June 9, 2016

Ms. Noreen Walsh
Regional Director
US Fish & Wildlife Service
Mountain-Prairie Region
134 Union Boulevard
Lakewood, CO 80228

SUBJECT: Project: Scientific Peer Review for Greater Yellowstone Grizzly Bears

Dear Ms. Walsh,

In accordance with the Statement of Work dated March 28, 2016, Amec Foster Wheeler
Environment & Infrastructure, Inc. (Amec Foster Wheeler) is pleased to submit the completed
*Peer Review (without attribution) of the Scientific Findings in U.S. Fish and Wildlife Service's
Proposed Rule Removing the Greater Yellowstone Ecosystem Population of Grizzly Bears From
the Federal List of Endangered and Threatened Wildlife; Availability of Draft Recovery Plan
Supplement: Revised Demographic Criteria and a Draft 2016 Conservation Strategy for this
Population*.

The three documents (Proposed Rule, Revised Demographic Criteria, and Draft 2016
Conservation Strategy) were provided to five reviewers on April 14, 2016. Each reviewer
independently evaluated the documents and prepared their individual responses to the
questions included in the Statement of Work. After receipt of each individual review, I assigned a
random number to each review, proofread them, ensured all reviews were in the same format,
and coordinated with the reviewer for any clarifications and approval of typographical edits.
Individual reviews were received between May 19, 2016 and June 9, 2016.

The five reviewers, all of whom are bear biologists, included:
- Jerrold (Jerry) Belant, PhD, from Mississippi State University
- Mark Boyce, PhD, from the University of Alberta
- John Cox, PhD, from the University of Kentucky
- Andrew Derocher, PhD, from the University of Alberta
- Dwayne Etter, PhD, from Michigan Department of Natural Resources

Continued...

Enclosed with this letter are the five reviews with randomly assigned numbers, along with the resume for each reviewer. The administrative record will provided after completion of the question and answer (Q&A) period. Please contact Dawn Johnson at (805) 252-4370 if you have any questions or need clarification on the process or for any of the reviews.

Yours sincerely,

Dawn L. Johnson, PhD
Project Manager, Senior Biologist

Enclosures: Individual Reviews and Resumes

Scientific Peer Review for
Delisting of Greater Yellowstone Ecosystem Grizzly Bears

Reviewer 1
May 2016

Grizzly bears (*Ursus arctos*) of the Greater Yellowstone Ecosystem (GYE) are likely the most well studied group of their species worldwide and the depth of understanding of the bears and their ecosystem has reached a profound level rarely matched by other large carnivores. This background of scientific insight provides a solid basis for the three documents reviewed in this report. In overview, the Federal Register Proposed Rule, Conservation Strategy, and Grizzly Bear Recovery Plan Draft Supplement are all rigorous and scientifically sound documents. I could find no errors of logic or scientific method. The Conservation Strategy is a comprehensive and well-considered document. The management efforts that arise from this document are profound and well designed to meet the target of managing a delisted species such as the GYE grizzly bears.

The Proposed Rule provides and adequate review and analysis of the factors relating to the persistence of the grizzly bear population in the GYE. The document is rigorous, science-based, and founded on the best available science. The Recovery Plan and Draft Supplement are scientifically sound.

I conclude that the three documents provide a science-based approach to the GYE grizzly bears management and conservation. The three documents provide a science-based plan for management into the future. The Conservation Strategy, if fully implemented as outlined, is a scientifically sound and logical approach to ensure the long-term viability of the GYE grizzly bear population. The care, thought, and attention to the full range of threats to the GYE grizzly bears is evident and I have no hesitation in supporting the full breadth of the Conservation Strategy and other two documents. This is a robust and well-considered approach that meets the highest standards of science-based management and conservation.

My review covers the three documents provided and include:

1) Federal Register / Vol. 81, No. 48 Friday March 11, 2016 / Proposed Rule 13174-13227

2) Final Draft: Draft 2016 Conservation Strategy for the Grizzly Bear in the Greater Yellowstone Ecosystem

3) Grizzly Bear Recovery Plan: Draft Supplement: Draft Revised Demographic Recovery Criteria for the Yellowstone Ecosystem. Draft Approved: 2.19.16

I have provided direct responses on the 13 questions identified as part of the Scientific Peer Review for Greater Yellowstone Grizzly Bears: some of this information is repeated in the specific sections on each document. My review also identifies specific points noted with a reference to location in the document; these are provided following my answers to the 13 questions.

Proposed Rule:

1.   Does the proposed rule provide adequate review and analysis of the factors relating to the persistence of the grizzly bear population in the Greater Yellowstone (demographics, habitat, disease and predation, and genetics)?

The Proposed Rule provides an adequate review and analysis of the factors relating to the persistence of the grizzly bear population in the GYE. The document is rigorous, science-based, and founded on the best available science. Much more could be written to cover the full breadth of the literature on the GYE grizzly bears but the current document provides a solid overview.

The demographic information is solid, science-based, in-depth, and based on the best available science. The methods used attain a very high level acceptable on an international level. Similarly, the analyses of habitat, disease, predation, and genetics are all held to the same high standard.

I could find no errors of interpretation or analyses in the documents. The conclusions on each of the factors pertaining to the persistence of grizzly bears in the GYE are well supported by the Proposed Rule.

2.   Are our assumptions and definitions of suitable habitat logical and adequate?

The assumptions and definitions of suitable habitat are both logical and adequate. It is possible that new findings may alter our understanding of grizzly bear habitat and what is deemed secure but the Proposed Rule uses the best available science to support the habitat analyses and management protocols. The use of adaptive management will allow new scientific insights or methods to be applied should they prove to be advances beyond the current state of knowledge.

3.   Are the details for habitat management adequate in the proposed rule?

The details for habitat management are adequate in the Proposed Rule. Use of adaptive management and the ongoing research and monitoring will allow for improvements, should they prove possible, over time. The standards applied for the GYE grizzly bears as they pertain to habitat management are of the highest standard possible. Scientific methods and the depth of understanding of the GYE grizzly bears are profound and few other wildlife species have such a depth of science supporting their management and conservation.

4.   Is management to facilitate connectivity with other grizzly populations adequately addressed in the proposed rule?

Connectivity of the GYE grizzly bear population is an ongoing issue and one that will persist into the foreseeable future. The current levels of genetic diversity do not indicate a problem at this time and ongoing monitoring will allow detection of any emerging issues. The proposal to increase linkages with adjacent areas is a meaningful conservation solution and, thus, I have no concerns about the proposed management protocols to facilitate connectivity with other grizzly bear populations. The consideration of translocation of bears is a viable option should connectivity and gene flow not be adequately established. At this time, I concur that connectivity as it exists now has not been detrimental to the GYE grizzly bears. The proposed facilitation of linkages is meaningful, logical, and based on the best available scientific data.

5.   Is the management of discretionary mortality, including hunting, scientifically sound and sufficiently detailed?

The approach taken to manage discretionary mortality, including hunting, is based on the best available scientific information. I am satisfied that the discretionary mortality management plan is adequate and sufficiently detailed such that it should pose no significant threat to the GYE grizzly bear population. Actions that allow relisting are a significant inducement to ensure that no future threat emerges from discretionary mortality. In summary, I am satisfied that the proposed approach is scientifically sound, conservative, and is precautionary in approach.

6.   Are the conclusions relating to the effects of changes in food resources on the GYE grizzly bears scientifically based and logical?

Grizzly bears are omnivores and their diet across their range is hugely variable. This pattern of a highly diverse diet in grizzly bears in the GYE is also well supported. The monitoring of the 4 main high-energy foods is a meaningful approach but given the generalist nature of grizzly bears, the evidence suggests that changes in the abundance and availability of these four foods do not pose a significant threat to the GYE grizzly bears. The conclusions about the effects of changes in food resources are scientifically sound and based on the best available science. The use of adaptive management approaches, habitat management, and close monitoring of the GYE grizzly bear population is adequate to minimize any risk to the population from changes in food resources. The conclusion pertaining to the effects of changes in food resources in the GYE is based on the best available science, is logically addressed, and is scientifically sound.

7.   Is our explanation of density dependent effects versus whitebark pine decline driven effects scientifically sound?

Demonstration of carrying capacity in any wildlife population remains a challenge. On balance, the evidence in the GYE grizzly bears is that the decline in the population rate of increase is associated with carrying capacity. This finding was supported by van Manen et al. (2016) that "Cub survival and reproductive transition were negatively associated with an index of grizzly bear density, indicating greater declines where bear densities were higher." Nonetheless, the documentation of density dependence in the GYE grizzly bear population remains inconclusive although it is unlikely that any additional research or monitoring could provide a conclusive answer. From the perspective of conservation of the GYE grizzly bears, I do not deem the existence of density dependence a critical component of the delisting process. Density dependence is useful for understanding the observed changes in the population but the existing analyses and data cannot fully preclude other mechanisms. Lastly, van Manen et al. (2016) could not find a link between the observed demographic patterns and whitebark pine but this does not in and of itself result in acceptance of density dependence although I concur that it is a plausible explanation that is consistent with the data. Further to this point, van Manen et al. (2016, page 309) noted that a decrease in carrying capacity was a possible alternative explanation for the demographic changes. In overview, the logic and science behind the explanation of density dependent effects versus whitebark pine decline favors the density dependent explanation although firm conclusions on this are impossible at this time with the available data.

It would be useful to assess the importance of whitebark pine as a dietary item to know if there are significant differences in the vital rates of bears that feed on whitebark pine compared to those that do not. I recommend an assessment of the survival rates and reproductive rates of grizzly bears that feed on whitebark pine compared to those that do not. Potential differences in vital rates relative to

diet are viewed as a research recommendation and do not impinge on the delisting of the DPS and the proposed rule.

Draft 2016 Conservation Strategy:

1.   Are the habitat management mechanisms scientifically sound and sufficiently detailed in the draft 2016 Conservation Strategy?

The habitat Conservation Strategy as outlined is a stellar merger of the best available science and the best known approaches for wildlife management. The specific mechanisms to maintain habitat to conditions during which the GYE grizzly bear population was increasing (i.e., 1998) is a meaningful and scientifically sound approach. The care and attention to the full breadth of possible threats is meaningful, science-based, and appropriate. Integration of adaptive management is a valid approach to ensure that habitat-based threats to the GYE grizzly bear population do not emerge and are mitigated, if they develop over time.

2.   Is the management of discretionary mortality, including hunting, scientifically sound and sufficiently clear and detailed so that managers can use this document to successfully implement mortality management in the future?

The management of discretionary mortality, including hunting, is scientifically sound and well considered. Managers will be well served by the outlined criteria and the approach is adequately described to allow replication across the range of the GYE grizzly bear population. The rationale presented for the management of discretionary mortality is based on the best available science and the close monitoring in association with adaptive management should result in a well-managed harvest that poses little or no threat to the GYE grizzly bear population for the foreseeable future. Safeguards for emergency relisting based on the criteria noted provide additional confidence in the approach taken.

3.   Is management to facilitate connectivity with other grizzly populations adequately addressed in the draft 2016 Conservation Strategy?

The Conservation Strategy's approach to facilitate connectivity of the GYE grizzly bear population with other areas is adequately addressed. Given the use of adaptive management, the approach taken may provide additional insights and guidelines to improve the likelihood of successful genetic linkages with adjacent populations. Identification of potential linkage areas and management of these habitats will be an important component of the management of the GYE grizzly bear population. Guidelines for road construction, however, are vague and would benefit from additional clarification. Use of crossing structures, signage, and other aspects that might reduce effective immigration would benefit from additional clarity. Use of words such as "should", "encouraged", "consideration", and "can recommend" are inadequate to bring about consistent and effective management responses. In the foreseeable future, however, the steps being taken to facilitate connectivity are meaningful and science-based. Application of adaptive management is a positive aspect for future improvements in management protocols and connectivity.

4.   If implemented, is the Conservation Strategy adequate to reasonably ensure the long-term viability of the Greater Yellowstone grizzly bear population?

The Conservation Strategy, if fully implemented as outlined, is a scientifically sound and logical approach to ensure the long-term viability of the GYE grizzly bear population. The care, thought, and attention to full range of threats to the GYE grizzly bears is evident and I have no hesitation in supporting the full breadth of the Conservation Strategy. This is a very robust and well-considered approach that meets the highest standards of science-based management and conservation.

Draft Recovery Plan Supplement: Revised Demographic Criteria:

1.   Please provide your scientific evaluation (e.g., the pros and cons) of the revised recovery goal's objective to manage and maintain the population around the 2002–2014 model-average Chao2 estimate of 674 (95% CI 600–757).

With respect to the use of Chao2 population estimate for the DMA, Keating et al. (2002) noted "Over all CV values, RMSEs for NChao2 were lower than for NC2 (Fig. 2), but Nchao2 became increasingly and negatively biased as CV increased (Fig. 1). Because individual animals clearly are not equally sightable, use of such an estimator would introduce a chronic, negative bias into estimates of population size and sustainable mortality." Therefore, the use of the Chao2 estimator would tend towards a conservative estimate of population size and a lower level of sustainable harvest. Because of this bias over all of the CV (coefficient of variation) values, the approach being proposed is precautionary and viewed as a "pro".

The only "con" associated with the use of the Chao2 estimator is that is negatively biased and thus, should the goal of management be to increase the harvest levels, use of other, less biased estimators may indicate a higher level of sustainable mortality.

I deem the use of the Chao2 estimator as appropriate and precautionary in approach. The statement that new estimators may be used, should an improved method become available, is a meaningful and scientifically sound approach. Continuation of the Chao2 estimator should a new estimator be used is deemed appropriate for long-term monitoring and trend detection.

2.   Please provide your scientific evaluation (e.g., the pros and cons) of monitoring the demographic criteria exclusively within the demographic monitoring area.

The proposed approach to monitor the demographic criteria within the specified "demographic monitoring area" (DMA) is a scientifically meaningful approach. Populations at their fringes may differ in vital rates due to a variety of biotic and abiotic factors. The major advantages of the DMA approach is consistency over time, focus on the core reproductive nucleus of the GYE grizzly bear population, and the approach is scientifically sound. Monitoring the GYE as a whole would likely result in greater stochasticity in the data and would not necessarily provide any information that would significantly alter management. The core objective of the Conservation Strategy is the maintenance of the primary conservation area as the reproductive core of the GYE grizzly bear population. The DMA is a significantly larger area and, thus, liable to provide more information on the status of the GYE population as a whole.

The "cons" associated with having a smaller DMA than the whole area of suitable grizzly bear habitat is that the status of the broader area will be less well understood. From a management perspective, knowing the status of the core DMA is a scientifically sound approach. Monitoring of segments of a population is a common strategy and there is no logical reason to not apply it for GYE grizzly bears.

Literature cited

Bunnell FL, Tait DEN (1980) Bears in models and in reality - implications to management. Int Conf Bear Biol Manage 4:15-23.

Delibes M, Gaona P, Ferreras P (2001) Effects of an attractive sink leading into maladaptive habitat selection. Am Nat 158:277-285.

Harvell CD, Mitchell CE, Ward JR, Altizer S, Dobson AP, Ostfeld RS, Samuel MD (2002) Climate warming and disease risks for terrestrial and marine biota. Science 296:2158-2162.

Keating KA, Schwartz CC, Haroldson MA, Moody D (2002) Estimating numbers of females with cubs-of-the-year in the Yellowstone grizzlybear population. Ursus 13:161-174.

van Manen FT, Haroldson MA, Bjornlie DD, Ebinger MR, Thompson DJ, Costello CM, White GC (2016) Density dependence, whitebark pine, and vital rates of grizzly bears. The Journal of Wildlife Management 80:300-313.

DOCUMENT 1: Federal Register / Vol. 81, No. 48 Friday March 11, 2016 / Proposed Rules

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13175 – Greater Yellowstone Ecosystem (GYE): No issues of concern.

13176 - Taxonomy and Species Description: No issues of concern.

13176 - Behavior and Life History: No issues of concern.

13177 – Nutritional Ecology

13178 – "Nearly one third of grizzly bear home ranges in the GYE do not contain any whitebark pine… Bears in these areas consume other food even during years of good whitebark pine production."

It would be useful to the assessment of whitebark pine as a dietary item to know if there are differences in the vital rates of bears that feed on whitebark pine compared to those that do not. I recommend an assessment of the survival rates and reproductive rates of grizzly bears that feed on whitebark pine compared to those that do not. Potential differences in vital rates relative to diet are viewed as a research recommendation and does not impinge on the designation of the DPS and the Proposed Rule.

13178 – Habitat Management

13178 - "The primary factor affecting grizzly bears at both the individual and population level is excessive human-caused mortality."

Issue: Unsubstantiated statement. This may be correct but every population is affected by different factors.

Recommendation: Provide references and justification for the statement or conduct appropriate analyses to support it.

13179 – Population Ecology – Background

In overview, the section is solid, fact-based, and presents the issues clearly. At times, over-simplification has introduced ambiguity but this was viewed as a minor issue.

13180 – "Among grizzly bears, indicators of density-dependent population regulation can include: (1) Decreased yearling and cub survival due to increases in intraspecific killing".

Issue: Intraspecific killing of cubs and yearling can occur for many reasons. Such killing can be, but is not necessarily, restricted to density-dependence. Intraspecific predation may be related to nutritional stress or as part of a reproductive strategy by adult males.

Recommendation: Clarify that intraspecific predation cannot be used to assume density-dependent population regulation.

13180 – "Indicators that density-independent effects are influencing population growth can include… increases in age of first reproduction due to limited food resources"

Issue: The text is presenting a simplified perspective on indicators of density dependence and density independence. There is solid scientific evidence to link an increase in age of first reproduction to density dependence (e.g., food resources are limited due to scramble

competition or interference competition) but equally to density independent factors (e.g., weather, climate).

Recommendation: Clarify that indicators as noted are insufficient to assess population status relative to carrying capacity. The data needed to demonstrate density dependence is beyond most wildlife monitoring programs and particularly so for large carnivores.

13180 – Figure 1.

Issue: Portrayal of carrying capacity as a constant is a dated perspective. Most ecologists view carrying capacity as dynamic over time.

Recommendation: Clarify that Figure 1 is a simplification.

13181 – Recovery Planning and Implementation

13182 – Habitat-Based Recovery Criteria

As noted, there are no published methods to calculate minimum habitat values for a healthy and recovered population. Nonetheless, the approach taken, using the 1990s as a baseline (specifically 1998) for conditions is logical and well considered. The monitoring items noted (e.g., food resources, grizzly mortality) are useful for informing management actions and assessing population information.

13183 – Suitable Habitat

The process of defining suitable habitat is logical and well founded in the best available science.

13186 – Population and Demographic Recovery Criteria

The assumptions and methods used are appropriate and scientifically sound.

13187 – Demographic Recovery Criterion 1

The recover criterion is well described and rigorously applied. The criterion has been met since 2003 and, thus, supports removing the GYE population of grizzly bears from the Federal List of Endangered and Threatened Wildlife.

13188 – Demographic Recovery Criterion 2

The recover criterion is well described and rigorously applied. The criterion has been met since 2003 and, thus, supports removing the GYE population of grizzly bears from the Federal List of Endangered and Threatened Wildlife.

13188 – Demographic Recovery Criterion 3

The recover criterion is well described and rigorously applied. The criterion has been met since 2003 and, thus, supports removing the GYE population of grizzly bears from the Federal List of Endangered and Threatened Wildlife.

13188 – The Conservation Strategy

The scientific basis of the Conservation Strategy is sound. The proposal to allow updating of the 2016 strategy based upon the best available science, subject to public comment, is meaningful and logical.

13190 – Distinct Vertebrate Population Segment Policy Overview

The two identified factors for DPS are logical and appropriate for conservation and management.

13190 – Past Practice and History of Using DPSs

The case studies are meaningful and useful context for the GYE DPS. Use of a DPS for the GYE grizzly bears is consistent with its application to other taxa.

13191 – Distinct Vertebrate Population Segment Analysis

13191 – Analysis of Discreteness in Relation to Remainder of Taxon

No issues of concern. The scientific basis for discreteness of the GYE DPS is logical and well supported from the information provided and published research.

13192 – Analysis of Significance of Population Segment to Taxon

No issues or concerns. Consideration under points 1, 2, and 4 are logical.

13192 – Unusual or Unique Ecological Setting

The Proposed Rule concludes that the GYE grizzly bear population does not meet the standard for significance based on its persistence in an ecological setting unusual or unique for the taxon. Whitebark pine, which has a large extension in range into British Columbia and Alberta, and the findings of reduced reliance on this species, makes the conclusion of not meeting the standards for significance a logical and science-based finding. Reliance on meat is dynamic in all grizzly bear populations and, in and of itself, is not unusual at any end of the spectrum. The collective assemblage of species in the GYE, however, likely differs from all other parts of the species range so there is an element of unique ecological setting. The contribution of bison to the diet of grizzlies is likely unique when considered in the context of the whole diet of grizzly bears in the GYE. This aspect, however, is not addressed and the decision focuses on the above 2 components (i.e., whitebark pine and meat). In summary, the section's conclusions are well considered.

13192 – Significant Gap in the Range of the Taxon

I concur with the findings of this section. Loss of the GYE DPS would be a significant loss and create a significant gap in the range of grizzly bears.

13193 – Marked Genetic Differences

The lack of clear criteria to identify "marked" genetic differences makes this criterion challenging for any species. The conclusion reached for the GYE DPS is logical.

13193 – Summary of Distinct Population Segment Analysis

I concur that the GYE grizzly bears are discrete and significant and therefore meets the definition of a DPS.

13193 – Summary of Factors Affecting the Species

13193 - A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

I have no issues with this section. The nine considerations cover the primary concerns relative to grizzly bear habitat or range. It is clear that significant improvements to GYE grizzly bear habitats have been established. The changes are meaningful and improve the status of grizzly bears in the GYE for the foreseeable future.

13194 – Habitat Management Inside the Primary Conservation Area

No reduction of secure habitat below the 1998 level is a meaningful and significant conservation standard.

13194 – Motorized Access Management

Increases in secure habitat are meaningful in the three subunits. Such changes are indicative of measures needed to reduce detrimental effects of human activity. The stated goal of the draft 2016 Conservation Strategy to ensure no net decrease in habitat in the PCA is a significant and important objective. Conservation of secure habitat is a critical aspect of GYE grizzly bear conservation.

13195 – Developed Sites

No issues or concerns. Food storage and attractant control are critical for conservation efforts and measures are in place to reduce concerns

13195 – Livestock Allotments

It is evident that livestock are, and remain, a threat to grizzly bears in GYE with 14% of the human-caused mortalities associated with management removal actions related to livestock. The key issue is the mortality source related to livestock relative to overall mortality and the mortality level remaining at a low enough level to ensure a stable or increasing population. Efforts to minimize livestock-related issues are noted. The key conservation action is the one associated with livestock being kept at or below 1998 levels. Control of livestock to such the 1998 level is a significant and critical aspect of the conservation of the GYE grizzly bears into the foreseeable future. The objective of reducing sheep grazing is an important step in improving the conditions for grizzly bears and should be active pursued as noted.

The conclusion that livestock allotments inside the PCA will not constitute a threat to the GYE grizzly bear DPS now, or in the future, is an optimistic statement that is challenging to assess. Changing environmental conditions may alter the conflict dynamics and, thus, the issue of livestock management remains an important aspect for grizzly bear conservation. In summary, I concur that for the foreseeable future, livestock issues are being controlled and do not pose a significant threat to the GYE grizzly bear DPS.

13196 – Mineral and Energy Development

That up to 4% of all suitable habitat in the PCA is available for surface occupancy is an issue of concern for the conservation of the GYE DPS. The effects of such developments can extend well beyond the footprint itself. While mitigation measures may reduce the

possible effects of development, the effects of increased human presence, increased potential for conflict, and habitat loss remain an ongoing concern to the population but mitigation and careful management can offset the risk. Within the context of the whole GYE grizzly bear DPS, the effects of mineral and energy development may be mitigated sufficiently to reduce the threat sufficiently to ensure no population decline from associated development.

This aspect will require intense scrutiny, monitoring, and mitigation.

13196 – Recreation

Recreation in the GYE has increased markedly in the recent past. While recreation activities may be similar whether this DPS is listed or not, the trend for increased recreation remains a manageable concern. Presumably a limit on visitation will be needed at some point and should be considered. I concur that recreation is not a threat to the GYE grizzly bear DPS at this time and that management actions as outlined are sufficient to deal with any concerns.

13196 - Snowmobiling

I am not convinced with the finding that snowmobiling does not constitute a threat to the GYE grizzly bear DPS although I concur that the evidence is limited to suggest a major negative effect at the population level. Of particular concern is the risk of den abandonment by females with young cubs: such events could reduce reproductive success.

One mediation approach not considered in the report is the potential to minimize the overlap between snowmobiles and grizzly bear den habitat. Such actions could work to mitigate the potentially negative effects of snowmobiling on the GYE grizzly bears. Monitoring is an inadequate response and an active management program to mitigate impacts is needed. The consideration of the possible effects on reproductively active female grizzly bears was deemed to be below the standard of the precautionary principle (i.e., "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation." Principle 15, Rio Declaration on Environment and Development).

13197 – Vegetation Management: No issues or concerns.

13197- Climate change

I concur with the statement "most grizzly bear biologists in the United States and Canada do not expect habitat changes predicted under climate change scenarios to directly threatened grizzly bears (Servheen and Cross 2010, p.4)." Nonetheless, it is the indirect effects of climate change that are of concern. Despite this, grizzly bears are a species that will likely adapt to changing environmental conditions given the wide range of ecological conditions that they have evolved to exploit (e.g., from Mexico to Arctic Ocean, Gobi Desert to boreal forests in Scandinavia). Climate change is unlikely to present a significant threat to the GYE grizzly bears.

13197 – Habitat Fragmentation

I concur with the statement that fragmentation is not a major conservation concern for the GYE grizzly bear DPS at this time.

13198 – Habitat Management Outside the Primary Conservation Area

On the whole, the management outside the PCA could cause conservation concerns for the GYE grizzly bear DPS. While mechanisms are in place with various Federal and State agencies to ensure that management plans comply with the ecological needs of grizzly bears, there is cause for careful monitoring of habitat outside the PCA although the core grizzly bear population in the PCA is less likely to be affected. Restriction and reduction of livestock allotments should be a management priority outside the PCA. The presence of 500 development sites on the 5 National Forests is a concern: control, reduction, and outreach will be essential to ensure the long-term conservation of grizzly bears in the GYE. That current Forest Plan direction allows up to 19% of suitable habitat outside the PCA within the DPS boundaries to have surface occupancy and 11% allows timber harvest is an ongoing conservation concern that will require careful management. Mitigation and reclamation of disturbed habitats will be an important conservation measure: oil and gas developments are potentially more problematic than timber harvest. As noted, the level of annual disturbance is much lower than the total and with care for reclamation, the long-term threat is minimal. With 9% of the area of the suitable habitat outside the PCA held privately, education and mitigation will be important to reduce the likelihood of attractive sinks (*sensu* Delibes et al. 2001) developing.

In overview, habitat management procedures in place outside the PCA are significant and likely to achieve the conservation goals for grizzly bears in the GYE for the foreseeable future. Designation of grizzly bears as a species of conservation concern (or equivalent) on Forest Service lands is an important component of ongoing management to ensure that grizzlies remain a management priority. Reduction of conflicts on private lands will be a critical aspect of conservation and population trajectory. While the Proposed Rule considers human population growth to not be a threat on private lands, this conclusion is reliant on careful and intensive management actions undertaken at several levels.

13200 – Summary of Factor A

The summary provides a solid consideration of the threat to the GYE grizzly bear DPS and the efforts to mitigate them. The key is retention of conditions that are at or below those found in 1998. Focus on PCA is a meaningful and well-considered strategy for achieving conservation of the DPS for the foreseeable future. Clearly, the future of the GYE grizzly bears DPS is conservation and management dependent. I am satisfied that the appropriate plans, protocols, and mitigation is in place as it pertains to the 9 factors noted. From a first principles perspective, the GYE grizzly bear DPS is limited in the number of bears that can live in the area: human-related morality will continue but minimizing the losses will reduce population-level impacts. Further, the core of the reproductive potential of the population is in secure habitat and thus provides a safeguard for the foreseeable future.

I concur with the conclusions of the Summary of Factor A.

131200 – B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Four bands of mortality are set based on the population size in the DMA. The mortality rates vary from no discretionary mortality up to 22% for independent males should the population be >747 individuals. The basis for these mortality rates is unclear and the rates are at the higher end of the range of what I would consider sustainable. Given that these rates can be modified should reproductive rates decline, I believe the risk of overutilization is very low. These are annual rates intended to reduce the population back to the state target size in some areas. Given that the mortality rates can be adjusted, the consequences of the removal can be dynamic and respond to changing conditions over time. Given that the stated goal is to maintain the population around the long-term average population size of 674, harvest is a means of controlling the population size. In theory, however, the harvest levels at the upper end would be unlikely if the population is thought be close to, or at, carrying capacity with 674 bears.

Implementation of a hunt for grizzly bears as a management tool requires careful and conservative harvest levels. Tables 2 and 3 outlines the management framework and total mortalities.

My major concerns on the allowable number of mortalities are:

 1) the basis for the allowable number of total mortalities,

 2) the high level of allowable and the potential to overshoot (i.e., excessive mortality) the target population size with hunting.

Bear populations, noted for their slow reproductive potential (e.g., Bunnell and Tait 1980), are relatively easy to deplete by non-sustainable harvest but slow to recover. If the allowable mortality rates are viewed as adaptive management guidelines, the management scenario and the planned responses are adequate for population management. In and of itself, harvest of grizzly bears in DPS is not a threat to their persistence but it will increase the risk of over-harvest and the need for recovery actions or reduced mortality.

The harvest management protocol for assigning allowable harvest mortality is reasonable and scientifically sound. The only caveat is that there is little or no consideration of annual environmental considerations in setting of discretionary hunting levels. Consideration of environmental conditions such as drought, fire, or berry crop failure may refine and temper harvest levels. As ecological conditions change with climate change, developing and formalizing protocols for a more ecological harvesting strategy may be less risky.

The possible response by the Service to implement an emergency relisting of the GYE grizzly population is a significant management response that works to ensure mortality limits are not exceeded and that the target population size is maintained.

The proposal for the IGBST to conduct a demographic review every 5 to 10 years was deemed inadequate. The generation length for grizzly bears is likely close to 10 years and a frequency of review closer to 5 years would be more consistent with precautionary management. The various conditions set for changes in laws or rules, population size, total independent female mortality, and occupancy of bear management units are all meaningful

triggers for initiation of a status review but a review of demographics more frequently would diminish the likelihood of the population entering a depleted state.

13204 – Summary of Factor B

The regulatory commitments to minimize the threats posed by commercial and recreational hunting is significant and precautionary. Responses are rigorous and reflect a very high level of monitoring with appropriate responses that can act in a timely fashion. The statement "In addition, the Service may initiate a status review with possible emergency relisting…" is vague. Specifically, the four identified conditions should be sufficient to warrant a status review although an emergency listing would remain only a possible outcome. The four conditions noted and the thresholds noted are significant indicators of major changes in the DPS. Having a firm threshold for a review would be preferable to a "may initiate" position. The lack of commitment on this point diminishes the conclusion that the Federal regulatory commitments result in commercial and recreational hunting that do not constitute a substantial threat to the GYE grizzly bear DPS. Nonetheless, the risk was deemed minimal.

Again, the demographic review period upper limit of 10 years was deemed too long. A review every 5 years would be precautionary.

The overall approach meets the highest standards for wildlife management. I concur that the commercial and recreational hunting will not constitute a substantial threat to the GYE grizzly bear DPS but it warrants the close and careful monitoring as outlined. Clear conditions to trigger a status review would be preferable.

13204 – Disease or Predation

13205 - Disease

In overview, I agree with the conclusion that disease is unlikely to be a significant threat to the GYE grizzly bear DPS. The only caveat is that both diseases and parasites are likely to change with climate change (Harvell et al. 2002). Monitoring for new or emerging diseases should be a priority for ongoing monitoring.

13205 – Natural Predation

I concur with the findings of this section.

13205 – Human-Caused Mortality

The statement "If anything, authorized hunting through designating the grizzly bear as a game animal may reduce the amount of illegal poaching." The scientific basis for this supposition is unclear. I can find no supporting information. It is equally likely, with the information presented, that the level of illegal poaching could remain the same or increase. The amount of illegal poaching is an unknown that needs to be monitored.

I concur with the remaining findings of this section.

13208 –Summary of Factor C

The definition of a recovered population as being able to "sustain the existing level of known and estimated unknown, unreported human-caused mortality that exists within the ecosystem,'' is a meaningful approach. Further, that "the 1993 Recovery Plan recognized

that eliminating all human-caused mortality was not possible or necessary" is a scientific and management aspect central to the delisting process. The evidence is clear and well-founded that the existing levels of mortality are balanced by existing levels of recruitment. Fundamental to the recovery is the maintenance of the various vital rates close to those of the growth phase of the DPS and sufficient to offset all sources of mortality. Science-based management, monitoring, and education efforts to date, and projected for the future, are essential for delisting.

I concur with conclusions of this section and find no failure of scientific thought.

13208 – D. The Inadequacy of Existing Regulatory Mechanisms: No issues or concerns.

13209 – U.S. Forest Service: No issues.

13210 – National Park Service: No issues.

13210 – Tribal Lands: No issues.

13210 – State Regulatory Mechanisms: No issues.

13211 – Summary of Factor D

No issues or concerns. I concur that sufficient safeguards, proposed or in place, and regulatory mechanisms, proposed or in place, are adequate to protect the GYE grizzly bear DPS, if adequately imposed.

13211 – E. Other Natural or Manmade Factors Affecting Its Continued Existence

13211 – Genetic Health

I have no concerns about the genetic health of the DPS and the effective population size is sufficiently large enough to assure minimal risks of detrimental effects due to genetic issues. Translocation of bears into GYE every 10 years would further minimize genetic risk and is a meaningful management action for consideration in the future. I concur that there is no immediate need for translocation of grizzly bears. Facilitation of movement from adjacent grizzly bear populations is a useful conservation action and should be supported as a management objective.

I have assumed the statement "This approach ensures that long-term genetic diversity does warrant a continued threatened listing for the GY DPS." [13212, 2nd column, 23 lines up] is a typo and should read "does not warrant".

13212 – Changes in Food Resources

No issues or concerns. Grizzly bears have a highly variable diet across their range (over 260 species in the GYE as noted in the Proposed Rule) and changes in the abundance of a few items are unlikely to be a major concern. The only exception in the GYE would be whitebark pine loss or reduction as a dietary component. Loss of whitebark pine as a dietary item could affect grizzly bear mortality and reproduction but such an issue would be identified during the demographic reviews and changes to mortality schedules (Tables 1, 2, and 3) could be modified to reflect these changes. The increase in the GYE grizzly bear DPS in 2002 to 2011 despite low whitebark pine availability suggests that the DPS will not be threatened by changes in this one dietary component. Similarly, cutthroat trout

as a food source does not appear to be critical to the persistence of the grizzly bear DPS for the foreseeable future.

Collectively, the body of research on grizzly bear diet in the GYE DPS is significant, rigorous, and appropriate to address the diverse concerns that arise from changes in the diet of the DPS. The review provided in this section is sufficient to allay concerns about threats to the GYE grizzly bear DPS.

I concur that changes in food resources for the GYE grizzly bear DPS do not present a threat to the bears.

13216 – Climate change

I concur with the overall conclusion that climate change does not present a significant threat to the GYE grizzly bear DPS. This potential threat, however, warrants monitoring (as proposed) to assess the possible effects of climate change on vital rates over time.

13217 – Public Support and Human Attitudes

I concur with the conclusions of this section: public support and attitude do not constitute a threat to the GYE grizzly bear DPS.

13219 – Summary of Factor E

I concur with the findings of this section and find no errors of logic or scientific interpretation.

13219 – Cumulative Effects of Factors A Through E: No issues.

13219 – Summary of Factors Affecting the Greater Yellowstone Ecosystem Grizzly Bear Population

I concur with the conclusions of this section. Threats exist for any species but effective management (as proposed for the GYE grizzly bear DPS) greatly minimize the threats and allow effective and time responses should the threats significant alter vital rates.

13220 – Proposed Determination

I concur with the conclusion that the GYE grizzly bear DPS is a biologically recovered population. The scientific evidence supporting this conclusion is rigorous.

13221 – Significant Portion of Range Analysis

13221 – Background: No issues.

13222 – SPR Analysis for the GYE Grizzly Bear DPS

I concur with the logic of the section. Removing the GYE grizzly bears DPS from the List of Endangered and Threatened Species is a logically proposed consequence.

13223 – Effects of the Rule: No issues.

13223 – Post-Delisting Monitoring: No issues.

13223 - Monitoring

No issues. The proposed monitoring is rigorous and appropriate to the stated purpose.

13224 – Triggers for a Biology and Monitoring Review by the IBGST

The triggers for a biology and monitoring review are significant, meaningful, and comprehensive. The approach taken is rigorous and follows a precautionary approach. I support the triggers and outline as proposed.

13225 – Triggers for a Service Status Review

The four stated triggers for a Service status review are significant, meaningful, and appropriate.

The stated example "For example, if independent female mortality limits were exceeded in 3 of 4 years, the Service would conduct a status review." is unclear and requires further clarification as it appears inconsistent with points 1-4. What example is this statement supporting or supposedly clarifying?

No additional issues noted.

13225 – Required Determinations

13225 – Clarity of the Rule: No issues.

13225 – National Environmental Policy Act: No issues.

13225 – Government-to-Government Relationships With Tribes: No issues.

DOCUMENT 2: Draft 2016 Conservation Strategy for the Grizzly Bear in the Greater Yellowstone Ecosystem – Final Draft

The Conservation Strategy provides a vision of how the grizzly bears in the GYE will be managed for their long-term conservation if delisted.

Chapter 1 Introduction and Background

In overview, the approach is to use standard wildlife management techniques to monitor the population, maintain a core-protected area, and manage grizzly bears as a game animal (i.e., allow a regulated hunt). Of the whole Conservation Strategy, it is the management of grizzly bears as a game animal that is likely to be the most controversial aspect. The issue of harvest as a game animal, however, is not a scientific issue but rather one that reflects the philosophy of the individual. Harvest management with a science-based approach can allow for harvest of grizzly bears and retain the core conservation values in the non-harvested areas. The potential, however, exists for excessive harvest, which could put the core conservation value of the GYE grizzly bears at risk but the key is to ensure adequate oversight, monitoring, and timely management action should changes to the Conservation Strategy be required.

The use of a Primary Conservation Area (PCA) is consistent with population conservation strategies and is deemed a meaningful and scientifically sound approach warranted by the shift from recovery to management. The approach results in 2 management scenarios where the PCA is protected and the areas outside the PCA allow management actions including a regulated hunt. Given that the core of the GYE grizzly bear population will remain protected, the strategy is a logical approach to dealing with a population recovered in this specific area and in particular, a population that is likely approaching carrying capacity when additional management action and public information is needed to address the likelihood of increased dispersal and range expansion of grizzly bears into areas where the potential for human-bear conflicts is likely high. That the GYE grizzly bear population cannot increase in perpetuity is a biological reality and, thus, transition to management from recovery efforts is a logical and necessary step.

The use of 18 bear management units and 40 subunits is a logical approach and allows greater refinement of monitoring and management activities.

I concur that, as stated (page 24), it is impossible to specify the precise mixture of the diverse habitats and area required to support a grizzly bear population. Therefore, the approach taken to use a benchmark condition when the population was growing (i.e., 1998) is logical and scientifically sound. The use of both population metrics and habitat maintenance is a solid approach to the long-term conservation of the GYE grizzly bears. Use of adaptive management is appropriate.

Issues pertaining to food, cover, denning, and secure habitat were deemed relevant and appropriate considerations for management of the GYE grizzly bear population. Control of motorized access is a key factor in the Conservation Strategy and should be rigorously pursued.

Some sources used in the Final Draft would benefit from updated information. Use of Boyce et al. (2001b) and Schwartz et al. (2002) on page 28, reflect analyses that are over 15 years old. Updated information and citations would increase rigor.

The management improvements related to habitat were deemed significant and meaningful changes that would aid in the conservation of GYE grizzly bears. The focus on land management practices, scientific information to support management and recovery, problem bear guidelines, access, highway changes, closed areas, and development have allowed a very high level of management. Given that an adaptive management approach is proposed, the recent history of management bodes very well for the future of the GYE grizzly bears.

Reduction of human-caused mortality is significant and essential for maintenance of the recovered status of the GYE grizzly bears. Reduction of human-caused mortality is mainly an issue when it is uncontrolled. Therefore, a regulated hunt would not be counter to the aim of the limiting human-caused mortality although it is clear that careful, precautionary, and conservative harvest levels are necessary. Advances in this area will be required. For example, it was noted that "some counties and communities have improved their landfills and garbage collection" (page 31). It is unfortunate that improvements in waste management have not been expanded as a priority across the entire GYE.

Provisions to end baiting across the GYE for the purposes of bear hunting would reduce the potential for human-bear conflicts. While Montana does not allow baiting, use of baits in Wyoming and Idaho, even though it would be outside the PCA, may be a risk to the long-term conservation and management of the GYE grizzly bears. I recommend that baiting for bears be discontinued throughout the GYE. It is unlikely to be possible to bait and not have grizzly bears associate humans with food. Further, baiting may create attractive sinks for bears that are in the PCA. The risks associated with baiting outweigh any possible benefits (e.g., possible hunter selectivity, reduced wounding) and a full review of bear baiting is warranted. Use of adaptive management and additional research on bear baiting is warranted.

No other issues or concerns.

Chapter 2 Population Standards and Monitoring

This chapter identifies seven population standards and monitoring items that pertain to maintenance of a healthy (i.e., recovered) grizzly bear population in the GYE. The increase in the DMA was deemed a significant improvement over the 1993 Recovery Plan. Each of the items is well considered, scientifically rational, and reflects the best available scientific approaches. In essence, the standards are designed to ensure recruitment, mortality within sustainable limits, spatial distribution, and abundance near the goal set to provide for genetic health.

The specifics of each of the targets are set based on logical values but are subjective reflecting that no clearly definable level is possible for biological systems. The core goal, however, is to maintain the population abundance and the standards and monitoring items are designed to achieve this goal with a high level of robustness. Grizzly bears in the GYE

will remain a conservation dependent species for the foreseeable future and the management responses are a key to success.

Explicitly including state plans in the Conservation Strategy assists with long-term coordination and management effects. Given the importance of national forest and national park plans, the close working relationship of the YGCC will be critical for maintaining a recovered population.

Issues pertaining to the 3 Demographic Recovery Criterion are addressed under the Proposed Rule Section.

With respect to the use of Chao2 population estimate for the DMA, Keating et al. (2002) noted "*Over all CV values, RMSEs for NChao2 were lower than for NC2 (Fig. 2), but Nchao2 became increasingly and negatively biased as CV increased (Fig. 1). Because individual animals clearly are not equally sightable, use of such an estimator would introduce a chronic, negative bias into estimates of population size and sustainable mortality.*" Therefore, the use of the Chao2 estimator would tend towards a conservative estimate of population size and a lower level of sustainable harvest. Because of this bias over all of the CV (coefficient of variation) values, the approach being proposed, and allowing for a change in approach should an improved method become available, was deemed appropriate and scientifically sound.

The 10 points used to manage mortality are robust and scientifically sound.

For the criteria of probable mortalities, reliance on past male and female deaths in the GYE was deemed an issue requiring further consideration and monitoring. As the population composition may change over time (e.g., fewer males with a regulated hunt), the sex ratio of lone bears may change. Therefore, I recommend shifting from a 59:41 male:female sex assignment for probable adult mortalities to either be a dynamic ratio or preferentially, a more conservative 50:50 sex ratio. The most conservative approach would be to assume any probable mortality was an adult female and thus, the onus on sex verification would be critical to sustain a higher level of allowable harvest. Sex ratio assignment for cubs-of-the-year was not deemed a significant issue.

Demonstration of carrying capacity in any wildlife population remains a challenge. On balance, the evidence in the GYE grizzly bears is that the decline in the population rate of increase is associated with carrying capacity was supported by van Manen et al. (2016) that "*Cub survival and reproductive transition were negatively associated with an index of grizzly bear density, indicating greater declines where bear densities were higher.*" Nonetheless, the documentation of density dependence in the GYE grizzly bear population remains uncertain. From the perspective of conservation of the GYE grizzly bears, the existence of density dependence was not deemed a critical component of the delisting process. Density dependence is useful for understanding the observed changes in the population but the existing analyses and data cannot fully preclude other mechanisms. Lastly, van Manen et al. (2016) could not find a link between the observed demographic patterns and whitebark pine but this does not in and of itself result in acceptance of density dependence although I concur that it is a plausible explanation. Further to this point, van Manen et al. (2016, page 309) noted that a decrease in carrying capacity was a possible alternative explanation for the demographic changes.

The target of maintaining 25 adult females collared was deemed a sufficient sample size for monitoring.

I concur that genetic issues do not pose as substantial risk to the GYE grizzly bear population at this time. The goal increasing connectivity with other grizzly bears is a positive step for the long-term genetic health of GYE grizzly bears.

This section meets the goal of presenting the best available science.

I see no other omissions or errors in logic in this chapter.

Chapter 3 Habitat Standards and Monitoring

The overall goal is to maintain habitat at the levels identified within the Primary Conservation Area. The habitat standards are to be revised based on the best available science and this was deemed a significant and meaningful goal.

The maintenance of secure habitat at the 1998 levels in each Bear Management Unit is critical to the long-term persistence of the GYE grizzly bears. Definition of "secure habitat" is a key parameter that may need modification over time but such a change is allowed under the management protocols.

Monitoring of the four high-calories foods was deemed relevant for understanding changes observed into the future and for ongoing monitoring. Regular reviews of the diet of the GYE grizzly bears as a whole, however, would also provide interesting additional insights of possible dietary shifts beyond these 4 foods. Clearer description of terms such as "detectable declines" and "are related to biologically significant changes in demographic parameters" would be beneficial for clarity and repeatability. A change may be detectable yet have no biological ramifications. Conversely, a major decline might not be statistically significant yet from a precautionary perspective, might warrant management action. Similarly, clarification of "biologically significant" would be useful. For example, a decline in litter size may be biologically significant yet have no effect on population growth rate if offset by higher survival.

The use of a flexible management strategy to promote acceptance and tolerance for grizzly bears as they expand into suitable habitat outside the PCA was deemed a reasonable approach. Expansion in the range of grizzly bears after a long period of absence is a major adjustment for people in the area and to ensure acceptance over the longer term, an adaptive approach is critical.

Issues pertaining to secure habitats are robust and meaningful. Measures to ensure no net loss are appropriate and sensible.

Existing oil and gas or other mineral leases remain an ongoing possible source of habitat loss. I view this as a chronic threat but one that is likely manageable with mitigation measures. The limits placed on habitat loss are critical to ensure the population does not slip below the recovered level.

Controlling livestock to levels that do not exceed 1998 levels inside the PCA is appropriate and meaningful. Phasing out sheep allotments is a positive step for the future and should reduce human-bear conflicts. Reducing sheep grazing should be a long-term goal for the GYE in areas with high conflict or in areas with high value habitat.

Management of developed sites is a critical conservation strategy. Exceptions for administrative and maintenance needs should be minimized (or stated more clearly).

The four monitored areas (i.e., access, foods, hunters, and habitat connectivity) are important and meaningful for conservation. In association with the monitoring of four high-calorie foods, there would be merit to monitoring diet in the population overall. Grizzly bears are generalist omnivores and monitoring overall diet would allow insights should changes in the population be observed. The protocols for monitoring are not detailed in the Conservation Strategy but the overview suggests the methods will be adequate for monitoring.

I deemed monitoring habitat connectivity as a high priority. Even small losses in connectivity can accumulate over time and result in negative consequences for the GYE grizzly bears. Effective mitigation will be a key aspect of ensuring the long-term persistence of the grizzly bears in GYE. Some of the wording is unnecessarily vague or weak (e.g., "Highway planner are encouraged to place warning signs at points of high mortality risk…" page 86). Such weak wording does not provide the directives needed. This section on page 86 would benefit from more rigorous actions.

No other issues or concerns were noted.

Chapter 4 Management and Monitoring of Grizzly Bear-Human Conflicts

The overall goal is to reduce human-bear conflicts and to develop plans for management of nuisance bears. The definitions and protocols are meaningful and appropriate. I find the details sufficient for consistent application across the GYE.

Monitoring the fate of relocated grizzly bears should be a priority for ongoing research. Tracking the success of relocated animals should be assessed to determine its efficacy (i.e., genetic contribution to relocation sites, homing of bears).

Chapter 5 Information and Education

Public information and responsiveness to public concerns are critical to long-term success. The approach outlined is meaningful and appropriate.

The section is mute on use of more modern media (e.g., social media). It may be advantageous to integrate education with apps appropriate for remote use. Use of citizen science approaches may also be advantageous.

Chapter 6 Implementation and Evaluation

The key to the Biology and Monitoring review is the ability for the YGCC to assess the success of the Conservation Strategy objectives and if they are not, and cannot be met, to then petition for relisting. The mechanism identified is a simple majority. Given the clear goals of the Conservation Strategy, the assessment of attaining the stated goals should be achievable. The composition of the YGCC provides the breadth across the management agencies and stakeholders necessary to act for the success of the Conservation Strategy or to recommend relisting. The alternatives to petition for relisting provide additional safeguards. The potential for emergency relisting provides a meaningful additional safeguard.

The four stated triggers for a Biology and Monitoring Review are significant and appropriate. The stated purposes of the Review are clearly articulated.

The protocols outlined are appropriate and I have no concerns on this chapter.

Chapter 7 Existing Authorities

Memorandum of Understanding Detailing Agency Agreement to Implement this Conservation Strategy

No issues identified.

DOCUMENT 3: Grizzly Bear Recovery Plan – Draft Supplement: Draft Revised Demographic Recovery Criteria for the Yellowstone Ecosystem *Draft Approved 2.19.16*

In overview, the Draft Supplement (DS) outlines changes to three demographic recovery criteria for the GYE.

The Demographic Recovery Criterion 1 focuses on he method applied to determine grizzly bear abundance, with the target of maintenance of at least 500 grizzly bears and at least 48 females in the DMA. The Criterion change is to allow flexibility in the specific method applied to obtain the population estimate. This objective is deemed both reasonable and meaningful for the conservation and management of grizzly bears in the GYE. The proposal to remove the single prescribed population estimator (i.e., Chao2) is deemed reasonable, science-based, and is viewed as a positive step in management. Reliance on a single population estimator may or may not be the best option and while the Chao2 method is both appropriate and conservation-based, allowing for improved methods to be applied is a logical step forward. Development of population estimation methods is an active field and it is deemed sensible and scientifically sound to allow for modification in estimation methods over time. There is, however, a need to calibrate any new estimation method with the previous approaches to ensure long-term comparability of data.

Setting a goal of at least 500 grizzly bears and at least 48 females with cubs in the DMA is significant and meaningful, especially when combined with Demographic Recovery Criterion 2. Focusing on the DMA is a logical and meaningful approach that ensures that the core of the GYE grizzly bears is maintained over the foreseeable future.

Demographic Recovery Criterion 2 is focused on the spatial distribution of reproductive females and the potential for recruitment to be spread across the DMA. The goal is conservation oriented and a meaningful objective. Having 16 of 18 bear management units occupied by females with young (with some time caveats) was deemed appropriate and logical.

Demographic Recovery Criterion 3 is focused on the goal to maintain the population of grizzly bears in the DMA at the size observed in 2002-14 based on the Chao2 modeled average. The annual mortality limits for independent females, independent males, and dependent young are intended to reduce the likelihood of a population decline below 612 (i.e., the lower bound of the 90% confidence interval). If the abundance estimate drops below 612, a Biology and Monitoring Review will be undertake to review management responses. The implementation of a trigger for no discretionary mortality is a meaningful management and conservation measure.

Sustainable mortality rates are dynamic and vary over time. For large mammals such as grizzly bears, they are unlikely to show high variation over the short-term (i.e., several years) but may vary for both biotic and abiotic reasons. Annual variation, however, is to be expected and thus working across multiple years and averaging is a meaningful and logical approach. Over longer-term periods (i.e., decades or more), we may expect mortality rates to vary in response to both intrinsic factors and extrinsic factors. The downward adjustment of the sustainable mortality rates is reasonable and reflects the best available science. Maintaining the population close to the size where density-dependent population

regulation was noted is meaningful from a conservation perspective given the genetic benefits of a larger population and the reduction of possible impacts from stochastic events. Confining the population size goal and the mortality limits to the DMA is a logical approach.

All methods applied to wildlife management and conservation have an inherent level of risk. The approach taken to modify the three criteria is sensitive to the risk, conservation-oriented, and reflects the best available scientific knowledge.

Appendix A outlines the implementation schedule and the costs associated with key monitoring actions. The outline is significant and meets the key information and monitoring needs. The resources allocated are meaningful but cannot be assess with the information provided.

Note: Figure 3 is mislabeled as Figure 1 (page 12).

Reviewer 2
May 2016

Proposed Rule:

1.   Does the proposed rule provide adequate review and analysis of the factors relating to the persistence of the grizzly bear population in the Greater Yellowstone (demographics, habitat, disease and predation, and genetics)?

The Proposed Rule does provide adequate review and analysis of the factors relating to the persistence of the grizzly bear population in the Greater Yellowstone Ecosystem (GYE). Some comments are as follows:

I agree that available information supports that disease possess little threat to grizzly bears and this is sufficiently addressed; however, statements throughout the Proposed Rule make it clear that human-caused mortality has the greatest population level impact on grizzly bears in the GYE. Several statements are also made regarding increased numbers of people living and recreating in the GYE (some examples on pages 13178, 13185 and 13206). The fact that the GYE population is increasing or stable is used to justify that present actions to limit human-caused mortalities are effective. This is somewhat misleading because the rate of growth (or stabilization) is partly a function of the rate of human-related mortalities, and thus an increase in human-caused mortalities could be decreasing the rate of growth and limiting growth beyond the present population goal. One could question whether the stabilization of the population is a function of reaching biological carrying capacity or social carrying capacity? Given that human occupancy and recreation will likely continue to increase in the GYE (see page 13196), there should be additional review and consideration regarding how factors used to regulate human-caused mortality (e.g., public education, management removal policy or procedures, etc.) might be modified in response to changes in human activity in the GYE.

Given that human caused mortality is significant relative to the management of grizzly bears in the GYE, it would be of value to provide a brief review of the social aspects of managing large predators. There is considerable literature available on the subject.

On page 13205, there is a statement regarding changing attitudes of persons regarding poaching when predators are made a game species. "If anything, authorized hunting through designating the grizzly bear as a game animal may reduce the amount of illegal poaching." I've seen this statement previously, most recently in regard to harvesting wolves in the Upper Great Lakes Region, but have not seen literature that supports this? Can a citation be provided? If not, this is a strong statement to make without supporting documentation.

Detecting movements among different population segments in order to evaluate genetic exchange might be improved by incorporating relatively new sampling strategies. For example, establishing periodic sampling protocols for collection of environmental DNA (eDNA) among the different population segments or in intervening habitat might reveal new mitochondrial DNA haplotypes indicating grizzly bear movements. Collection and storage of grizzly bear scat is also relatively inexpensive and could be analyzed when funding is available. Additional review and discussion of these options is warranted.

2.   Are our assumptions and definitions of suitable habitat logical and adequate?

The assumptions and definitions of suitable habitat are logical, but I find some to be less than adequate in their description.

The definition presented for ''suitable habitat'' is "the area within the DPS boundaries capable of supporting grizzly bear reproduction and survival now and in the foreseeable future". Of the 3 Criteria listed on page 13183, very little is addressed regarding Criteria 1 and 2. I suggest more detailed descriptions of what "biological" habitats grizzly bears focus on in the GYE during the different seasons and how these vary by sex-age classes (e.g., females with cubs and yearlings, sub-adult males, etc.). Home-range size information could also be included to better understand the extent of area required by grizzly bears.

3.   Are the details for habitat management adequate in the proposed rule?

I find what is described throughout the Proposed Rule as "habitat management" is more about "managing human activity" to reduce grizzly bear mortality.

I suggest that more focus be given to "what makes up biological grizzly bear habitat in the GYE" other than just controlling human induced mortality (e.g., secure habitat).

On page 13182, "The habitat-based recovery criteria established objective, measurable values for levels of motorized access, secure habitat, developed sites, and livestock allotments (i.e., ''the 1998 baseline'') for the GYE." What is listed is not "habitat management" per se, but rather managing landscape change specific to human activities. This is all focused on limiting human induced mortality, but it does not address habitat needs of the different sex-age classes of grizzly bears. For example, what habitats (food resources and cover) are required for females with cubs? "Habitat" (not just secure habitat) play a critical role in all grizzly bear vital rates and it can also facilitate dispersal which links to genetic stability of the GYE population.

On page 13178 the following statement is made, "The GYE is part of the Middle Rockies ecoregion (Omernik 1987, pp. 120–121; Woods et al. 1999, entire; McGrath et al. 2002, entire; Chapman et al. 2004, entire) and provides the habitat heterogeneity necessary for adequate food, denning, and cover resources. Because there are limited opportunities to increase or control these habitat components, the objective for grizzly bear habitat management is to reduce or mitigate the risk of human-caused mortality." There needs to be more detail about what makes up grizzly bear "biological" habitat before one can understand the limitations of managing for these resources. Are there really no plans to "control important habitat components" within the GYE? One question that comes to mind is, what role does fire play in the GYE and what are the plans for managing fires (both natural and human-induced). How does this influence grizzly bear biological habitat? Additionally, are there habitat management actions in place within the GYE directed at influencing abundance or distribution of ungulates? If so, wouldn't these potentially influence abundance and distribution of their predators? What role did the introduction of wolves to the GYE play in habitat management?

4.   Is management to facilitate connectivity with other grizzly populations adequately addressed in the proposed rule?

I found this area to be lacking in detail about what factors potentially influence connectivity.

The citations describing grizzly bear genetics and movements are scientifically sound. Not everyone reviewing the Proposed Rule may be familiar with the distribution of the different grizzly

bear population segments. A map of the segments would be useful for better understanding connectivity.

There is discussion about distances among the different population segments, but more information about the landscape (i.e., topography, man-made structures, etc.) and how these mediate movements would be useful. For example, the distance between the GYE and NCDE is 160 km but there has not been detection of movement. Distance alone likely is not enough to limit movements between these populations, but are there other factors that could be limiting?

5.   Is the management of discretionary mortality, including hunting, scientifically sound and sufficiently detailed?

Management of discretionary mortality, including hunting, is scientifically sound, but there should be some additional details.

Management of "discretionary mortality" is about managing numbers of bears in the different sex-age classes. Regarding the total population, the Chao 2 estimate of 674 (95% CI = 600–747) is presented throughout the Proposed Rule but there is no additional information to evaluate potential impacts of mortality to the different sex-age classes. Population and Demographic Recovery Criteria require maintaining a total population of 500 bears and at least 48 females with cubs, but there is nothing presented regarding the later or the trend in sex-age distribution over the same time period as the model-averaged Chao2 estimate (2002-2014). Without this information it is not possible to comprehend what, "7.6 % of independent females" represents (e.g., 10 bears, 5 bears, 2 bears?) and how it might impact the total population (Note: I made these comments before reviewing the example provided on page 13203, however; I still believe a long-term examination of how many individual bears would be available for discretionary mortality would be of value). A suggestion is a statement on page 13202 of how many years from 2002-2014 were there bears available for hunting harvest, and what was the annual range of bears available. These differences are significant, particularly in the context of simultaneously coordinating and controlling hunting harvest among several states and tribal governments. Furthermore, in open systems there is no such thing as a stable age distribution and natural (or regarding discretionary mortality, man-made) shifts in age distribution can be expected. Is there a contingency for how discretionary mortality might be adjusted in response to substantial shifts in sex-age distribution of the population? For example, drastic changes in environmental conditions (i.e., severe drought or another fire event such as 1988) would likely impact sex-age classes differently. Would there be a way to track population level changes in sex-age distribution and would it alter how discretionary mortality is distributed?

The definition of the "Chao2 estimator" in the Glossary is "a bias-corrected estimator of the total number of female grizzly bears with cubs-of-the year, derived from the frequency of single sightings or double sightings of unique females with cubs-of-the-year as identified based on a rule set by Knight et al. (1995)". However, throughout the Proposed Rule the Chao2 estimator is referenced as producing an estimate of "overall grizzly bear abundance within the DMA"? This discrepancy should be resolved.

There is a great deal of emphasis placed on the ability of the Chao2 estimator to predict abundance of total population and sex-age cohorts. Although a number of citations are provided that address sightability issues for female bears with cubs of the year (i.e., Cherry et al. 2007, Keating et al. 2002), there is no "one" citation describing in its entirety the "Chao2 estimator". There is reference to the Chao2 estimator in the Interagency Grizzly Bear Study Team reports, but these are not easy documents to obtain. If there is readily available published literature describing the Chao2 estimator in its entirety, than it should be referenced. These statistical models are often complex,

and from what I can interpret from the Proposed Rule the Chao2 estimator likely contains some derivations specific to the GYE population? Has the Chao2 population estimator been subjected to peer review? In general, there needs to be more transparency regarding the Chao2 estimator (i.e., What are the demographic inputs and how were they determined? What are the model assumptions? How were initial population size and the different sex-age distributions estimated? and How were natural mortalities estimated and incorporated? etc.). Furthermore, on page 13201, there are separate Discretionary Mortality Criteria if the Chao2 population estimate = 674. No population model is accurate to a single animal and this falsely implies that it is. There should be agreement to incorporate the estimate of 674 into one of the adjacent ranges.

6. Are the conclusions relating to the effects of changes in food resources on the GYE grizzly bears scientifically based and logical?

Over the past decade, this area has been extensively researched and published in peer-reviewed journals. The conclusions and scientific basis is sound with a few minor suggestions.

On page 13213, it should be recognized that a significant decrease in combined important food resources (e.g., such as whitebark pine seeds, fish and ungulates) could result in a decrease in biological carrying capacity of the GYB population.

The findings of Schwartz et al. (2014) that body fat in adult females showed a slight decline since 2006 is important because of the link between body fat and reproduction. Although this is recognized in the Proposed Rule, there should be additional attention to overall cub survival throughout this time period (assuming this data is available). Complex predator-prey relationships may take many years to become evident. More meat consumption by adult females with cubs in replace of whitebark pine seeds could be a sink if accessing these resources results in additional cub mortalities during confrontations with other predators or adult male grizzly bears.

An alternative hypothesis presented to answer Research Questions 5 & 6 (page 13213) as stated on page 13214 is that movements and home-range size of females decreased in response to increasing bear density because females with cubs were attempting to decrease encounters with other bears (particularly adult males). If true, this would decrease the food resources available to females with cubs but also would support the hypothesis that the population is approaching biological carrying capacity. If sufficient data is available to assess movements and home-range size of females with cubs it would be worth examining.

The statement on page 13214, "In response to the seventh question, while land managers have little influence on how calories are spread across the landscape we have much more influence on human-caused mortality risk" is misleading and focuses on the easier solution (e.g., control human induced mortality). Options to "spread more calories across the landscape" include among other things, increasing ungulate densities through improving habitat and controlling hunting harvest; improving fish stocks and habitat; controlling invasive species to protect native food resources desired by grizzly bears, etc. Additionally, existing actions to decrease bison abundance in Yellowstone National Park to control brucellosis also impacts habitat and existing food resources for grizzly bears.

7.   Is our explanation of density dependent effects versus whitebark pine decline driven effects scientifically sound?

The explanation of density dependent effects versus whitebark pine decline has been addressed in peer-reviewed literature and is scientifically sound. However, as noted above, it should be recognized that a significant decrease in combined important food resources (e.g., such as whitebark pine seeds, cutthroat trout and ungulates) could result in a decrease in biological carrying capacity of the GYE population.

Draft 2016 Conservation Strategy:

1.   Are the habitat management mechanisms scientifically sound and sufficiently detailed in the draft 2016 Conservation Strategy?

The habitat management mechanisms are scientifically sound, but there is need for more detail.

What is the significance of "10 acres" in defining "secure habitat"?

Consideration should be given to analyzing the relationship between annual abundance and availability of the four food types with reproductive parameters (i.e., fecundity, recruitment and survival of young bears). Any declines in nutrition are likely to be observed first in females with young and in younger bears.

Monitoring "bear use of army cutworm moth sites" may not be a good measure of cutworm moth relative abundance because grizzly bears may return to areas where they've found abundant food sources in the past even though those resources are not present. This relationship should be explored and monitoring protocols adjusted if the relationship is not true.

"Land managers will ensure that habitat connectivity is addressed…" is vague. For consideration, can there be a commitment that land managers "include habitat connectivity" in planning any new road construction and "maintain or improve existing habitat connectivity" in any reconstruction projects?

Consideration should be given to limit snowmobile use after typical den emergence dates. Den emergence is a critical time for mothers with new cubs, and disturbance and stress of the mother at this time could result in lowered cub survival. When bears are out of dens, all motorized traffic should be limited.

Consideration should be given to eliminate vacant livestock allotments if chronic grizzly bear conflicts have occurred on these allotments in the past.

2.   Is the management of discretionary mortality, including hunting, scientifically sound and sufficiently clear and detailed so that managers can use this document to successfully implement mortality management in the future?

The management of discretionary mortality, including hunting, is scientifically sound and sufficiently clear and detailed so that managers can use this document to successfully implement mortality management in the future. However, Appendix P will not be added until the Plan is finalized. The complexities of simultaneously allocating harvest among three states and a tribal government are many. However, given that harvest will occur only outside the PCA any difficulties in managing hunting harvest should not immediately impact recovery of the GYE grizzly bear population.

Assigning sex of orphaned cubs as probable deaths is described as follows, "cubs-of-the-year that are orphaned and counted as mortalities will be assigned sex based a 50:50 sex ratio at birth (Eberhardt et al. 1994). For each cub, a random number will be drawn between 1 and 100. If the number is 1 through 50, the sex will be assigned as male; if the number is 51 to 100, the sex will be assigned as female." As cub sex ratio in a given year is unlikely to fluctuate >60:40 it is more logical to alternate assignment of sex with the more conservative approach assigning female first.

3.   Is management to facilitate connectivity with other grizzly populations adequately addressed in the draft 2016 Conservation Strategy?

This section is not adequately addressed.

Monitoring is limited to road projects; however, many other factors influence connectivity with other grizzly bear populations. Listing these factors is an important first step to assess if connectivity is adequately addressed. Additionally, are there references to support the successful use of crossing structures by grizzly bears?

Landscape features alone do not facilitate connectivity with other grizzly bear populations and the likelihood of potential immigration and emigration. Some of these factors are likely associated with human-induced mortality which are addressed in other sections of the plan, but these should also be discussed here. If connectivity is important, should bears be hunted outside of the GYE, as these bears are living in suboptimal habitat and most likely to disperse? As biological carrying capacity is reached in the different populations, dispersal by young males is likely to increase. Many factors play a role in connecting the different grizzly bear populations and it should be addressed in more detail.

What is the plan for monitoring movements? Given that this is a plan for the GYE, detecting movements and potential gene flow into, as opposed to out of, the population is most critical. How will this be achieved? If bears are hunted outside of the GYE, genetic samples could be easily obtained through mandatory registration.

4.   If implemented, is the Conservation Strategy adequate to reasonably ensure the long-term viability of the Greater Yellowstone grizzly bear population?

Yes, if implemented the Conservation Strategy is adequate to reasonably ensure the long-term viability of the GYE grizzly bear population.

Draft Recovery Plan Supplement: Revised Demographic Criteria:

1.   Please provide your scientific evaluation (e.g., the pros and cons) of the revised recovery goal's objective to manage and maintain the population around the 2002–2014 model-average Chao2 estimate of 674 (95% CI 600–757).

This appears to be the same goal that was listed in the Draft Plan? Regardless, the information provided within the Draft Plan indicate that the GYE population appears to be reaching biological carrying capacity and thus the goal proposed will assure that the population is maintained at this level for the foreseeable future. Furthermore, if the population has reached biological carrying capacity, abundance beyond the present level likely will not increase unless there is an increase in available resources or changes in vital rates (i.e., human-induced mortality).

The change (described in the supplement under Demographic Recovery Criterion 1) to eliminate the criterion's dependence on the Chao2 estimator if improved, peer-reviewed methods become

available agrees with using the best available science. The Chao2 estimator is somewhat dated and there are likely improved statistical methods available. However, if it is the opinion of the scientists and statisticians involved that the Chao2 estimator is performing well and there are independent measures of relative abundance to verify that it is, then there likely isn't a significant advantage of switching to a newer estimator. All models of biological systems perform poorly with poor input data and those that have been through the peer-review process should perform well if provided with good inputs. It is my opinion that the input data for the GYE is excellent for informing biological models.

Within the Proposed Plan or the Supplement there is no mention of independent measures to verify model trends. Including independent sampling for this purpose would strengthen interpretation of any model employed.

2.   *Please provide your scientific evaluation (e.g., the pros and cons) of monitoring the demographic criteria exclusively within the demographic monitoring area.*

It's logical and scientifically sound to monitor the demographic criteria within the area for which an estimate will be generated (e.g., DMA). This represents the best available data and assures that changes in vital rates will not be unnecessarily influenced by altered vital rates outside of the DMA. There are biologically sound reasons why vital rates (particularly mortality) may differ outside of the DMA. More resources (i.e., radio-telemetry) can be focused in a defined area improving precision of estimates of vital rates. Because the majority of lands within the DMA are in Federal ownership, access to monitor grizzly bears will not be denied. However, this could also be a disadvantage regarding rules limiting certain types of access on National Park lands.

One vital rate that could be misinterpreted by limiting monitoring to the DMA is mortality. Bears killed outside of the DMA could also spend time inside of the DMA if they have a home-range that overlaps the boundary. Misinterpreting mortalities could also impact sex-age ratios. Unforeseen, catastrophic events within the DMA (for example another fire on the scale of 1988) could displace grizzly bears forcing some to shift home-ranges to outside of DMA boundaries. This could result in decisions having to be made to sample areas outside of the DMA or extend DMA boundaries. An important reason to sample grizzly bears outside the DMA is to detect likely immigrators or emigrators which are important to document for potential genetic exchange among populations. Monitoring grizzly bears outside the DMA also provides valuable information about vital rates in the area where expansion is still occurring. There also will likely be considerable resources spent managing grizzly bear-human conflicts outside of the DMA and having additional information on grizzly bears in this area will be important for managing these conflicts. Lastly, the DMA does not make up what is considered the entire GYE population. Impacts to grizzly bear vital rates outside the DMA still influences the entire GYE population.

Reviewer 3
May 2016

I have reviewed the proposed rule in the Federal Register, the new conservation strategy, and the supplement on revised demographic criteria. Overall, these documents represent a large amount of effort and demonstrate strong familiarity with the scientific literature on grizzly bear ecology and management. I agree with the assessment presented in the Proposed Rule and concur that the best-available science indicates that the species is secure and delisting is appropriate. I will respond to the specific questions as requested.

Proposed Rule:

1.   Does the proposed rule provide adequate review and analysis of the factors relating to the persistence of the grizzly bear population in the Greater Yellowstone (demographics, habitat, disease and predation, and genetics)?

Generally I found the proposed rule to be remarkably comprehensive and conservative. Clearly the GYE grizzly bear population has far exceeded recovery criteria and the probability of long-term persistence is extremely close to one. That said, one can always argue that there remains considerable uncertainty about the status and future of the grizzly bear population (Artelle et al. 2013, 2014). Yet, all resource management decisions are made in the context of uncertainty and the Yellowstone grizzly bears are among the most-intensively study populations of large mammals in the world. Even in the face of climate change, grizzly bears are highly adaptable and can use a broad array of habitats and their omnivorous foraging ensures that they will find something to eat. I agree with the Proposed Rule's assessments on disease, predation, and genetics. I found it to be a very powerful observation that "we know levels of genetic diversity have not declined in the last century."

2.   Are our assumptions and definitions of suitable habitat logical and adequate?

The definitions of suitable habitat are qualitative and weakly done. Indeed, this is one of the weakest components of the *Proposed Rule*. Quantitative methods for identifying habitats selected by grizzly bears are well developed, e.g., see Proctor et al. (2015). Estimating resource selection functions or similar models to characterize habitat selection and use is an important research need. There exists precedent where courts have accepted resource selection functions as rigorous definition of suitable habitat, and these methods certainly ought to be in the tool kit of the US Fish & Wildlife Service.

3.   Are the details for habitat management adequate in the proposed rule?

I certainly agree that access management is probably one of the most-important management actions that can be used to enhance grizzly bear habitats. But there is little else in this section. Elsewhere domestic sheep management is mentioned, and probably belongs here. Likewise, competing land uses get little attention, e.g., livestock use, timber harvest, mining, but these have major consequences for grizzly bear habitat and are human influences that could be managed if there was sufficient will. Obviously there would be strong political opposition to infringing on any of these to benefit grizzly bear habitat. All of these topics are covered in the *Conservation Strategy*.

4.   Is management to facilitate connectivity with other grizzly populations adequately addressed in the proposed rule?

Substantial advance on this topic appeared in a recent paper by Proctor et al. (2015). Yet, I do not see that anything in this paper that would change the *Proposed Rule*.

5.   Is the management of discretionary mortality, including hunting, scientifically sound and sufficiently detailed?

Yes, I think that this material is fine and I agree with the assessment. Despite the media attention to hunting, carefully managed hunting is not a threat to the long-term viability of this population and can be highly effective at reducing concerns by local ranchers and other members of the public.

6.   Are the conclusions relating to the effects of changes in food resources on the GYE grizzly bears scientifically based and logical?

Yes, I agree and find the summary to be reasonably complete.

7.   Is our explanation of density dependent effects versus whitebark pine decline driven effects scientifically sound?

Yes, I do not see any problems here. Clearly bear populations have continued to increase despite declines in whitebark pine and cutthroat trout. Those food resources are not available over major portions of the species range and my view is that these food resources were beneficial but not essential for grizzly bears.

Draft 2016 Conservation Strategy:

1.   Are the habitat management mechanisms scientifically sound and sufficiently detailed in the draft 2016 Conservation Strategy?

The habitat management section fails to rigorously identify grizzly bear habitats and as a consequence some of the habitat recommendations are actually demographic recommendations and not necessarily related to habitat. See, for example, the first paragraph under Background on p. 55. The first sentences make reference to habitat preservation but then the discussion drifts off to causes of bear mortality. On page 57, the goal for habitat management is stated to reduce human-caused mortality—the connection with habitat is not defined. I believe that the *Conservation Strategy* would be improved with a rigorous quantitative assessment of grizzly bear habitats, which is currently lacking, although there exists extensive literature on the topic. The habitat management guidelines that are actually habitat management guidelines seem sensible and appropriate.

There is no scientific basis for the lower limit of 500 bears. We have no evidence that this is the number of bears required for genetic integrity, and the theory behind this estimate is almost entirely irrelevant, referencing an old reference by Franklin (1980). Incidentally, this reference is not included in the Literature Cited; I think that this is a typo and the appropriate source is Frankham (1980) although again this paper is not listed in the Literature Cited. The 500 bears guideline might be the right number, but it is not based on sound science. A critical assessment of the use of effective population size in conservation is found in Ewens (1990) and a reassessment of the old 50/500 rule was published by Frankham et al. (2014).

My concerns about habitat effectiveness raised above regarding the Proposed Rule, are covered quite adequately in the *Conservation Strategy*.

2.   Is the management of discretionary mortality, including hunting, scientifically sound and sufficiently clear and detailed so that managers can use this document to successfully implement mortality management in the future?

Yes, I agree with the *Conservation Strategy*'s assessment that mortality management is key to successful grizzly bear management. And I concur with the proposed management strategy.

3.   Is management to facilitate connectivity with other grizzly populations adequately addressed in the draft 2016 Conservation Strategy?

On page 7, the document notes: "Land managers will ensure that habitat connectivity is addressed throughout the Yellowstone area as part of any new road construction or reconstruction and that food storage orders are in place." I can understand how roads can create barriers to movement as explained on page 85, thereby interfering with connectivity. But what does food storage orders have to do with habitat connectivity? I think that the author of this section was considering the road construction crews for which storage orders need to be in place. If this was the intent, it is poorly articulated and I believe that this is in the wrong place. On page 57, we are told that habitat connectivity will be monitored but how this will be done has not been explained. Really, the only connectivity discussion appears to relate to roads. As for habitat selection, some sophisticated methods have been developed for modelling grizzly bear connectivity, but none of this material is cited. For example, step-selection functions can be used to model habitat attributes that facilitate movement and connectivity (Thurfjell et al. 2014), but this is not reviewed. I believe that more discussion about how to achieve connectivity to the north and to the west of the GYE might receive more attention.

4.   If implemented, is the Conservation Strategy adequate to reasonably ensure the long-term viability of the Greater Yellowstone grizzly bear population?

Yes, absolutely. There is no basis for concern about the long-term viability of the population except for the fact that we cannot anticipate the future. Political interference, climate change, and disease outbreaks cannot be predicted and might become issues in the future (Artelle et al. 2013, 2014). Only through adaptive management can we accommodate such vagaries about the future into sound management policy. Such uncertainties should not interfere with our ability to perform sound management practices based on the best available science today.

Draft Recovery Plan Supplement: Revised Demographic Criteria:

1.   Please provide your scientific evaluation (e.g., the pros and cons) of the revised recovery goal's objective to manage and maintain the population around the 2002–2014 model-average Chao2 estimate of 674 (95% CI 600–757).

The target population size is largely arbitrary, yet reasonable, given existing information and the apparent leveling of population size. I attempted to find the details of model averaging as used with the Chao2 estimator, but could not find it. Model averaging is a method used when alternative models are evaluated using information-theoretic procedures. This is something that warrants careful attention because of problems that can exist with model averaging (Cade 2015). Or possibly

the intent is to estimate abundance for each year between 2002 and 2014 and to average those estimates. If the latter, a few more words of clarification might be inserted and the term "model-averaged Chao2 estimate" should be avoided.

Likewise, again, the lower population target of 500 cannot be defended based on science. This estimate was based on a mutation rate for *Drosophila* abdominal bristle number and we know that mutation rates can vary by 2 orders of magnitude.

2.   Please provide your scientific evaluation (e.g., the pros and cons) of monitoring the demographic criteria exclusively within the demographic monitoring area.

I think that the demographic monitoring area concept makes sense. Yes, covering a larger area could encompass the entire area occupied by bears, but I think that it is evident that bears on the margins of their distribution are at greater risk. And this risk does not necessarily jeopardize the population. Indeed, the higher mortality along the range boundary is what creates the range boundary. Persistence of the population will be better reflected by focusing on the demographic monitoring area as proposed. A much greater effort could go into monitoring, but it is not clear to me that this would improve conservation and expenditures for monitoring compete for limited funds needed for grizzly bear management (McDonald-Madden et al. 2010).

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Proposed Rule:

1.   Does the proposed rule provide adequate review and analysis of the factors relating to the persistence of the grizzly bear population in the Greater Yellowstone (demographics, habitat, disease and predation, and genetics)?

A key word in consideration of the Greater Yellowstone Ecosystem (GYE) Distinct Population Segment (DPS) delisting is persistence, meaning long-term viability in one or more areas. Most factors that influence bear population dynamics are adequately addressed in some detail in the proposed rule. The GYE population in and of itself is large enough to sustain losses in heterozygosity due to genetic drift, and it would be easy enough to supplement the population using translocation of a few individuals to maintain genetic diversity of this population. However, the uncertainty about the impacts of climate change on bear food sources, surrounding human land use patterns, and the synergistic effects of these multiple potential threats to grizzly bear persistence are unclear and difficult to predict. Without clear evidence of connectivity to other grizzly populations (e.g. NCDE) in the 6 recovery ecosystems, nor concrete implementation plans for creating redundant populations elsewhere through reintroductions (e.g. Bitterroots), the GYE population would remain more vulnerable to local extinction than if connectivity was well established to other populations.

2.   Are our assumptions and definitions of suitable habitat logical and adequate?

Habitat designations appear adequate for GYE grizzly bears, a habitat generalist species, in most areas of the PCA, a sizeable portion of which are National Parks that already have management policies that favor grizzly occupancy. The GIS-based classification of habitats as suitable or unsuitable are largely habitat and conflict-based which is logical and typical of habitat suitability models of large carnivores. I would, however, strongly recommend development of a comprehensive assessment of the impacts of climate change on habitat suitability in the GYE. Climate change renders the future occupancy of protected areas such as parks into question.

3.   Are the details for habitat management adequate in the proposed rule?

The habitat plan appears to be science-based and adequate for managing the species within the GYE. There is essentially a "no net loss" policy of maintaining or reducing 1998 levels of activities that conflict with grizzly occupancy. Approximately 90% of suitable habitat is already occupied, leaving little room for range expansion and population growth. Consideration of "edge" areas on the periphery of grizzly range that have livestock (particularly sheep) allotments could be problematic. Grizzly conflict with livestock interests is the top source of mortality. If these edge areas are leases on public land, then consideration should be given to removing these areas from grazing use in favor of species such as the grizzly where there are opportunities to expand population size and range and make it less vulnerable to local extinction. On federal lands, the phasing out of sheep grazing permits, measures to reduce grizzly attractants in developed areas, and reduction of road access are all positive steps towards grizzly recovery in these peripheral areas. Perpetuating activities (e.g. motorized access, livestock grazing) that may conflict with bear recolonization and long-term occupancy in these edge areas "unless improvements benefit bears" at 1998 baseline levels assures a high probability that bears indeed will not reoccupy these portions of

their former range. An economic cost benefit analysis of the economic value of grazing leases versus dealing with depredations and perhaps a more intensive grizzly monitoring effort in this peripheral areas should be factored into such a decision.

4.   Is management to facilitate connectivity with other grizzly populations adequately addressed in the proposed rule?

Not in the rule per se. Other than to "manage for discretionary mortality" and having "attractant storage rules", other components of Montana's management plan to facilitate GYE connectivity to the NCDE population are unmentioned.

The delisting proposal only mentions GYE as a source for recolonizing the Bitterroot area, but there are no planned actions to facilitate this process (e.g. road over- or underpasses, land management between these areas). Idaho's grizzly management plan clearly states that moving grizzlies into new areas (e.g. Bitterroot) is prohibited and intentions to connect GYE bear populations to these unoccupied areas is vague.

5.   Is the management of discretionary mortality, including hunting, scientifically sound and sufficiently detailed?

The plan to maintain the GYE grizzly population within the approximate current population estimate appears to be based on sound wildlife science using established and repeatedly tested analyses used to generate these population parameters. Specific numerical criteria are established as multi-agency management "failsafe" switches to minimize the likelihood of population decline through active management and accountability of and response to natural mortality. As a final contingency, USFWS has discretionary power to act unilaterally to propose relisting if deemed necessary. I do have concerns about lags in decision-making in response to population declines that drop numbers below 600.

6.   Are the conclusions relating to the effects of changes in food resources on the GYE grizzly bears scientifically based and logical?

Several published studies have suggested dietary plasticity of the grizzly bear which was already well known to be a habitat generalist species. The plan outlines several monitoring actions that have been occurring and will continue to further refine our understanding of the relationship between grizzly bear population dynamics and key food sources (e.g. trout, whitebark pine, ungulate neonates). Currently, there appears to be an abundance of many of the more commonly used food sources to sustain grizzly numbers if one fails. What is unclear, however, is how a warming climate in this area, lower elk numbers in the GYE, the continued impacts of invasive species (e.g. rainbow trout) and disease (whitebark pine) will synergistically impact the very complex trophic web in this region and affect bear numbers in coming decades. Concurrent declines in the abundance of multiple food sources could force bears outside core protected areas and into increased conflict with humans on private and public lands, which in turn could lead to population declines below the desired threshold given that bears could be increasingly euthanized for human safety reasons.

7.   Is our explanation of density dependent effects versus whitebark pine decline driven effects scientifically sound?

Research on vital rates is suggestive of a density dependent effect leading to population saturation and slowed growth within the past decade. While whitebark pine availability will continue to be an important component of grizzly diet and influence population dynamics in certain areas, recent findings suggest it may not be as critically important a food source as once thought. Longer-term datasets generated by the proposed continued monitoring of whitebark pine nut availability should further clarify the strength of this relationship, and future management plans revised to reflect new findings that may reinforce the relative importance of this food.

Draft 2016 Conservation Strategy:

1.   Are the habitat management mechanisms scientifically sound and sufficiently detailed in the draft 2016 Conservation Strategy?

Yes. A number of important habitat standards and monitoring activities of key resources (e.g. cutthroat trout) are in the plan. Management is divided at various spatial scales to facilitate delegation of management responsibilities, and data collection and interpretation. A no net loss policy of suitable grizzly habitat within the PCA underpins management of the species. In general, categories of habitat (e.g. "secure") and application rules are easy to understand and follow.

2.   Is the management of discretionary mortality, including hunting, scientifically sound and sufficiently clear and detailed so that managers can use this document to successfully implement mortality management in the future?

Discretionary mortality rules are clearly explained and should be relatively easy to follow within the PCA, but differ on lands outside the PCA where state wildlife agency approaches to this issue somewhat vary depending on the severity of human-bear conflict. The management plans of Idaho, Montana, and Wyoming indicate a desire for the grizzly to be classified as a game species for the purposes of hunting. Montana's plan also indicates a strong commitment to facilitate reconnection of the GYE and NCDE bear populations in the western portion of the state. Other than to comply with maintaining a minimum population size within the DMA, none of the states establish population targets and associated specific harvest criteria within their management plans. It is concerning that overharvest and a potential subsequent lag in management response could drive bear numbers below the desired minimum population size.

3.   Is management to facilitate connectivity with other grizzly populations adequately addressed in the draft 2016 Conservation Strategy?

Although Montana considered "limiting grizzly bear distribution to just the PCA"., it was "in FWP's judgment" "logistically impossible and biologically undesirable". Montana's grizzly management plan clearly conveys a desire to have grizzlies repopulate western Montana and create connectivity between GYE and NCDE bear populations through identification of a linkage zone using GIS, management of non-conflict bears, and implementation of subsequent land management measures (e.g. working with DOT on road crossing locations) to catalyze this process. Management plans for Idaho and Wyoming strongly indicate that grizzlies will not be allowed to recolonize major portions of their respective states.

The plan only mentions GYE as a source for recolonizing the Bitterroot area, but there are no planned actions to facilitate this process (e.g. road over- or underpasses, land management between these areas). Idaho's grizzly management plan clearly states that moving grizzlies into new areas (e.g. Bitterroot) is prohibited, and intentions to connect GYE bear populations to these unoccupied areas is vague.

4.   If implemented, is the Conservation Strategy adequate to reasonably ensure the long-term viability of the Greater Yellowstone grizzly bear population?

The GYE population has recovered to a population of sufficient size to buffer against the most common deleterious vulnerabilities of small populations, including loss of genetic diversity, and typical stochastic events. The prospects of a warming climate and its unknown effects on common grizzly foods, increased development of lands around national parks, and reliance on occupation of a highly geologically unstable area should be strongly considered before a decision on delisting is made. Long-term viability would best be ensured by establishing and maintaining connectivity with grizzly populations in other portions of the species range, reintroducing the species to suitable vacant range within dispersal distance of existing populations, or facilitating recolonization into former areas; state management plans by Idaho and Wyoming appear to disfavor the latter two actions. Montana's stated commitment to reconnection of bear populations should be strongly supported and encouraged to maximize the species persistence in the lower 48 states in the US.

Draft Recovery Plan Supplement: Revised Demographic Criteria:

1.   Please provide your scientific evaluation (e.g., the pros and cons) of the revised recovery goal's objective to manage and maintain the population around the 2002–2014 model-average Chao2 estimate of 674 (95% CI 600–757).

Advantages:

   a)   It establishes a numerical population target and lower population size threshold that can be easily understood, upon which management decisions (e.g. harvest, non-harvest kills) can be based (e.g. sliding scale action), and which can account for variance within the data.

   b)   It relies on a given subset of individuals of specific demographic classes (e.g. females w/ cubs) that can be repeatedly monitored over a given time interval using well-established field methods (e.g. radio-telemetry).

   c)   Multi-model framework uses currently accepted and established approach ("best available science") for population estimation.

Disadvantages:

   a)   Assumes sufficient federal and state funds will be available for the foreseeable future to monitor and detect population changes with enough resolution to trigger management fallback mechanisms (e.g. no discretionary mortality if population < 600).

   b)   Monitored individuals may not be representative of the population at large as sample size decreases; very often related to funding and personnel resources.

   c)   Monitored individuals may be more susceptible to capture and not be representative of the population (e.g. individuals more likely to exhibit neophilic behavior that could affect survival or other vital rate parameters).

d)   During potentially high mortality years (e.g. natural food shortages leading to increased human-bear conflicts and bear kills), management responses may be lagging and allow population to dip < 600 before corrective actions are taken, (e.g. "the IGBST will produce a Biology and Monitoring Review to inform the appropriate management response" pp. 40).

2.   Please provide your scientific evaluation (e.g., the pros and cons) of monitoring the demographic criteria exclusively within the demographic monitoring area.

Advantages:

Provides a defined geographical area in which scientific inferences can be made which is important for a wide-ranging species that is difficult and expensive to monitor. In essence, a higher quality dataset can typically be obtained for a "core" area given a limited amount of resources to monitor the species, as opposed to one more disparate and less efficiently collected. With increased sample sizes within the core area, analyses can provide a more accurate portrayal of the entire population.

Disadvantages:

Monitoring is less intense outside the DMA, thus usually resulting in less data about individual bears that may behave differently than those within the DMA. For example, a disproportionate number of bears outside the DMA will likely be young males forced outside existing territories by older bears. Some adult bears outside the DMA may have greater tendencies for dispersal or less fear of humans (neophilia) than those within the DMA, and/or perhaps have differences in vital rates (survival, natality), thus inferences derived inside the DMA may not as applicable in these peripheral areas.

Scientific Peer Review for
Delisting of Greater Yellowstone Ecosystem grizzly Bears

Reviewer 5
June 2016

In general I have found the documents reviewed to be quite thorough and complete. In totality, they provide scientifically credible support for delisting the Greater Yellowstone population of grizzly bears. I offer the following comments for consideration with the intent to further improve an already solid and thorough synthesis.

Proposed Rule:

1.   Does the proposed rule provide adequate review and analysis of the factors relating to the persistence of the grizzly bear population in the Greater Yellowstone (demographics, habitat, disease and predation, and genetics)?

Yes, the proposed rule does an overall excellent job of reviewing and assessing the most important factors influencing the long-term persistence of grizzly bears in the Greater Yellowstone Ecosystem. I have also reviewed associated references and found interpretation of these supporting documents appropriate.

2.   Are our assumptions and definitions of suitable habitat logical and adequate?

I consider the assumptions and definitions of suitable habitat logical and adequate; that is, the area within the DPS that can support reproduction and survival at present and in the future is direct and straightforward. They have supported this using site-specific peer reviewed literature.

3.   Are the details for habitat management adequate in the proposed rule?

I recognize the importance of the potential adverse anthropogenic effects on grizzly bears and agree that ameliorating this through management of motorized access is likely the most effective management tool available. Too, I agree that implementation and enforcement of food storage (both waste and non-waste) can also be an effective management tool. Habitat management in the more traditional sense (i.e., direct alteration of habitat) would be largely ineffective and impractical.

Overall, I support the definition of what constitutes secure habitat and appreciate the no net loss of secure habitat as a consequence of human activities, especially that this acquisition occurs within the same area as secure habitat is lost. I do suggest that consideration be given to the juxtaposition of secure habitat, particularly if substantial changes to its distribution occur over time. Connectivity and corridors can be considered hierarchical, not only necessary to facilitate exchange among populations, but to facilitate movements at the individual and subpopulation level. Ensuring the spatial distribution of secure habitat within and across bear management units facilitates these finer scale movements is warranted.

I am uncertain about the apparent spatial mismatch between minimum secure habitat area size (10 acres) and lake size (lakes < 1 mi^2 are considered secure). I would consider most of any lake (open water) as unsuitable (unused) for grizzly bears, thus by definition cannot be secure. Though bear use of these lakes may in part be dependent on what occurs in areas of the lake unused, bears likely use little more than the edge for foraging. Instead of using the entire lake surface area (for those < 1 mi^2) as secure habitat, I would consider creating a buffer along the respective shorelines that represents the actual area used by grizzly bears.

4.   Is management to facilitate connectivity with other grizzly populations adequately addressed in the proposed rule?

Management to facilitate connectivity is largely reactionary, through management of impacts of road construction and improvement. In addition, use of genetic sampling will be used to assess and monitor potential gene flow among populations. Overall, this is not a habitat restoration issue but rather a more direct issue of modifying human behavior to facilitate connectivity. Reducing access to human foods (i.e., garbage) and regulation of hunting (presumably of bears) should aid bear movements and improve connectivity. Though genetic heterozygosity is not presently of concern, the proposed actions will maintain and perhaps further increase heterzygosity, which is commendable.

5.   Is the management of discretionary mortality, including hunting, scientifically sound and sufficiently detailed?

The management of discretionary mortality is sound and reasonable. Total (I presume annual but should be clarified) mortality rates by sex and age class are provided relative to three population ranges. Discretionary harvest is allocated based on these populations relative to the overall population goal. Planning annual meetings following the results of annual monitoring of populations provides a proactive strategy to ensure discretionary mortality levels are not exceeded.

6.   Are the conclusions relating to the effects of changes in food resources on the GYE grizzly bears scientifically based and logical?

Yes, the conclusions are logical based on the evidence available. The document interprets the relationships between food and grizzly bear demography well and consistent with prevailing science. When warranted, they exercise appropriate caution in their interpretation of available data.

7.   Is our explanation of density dependent effects versus whitebark pine decline driven effects scientifically sound?

Based on the documents provided and the references therein, I consider the explanation of this relationship scientifically credible. There can be alternative explanations for some elements, but the interpretations provided are plausible and quite reasonable. There is occasional confusion in the use of 'cause', suggesting causality and 'association'; however, this is minor overall and the intent of statements misusing this term was clear.

Draft 2016 Conservation Strategy:

1.   Are the habitat management mechanisms scientifically sound and sufficiently detailed in the draft 2016 Conservation Strategy?

Yes, overall the strategies considered are sound and broadly encompass the needs of grizzly bears. The emphases on food abundance and effects of human activities are appropriate.

Food – I am supportive of the four indices of bear foods recommended for monitoring. I also suggest that anthropogenic subsidies in the form of ungulate carcass remains from hunter kills can be an important seasonal food source for grizzly bears. In areas of the PCA where ungulate harvest is allowed, monitoring numbers of ungulates killed, by species, along with mass estimates of typical carcass remains, may be warranted. If numbers of ungulates killed annually are high and

used by grizzly bears, it could be an important seasonal food source, particularly during hyperphagia. This too could be a better metric than number of hunters. Consideration of NDVI data also may be of value, particularly during the pre-hyperphagic period, to understand bear distributions during this period and potential relationships to human-bear conflict. Finally, with the exception of whitebark pine, sampling across years seems variable relative to intensity and methodologies. I would encourage greater standardization across years to improve strength in inference from these indices.

Denning – I appreciate the consideration of denning habitat as critical for long-term persistence of this grizzly bear population. Further, I agree with their assessment that denning habitat for this population is not limited. Considering the current spatial distribution of known denning habitat, the physical attributes of these sites (e.g., higher elevations), and current levels of human development and recreational activities, I would not anticipate this habitat to become limited in the foreseeable future.

Secure habitat – In general, I support the definition of secure habitat and appreciate the no net loss of secure habitat as a consequence of human activities, especially that this acquisition occurs within the same area as secure habitat is lost. I do suggest that consideration be given to the juxtaposition of secure habitat, particularly if substantial changes to its distribution occur over time. Connectivity and corridors can be considered hierarchical, not only necessary to facilitate exchange among populations, but to facilitate movements at the individual and subpopulation level. Ensuring the spatial distribution of secure habitat within and across bear management units facilitates these finer scale movements is warranted.

I am uncertain about the apparent spatial mismatch between minimum secure habitat area size (10 acres) and lake size (lakes < 1 mi^2 are considered secure). I would consider most of any lake (open water) as unsuitable (unused) for grizzly bears, thus not secure. Though bear use of these lakes may in part be dependent on what occurs in areas of the lake unused, bears likely use little more than the edge for foraging. Instead of using the entire lake surface area (for those < 1 mi^2) as secure habitat, I would consider creating a buffer along the respective shorelines that represents the actual area used by grizzly bears.

Other - The effects of honoring existing oil, gas, and other mineral leases is unclear. Further 'striving' to meet the application rules for changes to secure habitat is unclear. Additional clarification on the number of leases, the location and area of leases, and possible range of effects of these leases on grizzly bears is warranted.

I appreciate that the number and net acreage of livestock allotments will not exceed the 1998 baseline. However, there is potential concern that the number of livestock on these allotments is independent of the acreage and allotments. The document states 'Appropriate analysis by the agency must be conducted to evaluate impacts on grizzly bears'. Evaluation of impacts does not directly translate to ensuring non-detrimental effects on grizzly bears. A brief description of appropriate analyses and the desired outcome relative to grizzly bears is warranted.

2.   Is the management of discretionary mortality, including hunting, scientifically sound and sufficiently clear and detailed so that managers can use this document to successfully implement mortality management in the future?

The management of discretionary mortality is sound and reasonable. Total (I presume annual but should be clarified) mortality rates by sex and age class are provided relative to 3 population ranges. Discretionary harvest is allocated based on these populations relative to the overall

population goal. Planning annual meetings to follow the results of annual monitoring of populations provides a proactive strategy to ensure discretionary mortality levels are not exceeded.

To gain additional insight I searched for Appendix P 'Memorandum of Agreement between the States of Idaho, Montana, Idaho, and Wyoming Regarding the Management and Allocation of Discretionary Mortality of Grizzly Bears in the Greater Yellowstone Ecosystem'. which was not provided and apparently will be added to the overall documentation upon finalization of the conservation strategy.

3.   Is management to facilitate connectivity with other grizzly populations adequately addressed in the draft 2016 Conservation Strategy?

The emphasis on roads as a primary driver of fragmentation and loss of connectivity is appropriate. However, many of the practices outlined (e.g., place warning signs at points of high mortality risk) appear narrow and limited relative to ensuring grizzly bear connectivity. Also, NEPA analyses of road construction projects in my opinion do not adequately address larger scale and long-term effects of road construction on species. I think an expansion of this area is appropriate and could describe actions taken to preclude cumulative adverse effects of fragmentation from road construction in the context of connectivity.

4.   If implemented, is the Conservation Strategy adequate to reasonably ensure the long-term viability of the Greater Yellowstone grizzly bear population?

Overall, I believe this conservation strategy is adequate to facilitate the long-term viability of this grizzly bear population. The strategy outlines myriad techniques in a comprehensive framework to ensure this. In particular, I applaud the multiple elements of long-term monitoring (e.g., bear foods, mortality, conflict) and the adaptive nature of strategies to address and mitigate potential adverse effects of mechanisms influencing population change.

However, as with any plan or strategy, the full range of conditions influencing populations are rarely if ever realized. Though the adaptive strategies outlined in this document will address many of the management challenges, I encourage an adaptive process to the plan itself, through periodic assessment and revision as warranted, to ensure any unanticipated mechanisms affecting population-level outcomes are addressed. In addition, the comments offered above are suggestions to further improve an already sound conservation strategy.

Draft Recovery Plan Supplement: Revised Demographic Criteria:

1.   Please provide your scientific evaluation (e.g., the pros and cons) of the revised recovery goal's objective to manage and maintain the population around the 2002–2014 model-average Chao2 estimate of 674 (95% CI 600–757).

Pros: Management of this bear population using the recent population abundance estimates would be apparent considering the current state of resource conditions and constraints (e.g., human) on this bear population. The population has apparently plateaued under these conditions. Based on previous analyses, the long-term viability of this population is secure.

Cons: To manage populations at pre-determined numeric values (or ranges of values) can be inherently problematic. Considering ecosystems are dynamic, both from natural and anthropogenic processes (e.g., climate change), long-term management of populations against target goals is frequently not tenable. However, having periodic reassessments of population goals in the context of dynamic processes could mitigate this concern.

2.   Please provide your scientific evaluation (e.g., the pros and cons) of monitoring the demographic criteria exclusively within the demographic monitoring area.

Pros: The 2-years data provided comparing the previous monitoring area to the demographic monitoring area (DMA) appears to be consistent across the sex and age classes provided. The greatest difference is with independent male mortalities; however, the relative magnitude of difference appeared consistent.

The established DMA was developed using sound criteria, namely estimated suitable habitat and potential mortality sinks.

Cons: As with any index, there is increased opportunity for error when the area of monitoring is reduced with greater potential for loss of accuracy and precision in monitoring. However, in this case I am supportive of using the DMA as currently proposed/defined, based on data reported through 2015, as basic trends seemed supportive. The greatest disparity in mortalities occurred in the independent male segment of the population, the least important from a demographic standpoint.

Though the DMA appears credible from all perspectives, it may be advantageous to have additional years' comparison of mortality events for this and the previous monitoring area to ensure mortalities from the DMA only are not misleading.