reassessing Methods Document (Interagency Grizzly Bear Study Team 2006, pp. 2-10)
4. The predicted number of females with cubs of the year obtained from the model fit will be used as the best estimate of the total number of independent females in the population accompanied by cubs of the year for that year.
5. The purpose of the model is to get the best estimate of the current number of females with cubs of the year borrowing information from past estimates, recognizing that with each iteration some change is expected. Estimates of females with cubs of the year for previous years will not be retrospectively adjusted with data from the current year.
6. The predicted number of females with cubs of the year will be divided by the proportion of females ≥4 years old estimated to be accompanied by cubs of the year (transition probability = 0.289). The resulting value represents the best estimate of the total number of females in the population ≥4 years old.
7. The number of females ≥4 years old will be divided by the estimated proportion of females ≥4 years old in the population of females ≥2 years old (0.77699). The resulting value is the best estimate of the number of independent females (≥2 years old) in the population that year.
8. The sustainable mortality limit for independent females is 9% of the population estimate of independent females.
9. Unknown and unreported mortality will be estimated based on the methods of (Cherry et al. 2002, p. 179; Interagency Grizzly Bear Study Team 2005, pp. 39-41).
10. The number of independent males in the population will be based on the estimated ratio of independent males to independent females (0.63513) derived

via stochastic modeling described in the Supplement to the Reassessing Methods Document (Interagency Grizzly Bear Study Team 2006, pp. 10-11). The number of independent females in the population will be multiplied by 0.63513 and the resulting value represents the best estimate of the number of independent males that year.

11. The sustainable mortality limit for independent males is 15% of the population estimate of independent males.
12. The number of cubs of the year in the annual population estimate will be calculated directly from the model-predicted estimate of females with cubs of the year (Interagency Grizzly Bear Study Team 2006, p. 17). The number of cubs will be estimated by multiplying the modeled estimate by the mean litter size (2.04) observed from 1983–2002.
13. The number of yearlings will be estimated by multiplying the estimated number of cubs from the previous year by the mean survival rate for cubs (0.638) observed from 1983–2001.
14. The sustainable mortality limit for dependent young (cubs and yearlings) is 9% of the annual estimate of dependent young. Only human-caused deaths (reported known and probable) will be tallied against this threshold.
15. Unknown and unreported mortality will not be estimated for dependent young.
16. Allowable mortality limits will be established annually following methods detailed in Cherry et al. 2002. Because we are using modeled predictions, annual variability among years has been addressed and we recommend annual mortality limits based on the current year.
17. Estimates of uncertainty about the number of independent females, independent males, dependent young, and total population size will be derived following methods detailed in the Supplement to the Reassessing Methods Document (Interagency Grizzly Bear Study Team 2006, pp. 10-15).
18. The number of 48 adult females each year will be calculated using the predicted number based on model averaging (Interagency Grizzly Bear Study Team 2006, pp. 2-10).
19. If the AIC_c weight favors the quadratic term (i.e., >0.5) in modeling the rate of change of females with cubs (Interagency Grizzly Bear Study Team 2006, pp. 4-8), a full review of the population's demographics will be undertaken by the Study Team to better understand population status.
20. Dead bears reported in years subsequent to the actual year of mortality will be tallied against the estimated year of death and mortality total will be recalculated for that year. If mortality exceeds the threshold for that year, the difference (total mortality minus threshold) should be counted against the current years' threshold. If sex of the dead bear cannot be determined, sex will be assigned randomly using ratio of 59:41 male:female as recommended in Appendix A of Schwartz and Haroldson (2001, pp. 119-121).

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Appendix A.

Implementation Schedule

The following Implementation Schedule outlines actions and estimated costs for the grizzly bear (*Ursus arctos horribilis*) recovery program over the next 5 years. Functioning as a practical guide for meeting the species' recovery goals, this schedule indicates action priorities, action numbers, action descriptions, duration of actions, and estimated costs. In addition, parties with authority, responsibility, or expressed interest in implementing a specific recovery action are identified: however, this neither obligates nor implies a requirement for the identified party to implement the action(s) or secure funding for implementing the action(s). However, parties willing to participate may benefit by being able to show in their own budgets that their funding request is for a recovery action identified in an approved recovery plan and, therefore, is considered a necessary action for the overall coordinated effort to recover the grizzly bear. Also, section 7(a)(1) of the ESA, as amended, directs all Federal agencies to utilize their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation threatened and endangered species.

Key to Implementation Schedule Priorities (column 1)

PRIORITY 1: An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

PRIORITY 2: An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

PRIORITY 3: All other actions necessary to provide for full recovery of the species.

Key to responsible parties in column 6:

USFS = U.S. Forest Service
YNP = Yellowstone National Park
USGS = U.S. Geological Survey
MT = Montana Fish Wildlife and Parks Department
ID = Idaho Fish and Game Department
WY = Wyoming Game and Fish Department
GTNP = Grand Teton National Park

Action Priority	Action Number	Action Description	Action Duration	Responsible Parties	USFWS Lead	Total (annual) Costs	2007	2008	2009	2010	2011	Comments
3	Y11	Monitor total population size by counting females with cubs. Monitor mortality and set annual mortality limits.	Annual	USGS, MT, WY, ID, YNP, GTNP, USFS	N	678,193[1]	339,097[1]	0	0	0	0	Funding in FY07 is approximately 0.50 of full cost as this DPS is recovered and may be delisted in mid-FY07.

[1] The same funding applies to both monitoring population size and mortality management as they are interrelated.

RESPONSES TO PUBLIC COMMENTS ON THE REASSESSING METHODS DOCUMENT

The document Reassessing Methods to Estimate Population Size and Sustainable Mortality Limits for the Yellowstone Grizzly Bear (Reassessing Methods Document) was released for public comment on November 22, 2005 (70 FR 70632). The objectives of this document "…were to 1) evaluate current information to establish methods to estimate total population size and sustainable mortality, and 2) address issues of unknown and unreported mortality for the grizzly bear population in the Greater Yellowstone Ecosystem" (Interagency Grizzly Bear Study Team 2005, p. 5).

The comment period ran concurrently with the comment period for the Proposed Rule Designating the Greater Yellowstone Ecosystem Population of Grizzly Bears as a Distinct Population Segment (DPS) and Removing the Yellowstone DPS from the Federal List of Endangered and threatened Wildlife (70 FR 69854, November 17, 2005). During the comment period, we received 9 comments specifically identified as addressing the Reassessing Methods Document. We also received several other comments about the methods described in the Reassessing Methods Document in comments about the Proposed Rule, including some from peer reviewers of the Proposed Rule. We considered all comments received and summarize them below. Groups of similar concerns are categorized together under "Issues", followed by our "Response" to each.

A. General Issues

Issue 1: Several commenters were concerned about the variability associated with the total population estimate using the revised methods. Because the total population estimate for each year suggests population dynamics that are "clearly outside the biological capability for a grizzly bear population", they cited this variability as evidence that the new methods are inadequate. Some felt that the increased level of uncertainty associated with the revised methods made them an inappropriate tool to use when making decisions about delisting and a hunting season.

Response: The scientists who developed the recommendations in the Reassessing Methods Document (Interagency Grizzly Bear Study Team 2005, pp. 17-31) recognized the uncertainty in estimating total population size from counts of females with cubs. The previous method dealt with this issue by using a 3-year running average of counts of females with cubs. These scientists had reservations about averaging the estimates, although it was generally accepted that some form of statistical "smoothing" was necessary due to the high process variation associated with grizzly bear reproductive biology. It was decided that it was appropriate to average the mortality limits given to managers to dampen variability and provide managers with inter-annual stability in mortality thresholds (Interagency Grizzly Bear Study Team 2005, pp. 6, 7, 9). Changes in the numbers of females with cubs are representative of the rate of change for the entire population, but with additional variation coming from the proportion of the female

population that has cubs of the year. The variation of the population estimate is due to both sampling variation from the Chao2 estimator and process variation related to the proportion of the population with cubs of the year. In response to this concern, the scientists involved with the Reassessing Methods Document met again in May 2006, to address this problem and recommended the use of a regression model fitted to the data from all years to smooth this variation and provide a biologically reasonable estimate of the population (Interagency Grizzly Bear Study Team 2007, pp. 2-6).

Issue 2: Some commenters asserted that the Reassessing Methods Document was written to change our current mortality standards contained in the 1993 Grizzly Bear Recovery Plan (Recovery Plan) that were exceeded in 2004 and 2005 so that the delisting process could continue.

Response: The process to reevaluate the methods used to estimate population size and the sustainable level of mortality was initiated in 2000 in response to a September 25, 1995 court decision about the 1993 Grizzly Bear Recovery Plan (Fund for Animals v. Babbitt, 903 F. Supp. 96(D. D.C. 1995); 967 F. Supp. 6 (D. D.C. 1997)). The judge remanded five issues to us for further consideration. One of the issues was, "Accordingly, the Service must reconsider the available evidence and its decision to adopt the population monitoring methodology that it has incorporated into the Recovery Plan" (Court decision at p. 29). Additionally, Task Y11 of the 1993 Grizzly Bear Recovery Plan recommended that we reevaluate and refine population criteria as new information becomes available. The Reassessing Methods Document (Interagency Grizzly Bear Study Team 2005, pp. 17-31) was produced in response to this remand and Task Y11 of the Recovery Plan. When this review and reanalysis began in 2000, demographic recovery criterion 3 had been met since 1998 (Haroldson and Frey 2006, p. 35). It was only in 2004, four years after the reassessment work began, that the old demographic criterion limiting female mortality began to be exceeded (Haroldson and Frey 2006, p. 35).

Issue 3: Several commenters said the revised methods inadequately addressed the biases the Court found with the use of females with cubs of the year (FCOY) data to assess population size and trend, and that the new methods do not satisfy the agreed upon Court settlement in response to a lawsuit on the 1993 Grizzly Bear Recovery Plan. Specifically, one comment argued that the high correlation between the number of FCOY observed and the resulting $Chao_2$ estimate suggested a limited correction of detection bias.

Response: The Reassessing Methods Document and its Supplement (Interagency Grizzly Bear Study Team 2005; 2007) are a detailed effort to "reconsider the available evidence and its decision to adopt the population monitoring methodology that it has incorporated into the Recovery Plan", as specifically directed by the court opinion. As for the high correlation, this is expected between raw counts of female with cubs and the resulting Chao2 estimate. Such a correlation is driven by the slow increase in raw counts over time and the subsequent adjustment to them. This does not imply limited correction of detection bias. On average, the Chao2 adjustment resulted in a value 36.5% larger than the raw count. However, the adjustment ranged from 11.9% up to 153% and is

principally related to the frequency of bears sighted one time versus bears sighted more than once and not necessarily to the actual raw count.

Issue 4: Some commenters noted that there is no assurance or requirement that States comply with the new mortality limits. This is especially disconcerting because four Wyoming counties, representing jurisdiction over 30% of currently occupied grizzly bear habitat, have banned bears within their borders and the State of Wyoming has expressed a desire to manage the population down to 500 bears and increase total allowable mortality to 12%.

Response: In response to concerns about the ordinances, regulations, or resolutions passed by county governments in Wyoming addressing the presence or distribution of grizzly bears, we requested a letter from the Wyoming Attorney General's office clarifying the authority of counties to legislate grizzly bear management. The response from the Wyoming Attorney General's office, dated August 8, 2006, states on p. 2:

> "…as an arm of the state, the county has only those powers expressly granted by the constitution or statutory law or reasonably implied from the powers granted." *Laramie Co. Comm'rs v. Dunnegan*, 884 P.2d 35, 40 (Wyo. 1994). Neither the Wyoming Constitution nor the legislature has provided the counties in Wyoming with any expressed or implied authority over management of grizzly bears. Therefore, counties lack the authority to enact any ordinances(s), regulation(s), or resolution(s) which would affect the (Wyoming Game and Fish) Commission's Grizzly Bear Plan on mortality or distribution of grizzly bears in Wyoming." (Martin 2006).

This letter clearly states that Wyoming county governments have no authority to affect grizzly bear management and that county ordinances, etc. have no legal standing or impact on commitments made by the Wyoming Game and Fish Commission. All three States are signatories to the Conservation Strategy that limits human-caused mortalities and the State plans commit to limiting total human caused mortality to the limits described in the Final Rule by implementing adaptive and responsive management regimes post delisting. To be responsive to changing demographic and habitat conditions, Idaho, Montana, Wyoming, and Grand Teton and Yellowstone National Parks will coordinate the removal of nuisance bears while planning for future conflicts. Those agencies intend to provide consistent nuisance programs, which will mean that annual mortality for the entire population is within the biologically sustainable limits established by the Reassessing Methods Document (Interagency Grizzly Bear Study Team 2005, pp. 6-9).

Potentially reducing the population to 500 bears is not an issue since all of the agencies have committed to the newly revised mortality thresholds. Maintaining mortality within the limits described in the revised Workshop Document and Final Rule precludes reducing the population to 500 bears. Wyoming has not indicated that 12 percent is an acceptable allowable take for this population and is committed to the revised

thresholds as per their signature on the Conservation Strategy as approved by the Wyoming Game and Fish Commission. Changes in these mortality limits cannot be done unilaterally by Wyoming but instead must be based on the best available science, documented by a process lead by the Interagency Grizzly Bear Study Team, opened to public comment, and approved through a majority vote of the Yellowstone Grizzly Bear Coordinating Committee (U.S. Fish and Wildlife Service 2007, p. 63).

Issue 5: Some commenters said that it was incorrect for the Reassessing Methods document to establish mortality limits based on the assumption that Wyoming and Idaho set a near-term objective of allowing grizzly bears to expand into suitable habitat. Because this assumption is not supported by the Idaho and Wyoming plans, the Reassessing Methods document should be revised in a more conservative direction. The ESA requires us to evaluate the "foreseeable future" not "near-term objectives."

Response: We disagree with this interpretation of the Reassessing Methods Document. The Reassessing Methods Document does not rely on any assumptions about the intentions of the States when calculating survival or estimates of population trend. Instead, the authors use a survival rate that corresponds with a stable to increasing population 95 percent of the time to set a conservative approach to mortality management (Interagency Grizzly Bear Study Team 2005, p. 35; Harris et al. 2006, p. 50). Therefore, the population will continue to have a stable to increasing growth rate regardless of language in the Idaho and Wyoming management plans.

Issue 6: Estimates of survival and mortality are based on "good" bears and do not include "conflict" bears, which are known to have higher mortality rates, so the estimates of growth rate and survival that the Reassessing Methods Document is based on are not representative of the entire Greater Yellowstone Area (GYA) population.

Response: This is incorrect. The sample of bears used in calculation of mortality and survival rates included both research ("good" bears) and management ("conflict") bears. See Schwartz et al. (2006b, pp. 11-12) for a full explanation of this method.

Issue 7: Some commenters cited a section from the 1993 Recovery Plan which states that FCOY "…is not adequate to characterize population trend or precise population size. Any attempt to use this parameter to indicate trends or precise population size would be an invalid use of these data" (U.S. Fish and Wildlife Service 1993, p.20) as evidence that the revised methods are inconsistent with the 1993 Recovery Plan.

Response: When the 1993 Grizzly Bear Recovery Plan was written, a method was not available to use counts of FCOY alone to estimate population size or trend. The Reassessing Methods Document does not use FCOY data alone to calculate population size. The method in the Reassessing Methods Document uses the corrected Chao2 estimator, which is derived from sightings and resightings of FCOY as described in Keating et al. (2002, p. 162) and the Interagency Grizzly Bear Study Team (2007, p. 7). This accounts for many of the biases inherent in FCOY data alone to estimate total population size. We emphasize that this estimate is not a census or point estimate but an

annual index used to estimate annual allowable sustainable mortality. An index is an indirect measure of population size whereas a census or point estimate refers to a direct measure of population size. Because our index of population size is derived from estimated proportions of independent females, males, and cubs in the population, it is considered an index. The calculation of population trend in Harris et al. (2006, p. 48) does not use FCOY data to estimate population trend. Population trend is calculated using reproductive rate and survivorship data in a life table and matrix projection model format (see Harris et al. 2006, pp. 44-45). This method of using reproductive rate and survivorship data in a life table and matrix projection model format is the method that will continue to be used to calculate population trend. The evolution of the science has been significant since the 1993 Recovery plan was written and we are committed to using the best available science.

Issue 8: One peer reviewer was critical of the treatment of the denominator in the FCOY estimate. Since the Interagency Grizzly Bear Study Team knows there is variation in the proportion of FCOYs in the total population of females $\geq$ 4-years old, that variation should be considered to derive a target range of FCOYs (instead of a point target of Chao2 = 48). This lack of a variance measure for the population estimator may affect how the mortality criteria are interpreted and should be addressed.

Response: The scientists involved in making the recommendations in the Reassessing Methods Document (Interagency Grizzly Bear Study Team 2005, pp. 12-17) recognized that the proportion of breeding females with cubs of the year varied annually. They investigated the possibility of varying the denominator but concluded they lacked sufficient data to do so. The revised method in the Supplement to the Reassessing Methods Document that uses regression analysis on all of the data to address this variation and provide an estimate of confidence about the mean (Interagency Grizzly Bear Study Team 2007, pp. 2-5, 11-17).

Issue 9: One peer reviewer noted that it is not correct to assume that females 2 to 4 years old and females greater than 4 years old can be pooled. Just because there aren't any differences in survival does not necessarily mean they experience similar mortality.

Response: We agree that we can not rule out the fact that juvenile females may have different rates of survival than adult females. The best model, as selected by the information theoretic approach, did not contain a covariate for age class—suggesting the model without age class better described survival for independent bears. The point estimate for survival of subadult and adult bears calculated from models where age class was considered were not statistically different. Subadult bears may die for different reasons than adult bears. In the known fate analyses of survival used in the Wildlife Monograph (Haroldson et al. 2006, p. 33), cause of death was not considered. The only issue was if a bear died while wearing a radio collar. Consequently, different forms of mortality are not an issue.

Issue 10: Several commenters criticized our lack of confidence intervals around estimates of population size and population growth rates noting that we should disclose what the

95% confidence intervals around these estimates are. It was also noted that we should account for sources of both random and nonrandom variation in the calculation of confidence intervals.

Response: The 4 to 7 percent annual population growth rate is based on analyses conducted by Harris et al. (2006, p. 48) using survival and reproductive estimates of grizzly bears determined by Haroldson et al. (2006, p. 36) and Schwartz et al. (2006a, p. 19; 2006c, p. 27). Through additional analyses, confidence intervals for the population growth rate (lambda) values estimated by Harris et al. (2006, p. 48) accounting for sampling variance have been calculated and are reported here. For the estimate of population growth rate based on the assumption that all females with unresolved fates died at last contact, the mean value of lambda is 1.042, with an approximate 95 percent confidence interval of 0.969 – 1.093. For the estimate of population growth rate when adult survival was estimated censoring females with unresolved fates, the mean value is 1.076, with an approximate 95 percent confidence interval of 1.003-1.113.

Regarding the confidence interval around the total population estimate, the index of total population size is produced using the total number, an adjusted estimate of the total number of females with cubs of the year (Interagency Grizzly Bear Study Team 2005, pp. 24-26) and the proportions of females in the population applied to the proportions of sex and age classes in the population. The estimator chosen by the Interagency Grizzly Bear Study Team to adjust the number of observed FCOY is the Chao2 estimator (Keating et al. 2002, p. 170; Interagency Grizzly Bear Study Team 2005, pp. 25-26). The Chao2 estimate consistently returns results that are correct or biased low (Interagency Grizzly Bear Study Team 2005, p. 20). Confidence intervals for the total population index from years 1983-2005 are reported in the Supplement to the Reassessing Methods Document (Interagency Grizzly Bear Study Team 2007, p. 16). For 2005, the total population index is 546 bears with a 95 percent confidence interval between 491 and 602 (Interagency Grizzly Bear Study Team 2007, p. 16). Because the confidence intervals reported in that Supplement are only educated approximations of uncertainty (Interagency Grizzly Bear Study Team 2007, p. 16), we rely on the demonstrated conservative nature of the Chao2 estimator (Keating et al. 2002, p. 173) to be assured that both the population index and the sustainable mortality limits are conservative and sustainable.

Issue 11: Some commenters noted that the Reassessing Methods Document implicitly assumes future demographic conditions will be similar to current and past conditions and because the Greater Yellowstone Area grizzlies have been able to sustain 9% female mortality and 15% male mortality in the past, while increasing at 4-7%, this will continue into the future. However, this may not be the case, as evidenced by Schwartz (2004) who documented a decrease in average litter size in the last decade from 2.1-2.2, down to 1.90.

Response: We are not familiar with the reference cited by the commenter as "Schwartz (2004)", but we believe that the data referred to are presented in Haroldson (2005, p.15), where the 6-year running average litter sizes are 1.9 each year for the years 2002 to 2004.

Using data from radio-collared bears, Schwartz et al. (2006a, p. 19) calculated ecosystem-wide litter size to be 2.04 between 1983 and 2002. This was comparable to the average litter size of 2.10 reported by Craighead et al. (1995, pp. 173-175). The 95% confidence intervals for litter size by adult female age interval class overlapped between the 1983-2002 data (Schwartz et al. 2006a, p. 22) and the 1975-1989 data (Craighead et al. (1995, pp. 173-175) indicating no statistical difference between these time periods. The Reassessing Methods Document does not assume that the 4-7% annual increase is required to maintain the mortality levels recommended in the document.

B. Policy questions

Issue 1: Several commenters noted that we must clarify why we chose to use the lower bound of the 80 percent confidence interval instead of the 95% confidence interval as a trigger for more precautionary management of female mortality.

Response: This recommendation was changed in the Supplement to the Reassessing Methods Document and the 80 percent lower bound language was removed from the management recommendations. Instead it was recommended that in any year that the regression estimate falls below 48 females, the agencies should implement measures to reduce female mortalities (Interagency Grizzly Bear Study Team 2007, p. 18).

Issue 2: Some commenters noted that we must explain the biological justification of establishing 500 as the goal for total population size. If we intend to change the current recovery goal of allowable mortality limits or establish a recovery goal of total population size equal to 500, such a change must be established before delisting is considered.

Response: The number of 500 is not a population target. It is a minimum number of animals in the population that must be maintained. "It is the goal of the agencies implementing this Conservation Strategy to manage the grizzly population in the entire GYA (Greater Yellowstone Area) at or above 500 bears." (U.S. Fish and Wildlife Service 2007, p. 26). The Reassessing Methods Document calculates that a Chao2 estimate of 48 adult (age $\geq$ 4 years) females is equivalent to a population of 500 bears. This number comes from a recommendation in Miller and Waits (2003, p. 4338), citing Franklin (1980, p. 147), that effective population size should be at least 50 or viability would be significantly depressed. The figure of 500 was chosen to assure that effective population size remained far above 50. Assuming effective population size is approximately 27% of total population size (Miller and Waits 2003, p. 4338), a population of 500 is equal to an effective population size of 135 or more.

Issue 3: While some commenters thought that the trigger for a Biology and Monitoring Review should be based on the 3-year average of the $Chao_2$ estimator to account for reproductive cycles and annual variation in sightability, other commenters were concerned that the use of a 3-year running average tends to mask the significance of single years and disguise important population dynamics.

Response: In response to this concern, the scientists who developed the Reassessing Methods Document (Interagency Grizzly Bear Study Team 2005, p. 2) revised their approach in the Supplement to the Reassessing Methods Document. This document proposes using the average of a linear and quadratic model to estimate changes in lambda and the predicted numbers of FCOY (Interagency Grizzly Bear Study Team 2007, pp. 2-10). Results will then be used in calculations to estimate the number of independent (aged ≥2 years) females, independent males, and dependent young following procedures in the Reassessing Methods Document (Interagency Grizzly Bear Study Team 2005, pp. 5-9). This new method using model-averaged estimates will replace the one proposed in the Reassessing Methods Document, which recommended using the individual Chao2 estimates of FCOY produced annually to estimate the total number of independent females. The new method addresses normal process variation related to grizzly bear reproductive biology and the number of FCOY each year. A decline below 48 should not be triggered by the expected process variance associated with reproduction and would be more reflective of a possible decline in the population. If the estimate of FCOY based upon the new model averaged method drops below 48 for 2 consecutive years, it will trigger a Biology and Monitoring Review (Interagency Grizzly Bear Study Team 2007, p. 18).

Issue 4: Some commenters stated that the Reassessing Methods Document must be clear about the result of a violation of the demographic standards. It must describe a clear response that should occur if mortality limits are exceeded and cannot rely on a Biology and Monitoring Review that has no real ability to compel a change in management decisions. Some commenters requested clarification as to whether limiting female mortality if the $Chao_2$ estimator is below the lower bound of the 80% confidence interval is a recommendation or a requirement.

Response: The Reassessing Methods Document does not describe the response of management agencies to deviations from the demographic criteria. This response protocol is in the Conservation Strategy (U. S. Fish and Wildlife Service 2007, pp. 63-67). If the point estimate of FCOY based upon the model-averaging regression method falls below 48 for 2 consecutive years, a Biology and Monitoring Review led by the Interagency Grizzly Bear Study Team is required. If a Biology and Monitoring Review is necessary, its results will direct the management response of the agencies. The use of a lower 80 percent bound as a trigger for managers to limit female mortality is no longer recommended by the Interagency Grizzly Bear Study Team (2007, pp. 18-19). Instead, the Interagency Grizzly Bear Study Team now recommends that if the model-averaged estimate falls below 48 in any given year, management agencies throughout the GYA should take all possible steps to reduce female mortality which could include the Yellowstone Grizzly Bear Coordinating Committee implementing actions to eliminate discretionary mortalities like hunting, enhancing outreach to reduce bear/human conflicts with specific groups like private residents in key use areas, and reducing nuisance bear removals by preemptive moves with possible and extra efforts to move females to remote areas after initial conflicts.

C. Population Increase

Issue 1: One commenter noted that we have not demonstrated that higher counts of FCOY necessarily mean that the GYA population is increasing in size. The increase in FCOY counts could be due to high cub mortality, which would cause adult females to breed more frequently than once every 3 years. High counts of FCOY would then be observed even though the total population was not increasing. This condition prevailed throughout the period of the Craigheads' work (1959-1970).

Response: Harris et al. (2006, p. 48) provided estimates of population growth in the GYA using estimates of reproduction and survival obtained from radio collared bears. His results indicate that, on average, the bear population was increasing at a rate between 4 and 7 percent per year from 1983 to 2002. His estimates were not based on counts of females with cubs. Schwartz et al. (2006a, p. 19) observed 104 cub litters over 329 bear years, for an estimate of 3.16 years/litter. These data do not indicate any significant reduction in interbirth intervals from the Craighead data set. Estimates of sustainable mortality provided in the Reassessing Methods document link estimates of female survival with those of reproduction. If female reproduction were to decline, or if survival of dependent young were to change, ongoing monitoring would detect these changes and result in revised estimates of sustainable mortality. It is recommended that these estimates be revised every 8-10 years to reflect any changes in demographic parameters (Interagency Grizzly Bear Study Team 2005, p. 45). The ongoing monitoring of female reproduction and cub survival using radio collars from a sample of bears provides consistent, detailed data that will capture any changes in these vital rates.

Issue 2: One commenter noted that because detection efforts for FCOY have increased over time, the number of FCOY detected has also increased, and the apparent increase in population size may not reflect a true increase in the population. Another commenter noted that an increase in effort over time with an accompanying decrease in bias in the Chao2 estimator might indicate an increasing population even if the true population were stable to decreasing.

Response: Simulation results indicate that the Chao2 estimator is biased low and that as detection efforts increase, the bias decreases. Simulation results also indicate that bias does not change enough to account for much of the indicated increase in bear numbers. On an annual basis, this amount is 0.5 perent or less, and would have a negligible impact on our estimates of growth rate.

D. Public involvement

Issue 1: One commenter noted that the workshops that produced the Reassessing Methods Document should have included public and scientists who were not biased by their desire to increase allowable mortality. The commenter is concerned that we have "chosen to ignore the democratic process" and cater to the interest of the vocal minority that wants to increase allowable mortality and allow a hunting season.

Response: The objectives of the workshops were to establish a biologically sustainable mortality limit and to produce a scientific reevaluation of the methods used to estimate population size using the best available science as directed by the court and the 1993 Recovery Plan (Interagency Grizzly Bear Study Team 2005, p. 17). There was no interest in producing any particular result. The effort was a scientific process involving experts in the field applying the best available scientific information and independent peer review of the results, not a "democratic process". Several members of the group who produced the Reassessing Methods Document are university scientists not affiliated with any management agency. The Reassessing Methods Document was sent out for independent scientific peer review to 3 scientists having no agency affiliations and the comments of these peer reviewers were incorporated into the draft Reassessing Methods Document released in November of 2005 (70 FR 70632, November 22, 2005). At a meeting in Bozeman, Montana in June 1998, the Interagency Grizzly Bear Study Team invited a well-known non-agency scientist to participate in addressing demographic issues in the GYA, but the invitee chose not to participate.

Issue 2: Commenters noted that the highly complex scientific nature of the Reassessing Methods Document frustrates public comment and masks the significance of the proposed changes. If an agency seeks meaningful public comment, it must produce a document that the average person can understand.

Response: We agree that the Reassessing Methods Document is highly technical but it must be so to fully describe the application of the best available scientific and mathematical methodologies to adequately address these issues. To make the document more readable to the non-scientist, a non-technical summary was written and is available online at http://mountain-prairie.fws.gov/species/mammals/grizzly/yellowstone.htm

E. Data collection and FCOY

Issue 1: Several commenters noted that the use of FCOY is inherently biased by 1) variation in sightability in different portions of the GYA; 2) variation in observer intensity in different portions of the GYA; 3) non-random observer effort as applied to different bears; 4) variation in the likelihood that a grizzly bear sighting will be reported; 5) variation in the likelihood that a FCOY sighting reported is actually recorded in the FCOY database; and 6) the fact that these biases have probably changed through time. In light of these sources of variation, we should not use FCOY as a population parameter. One commenter requested that we disclose how much and in what direction each source of variation biases the estimate of total population size. Another commenter emphasized that it is important to define in advance which observations will be accepted and how the quality of the observation will be confirmed.

Response: The first four items of this issue focus on heterogeneity in sighting probabilities. The methods recommended by Keating et al. (2002, p. 162) and Cherry et al. (2002, pp. 179-180) were developed to account for this anticipated heterogeneity. The fifth item suggests that the Interagency Grizzly Bear Study Team change their recording methodology. There is a strict written protocol in place that has been peer reviewed and

published (Knight et al. 1995, pp. 246-247). Only qualified agency personnel are considered as observers. Sightings from the general public are not used unless they can be verified by an agency biologist after reviewing a photograph or video clip. If human error resulted in incorrectly recording information, this would be accounted for as random error in our estimates of sampling variance. A discussion of sources of variation and expected limitations of various methods are discussed in the Reassessing Methods Document (Interagency Grizzly Bear Study Team 2005, pp. 15-26). The sixth item is unknown and if true would likely be dependent on the time period. Consistent results of the data collected over long period of time indicate that if there has been changing bias over time, it is likely resulting in limited influence to the results.

Issue 2: Some commenters questioned if the models of Keating et al. (2002, p. 170) adequately corrected the biases associated with FCOY and if the assumptions of Keating et al. (2002, p. 170) had been met. Another commenter noted that it is impossible to identify unmarked bears and that the methodology described in the Reassessing Methods Document based on Keating et al. (2002, p. 166) may be inappropriate.

Response: We agree that Keating et al. (2002, p. 170) assume that all bears seen can correctly be identified and that we violate this assumption. To address this matter, our protocol for sighting data is extremely conservative. Knight et al. (1995, pp. 246-247) established a rule set to differentiate between repeat sightings of the same bear and sightings of different bears. The rule set is very conservative and tends to identify different bears as the same bear instead of incorrectly identifying the same bear as different bears, resulting in lower FCOY counts than probably exist.

Issue 3: One commenter recommended that two independent scientists go through the FCOY raw data separately and determine which were observations of the same bear and which were different bears (i.e. unduplicated) to quantify the subjectivity associated with the use of Knight et al.'s (1995, pp. 246-247) rule set.

Response: In most cases separation or clustering of sightings is quite clear based upon the Knight et al. (1995, pp. 246-247) rule set. In those cases where subjectivity is necessary, 2 biologists make the determinations. To eliminate any possible subjectivity, the Interagency Grizzly Bear Study Team will soon defer to a computer program based on these rules, thus removing any sources of human bias or inconsistency. This program is nearly complete and will be implemented once verified for accuracy and consistency.

F. Estimates of unknown mortality

Issue 1: Some commenters stated that the Reassessing Methods Document cannot use the methods of Cherry et al. (2002, pp. 179-180) because certain scenarios could violate all four of its assumptions. The implications of violating these assumptions should be reported in the Supplement to the Reassessing Methods Document.

Response: The critical assumptions of the Bayesian estimator of total mortality are 1) the probability that a death is reported is constant over time; 2) the probability that a death is

reported is independent of the cause of death; 3) the probability that the death of a radio-instrumented bear is reported by the public is approximately equal to the probability that the death of a non-instrumented bear is reported by the public; and 4) deaths occur independently of one another. At this time we consider the Bayesian method to be the best tool available for estimation of unreported mortality. All assumptions have been clearly stated and violations of such assumptions are known and the impacts are described in Cherry et al. (2002, pp. 179-180) and the Reassessing Methods Document (Interagency Grizzly Bear Study Team 2005, pp. 41, 66-67). The method should be viewed as one step in a process with multiple checks and balances. The checks and balances indicate that the method of estimating total mortality is producing reasonable estimates. Efforts will continue to work on improving the methodology and the Interagency Grizzly Bear Study Team will revise its estimates of unknown mortality based on the best available scientific information.

Issue 2: One peer reviewer suggested that radio-telemetry bears could be used to estimate unreported mortality by assuming that undocumented signal losses were the result of mortality.

Response: This use of radio-telemetry bears as a part of the method to assess unknown-unreported mortality is discussed in detail in Cherry et al. (2002, pp. 175-176, 179-180). Data from radio telemetry bears are a component of the unknown-unreported mortalities, but are insufficient to estimate unreported mortality without additional analysis (Cherry et al. 2002, pp. 175-176, 179-180).

G. Raw data requests

Issue 1: Several commenters requested that we provide the raw data relied upon in calculating total population size, sustainable mortality limits, population growth rates, transition probabilities, and reported/unreported mortality. These commenters believed that we undermined the public and scientific process by not allowing independent scientists (non-agency scientists) access to these data for analyses.

Response: Mortality information, including date of death, sex, age, certainty of death, if the bear was marked or not, and location is published annually in the Interagency Grizzly Bear Study Team Annual Reports. The status of marked bears is also published in the annual reports. This information is publicly available at http://nrmsc.usgs.gov/research/igbst-home.htm Data used to calculate population size are available in the tables provided by Keating et al. (2002, p. 171), and are included in the Supplement to the Reassessing Methods Document (Interagency Grizzly Bear Study Team 2007, p. 7). Estimates of sustainable mortality limits recommended in the Reassessing Methods Document are based on survival and associated population growth rates analyzed by Harris et al. (2006, p. 50). All results of Harris et al. (2006, p. 48) where estimates of population growth were made can be duplicated from data available in the other chapters of the Monograph. Data used to calculate transition probabilities are included in the Supplement to the Reassessing Methods Document (Interagency Grizzly Bear Study Team 2007, pp. 19-21). The Interagency Grizzly Bear Study Team also

released the raw data files and digital records from 1975-1998 in response to a Freedom of Information Act request. The Interagency Grizzly Bear Study Team replied to a later request for such data but has not received a formal Freedom of Information Act request for these. It is important to note that we did not rely upon any of this raw data to make our decisions, but rather on the peer-reviewed published interpretations of that raw data. We did not have any additional data than what was available to the public.

Issue 2: One commenter suggested that we provide complete information on the cause of death for each bear, when and where it died, and the location of hiding cover, attractants, roads, clearcuts, industrial activities, and food sources.

Response: The Interagency Grizzly Bear Study Team provides information on each reported bear mortality in its annual reports. Information is publicly available on date of death, if known or estimated, sex, age, general location, cause, certainty, and marks. The Interagency Grizzly Bear Study Team does not attribute locations to hiding cover, etc. because they do not have spatial coverage for most of these covariates and do not routinely add variables that may or may not be relevant to mortality.

H. Habitat and Spatial Aspects

Issue 1: Some commenters expressed concern that the new mortality limits in the Reassessing Methods Document are based on the incorrect assertion that habitat conditions will remain the same in the future. This may not be the case for several reasons: 1) human population growth; 2) declines in whitebark pine communities; 3) private land development; and 4) road densities on private and public land outside the PCA.

Response: The mortality limits described in the Reassessing Methods Document do not assert or rely on this assumption. We propose an adaptive management approach and a comprehensive monitoring system. By monitoring habitat conditions and population parameters, changes in the system will be detected and adaptive management principles applied. If changes in the system indicate that mortality limits are no longer consistent with a stable or increasing population, it will be publicly reported in the Interagency Grizzly Bear Study Team Annual Reports and public meetings of the Yellowstone grizzly bear managers. Management decisions will be reevaluated as necessary and any changes to the mortality limits will be made based upon the best available science and the Yellowstone Grizzly Bear Coordinating Committee process which includes a public comment process (U.S. Fish and Wildlife Service 2007, p. 63).

Issue 2: Many commenters stated that we should initiate a habitat-based population viability analysis (PVA) that considers future environmental conditions that could determine the carrying capacity of the GYA. It was also suggested that we should conduct a coarse-scale habitat-based PVA that considers geographic differences in mortality risk and the relationship between survival, reproduction, and whitebark pine. Some commenters endorsed the use of resource selection functions to create a habitat-based PVA.

Response: We agree that linking habitat conditions to demographic data would be an invaluable management tool. The Interagency Grizzly Bear Study Team is currently developing habitat-based risk analysis models of equal value to the resource selection function model approach that will provide insight into these relationships. One of the management recommendations of the Monograph, (Schwartz et al. 2006d, p. 62) was to explore more spatially explicit models beyond the three political zones addressed. Prior to the publication of the Monograph, the Interagency Grizzly Bear Study Team addressed this recommendation and constructed models to assess how hazards on the landscape affect grizzly bear survival. These models consider foods, habitat productivity, and human impacts to the landscape. As part of the adaptive management approach in the Conservation Strategy, the Interagency Grizzly Bear Study Team intends to link these hazard models with models of reproduction to predict population change and viability. These models have not undergone peer review yet, so their results are not publicly available as per U.S. Geological Survey policy. These modeling efforts will continuously be updated and improved as new methods and information become available.

Issue 3: Commenters noted that the Reassessing Methods Document ignored the source-sink dynamics identified by Schwartz et al. (2006d, p. 59) and assumed the population operates uniformly. Allowable mortality limits should be specific to different geographic areas because of their varying importance to population trajectories and mortality should be limited in areas already experiencing negative population growth rates unless the explicit goal of such mortality is to cause further declines in those areas.

Response: The Reassessing Methods Document establishes biologically sustainable mortality limits for the entire Greater Yellowstone Area and, in doing so, incorporates the source-sink dynamics of the population into the demographic management system. Areas that are currently population sinks may remain so in the future but their impact on the overall trajectory of the population is incorporated into calculations of the sustainable mortality level and the measurement of population trajectory.

Issue 4: Some commenters noted that the Reassessing Methods Document failed to account for the density-dependent effects documented by Schwartz et al. (2006c, pp. 29-30) for grizzly bears inside Yellowstone National Park and that this oversight could lead to an overestimation of sustainable mortality.

Response: The methods in the Reassessing Methods Document do account for density dependent effects reported by Schwartz et al. (2006c, p. 29-30) by basing mortality management on a composite sample of survivorship and reproductive rate data from all areas, including areas in and out of Yellowstone National Park. This combined sample is used to establish population size and to quantify all sources of bear mortality. The methodology described in the Reassessing Methods Document can and will change as conditions change, using annual reports of multiple indices, the best available science, and the commitment of the Conservation Strategy to use an adaptive management system when warranted by the data.

I. Alternative Population Estimation Methods

Issue 1: Some commenters suggested that we explore the benefits and costs associated with developing a more reliable method of estimating total population size using capture-mark-recapture or DNA and disclose our reasoning behind abandoning the capture-mark-recapture methodology used in 1998 and 1999.

Response: The costs of a DNA-based population estimate for the Yellowstone area using capture-mark-recapture approach would be approximately $3.5-5 million and would yield a one time point estimate for the population. The time lag between data collection and the final population estimate is approximately 3 years, making this type of population estimate inappropriate for responsive management or as a way to establish annual sustainable mortality limits. This $3.5-5 million cost for a one time point estimate of population size is approximately the same cost as roughly eight years of the intensive demographic and habitat data collection currently conducted by the Interagency Grizzly Bear Study Team. Given that the agencies do not have a budget for this amount and that peer reviewed scientific methods (Keating et al. 2002, pp. 170-173) are available to make population estimates for the Yellowstone system on an annual basis, the Service believes that application of a DNA-based estimate in the Yellowstone is not necessary.

A more traditional capture-mark-recapture (CMR) methodology using radio-collared bears to produce a population estimate was evaluated by the Interagency Grizzly Bear Study Team in 1998 and 1999 (Schwartz 2000, pp. 15-18). Unexplained low sightability resulted in confidence intervals so large it makes the application of the CMR technique of limited value in the GYA even though it appears that all assumptions necessary for the application of the technique were met (Schwartz 2000, p. 17). The CMR technique does have some value in establishing the absolute low bound of the population estimate, which yields a low bound estimate of 627 bears in the recovery zone and the 10-mile perimeter surrounding the recovery zone in 1999.

J. Clarification needed

Issue 1: Commenters noted that we must describe, in detail, if and how changes to the Reassessing Methods Document (and mortality limits) will be made in the future.

Response: Any change in the methods described in the Reassessing Methods Document and its Supplement would be considered a change to the Conservation Strategy and would be revised through the Yellowstone Grizzly Bear Coordinating Committee process and based upon the best available science (U.S. Fish and Wildlife Service 2007, p. 63). The methods described in the Reassessing Methods Document may change in the future as new scientific approaches become available or new data are analyzed that might require such a revision. The Interagency Grizzly Bear Study Team would produce a peer-reviewed report evaluating any new scientific data or methods and present this report, along with recommendations, to the Yellowstone Grizzly Bear Coordinating Committee. Any such recommendations would then be open to public comment. After considering public comments, the Yellowstone Grizzly Bear Coordinating Committee would decide whether to append the recommended revisions to the Conservation Strategy

through a majority vote (U.S. Fish and Wildlife Service 2007, p. 63). No changes in the population management systems will be made unless these changes are based on the best available science and the changes have been subject to peer review and an open public process.

Issue 2: One commenter requested clarification about Table 5 from Keating et al. (2002, p. 171) and Table 1 in the Reassessing Methods Document (Interagency Grizzly Bear Study Team 2005, p. 6). These tables both show FCOY count data for 1999-2004, but the numbers of FCOY and the resulting $Chao_2$ estimates are different for 2001 and 1999 in each table.

Response: The numbers in Keating et al. (2002, p. 171) are counts in the recovery zone plus the 10 mile buffer while the numbers in Table 1 in the Reassessing Methods Document encompass the entire GYA. The larger area covered in the counts reported in the Reassessing Methods Document account for the larger number than reported by Keating et al. (2002, p. 171) as the "m" value. The "observed count" in Table 1 of the Reassessing Methods Document (Interagency Grizzly Bear Study Team 2005, p. 6) is adjusted to remove any FCOY that were sighted in the GYA because they were wearing radio collars. The Chao2 estimator is applied to this FCOY value (the number of FCOY in the entire GYA minus the number of FCOY seen as a result of wearing a radio collar).

Issue 3: One commenter suggested that we finalize the exact language we propose to append to the Recovery Plan and the Conservation Strategy and solicit public comment on that language so that the public knows exactly what they are commenting on.

Response: The Interagency Grizzly Bear Study Team produced the Reassessing Methods Document to fully explain the rationale and the science behind the methods we are proposing to append to the Recovery Plan and the Conservation Strategy for estimating population size, calculating unknown/unreported mortality, and establishing sustainable mortality limits. Public comments were solicited on the Reassessing Methods Document. The final wording will be based on the management recommendations in the Supplement to the Reassessing Methods Document, including any improvements or clarifications resulting from the public comment process, and will be made available to the public.

Issue 4: One commenter noted that the formal evaluation phase of the Adaptive Management strategy occurs at intervals too long (8-10 years) to be responsive to population declines.

Response: We do not require nor recommend that changes or reevaluations of mortality management be done only every 8-10 years. The Reassessing Methods Document recommends a formal evaluation every 8-10 years in which demographic parameters (lambda, survival, litter size, litter interval, transition probabilities, etc.) are recalculated based on the radio-collared sample (Interagency Grizzly Bear Study Team 2005, p. 45). Necessary adjustments can be made based on annual analyses if necessary to assure a healthy population (Interagency Grizzly Bear Study Team 2005, p. 45). The 8-10 year time period was suggested because it is roughly how long the population should be

monitored to gather adequate data to make new estimates of survival, cub production, interbirth interval, and population growth rates without overlapping with previous sampling periods. It is desirable to recalculate these demographic rates every 8-10 years with "fresh" data so that data obtained in the previous sampling period are not masking more recent trends. The Interagency Grizzly Bear Study Team will recalculate demographic rates every 8-10 years but may choose to initiate this process sooner if annual demographic rates indicate that declines beyond normal variability are occurring or if population standards are not being achieved.

Issue 5: Some commenters requested that we explain to the public and the scientific community, why we consider the Precautionary Principle, an "undisputed tenet of science", to be contrary to good conservation.

Response: We support the application of the precautionary principle and consistently incorporate it into the conservative approaches in the Reassessing Methods Document including the management of mortality and the estimation of population size. The use of FCOY data are considered conservative because the strict rule set (Knight et al. 1995, pp. 246-247) tends to make population estimates biased low. Model simulations have demonstrated that the Chao2 estimator biases the estimate of the total number of FCOY low (Interagency Grizzly Bear Study Team 2005, p. 20). In addition, the sustainable mortality limits for independent females (greater than or equal to 2 years old) were set at a rate that allows for a stable to increasing population growth rate 95 percent of the time even under high process variation (Harris et al. 2006, p. 50).

K. More analysis or research needed

Issue 1: Some commenters requested that we disclose how many bears can be killed under the alternate methods considered.

Response: The Recovery Plan sets known human-caused mortalities within the recovery zone and 10 miles outside the recovery zone to be no more than 4% of the minimum population estimate and no more than 30% of these can be female, calculated on a running 6-year average. The new method counts all known human-caused, natural, and unknown/unreported mortalities throughout the GYA and sets this number to be no more than 9% of the total adult female population, 15% of the total adult male population, and 9% of the total dependent young population. These methods differ markedly due to different areas where they apply, minimum versus total population sizes to which the percentages apply, counting natural mortalities versus not counting natural mortalities, and using a calculated unknown/unreported level versus a set 2:1 ratio for known/unknown mortalities. Given all these reasons, it is not possible to do a numerical comparison of "how many bears can be killed" between the two methods. This is explained and discussed in detail in the Reassessing Methods Document (Interagency Grizzly Bear Study Team 2005, pp. 31-39).

Issue 2: Some commenters noted that the importance of males to the population must be quantified. At some point, their survival does affect population trajectory. Studies of

other bear populations indicate that the loss of males due to hunting may negatively affect cub survival through sexually-selected infanticide.

Response: We agree that the original wording was susceptible to misinterpretation and that it is conceivable that male abundance could decline to the point where recruitment would be affected, and possibly lead to other negative biological consequences. The underlying population trajectory that we used to establish sustainable mortality limits is independent of male survival rate (Harris et al. 2006, p. 50) but the adopted mortality limits do not establish a substantial increase in male mortality over what occurred during the 1983-2002 period (Haroldson et al. 2006, p. 36) when the population was increasing, reproductive rates were adequate, and cub survival was relatively high. We do not anticipate that the male to female ratio would change markedly under the adopted mortality limits or that sexually-selected infanticide would become an issue affecting population trajectory of the Yellowstone grizzly bear population. Miller et al. (2003, p. 144) and McLellan (2005, pp. 153-154) could not find evidence of population level effects of sexually selected infanticide in North American grizzly populations. Continued monitoring of the population through radio-telemetry and observations of unmarked reproductive females will alert the Interagency Grizzly Bear Study Team to any substantial changes in cub survival or production and appropriate management responses.

Issue 3: Some commenters recommended that we conduct a comprehensive Risk Assessment that discloses the real life consequences for grizzlies if the conclusions reached in the Reassessing Methods Document are wrong, even by small amounts.

Response: The Reassessing Methods Document (Interagency Grizzly Bear Study Team 2005) is a comprehensive analysis that assesses the potential risks of the proposed system and alternative approaches in detail.

Issue 4: One commenter suggested that the analyses described in the Reassessing Methods Document (Interagency Grizzly Bear Study Team 2005, pp. 42-43) be completed and the Final Document revised to incorporate the results of these analyses.

Response: The list in the Reassessing Methods Document identifies research topics that we are either currently engaged in or that should be pursued in the future (Interagency Grizzly Bear Study Team 2005, pp. 42-43). This list was placed in the Reassessing Methods Document to demonstrate our ongoing commitment to future science and to the application of adaptive management. It is not necessary to complete this list of research topics to make an informed decision about the best available methodology for calculating population size and sustainable mortality limits currently available.

Issue 5: Several comments that are not directly relevant to the Reassessing Methods Document were also received. These included comments about future funding, threats to habitat and major foods, stochastic events, genetic isolation, and the adequacy of the post-delisting monitoring plan.

Response: These comments will be addressed in the Final Rule.

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