UNITED STATES FISH & WILDLIFE SERVICE

FINAL Wyoming Gray Wolf Peer Review Panel Summary Report

Proposed Ruling: Removal of the Gray Wolf in Wyoming from the Federal List of Endangered and Threatened Wildlife and Removal of the Wyoming Wolf Population's Status as an Experimental Population

(50 CFR Part 17; Docket No. FWS-R6-ES-2011-0039; 92220-1113-0000-C6)

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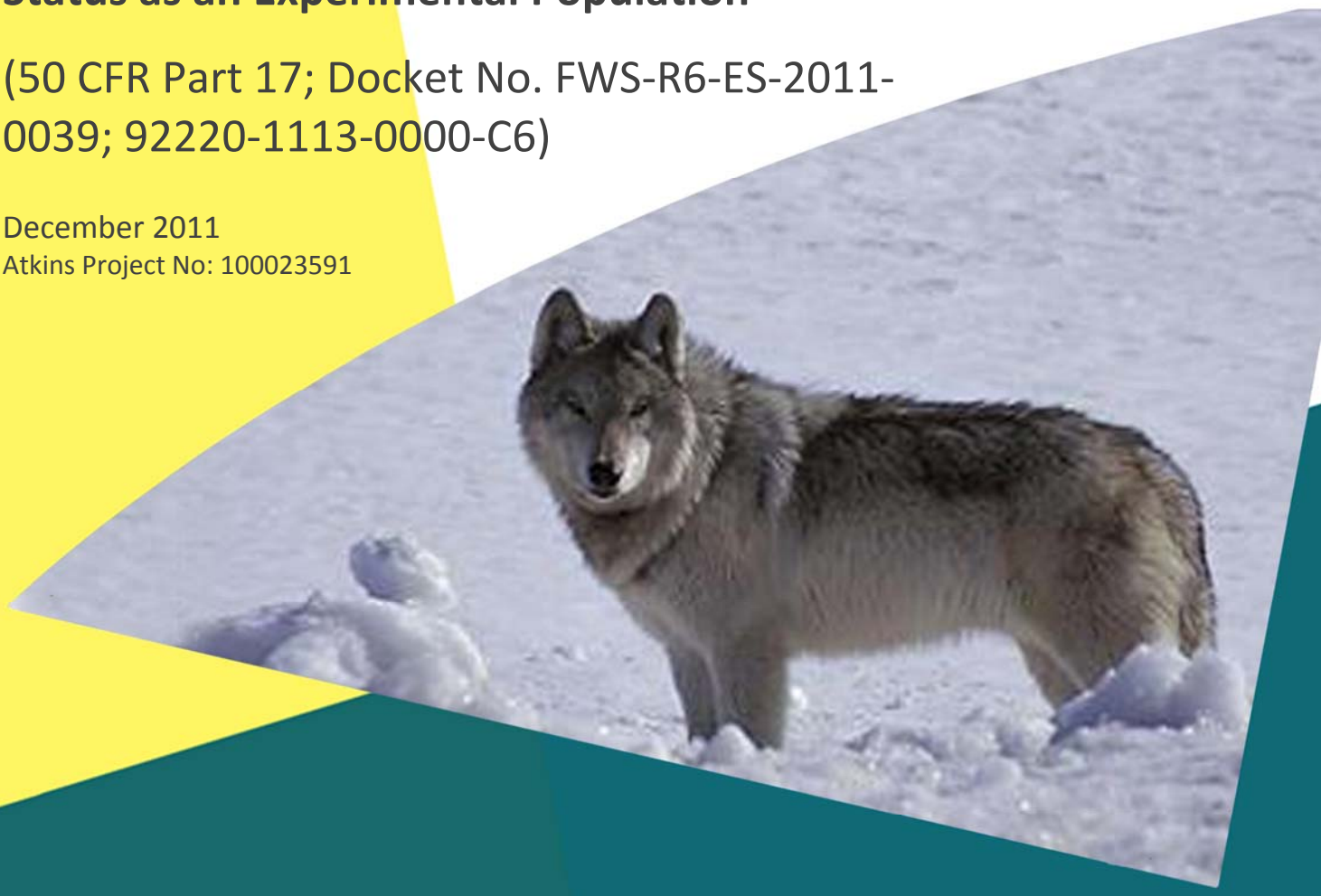

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United States Fish & Wildlife Service Proposed Ruling: Removal of the Gray Wolf in Wyoming from the Federal List of Endangered and Threatened Wildlife and Removal of the Wyoming Wolf Population's Status as an Experimental Population
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Final Wyoming Gray Wolf Peer Review Panel Summary Report

Panel Reviewers:

Dr. Layne Adams, *USGS Alaska Science Center*
Dr. Scott Mills, *University of Montana*
Dr. David Mech, *USGS Northern Prairie Wildlife Research Center*
Daniel Stark, *Minnesota Department of Natural Resources*
Dr. John Vucetich, *Michigan Technological University*

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Executive Summary

The U.S. Fish & Wildlife Service (USFWS or Service) asked Atkins to conduct a peer review of their proposed ruling to delist the gray wolf in Wyoming and return management of this species to the state.

Atkins contracted with five independent panelists to review the proposed rule, draft Wyoming Gray Wolf Management Plan (the Plan) and supporting documentation. The panelists were drawn from several areas of expertise related to wolf biology, but each one is considered to be an expert in the field of gray wolf life history and biology, predator/wildlife management, population viability, genetics, and/or subpopulation integration within metapopulations. The panelists had a variety of past wolf biology and/or management experience in different locations across the United States.

The panel members were asked to review the proposed rule, Plan and supporting documentation and address six key questions regarding the adequacy of the proposed rule and the ability of Wyoming to maintain the recovery of the gray wolf under their proposed management. The key questions posed to the panel were:

Question 1.
Is the Service's description and analysis of the biology, population, and distribution accurate?

Question 2.
Does the proposed rule provide accurate and adequate review and analysis of the factors relating to the threats?

Question 3.
Are the conclusions the Service reaches, including their projection of maintenance of a viable population, logical and supported by the evidence they provide?

Question 4.
Did the Service include all the necessary and pertinent literature to support their assumptions/arguments/conclusions?

Question 5.
Is it reasonable for the Service to conclude that Wyoming's approach to wolf management, as described in the Plan and the proposed rule, in the context of wolf management throughout the entire Northern Rocky Mountain (NRM) region, is likely to maintain Wyoming's wolf population above recovery levels?

Question 6.
Is it reasonable for the Service to conclude that Wyoming's approach to wolf management, as described in the Plan and the proposed rule, in the context of wolf management

throughout the entire NRM region, is likely to provide for sufficient levels of gene flow to prevent genetic problems from negatively impacting the Greater Yellowstone Area's population or the larger NRM metapopulation in a manner that would meaningfully impact viability?

It should be noted that the panel has not reviewed the underlying Wyoming State statutes or the Wyoming Game and Fish Commission regulations as revisions to these documents are ongoing or pending. Instead, the panel (like the USFWS) assumes conforming changes will occur making these two documents compatible. Thus, the contract for this review (which runs through April 30, 2012) provides peer reviewers an opportunity to revise or amend their reviews and the report once these documents are finalized.

Following the initial presentation of the panel's responses to the Service, there was disagreement among the panel on several key issues. To further understand these disagreements and synthesize how the panel's analysis would affect the objectives of the Service, the Service requested clarification from the panel on the following six issues raised by the panel:

1. How important, in terms of the survival of the wolf population, is the 'buffer'? Is it adequate for the buffer to be determined on an adaptive management/learning basis? Is a buffer critically necessary?
2. How large should the buffer be?
3. Is it reasonable to assume, for management purposes, that wolf packs would not survive in areas where allowable mortality is planned?
4. Whether dissenting panelist comments have changed panel opinion (on wolves' high intrinsic growth rate, and ability to compensate for human caused mortality).
5. Whether there would be adequate gene flow in the planned scenario.
6. Is there any level of anthropogenic mortality that would be too high (exceeding 36 percent) on a temporary basis?

Extinction risk and recovery under the Wyoming Plan

The key overarching issue for the panelists (and for the USFWS) is the extinction risk faced by the wolf population in the NRM, and its potential for recovery. One panelist was of the strongly expressed opinion that the Wyoming's Plan is inconsistent with recovery goals. The remaining four panelists believe that the Plan is, or could be, consistent with recovery.

One of the chief sources for the disagreement between reviewers was the management target for the wolf population, and how Wyoming will treat this target: will the population be rapidly reduced to the minimum necessary, or will there be an adaptive process and a buffer above the minimum? It may indeed be that it is not in the State's interest to manage down to the absolute minimum population; however that is what is stated in the Plan, and it is not reasonable to simply assume that there will be consistent and long-term commitment to managing for levels above that target.

Atkins found that the Plan, as written, does not do an adequate job of explaining how wolf populations will be maintained, and how recovery will be maintained. It is clear that more than one panelist believes that there is a need for explicit buffering, and better explanations of the adaptive processes that will be used in managing down the wolf populations. At the same time, no panelist appears to believe that there is a need for an explicit numerical buffer - but rather panelists believe that there should be an explicit process for integrating monitoring data, and for showing how such data will be used to set ongoing management objectives.

Transitional and Long-term mortality rates

In response to clarifying questions, some additional differences between panelists became resolved. It is clear that most panelists recognize that a very high level of anthropogenic mortality would be unsustainable; however in a population that is being actively reduced in size mortality may be temporarily high. Several panelists were of the opinion that this was a moot point - that in fact the proposed hunting harvest approach to reducing population size was unlikely to have as large an impact as predicted.

Atkins is of the opinion that the issue of actual mortality rate is a non-issue, *precisely* to the extent the harvest is indeed carried out in an adaptive and incremental manner. If the reduction in population is as gradual (and ineffective) as predicted by most panelists, then it is unimportant to determine precisely what level of reduction could hypothetically be tolerated. If however population reduction is prosecuted in an aggressive and non-adaptive fashion, then such maximum mortality rates become far more important.

Genetics

Most panelists were of the opinion that genetic concerns (inbreeding, maintenance of gene flow) are minor. Some panelists disagreed. These differences of opinion persisted through the clarification questions.

Atkins is of the opinion, following consensus in conservation biology as a whole, that demographic fluctuations usually impact a population earlier and more strongly than do genetic factors. Similarly even low rates of gene flow can maintain genetic uniformity over long distances. In such an accomplished dispersing species as this, we believe that gene flow is likely to be adequate in the short- and medium-term. This is not to say that genetics can never be important. The proposed monitoring and deliberate transportation of animals will be adequate to address such concerns if they arise. Whether or not to employ such artificial means of gene flow is a policy concern, not a scientific one.

Atkins has evaluated all the available information from this peer review and believes that the following conclusions are appropriate for Questions 1, 2, 3 and 5:

We believe that the answers to all these questions hinge on the key question of management targets and actual practices as they are described and followed. Atkins supports the minority opinion of Dr. Vucetich, that (based on the Plan as written) there is substantial risk to the

population. We believe that the later responses of some of the other panelists support this viewpoint. However, we also believe that the distance between the panelists is less great than initially perceived. If there is adequate documentation and commitment to adaptive and incremental practices, and to describing how the target population will be 'buffered' the risk to the population can be minimized. However we agree with Dr. Vucetich that a verbal commitment is too weak to have much long-term value in assessing risk.

Atkins has evaluated all the available information from this peer review and believes that the following conclusion is appropriate for Question 4:

Additional information and literature was provided by the panel and is summarized in Section 3.0, Question 4.

Atkins has evaluated all the available information from this peer review and believes that the following conclusion is appropriate for Question 6:

Atkins believes that the proposed strategy is well-supported by the literature, and that genetics concerns are limited. In this case we believe that the majority opinion is the best supported one – sufficient gene flow would occur.

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1.0 Introduction

The U.S. Fish & Wildlife Service (USFWS or Service) published a proposed ruling to delist gray wolves in Wyoming in the Federal Register on October 5, 2011. In accordance with the Service's July 1, 1994 peer review policy (59 FR 34270) and the Office of Management and Budget's December 16, 2004 Final Information Quality Bulletin for Peer Review (OMB 2004), the Service subjected this proposal to peer review. A peer review panel was convened and managed by Atkins, a third party contractor, in accordance with 59 FR 34270 and OMB (2004).

1.1 Objectives

Peer reviewers were selected to provide expert panel peer review of the USFWS proposed rule and all pertinent supporting documents, including the draft Wyoming Wolf Management Plan (herein referred to as the Plan) (WGFC 2011) which along with supporting changes in statute and regulation would allow the Service to make an objective, science-based decision on delisting gray wolves in Wyoming (and hence to return the management of the species to the state). It is important to note that, in compliance with the Federal Advisory Committee Act (FACA), the peer review panel was not established or encouraged to provide advice or recommendations, nor to act "as a group". The peer review panel did meet together, but solely to share information so that reviewers would have the same information when preparing their individual reports. The purpose of this peer review was not to develop group consensus.

Following the guidance outlined in OMB (2004), Atkins provided the peer reviewers with sufficiently detailed questions so that they could provide adequate and accurate analysis. Therefore, after reviewing the proposed rule, Plan and supporting information, the panel members were charged with providing conclusions related to six specific questions:

> Question 1.
> Is the Service's description and analysis of the biology, population, and distribution accurate?
>
> Question 2.
> Does the proposed rule provide accurate and adequate review and analysis of the factors relating to the threats?
>
> Question 3.
> Are the conclusions the Service reaches, including their projection of maintenance of a viable population, logical and supported by the evidence they provide?
>
> Question 4.
> Did the Service include all the necessary and pertinent literature to support their assumptions/arguments/conclusions?
>
> Question 5.
> Is it reasonable for the Service to conclude that Wyoming's approach to wolf management,

as described in the Plan and the proposed rule, in the context of wolf management throughout the entire NRM region, is likely to maintain Wyoming's wolf population above recovery levels?

Question 6.
Is it reasonable for the Service to conclude that Wyoming's approach to wolf management, as described in the Plan and the proposed rule, in the context of wolf management throughout the entire NRM region, is likely to provide for sufficient levels of gene flow to prevent genetic problems from negatively impacting the Greater Yellowstone Area's population or the larger NRM metapopulation in a manner that would meaningfully impact viability?

The panel members analyzed the proposed rule, Plan and supporting documentation in order to answer these questions, as well as evaluate "the validity of the research design, the quality of data collection procedures, the robustness of the methods employed, the appropriateness of the methods for the hypotheses being tested, [and] the extent to which the conclusions follow from the analysis" (OMB 2004, page 4). It should be noted that the panel has not reviewed the underlying Wyoming State statutes or the Wyoming Game and Fish Commission regulations as revisions to these documents are ongoing or pending. Instead, the panel (like the USFWS) assumes conforming changes will occur making these two documents compatible. Thus, the contract for this review (which runs through April 30, 2012) provides peer reviewers an opportunity to revise or amend their reviews and the report once these documents are finalized.

2.0 Peer Review Process

2.1 Panelist Selection

Guidelines for the selection of peer review panelists are provided in OMB (2004). The most important selection criterion was expertise; the panelists must be high-level scientists and possess the knowledge and experience necessary to perform the review. Secondly, the panelists must be free of conflicts of interest that could, or give the appearance of, introducing bias into the review. For this panel, reviewers needed to be independent of the USFWS, the Idaho Department of Fish & Game, Montana Department of Fish, Wildlife & Parks and all Wyoming state agencies including the Wyoming Game and Fish Department (WGFD). Finally, the panel should be balanced and include panelists that cover the full spectrum of scientific disciplines, perspectives and backgrounds.

This USFWS proposed rule peer review panel had to include individuals with a variety of professional qualifications and experience related to gray wolf life history and biology, predator/wildlife management, population viability, genetics, and subpopulation integration within metapopulations. After performing a search and review for authors of some of the wide body of scientific literature available for the gray wolf, Atkins solicited the opinion of a variety of wolf biologists and wildlife managers across the United States and Canada to identify a list of potential panelists. Fifteen potential candidates for the peer review panel were identified who

appeared to meet the requirements of scientific excellence in the required fields, appropriate background and lack of conflict of interest. Of these candidates, seven expressed interest in and the ability to serve on the panel. Atkins examined these seven candidates and selected the five that best represented a balance across all required disciplines and provided both academic focus and management (agency) experience. These candidates completed a Conflict of Interest Statement (based on the National Academies of Science form) and were interviewed to identify any conflict of interest that would preclude a non-biased review, or even appearance of non-bias. There were no conflicts of interest identified for any of the panelists.

The five panelists bring a wealth of knowledge and experience across the contiguous United States, Alaska, and Canada. The panelists include:

Dr. Layne Adams, *USGS Alaska Science Center*
Dr. David Mech, *USGS Northern Prairie Research Center*
Dr. Scott Mills, *University of Montana*
Daniel Stark, *Minnesota Department of Natural Resources*
Dr. John Vucetich, *Michigan Technological University*

The qualifications of each of the panelists are included as Appendix C.

2.2 Document Review

The panelists reviewed the proposed rule, Plan and supporting documentation, as appropriate. The panelists were charged with answering the questions identified in Section 1.1. In addition, the panelists were asked to consider the following as part of their review:

- "the validity of the research design, the quality of data collection procedures, the robustness of the methods employed, the appropriateness of the methods for the hypotheses being tested, [and] the extent to which the conclusions follow from the analysis" (OMB 2004, page 4);
- uncertainties, limitations and/or deviations from "best available science" in the conclusions of the proposed rule and Plan; and
- potential scientific implications of those uncertainties and limitations.

Per OMB (2004) guidance, the panelists were instructed not to provide advice on policy or management, e.g. the direction the USFWS should take or the amount of uncertainty that is acceptable to the agency.

2.3 Panel Meeting

A peer review panel meeting was held at the Atkins office in Denver, Colorado on October 17, 2011. This meeting was held so that the panel members could question agency biologists and therefore would all have the same set of information and data when preparing their reports. Attendees included the Atkins Project Lead; all of the panelists; staff from USFWS and WGFD that participated in the preparation of the proposed rule and Plan, respectively; the Special Assistant to

the Governor of Wyoming and the U.S. Department of Interior Attorney Advisor for the Rocky Mountain Region Office of the Solicitor.

The panel members, USFWS and WGFD staff participated in a question and answer session regarding the documents, including the technical information contained within them and regarding the process that the agencies went through to develop the documents.

3.0 Panel Initial Response

Based on their review of the proposed rule, Plan, supporting documents, and additional information gained during the panel meeting, each panelist prepared an individual memorandum detailing their response to each of the questions listed in Section 1.1 of this report. Atkins reviewed each memorandum and compiled their responses in the summaries below. As stated in Section 1.1 of this report, the panel was not required to reach consensus on the questions posed to them by the USFWS. Instead, each panelist was instructed to reach his own conclusion.

All of the conclusions and statements made by the panelists appeared to be sound, well thought out and substantiated. For the most part, the panelists had similar views; some panelists had a stronger emphasis on certain points (especially if one was part of their specialized subject area related to wolf biology). A compilation and response to all comments is provided in Table A-1 in Appendix A. All comments provided by the panelists can be viewed in the individual panelist memorandums provided as Appendix B and in Table A-1, Appendix A.

> Question 1:
> Is the Service's description and analysis of the biology, population and distribution [of the gray wolf] accurate?

Four out of five of the panelists concluded that, overall, the Service's description and analysis of the biology, population and distribution of the gray wolf was accurate, but several panelists disagreed with certain points made in the proposed rule and Plan, as summarized below.

- Three panelists (Adams, Mech and Mills) stressed that population counts of wolves in the Northern Rocky Mountain (NRM) population should be considered minimums or "abundance indices" (Mills 2011) (Appendix B) due to the fact that many wolves are missed in these counts.
- Dr. Adams commented that the 75 percent survival rate for adult wolves in the NRM provided in Smith et al. (2010) likely was an underestimate due to the likelihood that targeted, depredating wolves were overrepresented in the marked sample. Dr. Adams also stated that in contrast to the assertion in the proposed rule and Plan that wolf mortality is highest prior to December 31, continued mortality as well as dispersal typically occurs until the population actually reaches its lowest point in late April.
- Dr. Adams pointed out that the NRM wolf packs have territories that substantially overlap, rather than being totally distinct as was stated in the rule. Furthermore, it was Dr. Adams opinion that the estimate of 10 percent annual dispersal rate in NRM wolves was likely too low, based on the Adams et al. (2008) study that indicated the most likely dispersers, yearlings

and two-year-olds, dispersed at rates of 61 percent and 35 percent, respectively[1]. Dr. Adams also expressed doubt that dispersal through Yellowstone National Park (YNP) would be limited by the lack of social openings in YNP.

These panelists' opinions were substantiated with adequate information and citations. It is Atkins' opinion that these scientific opinions, although they differed somewhat with the Service's assessment, were valid. Nevertheless these panelists were still of the general opinion that the proposed rule did provide an adequately accurate description of the biology, population and distribution of the gray wolf. Therefore we regard these above criticisms as minor.

Dr. Vucetich in contrast was more strongly critical of the analysis in the proposed rule and Plan and how these documents described anthropogenic (human-caused) mortality and mortality compensation related to the gray wolf. Three other panelists (Adams, Mech and Mills) also expressed concerns with how the proposed rule synthesized the effects of anthropogenic mortality rates on population viability of gray wolf. Because this issue is directly related to the maintenance of a viable Wyoming wolf population it is summarized under Question 3, below.

> Question 2:
> Does the proposed rule provide accurate and adequate review and analysis of the factors relating to the threats [to the gray wolf]?

Four out of five of the panelists concluded that, overall, the proposed rule provided accurate and adequate review and analysis of the factors relating to the threats to the gray wolf, but several of these panelists disagreed with certain points made in the proposed rule and Plan, as summarized below.

- As stated under Question 1, several of the panelists expressed concerns with the anthropogenic mortality rate and mortality compensation on population viability stated in the proposed rule and Plan; these concerns are discussed under Question 3, below.
- One panelist (Adams) stated that the assertion that the threat of intraspecific killing in the NRM was infrequent except at carrying capacity was inaccurate, and that "intraspecific strife is characteristic of wolf populations regardless of their status relative to carrying capacity" (Adams 2011) (Appendix B).
- Two panelists (Mills and Vucetich) stated that the proposed rule and Plan inappropriately downplay the threat of inbreeding depression to population persistence. Dr. Mills stated that inbreeding depression is likely not a threat to the NRM population specifically, as is correctly stated in the rule and Plan, but these documents incorrectly imply that "inbreeding depression is merely 'theoretical' or hypothetical in its potential effects on persistence of small wildlife populations" (Mills 2011) (Appendix B). This implication is neither correct nor is inbreeding depression likely to affect the NRM population, so it is an unnecessary and misleading section in the proposed rule and Plan.

[1] Mike Jimenez (USFWS) in a December 1, 2011 comment added "From 1995 -2008, NRM wolves dispersed at a mean age of 32 months. During that study period, 59% were adults and 37% were yearlings. Only 4% were pups."

These panelists' opinions were substantiated with adequate information and citations. It is Atkins' opinion that these scientific opinions, although they differed somewhat from the Service's assessment, were valid. Nevertheless, with the exception of Dr. Vucetich these panelists were still of the general opinion that the proposed rule and Plan did indeed provide an accurate and adequate review and analysis of the factors relating to the threats to the gray wolf. Therefore we regard these above criticisms as minor. Dr. Vucetich's concerns with anthropogenic mortality are described below under Question 3.

> Question 3:
> Are the conclusions the Service reaches, including their projection of maintenance of a viable population, logical and supported by the evidence they provide?

Four of the five panelists were in agreement that overall, the conclusions the Service reaches, including their projection of maintenance of a viable population, were logical and supported by the evidence they provide; however, all of the panelists expressed concerns with the use of a 36 percent "acceptable" anthropogenic mortality rate[2]. Four out of five of the panelists believed that this specific rate was inappropriate and unsubstantiated by the literature, and therefore should be removed and a range of anthropogenic mortality should be used. Dr. Vucetich had a stronger opinion on the matter; he stated that the Plan may not maintain a viable wolf population due to the level of anthropogenic mortality that was reported as "acceptable". Further details are provided below.

- Panelists Adams, Mech, Mills and Stark stated that the anthropogenic mortality rate of 36 percent reported to be sustainable by the Wyoming wolf population is within an acceptable *range* but that the value itself should be deleted because it is unsubstantiated and does not meet scientific standards.
- Dr. Vucetich stated stronger concerns about the anthropogenic mortality rate of 36 percent used by the Service as the maximum rate before a wolf population would become unable to sustain itself (i.e. would decline). Dr. Vucetich provided the results from six additional studies that reported a wide range of anthropogenic mortality rates that would cause population decline, most of which indicated a lower rate than 36 percent; Vucetich and Carroll (*unpubl. manusc.)* reported that the wolf population in the NRM would likely decline with anthropogenic mortality rates greater than 17 percent (Vucetich 2011) (Appendix B). It should be noted that this unpublished manuscript was not reviewed by the other panel members, but it simply offers additional support to Dr. Vucetich's fundamental concerns with the proposed rule's use of the 36 percent anthropogenic mortality rate.
- Panelists Adams, Mech and Vucetich pointed out that the proposed rule's reference to Fuller et al. (2003) stating that anthropogenic mortality can replace up to 70 percent of natural mortality in the NRM population has since been shown to be erroneous; therefore, this statement should be deleted.

[2] Mike Jimenez (USFWS) in a December 1, 2011 comment added "From 2007-2011, the Wyoming wolf population (outside YNP) had a[n] average total mortality rate of 22%. WY (including YNP) had 18% total mortality. These mean values included all sources of mortality (including radiocollared and uncollared wolves)."

All of the panelists provided adequate information and citations to support their concerns with the anthropogenic mortality rate. Based on the information and citations provided, it is Atkins opinion that the proposed rule and Plan should not report the value of 36 percent because it is unsubstantiated and misleading. Providing a range of anthropogenic mortality rates as reported in the literature and that would still maintain a viable wolf population in the NRM may be more appropriate based on the panel's conclusions.

> Question 4:
> Did the Service include all the necessary and pertinent literature to support their assumptions/arguments/conclusions?

Generally the panelists thought that the rule included an adequate synthesis of the body of literature available on wolf biology and recovery. All of the panelists stated that there was additional literature that should be included to add additional background and/or substantiate assumptions/arguments/conclusions made by the Service and WGFD. Furthermore, on the issue of anthropogenic mortality and population viability, there were several suggestions of literature that refuted assumptions presented in the proposed rule and Plan.

Suggested literature and corresponding Federal Register page number:

p. 61801; several studies related to the effect of anthropogenic mortality rate on population dynamics should be considered: Adams et al. (2008), Sparkman et al. (2011), and Gude et al. (2011).

p. 61804; should be an update to potential demographic effects of canine parvovirus (CPV) and the evidence of only a temporary effect on wolf populations by using Mech and Goyal (2011)

p. 61814; Mills and Allendorf (1996) and Mills (2007) further bolster the proposed rule and Plan's assessment of sufficient genetic connectivity on "one migrant per generation"

p. 61819; Rutledge et al. 2010 should be included in this section on consideration of human-caused mortality on wolf pack social structure; however, Dr. Mech noted that this article pertains to a species of wolf that many geneticists consider different from the NRM wolves (Mech pers. comm. 2011).

> Question 5:
> Is it reasonable for the Service to conclude that Wyoming's approach to wolf management, as described in the Plan and the proposed rule, in the context of wolf management throughout the entire NRM region, is likely to maintain Wyoming's wolf population above recovery levels?

Four of the five panelists agreed that Wyoming's approach to wolf management is likely to maintain Wyoming's wolf population above recovery levels. There were several points made in the panelists' conclusions that were cautionary:

- Panelists Mills and Vucetich expressed concern that, as written in the Plan and rule, Wyoming's Plan does not adequately explain how the recovery goal of 10 breeding pairs/100 wolves will be maintained when compared to the objectives of harvest and managing conflicts. More specifically, they both stated that there is inadequate detail regarding what the standards for alleviating conflict are or what constitutes an unacceptable impact (e.g. to elk populations); therefore, the objectives of harvest and managing conflicts may be inconsistent with the recovery goals. Although a buffer above the minimum goals is mentioned, just what an adequate buffer is, in the face of other management realities (e.g. hunting, depredation management actions, etc.), is not stated explicitly. Dr. Mills did conclude that the State of Wyoming is unlikely to threaten the recovery goals for Wyoming wolves because of the strong desire to avoid relisting review.
- Both Dr. Mills and Dr. Vucetich strongly emphasized that human-assisted genetic dispersal is inappropriate for a recovered population and should only be utilized in emergency situations, and not to overcome anthropogenic barriers to dispersal or other human-caused threats such as management actions. Human-assisted dispersal is counter to delisting objectives and is also unnecessary and inefficient for a truly recovered population. Individuals chosen for relocation may have particularly high or low reproductive values (therefore contributing differently to the genetics of the local population), and may vary in diseases from the local population.

It is Atkins' opinion that while Dr. Mills' and Dr. Vucetich's points regarding human-assisted genetic dispersal are well made, this is essentially a management and/or policy issue rather than a strictly scientific one. Therefore, this issue falls outside the purview of this scientific analysis. However, Dr. Mills and Dr. Vucetich disagree with Atkins' opinion; human assisted dispersal has "fundamental implications for metapopulation and local population genetic structure, numerical dynamics, and susceptibility to disease" (Mills pers. comm. 2011) and therefore is as much a scientific issue as well as a management issue (Mills pers. comm. 2011, Vucetich pers. comm. 2011).

> Question 6:
> Is it reasonable for the Service to conclude that Wyoming's approach to wolf management, as described in the Plan and the proposed rule, in the context of wolf management throughout the entire NRM region, is likely to provide for sufficient levels of gene flow to prevent genetic problems from negatively impacting the Greater Yellowstone Area's population or the larger NRM metapopulation in a manner that would meaningfully impact viability?

Four of the five panelists (Adams, Mech, Mills and Stark) agreed that Wyoming's approach to wolf management is likely to provide for sufficient levels of gene flow within the Greater Yellowstone Area (GYA) and NRM. Dr. Vucetich dissented, stating that Wyoming's approach to wolf management may not maintain sufficient levels of gene flow for the reason summarized below.

- Dr. Vucetich offered reasons to be concerned that 1) the Plan does not make provision for emigration from Wyoming as it does for immigration into Wyoming; 2) observations related to the study used to assert genetic conductivity (Von Holdt et al. 2010) within the GYA may not

conform with a ≥5.4 effective migrants per generation as implied by the Plan; 3) the strategy of employing human-assisted migration versus natural migration is vague and potentially inconsistent with management goals; 4) the State of Wyoming should still assume responsibility of genetic connectivity even in areas outside of the Wolf Trophy Game Management Area (WTGMA); and 5) the rule does not include a relisting trigger related to genetic connectivity.

Two of the panelists expressed concern with conclusions provided in the proposed rule and Plan; although they did not believe that these issues would hinder wolf gene flow in the GYA and NRM:

- Dr. Mills expressed that the assertion in the proposed rule and Plan that anthropogenic mortality could enhance and benefit genetic exchange is not scientifically credible. If natural genetic dispersal is sustained, then a robust wolf population will maintain gene flow on its own.
- Similarly, Dr. Adams stressed that examining and revising population management protocols to address inadequate genetic connectivity should be the priority over adjusting monitoring protocols.

4.0 Initial Peer Review Conclusions

At the request of the USFWS, Atkins convened a peer review panel to provide expert review of the USFWS proposed rule and all pertinent supporting documents which along with supporting changes in statute and regulation would allow the Service to delist gray wolves in Wyoming and return management of the species to the State. Atkins summarized the initial results of the panel review, and submitted them to the Service to determine if there were needs for clarification of panelists' opinions on these complex scientific issues. The initial results of the panel review were as follows.

Question 1.
Is the Service's description and analysis of the biology, population, and distribution accurate?

> Conclusion: Yes (four panelists); No (one panelist). Some concerns were noted; in most cases the reasons offered for dissent by the dissenting panelist did overlap to a certain degree with the assenting panelists.

Question 2.
Does the proposed rule provide accurate and adequate review and analysis of the factors relating to the threats?

> Conclusion: Yes (four panelists); No (one panelist). Some concerns were noted; in most cases the reasons offered for dissent by the dissenting panelist did overlap to a certain degree with the assenting panelists.

Question 3.
Are the conclusions the Service reaches, including their projection of maintenance of a viable population, logical and supported by the evidence they provide?

> Conclusion: Yes (four panelists); No (one panelist). Some concerns were noted; in most cases the reasons offered for dissent by the dissenting panelist did overlap to a certain degree with the assenting panelists.

Question 4.
Did the Service include all the necessary and pertinent literature to support their assumptions/arguments/conclusions?

> Conclusion: Generally, yes (all panelists). Additional suggested literature was provided with explanations of why the literature was necessary and pertinent to support the assumptions/arguments/conclusions in the proposed rule.

Question 5.
Is it reasonable for the Service to conclude that Wyoming's approach to wolf management, as described in the Plan and the proposed rule, in the context of wolf management throughout the entire NRM region, is likely to maintain Wyoming's wolf population above recovery levels?

> Conclusion: Yes (four panelists); No (one panelist). Some concerns noted; in most cases the reasons offered for dissent by the dissenting panelist did overlap to a certain degree with the assenting panelists.

Question 6.
Is it reasonable for the Service to conclude that Wyoming's approach to wolf management, as described in the Plan and the proposed rule, in the context of wolf management throughout the entire NRM region, is likely to provide for sufficient levels of gene flow to prevent genetic problems from negatively impacting the Greater Yellowstone Area's population or the larger NRM metapopulation in a manner that would meaningfully impact viability?

> Conclusion: Yes (four panelists); No (one panelist). Some concerns were noted; in most cases the reasons offered for dissent by the dissenting panelist did overlap to a certain degree with the assenting panelists.

5.0 Clarification, Discussion and Final Conclusions

Following the initial presentation of the panel's responses to the Service, it was clear that there was a need for further elaboration and discussion regarding these complex scientific issues. The Service provided numerous comments, focusing their questions on the following issues:

a. whether the proposed rule was well-written and based on sound science
b. whether the recovery criterion are adequate and likely to lead to successful de-listing
c. the extent to which the predator zone is a concern

d. whether available information suggests a reasonable assurance that recovery criteria would be maintained
e. whether genetic connectivity would be maintained
f. whether there are any major issues concerning the panel, and options for how these may be remedied
g. whether any of these issues 'are so important that without being adequately addressed, the Service should reconsider the proposed action'.

However, not all these questions fall within the strictly scientific and independent charge of the panel, some invite comment on management, or on Service decisions (and question [a] had previously been answered by the panel). Such questions were therefore not posed to the panel. Atkins did seek clarification from the panel on the following six issues:

1. How important, in terms of the survival of the wolf population, is the 'buffer'? Is it adequate for the buffer to be determined on an adaptive management/learning basis? Is a buffer critically necessary?
2. How large should the buffer be?
3. Is it reasonable to assume, for management purposes, that wolf packs would not survive in areas where allowable mortality is planned?
4. Whether Dr. Vucetich's comments have changed panel opinion (on wolves' high intrinsic growth rate, and ability to compensate for human caused mortality).
5. Whether there would be adequate gene flow in the planned scenario.
6. Is there any level of anthropogenic mortality that would be too high (exceeding 36 percent) on a temporary basis?

5.1 Final Conclusions

All panelists were selected for their high level of expertise and professional qualifications. All are well-versed in the literature and practice of wolf biology. All considered the same information. Nevertheless there was a substantive disagreement between the panelists over the proposed rule, and its grounding in science. Such disagreement between scientists is not unusual, and indeed is part of the healthy debate that is the scientific process. Atkins sees no reason to doubt the sincerity of the opinions expressed, or to believe that they were reached for anything other than genuinely held professional opinion. All opinions were well grounded in the literature, and were clearly articulated and supported. Note also that, while the panelists were encouraged to discuss issues among themselves, they were not obligated to provide a consensus report, and were in fact asked to express individual opinions.

It falls to Atkins, as the convener of the peer review process, to make the final evaluation and presentation of the issues addressed. In essence, Atkins must act (in a manner analogous to that of a journal editor) to present the different opinions expressed, and to analyze which (if any) is most convincing. Ultimately, of course, the Service must make its own evaluation of the materials,

and must determine which of the varying scientific viewpoints is most convincing or represents the 'best available science'.

It is important to note that a majority opinion, although held by most scientists, is not necessarily *correct*. The 'preponderance of evidence' standard must be weighed against other information. The fact that most scientists share a particular opinion is indeed useful knowledge, and does speak to how the profession as a whole may evaluate an issue - but it is still important to determine whether the minority viewpoint is valuable, or indeed convincing. Hence we have attempted to evaluate the differences among the panelists, and to determine which of the differing viewpoints are the best supported by the facts.

Differences of scientific opinion are also important in another way: they are a way to judge scientific uncertainty (and hence risk). If all scientists are united in their view on an issue, then that is an indicator that there is little uncertainty on that issue - and hence that there may be little risk in any decisions that flow from such information.

In our evaluations of the various issues, we have attempted to determine which of the various viewpoints is best supported by the available information. Where we believe that contrasting viewpoints are both equally well supported, we have stated this too. We have then determined what will be the uncertainties associated with equally supported but contrasting opinions.

All of the responses of the panelists to the Service's request for clarifications are shown in Appendix D.

Dr. Vucetich responded to the questions and issues by stating that he maintained the opinions expressed in his initial review. The remaining panelists provided clarification or additional responses. On some issues (e.g. regarding the 'buffer') this additional clarification of panelists' opinion substantially and usefully clarifies the overall conclusions reached in the review.

The initial conclusions of the panel, their discussions, and their responses to requests from the Service for clarification were synthesized and analyzed by Atkins. Atkins' final conclusions are presented below.

5.1.1 Extinction Risk and Recovery under the Wyoming Plan

The key overarching issue for the panelists (and for the USFWS) is the extinction risk faced by the wolf population in the NRM, and its potential for recovery. One panelist (Dr. Vucetich) is of the strongly expressed opinion that the Wyoming's Plan is inconsistent with recovery goals. The remaining four panelists believe that the Plan is, or could be, consistent with recovery. We believe that all the other differences between Dr. Vucetich and the other reviewers either flow from this opinion, or contribute to it. For instance, Dr. Vucetich believes that the scientific information available to the Service has either not been used in its entirety, or has been used inappropriately; the other four panelists are (with minor caveats) satisfied with the use of information.

Following our careful analysis of the comments of the reviewers, and particularly the clarifications received during the responses to the Service's additional questions, we believe it is possible to pinpoint one of the chief sources for the disagreement between reviewers. This concerns the management target for the wolf population, and how Wyoming will treat this target: will the population be rapidly reduced to the minimum necessary, or will there be an adaptive process and a buffer above the minimum? Wyoming biologists indicated to the panel in the panel meeting that the State would take a conservative approach and that there would be a cautious and gradual reduction of wolf numbers. Most of the panelists (initially at least) accepted this verbal assurance, since it is transparently in the State's interest not to reduce the population so far as to trigger re-listing under ESA. Dr. Vucetich however did not agree that such assurances should be part of his evaluation, and instead based his evaluation on the plan as written, which implies a hard minimum, and a target of reducing the population to this minimum, without buffers or timeframes. This issue becomes clear when the panel were queried about 'buffers'. Although Dr. Adams stated that he was 'confident that Wyoming would do the right thing', and Dr. Mech thought buffers were unnecessary, Mr. Stark and Dr. Mills stated that this buffering approach was necessary. Dr. Mills went so far as to state this was a 'deal-breaker' for him.

Hence the clarification questions helped to determine why some reviewers had initially disagreed - and perhaps also why they continue to disagree. Dr. Vucetich believes (and has stated consistently) that only the plan as written should be evaluated; Dr. Adams at least continues to believe that verbal or implied policy assurances can be evaluated alongside the plan.

We believe that in this case the initial minority opinion of Dr. Vucetich is the most appropriate one. While all information, written or otherwise, may be useful in a panel evaluation, verbal assurances of policy must necessarily carry little weight. It may indeed be that it is not in the State's interest to manage down to the absolute minimum population; however that is what is stated in the Plan, and it is not reasonable to simply assume that there will be consistent and long-term commitment to managing for levels above that target.

Hence Atkins finds that the Plan, as written, does not do an adequate job of explaining how wolf populations will be maintained, and how recovery will be maintained. Our position is substantially bolstered by the responses of Dr. Mills and Mr. Stark in response to the clarifying questions from the Service. It is clear that more than one panelist believes that there is a need for explicit buffering, and better explanations of the adaptive processes that will be used in managing down the wolf populations. At the same time, no panelist appears to believe that there is a need for an explicit numerical buffer - but rather panelists believe that there should be an explicit process for integrating monitoring data, and for showing how such data will be used to set ongoing management objectives.

5.1.2 Transitional and Long-term Mortality Rates

In response to clarifying questions, some additional differences between panelists became resolved. It is clear that most panelists recognize that a very high level of anthropogenic mortality would be unsustainable; however in a population that is being actively reduced in size mortality may be temporarily high. Several panelists were of the opinion that this was a moot point - that in

fact the proposed hunting harvest approach to reducing population size was unlikely to have as large an impact as predicted.

Atkins is of the opinion that the issue of actual mortality rate is a non-issue, *precisely* to the extent the harvest is indeed carried out in an adaptive and incremental manner, a point made well by Drs. Adams and Mech, and Mr. Stark. If the reduction in population is as gradual (and ineffective) as predicted by most panelists, then it is unimportant to determine precisely what level of reduction could hypothetically be tolerated. If however population reduction is prosecuted in an aggressive and non-adaptive fashion, then such maximum mortality rates become far more important.

5.1.3 Genetics

Most panelists are of the opinion that genetics concerns (inbreeding, maintenance of gene flow) are minor. Some panelists (notably Dr. Vucetich) disagree. These differences of opinion persisted through the clarification questions.

Atkins is of the opinion, following consensus in conservation biology as a whole, that demographic fluctuations usually impact a population earlier and more strongly than do genetic factors. Similarly even low rates of gene flow can maintain genetic uniformity over long distances. In such an accomplished dispersing species as this, we believe that gene flow is likely to be adequate in the short- and medium-term. This is not to say that genetics can never be important. The proposed monitoring and deliberate transportation of animals will be adequate to address such concerns if they arise. As stated in our initial conclusions, whether or not to employ such artificial means of gene flow is a policy concern, not a scientific one.

5.2 Final Summary Conclusion

We believe that the Service's clarifying questions, and the panel's responses to them, have highlighted the causes for disagreements among the panelists and allowed Atkins to identify some key uncertainties. Differences in opinion regarding management targets and population levels are responsible for other differences in opinion among the panelists, notably the adequate use of the literature.

Atkins has evaluated all the available information from this peer review and believes that the following conclusions are appropriate for Questions 1, 2, 3 and 5:

> Question 1.
> Is the Service's description and analysis of the biology, population, and distribution accurate?
>
> Question 2.
> Does the proposed rule provide accurate and adequate review and analysis of the factors relating to the threats?

> Question 3.
> Are the conclusions the Service reaches, including their projection of maintenance of a viable population, logical and supported by the evidence they provide?
>
> Question 5.
> Is it reasonable for the Service to conclude that Wyoming's approach to wolf management, as described in the Plan and the proposed rule, in the context of wolf management throughout the entire NRM region, is likely to maintain Wyoming's wolf population above recovery levels?

We believe that the answers to all these questions hinge on the key question of management targets and actual practices as they are described and followed. As stated above we support the minority opinion of Dr. Vucetich, that (based on the Plan as written) there is substantial risk to the population. We believe that the later responses of some of the other panelists support this viewpoint. However we also believe that the distance between the panelists is less great than initially perceived. If there is adequate documentation and commitment to adaptive and incremental practices, and to describing how the target population will be 'buffered' the risk to the population can be minimized. However we agree with Dr. Vucetich that a verbal commitment is too weak to have much long-term value in assessing risk.

Atkins has evaluated all the available information from this peer review and believes that the following conclusion is appropriate for Question 4:

> Question 4.
> Did the Service include all the necessary and pertinent literature to support their assumptions/arguments/conclusions?

Additional information and literature was provided by the panel and is summarized in Section 3.0, Question 4.

Atkins has evaluated all the available information from this peer review and believes that the following conclusion is appropriate for Question 6:

> Question 6.
> Is it reasonable for the Service to conclude that Wyoming's approach to wolf management, as described in the Plan and the proposed rule, in the context of wolf management throughout the entire NRM region, is likely to provide for sufficient levels of gene flow to prevent genetic problems from negatively impacting the Greater Yellowstone Area's population or the larger NRM metapopulation in a manner that would meaningfully impact viability?

We believe that the proposed strategy is well-supported by the literature, and that genetics concerns are limited. In this case we believe that the majority opinion is the best supported one – sufficient gene flow would occur.

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Appendix A. Comment Table A-1

Table A-1 Peer Report Comments

Panelist Last Name	Comment	Question	Response
Stark	Yes. The Service has provided a thorough description and analysis of the biology, population, and distribution of the Wyoming wolf population based on current scientific literature and agency data. Information provided in the proposed rule accurately reflects the current biology and population data of the wolf population in Wyoming and the Greater Yellowstone Area, as well as sections that address information on wolves in the Northern Rocky Mountains Distinct Population Segment.	1	Noted. Panelist affirms the question.
Mech	For the most part, yes. Exceptions follow:	1	Noted
Mech	p. 61792, col. 3, l. 6 Substitute “at least” for “approximately.” Gude et al. 2011 documented that many animals are missed.	1	Noted - will bring to attention to Service but no action immediately necessary.
Mech	p. 61795, col. 3, l. 20 Change to “In 2010, the minimum count declined. However because both the 2009 and 2010 were minimal counts, no valid inference can be drawn regarding population change.”	1	Noted - will bring to attention to Service but no action immediately necessary.
Mech	p. 61795, col. 3, l. 25 Insert “at least” before “739” and before “47”	1	Noted - will bring to attention to Service but no action immediately necessary.
Mech	p. 61797, col. 3, l. 18 Insert “these 2” before “theoretical”	1	Noted - will bring to attention to Service but no action immediately necessary.
Mech	p. 61797. col. 3, l. 40 What about Canada? The northern part of the DPS is not up against unsuitable habitat.	1	Noted - will bring to attention to Service but no action immediately necessary.
Mech	p.61801, col. 2, l. 2 Delete previous sentence. This statement has now been shown by Creel and Rotella (2010) to be erroneous.	1	Noted - will bring to attention to Service.
Mech	p. 61802, col. 2, lines 8-10 This begs for documentation.	1	Noted - documentation needed.
Mech	p. 61803, col. 2, l. 52 The 36% needs documentation. Also “about 35%” would be better.	1	Noted - all panelists are in agreement that the 36 percent value is not substantiated adequately.
Mech	p. 61806, col. 1, l. 65 Delete previous sentence. This statement has now been shown by Creel and Rotella (2010) to be erroneous.	1	Creel and Rotella (2010) is cited in this sentence.
Mills	I found the proposed rule to be well-written and thorough in its attention to wolf biology, population dynamics, and human dimensions. The format of my comments are to note brief responses to the specific questions posed by the Proposed Rule (below), with reference to much more extensive comments that follow.	1	Noted. Panelist affirms the question.
Mills	I find the description and analysis to be quite well written. The analysis is thoughtful and thorough, and captures nicely most of the key biological points relevant to delisting of wolves in Wyoming. See my specific comments below for some areas for consideration.	1	Noted. Panelist affirms the question.
Adams	Overall, the proposed rule provides an accurate description and analysis of the biology, population characteristics, and distribution of wolves in the Northern Rocky Mountains (NRM).	1	Noted. Panelist affirms the question.
Adams	Based on my review of the proposed rule, the Wyoming Gray Wolf Management Plan, and various supporting documents, I conclude that the USFWS proposal to delist gray wolves in Wyoming is well supported by our current scientific understanding of wolf biology and reasonable assumptions of how wolf management is likely to occur in Wyoming upon delisting.	1	Noted. Panelist affirms the question.

Panelist Last Name	Comment	Question	Response
Adams	-61814, 3rd col., 1st para.: The estimate of 10% annual dispersal is probably substantially low. Yearlings and two-year-olds have the highest propensity to disperse but they tend to be underpresented in any radiocollared sample for a variety of reasons, including their likelihood of dispersing and thus not lasting long in the radiocollared sample compared to older wolves that hang around. Adams et al. 2008 (pg. 11) estimated age-specific dispersal rates in a similar fashion to mortality rates and arrived at 61%, 35%, and 11% for dispersal by yearlings, 2-year-olds, and older wolves, respectively. Given that yearlings constitute a large segment of the non-pup segment of a wolf population, overall dispersal rate may have been around 30% annually. See Adams et al. 2008: 14- 16 for discussion re: issues with calculating dispersal rates.	1	Noted. Will make suggestion to the Service.
Adams	-61 815, 1st col., 1st para.: See comment above about low dispersal estimate.	1	Noted. See comment above.
Adams	-61821, 3rd col. , 2nd para.: It needs to be clearly stated that these data certainly underestimate the wolf population in that some packs are undetected and the transient segment of the wolf population cannot be enumerated.	1	Noted. Will make suggestion to Service.
Vucetich	The Service's description of the population ecology associated with how human--- caused (anthropogenic) mortality affects wolf population dynamics is inappropriate.	1	All panelists disagreed with the discussion of human-caused mortality rates, especially the "acceptable" value of 36 percent human caused mortality.
Vucetich	[1] First some background: The most appropriate way to assess how the annual rate of anthropogenic mortality (ma) affects wolf population dynamics is to assess the statistical relationship between ma and r, the annual population growth rate. To date, this relationship has been examined in 5 published studies and 1 unpublished study. These studies are: A) Fuller et al. (2003) analyzed the relationship between ma and r for 19 populations from across North America. They concluded (p. 184): "On average, wolf population size should stabilize with a mortality rate of 0.34+/--- 0.06 SE, or a human---caused rate of 0.22 +/---0.08 SE." B) Adams et al. (2008) performed a similar analysis on an expanded set of observations from across North America. This analysis indicates that the expected growth rate of a population is less than zero if ma is greater than ~0.29 (Fig. 19 of Adams et al. 2008). C) Creel and Rotella (2010) investigated the relationship between ma and λ (=exp[r]) for the three populations of wolves living in the Northern Rocky Mountain (NRM) region of the United States between 1999 and 2009. That analysis indicates that (in the absence of information about recruitment), a wolf population would be expected to decline if ma is greater than ~0.22. D) Sparkman et al. (2011) examined the effect of anthropogenic mortality in red wolves and concluded that decline in those populations should be expected for rates of anthropogenic mortality that exceed ~0.25. E) Gude et al. (2011) analyzed the same populations, using the same source data, that Creel and Rotella (2010) analyzed. They concluded that (in the absence of information about recruitment), wolves in the NRM populations should not be expected to decline unless ma is greater than ~0.48. Gude et al. (2011) attributes differences between their results and those of Creel and Rotella (2010) to: (i) their having omitted three data points that they considered unreliable, and (ii) constructing population models that also account for the mediating influence that recruitment would have on the relationship between ma and population growth rate. Creel and Rotella (in prep) provide a reasonable explanation for why their results are appropriate even though they included these 3 data points and failed to account explicitly for recruitment. F) Vucetich and Carroll (unpubl. manusc)1 show that Gude et al. (2011) and Creel and Rotella (2010) arrived at different conclusions because they computed estimates	1	Noted, see comment above. The panel agrees that a rate range based on cited literature, and literature cited in this comment, is more appropriate.

Panelist Last Name	Comment	Question	Response
	of survival in different ways. More specifically, they show how Gude et al.'s calculations overestimate ma, which led them to overestimate the value of ma at which wolf populations in the NRM should be expected to decline. Vucetich and Carroll also reanalyzed the NRM data using an analysis that is more appropriate than that used by either Gude et al. (2011) and Creel and Rotella (2010). In doing so, they showed that wolves in the NRM are likely to decline at rates of anthropogenic mortality that exceed ~0.17.		
Vucetich	[2] The summary of research described above in point [1] contrasts with the USFWS review of the effect of anthropogenic mortality on wolf population dynamics (p. 61801): " Wolf conservation can be compatible with harvest. [A] Wolves can maintain population levels despite very high sustained human---caused mortality rates of 22 to greater than 50 percent (Keith 1983; Ballard et al. 1987; Fuller 1989; Fuller et al. 2003, pp. 182–184; Creel and Rotella 2010). [B] Mortality rates and population growth rates reported from 2007 to 2010 indicate that the wolf population in Wyoming outside YNP can sustain, on average, a 36 percent mortality rate from human causes (WGFC 2011, p. 12). [C] When populations are maintained below carrying capacity and natural mortality rates remain low, human---caused mortality can replace up to 70 percent of natural mortality (Fuller et al. 2003, p. 186). [D] Wolf pups can also be successfully raised by other pack members (Boyd and Jimenez 1994) and breeding individuals can be quickly replaced by other wolves (Brainerd et al. 2008, p. 89), which further mitigates the impact of harvest." (I added the letters in square brackets at the beginning of various sentence for the purpose of referencing those statement.) Statements [A] and [C] represent an extremely misleading interpretation of the six studies that have been conducted on the relationship between ma and r. Statement [B] is supposed to be justified by referencing (WGFC 2011, p. 12). Page 12 of WGFC (2011) says: "Mortality rates and population growth rates reported for wolves in Wyoming outside YNP from 2007 to 2010 suggest that the wolf population in Wyoming can sustain, on average, a 36% mortality rate from human causes and 43% total mortality rate without declining." This statistic is not supported by any references or analysis. Moreover, this anthropogenic mortality rate is 60% to 100% greater than existing research suggests wolves in the NRM could tolerate without being expected to decline. Existing literature suggests that a wolf population that endured these rates of mortality would be expected to decline, especially if that population is not bolstered by many immigrants each year. Statement [C] is not a result that is presented in Fuller et al. (2003), but is instead speculation that they offer to explain the results they observed. Moreover, more research suggests that the opposite it true. For example, analyses in Sparkman et al. (2011) suggest that the ma* (the value of ma at which a population is expected to decline) is lower (not greater) for populations less affected by density dependent processes (i.e., further from carrying capacity). Moreover, existing research suggests that ma* is greater for most North American populations than it is for NRM wolves. This pattern is seen for example in comparing the North American data in Fig. 19 in Adams et al. [2008] and the NRM data in Figure 2 of Creel and Rotella (2010). This pattern is also documented by Vucetich and Carroll (unpubl. manusc.). This difference may be attributable to two characteristics of the NRM wolf populations. First, NRM wolf populations have been expanding and consequently density---dependence processes, such as food limitation and territoriality, have probably not been especially influential in these populations. In such cases, anthropogenic mortality is less likely to be compensated by reductions in mortality attributable to other causes. By contrast, the wolf populations represented in the North American data set are not newly established, and consequently	1	Noted, see comment above.

Panelist Last Name	Comment	Question	Response
	are likely more influenced by density---dependent processes. In these cases, there is a greater capacity for anthropogenic mortality to be compensated by reductions in mortality attributable to other causes. Second, differences in dispersal may also account for observed differences in ma*. Specifically, the NRM populations are near the edge of their geographic range. The capacity for immigration into these populations to offset losses due to anthropogenic mortality is likely limited (see also VonHoldt et al. 2010, 2011). By contrast, the populations represented in the North American data are, for the most part, embedded deep within the geographic range of wolves. Here the capacity for immigration to offset losses to anthropogenic mortality is likely greater. This description of the ecology of anthropogenic mortality in wolves is not adequately reflected by statement [C]. Statements [C] and [D] together are meant to illustrate the ecological processes that explain why anthropogenic mortality is largely compensatory in wolf populations. From a technical perspective, anthropogenic mortality is completely compensatory with other demographic processes when the slope between ma and r is zero, and completely additive when the slope is –1. Similarly, anthropogenic mortality is completely compensated by other sources of mortality when the slope between ma and overall survival rate is zero, and completely additive when the slope is – 1. Using telemetry---based estimates of survival, Murray et al. (2010) concluded (p. 2520): "At the population---level anthropogenic mortality was largely additive, with the regression slope for annual survival vs. annual anthropogenic mortality rate being closer to 1 than zero… These findings reinforce the primacy but non--- exclusivity of additive mortality from anthropogenic causes…" If anthropogenic mortality also has indirect effects on recruitment (e.g., through the disruption of social structure or pup survival), then the overall effect of ma on r would be more severe than what is indicated by this analysis of ma and overall survival. 4 The estimated slope for the relationship between ma and r is less than –1 for the NRM wolf populations and the red wolf population (Creel and Rotella 2010; Sparkman et al. 2011; Vucetich and Carroll [unpubl. ms.]). Slopes less than –1.0 correspond to an anthropogenic mortality being super additive. That some cause--- specific mortalities are super additive, or nearly so, due to the nonlethal effects of harvest, may occur more frequently than has generally been appreciated (e.g., Milner et al. 2007, Pauli & Buskirk 2007, Vucetich et al. 2004; see also Kokko 2001). This circumstance may be more likely in species where mortality can disrupt social structure and/or the rearing of offspring (Brainerd et al. 2008; Sparkman et al. 2011). Finally, for the North American data, the estimated slope of the relationship between ma and r is –1.1 when ma=0.32 (Fig. 3 of Vucetich and Carroll [unpubl. manuscr.]). Statement [D] is true in the sense that "wolf pups can be successfully raised by other pack members" and "breeding individuals can be quickly replaced by other wolves." (italics added). However, statement [D] is misleading for implying that anthropogenic mortality is largely compensatory in the NRM wolf population, when important data suggest otherwise.		
Vucetich	[3] CONCLUSION: For the reasons explained above in [1] and [2], the Service's review of the ecology of anthropogenic mortality in wolves is inappropriate. Moreover, the review of this topic in the Wyoming management plan is virtually identical. This inappropriate review of anthropogenic mortality is a critical weakness of both the Service's proposed rule and Wyoming's plan for two reasons: (i) The Wyoming plan is largely devoted to describing the many reasons for and methods by which Wyoming plans to kill wolves (i.e., regulated public harvest, aerial gunning, lethal take permits, and allowance for property owners to immediately kill a wolf doing damage [or likely to do damage at any moment] to private property). (ii) The Wyoming plan suggests that it will use anthropogenic mortality to reduce	1	Although the other panelists agreed that the cited "acceptable" human-caused mortality rate of 36 percent was inappropriate, the other panelists did not find it to be a fatal flaw, i.e. one that would not maintain an adequate wolf population in Wyoming.

Panelist Last Name	Comment	Question	Response
	wolf abundance, which suggests it would manage for rates of anthropogenic mortality well in excessive of 36%. The Wyoming plan mentions that it will manage wolf abundance with a buffer that exceeds the minimum required number of wolves; however, the Wyoming plan does not indicate in anyway how large that buffer will be. These two circumstances and the failure to demonstrate a reasonable understanding of anthropogenic mortality mean: (i) that implementation of the USFWS proposed rule and Wyoming plan could cause declines in wolf abundance that Wyoming and the Service would not anticipate; and (ii) one cannot reasonably exclude the possibility that these "unanticipated" declines would conflict with the objectives of recovery.		
Mech	Yes, except for the following:	2	Noted.
Mech	p. 61788, col. 2, l. 2 Except in the seasonal WTGMA when open?	2	This question is not clear. The intent conveyed in the proposed rule at this location is that Wyoming will modify the State law to ensure wolves are not treated as predatory animals in the WGTMA under any circumstances.
Mech	p. 61812, col. 2, l. 40 This statement bears more discussion because it has been challenged in the scientific literature (Bruskotter et al. 2010a, b). I suggest adding a new paragraph here as follows: "Our findings that Americans generally hold favorable attitudes towards wolves has been challenged (Bruskotter et al. 2010 a, b). However a close examination of their evidence in those studies indicate that they conflated the results of a meta-analysis of public attitudes toward wolves across the world with those of Americans (Williams et al., 2002). Specifically Bruskotter et al. (2010 a, b) quoted a summary statement from Williams et al. (2002) out of context. In fact, Williams et al. (2002) stated that 60% of the 109 U.S. attitude surveys they examined from 1972 to 2000 supported wolf restoration."	2	Noted. Will make suggestion to the Service.
Mech	p. 61813, col. 2, lines 62-67 Given the Bruskotter et al. challenges, it is especially important to add "besides legal protection or regulated taking."	2	Noted. Will make suggestion to the Service.
Mech	p. 61819, col. 2, l. 38 Insert "from defense of livestock" because obviously human-caused mortality will increase considerably by hunting.	2	Noted. Will make suggestion to Service.
Mills	Yes, with only a few exceptions. See points 3B, 3C.	2	Noted. Panelist affirms the question.
Stark	Yes. I have reviewed the proposal's discussion of the five listing factors (p. 61796 –61819) and concur with the conclusions. In general these factors will likely have no significant impact to the wolf population in Wyoming as long as population levels are maintained above recovery levels as indicated in the proposal and large blocks of public land continue to support suitable wolf habitat.	2	Noted. Panelist affirms the question.

Panelist Last Name	Comment	Question	Response
Mills	Point 3B: Although within a reasonable range, the statement that "wolf populations in Wyoming outside YNP can sustain a 36% mortality rate from human causes" should be deleted from the plan document as it does not meet scientific standards. I do recommend the deletion of one often-repeated statement from the proposed rule because it does not carry credibility by itself. The statement is: "Mortality rates and population growth rates reported from 2007 to 2010 indicate that the wolf population in Wyoming outside YNP can sustain, on average, a 36 percent mortality rate from human causes (WGFC 2011, p. 12)." And yet, page 12 of WGFC 2011 only repeats that same statement; no publication, analyses or raw data are given to support the statement. Thus, although this figure falls in a range that strikes me as intuitively plausible for this species (see above), the fact that this 36% threshold in Wyoming is unsupported by available analyses or data makes it unreliable as a scientific statement; I recommend it be removed in the half-dozen or so places it is used.	2	All panelists disagree with the 36 percent "acceptable" human-caused mortality rate on the basis that it is unsubstantiated.
Mills	Point 3C: Human-caused mortality is unlikely to provide a benefit to genetic connectivity at the relevant scale. On the topic of human-caused mortality, one point that does not carry scientific credibility is that "Human-caused mortality may also provide a potential benefit to genetic exchange." (p. 61816 1st column). Although my comment here should be clear that I do not believe that human-caused mortality will overwhelm genetic exchange, I don't believe that a scientific basis exists for arguing that mortality will benefit genetic exchange across the scale being considered. The interpretation that removals are 'needed' to precipitate incoming gene flow would lead, for example, to a rather extreme idea that wolves should be removed from Yellowstone National Park to allow migrants that have immigrated into the GYA to enter the Park. If connectivity is sustained, gene flow will happen at a time scale appropriate to the species' life history and mating system. We don't need to implement mortality to promote immediate gene flow into robust populations.	2	Noted. Will make suggestion to Service.
Adams	Building from that foundation of biological information, the USFWS has accurately and adequately analyzed the threats to wolves in Wyoming and the NRM and has reached logical conclusions regarding the maintenance of aviable wolf population in the region.	2	Noted. Panelist affirms the question.
Adams	-61799, 1st col., 2nd para.: The limits reached by the Wyoming wolf population are not strictly biological. They are also related to limits of human tolerance imposed by control relative to livestock depredation.	2	Noted. No change necessary.
Adams	-61805, 3rd col., 3rd para.: The statement regarding wolf populations being se lf-regulating and intraspecific killing is infrequent except at carrying capacity is unsubstantiated and inaccurate. Intraspecific killing has been noted in newly expanding populations or restored populations (Fritts and Mech 1981 , Wydeven et al. 1995, Mech and Boitani 2003, Smith 2005), following wolfcontrol (Hayes et al. 1991) and on Isle Royale during periods of relatively high prey abundance (Peterson and Page 1988). Intraspeci fie strife is characteristic of wolf populations regardless of their status relative to carrying capacity.	2	Noted. Will make suggestion to Service.
Adams	-61806, 2nd col., 2nd para.: It is important to note that the 75% survival rate for wolves in the NRM reported by Smith et al. 2010 is probably an underestimate because of the large differences in survival of wolves collared for monitoring and depredation purposes and the inability to assess the proportions of the overall population that each group represented. Further, it is likely that the targeted, depredating wolves with markedly low overall survival were overrepresented in the marked sample.	2	Noted. Will make suggestion to Service.

Panelist Last Name	Comment	Question	Response
Vucetich	The Service's description of population ecology associated with how human---caused (anthropogenic) mortality affects wolf population dynamics is inappropriate. This concern is described in the response to question 1.	2	Noted. Panelist does not support the statement.
Stark	Yes. Despite changes to the legal status for wolves in Wyoming, the monitoring and management of wolves post delisting, as described in the proposed rule and the Wyoming wolf plan, are similar to how wolves are monitored and managed under the nonessential experimental designation that is currently in place. The one change will be a regulated harvest by Wyoming Game and Fish Department. The Department has demonstrated effective management of wildlife populations and is well suited to maintain the wolf population above the recovery objective.	3	Noted.
Mech	Yes, except for the following:	3	Noted. Panelist affirms the statement.
Mech	p. 61808, col. 3, l. 47 600 out of at least how many?	3	Noted. Question and request to clarification for Service.
Mech	p. 61814, col. 2, l. 55 Change "will" to "might"	3	Noted. Will make suggestion to Service.
Mech	p. 61820, col. 1, lines 44-45 Out of a minimum of how many?	3	Noted. Question and request to clarification made to Service.
Mills	Yes. See point 1.	3	Noted
Mills	Point #1: Numerical thresholds for delisting have emerged from detailed, long-term consideration and are neither arbitrary nor capricious. I appreciate the historical overview on the topic of minimum population sizes for NRM wolf recovery and delisting (especially pp. 61789-61790). Social conflict, especially involving livestock depredation (but increasingly pets as wolves spread into more urban zones), will inevitably affect the upper sustainable limit, or carrying capacity, for NRM wolves. NRM wolf recovery and delisting criteria (30 breeding pairs: 300 total wolves) emerged from extensive consideration of biological and non-biological factors in 1987 and 1994 and was agreed upon by stakeholders before reintroductions occurred in 1995. If the minimum size for recovery and viability were re-examined now, using current state-of-the-art viability analyses, incorporating the analytic and genetic developments of the last decade, and embracing a range of possible persistence and probability thresholds, it might be different than 30:300. But how different, and in which direction, is not clear. For example, if the robust adjacent wolf populations in Canada, sympatric with Montana NRM wolves, were included, the recovery threshold for NRM wolves may decline; on the other hand, it may also be that 30:300 is conservative and minimal, as noted on p. 61790 of the proposed rule. In short, there is nothing egregious in the 30-300 number as it stands with respect to the current state of the art in viability analyses (see Chapter 12 in Mills 2007). Of course, the minimum viable, or recoverable, population size is almost always smaller than ecologically effective population sizes, for wolves or any other species (Soule et al. 2003). This relatively recent ecological concept should be incorporated in future setting of recovery criteria for other species. However, in this case with NRM wolves, I am satisfied with 30:300 (broken down as 10:100 for each of the 3 states) as an appropriate standard for the delisting decision. It is the threshold decided on via biological considerations and extensive good faith negotiations and compromises from stakeholders involved in reintroductions in the mid 1990s,with subsequent additional evaluations. Therefore, I support the benchmark criteria (30-300 and 10-100) for delisting. The NRM wolves have exceeded these delisting criteria for a decade.	3	Noted.

Panelist Last Name	Comment	Question	Response
Adams	The biological information, analyses, and conclusions are well-supported by the relevant scientific literature.	3	Noted. Panelist affirms the question.
Adams	-61788, 3rd col., 3rd para.: "Packs typically occupy large distinct territories ... ". While wolves are territorial, their territories overlap substantially, as shown in all maps of wolf distribution in the NRM, even though these maps are commonly comprised of 95% minimum convex polygons that minimize the observed territorial overlap.	3	Noted. Will make suggestion to the Service.
Adams	-61791, 2nd col., 1st para.: " ... are measured in mid-winter when the wolf population is near its annual low point. .. " See comment above. This statement is built on the unsubstantiated assertion that mortality rates are highest prior to December 31. Additional mortality, as well as dispersal, continues throughout the winter with the wolf population reaching its annual low point in late April immediately prior to the birth of pups.	3	Noted. Will note that the statement is unsubstantiated.
Adams	-61801, 1st col., 3rd para.: The method used to derive the 36% mortality rate need to be briefly described. Given that it was based on a simple regression of only 4 years of data the range of prediction (95% confidence interval), given the amount of error likely associated with this result, would be more appropriate than the point estimate without any acknowledgement of the associated error.	3	All panelists stated that the 36 percent human-caused mortality rate was unsubstantiated and that a rate was more appropriate.
Adams	-61801, 1st col., 3rd para.: The statement for Fuller et al. 2003 that human-caused mortality can replace up to 70 percent of natural mortality is unsubstantiated and should be removed. See Adams et al. 2008 regarding a review of evidence of compensatory mortality in North American wolf studies.	3	Noted. Will make suggestion to the Service.
Adams	-61803, 2nd col., 3rd para.: Sec comment above re: 36% mortality rate. Range would be better here.	3	Noted, see comments above.
Adams	-61805, 3rd col., 3rd para.: Intraspecific killing in wolves is generally quite a bit higher than reported by Murray et al. 2010. Commonly these deaths account for about half the natural mortality.	3	Noted. Will make suggestion to Service.
Adams	-61806, 1st col., 3rd para.: See comments above re: Adams et al. 2008, estimation of 36% harvest rate, and compensatory mortality.	3	Noted, see comments above.
Adams	-61808, 3rd col., 2nd para.: See comments above re: Adams et al. 2008, and 36% harvest rate.	3	Noted, see comments above.
Adams	-61815, 1st col., 3rd para.: See comments above re: human-caused mortality.	3	Noted, see comments above.
Adams	-61820, 1st col. , 2nd para.: See comments above re: human-caused mortality.	3	Noted, see comments above.

Panelist Last Name	Comment	Question	Response
Vucetich	A. The Service's position on human--assisted dispersal is not logical for the reasons outlined below: [1] The most basic and general equation in all population biology is: Nt+1 = Nt+Bt+It--- Dt---Et, where N is abundance, B is the number of births, D is the number of deaths, I is the number of immigrants, and E is the number of emigrants. This equation highlights the three fundamental processes of a population: reproduction, mortality, and dispersal. It seems straightforward to expect that a recovered population should be able to perform these fundamental processes without the direct assistance of humans. For example, one cannot reasonably expect a population to be considered recovered if it required the regular addition of individuals from a captive population to offset either low recruitment or survival in the wild. For the same kind of reasoning a population should not be considered recovered if it cannot exhibit critical levels of dispersal on its own. [2] Perhaps an exception could be made if there were something peculiar about the natural history of the population in question that excluded its ability to disperse on its own. However, this case does not apply to NRM wolves. Wolves are capable dispersers. Moreover, the main limitation on dispersal in NRM wolves is anthropogenic mortality and the effect anthropogenic mortality has on population abundance. That is, one of the main limitations to natural dispersal is one of the main threat factors that is supposed to be removed. [4] The Service does attempt to provide a justification for why human---assisted dispersal is acceptable. First they argue that some species should be considered perpetually conservation reliant. The weakness of this reasoning is explained above in point [3]. The Service also attempts to justify the appropriateness of human--- assisted dispersal by explaining how it has for a long period of time, and in many documents, expressed its intention to use human---assisted dispersal. The weakness of this reasoning is that claiming to have intended an action repeatedly, over a long period of time, does not represent an adequate justification for an action.	3	Dr. Mills also disagreed that human-assisted dispersal should be part of the management plan; although he stated it was acceptable under "emergency" situations.
Vucetich	B. The service's account for the relationship between hunting and human tolerance of wolves is weak: The proposed rule says (p. 61813): "We believe public tolerance of wolves will improve as… hunters start to see wolves as a trophy animal with value." The proposed rule also says (p. 61813): "Despite the variety of opinions, research is scarce on what factors increase human tolerance of wolves and how those translate into conservation success by preventing excessive rates of human---caused mortality (Bath and Buchanan 1980; Williams et al. 2002; Ericsson et al. 2003; Fritts et al. 2003)." This second statement is certainly true, and it casts significant doubt on the first sentence.	3	Noted.

Panelist Last Name	Comment	Question	Response
Stark	Several citations listed may be appropriate to include in the rule. p. 61801, human-caused mortality rates - Adams et al. 2008 should be included in this and other sections discussing ranges of human – caused mortality rates. The authors determined that wolf population trends are not affected by human-caused mortality less than 30 percent per year. Adams, L. G., R. O. Stephenson, B. W. Dale, R. T. Ahgook, and D. J. Demma. 2008. Population dynamics and harvest characteristics of wolves in the central Brooks Range, Alaska. Wildlife Monographs 170. Also on this page a 36 percent human-caused mortality rate is first cited here as a sustainable level for wolves in Wyoming outside YNP. This reference to the Wyoming wolf plan figure is repeated several times in the rule. This figure represents a course evaluation of sustainable harvest for the wolf population and needs further justification if it is going to be used to demonstrate sustainable harvest. This reference could be excluded or provide further explanation of how this figure was determined. p. 61804, CPV – Although Mech et al. 2008 concluded CPV reduced overall rate of population growth in Minnesota, Mech and Goyal 2011 found that there was only a period of seven years that CPV prevalence correlated with pup survival indices. This reference should be included to update potential demographic effects of CPV and the evidence of only a temporary effect on wolf populations. Mech L. D. and S. M. Goyal. 2011 Parsing demographic effects of canine parvovirus on a Minnesota wolf population. Journal of Veterinary Medicine and Animal Health 3(2):27-30. p. 61819, wolf pack social structure – Rutledge et al. 2010 should be included in this section on consideration of human-caused mortality on wolf pack social structure. Rutledge, L. Y., K. Mills, K. M. Loveless, D. L. Murray, B. R. Patterson, and B. N. White. 2010. Protection from harvesting restores family pack structure of Eastern wolves in Algonquin Provincial Park. Biological Conservation 143:332–339.	4	All panelists agreed that additional literature was necessary to support their assumptions/arguments/conclusions.
Mech	No. See the following:	4	All panelists agreed that additional literature was necessary to support their assumptions/arguments/conclusions.
Mech	p. 61801, col. 1, l. 60 Add Adams et al. 2008 Wildlife Monograph, and Gude, J. A., M. S. Mitchell, R. E. Russell, C. A. Sime, E. E. Bangs, L. D. Mech, R. R. Ream. 2011. Wolf population dynamics in the U. S. Northern Rocky Mountains are affected by recruitment and human-caused mortality. Journal of Wildlife Management doi: 10.1002/jwmg.201	4	All panelists agreed that additional literature was necessary to support their assumptions/arguments/conclusions.
Mech	p..61804, col. 2, lines 15-21 Delete sentence and update with “Mech and Goyal (2011) recently found that from 1987 to 1993, CPV reduced pup survival, subsequent dispersal and overall population growth in the Superior National Forest of Minnesota (a population at carrying capacity in suitable habitat); after that the population apparently gained resistance to CPV.” Add “Mech, L. D. and S. Goyal. 2011. Parsing demographic effects of canine parvovirus on a Minnesota wolf population. J. of Veterinary Medicine and Animal Health 3(2):27-30” to Literature Cited and delete “Mech et al. 2008”.	4	All panelists agreed that additional literature was necessary to support their assumptions/arguments/conclusions.
Mech	p. 61808, col. 3, lines 32-34 Add Adams et al. 2008 Wildlife Monograph, and Gude, J. A., M. S. Mitchell, R. E. Russell, C. A. Sime, E. E. Bangs, L. D. Mech, R. R. Ream. 2011. Wolf population dynamics in the U. S. Northern Rocky Mountains are affected by recruitment and human-caused mortality. Journal of Wildlife Management doi: 10.1002/jwmg.201	4	All panelists agreed that additional literature was necessary to support their assumptions/arguments/conclusions.
Mills	For the most part; see especially points 4A, 4B, 4C, 5, 6.	4	Noted.

Panelist Last Name	Comment	Question	Response
Mills	Point #5: The delisting Rule should note that determination of wolf predation effects on ungulate numbers is a complex scientific question that cannot be made based on emotion or speculation. In several places, the Rule refers to wolf control being initiated based on "unacceptable impacts" of wolves on ungulate population size (eg p. 61807 middle column). Ultimately what is an 'unacceptable' effect is a normative, value-term (e.g. some would say a 1% decline in ungulate numbers due to wolf predation is too much; others would allow massive ungulate declines in order to not have a wolf be killed). However, whether an ungulate population is declining, and whether the cause is predation by wolves, is a complex question that can be addressed by rigorous biological analysis. As reviewed in Mills (2007 Chapter 8), whether or not any predator controls a prey population (eg causes the prey's growth rate to be lower than it would be in the predator's absence) depends on: a) the predation rate (a product of the predator's functional response, or kill rate, and the numbers of predator and prey); b) on whether mortality can be compensated by other mortality sources, reproduction, or immigration; and c) on which stage classes are killed (because some stages, such as fawn deer, can sustain high mortality rates without affecting deer population growth, while the same mortality on adults would affect population growth more). Merely observing a change in calf/cow ratios (p. 61807) does not indicate a decline (see Harris et al. 2008), and cannot be attributed to wolf predation just because wolves are present (eg a rich literature describes the need to consider weather, density dependence, and other predators). Likewise, an observation of wolves killing large numbers of ungulates does not necessarily imply control because the kill rate could be countered by low numeric responses, by compensation, or by the age classes being killed having low reproductive value. In short, missing in the plan is the population biology literature that makes it clear that whether or not wolves control the numbers of their ungulate prey can be answered, but not by casual observation or intuition; a careful analysis will be required. As has been found in other places and other times, wolves will be shown to cause massive decline to ungulate numbers in some cases, and to have little to no effects in others. With respect to the delisting of Wyoming wolves I do not find this to be a critical issue, as long as wolf control due to all sources (including those perceived necessary for increasing ungulate numbers) do not reduce wolf numbers below the specified thresholds.	4	This concern was also noted by Dr. Vucetich - "unacceptable impacts" to ungulate populations cannot solely be attributed to wolves without more analysis that is missing in the Plan.
Mills	Point #6: Post delisting population assessments will require improved methodology to account for incomplete detection of wolves. We have remarkably detailed information about NRM wolves, due to high agency investment, comprehensive genetic samples, and approximately 2,000 wolves being radiocollared since the early 1980s; Gude et al. (2010) notes that "30% of the known NRM wolf packs were monitored annually, and observations from monitoring these wolves were supplemented by agency track surveys and public observations of wolf pack size for the remaining packs." Even with this intensive efforts, these are abundance indices, without accounting for wolves missed in monitoring efforts. I realize that post-delisting the collection of genetic samples will be intensive and extensive, a terrific idea. Less mentioned in the proposal, however, is how abundance estimates, and therefore trend evaluation, will be made. Because abundance estimates depend on both animal abundance and the probability of detecting them, and because detection probability can change over both time and space (eg it will be lower in thick forests; see p. 61795), I encourage agencies to establish formal frameworks to estimate detection probabilities as part of an abundance estimation protocol (as opposed to counts uncorrected for – and therefore confounded by – detection probabilities). This will incorporate the 'best available science' for wildlife population monitoring, critical given the	4	All panelists agreed that incomplete detection of wolves make it difficult to predict population size and consequentely, impacts.

Panelist Last Name	Comment	Question	Response
	contentious nature of monitoring this species.		
Adams	-61790, 3rd col., 1st para., last line: .. ... following the point of the year with the highest mortality rates (summer and fa ll); ... " I am unaware of any literature supporting the contention that mortality rates are highest during summer and fall. Further, dispersal from packs is an important mechanism resulting in population decline throughout the winter. This statement needs to be supported by literature citation, modified or removed.	4	Noted, will make suggestion to the Service.
Adams	-61801, 1st col., 3rd para.: Adams et al. 2008 contains a recent and complete assessment of sustainable human-caused mortality and should be included here.	4	Noted, see comments above.
Adams	-61814, 3rd col., 2nd para.: The statement about limited social openings in YNP serving as a barrier to dispersers through YNP is unsubstantiated and unlikely. While there is genetic evidence that dispersers have not successfully entered the YNP resident population and bred (vonHoldt et al. 2007), that provides no evidence one way or the other regarding wolves dispersing through the area.	4	Noted. Will make suggestion to the Service.
Adams	-61817, 1st col., 2nd para.: The Isle Royale example is no longer relevant given the recent detection of an immigrant that successfully bred on the island. Given that this immigrant was only detected via intensive genetic monitoring in place for just the last several years of the Isle Royale study, it is certai nly conceivable that other undetected immigrants made it to the island carlier in the study. Further, the Kenai Peninsula is a poor example given the lack of any evidence that the wolf population there is truly isolated from mainland populations. In general, this paragraph is unnecessary given that dispersal by wolves in the NRM is likely to provide sufficient genetic connectivity, and Wyoming have agreed to monitor gene flow and take act ion if gene flow is below the 1 effective migrant per generation, thus well in advance of any notable loss in genetic diversity.	4	Noted. Will make suggestion to the Service.
Vucetich	On page 61817, the Proposed rule uses Isle Royale wolves as an example of a population that does not suffer from inbreeding depression. Two papers explain how the fitness and demography of Isle Royale wolves have been affected by inbreeding depression. These papers are: * Adams et al. 2011. Genomic sweep and potential genetic rescue during limiting environmental conditions in an isolated wolf population. Proc R Soc. 278(1723):3336---44. * Raikkonen, J., J. A. Vucetich, R. O. Peterson, M. P. Nelson. 2009. Congenital bone deformities and the inbred wolves (Canis lupus) of Isle Royale. Biological Conservation 142(5): 1025---1031.	4	Noted. Will make suggestion to the Service.
Stark	Yes. Although I expect from the information in the proposed rule and the WY wolf management plan for the population to exceed the agreed to objective of at least 10 breeding pairs and at least 100 wolves in Wyoming outside of YNP, counting wolves outside the WTGMA towards this objective should be avoided if packs are not expected to persist in the area outside the WTGMA. The objective would be better addressed if only those wolves in the WTGMA counted towards the 10 & 100 objective.	5	Noted. Panelist affirms the statement.
Mech	Yes, and although the recovery criteria of 300 wolves and 30 breeding pairs were originally determined subjectively by a panel of wolf authorities in a process similar to the Delphi Method, upon my current review, and knowledge of wolf population persistence (Fuller et al. 2003: Table 6.9) these numbers still seem adequate.	5	Noted. Panelist affirms the statement.
Mills	Yes, see 2, 3, 3A, 4, 4A. However also see 4B for the final part of this question.	5	Noted.

Panelist Last Name	Comment	Question	Response
Mills	Point #2: The potential re-listing thresholds provide an incentive for Wyoming to maintain wolves above the minimum threshold after delisting occurs. Under terms of the proposed delisting, Wyoming Game and Fish Department (WFGD) would maintain at least 10:100 (10 breeding pairs and 100 total wolves), measured in midwinter, and including GTNP and the National Elk Refuge (small areas that hold only transboundary packs), but not counting YNP or Wind River Indian Reservation. Instead of the 'step down' buffer of an additional 50% more (5:50 for a total of 15:150) being managed by the state, as in Montana and Idaho, the Wyoming Plan is to have the step down extra buffer (5:50) be sustained in YNP and Wind River Indian Reservation. As a result, the minimum requirement for wolves under Wyoming state management is 10:100. Both the proposed rule and the Wyoming Plan (WGFC 2011) state that Wyoming does not intend to reduce the Wyoming population down to this minimum 10:100 level, and will instead provide a buffer that is "adequate", "sufficient", or "comfortably above" the minimum. Such a buffer is stated to be necessary to protect against unexpected losses of wolves that may arise from takes in defense of property, perceived ungulate losses requiring special regionspecific wolf hunts, uncertainty in counts, and disease. I agree with this stated need to provide a buffer above the 10:100 threshold, but just what this "adequate" buffer would be, or how it would be determined, is never specified in the plan. Further, both the delisting proposal (eg p. 61822 middle column) and especially the Wyoming Plan make clear that Wyoming is not obligated to maintain more than 10:100 (eg WGFC 2011: last sentence of Executive Summary). At the same time, the Plans make clear the pressures that could inexorably pressure the WGFD to allow harvest to push wolf numbers closer and closer to the razor edge of the 10:100 minimum: e.g. hunting opportunities for the public, depredation actions, and perceived 'unacceptable impacts' by wolves on ungulate populations (See my point 5 below). Although the plan provides no real evidence (beyond assurances) that Wyoming would not harvest wolves all the way down to as close as possible to 10:100, a criteria is provided in the form of re-listing criteria (page 61822). Specifically, the USFWS would initiate a formal status review for relisting if the Wyoming wolf population falls below specified thresholds for 1 or 3 years, and including or excluding YNP and Wind River Indian Reservation wolves from the count. The prospect of a relisting review is obviously one that the state of Wyoming would like to avoid. So even though we're not given an operational protocol for how an 'adequate' buffer above 10:100 would be established by WGFC, I am comforted that indeed a buffer will be in place, if for no other reason than to make sure relisting review does not occur.	5	Noted. Will make suggestion to Service.
Mills	Point #3: Wolf populations can sustain relatively high mortality rates. Overall, the proposed rule does provide accurate and adequate review and analysis of the factors relating to the threats. With respect to harvest, wolves have a high intrinsic growth rate and the ability to compensate some human-caused mortality through replacing other mortality sources, as well as compensation via reproduction and immigration. That NRM wolf populations can grow in the face of human-caused mortality is evidenced by the fact that NRM wolves have continued to increase in numbers (approximately 20% per year) even as human caused harvest under ESA Threatened status has remained substantial: 23% mortality rate since reintroduction arising from illegal kills (10%), control actions due to livestock conflicts (10%), and accidental human causes (3%) (P. 61806 1st column). Exactly how much mortality can be sustained before causing a population to decline is a complex topic (eg Mills 2007 Ch. 8, 14), but the proposal's review of the topic is adequate in listing a range of figures applicable to wolves, from 20% to up to about 50% [these figures are given, for example, on p. 61801 col 1; p. 61806 col 1;	5	Noted. Panelist affirms the question.

Panelist Last Name	Comment	Question	Response
	61808 col. 3; p. 61815 col 1 and 2, p. 61820, col 1].		
Mills	Point 3A: Because it includes most of the wolves in Wyoming, the approach of managing the "Wolf Trophy Game Management Area" is reasonable. The document convincingly addresses the Wyoming Management plan to manage harvest in a Wolf Trophy Game Management Area (WTGMA) in the western portion of Wyoming. Wolves will be hunted without regulation outside the WTGMA in a so-called 'predator zone', and are not expected to persist there. The document notes that although the WGMA consists of only 16% of the state, the region comprises 100% of the original Greater Yellowstone Area within Wyoming, the majority of suitable habitat (defined at least in part by social tolerance compared to the open, sheep-and-cattle country outside of NW Wyoming) and, most importantly, the entire home range for 24 of 27 breeding pairs and 24 of 34 packs currently in the state (pp. 61786-61787). The WTGMA would be seasonally flexed approximately 80km southward from October 15 through February to facilitate some natural dispersal of wolves and Idaho during that period (the region will be part of the predator zone for the rest of the year). Although small as a percent of the state, the fact that the WTGMA contains virtually all of Wyoming's wolves and wolf habitat implies to me that it will be sufficient to sustain both the requisite number of wolves and necessary levels of connectivity to other parts of the NRM population.	5	Noted. Panelist affirms the question.
Mills	Point 4c: Although inbreeding depression is not a pressing concern for NRM wolves under delisting, the general importance of inbreeding depression for population persistence should not be dismissed. I recommend that the final rule remove the paragraph on Page 61817 beginning with "In all but the most extreme cases", because it seems to imply in general inbreeding depression is merely 'theoretical' or hypothetical in its potential effects on persistence of small wildlife populations. For many species, the effects of inbreeding can and have been measured with hard field data, including pedigrees based on observation or molecular genetic analysis, and fieldbased vital rate measurements. Likewise, thesecosts of inbreeding can and have been incorporated into rigorous (not 'theoretical') population models based on first principles of life, death, and population dynamics (see Mills 2007). In this sense, inbreeding depression, and its potential effects on population dynamics, is no more theoretical or hypothetical than the effects of harvest, predation, density dependence, weather, or any other potential stressor on a wildlife population. In all cases, each of these factors may have effects that range from high to nonexistent. Also, the description on p. 61817 of several wolf populations that have persisted through small bottlenecks is irrelevant to the question of inbreeding depression, just as a record of 3 friends who smoked a pack of cigarettes per day and lived to be 100 years old cannot be taken as evidence for or against the harmful effects of smoking. In other words, highlighting the populations (of any species) that made it through bottlenecks and persisted, while ignoring (because they are extinct) those that did not persist, leads to unreliable inference. Although not a concern in the case of NRM wolves, inbreeding depression remains a real and prevalent driver in many populations under many circumstances. In short, this section is unnecessary and risks appearing to wrongly imply that in general (beyond NRM wolves) inbreeding depression is more theoretical, and therefore less relevant, to small population dynamics than other stressors such as density, predation, or weather. Inbreeding depression has already been credibly and well-established in this document as not a primary concern for delisting NRM wolves in general or Wyoming wolves in particular, and this paragraph is unnecessary and could be interpreted as a false general statement going beyond NRM	5	Noted. Will make this suggestion to the Service.

Panelist Last Name	Comment	Question	Response
	wolves.		
Adams	The Wyoming Gray Wolf Management Plan clearly establishes that the State has committed to managing wolves to maintain a population of at least 10 breeding pairs and 100 wolves on lands under their jurisdiction. As described in the proposed rule, this commitment by Wyoming, along with commitments from Idaho and Montana, will ensure that the NRM wolfpopulalion is maintained above the specified recovery goals.	5	Noted. Panelist affirms the question.
Adams	While the Wyoming Plan specifically commits to "manage for at least 10 breeding pairs and at least 100 wolves in Wyoming outside YNP (Yellowstone National Park) and the WRR (Wind River Reservation)" (pg. 1; parenthetical infonnation added), it is justifiably lacking in detail on how wolf management in the State will actually play out given the many uncertainties. Therefore, as a reviewer I needed to consider the likely outcome of their management based on realistic assumptions. It is reasonable to conclude that Wyoming will manage wolf numbers well above the 10 breeding pair/100 wolf level to avoid relisting under the Endangered Species Act (ESA) while maintaining sufficient wolf numbers to accommodate control actions to address specific livestock depredation cases, conflicts on elk feed grounds and other wolf/human conflicts, as well as hunter harvests. Further, some wolves under Wyoming's management will be subject to harvest/control in adjacent states or Wyoming's predator area as they travel in and out of those areas. In concert, these factors will req uire that Wyoming manage conservatively with a sizable buffer above the minimum population levels they have agreed to. It is clearly stated in the Wyoming Plan that they will not authorize lethal control of wolves if it will risk relisting under the ESA (pg. 32) and they intend to approach harvests in a gradual and incremental fashion as they gain experience in managing wolves (pg. 24), indicative of an overall conservative approach.	5	Noted. Panelist affirms the question.
Adams	As thoroughly described in the proposed rule, northwest Wyoming contains most of the suitable wolf habitat in the State capable of supporting persistent wolf packs, thus contributing to the regional Yellowstone population. Wyoming's Wolf Trophy Game Management Area (WTGMA) encompasses most of that suitable habitat and is of sufficient size to maintain the portion of the regional population that Wyoming has agreed to. However, because Wyoming has drawn a specific management boundary that detennines where wolves will and will not be allowed to persist, the Wyoming contribution of at least 10 breeding pairs/100 wolves should be limited to the WTGMA. Outside the WTGMA, wolves will be subjected to unregulated harvest and are not expected to persist (61798, pt col., 2nd para.). As described above, Wyoming will likely manage well above the 10 breeding pair/100 wolf threshold, minimizing the chances that wolves that happen to briefly persist outside the WTGMA during the end-of-the-year census period will be necessary to meet the minimum threshold. However, should the State's wolf population decline to near that threshold, it is only reasonable that wolves counted toward recovery goals have some realistic potential for persisting in the population.	5	Noted. Panelist affirms the question.
Adams	-61811 , 1st col., 1st para.: The statement "Within the WTGMA, Wyoming has agreed to maintain a population of at least 10 breeding pairs and at least 100 wolves in areas under State jurisdiction." is incorrect. The state plan does not limit their agreement to ensure 10 breeding pairs and 100 wolves to the WTGMA, but those wolves can occur throughout Wyoming.	5	Noted.

Panelist Last Name	Comment	Question	Response
Vucetich	[1] On 17 Oct 2011, the peer---reviewers of the proposed rule and Wyoming plan met in Denver to discuss these documents. At this meeting, the people representing the proposed rule and the Wyoming plan expressed: (i) a very clear intention to manage wolves without compromising the objectives of recovery, and (ii) a very clear understanding of the negative consequences of failing to meet this intention. I was impressed by these expressions – they represent a strong reason to believe that wolves will remain recovered in Wyoming for some period of time after delisting. However, several critical portions of the Wyoming plan do not seem quite congruent with these expressions of intent. This disparity is important because wolves in Wyoming may be managed, at some point in the future, according to the principles of the written plan without as much regard for the intentions expressed at the 17 Oct meeting. So, while I was impressed by these verbal expressions of intention, my responsibility is to review the proposed rule and the Wyoming plan. My comments in this review are, for this reason, focused on the written documents.	5	Noted.
Vucetich	[2] Wyoming's management plan does not allow the Service to reasonably conclude that Wyoming's approach to wolf management is consistent with agreed upon objectives of recovery. This concern is largely associated with Wyoming's plans for harvesting and lethally controlling wolves.	5	Noted. Panelist does not agree that the Plan is consistent with maintaining recovery goals.
Vucetich	[3] The WY plan states (p. 23): "The primary purpose of regulated public harvest of wolves in Wyoming will be to manage the wolf population and alleviate conflicts with livestock, domesticated animals, and unacceptable impacts to big game." Several important concerns for the WY plan arise from reviewing each of the three stated purposes.	5	Noted. Will provide these concerns to the Service.
Vucetich	[4a] One purpose of wolf harvesting is to "manage the wolf population." The grammar of the sentence explaining the purpose of the harvest suggests that "manage the wolf population" is different than "alleviate conflicts with livestock, domesticated animals, and unacceptable impacts to big game." One might infer, from the WY plan, that "manage the wolf population" means control wolf abundance. If not, then what does that phrase mean? If so, then what abundance will managers target? The WY plan does not answer these questions. Specifically, the WY plan does not adequately indicate how many wolves the state will manage for, in the areas outside YNP and WRR. Several passages of text in the plan refer to (e.g., p. 7): "the objective of at least 10 breeding pairs and at least 100 wolves outside YNP and the WRR." However, the plan also draws prominent attention to (p. 1): "Wyoming would not be required to contribute more than 10 breeding pairs and 100 wolves outside YNP and the WRR." Is Wyoming's management plan, for the areas outside YNP and WRR, designed to result in no fewer than 10 breeding pairs and 100 wolves, or no more than 10 breeding pairs and 100 wolves? The WY plan also says (p. 24): "The Department will manage for a buffer above the minimum objective of 10 breeding pairs and 100 wolves because this allows for the flexibility needed to resolve wolf conflicts through control actions." Wyoming's apparent understanding is correct in that: (i) managing a harvest for the purpose of reducing abundance without letting abundance fall below a minimum threshold requires a buffer, and (ii) without a buffer the objectives of the harvest would conflict with the objectives of recovery. For the same reasons, the objectives of the harvest would conflict with the objective of recovery, if the buffer is too small. The WY plan does not indicate in any way how large or small that buffer will be. Without knowing more about the size of the buffer there is reason to be concerned that the objective of the regulated public harvest (and other plans for managing anthropogenic mortality) are inconsistent with the objectives of recovery. On page 6 the plan says:	5	Noted. Other panelists expressed concern with the lack of buffer on the 10/100, this concern will be communicated to the Service.

Panelist Last Name	Comment	Question	Response
	"Step--down recovery targets require Montana, Idaho, and Wyoming to each maintain at least 10 breeding pairs and 100 wolves by managing for a safety margin of at least 15 breeding pairs and at least 150 wolves in mid--winter." Because no other details are provided about the buffer, one might infer that the buffer is the 5 breeding pairs and 50 wolves that are the "agreed upon" minimum numbers in Yellowstone National Park and Wind River Reserve. If so, that would be an inappropriate buffer. If a regulated public harvest is expected to reduce abundance to a level that is numerically close to the recovery target, then objectives of the harvest would conflict with the objectives of recovery. Because the Wyoming plan does not indicate what abundance it will target, the Wyoming plan does not exclude the possibility that this objective harvest is inconsistent with the objectives of recovery.		
Vucetich	[4b] A second purpose of the regulated public harvest is to "alleviate conflicts with livestock [or] domesticated animals." The Wyoming plan describes other well--- developed plans for controlling these conflicts (i.e., aerial gunning [p. 53), lethal take permits [p. 22], and allowance for property owners to immediately kill a wolf doing damage [or likely to do damage at any moment] to private property [p.22]). This purpose of general harvest suggests that the state of Wyoming believes these other plans would be inadequate for alleviating conflict with livestock. This suggests that WY has a high standard for alleviating conflict. If these other plans do not (meet the apparently high standards to) alleviate conflicts, what kind of regulated public harvest would be able to alleviate conflicts? If the standards for alleviating conflict are high enough, then objectives of the harvest would be inconsistent with the objectives of recovery. Because the WY plan does not adequately explain the standards for alleviating conflict, one cannot confidently conclude that the objectives of the harvest are consistent with the objectives of recovery.	5	Noted. The panelist does not agree that the recovery goals will be met.
Vucetich	[4c] A third purpose of the regulated public harvest is to "alleviate… unacceptable impacts to big game." The WY plan also states that the (p. 39): "Commission has defined 'unacceptable impact' as any decline in a wild ungulate population or herd that results in the population or herd not meeting the state population management goals or recruitment levels established for the population or herd' in Commission regulation." The logic of this statement is functionally equivalent to defining an 'unacceptable impact' as any decline that does not meet desired goals. The statement is a virtual tautology. For the purposes of managing wolves, the WY plan's explication for the meaning of "unacceptable impact" is inadequate because: If the standards for alleviating conflict and unacceptable impact are high enough, there is reason to be concerned that the objectives of the harvest are inconsistent with the objectives of recovery. The WY plan states (p. 39): "Management actions may be taken where wolves significantly affect ungulate populations. Wolves may be lethally removed when, based on best scientific data and information available, the Department determines a wild ungulate herd is experiencing unacceptable impacts or when wolf/wild ungulate conflict occurs at state operated feedgrounds." These statements fail to provide due diligence in recognizing the great difficulty of knowing why a population is declining, especially when that population is affected by many factors such as climate, forage availability, harvest, and predation. Elk on the Northern Range of Yellowstone National Park is an illuminating example. That population declined from 1995 to 2004. That decline is associated with a remarkable amount of information that has been studied and scrutinized intensively by many researchers (e.g., Vucetich et al. 2004; White & Garrott 2005; Varley and Boyce 2006; Eberhardt et al. 2007). Nevertheless, seven years after that decline there is still no	5	Noted. The panelist does not agree that the Plan is consistent with recovery goals.

Panelist Last Name	Comment	Question	Response
	consensus on the relative influence of climate, harvest and predation on that elk decline. Recent moose decline in northern Minnesota represents another important example of the difficulty of attributing population decline to one factor 9 (such as predation), when many factors are involved (Murray et al. 2006). In failing to recognize these difficulties, the above---cited statement from page 39 suggests a particularly aggressive approach to managing wolves and may be inconsistent with the objectives of recovery. If the standards for unacceptable impact are high enough, then objectives of the harvest would be inconsistent with the objectives of recovery. Because the WY plan does not adequately explain the standards for what counts as unacceptable impact, one cannot confidently conclude that the objectives of the harvest are consistent with the objectives of recovery.		
Vucetich	[5] In addition to describing the purpose of a regulated public harvest, the Wyoming plan includes text (pages 23---25) intended to describe how it would establish quotas. The level of detail and specificity for how quotas will be established is well captured by (p. 25): “The department will take into consideration, but not be limited to, the following when developing wolf regulations: wolf breeding seasons; short and long range dispersal opportunity, survival, and success in forming new or joining existing packs; conflicts with livestock; and the broader game management responsibilities related to ungulates and other wildlife.” It is certainly important that these factors be “take[n] into consideration.” However, the WY plan offers virtually no detail about how it will take these factors into consideration. This lack of detail represents a critical inadequacy because the Wyoming plan (and the Service’s proposed rule) also demonstrates an inadequate understanding for the effect of anthropogenic mortality on wolf populations in the NRM (see page 1 of this document). The Wyoming plan states (p. 23): “The Department will use an adaptive management approach to employ harvest strategies to meet management objectives.” While this statement appears as though it might be intended as the topic sentence of the paragraph in which it appears, no further explanation for this sentence is offered. As such, one can only infer that the currently planned approach for setting quotas will change if future contingencies suggest the need for change. This is fine, except there is no adequately detailed explanation of the currently planned approach for setting quotas. The only operational detail offered in the plan for how the department will determine each year’s quota is (p. 24): “The Department plans to manage wolf numbers with graduated increases in hunting quotas over a series of years.” This may be fine if the harvest begins at a low enough rate. However, there are doubts about Wyoming’s understanding about what might represent a low enough rate (see page 1 of this document).	5	Noted. The panelist does not agree that the Plan is consistent with recovery goals.
Vucetich	[6] SUMMARY: Hunting and lethal control is not necessarily incompatible with recovery, but it can be. Anthropogenic mortality is a threat factor for NRM wolves. For this reason, a regulated public harvest is not an obvious tool for maintaining recovery. As such, it is reasonable to expect adequate answers to these questions, What is the purpose of the regulated public harvest? and What are the details for how each year’s quota will be determined? The WY plan does not offer adequate answers 10 to these questions. The ideas in [1] and [2] suggest that the objectives and (or) implementation of the harvest may well be inconsistent with the objectives of recovery.	5	Noted. The panelist does not agree that the Plan is consistent with recovery goals.

Panelist Last Name	Comment	Question	Response
Stark	Yes. The level of gene flow adequate to prevent genetic problems is supported by vonHoldt 2010 and represents a minimum level of gene flow that has occurred in Wyoming, GYA, and the NRM wolf population. This study was conducted with data through 2004 and a wolf population of 835 wolves. The current population is at least 1,600 wolves and at nearly twice the population number has likely much higher gene flow than it did in 2004. Dispersal information based on radio-collared wolves cited in the proposed rule further supports effective migration of wolves between recovery areas in the NRM region (Jimenez et al. 2011). Although likely not a barrier to dispersal, because wolves move through YNP and other parts of Wyoming to contribute to the connectivity of the region the flex area of the WTGMA will further facilitate dispersal during peak times of the year. Genetic as well as radio monitoring by the Wyoming Game and Fish Department will be adequate to document effective gene flow for the Wyoming wolf population and the GYA.	6	Noted. The panelist affirms the question.
Mech	Yes, but on p. 61815, col. 1, l. 8, it would be more accurate to change “almost certainly” to “probably”.	6	Noted.
Mills	Yes, see 4, 4A, 4B.	6	Noted
Mills	POINT #4: Genetic connectivity for wolves will be sufficient with the proposed delisting As I have noted in a declaration to the U.S. District Court (Mills 2008), I believe the wolf’s life history, as well as extensive radiotelemetry and genetic data for NRM wolves, minimize threats from inbreeding depression in the GYA. Additional studies since 2008 reinforce this conclusion and indicate ongoing genetic connectivity across the NRM. First, Jimenez et al. (Unpubl. Manuscript, referred to in proposed rules as “Jimenez et al. 2011”, available from author and from USFWS website) has amassed a remarkable dataset from 681 wolves radiocollared in NRM from 1993-2008. Of these, 281 wolves dispersed (this comprised 10% of the population, overall). The majority of dispersal events (58%) occurred between October and February, the times when the WTGMA would be flexed south to incorporate exactly this peak of dispersal. Some of the movements were long-distance (23% of dispersers >100 miles, the distance between central Idaho and occupied areas in GYA), and in all directions. Finally, 35% of dispersing wolves reproduced. These findings underscore the critical fact that wolf connectivity should be high as long as mortality in connectivity zones is not excessive. Of course, genetically effective dispersers will be fewer than dispersals per se if the dispersers do not successfully reproduce (Mills et al. 2003). In the case of NRM wolves, many dispersers are reproducing, meaning that genetically effective dispersal is occurring. As noted on p. 61814 of the Rule, VonHoldt et al. (2010; see also perspective on this article by Hebblewhite et al. 2010) conducted an ambitious analysis of NRM wolf samples 1995-2004 and showed minimum gene flow estimates of about 3 per generation among the 3 main subpopulations, including into the GYA. Although no gene flow was documented into YNP per se, this is clearly not an issue of human perturbation but rather due to challenges for immigrants to enterthe established social structure in the Park (i.e. territory saturation). Also, the sampling was incomplete (only a portion of the population sampled) for the time period considered, and extend only to 2004, again indicating that these are minimal gene flow estimates. Further, as mentioned in the previous paragraph, the Jimenez et al. (unpublished) telemetry data through 2008 directly documents dispersal, including breeding in GYA (p. 61814). Overharvest is the only plausible factor that would cause genetic connectivity to be inadequate for NRM wolves into the future. The seasonal wolf trophy game management area -- where the WTGMA is extended 80 km south for 4.5 months during from mid October through February -- seems critical in	6	Noted. The panelist affirms the question.

Panelist Last Name	Comment	Question	Response
	this regard. Based on the observed dispersal patterns of NRM wolves over time and across their range (eg page 61814; also Jimenez et al. unpublished Figure 1), reducing mortality in this seasonal WTGMA zone during the times of peak dispersal is an important step to nurture continued connectivity. In short I believe it is reasonable to conclude that the proposed rule, in the context of wolf management throughout the entire NRM region, will provide for sufficient levels of gene flow to prevent genetic problems from negatively impacting the GYA's population or the larger NRM metapopulation.		
Mills	Point 4A: 'One [effective] migrant per generation' is a reasonable rule of thumb for delisting purposes, but should be updated for future monitoring and evaluation post-delisting. The delisting Rule grounds its assessment of sufficient genetic connectivity on "onemigrant-per-generation" (eg p. 61814). This rule of thumb (often generalized to 1 to 10 migrants per generation to account for mating system and immigrant idiosyncracies) has wide acceptance in conservation genetics (Mills and Allendorf 1996, Mills 2007), because it provides a reasonable tradeoff between the benefits of gene flow to reduce genetic drift versus the costs of gene flow in swamping local adaptive variation. Both field (eg telemetry) and genetic data described above indicate that NRM wolves have achieved this level of genetically effective connectivity. While the one-migrant-per-generation is useful as a rule of thumb at this point for evaluating sufficiency of genetic connectivity, future evaluations of connectivity can and should be much more sophisticated, accounting for observed genetic structure, disperser characteristics, landscape barriers, and other factors. The genetic samples and radiotelemetry data can be placed into a population dynamic modeling framework to provide more accurate and spatially efficient assessments of sufficiency of gene flow.	6	Noted. Suggestion will be made to Service.
Mills	Point 4B: Human assisted migration should be considered a method of last resort. Because connectivity via natural movements is likely, and presumably will be nurtured as described in the proposed Rule, I encourage more critical consideration of the prospect of managed relocation of individual wolves. Page 61816 notes that "Human intervention in maintaining recovered populations is necessary for many conservation-reliant species and a wellaccepted practice in dealing with population concerns (Scott et al. 2005)." It should be clarified, however, that Scott et al. (2005) did not intend for continued managed relocations to be a legitimate strategy for sustaining a conservation reliant species: "Although occasional translocations to maintain genetic diversity would not violate this notion of a self-sustaining population, frequent translocations to overcome anthropogenic dispersal barriers or to compensate for losses due to predation disease, or other mortality factors would." (Scott et al. 2005:386). Although wolves will likely always be a high-investment species for whatever state or federal agency is responsible for managing them, it seems inefficient, unnecessary, and counter to the objective of the ESA to conserve ecosystems [ie ESA sec 2(b)] to rely heavily on managed translocations of a species that would, with management to sustain survival of dispersers, be perfectly capable of persisting on its own (Scott et al. 2005). Another advantage of managing dispersal of natural connectivity as opposed to managed translocations is that managed translocations requires decisions on which individual(s) should be moved. Relevant considerations would need to consider demographic effects of removals on the source populations, screening for potential disease transmission or behavioral issues and, in the long term, whether local adaptation may be compromised by the managed translocation. Risks are inherent in these choices. In short, I encourage a focus on managing for natural connectivity, viewing managed translocation as a rare and extreme option to be implemented only in emergency situations.	6	Noted. Suggestion will be made to Service.

Panelist Last Name	Comment	Question	Response
Adams	Wyoming, along with the other 2 states, have committed to a program of genetic monitoring to guarantee that in the unlikely event that gene flow into the Yellowstone recovery area is insufficient, that the deficit will be detected and appropriate actions can be taken.	6	Noted. Panelist affirms the question.
Adams	Establishment of the predator area encompassing much of Wyoming, where wolves will be subjected to unregulated harvest, has certainly been controversial. However, there is little functional difference between Wyoming's explicitly-defined predator area and eastern Montana or southern Idaho where wolves have not become established, even under ESA protection, due to lack of suitable habitat and high potential for livestock conflicts. In. any case, wolves that move into these areas are likely to be subject to removal and unlikely to persist. In Wyoming, wolves can be killed as soon as they are detected in the predator area, whereas in the other 2 states they are generally eliminated once they begin depredating li vestock. Any minor difference in timing of removal has little bearing on maintaining viable wolf populations in the NRM because these areas are peripheral to the core regions of suitable habitat and thus are not important for maintaining gene now among the 3 recovery areas.	6	Noted.
Adams	The seasonal expansion of WTGMA was included in the Wyoming plan to facilitate natural dispersal from central Idaho into the Yellowstone population. I doubt this management prescription will contribute much to gene flow. Most of the dispersers coming into the Yellowstone region will come from areas north of the seasonal expansion area. Although there is some evidence that dispersers were unable to settle into the YNP population prior to 2004 (vonHoldt et al. 2007), I doubt that has continued and certainly dispersing wolves are capable of travelling across areas inhabited by existing wolfpacks, thus YNP would not present any kind of barrier to dispersers. Further, any dispersers that successfully breed in the Yellowstone region, including along the northern and western edges where there may be more turnover of wolf packs than in the core of YNP, will contribute to the genetic diversity of wolf population of the Yellowstone recovery area.	6	Noted.
Adams	Under the NRM recovery criteria, the recovery area is the appropriate ecological scale to assess each of the 3 contributing populations, whereas State wolf management thresholds are politically necessary to ensure that each State's responsibility for wolf conservation is "fair, consistent, and clear" (61791 , 1st col., 1st para.). Wolves in the Yellowstone recovery area are likely to occur in excess of the 15 breeding pair/150 wolf buffer above the recovery threshold, given the contribution of at least 10 breeding pairs/100 wolves from Wyoming along with expected wolf numbers in YNP and the Idaho and Montana portions of the recovery area. Further, NRM wolves are unlikely to suffer from losses of genetic diversity given they occur as an extension of the extant wolf population stretching across northern North America and the propensity for wolves to disperse long distances and become established within existing wolf populations. In the improbable event that gene exchange is inadequate, the States have agreed to monitor genetic diversity and take action to correct any deficiencies that are detected.	6	Noted.

Panelist Last Name	Comment	Question	Response
Adams	·61815, 1st col., 1st para.: The statement that" ... if genetic exchange drops below one effective migrant per generation, the States will implement a human-assisted migration program ... .. is not accurate. The Wyoming plan (pgs 28-29) states that should genetic connectivity be insufficient they will "invoke adaptive management" that will include at least the following "as deemed appropriate": improved genetics monitoring, population management, and translocation for genetic purposes. Further, the MOU regarding protecting genetic diversity for NRM wolves states that "translocations or other management techniques" will be used " if demographic or genetic monitoring suggests that wolf populations are likely to become threatened for genetic-related reasons" with no mention of the I effective migrant per generation criteria.	6	Noted. Suggestion will be made to the Service.
Adams	-61816, 2nd col., 2nd para.: This section need some revision to present a clear and response to the detection of insufficient genetic exchange. It is odd that reviewing and revising monitoring protocols is the first response mentioned to lower than desired genetic exchange. While that would be an important component of the response, the response should focus assessing management actions that could be limiting gene flow and adjusting them as necessary. In the second paragraph, the sentence beginning "Specifically, Wyoming will .. " is a better lead in to the response to low genetic exchange, with evaluation of monitoring methods to follow .	6	Noted.
Vucetich	It may not be reasonable for the Service to conclude that Wyoming's approach to wolf management (and the approach of other states) is likely to maintain sufficient levels of gene flow.	6	Noted. Panelist does not agree that the Plan will ensure sufficient gene flow.
Vucetich	[1] The WY plan indicates that its objective for maintaining sufficient levels of gene flow is (p. 54) “at least one effective natural migrant per wolf generation entering into the GYA.” Existing literature suggests that this objective for immigration is appropriate. However, adequate connectivity among the NRM wolves should involve not only immigration into Wyoming, but also emigration from Wyoming into the other populations in the NRM. The Wyoming plan makes no provision for emigration.	6	Noted. Suggestion will be made to Service.
Vucetich	[2] The WY plan indicates that its overall management of wolves (with provisions for a regulated public harvest, aerial gunning, lethal take permits, and allowance for property owners to immediately kill a wolf doing damage [or likely to do damage at any moment] to private property) is likely to result in meeting the objective of sufficient genetic connectivity. The primary reason offered by the WY plan for this conclusion is that genetic connectivity was (p. 27) “more than adequate when the NRM wolf population was much lower than the current number (≥5.4 migrants per generation at a population of ~835 wolves in 2004 vs. ~1,614 wolves in 2010).” This reason is weakened by two concerns. First: This statement is based on work by Von Holdt et al. (2010). When I read these papers and spoke with an author of these papers, the impression I get is that during the ten years (1995---2010) that were studied: (i) The GYA produced zero emigrants that migrated to and reproduced in either CID or NWMT, (ii) one wolf from CID migrated to and reproduced in GYA, and (iii) two wolves were translocated from NWMT into the GYA. This corresponds to less than 0.5 effective immigrants per generation occurring naturally (i.e., not human---assisted migration). Also, dispersal data gathered from radio---collared wolves living between 1992 and 2008 suggest that the GYA received approximately 1.5 migrants per generation (p. 61814 of the proposed rule). Even though the methods used in Von Holdt et al. (2010) are expected to underestimate dispersal, these observations suggest that migration into the WY population may not be ≥5.4 effective migrants per generation, as implied	6	Noted. Panelist does not agree that the Plan will ensure sufficient gene flow.

Panelist Last Name	Comment	Question	Response
	by the Wyoming plan. 11 Second, much of the migration that has been documented occurred when abundance was greater than that specified for recovery in the NRM (i.e., 30 packs and 300 wolves). It is unclear whether any of the states, including WY, will maintain enough wolves to maintain sufficient genetic connectivity.		
Vucetich	[3] The WY plan says (p. 6): "Genetic exchange can be natural or, if necessary, agency managed." Page 4 of this document offers reason for concern over the appropriateness of considering a population recovered if it depends on human--- assisted migration. Moreover, the words "can be" and "if necessary," in the above cited sentence, represent an inappropriate level of inconsistency and vagueness. Specifically, it is unclear whether this statement means: (i) "Natural genetic exchange is preferred so long as it does not conflict with other management preferences; and if natural migration does conflict with other management preferences, then human--assisted migration is appropriate," or does the WY plan mean (ii) "Human--assisted migration is acceptable only if natural migration cannot occur when anthropogenic mortality is negligible"? A passage of text on page 28 suggests (but is not clear) that this ambiguity is of concern: "Population management, to the maximum extent practicable, should facilitate the above objective through natural dispersal. Therefore, if wolf population management strategies implemented by the Department are identified as a meaningful factor preventing the connectivity objective from being met, population management will be modified as necessary and appropriate." It seems very clear that effective migration is limited by wolf abundance and the rate of anthropogenic mortality. Would Wyoming, for example, reduce the quota for a regulated public harvest to zero (and other sources of anthropogenic mortality) if natural migration did not result in meeting the goals for genetic connectivity? This vagueness and potential inconsistency is of concern, in part, because of the prospect for inadequate connectivity described above in point [2].	6	Noted. Panelist does not agree that the Plan will ensure sufficient gene flow.
Vucetich	[4] WY plan says (p. 27): "The Department recognizes dispersing wolves will travel through some habitats that are unsuitable for long--term occupancy due to high conflict potential. The majority of these areas will be outside of the WTGMA where the Department has no management authority." This idea is incomplete. A more complete expression of these ideas includes: (i) Dispersing wolves will travel through some habitats that are unsuitable for long---term occupancy due, in part, to Wyoming statutes that define the size and location of the Wolf Trophy Game Management Area, and (ii) While the department does not have management authority over those area, the state of Wyoming is still responsible for maintaining genetic connectivity.	6	Noted.
Vucetich	[6] The Wyoming plan states (p. 28): "This goal of genetic connectivity is not a relisting trigger. Instead, it is a trigger to conduct effective adaptive management intended to preclude the need to ever consider relisting due to genetic issues." The proposed rule makes it very clear that genetic connectivity is very important. If it were determined, after a period of monitoring, that connectivity goals had not been met; why shouldn't the states automatically engage in human---assisted 12 migration? Yes, it is unacceptable to consider a population recovered if it requires human---assisted migration (see p. 4 of this document). However, because genetic connectivity is important, this condition would seem to warrant human---assisted migration, even though reliance on human---assisted migration should not be considered a condition of a recovered population. Moreover, if failing to meet requirements for connectivity is not a relisting criterion, then what would be a relisting	6	Noted. Suggestion will be made to Service.

Panelist Last Name	Comment	Question	Response
	trigger with respect to genetic connectivity? This needs to be specified. Without a relisting trigger related to genetic connectivity, it cannot be taken as a serious objective of recovery.		
Vucetich	[7] SUMMARY: Existing evidence indicates that the three populations of the NRM have been sufficiently connected in recent years. However, the least connected subpopulation seems to be Wyoming. In recent years, the number of effective migrants that Wyoming has received is close to the minimum number considered to be sufficient. The rate of effective migration is importantly influenced by abundance and mortality. Moreover, state management will almost certainly lead to reduced abundance and increased mortality. In particular, no state is required to have more than 150 wolves, which is much lower than current or recent population sizes. These circumstances raise concern about whether adequate levels of connectivity would exist under state management. Finally, the Wyoming plan makes no provisions for the Wyoming population to provide emigrants that would reproduce in other NRM populations.	6	Noted. Panelist does not agree that the Plan will ensure sufficient gene flow.
Mech	p. 3, 2nd full par., l. 2 – It would be helpful here and elsewhere to state that the estimated number of wolves in the predatory animal zone is 30-35.	General	Noted. Suggestion will be made to Service.
Mech	p. 13, 2nd full par., l. 5-6 and elsewhere – all wolf numbers should be qualified with “at least” unless the exact number is known.	General	Noted. Suggestion will be made to Service.
Mech	p. 14, l. 3 – It would be more accurate and realistic here to cite Oakleaf et al. (2003 JWM) that these figures are probably quite minimal.	General	Noted. Suggestion will be made to Service.
Mech	p. 21, last par. – Should cite Adams et al. (2008) Wildlife Monograph and Gude et al. (2011) – (Gude, J. A., M. S. Mitchell, R. E. Russell, C. A. Sime, E. E. Bangs, L. D. Mech, R. R. Ream. 2011. Wolf population dynamics in the U. S. Northern Rocky Mountains are affected by recruitment and human-caused mortality. Journal of Wildlife Management doi: 10.1002/jwmg.201).	General	Noted. Suggestion will be made to Service.
Mech	p. 22, 1st par. – Would be better to delete reference to Mech et al. (2008) and cite Mech and Goyal (2011) - (Mech, L. D. and S. Goyal. 2011. Parsing demographic effects of canine parvovirus on a Minnesota wolf population. J. of Veterinary Medicine and Animal Health 3[2]:27-30).	General	Noted. Suggestion will be made to Service.
Mech	p. 46, Forbes and Boyd reference – add “y” to “Rock”	General	Noted. Suggestion will be made to Service.
Mech	p. 54 – This entire subject of attempting to maintain wolf genetic diversity by natural or artificial means is totally overblown. Wolves can survive considerable inbreeding as indicated by the Isle Royale population of 25 wolves that was totally inbred for 50 years and survived (See Mech andBoitani 2003:189-190).	General	Noted. Suggestion will be made to Service.
Mech	p. 55 – Fig. 1 could use a state map for perspective.	General	Noted. Suggestion will be made to Service.

Panelist Last Name	Comment	Question	Response
Mills	The reintroduction of the gray wolf to the Northern Rocky Mountains (NRM) has been a spectacular success story, a point often missed in the contentious discussions of the topic. From a pre-introduction size of about 55 wolves in NW Montana in 1993, the population was supplemented by 66 translocated (reintroduced) wolves in 1995 and 1996 (35 in Idaho and 31 in YNP). Subsequently, the NRM population has grown by an average 20% per year1 from 1997 to 2008, exceeding 1,655 wolves (minimum count) by 2008. A 20% annual growth rate is remarkably high for nearly any wild vertebrate species, including translocated populations unencumbered by density dependence. The success of the reintroduction has clearly been aided by the wolf's life history characteristics, as adaptable relative generalists with high potential for reproduction and extraordinary capacity for dispersal, leading to the population being widespread and well distributed. As an unexpected bonus, reintroduced wolves have actively avoided close inbreeding, so genetic variation has remained high in NRM wolves, minimizing problems with inbreeding depression and retaining variation critical to adaptation to future conditions (VonHoldt et al. 2008, Hebblewhite et al. 2010).	General	Noted. Suggestion will be made to Service.
Mills	By any criteria, the wolf has exceeded for about a decade the recovery thresholds established by extensive stakeholder agreement (30 breeding pairs; 300 total wolves; see point 1 in my review comments below). Because the wolf has exceeded recovery (delisting) criteria, is predisposed through its life history to persist across a broad landscape as long as harvest levels aren't excessive, and because the delisting proposal gives adequate attention to limiting human caused mortality while accommodating the inevitable conflicts in rural communities of the Rocky Mountain West, I support the proposed delisting of NRM wolves in general and in Wyoming in particular.	General	Noted. Suggestion will be made to Service.
Adams	-6 1797, I st col., 2nd para.: Citation in first sentence and second to last sentence should be Oakleaf et al. 2006, not 2005.	General	Noted. Correction will be communicated to Service.
Adams	-61797, 3rd col., 2nd para.: Again, Oakleaf et al. 2006 miscited as 2005.	General	Noted. Correction will be communicated to Service.
Adams	-61798, 2nd col., 2nd para.: Again, Oakleaf et al. 2006 cited as 2005.	General	Noted. Correction will be communicated to Service.
Adams	-61799, 1st col., 3rd para.: Erroneous citation of Oakleafet al. 2005 again.	General	Noted. Correction will be communicated to Service.
Adams	-61802, 1st col. 2nd para.: Mills 2011, in litt. Not included in Literature Cited.	General	Noted. Correction will be communicated to Service.
Adams	-61803, 1st col., 2nd para.: Service et al. 20009 should be 2009.	General	Noted. Correction will be communicated to Service.
Adams	-61805, 3rd col., 2nd para.: "wolf morality" should be wolf mortality.	General	Noted. Correction will be communicated to Service.
Adams	-61806, 2nd col., 2nd para.: Hensey and Fuller 1983 not in lit cited. If this is Heisey and Fuller 1985, then that paper does not support this statement and is an incorrect citation.	General	Noted. Correction will be communicated to Service.

Appendix B. Individual Panelist Memorandums

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
ALASKA SCIENCE CENTER
4210 University Drive
Anchorage, Alaska 99508

IN REPLY REFER TO:

24 October 2011

MEMORANDUM

TO: Stephanie Lauer, Atkins North America, Inc., Missoula, Montana
FROM: Layne G. Adams, USGS-Alaska Science Center, Anchorage, Alaska

10/24/11

SUBJECT: Peer Review of Proposed Rule for Removal of the Gray Wolf in Wyoming from the Federal List of Endangered and Threatened Wildlife and Removal of the Wyoming Wolf Population's Status as an Experimental Population (76 FR 61782, 5 October 2011)

This memorandum constitutes my peer review, as requested by the US Fish and Wildlife Service (USFWS), of the proposed rule to delist gray wolves in Wyoming and transfer management of wolves to the State of Wyoming. After studying the Statement of Work (dated 27 July 2011), I concluded that the USFWS intended that the peer review focus on the proposed rule; thus I am not providing specific comments on the Wyoming Gray Wolf Management Plan (dated 14 September 2011). Because it is the primary supporting document for the proposed rule, I have thoroughly studied the Wyoming Plan and address its main components in my comments on the proposed rule. Further, given that the proposed rule commonly paraphrases and references the Wyoming Plan, my comments would be relevant to those sections of the Wyoming Plan as well.

Overall, the proposed rule provides an accurate description and analysis of the biology, population characteristics, and distribution of wolves in the Northern Rocky Mountains (NRM). I have provided some specific comments regarding the biological information and analysis provided (see below), but my comments were minor and generally serve to lend additional support to the biological analysis presented in the rule. Building from that foundation of biological information, the USFWS has accurately and adequately analyzed the threats to wolves in Wyoming and the NRM and has reached logical conclusions regarding the maintenance of a viable wolf population in the region. The biological information, analyses, and conclusions are well-supported by the relevant scientific literature.

The Wyoming Gray Wolf Management Plan clearly establishes that the State has committed to managing wolves to maintain a population of at least 10 breeding pairs and 100 wolves on lands under their jurisdiction. As described in the proposed rule, this commitment by Wyoming, along with commitments from Idaho and Montana, will ensure that the NRM wolf population is maintained above the specified recovery goals. Further, Wyoming, along with the other 2 states, have committed to a program of genetic monitoring to guarantee that in the unlikely event that gene flow into the Yellowstone recovery area is insufficient, that the deficit will be detected and appropriate actions can be taken.

While the Wyoming Plan specifically commits to "manage for at least 10 breeding pairs and at least 100 wolves in Wyoming outside YNP (Yellowstone National Park) and the WRR (Wind River Reservation)" (pg. 1; parenthetical information added), it is justifiably lacking in detail on how wolf management in the State will actually play out given the many uncertainties. Therefore, as a reviewer I needed to consider the likely outcome of their management based on realistic assumptions. It is reasonable to conclude that Wyoming will manage wolf numbers well above the 10 breeding pair/100 wolf level to avoid relisting under the Endangered Species Act (ESA) while maintaining sufficient wolf numbers to accommodate control actions to address specific livestock depredation cases, conflicts on elk feed grounds and other wolf/human conflicts, as well as hunter harvests. Further, some wolves under Wyoming's management will be subject to harvest/control in adjacent states or Wyoming's predator area as they travel in and out of those areas. In concert, these factors will require that Wyoming manage conservatively with a sizable buffer above the minimum population levels they have agreed to. It is clearly stated in the Wyoming Plan that they will not authorize lethal control of wolves if it will risk relisting under the ESA (pg. 32) and they intend to approach harvests in a gradual and incremental fashion as they gain experience in managing wolves (pg. 24), indicative of an overall conservative approach.

As thoroughly described in the proposed rule, northwest Wyoming contains most of the suitable wolf habitat in the State capable of supporting persistent wolf packs, thus contributing to the regional Yellowstone population. Wyoming's Wolf Trophy Game Management Area (WTGMA) encompasses most of that suitable habitat and is of sufficient size to maintain the portion of the regional population that Wyoming has agreed to. However, because Wyoming has drawn a specific management boundary that determines where wolves will and will not be allowed to persist, the Wyoming contribution of at least 10 breeding pairs/100 wolves should be limited to the WTGMA. Outside the WTGMA, wolves will be subjected to unregulated harvest and are not expected to persist (61798, 1st col., 2nd para.). As described above, Wyoming will likely manage well above the 10 breeding pair/100 wolf threshold, minimizing the chances that wolves that happen to briefly persist outside the WTGMA during the end-of-the-year census period will be necessary to meet the minimum threshold. However, should the State's wolf population decline to near that threshold, it is only reasonable that wolves counted toward recovery goals have some realistic potential for persisting in the population.

Establishment of the predator area encompassing much of Wyoming, where wolves will be subjected to unregulated harvest, has certainly been controversial. However, there is little functional difference between Wyoming's explicitly-defined predator area and eastern Montana or southern Idaho where wolves have not become established, even under ESA protection, due to lack of suitable habitat and high potential for livestock conflicts. In any case, wolves that move into these areas are likely to be subject to removal and unlikely to persist. In Wyoming, wolves can be killed as soon as they are detected in the predator area, whereas in the other 2 states they are generally eliminated once they begin depredating livestock. Any minor difference in timing of removal has little bearing on maintaining viable wolf populations in the NRM because these areas are peripheral to the core regions of suitable habitat and thus are not important for maintaining gene flow among the 3 recovery areas.

The seasonal expansion of WTGMA was included in the Wyoming plan to facilitate natural dispersal from central Idaho into the Yellowstone population. I doubt this management prescription will contribute much to gene flow. Most of the dispersers coming into the Yellowstone region will come from areas north of the seasonal expansion area. Although there is some evidence that dispersers were unable to settle into the YNP population prior to 2004 (vonHoldt et al. 2007), I doubt that has continued

and certainly dispersing wolves are capable of travelling across areas inhabited by existing wolfpacks, thus YNP would not present any kind of barrier to dispersers. Further, any dispersers that successfully breed in the Yellowstone region, including along the northern and western edges where there may be more turnover of wolf packs than in the core of YNP, will contribute to the genetic diversity of wolf population of the Yellowstone recovery area.

Based on my review of the proposed rule, the Wyoming Gray Wolf Management Plan, and various supporting documents, I conclude that the USFWS proposal to delist gray wolves in Wyoming is well supported by our current scientific understanding of wolf biology and reasonable assumptions of how wolf management is likely to occur in Wyoming upon delisting. Under the NRM recovery criteria, the recovery area is the appropriate ecological scale to assess each of the 3 contributing populations, whereas State wolf management thresholds are politically necessary to ensure that each State's responsibility for wolf conservation is "fair, consistent, and clear" (61791, 1st col., 1st para.). Wolves in the Yellowstone recovery area are likely to occur in excess of the 15 breeding pair/150 wolf buffer above the recovery threshold, given the contribution of at least 10 breeding pairs/100 wolves from Wyoming along with expected wolf numbers in YNP and the Idaho and Montana portions of the recovery area. Further, NRM wolves are unlikely to suffer from losses of genetic diversity given they occur as an extension of the extant wolf population stretching across northern North America and the propensity for wolves to disperse long distances and become established within existing wolf populations. In the improbable event that gene exchange is inadequate, the States have agreed to monitor genetic diversity and take action to correct any deficiencies that are detected.

Specific comments

-61788, 3rd col., 3rd para.: "Packs typically occupy large distinct territories…" . While wolves are territorial, their territories overlap substantially, as shown in all maps of wolf distribution in the NRM, even though these maps are commonly comprised of 95% minimum convex polygons that minimize the observed territorial overlap.

-61790, 3rd col., 1st para., last line: "…following the point of the year with the highest mortality rates (summer and fall);…" I am unaware of any literature supporting the contention that mortality rates are highest during summer and fall. Further, dispersal from packs is an important mechanism resulting in population decline throughout the winter. This statement needs to be supported by literature citation, modified or removed.

-61791, 2nd col., 1st para.: "…are measured in mid-winter when the wolf population is near its annual low point…" See comment above. This statement is built on the unsubstantiated assertion that mortality rates are highest prior to December 31. Additional mortality, as well as dispersal, continues throughout the winter with the wolf population reaching its annual low point in late April immediately prior to the birth of pups.

-61797, 1st col., 2nd para.: Citation in first sentence and second to last sentence should be Oakleaf et al. 2006, not 2005.

-61797, 3rd col., 2nd para.: Again, Oakleaf et al. 2006 miscited as 2005.

-61798, 2nd col., 2nd para.: Again, Oakleaf et al. 2006 cited as 2005.

-61799, 1st col., 2nd para.: The limits reached by the Wyoming wolf population are not strictly biological. They are also related to limits of human tolerance imposed by control relative to livestock depredation.

-61799, 1st col., 3rd para.: Erroneous citation of Oakleaf et al. 2005 again.

-61801, 1st col., 3rd para.: Adams et al. 2008 contains a recent and complete assessment of sustainable human-caused mortality and should be included here.

-61801, 1st col., 3rd para.: The method used to derive the 36% mortality rate need to be briefly described. Given that it was based on a simple regression of only 4 years of data the range of prediction (95% confidence interval), given the amount of error likely associated with this result, would be more appropriate than the point estimate without any acknowledgement of the associated error.

-61801, 1st col., 3rd para.: The statement for Fuller et al. 2003 that human-caused mortality can replace up to 70 percent of natural mortality is unsubstantiated and should be removed. See Adams et al. 2008 regarding a review of evidence of compensatory mortality in North American wolf studies.

-61802, 1st col. 2nd para.: Mills 2011, in litt. not included in Literature Cited.

-61803, 1st col., 2nd para.: Service et al. 20009 should be 2009.

-61803, 2nd col., 3rd para.: See comment above re: 36% mortality rate. Range would be better here.

-61805, 3rd col., 2nd para.: "wolf morality" should be wolf mortality.

-61805, 3rd col., 3rd para.: Intraspecific killing in wolves is generally quite a bit higher than reported by Murray et al. 2010. Commonly these deaths account for about half the natural mortality.

-61805, 3rd col., 3rd para.: The statement regarding wolf populations being self-regulating and intraspecific killing is infrequent except at carrying capacity is unsubstantiated and inaccurate. Intraspecific killing has been noted in newly expanding populations or restored populations (Fritts and Mech 1981, Wydeven et al. 1995, Mech and Boitani 2003, Smith 2005), following wolf control (Hayes et al. 1991) and on Isle Royale during periods of relatively high prey abundance (Peterson and Page 1988). Intraspecific strife is characteristic of wolf populations regardless of their status relative to carrying capacity.

-61806, 1st col., 3rd para.: See comments above re: Adams et al. 2008, estimation of 36% harvest rate, and compensatory mortality.

-61806, 2nd col., 2nd para.: Hensey and Fuller 1983 not in lit cited. If this is Heisey and Fuller 1985, then that paper does not support this statement and is an incorrect citation.

-61806, 2nd col., 2nd para.: It is important to note that the 75% survival rate for wolves in the NRM reported by Smith et al. 2010 is probably an underestimate because of the large differences in survival of wolves collared for monitoring and depredation purposes and the inability to assess the proportions of the overall population that each group represented. Further, it is likely that the targeted, depredating wolves with markedly low overall survival were overrepresented in the marked sample.

-61808, 3rd col., 2nd para.: See comments above re: Adams et al. 2008, and 36% harvest rate.

-61811, 1st col., 1st para.: The statement "Within the WTGMA, Wyoming has agreed to maintain a population of at least 10 breeding pairs and at least 100 wolves in areas under State jurisdiction." is incorrect. The state plan does not limit their agreement to ensure 10 breeding pairs and 100 wolves to the WTGMA, but those wolves can occur throughout Wyoming.

-61814, 3rd col., 1st para.: The estimate of 10% annual dispersal is probably substantially low. Yearlings and two-year-olds have the highest propensity to disperse but they tend to be underpresented in any radiocollared sample for a variety of reasons, including their likelihood of dispersing and thus not lasting long in the radiocollared sample compared to older wolves that hang around. Adams et al. 2008 (pg. 11) estimated age-specific dispersal rates in a similar fashion to mortality rates and arrived at 61%, 35%, and 11% for dispersal by yearlings, 2-year-olds, and older wolves, respectively. Given that yearlings constitute a large segment of the non-pup segment of a wolf population, overall dispersal rate may have been around 30% annually. See Adams et al. 2008:14-16 for discussion re: issues with calculating dispersal rates.

-61814, 3rd col., 2nd para.: The statement about limited social openings in YNP serving as a barrier to dispersers through YNP is unsubstantiated and unlikely. While there is genetic evidence that dispersers have not successfully entered the YNP resident population and bred (vonHoldt et al. 2007), that provides no evidence one way or the other regarding wolves dispersing through the area.

-61815, 1st col., 1st para.: See comment above about low dispersal estimate.

-61815, 1st col., 1st para.: The statement that "... if genetic exchange drops below one effective migrant per generation, the States will implement a human-assisted migration program..." is not accurate. The Wyoming plan (pgs 28-29) states that should genetic connectivity be insufficient they will "invoke adaptive management" that will include at least the following "as deemed appropriate": improved genetics monitoring, population management, and translocation for genetic purposes. Further, the MOU regarding protecting genetic diversity for NRM wolves states that "translocations or other management techniques" will be used "if demographic or genetic monitoring suggests that wolf populations are likely to become threatened for genetic-related reasons" with no mention of the 1 effective migrant per generation criteria.

-61815, 1st col., 3rd para.: See comments above re: human-caused mortality.

-61816, 2nd col., 2nd para.: This section need some revision to present a clear and response to the detection of insufficient genetic exchange. It is odd that reviewing and revising monitoring protocols is

the first response mentioned to lower than desired genetic exchange. While that would be an important component of the response, the response should focus assessing management actions that could be limiting gene flow and adjusting them as necessary. In the second paragraph, the sentence beginning "Specifically, Wyoming will…" is a better lead in to the response to low genetic exchange, with evaluation of monitoring methods to follow.

-61817, 1st col., 2nd para.: The Isle Royale example is no longer relevant given the recent detection of an immigrant that successfully bred on the island. Given that this immigrant was only detected via intensive genetic monitoring in place for just the last several years of the Isle Royale study, it is certainly conceivable that other undetected immigrants made it to the island earlier in the study. Further, the Kenai Peninsula is a poor example given the lack of any evidence that the wolf population there is truly isolated from mainland populations. In general, this paragraph is unnecessary given that dispersal by wolves in the NRM is likely to provide sufficient genetic connectivity, and Wyoming have agreed to monitor gene flow and take action if gene flow is below the 1 effective migrant per generation, thus well in advance of any notable loss in genetic diversity.

-61820, 1st col., 2nd para.: See comments above re: human-caused mortality.

-61821, 3rd col., 2nd para.: It needs to be clearly stated that these data certainly underestimate the wolf population in that some packs are undetected and the transient segment of the wolf population cannot be enumerated.

Comments by Dr. L. Scott Mills
On Proposed Rule to Remove Gray Wolf in Wyoming From the ESA List
10/31/11

The reintroduction of the gray wolf to the Northern Rocky Mountains (NRM) has been a spectacular success story, a point often missed in the contentious discussions of the topic. From a pre-introduction size of about 55 wolves in NW Montana in 1993, the population was supplemented by 66 translocated (reintroduced) wolves in 1995 and 1996 (35 in Idaho and 31 in YNP). Subsequently, the NRM population has grown by an average 20% per year[1] from 1997 to 2008, exceeding 1,655 wolves (minimum count) by 2008. A 20% annual growth rate is remarkably high for nearly any wild vertebrate species, including translocated populations unencumbered by density dependence. The success of the reintroduction has clearly been aided by the wolf's life history characteristics, as adaptable relative generalists with high potential for reproduction and extraordinary capacity for dispersal, leading to the population being widespread and well distributed. As an unexpected bonus, reintroduced wolves have actively avoided close inbreeding, so genetic variation has remained high in NRM wolves, minimizing problems with inbreeding depression and retaining variation critical to adaptation to future conditions (VonHoldt et al. 2008, Hebblewhite et al. 2010).

By any criteria, the wolf has exceeded for about a decade the recovery thresholds established by extensive stakeholder agreement (30 breeding pairs; 300 total wolves; see point 1 in my review comments below). Because the wolf has exceeded recovery (delisting) criteria, is predisposed through its life history to persist across a broad landscape as long as harvest levels aren't excessive, and because the delisting proposal gives adequate attention to limiting human caused mortality while accommodating the inevitable conflicts in rural communities of the Rocky Mountain West, I support the proposed delisting of NRM wolves in general and in Wyoming in particular.

I found the proposed rule to be well-written and thorough in its attention to wolf biology, population dynamics, and human dimensions. The format of my comments are to note brief responses to the specific questions posed by the Proposed Rule (below), with reference to much more extensive comments that follow.

Here are the specific questions accompanying the request for comments by the USFWS on the proposed rule. My brief responses, referencing more detailed specific comments to follow, are in *italics*.

➔ Is the Service's description and analysis of the biology, population, and distribution accurate?

I find the description and analysis to be quite well written. The analysis is thoughtful and thorough, and captures nicely most of the key biological points relevant to delisting of wolves in Wyoming. See my specific comments below for some areas for consideration.

[1] I calculated growth rate from the NRM data in Table 4B of USFWS 2010 Rocky Mountain wolf recovery Interagency Annual Report. I used the state space exponential trend estimator of Humbert et al. (2009). Expressed as percent change per year, the 95% confidence interval on the mean estimate of 20% is (16%, 25%).

➔ Does the proposed rule provide accurate and adequate review and analysis of the factors relating to the threats?

Yes, with only a few exceptions. See points 3B, 3C.

➔ Are the conclusions the Service reaches, including their projection of maintenance of a viable population, logical and supported by the evidence they provide?

Yes. See point 1.

➔ Did the Service include all the necessary and pertinent literature to support their assumptions/arguments/conclusions?

For the most part; see especially points 4A, 4B, 4C, 5, 6.

➔ Is it reasonable for the Service to conclude that Wyoming's approach to wolf management, as described in the Plan and the proposed rule, in the context of wolf management throughout the entire NRM region, is likely to maintain Wyoming's wolf population above recovery levels [recovery goal as described in the 2009 delisting as: "Thirty or more breeding pairs (an adult male and an adult female that raise at least 2 pups until December 31) comprising 300+ wolves in a metapopulation (a population that exists as partially isolated sets of subpopulations) with genetic exchange between subpopulations (Service 1994; Fritts and Carbyn 1995). Step-down recovery targets require Montana, Idaho, and Wyoming to each maintain at least 10 breeding pairs and 100 wolves by managing for a safety margin of at least 15 breeding pairs and at least 150 wolves in mid-winter. Genetic exchange can be natural or, if necessary, agency managed."]?

Yes, see 2, 3, 3A, 4, 4A. However also see 4B for the final part of this question regarding genetic exchange that is "agency managed."

➔ Is it reasonable for the Service to conclude that Wyoming's approach to wolf management, as described in the Plan and the proposed rule, in the context of wolf management throughout the entire NRM region, is likely to provide for sufficient levels of gene flow to prevent genetic problems from negatively impacting the Greater Yellowstone Area's population or the larger NRM metapopulation in a manner that would meaningfully impact viability?

Yes, see 4, 4A, 4B.

DETAILED PEER-REVIEW POINTS:

Point #1: Numerical thresholds for delisting have emerged from detailed, long-term consideration and are neither arbitrary nor capricious.

I appreciate the historical overview on the topic of minimum population sizes for NRM wolf recovery and delisting (especially pp. 61789-61790). Social conflict, especially involving livestock depredation (but increasingly pets as wolves spread into more urban zones), will inevitably affect the upper sustainable limit, or carrying capacity, for NRM wolves. NRM wolf recovery and delisting criteria (30 breeding pairs: 300 total wolves) emerged from extensive consideration of biological and non-biological factors in 1987 and 1994 and was agreed upon by stakeholders before reintroductions occurred in 1995. If the minimum size for recovery and viability were re-examined now, using current state-of-the-art viability analyses, incorporating the analytic and genetic developments of the last decade, and embracing a range of possible persistence and probability thresholds, it might be different than 30:300. But how different, and in which direction, is not clear. For example, if the robust adjacent wolf populations in Canada, sympatric with Montana NRM wolves, were included, the recovery threshold for NRM wolves may decline; on the other hand, it may also be that 30:300 is conservative and minimal, as noted on p. 61790 of the proposed rule. In short, there is nothing egregious in the 30-300 number as it stands with respect to the current state of the art in viability analyses (see Chapter 12 in Mills 2007).

Of course, the minimum viable, or recoverable, population size is almost always smaller than ecologically effective population sizes, for wolves or any other species (Soule et al. 2003). This relatively recent ecological concept should be incorporated in future setting of recovery criteria for other species. However, in this case with NRM wolves, I am satisfied with 30:300 (broken down as 10:100 for each of the 3 states) as an appropriate standard for the delisting decision.. It is the threshold decided on via biological considerations and extensive good faith negotiations and compromises from stakeholders involved in reintroductions in the mid 1990s, with subsequent additional evaluations. **Therefore, I support the benchmark criteria (30-300 and 10-100) for delisting. The NRM wolves have exceeded these delisting criteria for a decade.**

Point #2: The potential re-listing thresholds provide an incentive for Wyoming to maintain wolves above the minimum threshold after delisting occurs.

Under terms of the proposed delisting, Wyoming Game and Fish Department (WFGD) would maintain at least 10:100 (10 breeding pairs and 100 total wolves), measured in mid-winter, and including GTNP and the National Elk Refuge (small areas that hold only transboundary packs), but not counting YNP or Wind River Indian Reservation.

Instead of the 'step down' buffer of an additional 50% more (5:50 for a total of 15:150) being managed by the state, as in Montana and Idaho, the Wyoming Plan is to have the step down extra buffer (5:50) be sustained in YNP and Wind River Indian Reservation. As a result, the minimum requirement for wolves under Wyoming state management is 10:100.

Both the proposed rule and the Wyoming Plan (WGFC 2011) state that Wyoming does not intend to reduce the Wyoming population down to this minimum 10:100 level, and will instead provide a buffer that is "adequate", "sufficient", or "comfortably above" the minimum. Such a buffer is stated to be necessary to protect against unexpected losses of wolves that may arise from takes in defense of property, perceived ungulate losses requiring special region-specific wolf hunts, uncertainty in counts, and disease.

I agree with this stated need to provide a buffer above the 10:100 threshold, but just what this "adequate" buffer would be, or how it would be determined, is never specified in the plan. Further, both the delisting proposal (eg p. 61822 middle column) and especially the Wyoming Plan make clear that Wyoming is not obligated to maintain more than 10:100 (eg WGFC 2011: last sentence of Executive Summary). At the same time, the Plans make clear the pressures that could inexorably pressure the WGFD to allow harvest to push wolf numbers closer and closer to the razor edge of the 10:100 minimum: e.g. hunting opportunities for the public, depredation actions, and perceived 'unacceptable impacts' by wolves on ungulate populations (See my point 5 below).

Although the plan provides no real evidence (beyond assurances) that Wyoming would *not* harvest wolves all the way down to as close as possible to 10:100, a criteria is provided in the form of re-listing criteria (page 61822). Specifically, the USFWS would initiate a formal status review for relisting if the Wyoming wolf population falls below specified thresholds for 1 or 3 years, and including or excluding YNP and Wind River Indian Reservation wolves from the count. The prospect of a relisting review is obviously one that the state of Wyoming would like to avoid. So even though we're not given an operational protocol for how an 'adequate' buffer above 10:100 would be established by WGFC, **I am comforted that indeed a buffer will be in place, if for no other reason than to make sure relisting review does not occur.**

Point #3: Wolf populations can sustain relatively high mortality rates.

Overall, the proposed rule does provide accurate and adequate review and analysis of the factors relating to the threats. With respect to harvest, wolves have a high intrinsic growth rate and the ability to compensate some human-caused mortality through replacing other mortality sources, as well as compensation via reproduction and immigration. That NRM wolf populations can grow in the face of human-caused mortality is evidenced by the fact that NRM wolves have continued to increase in numbers (approximately 20% per year) even as human caused harvest under ESA Threatened status has remained substantial: 23% mortality rate since reintroduction arising from illegal kills (10%), control actions due to livestock conflicts (10%), and accidental human causes (3%) (P. 61806 1st column). Exactly how much mortality can be sustained before causing a population to decline is a complex topic (eg Mills 2007 Ch. 8, 14), but the proposal's review of the topic is adequate in listing a range of figures applicable to wolves, from 20% to up to about 50% [these figures are given, for example, on p. 61801 col 1; p. 61806 col 1; 61808 col. 3; p. 61815 col 1 and 2, p. 61820, col 1].

Point 3A: Because it includes most of the wolves in Wyoming, the approach of managing the "Wolf Trophy Game Management Area" is reasonable.

The document convincingly addresses the Wyoming Management plan to manage harvest in a Wolf Trophy Game Management Area (WTGMA) in the western portion of Wyoming. Wolves will be hunted without regulation outside the WTGMA in a so-called 'predator zone', and are not expected to persist there. The document notes that although the WGMA consists of only 16% of the state, the region comprises 100% of the original Greater Yellowstone Area within Wyoming, the majority of suitable habitat (defined at least in part by social tolerance compared to the open, sheep-and-cattle country outside of NW Wyoming) and, most importantly, the entire home range for 24 of 27 breeding pairs and 24 of 34 packs currently in the state (pp. 61786-61787).

The WTGMA would be seasonally flexed approximately 80km southward from October 15 through February to facilitate some natural dispersal of wolves and Idaho during that period (the region will be part of the predator zone for the rest of the year).

Although small as a percent of the state, the fact that the WTGMA contains virtually all of Wyoming's wolves and wolf habitat implies to me that it will be sufficient to sustain both the requisite number of wolves and necessary levels of connectivity to other parts of the NRM population.

Point 3B: Although within a reasonable range, the statement that "wolf populations in Wyoming outside YNP can sustain a 36% mortality rate from human causes" should be deleted from the plan document as it does not meet scientific standards.

I do recommend the deletion of one often-repeated statement from the proposed rule because it does not carry credibility by itself. The statement is: "Mortality rates and population growth rates reported from 2007 to 2010 indicate that the wolf population in Wyoming outside YNP can sustain, on average, a 36 percent mortality rate from human causes (WGFC 2011, p. 12)." And yet, page 12 of WGFC 2011 only repeats that same statement; no publication, analyses or raw data are given to support the statement. Thus, although this figure falls in a range that strikes me as intuitively plausible for this species (see above), the fact that this 36% threshold in Wyoming is unsupported by available analyses or data makes it unreliable as a scientific statement; I recommend it be removed in the half-dozen or so places it is used.

Point 3C: Human-caused mortality is unlikely to provide a benefit to genetic connectivity at the relevant scale.

On the topic of human-caused mortality, one point that does not carry scientific credibility is that "Human-caused mortality may also provide a potential benefit to genetic exchange." (p. 61816 1st column). Although my comment here should be clear that I do not believe that human-caused mortality will overwhelm genetic exchange, I don't believe that a scientific basis exists for arguing that mortality will benefit genetic exchange across the scale being considered. The interpretation that removals are 'needed' to precipitate incoming gene flow would lead, for example, to a rather extreme idea that wolves should be removed from Yellowstone National Park to allow migrants that have immigrated into the GYA to enter the Park. If connectivity is sustained, gene flow will happen at a time scale appropriate to the species' life history and mating system. We don't need to implement mortality to promote immediate gene flow into robust populations.

POINT #4: Genetic connectivity for wolves will be sufficient with the proposed delisting

As I have noted in a declaration to the U.S. District Court (Mills 2008), I believe the wolf's life history, as well as extensive radiotelemetry and genetic data for NRM wolves, minimize threats from inbreeding depression in the GYA. Additional studies since 2008 reinforce this conclusion and indicate ongoing genetic connectivity across the NRM. First, Jimenez et al. (Unpubl. Manuscript, referred to in proposed rules as "Jimenez et al. 2011", available from author and from USFWS website) has amassed a remarkable dataset from 681 wolves radiocollared in NRM from 1993-2008. Of these, 281 wolves dispersed (this comprised 10% of the population, overall). The majority of dispersal events (58%) occurred between October and February, the times when the WTGMA would be flexed south to incorporate exactly this peak of dispersal. Some of the movements were long-distance (23% of dispersers >100 miles, the distance between central Idaho and occupied areas in GYA), and in all directions. Finally, 35% of dispersing wolves reproduced. These findings underscore the critical fact that wolf connectivity should be high as long as mortality in connectivity zones is not excessive.

Of course, genetically effective dispersers will be fewer than dispersals *per se* if the dispersers do not successfully reproduce (Mills et al. 2003). In the case of NRM wolves, many dispersers are reproducing, meaning that genetically effective dispersal is occurring. As noted on p. 61814 of the Rule, VonHoldt et al. (2010; see also perspective on this article by Hebblewhite et al. 2010) conducted an ambitious analysis of NRM wolf samples 1995-2004 and showed *minimum* gene flow estimates of about 3 per generation among the 3 main subpopulations, including into the GYA. Although no gene flow was documented into YNP per se, this is clearly not an issue of human perturbation but rather due to challenges for immigrants to enterthe established social structure in the Park (i.e. territory saturation). Also, the sampling was incomplete (only a portion of the population sampled) for the time period considered, and extend only to 2004, again indicating that these are minimal gene flow estimates. Further, as mentioned in the previous paragraph, the Jimenez et al. (unpublished) telemetry data through 2008 directly documents dispersal, including breeding in GYA (p. 61814).

Overharvest is the only plausible factor that would cause genetic connectivity to be inadequate for NRM wolves into the future. The seasonal wolf trophy game management area -- where the WTGMA is extended 80 km south for 4.5 months during from mid October through February -- seems critical in this regard. Based on the observed dispersal patterns of NRM wolves over time and across their range (eg page 61814; also Jimenez et al. unpublished Figure 1), reducing mortality in this seasonal WTGMA zone during the times of peak dispersal is an important step to nurture continued connectivity.

In short I believe it is reasonable to conclude that the proposed rule, in the context of wolf management throughout the entire NRM region, will provide for sufficient levels of gene flow to prevent genetic problems from negatively impacting the GYA's population or the larger NRM metapopulation.

Point 4A: 'One [effective] migrant per generation' is a reasonable rule of thumb for delisting purposes, but should be updated for future monitoring and evaluation post-delisting.

The delisting Rule grounds its assessment of sufficient genetic connectivity on "one-migrant-per-generation" (eg p. 61814). This rule of thumb (often generalized to 1 to 10 migrants per generation to account for mating system and immigrant idiosyncracies) has wide acceptance in conservation genetics (Mills and Allendorf 1996, Mills 2007), because it provides a reasonable tradeoff between the benefits of gene flow to reduce genetic drift versus the costs of gene flow in swamping local adaptive variation. Both field (eg telemetry) and genetic data described above indicate that NRM wolves have achieved this level of genetically effective connectivity.

While the one-migrant-per-generation is useful as a rule of thumb at this point for evaluating sufficiency of genetic connectivity, future evaluations of connectivity can and should be much more sophisticated, accounting for observed genetic structure, disperser characteristics, landscape barriers, and other factors. The genetic samples and radiotelemetry data can be placed into a population dynamic modeling framework to provide more accurate and spatially efficient assessments of sufficiency of gene flow.

Point 4B: Human assisted migration should be considered a method of last resort.

Because connectivity via natural movements is likely, and presumably will be nurtured as described in the proposed Rule, I encourage more critical consideration of the prospect of managed relocation of individual wolves. Page 61816 notes that “Human intervention in maintaining recovered populations is necessary for many conservation-reliant species and a well-accepted practice in dealing with population concerns (Scott et al. 2005).” It should be clarified, however, that Scott et al. (2005) did not intend for continued managed relocations to be a legitimate strategy for sustaining a conservation reliant species: "Although occasional translocations to maintain genetic diversity would not violate this notion of a self-sustaining population, frequent translocations to overcome anthropogenic dispersal barriers or to compensate for losses due to predation disease, or other mortality factors would." (Scott et al. 2005:386). Although wolves will likely always be a high-investment species for whatever state or federal agency is responsible for managing them, it seems inefficient, unnecessary, and counter to the objective of the ESA to conserve ecosystems [ie ESA sec 2(b)] to rely heavily on managed translocations of a species that would, with management to sustain survival of dispersers, be perfectly capable of persisting on its own (Scott et al. 2005).

Another advantage of managing dispersal of natural connectivity as opposed to managed translocations is that managed translocations requires decisions on which individual(s) should be moved. Relevant considerations would need to consider demographic effects of removals on the source populations, screening for potential disease transmission or behavioral issues and, in the long term, whether local adaptation may be compromised by the managed translocation. Risks are inherent in these choices. **In short, I encourage a focus on managing for natural connectivity, viewing managed translocation as a rare and extreme option to be implemented only in emergency situations.**

Point 4c: Although inbreeding depression is not a pressing concern for NRM wolves under delisting, the general importance of inbreeding depression for population persistence should not be dismissed.

I recommend that the final rule remove the paragraph on Page 61817 beginning with "In all but the most extreme cases", because it seems to imply in general inbreeding depression is merely 'theoretical' or hypothetical in its potential effects on persistence of small wildlife populations. For many species, the effects of inbreeding can and have been measured with hard field data, including pedigrees based on observation or molecular genetic analysis, and field-based vital rate measurements. Likewise, thesecosts of inbreeding can and have been incorporated into rigorous (not 'theoretical') population models based on first principles of life, death, and population dynamics (see Mills 2007). In this sense, inbreeding depression, and its potential effects on population dynamics, is no more theoretical or hypothetical than the effects of harvest, predation, density dependence, weather, or any other potential stressor on a wildlife population. In all cases, each of these factors may have effects that range from high to non-existent. Also, the description on p. 61817 of several wolf populations that have persisted through small bottlenecks is irrelevant to the question of inbreeding depression, just as a record of 3 friends who smoked a pack of cigarettes per day and lived to be 100 years old cannot be taken as evidence for or against the harmful effects of smoking. In other words, highlighting the populations (of any species) that made it through bottlenecks and persisted, while ignoring (because they are extinct) those that did not persist, leads to unreliable inference. **Although not a concern in the case of NRM wolves, inbreeding depression remains a real and prevalent driver in many populations under many circumstances.** In short, this section is unnecessary and risks appearing to wrongly imply that in general (beyond NRM wolves) inbreeding depression is more theoretical, and therefore less relevant, to small population dynamics than other stressors such as density, predation, or weather. **Inbreeding depression has already been credibly and well-established in this document as not a primary concern for delisting NRM wolves in general or Wyoming wolves in particular, and this paragraph is unnecessary and could be interpreted as a false general statement going beyond NRM wolves.**

POINT #5: The delisting Rule should note that determination of wolf predation effects on ungulate numbers is a complex scientific question that cannot be made based on emotion or speculation.

In several places, the Rule refers to wolf control being initiated based on "unacceptable impacts" of wolves on ungulate population size (eg p. 61807 middle column). Ultimately what is an 'unacceptable' effect is a normative, value-term (e.g. some would say a 1% decline in ungulate numbers due to wolf predation is too much; others would allow massive ungulate declines in order to not have a wolf be killed). However, whether an ungulate population is declining, and whether the cause is predation by wolves, is a complex question that can be addressed by rigorous biological analysis. As reviewed in Mills (2007 Chapter 8), whether or not any predator controls a prey population (eg causes the prey's growth rate to be lower than it would be in the predator's absence) depends on: a) the predation rate (a product of the predator's functional response, or kill rate, and the numbers of predator and prey); b) on whether mortality can be compensated by other mortality sources, reproduction, or immigration; and c) on which stage classes are killed (because some stages, such as fawn deer, can sustain high mortality rates without affecting deer population growth, while the same mortality on adults would affect population growth more). Merely observing a change in calf/cow ratios (p. 61807) does not indicate a decline (see Harris et al. 2008), and cannot be attributed to wolf predation just because wolves are present (eg a rich literature describes the need to consider weather, density dependence, and other predators). Likewise, an observation of wolves killing large numbers of ungulates does not necessarily imply control because the kill rate could be countered by low numeric responses, by compensation, or by the age classes being killed having low reproductive value. In short, missing in the plan is the population biology literature that makes it clear that whether or not wolves control the numbers of their ungulate prey can be answered, but not by casual observation or intuition; a careful analysis will be required. As has been found in other places and other times, wolves will be shown to cause massive decline to ungulate numbers in some cases, and to have little to no effects in others. With respect to the delisting of Wyoming wolves I do not find this to be a critical issue, as long as wolf control due to all sources (including those perceived necessary for increasing ungulate numbers) do not reduce wolf numbers below the specified thresholds.

Point #6: Post delisting population assessments will require improved methodology to account for incomplete detection of wolves.

We have remarkably detailed information about NRM wolves, due to high agency investment, comprehensive genetic samples, and approximately 2,000 wolves being radio-collared since the early 1980s; Gude et al. (2010) notes that "30% of the known NRM wolf packs were monitored annually, and observations from monitoring these wolves were supplemented by agency track surveys and public observations of wolf pack size for the remaining packs." Even with this intensive efforts, these are abundance indices, without accounting for wolves missed in monitoring efforts. I realize that post-delisting the collection of genetic samples will be intensive and extensive, a terrific idea. Less mentioned in the proposal, however, is how abundance estimates, and therefore trend evaluation, will be made. Because abundance estimates depend on both animal abundance and the probability of detecting them, and because detection probability can change over both time and space (eg it will be lower in thick forests; see p. 61795), I encourage agencies to establish formal frameworks to estimate detection probabilities as part of an abundance estimation protocol (as opposed to counts uncorrected for – and therefore confounded by – detection probabilities). This will incorporate the 'best available science' for wildlife population monitoring, critical given the contentious nature of monitoring this species.

I hope these comments are useful.

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Review by
L. David Mech, U.S. Geological Survey[1] and University of Minnesota[2]

of October 5, 2011 U.S. Fish and Wildlife Service proposed rule "Endangered and Threatened Wildlife and Plants; Removal of the Gray Wolf in Wyoming from the Federal List of Endangered and Threatened Wildlife and Removal of the Wyoming Wolf Population's Status as an Experimental Population" and "Wyoming Gray Wolf Management Plan" of September 14, 2011

Following are my responses to the questions the Peer Review Panel was charged with:

1. Is the Service's description and analysis of the biology, population, and distribution accurate?

For the most part, yes. Exceptions follow:

p. 61792, col. 3, l. 6	Substitute "at least" for "approximately." Gude et al. 2011 documented that many animals are missed.
p. 61795, col. 3, l. 20	Change to "In 2010, the minimum count declined. However because both the 2009 and 2010 were minimal counts, no valid inference can be drawn regarding population change."
p. 61795, col. 3, l. 25	Insert "at least" before "739" and before "47"
p. 61797, col. 3, l. 18	Insert "these 2" before "theoretical"
p. 61797. col. 3, l. 40	What about Canada? The northern part of the DPS is not up against unsuitable habitat.
p.61801, col. 2, l. 2	Delete previous sentence. This statement has now been shown by Creel and Rotella (2010) to be erroneous.

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p. 61802, col. 2, lines 8-10	This begs for documentation.
p. 61803, col. 2, l. 52	The 36% needs documentation. Also "about 35%" would be better.
p. 61806, col. 1, l. 65	Delete previous sentence. This statement has now been shown by Creel and Rotella (2010) to be erroneous.

2. Does the proposed rule provide accurate and adequate review and analysis of the factors relating to the threats?

Yes, except for the following:

p. 61788, col. 2, l. 2	Except in the seasonal WTGMA when open?
p. 61812, col. 2, l. 40	This statement bears more discussion because it has been challenged in the scientific literature (Bruskotter et al. 2010 a, b). I suggest adding a new paragraph here as follows: "Our findings that Americans generally hold favorable attitudes towards wolves has been challenged (Bruskotter et al. 2010 a, b). However a close examination of their evidence in those studies indicate that they conflated the results of a meta-analysis of public attitudes toward wolves across the world with those of Americans (Williams et al., 2002). Specifically Bruskotter et al. (2010 a, b) quoted a summary statement from Williams et al. (2002) out of context. In fact, Williams et al. (2002) stated that 60% of the 109 U.S. attitude surveys they examined from 1972 to 2000 supported wolf restoration."
p. 61813, col. 2, lines 62-67	Given the Bruskotter et al. challenges, it is especially important to add "besides legal protection or regulated taking."
p. 61819, col. 2, l. 38	Insert "from defense of livestock" because obviously human-caused mortality will increase considerably by hunting.

3. Are the conclusions the Service reaches, including their projection of maintenance of a viable population, logical and supported by the evidence they provide?

Yes, except for the following:

p. 61808, col. 3, l. 47	600 out of at least how many?
p. 61814, col. 2, l. 55	Change "will" to "might"
p. 61820, col. 1, lines 44-45	Out of a minimum of how many?

4. Did the Service include all the necessary and pertinent literature to support their assumptions/arguments/conclusions?

No. See the following:

p. 61801, col. 1, l. 60	Add Adams et al. 2008 Wildlife Monograph, and Gude, J. A., M. S. Mitchell, R. E. Russell, C. A. Sime, E. E. Bangs, L. D. Mech, R. R. Ream. 2011. Wolf population dynamics in the U. S. Northern Rocky Mountains are affected by recruitment and human-caused mortality. Journal of Wildlife Management doi: 10.1002/jwmg.201
p..61804, col. 2, lines 15-21	Delete sentence and update with "Mech and Goyal (2011) recently found that from 1987 to 1993, CPV reduced pup survival, subsequent dispersal and overall population growth in the Superior National Forest of Minnesota (a population at carrying capacity in suitable habitat); after that the population apparently gained resistance to CPV." Add "Mech, L. D. and S. Goyal. 2011. Parsing demographic effects of canine parvovirus on a Minnesota wolf population. J. of Veterinary Medicine and Animal Health 3(2):27-30" to Literature Cited and delete "Mech et al. 2008".

p. 61808, col. 3, lines 32-34	Add Adams et al. 2008 Wildlife Monograph, and Gude, J. A., M. S. Mitchell, R. E. Russell, C. A. Sime, E. E. Bangs, L. D. Mech, R. R. Ream. 2011. Wolf population dynamics in the U. S. Northern Rocky Mountains are affected by recruitment and human-caused mortality. Journal of Wildlife Management doi: 10.1002/jwmg.201

5. Is it reasonable for the Service to conclude that Wyoming's approach to wolf management, as described in the Plan and the proposed rule, in the context of wolf management throughout the entire NRM region, is likely to maintain Wyoming's wolf population above recovery levels [recovery goal as described in the 2009 delisting as: "Thirty or more breeding pairs (an adult male and an adult female that raise at least 2 pups until December 31) comprising 300+ wolves in a metapopulation (a population that exists as partially isolated sets of subpopulations) with genetic exchange between subpopulations (Service 1994; Fritts and Carbyn 1995). Step-down recovery targets require Montana, Idaho, and Wyoming to each maintain at least 10 breeding pairs and 100 wolves by managing for a safety margin of at least 15 breeding pairs and at least 150 wolves in mid-winter. Genetic exchange can be natural or, if necessary, agency managed."]?

Yes, and although the recovery criteria of 300 wolves and 30 breeding pairs were originally determined subjectively by a panel of wolf authorities in a process similar to the Delphi Method, upon my current review, and knowledge of wolf population persistence (Fuller et al. 2003: Table 6.9) these numbers still seem adequate.

6. Is it reasonable for the Service to conclude that Wyoming's approach to wolf management, as described in the Plan and the proposed rule, in the context of wolf management throughout the entire NRM region, is likely to provide for sufficient levels of gene flow to prevent genetic problems from negatively impacting the Greater Yellowstone Area's population or the larger NRM metapopulation in a manner that would meaningfully impact viability?

Yes, but on p. 61815, col. 1, l. 8, it would be more accurate to change “almost certainly” to “probably”.

Critique of Wyoming Gray Wolf Management Plan

I have no disagreements with this plan. However I have the following suggestions for improving its presentation and updating the information as follow:

p. 3, 2nd full par., l. 2 – It would be helpful here and elsewhere to state that the estimated number of wolves in the predatory animal zone is 30-35.

p. 13, 2nd full par., l. 5-6 and elsewhere – all wolf numbers should be qualified with "at least" unless the exact number is known.

p. 14, l. 3 – It would be more accurate and realistic here to cite Oakleaf et al. (2003 JWM) that these figures are probably quite minimal.

p. 21, last par. – Should cite Adams et al. (2008) Wildlife Monograph and Gude et al. (2011) – (Gude, J. A., M. S. Mitchell, R. E. Russell, C. A. Sime, E. E. Bangs, L. D. Mech, R. R. Ream. 2011. Wolf population dynamics in the U. S. Northern Rocky Mountains are affected by recruitment and human-caused mortality. Journal of Wildlife Management doi: 10.1002/jwmg.201).

p. 22, 1st par. – Would be better to delete reference to Mech et al. (2008) and cite Mech and Goyal (2011) - (Mech, L. D. and S. Goyal. 2011. Parsing demographic effects of canine parvovirus on a Minnesota wolf population. J. of Veterinary Medicine and Animal Health 3[2]:27-30).

p. 46, Forbes and Boyd reference – add "y" to "Rock"

p. 54 – This entire subject of attempting to maintain wolf genetic diversity by natural or artificial means is totally overblown. Wolves can survive considerable inbreeding as indicated by the Isle Royale population of 25 wolves that was totally inbred for 50 years and survived (See Mech and Boitani 2003:189-190).

p. 55 – Fig. 1 could use a state map for perspective.

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10/17/2011

Stephanie Lauer
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ATKINS
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Dear Ms. Lauer,

As requested I have reviewed the proposed rule "Endangered and Threatened Wildlife and Plants; Removal of the Gray Wolf in Wyoming From the Federal List of Endangered and Threatened Wildlife and Removal of the Wyoming Wolf Population's Status as an Experimental Population", issued on October 4, 2011. My comments are organized based on the specific questions to be addressed by the peer review panel.

1. **Is the Service's description and analysis of the biology, population, and distribution accurate?**

Yes. The Service has provided a thorough description and analysis of the biology, population, and distribution of the Wyoming wolf population based on current scientific literature and agency data. Information provided in the proposed rule accurately reflects the current biology and population data of the wolf population in Wyoming and the Greater Yellowstone Area, as well as sections that address information on wolves in the Northern Rocky Mountains Distinct Population Segment.

2. **Does the proposed rule provide accurate and adequate review and analysis of the factors relating to the threats?**

Yes. I have reviewed the proposal's discussion of the five listing factors (p. 61796 –61819) and concur with the conclusions. In general these factors will likely have no significant impact to the wolf population in Wyoming as long as population levels are maintained above recovery levels as indicated in the proposal and large blocks of public land continue to support suitable wolf habitat.

3. **Are the conclusions the Service reaches, including their projection of maintenance of a viable population, logical and supported by the evidence they provide?**

Yes. Despite changes to the legal status for wolves in Wyoming, the monitoring and management of wolves post delisting, as described in the proposed rule and the Wyoming wolf plan, are similar to how wolves are monitored and managed under the nonessential experimental designation that is currently in place. The one change will be a regulated harvest by Wyoming Game and Fish

Department. The Department has demonstrated effective management of wildlife populations and is well suited to maintain the wolf population above the recovery objective.

4. **Did the Service include all the necessary and pertinent literature to support their assumptions/arguments/conclusions?**

Several citations listed may be appropriate to include in the rule.

p. 61801, human-caused mortality rates - Adams et al. 2008 should be included in this and other sections discussing ranges of human –caused mortality rates. The authors determined that wolf population trends are not affected by human-caused mortality less than 30 percent per year.

Adams, L. G., R. O. Stephenson, B. W. Dale, R. T. Ahgook, and D. J. Demma. 2008. Population dynamics and harvest characteristics of wolves in the central Brooks Range, Alaska. Wildlife Monographs 170.

Also on this page a 36 percent human-caused mortality rate is first cited here as a sustainable level for wolves in Wyoming outside YNP. This reference to the Wyoming wolf plan figure is repeated several times in the rule. This figure represents a course evaluation of sustainable harvest for the wolf population and needs further justification if it is going to be used to demonstrate sustainable harvest. This reference could be excluded or provide further explanation of how this figure was determined.

p. 61804, CPV – Although Mech et al. 2008 concluded CPV reduced overall rate of population growth in Minnesota, Mech and Goyal 2011 found that there was only a period of seven years that CPV prevalence correlated with pup survival indices. This reference should be included to update potential demographic effects of CPV and the evidence of only a temporary effect on wolf populations.

Mech L. D. and S. M. Goyal. 2011 Parsing demographic effects of canine parvovirus on a Minnesota wolf population. Journal of Veterinary Medicine and Animal Health 3(2):27-30.

p. 61819, wolf pack social structure – Rutledge et al. 2010 should be included in this section on consideration of human-caused mortality on wolf pack social structure.

Rutledge, L. Y., K. Mills, K. M. Loveless, D. L. Murray, B. R. Patterson, and B. N. White. 2010. Protection from harvesting restores family pack structure of Eastern wolves in Algonquin Provincial Park. Biological Conservation 143:332–339.

5. **Is it reasonable for the Service to conclude that Wyoming's approach to wolf management, as described in the Plan and the proposed rule, in the context of wolf management throughout the entire NRM region, is likely to maintain Wyoming's wolf population above recovery levels [recovery goal as described in the 2009 delisting as: "Thirty or more breeding pairs (an adult male and an adult female that raise at least 2 pups until December 31) comprising 300+ wolves in a metapopulation (a population that exists as partially isolated sets of subpopulations) with genetic exchange between subpopulations (Service 1994; Fritts and Carbyn 1995). Step-down recovery targets require Montana, Idaho, and Wyoming to each maintain at least 10 breeding pairs and 100 wolves by managing for a**

safety margin of at least 15 breeding pairs and at least 150 wolves in mid-winter. Genetic exchange can be natural or, if necessary, agency managed."]?

Yes. Although I expect from the information in the proposed rule and the WY wolf management plan for the population to exceed the agreed to objective of at least 10 breeding pairs and at least 100 wolves in Wyoming outside of YNP, counting wolves outside the WTGMA towards this objective should be avoided if packs are not expected to persist in the area outside the WTGMA. The objective would be better addressed if only those wolves in the WTGMA counted towards the 10 &100 objective.

6. **Is it reasonable for the Service to conclude that Wyoming's approach to wolf management, as described in the Plan and the proposed rule, in the context of wolf management throughout the entire NRM region, is likely to provide for sufficient levels of gene flow to prevent genetic problems from negatively impacting the Greater Yellowstone Area's population or the larger NRM metapopulation in a manner that would meaningfully impact viability?**

Yes. The level of gene flow adequate to prevent genetic problems is supported by vonHoldt 2010 and represents a minimum level of gene flow that has occurred in Wyoming, GYA, and the NRM wolf population. This study was conducted with data through 2004 and a wolf population of 835 wolves. The current population is at least 1,600 wolves and at nearly twice the population number has likely much higher gene flow than it did in 2004. Dispersal information based on radio-collared wolves cited in the proposed rule further supports effective migration of wolves between recovery areas in the NRM region (Jimenez et al. 2011). Although likely not a barrier to dispersal, because wolves move through YNP and other parts of Wyoming to contribute to the connectivity of the region the flex area of the WTGMA will further facilitate dispersal during peak times of the year. Genetic as well as radio monitoring by the Wyoming Game and Fish Department will be adequate to document effective gene flow for the Wyoming wolf population and the GYA.

That concludes my review of the proposed rule. I appreciate the opportunity to review the proposal and the Wyoming wolf plan and if I can be of any further assistance please let me know.

Sincerely,

/s/ Daniel W. Stark

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Review of the Service's proposed rule (75 FR 61782 [2011-10-5]) and Wyoming's 2011 Management Plan for Wolves.
Submitted by John A. Vucetich on 24 October 2011

1. Is the Service's description and analysis of the biology, population, and distribution accurate?

The Service's description of the population ecology associated with how human-caused (anthropogenic) mortality affects wolf population dynamics is inappropriate.

[1] First some background: The most appropriate way to assess how the annual rate of anthropogenic mortality (m_a) affects wolf population dynamics is to assess the statistical relationship between m_a and r, the annual population growth rate. To date, this relationship has been examined in 5 published studies and 1 unpublished study. These studies are:

A) Fuller et al. (2003) analyzed the relationship between m_a and r for 19 populations from across North America. They concluded (p. 184): "On average, wolf population size should stabilize with a mortality rate of 0.34+/-0.06 SE, or a human-caused rate of **0.22** +/-0.08 SE."

B) Adams et al. (2008) performed a similar analysis on an expanded set of observations from across North America. This analysis indicates that the expected growth rate of a population is less than zero if m_a is greater than **~0.29** (Fig. 19 of Adams et al. 2008).

C) Creel and Rotella (2010) investigated the relationship between m_a and λ (=exp[r]) for the three populations of wolves living in the Northern Rocky Mountain (NRM) region of the United States between 1999 and 2009. That analysis indicates that (in the absence of information about recruitment), a wolf population would be expected to decline if m_a is greater than **~0.22**.

D) Sparkman et al. (2011) examined the effect of anthropogenic mortality in red wolves and concluded that decline in those populations should be expected for rates of anthropogenic mortality that exceed **~0.25**.

E) Gude et al. (2011) analyzed the same populations, using the same source data, that Creel and Rotella (2010) analyzed. They concluded that (in the absence of information about recruitment), wolves in the NRM populations should not be expected to decline unless m_a is greater than ~0.48.

Gude et al. (2011) attributes differences between their results and those of Creel and Rotella (2010) to: (i) their having omitted three data points that they considered unreliable, and (ii) constructing population models that also account for the mediating influence that recruitment would have on the relationship between m_a and population growth rate. Creel and Rotella (*in prep*) provide a reasonable explanation for why their results are appropriate even though they included these 3 data points and failed to account explicitly for recruitment.

F) Vucetich and Carroll (*unpubl. manusc*)[1] show that Gude et al. (2011) and Creel and Rotella (2010) arrived at different conclusions because they computed estimates of survival in different ways. More specifically, they show how Gude et al.'s calculations overestimate m_a, which led them to overestimate the value of m_a at which wolf populations in the NRM should be expected to decline. Vucetich and Carroll also reanalyzed the NRM data using an analysis that is more appropriate than that used by either Gude et al. (2011) and Creel and Rotella (2010). In doing so, they showed that wolves in the NRM are likely to decline at rates of anthropogenic mortality that exceed ~**0.17**.

[2] The summary of research described above in point [1] contrasts with the USFWS review of the effect of anthropogenic mortality on wolf population dynamics (p. 61801): " Wolf conservation can be compatible with harvest. [A] Wolves can maintain population levels despite very high sustained human-caused mortality rates of 22 to greater than 50 percent (Keith 1983; Ballard *et al*. 1987; Fuller 1989; Fuller *et al*. 2003, pp. 182–184; Creel and Rotella 2010). [B] Mortality rates and population growth rates reported from 2007 to 2010 indicate that the wolf population in Wyoming outside YNP can sustain, on average, a 36 percent mortality rate from human causes (WGFC 2011, p. 12). [C] When populations are maintained below carrying capacity and natural mortality rates remain low, human-caused mortality can replace up to 70 percent of natural mortality (Fuller *et al*. 2003, p. 186). [D] Wolf pups can also be successfully raised by other pack members (Boyd and Jimenez 1994) and breeding individuals can be quickly replaced by other wolves (Brainerd *et al*. 2008, p. 89), which further mitigates the impact of harvest." (I added the letters in square brackets at the beginning of various sentence for the purpose of referencing those statement.)

Statements [A] and [C] represent an extremely misleading interpretation of the six studies that have been conducted on the relationship between m_a and r.

Statement [B] is supposed to be justified by referencing (WGFC 2011, p. 12). Page 12 of WGFC (2011) says: "Mortality rates and population growth rates reported for wolves in Wyoming outside YNP from 2007 to 2010 suggest that the wolf population in Wyoming can sustain, on average, a 36% mortality rate from human causes and 43% total mortality rate without declining." This statistic is not supported by any references or analysis. Moreover, this anthropogenic mortality rate is 60% to 100% greater than existing research suggests wolves in the NRM could tolerate without being expected to decline. Existing literature suggests that a wolf population that endured these rates of mortality would be expected to decline, especially if that population is not bolstered by many immigrants each year.

[1] Vucetich and Carroll (*unpubl. manusc.*) is available upon request from John Vucetich (javuceti@mtu.edu). It will be submitted to the Journal of Animal Ecology in early November 2011.

Statement [C] is not a *result* that is presented in Fuller et al. (2003), but is instead speculation that they offer to explain the results they observed. Moreover, more research suggests that the opposite it true. For example, analyses in Sparkman et al. (2011) suggest that the m_a* (the value of m_a at which a population is expected to decline) is lower (not greater) for populations less affected by density dependent processes (i.e., further from carrying capacity).

Moreover, existing research suggests that m_a* is greater for most North American populations than it is for NRM wolves. This pattern is seen for example in comparing the North American data in Fig. 19 in Adams et al. [2008] and the NRM data in Figure 2 of Creel and Rotella (2010). This pattern is also documented by Vucetich and Carroll (*unpubl. manusc.*). This difference may be attributable to two characteristics of the NRM wolf populations. First, NRM wolf populations have been expanding and consequently density-dependence processes, such as food limitation and territoriality, have probably not been especially influential in these populations. In such cases, anthropogenic mortality is less likely to be compensated by reductions in mortality attributable to other causes. By contrast, the wolf populations represented in the North American data set are not newly established, and consequently are likely more influenced by density-dependent processes. In these cases, there is a greater capacity for anthropogenic mortality to be compensated by reductions in mortality attributable to other causes.

Second, differences in dispersal may also account for observed differences in m_a*. Specifically, the NRM populations are near the edge of their geographic range. The capacity for immigration into these populations to offset losses due to anthropogenic mortality is likely limited (see also VonHoldt et al. 2010, 2011). By contrast, the populations represented in the North American data are, for the most part, embedded deep within the geographic range of wolves. Here the capacity for immigration to offset losses to anthropogenic mortality is likely greater.

This description of the ecology of anthropogenic mortality in wolves is not adequately reflected by statement [C].

Statements [C] and [D] together are meant to illustrate the ecological processes that explain why anthropogenic mortality is largely compensatory in wolf populations. From a technical perspective, anthropogenic mortality is completely compensatory with other demographic processes when the slope between m_a and r is zero, and completely additive when the slope is –1. Similarly, anthropogenic mortality is completely compensated by other sources of mortality when the slope between m_a and overall survival rate is zero, and completely additive when the slope is – 1.

Using telemetry-based estimates of survival, Murray et al. (2010) concluded (p. 2520): "At the population-level anthropogenic mortality was largely additive, with the regression slope for annual survival vs. annual anthropogenic mortality rate being closer to 1 than zero… These findings reinforce the primacy but non-exclusivity of additive mortality from anthropogenic causes…" If anthropogenic mortality also has indirect effects on recruitment (e.g., through the disruption of social structure or pup survival), then the overall effect of m_a on r would be more severe than what is indicated by this analysis of m_a and overall survival.

The estimated slope for the relationship between m_a and r is less than –1 for the NRM wolf populations and the red wolf population (Creel and Rotella 2010; Sparkman et al. 2011; Vucetich and Carroll [*unpubl. ms.*]). Slopes less than –1.0 correspond to an anthropogenic mortality being super additive. That some cause-specific mortalities are super additive, or nearly so, due to the nonlethal effects of harvest, may occur more frequently than has generally been appreciated (e.g., Milner et al. 2007, Pauli & Buskirk 2007, Vucetich et al. 2004; see also Kokko 2001). This circumstance may be more likely in species where mortality can disrupt social structure and/or the rearing of offspring (Brainerd et al. 2008; Sparkman et al. 2011). Finally, for the North American data, the estimated slope of the relationship between m_a and r is –1.1 when m_a=0.32 (Fig. 3 of Vucetich and Carroll [unpubl. manuscr.]).

Statement [D] is true in the sense that "wolf pups *can* be successfully raised by other pack members" and "breeding individuals *can* be quickly replaced by other wolves." (italics added). However, statement [D] is misleading for implying that anthropogenic mortality is largely compensatory in the NRM wolf population, when important data suggest otherwise.

[3] CONCLUSION: For the reasons explained above in [1] and [2], the Service's review of the ecology of anthropogenic mortality in wolves is inappropriate. Moreover, the review of this topic in the Wyoming management plan is virtually identical. This inappropriate review of anthropogenic mortality is a critical weakness of both the Service's proposed rule and Wyoming's plan for two reasons: (i) The Wyoming plan is largely devoted to describing the many reasons for and methods by which Wyoming plans to kill wolves (i.e., regulated public harvest, aerial gunning, lethal take permits, and allowance for property owners to immediately kill a wolf doing damage [or likely to do damage at any moment] to private property). (ii) The Wyoming plan suggests that it will use anthropogenic mortality to reduce wolf abundance, which suggests it would manage for rates of anthropogenic mortality well in excessive of 36%. The Wyoming plan mentions that it will manage wolf abundance with a buffer that exceeds the minimum required number of wolves; however, the Wyoming plan does not indicate in anyway how large that buffer will be.

These two circumstances and the failure to demonstrate a reasonable understanding of anthropogenic mortality mean: (i) that implementation of the USFWS proposed rule and Wyoming plan could cause declines in wolf abundance that Wyoming and the Service would not anticipate; and (ii) one cannot reasonably exclude the possibility that these "unanticipated" declines would conflict with the objectives of recovery.

2. Does the proposed rule provide accurate and adequate review and analysis of the factors relating to the threats?

The Service's description of population ecology associated with how human-caused (anthropogenic) mortality affects wolf population dynamics is inappropriate. This concern is described in the response to question 1.

3. Are the conclusions the Service reaches, including their projection of maintenance of a viable population, logical and supported by the evidence they provide?

A. The Service's position on human-assisted dispersal is not logical for the reasons outlined below:

[1] The most basic and general equation in all population biology is: $N_{t+1} = N_t+B_t+I_t-D_t-E_t$, where N is abundance, B is the number of births, D is the number of deaths, I is the number of immigrants, and E is the number of emigrants. This equation highlights the three fundamental processes of a population: reproduction, mortality, and dispersal. It seems straightforward to expect that a recovered population should be able to perform these fundamental processes without the direct assistance of humans. For example, one cannot reasonably expect a population to be considered recovered if it required the regular addition of individuals from a captive population to offset either low recruitment or survival in the wild. For the same kind of reasoning a population should not be considered recovered if it cannot exhibit critical levels of dispersal on its own.

[2] Perhaps an exception could be made if there were something peculiar about the natural history of the population in question that excluded its ability to disperse on its own. However, this case does not apply to NRM wolves. Wolves are capable dispersers. Moreover, the main limitation on dispersal in NRM wolves is anthropogenic mortality and the effect anthropogenic mortality has on population abundance. That is, one of the main limitations to natural dispersal is one of the main threat factors that is supposed to be removed.

[4] The Service does attempt to provide a justification for why human-assisted dispersal is acceptable. First they argue that some species should be considered perpetually conservation reliant. The weakness of this reasoning is explained above in point [3]. The Service also attempts to justify the appropriateness of human-assisted dispersal by explaining how it has for a long period of time, and in many documents, expressed its intention to use human-assisted dispersal. The weakness of this reasoning is that claiming to have intended an action repeatedly, over a long period of time, does not represent an adequate justification for an action.

B. The service's account for the relationship between hunting and human tolerance of wolves is weak: The proposed rule says (p. 61813): "We believe public tolerance of wolves will improve as… hunters start to see wolves as a trophy animal with value." The proposed rule also says (p. 61813): "Despite the variety of opinions, research is scarce on what factors increase human tolerance of wolves and how those translate into conservation success by preventing excessive rates of human-caused mortality (Bath and Buchanan 1980; Williams et al. 2002; Ericsson et al. 2003; Fritts et al. 2003)." This second statement is certainly true, and it casts significant doubt on the first sentence.

4. Did the Service include all the necessary and pertinent literature to support their assumptions/arguments/conclusions?

On page 61817, the Proposed rule uses Isle Royale wolves as an example of a population that does not suffer from inbreeding depression. Two papers explain how the fitness and demography of Isle Royale wolves have been affected by inbreeding depression. These papers are:

* Adams et al. 2011. Genomic sweep and potential genetic rescue during limiting environmental conditions in an isolated wolf population. Proc R Soc. 278(1723):3336-44.
* Räikkönen, J., J. A. Vucetich, R. O. Peterson, M. P. Nelson. 2009. Congenital bone deformities and the inbred wolves (*Canis lupus*) of Isle Royale. Biological Conservation 142(5): 1025-1031.

5. Is it reasonable for the Service to conclude that Wyoming's approach to wolf management, as described in the Plan and the proposed rule, in the context of wolf management throughout the entire NRM region, is likely to maintain Wyoming's wolf population above recovery levels [recovery goal as described in the 2009 delisting as: "Thirty or more breeding pairs (an adult male and an adult female that raise at least 2 pups until December 31) comprising 300+ wolves in a metapopulation (a population that exists as partially isolated sets of subpopulations) with genetic exchange between subpopulations (Service 1994; Fritts and Carbyn 1995). Step-down recovery targets require Montana, Idaho, and Wyoming to each maintain at least 10 breeding pairs and 100 wolves by managing for a safety margin of at least 15 breeding pairs and at least 150 wolves in mid-winter. Genetic exchange can be natural or, if necessary, agency managed."]?

[1] On 17 Oct 2011, the peer-reviewers of the proposed rule and Wyoming plan met in Denver to discuss these documents. At this meeting, the people representing the proposed rule and the Wyoming plan expressed: (i) a very clear intention to manage wolves without compromising the objectives of recovery, and (ii) a very clear understanding of the negative consequences of failing to meet this intention. I was impressed by these expressions – they represent a strong reason to believe that wolves will remain recovered in Wyoming for some period of time after delisting.

However, several critical portions of the Wyoming plan do not seem quite congruent with these expressions of intent. This disparity is important because wolves in Wyoming may be managed, at some point in the future, according to the principles of the written plan without as much regard for the intentions expressed at the 17 Oct meeting.

So, while I was impressed by these verbal expressions of intention, my responsibility is to review the proposed rule and the Wyoming plan. My comments in this review are, for this reason, focused on the written documents.

[2] Wyoming's management plan does not allow the Service to reasonably conclude that Wyoming's approach to wolf management is consistent with agreed upon objectives of recovery. This concern is largely associated with Wyoming's plans for harvesting and lethally controlling wolves.

[3] The WY plan states (p. 23): "*The primary purpose of regulated public harvest of wolves in Wyoming will be to manage the wolf population and alleviate conflicts with livestock, domesticated animals, and unacceptable impacts to big game*." Several important concerns for the WY plan arise from reviewing each of the three stated purposes.

[4a] One purpose of wolf harvesting is to "manage the wolf population." The grammar of the sentence explaining the purpose of the harvest suggests that "manage the wolf population" is different than "alleviate conflicts with livestock, domesticated animals, and unacceptable impacts to big game." One might infer, from the WY plan, that "manage the wolf population" means control wolf abundance. If not, then what does that phrase mean? If so, then what abundance will managers target? The WY plan does not answer these questions.

Specifically, the WY plan does not adequately indicate how many wolves the state will manage for, in the areas outside YNP and WRR. Several passages of text in the plan refer to (e.g., p. 7): *"the objective of at least 10 breeding pairs and at least 100 wolves outside YNP and the WRR.*" However, the plan also draws prominent attention to *(p. 1): "Wyoming would not be required to contribute more than 10 breeding pairs and 100 wolves outside YNP and the WRR."* Is Wyoming's management plan, for the areas outside YNP and WRR, designed to result in no fewer than 10 breeding pairs and 100 wolves, or no more than 10 breeding pairs and 100 wolves?

The WY plan also says (p. 24): "*The Department will manage for a buffer above the minimum objective of 10 breeding pairs and 100 wolves because this allows for the flexibility needed to resolve wolf conflicts through control actions.*" Wyoming's apparent understanding is correct in that: (i) managing a harvest for the purpose of reducing abundance without letting abundance fall below a minimum threshold requires a buffer, and (ii) without a buffer the objectives of the harvest would conflict with the objectives of recovery. For the same reasons, the objectives of the harvest would conflict with the objective of recovery, if the buffer is too small. The WY plan does not indicate in any way how large or small that buffer will be. Without knowing more about the size of the buffer there is reason to be concerned that the objective of the regulated public harvest (and other plans for managing anthropogenic mortality) are inconsistent with the objectives of recovery.

On page 6 the plan says: "*Step-down recovery targets require Montana, Idaho, and Wyoming to each maintain at least 10 breeding pairs and 100 wolves by managing for a safety margin of at least 15 breeding pairs and at least 150 wolves in mid-winter.*" Because no other details are provided about the buffer, one might infer that the buffer is the 5 breeding pairs and 50 wolves that are the "agreed upon" minimum numbers in Yellowstone National Park and Wind River Reserve. If so, that would be an inappropriate buffer.

If a regulated public harvest is expected to reduce abundance to a level that is numerically close to the recovery target, then objectives of the harvest would conflict with the objectives of recovery. Because the Wyoming plan does not indicate what abundance it will target, the Wyoming plan does not exclude the possibility that this objective harvest is inconsistent with the objectives of recovery.

[4b] A second purpose of the regulated public harvest is to "alleviate conflicts with livestock [or] domesticated animals." The Wyoming plan describes other well-developed plans for controlling these conflicts (i.e., aerial gunning [p. 53), lethal take permits [p. 22], and allowance for property owners to immediately kill a wolf doing damage [or likely to do damage at any moment] to private property [p.22]). This purpose of general harvest suggests that the state of Wyoming believes these other plans would be inadequate for alleviating conflict with livestock. This suggests that WY has a high standard for alleviating conflict. If these other plans do not (meet the apparently high standards to) alleviate conflicts, what kind of regulated public harvest would be able to alleviate conflicts?

If the standards for alleviating conflict are high enough, then objectives of the harvest would be inconsistent with the objectives of recovery. Because the WY plan does not adequately explain the standards for alleviating conflict, one cannot confidently conclude that the objectives of the harvest are consistent with the objectives of recovery.

[4c] A third purpose of the regulated public harvest is to "*alleviate… unacceptable impacts to big game."* The WY plan also states that the (p. 39): "*Commission has defined 'unacceptable impact' as any decline in a wild ungulate population or herd that results in the population or herd not meeting the state population management goals or recruitment levels established for the population or herd' in Commission regulation*." The logic of this statement is functionally equivalent to defining an *'unacceptable impact' as any decline that does not meet desired goals.* The statement is a virtual tautology. For the purposes of managing wolves, the WY plan's explication for the meaning of "unacceptable impact" is inadequate because: If the standards for alleviating conflict and unacceptable impact are high enough, there is reason to be concerned that the objectives of the harvest are inconsistent with the objectives of recovery.

The WY plan states (p. 39):

> *"Management actions may be taken where wolves significantly affect ungulate populations. Wolves may be lethally removed when, based on best scientific data and information available, the Department determines a wild ungulate herd is experiencing unacceptable impacts or when wolf/wild ungulate conflict occurs at state operated feedgrounds."*

These statements fail to provide due diligence in recognizing the great difficulty of knowing why a population is declining, especially when that population is affected by many factors such as climate, forage availability, harvest, and predation. Elk on the Northern Range of Yellowstone National Park is an illuminating example. That population declined from 1995 to 2004. That decline is associated with a remarkable amount of information that has been studied and scrutinized intensively by many researchers (e.g., Vucetich et al. 2004; White & Garrott 2005; Varley and Boyce 2006; Eberhardt et al. 2007). Nevertheless, seven years after that decline there is still no consensus on the relative influence of climate, harvest and predation on that elk decline. Recent moose decline in northern Minnesota represents another important example of the difficulty of attributing population decline to one factor

(such as predation), when many factors are involved (Murray et al. 2006). In failing to recognize these difficulties, the above-cited statement from page 39 suggests a particularly aggressive approach to managing wolves and may be inconsistent with the objectives of recovery.

If the standards for unacceptable impact are high enough, then objectives of the harvest would be inconsistent with the objectives of recovery. Because the WY plan does not adequately explain the standards for what counts as unacceptable impact, one cannot confidently conclude that the objectives of the harvest are consistent with the objectives of recovery.

[5] In addition to describing the purpose of a regulated public harvest, the Wyoming plan includes text (pages 23-25) intended to describe <u>how</u> it would establish quotas. The level of detail and specificity for how quotas will be established is well captured by (p. 25):

> "*The department will take into consideration, but not be limited to, the following when developing wolf regulations: wolf breeding seasons; short and long range dispersal opportunity, survival, and success in forming new or joining existing packs; conflicts with livestock; and the broader game management responsibilities related to ungulates and other wildlife*."

It is certainly important that these factors be "take[n] into consideration." However, the WY plan offers virtually no detail about <u>how</u> it will take these factors into consideration. This lack of detail represents a critical inadequacy because the Wyoming plan (and the Service's proposed rule) also demonstrates an inadequate understanding for the effect of anthropogenic mortality on wolf populations in the NRM (see page 1 of this document).

The Wyoming plan states (p. 23): "*The Department will use an adaptive management approach to employ harvest strategies to meet management objectives*." While this statement appears as though it might be intended as the topic sentence of the paragraph in which it appears, no further explanation for this sentence is offered. As such, one can only infer that the currently planned approach for setting quotas will change if future contingencies suggest the need for change. This is fine, except there is no adequately detailed explanation of the currently planned approach for setting quotas.

The only operational detail offered in the plan for how the department will determine each year's quota is (p. 24): "*The Department plans to manage wolf numbers with graduated increases in hunting quotas over a series of years."* This may be fine if the harvest begins at a low enough rate. However, there are doubts about Wyoming's understanding about what might represent a low enough rate (see page 1 of this document).

[6] <u>SUMMARY</u>: Hunting and lethal control is not necessarily incompatible with recovery, but it can be. Anthropogenic mortality is a threat factor for NRM wolves. For this reason, a regulated public harvest is not an obvious tool for maintaining recovery. As such, it is reasonable to expect adequate answers to these questions, *What is the purpose of the regulated public harvest?* and *What are the details for how each year's quota will be determined?* The WY plan does not offer adequate answers

to these questions. The ideas in [1] and [2] suggest that the objectives and (or) implementation of the harvest may well be inconsistent with the objectives of recovery.

6. Is it reasonable for the Service to conclude that Wyoming's approach to wolf management, as described in the Plan and the proposed rule, in the context of wolf management throughout the entire NRM region, is likely to provide for sufficient levels of gene flow to prevent genetic problems from negatively impacting the Greater Yellowstone Area's population or the larger NRM metapopulation in a manner that would meaningfully impact viability?

It may not be reasonable for the Service to conclude that Wyoming's approach to wolf management (and the approach of other states) is likely to maintain sufficient levels of gene flow.

[1] The WY plan indicates that its objective for maintaining sufficient levels of gene flow is (p. 54) "*at least one effective natural migrant per wolf generation entering into the GYA.*" Existing literature suggests that this objective for immigration is appropriate.

However, adequate connectivity among the NRM wolves should involve not only immigration into Wyoming, but also emigration from Wyoming into the other populations in the NRM. The Wyoming plan makes no provision for emigration.

[2] The WY plan indicates that its overall management of wolves (with provisions for a regulated public harvest, aerial gunning, lethal take permits, and allowance for property owners to immediately kill a wolf doing damage [or likely to do damage at any moment] to private property) is likely to result in meeting the objective of sufficient genetic connectivity. The primary reason offered by the WY plan for this conclusion is that genetic connectivity *was (p. 27) "more than adequate when the NRM wolf population was much lower than the current number (≥5.4 migrants per generation at a population of ~835 wolves in 2004 vs. ~1,614 wolves in 2010)."*

This reason is weakened by two concerns. First: This statement is based on work by Von Holdt et al. (2010). When I read these papers and spoke with an author of these papers, the impression I get is that during the ten years (1995-2010) that were studied: (i) The GYA produced zero emigrants that migrated to and reproduced in either CID or NWMT, (ii) one wolf from CID migrated to and reproduced in GYA, and (iii) two wolves were translocated from NWMT into the GYA. This corresponds to less than 0.5 effective immigrants per generation occurring naturally (i.e., not human-assisted migration). Also, dispersal data gathered from radio-collared wolves living between 1992 and 2008 suggest that the GYA received approximately 1.5 migrants per generation (p. 61814 of the proposed rule). Even though the methods used in Von Holdt et al. (2010) are expected to underestimate dispersal, these observations suggest that migration into the WY population may not be ≥5.4 effective migrants per generation, as implied by the Wyoming plan.

Second, much of the migration that has been documented occurred when abundance was greater than that specified for recovery in the NRM (i.e., 30 packs and 300 wolves). It is unclear whether any of the states, including WY, will maintain enough wolves to maintain sufficient genetic connectivity.

[3] The WY plan says (p. 6): "*Genetic exchange can be natural or, if necessary, agency managed*." Page 4 of this document offers reason for concern over the appropriateness of considering a population recovered if it depends on human-assisted migration. Moreover, the words "can be" and "if necessary," in the above cited sentence, represent an inappropriate level of inconsistency and vagueness. Specifically, it is unclear whether this statement means: (i) "*Natural genetic exchange is preferred so long as it does not conflict with other management preferences; and if natural migration does conflict with other management preferences, then human-assisted migration is appropriate*," or does the WY plan mean (ii) "*Human-assisted migration is acceptable only if natural migration cannot occur when anthropogenic mortality is negligible*"? A passage of text on page 28 suggests (but is not clear) that this ambiguity is of concern:

> "*Population management, to the maximum extent practicable, should facilitate the above objective through natural dispersal. Therefore, if wolf population management strategies implemented by the Department are identified as a meaningful factor preventing the connectivity objective from being met, population management will be modified as necessary and appropriate*."

It seems very clear that effective migration is limited by wolf abundance and the rate of anthropogenic mortality. Would Wyoming, for example, reduce the quota for a regulated public harvest to zero (and other sources of anthropogenic mortality) if natural migration did not result in meeting the goals for genetic connectivity?

This vagueness and potential inconsistency is of concern, in part, because of the prospect for inadequate connectivity described above in point [2].

[4] WY plan says (p. 27): "*The Department recognizes dispersing wolves will travel through some habitats that are unsuitable for long-term occupancy due to high conflict potential. The majority of these areas will be outside of the WTGMA where the Department has no management authority*." This idea is incomplete. A more complete expression of these ideas includes: (i) Dispersing wolves will travel through some habitats that are unsuitable for long-term occupancy due, in part, to Wyoming statutes that define the size and location of the Wolf Trophy Game Management Area, and (ii) While the department does not have management authority over those area, the state of Wyoming is still responsible for maintaining genetic connectivity.

[6] The Wyoming plan states (p. 28): "*This goal of genetic connectivity is not a relisting trigger. Instead, it is a trigger to conduct effective adaptive management intended to preclude the need to ever consider relisting due to genetic issues*." The proposed rule makes it very clear that genetic connectivity is very important.

If it were determined, after a period of monitoring, that connectivity goals had not been met; why shouldn't the states automatically engage in human-assisted

migration? Yes, it is unacceptable to consider a population recovered if it requires human-assisted migration (see p. 4 of this document). However, because genetic connectivity is important, this condition would seem to warrant human-assisted migration, even though reliance on human-assisted migration should not be considered a condition of a recovered population.

Moreover, if failing to meet requirements for connectivity is not a relisting criterion, then what would be a relisting trigger with respect to genetic connectivity? This needs to be specified. Without a relisting trigger related to genetic connectivity, it cannot be taken as a serious objective of recovery.

[7] SUMMARY: Existing evidence indicates that the three populations of the NRM have been sufficiently connected in recent years. However, the least connected subpopulation seems to be Wyoming. In recent years, the number of effective migrants that Wyoming has received is close to the minimum number considered to be sufficient. The rate of effective migration is importantly influenced by abundance and mortality. Moreover, state management will almost certainly lead to reduced abundance and increased mortality. In particular, no state is required to have more than 150 wolves, which is much lower than current or recent population sizes. These circumstances raise concern about whether adequate levels of connectivity would exist under state management. Finally, the Wyoming plan makes no provisions for the Wyoming population to provide emigrants that would reproduce in other NRM populations.

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Appendix C. Panelist Qualifications

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Education and/or Training

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Population biology and predator/prey relationships of Alaskan large mammals.

Professional Experience

1993 - Present	Research Wildlife Biologist USGS, Alaska Science Center, Anchorage, Alaska
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Professional Activities and/or Memberships

IUCN Species Survival Commission, Wolf Specialist Group
The Wildlife Society
Arctic Institute of North America
American Society of Mammalogists

Significant Recent Publications

Collins, W. B, B. W. Dale, L. G. Adams, D. E. McElwain, and K. Joly. 2011. Fire, grazing history, lichen abundance and winter distribution of caribou in Alaska's taiga. Journal of Wildlife Management 75:369-377.

Adams, L.G., S.D. Farley, C.A. Stricker, D.J. Demma, G.H. Roffler, D.C. Miller, and R.O. Rye. 2010. Are inland wolf-ungulate systems influenced by marine subsidies of Pacific salmon? Ecological Applications 20:251-262.

Belant, J.L., B. Griffith, Y. Zhang, E.H. Follmann, and L.G. Adams. 2010. Population-level resource selection by sympatric brown and American black bears in Alaska. Polar Biology 33:31-40.

McIntyre, C. L., D. C. Douglas, and L. G. Adams. 2009. Movements of juvenile gyrfalcons from western and interior Alaska following departure from their natal areas. Journal of Raptor Research 43:99-109.

Dale, B. W., L. G. Adams, W. B. Collins, K. Joly, P. Valkenburg, and R. Toby. 2008. Stochastic and

compensatory effects limit persistence of variation in body mass of young caribou. Journal of Mammalogy 89:1130-35.

Adams, L. G., R. O. Stephenson, B. W. Dale, R. T. Ahgook, and D. J. Demma. 2008. Population dynamics and harvest characteristics of wolves in the central Brooks Range, Alaska. Wildlife Monographs 170:1-25.

Boertje, R.D., K.A. Kellie, C.T. Seaton, M.A. Keech, D.D. Young, L.G. Adams, and A.R. Aderman. 2007. Ranking Alaska moose nutrition: signals to begin liberal anterless harvests. Journal of Wildlife Management. 71:1494-1506.

Belant, J.L., K. Kielland, E.H. Follmann, and L.G. Adams. 2006. Interspecific resource partitioning in sympatric Ursids. Ecological Applications 16(6):2333-2343.

Meier, T., J. Burch, and L. G. Adams. 2006. Tracking the movements of Denali's wolves. Alaska Park Science 5 (1):30-35.

Adams, L. G., T. Meier, P. Owens, and G. H. Roffler. 2006. Interrelationships of Denali's large mammal community. Alaska Park Science 5(1):36-40.

Rupp, S., M. Olson, L.G. Adams, B.W. Dale, K. Joly, J. Henkelman, W.B. Collins, and A.M. Starfield. 2006. Simulating the influences of a changing fire regime on caribou winter habitat. Ecological Applications. 16:1730-1743.

Udevitz, M. S., B. Shults, L. G. Adams, and C. Kleckner. 2006. Evaluation of aerial survey methods for Dall sheep in Alaska. Wildlife Society Bulletin. 34:732-740

Burch, J. W., L. G. Adams, E. H. Follmann, and E.A. Rexstad. Evaluation of wolf density estimation from radiotelemetry data. Wildlife Society Bulletin 33(4):1225-1235.

Adams, L. G., B. W. Dale, and G. H. Roffler. Extraordinary movements of the Denali Caribou Herd following the perfect storm. Rangifer Special Issue 16:19-25.

Adams, L. G. 2005. Effects of maternal characteristics and climatic variation on birth masses of Alaskan caribou. Journal of Mammalogy 86:506-513.

Joly, K., B. W. Dale, W. B. Collins, and L. G. Adams. 2003. Winter habitat use by female caribou in relation to wildland fires in interior Alaska. Canadian Journal of Zoology 81:1192-1201.

L. G. Adams. 2003. Marrow fat deposition and skeletal growth in caribou calves. Journal of Wildlife Management. 67(1):20-24.

Joly, K., L. G. Adams, B. W. Dale, and W. B. Collins. 2002. Evaluating the impacts of wildland fires on caribou in interior Alaska. Pages 63-67 in Myers, C.E., and J.R. Hough (eds.). Arctic research of the United States, volume 16. Interagency Arctic Research Policy Committee, National Science Foundation, Arlington, Virginia.

Kleckner,C., M. S. Udevitz, L. G. Adams, and B. S. Shults. 2002. Demography of Dall's sheep in northwestern Alaska. Pages 68-73 in Myers, C.E., and J.R. Hough (eds.). Arctic research of the United States, volume 16. Interagency Arctic Research Policy Committee, National Science Foundation, Arlington, Virginia.

Ben-David, M., E. Shochat, and L. G. Adams. 2001. The utility of stable isotope analysis in studying foraging ecology of herbivores: Examples from moose and caribou. Alces. 37(2):421-434.

Zarnke, R. L., J. Evermann, J. M. Ver Hoef, M. E. McNay, R. D. Boertje, C. L. Gardner, L. G. Adams, B. W. Dale, and J. Burch. 2001. Serologic survey for canine coronavirus in wolves from interior Alaska, 1994-1999. Journal of Wildlife Diseases 37(4):740-745.

McIntyre, C. L., and L. G. Adams. 1999. Reproductive characteristics of migratory golden eagles in Denali National Park, Alaska. Condor 101:1115-1123.

Mech, L. D., and L. G. Adams. 1999. Killing of a muskox, *Ovibos moschatus*, by two wolves, *Canis lupus*, and subsequent caching. Canadian Field-Naturalist 113(4):673-675.

Merrill, S. B., L. G. Adams, M. E. Nelson, and L. D. Mech. 1998. Testing releasable GPS radiocollars on wolves and white-tailed deer. Wildlife Society Bulletin 26(4):830-835.

Adams, L. G., and B. W. Dale. 1998. Reproductive performance of female Alaskan caribou. Journal of Wildlife Management 62:1184-1195.

Adams, L.G., and B.W. Dale. 1998. Timing and synchrony of parturition in Alaskan caribou. Journal of Mammalogy 79:287-294.

Constable, P., K. Hinchcliff, N. Demma, M. Callahan, B. Dale, K. Fox, L. G. Adams, R. Wack, and L. Kramer. 1998. Electrocardiographic consequences of a peripatetic lifestyle in gray wolves (*Canis lupus*). Comparative Biochemistry and Physiology 120:557-563.

Constable, P., K. Hinchcliff, N. Demma, M. Callahan, B. Dale, K. Fox, L. G. Adams, R. Wack, and L. Kramer. 1998. Serum biochemistry of captive and free-ranging gray wolves (*Canis lupus*). Journal of Zoo and Wildlife Medicine 29:435-440.

Mech, L. D., L. G. Adams, T. J. Meier, J. W. Burch, and B. W. Dale. 1998. The wolves of Denali. University of Minnesota Press. 238pp.

Smith, D., T. J. Meier, E. Geffen, L. D. Mech, J. W. Burch, L. G. Adams, and R. K. Wayne. 1997. Is incest common in wolf packs? Behavioral Ecology 8:384-391.

Haufler, J. B., L. G. Adams, J. A. Bailey, R. G. Brocke, M. J. Conroy, G. Joslin, and K. G. Smith. 1996. Wildlife management in North American wilderness. Wildlife Society Technical Review 96-1. 23pp.

Adams, L. G., B. W. Dale, and L. D. Mech. 1995. Wolf predation on caribou calves in Denali National Park, Alaska. Pages 245-260 in L.N. Carbyn, S.H. Fritts, and D.R. Seip, eds. Ecology and conservation of wolves in a changing world: Proceedings of the second North American symposium on wolves. Canadian Circumpolar Institute Occasional Paper 35, University of Alberta, Edmonton. 642pp.

Adams, L. G., and L. D. Mech. 1995. Population trends of wolves and caribou in Denali National Park, Alaska. Pages 347-348 in E.T. LaRoe, G.S. Farris, C.E. Puckett, P.D. Doran, and M.J. Mac, eds. Our living resources: A report to the nation on the distribution, abundance, and health of U.S. plants, animals and ecosystems. U.S. Department of Interior, National Biological Service, Washington, DC. 530pp.

Adams, L. G., F. J. Singer, and B. W. Dale. 1995. Caribou calf mortality in Denali National Park, Alaska. Journal of Wildlife Management 59:584-594.

Dale, B. W., L. G. Adams, and R. T. Bowyer. 1995. Winter wolf predation in a multiple ungulate prey system, Gates of the Arctic National Park, Alaska. Pages 223-230 in L.N. Carbyn, S.H. Fritts, and D.R. Seip, eds. Ecology and conservation of wolves in a changing world: Proceedings of the second North American symposium on wolves. Canadian Circumpolar Institute Occasional Paper 35, University of Alberta, Edmonton. 642pp.

Mech, L. D., T. J. Meier, J. W. Burch, and L. G. Adams. 1995. Patterns of prey selection by wolves in Denali National Park, Alaska. Pages 231-244 in L.N. Carbyn, S.H. Fritts, and D.R. Seip, eds. Ecology and conservation of wolves in a changing world: Proceedings of the second North American symposium on wolves. Canadian Circumpolar Institute Occasional Paper 35, University of Alberta, Edmonton. 642pp.

Meier, T. J., J. W. Burch, L. D. Mech, and L. G. Adams. 1995. Pack structure and genetic relatedness among wolf packs in a naturally regulated population. Pages 293-302 in L.N. Carbyn, S.H. Fritts, and D.R. Seip, eds. Ecology and conservation of wolves in a changing world: Proceedings of the second North American symposium on wolves. Canadian Circumpolar Institute Occasional Paper 35, University of Alberta, Edmonton. 642pp.

Dale, B. W., L. G. Adams, and R. T. Bowyer. 1994. Functional response of wolves preying on barren-ground caribou in a multiple-prey system. Journal of Animal Ecology 63:644-652.

Davis, J. L., L. G. Adams, P. Valkenburg, and D. J. Reed. 1991. The relationship between caribou body weight and age and cohort specific reproduction. Pages 115-142 in Butler, C.E., and S.P. Mahoney, eds. Proceedings of the Fourth North American Caribou Workshop, Newfoundland and Labrador Wildlife Division. St. Johns's, Newfoundland. 529pp.

Websites of Interest

http://alaska.usgs.gov/science/biology/large_mammal/sheep/index.php

John A. Vucetich

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Michigan Technological University, Houghton, MI 49931 USA
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Research Interests

Demographic and genetic elements of population biology
Ecology of wolves and moose

Education

Ph.D., Forest Science, Michigan Technological University, 1999.
B.S., Biology, Michigan Technological University, 1994.

POSITIONS HELD

2006 – Research Assistant Professor, School of Forest Resources and Environmental Science, Michigan Technological University.
1999 – 2006: Research Assistant Professor, School of Forest Resources and Environmental Science, Michigan Technological University.
1996 – Visiting Scholar, Department of Zoology, Ohio State University, (Sponsor: Dr. P. Parker).

University Teaching Experience

Please see last page of CV for summary of teaching evaluations.

Isle Royale Field Ecology Camp (FW 4630), School of Forestry, 2000 – present.
Ecological Modeling (FW 4140), School of Forestry, 1999 – 2001.
Perspectives on Extinction & Loss of Biodiversity: a Freshman Seminar (UN1001), Fall 2000.
Conservation Biology (FW 341), School of Forestry, Spring 1998.
College Algebra (MA 130), Department of Mathematics, 1994 – 1996
Trigonometry (MA 131), Department of Mathematics, 1994 – 1996.

OUTREACH ACTIVITIES

● In 2004, I delivered public lectures on Isle Royale wolf-moose ecology to >500 people from the general public, including several high school venues.

● Developed and currently maintain a webpage on Isle Royale wolf-moose ecology. The webpage is used by many educators and people from the general public.

● Co-Director/Coordinator for the Michigan Summer Institute for Wildlife and Forest Ecology, 1998, 1999, 2000. (As a result of this experience, several high school participants eventually enrolled at MTU).

● Instructor for the USDA Forest Service Program of Advanced Studies in Silviculture, May 1998, 2000, 2002.

● Leader of Earthwatch expeditions investigating wolf-moose biology in Isle Royale Nat. Park.

● Founder and President of the Michigan Tech. Univ. Chapter of the Society for Conservation Biology, 1997-1998.

Professional ACADEMIC experiences

●2004, Visiting Scholar, Yellowstone National Park (D. Smith)

●2003, invited to participate in a working group at the National Center for Ecological Analysis and Synthesis (NCEAS, Santa Barbara, CA). Working group topic: *foodweb dynamics*

●2002-03, invited to participate in a working group at the National Center for Ecological Analysis and Synthesis (NCEAS, Santa Barbara, CA). Working group topic: *ungulate population dynamics*

● Invited talks:
2005, International Wolf Conference, Colorado Springs, Co.
2005, Nat'l Marine Fisheries Serv, Santa Cruz Laboratory & Univ Calif, Santa Cruz (M Mangel)
2005, Dept of Biology, Central Michigan University (B Swanson)
2004, Dept of Theoretical Ecology, Lund University (P Lundberg)
2004, Dept of Conservation Biololgy, Uppsala Univ (O Liberg),
2004, Dept of Philosophy, Univ Wis-SP (M Nelson)
2001, Canid Conservation Conference, IUCN/SSC Canid Specialist Group, London (D. MacDonald)

● Peer-reviewer – In a typical year, I review 6 manuscripts or proposals. Some of the Journals and Agencies for which I reviewed include: National Science Foundation, Ecology, Animal Conservation, Bioscience, Conservation Biology, Conservation Genetics, Journal of Wildlife Management, Proceedings of the Royal Society of London.

● Currently, I co-curate the world's largest collection of moose skeletal material (skulls or other bones from more than 3500 moose). The collection is widely known among mammal researchers and a potential source of much future research.

● Awarded "Outstanding Graduate Student Research Award" by the Dept of Mathematical Sciences, MTU, 1994-95.

● Awarded "Outstanding Contribution to Wildlife Management by an Undergraduate" by the Mich Chapter of Wildlife Society, 1992.

Professional MANAGEMENT experiences

● 2003 – present, Current member of the USFWS's Mexican Wolf Recovery Team – this team fulfills requirements stipulated by the Endangered Species Act to develop recovery criteria and a recovery plan.

● 2000-present, Serve the Michigan DNR in monitoring annual rates of human-caused mortality on wolves in Upper Michigan.

● 2000-2001, Served the IUCN's Conservation Breeding Specialist Group in public forums and data analyses that ultimately lead to the institution of a buffer zone surrounding Algonquin provincial park.

● 2000, Served the IUCN's Conservation Breeding Specialist Group in public forums and data analyses to assess the biological and social feasibility of reintroducing wolves to the Southern Rocky Mountain region.

Six most Significant research contributions

◦ Vucetich et al. (1997, *Evolution*) significantly advanced theoretical and empirical understanding of how fluctuations in population size affect the rate at which populations lose genetic diversity.

◦ Vucetich and Waite (1999, *Cons Biol*) developed theory providing the first and only general explanation for the existence of a mechanism necessary (not sufficient) for thinking that genetic deterioration may *generally* be expected to affect extinction risk.

◦ Vucetich et al. (2000, *Cons Biol*) explained what had been a paradoxical and general observation that populations with increased variability had *reduced* extinction risk.

◦ Vucetich et al. (2002, *Ecology*) provide the first and only significant demonstration that predator kill rates (functional response) are better described by ratio dependency than by prey dependency for a 'natural' (i.e., non-laboratory) population.

◦ Vucetich et al. (2004, *Anim Behav*) demonstrated that existing explanations for why wolves live in packs are inadequate, and how species that scavenge wolf-killed prey can explain the benefit of group living among wolves. This paper received press coverage from regional and national media including *Science News*, the CBC production, *Quirks & Quarks*, *Natural History*, & *USA Today*.

◦ Vucetich and Peterson (2004, *Proc Royal Soc., Lond.*) demonstrated that fluctuations in Isle Royale moose abundance from one year to the next are influenced more by abitoic (climate) factors than by biotic (predation, forage) factors. The result is distinctive, in part, because: *i*) recent research assessments of terrestrial, vertebrate systems have focused on the relative influences among biotic factors, and *ii*) it is based on an unmanipulated system that had been observed for >45 years.

◦ Vucetich et al. (in press, *Oikos*) demonstrated that wolf predation is not necessary to explain the 50% decline that Yellowstone elk have experienced since wolves were introduced in 1995. Human harvest and drought represent better explanations of the decline. This analysis represents the significant support for managers' planned decision to dramatically reduce harvest of Yellowstone elk.

Peer-reviewed publications

31 peer-reviewed articles published or in press; 4 articles are in-review; 17 senior-authored articles
These publications have been cited, in total, >200 times.
Undergraduate, senior-authors are indicated by an ''.*

In preparation:

Vucetich JA & P Lundberg. The consumption theory of populations and food webs. *Target Journal*: Oikos.

Giardina, CP & JA Vucetich. The effect of temperature on soil decomposition: Meta-analysis of field and laboratory results. Target journal: *Ecology*

* Erickson, M, JA Vucetich, LM Vucetich, & RO Peterson. Moose preference for balsam fir in relation to balsam fir abundance and forage quality. *Target Journal*: Ecology.

Brodeur-Campbell, S, C.-J. Tsai, JA. Vucetich, & TA Waite. Insect herbivory on low-lignin transgenic aspen. *Target Journal*: *Oecologia.*

Huntzinger, BA, JA Vucetich, & RO Peterson. The effect of snow depth and study duration on estimates of winter kill rate by wolves (Canis lupus). *Target Journal*: *Can. J. Zool.*

Kaplan JD, K Tischler, D McCormick, JA Vucetich, & LM Vucetich. The impact of human disturbance on loon fledging rate. *Target Journal*: *J. Wildlife Manag.*

In review:

Vucetich, JA, RO Peterson, P Outridge, & R Eide. Mercury in moose teeth declines dramatically following enactment of anti-pollution regulations. *Science*.

Vucetich, JA. and MP Nelson. Distinguishing experiential and physical conceptions of wilderness. *In* Nelson MP and Callicott JB (eds), The Great New Wilderness Debate, Vol. 2. University of Georgia Press. (This is an invited essay.)

Published & in press:

Waite, T. A., Vucetich, J., Saurer, T., Kroninger, M., Vaughn, E., Field, K. & Ibargüen, S., 2005. Minimizing extinction risk through genetic rescue. *Animal Biodiversity and Conservation* 28(2): 121–130.

Vucetich, JA, MP Nelson, & MK Phillips. 2006. The normative dimension and legal meaning of 'endangered' and 'recovery' within the United States' Endangered Species Act. *Conservation Biology in press*

Wilmers, CC, ES Post, RO Peterson, & JA Vucetich. 2006. Disease mediated switch from top-down to bottom-up control exacerbates climatic effects on moose population dynamics. Ecology Letters. *In press.*

Theberge JA, Theberge, MT, JA Vucetich, & PC Paquet. 2006. Pitfalls of Applying Adaptive Management to a Wolf Population in Algonquin Provincial Park, Ontario. *J Environ Management, in press.*

Potvin, MJ, T Drummer, J. A. Vucetich, D. E. Beyer, R. O. Peterson, J. H. Hammill. 2005. Monitoring and habitat analysis for wolves in Upper Michigan. J. Wildl Manag. 69(4)

Vucetich, JA, DW Smith, & DR Stahler. 2005. Influence of harvest, climate, and wolf predation on Yellowstone elk, 1961-2004. *Oikos, in press.*

Jost, C, G Devulder, JA Vucetich, R Peterson, & R Arditi. 2005. The wolves of Isle Royale display scale-invariant satiation and density dependent predation on moose. *J. Anim. Ecol.,* 74 (5): 809-816

* Potvin, MJ, RO Peterson, & JA Vucetich. 2004. Wolf Homesite Attendance Patterns. *Can. J. Zool* 82:1512-1518.

Lotts, KC, TA Waite, & JA Vucetich. 2004. Reliability of absolute and relative predictions of population persistence based on time series. *Conservation Biology* 18(5):1224-1232.

Vucetich, JA & RO Peterson. 2004. The influence of prey consumption and demographic stochasticity on population growth rate of Isle Royale wolves (*Canis lupus*). *Oikos* 107:309-320.

Vucetich, JA, & RO Peterson. 2004. The influence of top-down, bottom-up, and abiotic factors on the moose (Alces alces) population of Isle Royale. *Proceeding Royal Soc Lond*, B 271:183-189.

Vucetich, JA, RO Peterson, & TA Waite. 2004. Raven scavenging favours group foraging in wolves. *Animal Behaviour* 67:1117-1126.

Vucetich, JA & RO Peterson. 2004. Long-term population and predation dynamics of wolves on Isle Royale. Pages 281-292 in Biology and Conservation of Wild Canids, edited by D. Macdonald & C. Sillero-Zubiri, Oxford University Press.

Peterson, RO, JA Vucetich, RE Page, & A Chouinard. 2003. Temporal and spatial aspects of predator-prey dynamics. *Alces*, 39:215-232.

Vucetich, JA & TA Waite. 2003. Spatial patterns of demography and genetic processes across the species' range: Null hypotheses for landscape conservation genetics. *Conservation genetics* 4(5): 639-645.

Nagel, LM, JA Vucetich, DD Reed, GD Mroz, & H Parn. 2003. Woody biomass and annual production across a latitudinal gradient in northern Scots pine (*Pinus sylvestris*) forests. *Polish J Ecology* 51(4):471-479.

Oelfke J, RO Peterson, JA Vucetich, & LM Vucetich. 2003. Wolf handling at Isle Royale: Can we find another approach? *George Wright Society* 20(3):50-58.

Post ES, N.-C. Stenseth, RO Peterson, JA Vucetich & Ellis. 2002. Phase dependence and population cycles in a large mammal predator-prey system. *Ecology* 83(11): 2997-3002.

Vucetich, JA, RO Peterson, & CL Schaefer. 2002. The effect of prey and predator densities on wolf predation. *Ecology* 83(11): 3003-3013.

Krzys, G, TA Waite, M Stapanian, & JA Vucetich. 2002. Assessing avian richness in remnant wetlands: towards an improved methodology. *Wetlands* 22(1):186-190.

Vucetich, JA & TA Waite. 2001. Migration and inbreeding: the importance of recipient population size for genetic management. *Conservation Genetics* 2(2):167-171.

Vucetich, LM, Vucetich, JA, Cleckner, LB, Gorski, PR, & RO Peterson. 2001. Mercury concentrations in deer mouse (*Peromyscus maniculatus*) tissues from Isle Royale National Park. *Environmental Pollution* 14(1):113-118.

Vucetich, LM, Vucetich, JA, Waite, TA, Joshi, CP, & RO Peterson. 2001. Genetic (RAPD) diversity in *Peromyscus maniculatus* in a naturally fragmentation landscape. *Molecular Ecology* 10(1):35-40.

Vucetich, JA & TA Waite. 2000. Is one migrant per generation sufficient for the genetic management of fluctuating populations? *Animal Conservation* 3:261-266.

Vucetich, JA, TA Waite, L Qvarnemark, & S Ibarguen. 2000. Population variability and extinction risk. *Conservation Biology* 14(6):1704-1714.

Vucetich, JA, DD Reed, A Breyermeyer, M Degorski, GD Mroz, J Solon, E Roo-Zielinska, & R Noble. 2000. Carbon pools and ecosystem properties along a latitudinal gradient in high latitude Scots pine (*Pinus sylvestris*) forests. *Forest Ecology & Management* 136:135-145.

Vucetich, JA, & S Creel. 1999. Ecological interactions, social organization, and extinction risk in African wild dogs. *Conservation Biology*. 13(5): 1172-1182.

Vucetich, JA & TA Waite. 1999. Erosion of heterozygosity in fluctuating populations. *Conservation Biology* 13(4):860-868.

Vucetich, JA & TA Waite. 1998. On the interpretation and application of mean times to extinction. *Biodiversity and Conservation*. 7:1539-1547.

Vucetich, JA & TA Waite. 1998. The number of censuses required for demographic estimation of the effective population size. *Conservation Biology* 12:1023-1030.

Peterson, RO, NJ Thomas, JM Thurber, JA Vucetich, & TA Waite. 1998. Population limitation and the wolves of Isle Royale. *Journal of Mammalogy* 79(3):487-841.

Vucetich, JA, TA Waite, & L Nunney. 1997. Fluctuating population size and the ratio of effective to census population size (N_e/N). *Evolution* 51(6):2017-2021.

Vucetich, JA, RO Peterson, & TA Waite. 1997. Effects of social structure and prey dynamics on extinction risk in gray wolves. *Conservation Biology* 11:957-965.

Thurber, JM, RO Peterson, JD Woolington, & JA Vucetich. 1992. Coyote coexistence with wolves on the Kenai Peninsula, Alaska. *Canadian Journal of Zoology* 70:2494-2498.

Northern Prairie Wildlife Research Center

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Expertise:

- Wolf ecology and behavior
- Predator-prey relations
- Population regulation
- Wolf social ecology
- Radio-tracking

Current Projects:

- Role of prey nutrition in buffering wolf depredation on game animals and livestock in a restored population
- Determining factors affecting the forecasting of trends in restored wolf populations
- Determining rate and causes of elk mortality in Yellowstone National Park
- Ecology of the Canada Lynx in Northeastern Minnesota

Education:

- Ph.D., Purdue University, Lafayette, IN (1962)
- B.S., Cornell University, Ithaca, NY (1958)

Professional Experience:

- *Wildlife Research Biologist* and *Senior Research Scientist* for the U.S. Fish and Wildlife Service, the National Biological Service, National Biological Survey, and the U. S. Geological Survey, with administration from Patuxent Wildlife Research Center, Laurel, MD; Mid-Continent Ecological Science Center, Ft. Collins, CO; and Northern Prairie Wildlife Research Center, Jamestown, ND
- 1968-present: Studying wolf population trends and wolf-deer coactions in the Superior National Forest, Minnesota
- 1986-present: Studying wolf social behavior and musk-ox and arctic hare populations on Ellesmere Island, Canada
- 1995-present: Studying wolf-prey coactions in Yellowstone National Park
- 1986-1995: Studied wolf-population trends and wolf-caribou coactions in Denali National Park, Alaska

Selected Professional Achievements:

- Honorary Doctor of Agriculture, Purdue University (May 2005)
- Aldo Leopold Award for Distinguished Service to Wildlife Conservation, The Wildlife Society (March 23, 1993)

- Professional Award of Merit, North Central Section, The Wildlife Society (1988)
- The Minnesota Award for Outstanding Contribution to the Profession of Wildlife Management, Minnesota Chapter of The Wildlife Society (1986)
- Gulf Oil Professional Conservationist Award (1984)
- Terrestrial Wildlife Publication Award, The Wildlife Society (1972)

NPWRC Publications:

- View a current listing of NPWRC publications authored by L. David Mech

Selected Publications:

Mech, L. D. and L. Boitani (Eds). 2003. Wolves: ecology, behavior and conservation. University of Chicago Press. 448pp. (co-editor, and co-author of three chapters) (http://www.press.uchicago.edu)

Mech, L. D., D. W. Smith, K. M. Murphy, and D. R. MacNulty. 2001. Winter severity and wolf predation on a formerly wolf-free elk herd. J. Wildl. Mgmt. 65(4):998-1003.

Mech, L. D. (Ed). 2000. The wolves of Minnesota: howl in the heartland. Voyageur Press, Stillwater, MN. (Editor, and author of 6 chapters.)

Mech, L. D., L. .G. Adams, T. J. Meier, J. W. Burch, and B. W. Dale. 1998. The wolves of Denali. University of Minnesota Press, Minneapolis, MN. 227pp. (http://www.upress.umn.edu/mech/intro.html)

Mech, L. D. 1997. The arctic wolf: ten years with the pack. Voyageur Press, Stillwater, MN. 144pp. (English, Hungarian)

Mech, L. D. 1995. The challenge and opportunity of recovering wolf populations. Cons. Biol. 9(2):270-278. Reprinted in French in Faune De Provence 17:33-43, (1997).

Mech, L. D. 1992. Wolves of the high arctic. Voyageur Press, Stillwater, MN 127 pp.

Mech, L. D. 1991, The way of the wolf. Voyageur Press, Stillwater, MN. 120 pp. (English, German)

Mech, L. D., M. E. Nelson, and R. E. McRoberts. 1991. Maternal and grandmaternal nutrition effects on deer weights and vulnerability to wolf predation. J. Mammal. 72(1):146-151.

Mech, L. D. 1988. The arctic wolf: living with the pack. Voyageur Press, Stillwater, MN. 128 pp. (English, French, Italian, German).

Mech, L. D. 1983. Handbook of animal radio-tracking. University of Minnesota Press, Minneapolis, MN. 108pp.

Nelson, M. E., and L. D. Mech. 1981. Deer social organization and wolf depredation in northeastern Minnesota. Wildlife Monographs No. 77. July 1981. 53pp.

Fritts, S. H., and L. D. Mech. 1981. Dynamics, movements, and feeding ecology of a newly protected wolf population in northwestern Minnesota. Wildlife Monographs No. 80. October 1981. 79pp.

Mech, L. D. 1970. The wolf: ecology and behavior of an endangered species. Doubleday, 384pp. Reprinted in paperback by University of Minnesota Press, Minneapolis, MN. 1981.

Mech, L. D. 1966. Wolves of Isle Royale. U. S. Govt. Printing Office, 210pp. Reprinted 2002, University Press of the Pacific, Honolulu, Hawaii.

Additional Information:

- International Wolf Center (http://www.wolf.org)
- Lynx project (http://www.nrri.umn.edu/lynx/)
- Arctic wolf project (http://www.arctic.noaa.gov/essay_mech.html)
- NC and Dave Mech: A Research Partnership That Works (http://www.pwrc.usgs.gov/mechnc.htm)
- University of Minnesota - FWCB Faculty Profile (http://www.cnr.umn.edu/fwcb/personnel/faculty/mech.php)
- The Far Reach of David Mech (http://www.dnr.state.mn.us/volunteer/janfeb04/mech.html)
- Wolves: *Behavior, Ecology, and Conservation* (http://www.press.uchicago.edu)

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COLLEGE OF FORESTRY AND CONSERVATION
Where Ideas Take Flight

L. Scott Mills

Professor of Wildlife Population Ecology

Department of Ecosystem and Conservation Sciences
College of Forestry and Conservation
University of Montana
Missoula, MT 59812

Office: FOR 307
Phone: 406-243-5552
Email: lscott.mills@umontana.edu

Current Position:

Professor: Research and teaching emphasis on population ecology, conservation of fragmented populations, and community-level effects of species loss.


L. Scott Mills (Center) with colleagues in Bhutan

Awarded Guggenheim Fellowship, 2009
CFC wildlife biology Professor L. Scott Mills has been named a 2009 Guggenheim Fellow by the board of trustees of the John Simon Guggenheim Memorial Foundation.
Read more.

Personal Summary:

Dr. L. Scott Mills is a Professor in the Wildlife Biology Program in the College of Forestry and Conservation at the University of Montana. His research across normally disparate scientific disciplines has led to key advances in applying ecological science to wildlife conservation, including new insights into how genetic variation affects persistence of wild species, new methods for non-invasive abundance estimation and monitoring of population trend, and direct field measurements of how wildlife respond to climate change and other factors. His research species and systems range from marmots and coyotes in Olympic National Park, to endangered bighorn sheep in the California Sierra Nevada, to fruit bats in the Philippines, to snowshoe hares across North America, to snow leopards in the Himalayan kingdom of Bhutan.

Early in his career at University of Montana, Dr. Mills was awarded one of the most prestigious awards given by National Science Foundation to junior faculty: A Faculty Early Career Development award. Since then he has published over 85 scientific articles and has given over 100 professional presentations, including testimony to the U.S. Congress on the role of ethics in conservation science. His recently published textbook, Conservation of Wildlife Populations: Demography, Genetics, and Management, is already widely used by students and professionals throughout the world.

Dr. Mills has served on invited committees for the National Science Foundation, National Park Service, National Forest Service, the International Whaling Commission and the National Marine Fisheries Service. He also was a member of the Board of Governors for the Society of Conservation Biology, served on the Western Governor's Association Policy working group on Climate Change Effects on Wildlife, and was a Contributing author to the North America section of the Nobel-Prize winning report from the 2007 International Panel on Climate Change. His research has been covered by media outlets including "The Nature of Things With David Suzuki", Discovery Channel Canada, National Public Radio, National Geographic, Science News, Science, and a number of popular magazines and newspapers.

Education:

PH.D., Biology
University of California, Santa Cruz Ph. D., Biology July 1993
Advisor: Michael Soulé

M.S., Wildlife Ecology
Utah State University, Logan M. S., Wildlife Ecology July 1987
Advisor: Fred Knowlton

B.S., Zoology
North Carolina State University, Raleigh B. S., Zoology May 1983

Research Interests:

My primary research are in the area of applied population ecology. My students and I use population models and genetic tools, coupled with field experiments, to infer population and community-level effects of fragmentation and other human-caused perturbations.

Some of our current projects and study systems include: a) Olympic National Park, where we have documented a steep decline in an endemic marmot species (Olympic marmot) due to disruption of its metapopulation dynamics with the arrival of invasive coyotes; b) endangered Sierra Nevada bighorn sheep, where we are collecting and applying data on vital rates to model the most efficient management actions; c) drivers of spatial synchrony in snowshoe hares across their range; d) snow leopards and education outreach in Bhutan; e) new methods for prioritizing endangered species recovery actions; e) new tools for monitoring ranging from estimators of trend to novel methods of non-invasive genetic sampling.

I am embarking on a major study on whether snowshoe hares will be able to adapt in place to climate change, as their cryptic coat color becomes increasingly mismatched with the background. I am also hoping to spend an upcoming sabbatical helping to build capacity for establishing monitoring and risk assessment programs in Bhutan, a remarkable Himalayan country that is modernizing with a strong commitment to conservation..

Hare Today, Gone Tomorrow? - The snowshoe hare may become a climate change poster child (VISION - The University of Montana)

The Case of the Climate-Challenged Hare
-- You Tube -- Research by Scott Mills, Professor of Wildlife Population Ecology

Field of Study:

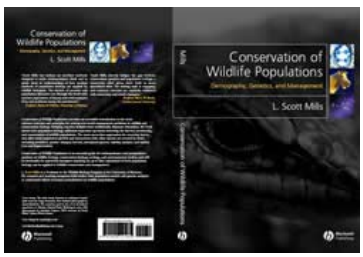
Wildlife Population Ecology

International Experience:

Philippine fruit bat work with Tammy Mildenstein (MS and PhD student); 1998-present.
New Zealand collaborative research / teaching exchange.
NSF-supported exchange with Univ. of Porto, Portugal.
Capacity building in Bhutan.
See the **5/6/07 New York Times article on our Program**.

Selected Publications:

BOOKS



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JOURNAL ARTICLES:

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Hebblewhite, M., M. Musiani, and L. S. Mills. 2010. **Restoration of gene flow among reintroduced Northern Rockies wolf populations.** Molecular Ecology 19:4383-4385.

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Johnson, H. R., L. S. Mills, T. Stevenson, and J. Weyhausen. 2010. **Population-specific Vital Rate Contributions Influence Management of an Endangered Ungulate**. Ecological Applications 20:1753-1765.

Griffin, S. C., M. L. Taper., R. Hoffman, and L. S. Mills. 2010. **Ranking Mahalanobis distance models to develop specific predictions of occupancy from presence-only data.** Journal of Wildlife Management 74:1112-1121.

Humbert, J-Y, L. S. Mills, J. S. Horne, and B. Dennis. 2009. **A better way to estimate population trend**. Oikos 118:1487-1498. PLUS **APPENDIX Reviewing exponential trend estimators.**

Hodges, K.. E., L. S. Mills, and K. Murphy. 2009. **Snowshoe hare distribution and abundance in Yellowstone National Park.** Journal of Mammalogy. 90:870-878.

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Griffin, P. C. and L. S. Mills. 2007. **Pre-commercial thinning reduces snowshoe hare abundance in the short term.** Journal of Wildlife Management 71:559-564.

Griffin, S. C., T. Valois**, M. L. Taper, and L. S. Mills. 2007. **The impact of tourism on Olympic marmot behavior and demography.** Conservation Biology 21:1070-1081.

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Mills, L. S., P. C. *Griffin, K. E. Hodges, K. McKelvery, L. Ruggiero, and T. *Ulizio. 2005. **Pellet count indices compared to mark-recapture estimates for evaluating snowshoe hare density**. Journal of Wildlife Management 69:1053-1062.

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*Tallmon, D. A., E. S. Jules, N. J. *Radke, and L. S. Mills. 2003. **Of mice and men and trillium: cascading effects of forest fragmentation.** Ecological Applications 13:1193-1203.

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*Funk, W.C., and L. S. Mills. 2003. **Potential causes of population declines in forest fragments in an Amazonian frog.** Biological Conservation. 111:205-214.

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*Citta, J. J., and L. S. Mills. 1999. **What do demographic sensitivity analyses tell us about controlling brown-headed cowbirds?** Studies in Avian Biology 18:121-134.

Soulé, M. E., and L. S. Mills. 1998. **No need to Isolate Genetics**. Science 282:1658-1659.

Wisdom, M. J., and L. S. Mills. 1997. **Using sensitivity analysis to guide population recovery: Prairie chickens as an example.** Journal of Wildlife Management 61:302-312.

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*Clarkson, D. A., and L. S. Mills. 1994. Ecological factors associated with Hypogeous sporocarps in fragmented forests. Northwest Science 68:259-265.

*Tallmon, D.A., and L. S. Mills. 1994. Log use and home ranges of California red-backed voles on a forest remnant. Journal of Mammalogy. 75:97-101.

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Running, S. W. and L. S. Mills. 2009. **Terrestrial Ecosystem Adaptation to Climate Change.** Resources for the Future Report for the Climate Policy Program at RFF.

Mills, L. S. 2008. Crossing Disciplines for Endangered Species. Review for Ecology of Scott, J. M., D. D. Goble, and F.W. Davis, editors. The Endangered Species Act at Thirty: Conserving Biodiversity in Human-Dominated Landscapes (Volume 2). Island Press, Washington, D.C. Ecology 89:592-593.

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Mildenstein, T.L., L.S. Mills, P. Landres, G. Rochefort, J. Scharberl. 2006. Recreation impacts on wildlife: review of recent research and a call for investigation of population and community level effects. Final report to Mount Rainier National Park VERP Program.

Mills, L. S., J. M. Scott, K. M. Strickler, and S. A. Temple. 2005. Ecology and management of small populations. Invited Article in Wildlife Techniques Manual. Wildlife Society.

Mills, L. S., and M. E. Soulé. In Press. A brief history of the role of genetics in conservation. Invited article ("box") in Conservation Genetics textbook by F. Allendorf and G. Luikart.

Mills, L. S., M. K. Schwartz, D. A. Tallmon, and K. P. Lair. 2003. **Measuring and interpreting changes in connectivity for mammals in coniferous forests.** Pages 587-613 in C. J. Zabel and R. G. Anthony, editors. Mammal Community Dynamics: Management and Conservation in the Coniferous Forests of Western North America. Cambridge University Press, New York, USA.

Griffin, P. C., and L. S. Mills. 2003 **"Snowshoe hares in a dynamic managed landscape."** Pages 438-449 in Editors H. R. Akcakaya, M. A. Burgman, O. Kindvall, C. Wood, P. Sjogren-Gulve, J. Hatfield, and M. A. McCarthy. Species Conservation and Management: Case Studies. Oxford University Press.

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Mills, L. S. 2002. "Genetics, Demography, and Viability of Fragmented Populations." (Book Review) Quarterly Review of Biology 77:222-223.

Mills, L. S., and D. Tallmon. 1999. "Genetic issues in forest fragmentation." Pages 171-184 In Forest Fragmentation: Wildlife and Management Implications. J. Rochelle, L. A. Lehmann, and J. Wisniewski, eds. Brill Publishers (Netherlands).

Dobson, A., K. Ralls, M. Foster, M. E. Soule, D. Simberloff, D. Doak, J. A. Estes, L. S. Mills, D. Mattson, R. Dirzo, H. Arita, S. Ryan, E. A. Norse, R. F. Noss, and D. Johns. 1999. "Connectivity: maintaining flows in fragmented landscapes." Pages 129-171 In Soulé, M. E. and J. Terborgh, editors. Continental Conservation: Scientific Foundations of Regional Reserve Networks. Island Press.

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Mills, L. S. 1997. "Book Review: Population Management for Survival and Recovery: Analytical Methods and Strategies in Small Population Conservation." Journal of Wildlife Management 61:251-252.

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Mills, L.S. 1996. "Keystone Species." in Paehlke, R., editor. Encyclopedia of Conservation and Environmentalism. Garland Publishing Co., New York.

Email: request@cfc.umt.edu

Mills, L.S. 1995. "Keystone Species." Pages 381-387 in Encyclopedia of Environmental Biology. Academic Press, Inc.

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OTHER PROFESSIONAL PUBLICATIONS:

- Hodges, K. E., and L. S. Mills. 2005. Snowshoe hares in Yellowstone. Yellowstone Science 13:3-6.
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Daniel W Stark
Minnesota Department of Natural Resources
Division of Fish and Wildlife
500 Lafayette RD
St. Paul, MN 55155
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WORK EXPERIENCE

Minnesota Department of Natural Resources
St. Paul, Minnesota US
8/2007 - Present

Wolf Specialist
Direct, plan, develop, administer, evaluate, and coordinate statewide gray wolf management program. Implement Minnesota Wolf Management Plan. Serve as Minnesota's inter-agency wolf management liaison with federal, state, tribal, and other non-governmental organizations. Serve as the Department spokesperson and representative regarding all aspects of wolf management in Minnesota, including contacts with the media. Develop and maintain wolf expertise through field work, participate and develop research and monitoring activities. Coordinate state depredation management activities. Black bear management program coordinator responsible for season management and other bear management policies.

U.S. Fish and Wildlife Service
Alpine, AZ US
9/2002 - 8/2007
Grade Level: 486-9/11

Wildife Biologist , GS
Provide technical oversight and expertise on the reintroduction and management of the Mexican Wolf Recovery Program, including: releasing, monitoring, and capturing of wolves; and the related data collection, management, and analysis. Prepare procedural, technical, and scientific documents related to the reintroduction of Mexican wolves by developing, researching issues and writing, reviewing, and editing documents. Present information orally and in writing to scientific and public audiences. Conduct outreach throughout the Recovery area. Purchase and Maintain Service property. Manage and supervise Service volunteer program. (Contact Supervisor: Yes, Supervisor's Name: John K. Oakleaf, Supervisor's Phone: 505-761-4782)

U.S. Fish and Wildlife Service
Alpine, AZ US
9/2000 - 9/2002
Grade Level: 401-5/7

General Biologist , GS
Field Biologist for the Mexican Wolf Recovery Program. Served as the acting Mexican Wolf Field Coordinator from October 2001 to September 2002. Responsible for directing field activities dealing with Mexican Wolf reintroduction, management, and monitoring. Supervised the interagency field team. Planned and conducted reintroduction and management of Mexican Gray Wolves using appropriate techniques and data management procedures. Prepare annual plans and reports. Develop and prepare procedural documents through research and field evaluation. Capture and handle wolves using safe and sound practices, including trapping and darting. Interact frequently with the public and represents field activities to the media. (Contact Supervisor: Yes, Supervisor's Name: Brian T. Kelly, Supervisor's Phone: 208-685-6953)

U.S. Fish and Wildlife Service
Zimmerman, MN US
8/1998 - 9/2000
Grade Level: 404-5/6

Biological Science Technician (Wildlife) , GS
Prescribed fire management. Assist with the implementation and maintenance of the fire effects monitoring program. Serve as an initial attack fire fighter. Implement

resource management objectives; habitat restoration, wildlife censusing, resource inventory, control of undesired species, and database management. Resource protection. Write articles for public newsletter. Environmental Education programs and public speaking. Supervise work crews and volunteers. Equipment operation and maintenance. (Contact Supervisor: Yes, Supervisor's Name: Brad Ehlers, Supervisor's Phone: 218-998-3590)

United States Marine Corp Reserve **12/1993 - 1/1999**
St. Paul, MN US

Lance Corporal, Military Police
Participated in annual training exercises and monthly drills, to include marksmanship and firearms safety training, first aid and CPR, law enforcement, land navigation, dessert survival, winter training. Also graduated Basic Training, Marine Combat Training, Military Police School. 300/300 physical fitness test and 1997 Marine of the Year. IRR through December 2001.

EDUCATION

St. Cloud State University
St. Cloud, MN US
Bachelor's Degree - 2/1998
192 Quarter Hours
Major: Biology
GPA: 2.91 out of 4.00
Relevant Coursework, Licensures and Certifications:
Biology 1 - General Principles, Biology 2 - Botany, Biology 3 - Zoology, Environmental Issues, General Ecology, Mammology, Wildlife Parasitology, Applied Statistics, Field Studies - Isle Royal, Soils, Wildlife Mangaemnet, Fall Ornithology, Readings in Biology, Animal Behavior, Aerial Photo Interpretation,

Sartell High School
Sartell, MN US
High School or equivalent - 5/1992

University of Arizona, Graduate School
Tucson, AZ US
Some College Coursework Completed
23 Semester Hours
Major: Wildlife Conservation and Management
GPA: 4.0 out of 4.0
Relevant Coursework, Licensures and Certifications:
Conservation Biology and Management of Large Mammals, Principles of Research, Geographic Information Systems, Population Regulation in Animals, Wildlife Habitat Analysis, Applied Biostatistics, Cartographic Modeling of Natural Resources

Appendix D. Panelists' Response to Comments

Lauer, Stephanie

From: Lauer, Stephanie
Sent: Tuesday, December 06, 2011 10:02 AM
To: 'Layne G Adams'
Cc: Vandam, Charlie; Dan Stark; John Vucetich; Scott Mills; Dave Mech
Subject: Clarification: USFWS comments to panelists

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Stephanie Lauer
Associate Project Manager

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From: Layne G Adams [mailto:ladams@usgs.gov]
Sent: Monday, December 05, 2011 4:58 PM
To: Lauer, Stephanie
Cc: Vandam, Charlie; Dan Stark; John Vucetich; Scott Mills; Dave Mech
Subject: Re: USFWS comments to panelists

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Cc: "Vandam, Charlie" <Charlie.Vandam@atkinsglobal.com>
Date: 12/05/2011 12:33 PM
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To: 'Dan Stark'; 'Dave Mech'; 'John Vucetich'; 'Layne Adams'; 'Scott Mills'
Cc: Vandam, Charlie
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Lauer, Stephanie

From: Layne G Adams [ladams@usgs.gov]
Sent: Wednesday, December 07, 2011 5:44 PM
To: Lauer, Stephanie
Cc: Vandam, Charlie; Dan Stark; John Vucetich; Scott Mills; Dave Mech
Subject: Re: Clarification: USFWS comments to panelists

Stephanie, et al.
Here are my specific thoughts on the comments below.

1. Enumerating a specific buffer above the 10:100 on Wyoming lands is not critically necessary as long as WGFD is allowed to maintain more than 10:100 by whatever the legislature does. Without some legislative constraint, I am confident that WGFD will manage for a number of wolves sufficiently above 10:100 to allow for ensuring that they are above the relisting threshold and dealing with conflicts when and where they occur.

2. See #1.

3. I brought this up because I believe it is something that the Wyoming Plan will be criticized for. While this may be unlikely to occur, it is no more or less theoretical than any of our predictions about how wolf management will play out following delisting.

4. I agree that wolves have a high intrinsic growth rate and the ability to compensate for quite a bit of human-caused mortality.

5. As stated in my original comments, wolves have substantial ability to disperse, will disperse into or through fully-stocked local wolf populations, such as YNP, and I do not expect that genetic issues will be a concern in NRM wolves over the long haul. Given that, I don't think that the WTGMA flex will make any difference and I brought it up mainly as unnecessarily complex management.

6. I don't see any reason to speculate on an upper allowable level of harvest when reducing wolf abundance. Wyoming clearly stated that they will take a conservative and incremental approach to increasing harvests to reach their management goals, so any kind of upper limit isn't necessary. I agree with Dave Mech that they will likely have difficulty reducing wolf numbers through public sport harvest.

Layne

Layne G. Adams, Ph.D.
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This message has been checked for all known viruses by MessageLabs.

Lauer, Stephanie

From: L. David Mech [mechx002@umn.edu]
Sent: Tuesday, December 06, 2011 1:52 PM
To: Lauer, Stephanie; 'Layne G Adams'
Cc: Vandam, Charlie; 'Dan Stark'; 'John Vucetich'; 'Scott Mills'
Subject: RE: Clarification: USFWS comments to panelists

1. I agree that a buffer other than YNP and WRR is not critically necessary.

2. See item 1.

3. I agree that 10/100 should be limited to WGTMA but that as SW states "this is more of a theoretical issue."

4. I agree with Mills on this.

5. As indicated in my original submission I do not anticipate that genetics will ever be an issue to this population or to the NRM population as a whole.

6. Not possible to give an exact figure. Like Montana and Idaho right now, Wyoming probably will have trouble reducing its population under fair-chase regulations no matter what they do. They will just have to play it by ear.

Dave
www.davemech.org

_____

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Sent: Tuesday, December 06, 2011 11:02 AM
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Cc: Vandam, Charlie; Dan Stark; John Vucetich; Scott Mills; Dave Mech
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_____
This message has been checked for all known viruses by MessageLabs.

Dec. 7, 2011

To: Stephanie Lauer

From: L. Scott Mills

RE: Response to USFWS comments on the draft Wyoming wolf peer review panel report.

Below I give comments on the 7 summary points you sent us in your Dec. 6 email, as well as additional comments regarding USFWS comments in the report and especially regarding my individual memo.

1. From Seth Willey: While we recognize a specific buffer (or range) would help clarify intent and ability to achieve the goal, Wyoming is unlikely to commit to a buffer unless it is a deal breaker. Instead, they will adaptively manage learning what the population can withstand (i.e., figure out the buffer over time). We have viewed such an approach as adequate given commitment to the overall goal and intention to slowly reduce the population. Need to know if the panel finds this thinking fatally flawed. i.e., is a buffer a good idea, or critically necessary.

I believe abandoning a buffer for the 10:100 threshold could well be a deal breaker in terms of my evaluation of the delisting plan's credibility. The delisting proposal (and the Wyoming Plan) refer many times to the establishment of buffers that are 'adequate", 'sufficient', or 'comfortably above' the 10:100 threshold (with YNP and Wind River providing additional buffer so as to parallel to the 15:150 threshold in Idaho and Montana). In my individual memo, I criticized the lack of specifics for how the buffer above 10:100 would be established, but assumed that the clear understanding that such a buffer is needed – and good faith commitment to it -- would suffice so that the specifics of setting it could be worked out on the ground. But I would strongly oppose the possibility of now changing direction and removing the commitment to a buffer of any sort. To commit to managing right down to 10:100 outside YNP is inviting disaster on a yearly basis, for at least 3 reasons: a) Inevitable uncertainty in wolf abundance estimates mean that an estimate of 10 breeding pairs (or 100 individuals) will overestimate or underestimate the actual number of wolves on the ground that year; b) inevitable lag times in responding to low numbers mean that one or more years below 10 or 100 may be difficult to respond to before small-population dynamics kick in; c) because the scenarios that would lead to formal status review for relisting are based on the 10:100 numbers, any management down to those numbers will lead to triggering of these relisting evaluation criteria on a regular basis, leading to a colossal waste of taxpayer dollars.

2. From Seth Willey: So, I'm guessing I can't get an answer here, but wondering what "a sizable buffer" means? Would 12 BPs be enough? 15 BPs? So, one question to consider (probably don't need to address yet, but which we may be asking at a future date depending on result of current negotiations) is what happens if some mandates for aggressive management are retained that preclude WGFD from managing much above the minimum?

There are a variety of ways to answer on a biological basis the question of an adequate buffer, building on a framework of risk assessment, harvest models and uncertainty analysis. I believe the key point is that challenges in how to operationally set that buffer should not be used to justify abandoning a buffer above 10:100 outside YNP. As noted above, this buffer is critical to accommodate uncertainty in both estimates of wolf abundance and in wolf population responses to management that may increase or decrease their numbers, dynamics, and persistence.

3. From Seth Willey: *"The WY contribution of 10 bp/100 wolves should be limited to the WGTMA…"* (Adams 2011)
   So question becomes how strongly does the panel feel about this. Isn't it reasonable to assume this will happen very very rarely as packs will almost never survive in this area through the end of the calendar year. Similarly, Wyoming would be fools to assume such a pack will survive when they are planning allowable mortality, so essentially, they'll be writing these wolves off anyway, at least for planning / management purposes. This would seem to make this more of a theoretical issue right?

I'm not sure of the question here.

4. From Seth Willey: "*wolves have a high intrinsic growth rate and the ability to compensate some human caused mortality through replacing other mortality sources, as well as compensation via reproduction and immigration."* (Mills 2011)
   Wonder if Vucetich's comments cast doubt on [this] for you?

Dr. Vucetich's comments do not cast doubt on my comments. Although I have not yet read Dr. Vucetich's draft manuscript, I expect it will be rigorous and thoughtful. I would like to reiterate that compensation of harvest mortality can occur through immigration and reproduction, in addition to compensation through other forms of mortality. In short, I have no reason to doubt or revise my text on this topic.

5. From Seth Willey: "*The level of gene flow adequate to prevent genetic problems is supported by VonHoldt 2010 and represents a minimum level of gene flow that has occurred in Wyoming, GYA and the NRM wolf population…*" (Stark 2011)
   Note Vucetich does not share this perspective. Would like this issue fleshed out a bit more in the discussion section if possible. [and relatedly]:
   Although likely not a barrier to dispersal, because wolves move through YNP and other parts of Wyoming to contribute to the connectivity of the region the flex area of the WTGMA will further facilitate dispersal during peak times of the year." (Stark 2011)

Adams seemed skeptical of this point. And Vucetich seemed skeptical that even with this area, we'd get the necessary level of gene flow. Wonder if additional explanation in the background section might help us understand these differences a little more and their basis.

I'm not sure I understand the problem to evaluate here.

6. From Seth Willey: I would agree anthropogenic mortality could be in excess of 36 percent while Wyoming is trying to reduce the population. After all, they are trying to reduce the population initially. But can't the population tolerate a few high years that result in modest reductions? How high would be too high recognizing the goal is to reduce the population?

Perhaps the key is to clearly articulate explicitly that population reduction is a short term goal, and that long term harvest mortality rates will be well below those initial "reduction mortality" levels.

Other Seth Willey comments not on your list that I would like to respond to:

Comments on my individual memo (NOTE: As Stephanie told you, Atkins inadvertently sent you an early *draft* version of my individual memo; please be sure to replace that with the final version [10/31/11]).

Page 4, Note 1: The point here regards the necessity of a buffer above 10:100, which I address above.

Page 4 note 2: Please see my actual final individual memo of 10/31/11.

Page 10: This does not really help. A fatal flaw in the regulation that you quote here is that it appears to attribute any decline in ungulates to predators, when in fact many factors could cause ungulates to decline (e.g. weather, disease, density dependence, age structure shifts, etc.). The tough – yet solvable -- scientific challenge I'm referring to in this comment has to do with correctly attributing ungulate decline to predation mortality.

Miscellaneous Comments

p. I 1st comment: I wholeheartedly agree: we certainly *should* make clear that our comments and review were conditioned on the Wyoming state statutes and regulations being revised as per the Wyoming Plan and the delisting document. Certainly that was my assumption as I prepared my comments.

p. 2 top: Not exactly sure what is meant here but I favor the specific inclusion of text considering the Wyoming population in the context of the rest of the NRM population.

Lauer, Stephanie

From: John Vucetich [javuceti@mtu.edu]
Sent: Tuesday, December 06, 2011 12:40 PM
To: Layne G Adams
Cc: Vandam, Charlie; Dan Stark; Scott Mills; Dave Mech; Lauer, Stephanie
Subject: Re: Clarification: USFWS comments to panelists

Stephanie,
I read through the comments below. At least superficially, those comments did not persuade me to revise the ideas I shared in my memo.
John

----- Original Message -----
From: "Layne G Adams" <ladams@usgs.gov>
To: "Stephanie Lauer" <Stephanie.Lauer@atkinsglobal.com>
Cc: "Charlie Vandam" <Charlie.Vandam@atkinsglobal.com>, "Dan Stark" <dan.stark@state.mn.us>, "John Vucetich" <javuceti@mtu.edu>, "Scott Mills" <lscott.mills@umontana.edu>, "Dave Mech" <mechx002@umn.edu>
Sent: Tuesday, December 6, 2011 1:54:08 PM GMT -05:00 US/Canada Eastern
Subject: Re: Clarification: USFWS comments to panelists

Stephanie,
Don't assume I agree with the Service's responses. I merely stated that I "didn't see anything that required or even asked for a response".

Layne

> From: "Lauer, Stephanie" <Stephanie.Lauer@atkinsglobal.com>
> To: Layne G Adams <ladams@usgs.gov>
> Cc: "Vandam, Charlie" <Charlie.Vandam@atkinsglobal.com>, Dan Stark <dan.stark@state.mn.us>, John Vucetich <javuceti@mtu.edu>, Scott Mills <lscott.mills@umontana.edu>, Dave Mech <mechx002@umn.edu>
> Date: 12/06/2011 08:02 AM
> Subject: Clarification: USFWS comments to panelists

One of the important items would be for you guys to review their comments on both the summary report and (more importantly?) your individual memos and state of you disagree with any of their “rebuttals” or reasoning in response to your disagreement with their science, literature, etc. You many not; as Layne stated he didn’t have anything to add to their commentary. In Layne’s case I would take that to mean he agrees with the Service’s responses to panel concerns or cautions on Wyoming’s proposed management.

However, the Service is looking for everyone’s opinion on a few issues so we can provide more information to them:

1. From Seth Willey: While we recognize a specific buffer (or range) would help clarify intent and ability to achieve the goal, Wyoming is unlikely to commit to a buffer unless it is a deal breaker. Instead, they will adaptively manage learning what the population can withstand (i.e., figure out the buffer over time). We have viewed such an approach as

adequate given commitment to the overall goal and intention to slowly reduce the population. Need to know if the panel finds this thinking fatally flawed. i.e., is a buffer a good idea, or critically necessary.

2. From Seth Willey: So, I'm guessing I can't get an answer here, but wondering what "a sizable buffer" means? Would 12 BPs be enough? 15 BPs? So, one question to consider (probably don't need to address yet, but which we may be asking at a future date depending on result of current negotiations) is what happens if some mandates for aggressive management are retained that preclude WGFD from managing much above the minimum?

3. From Seth Willey: “The WY contribution of 10 bp/100 wolves should be limited to the WGTMA…” (Adams 2011) So question becomes how strongly does the panel feel about this. Isn't it reasonable to assume this will happen very very rarely as packs will almost never survive in this area through the end of the calendar year. Similarly, Wyoming would be fools to assume such a pack will survive when they are planning allowable mortality, so essentially, they'll be writing these wolves off anyway, at least for planning / management purposes. This would seem to make this more of a theoretical issue right?

4. From Seth Willey: “ wolves have a high intrinsic growth rate and the ability to compensate some human caused mortality through replacing other mortality sources, as well as compensation via reproduction and immigration.” (Mills 2011) Wonder if Vucetich’s comments cast doubt on [this] for you?

5. From Seth Willey: “ The level of gene flow adequate to prevent genetic problems is supported by VonHoldt 2010 and represents a minimum level of gene flow that has occurred in Wyoming, GYA and the NRM wolf population… ” (Stark 2011) Note Vucetich does not share this perspective. Would like this issue fleshed out a bit more in the discussion section if possible. [and relatedly]:
Although likely not a barrier to dispersal, because wolves move through YNP and other parts of Wyoming to contribute to the connectivity of the region the flex area of the WTGMA will further facilitate dispersal during peak times of the year.” (Stark 2011) Adams seemed skeptical of this point. And Vucetich seemed skeptical that even with this area, we'd get the necessary level of gene flow. Wonder if additional explanation in the background section might help us understand these differences a little more and their basis.

6. From Seth Willey: I would agree anthropogenic mortality could be in excess of 36 percent while Wyoming is trying to reduce the population. After all, they are trying to reduce the population initially. But can't the population tolerate a few high years that result in modest reductions? How high would be too high recognizing the goal is to reduce the population?

I hope this helps.

Stephanie Lauer
Associate Project Manager

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From: Layne G Adams [mailto:ladams@usgs.gov]
Sent: Monday, December 05, 2011 4:58 PM
To: Lauer, Stephanie
Cc: Vandam, Charlie; Dan Stark; John Vucetich; Scott Mills; Dave Mech

Subject: Re: USFWS comments to panelists

Hi Stephanie,
I went through the USFWS comments in the summary report and my review and didn't see anything that required or even asked for a response. Nothing stated as a question; mostly just commentary.

Layne

Layne G. Adams, Ph.D.
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4210 University Drive
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907-786-7159 (phone)
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From: "Lauer, Stephanie" <Stephanie.Lauer@atkinsglobal.com>
To: Dan Stark <dan.stark@state.mn.us>, Dave Mech <mechx002@umn.edu>, John Vucetich <javuceti@mtu.edu>, Layne Adams <ladams@usgs.gov>, Scott Mills <lscott.mills@umontana.edu>
Cc: "Vandam, Charlie" <Charlie.Vandam@atkinsglobal.com>
Date: 12/05/2011 12:33 PM
Subject: USFWS comments to panelists

Gentlemen,

I hope you are all well and I trust you had a great Thanksgiving! I know you are all busy, but I wanted to follow up on my email below since I've received the comments from the Service.

They were very, very pleased with the level of expertise and the feedback they received in the summary report and the individual reports. The Service made comments that are directed to the panelists on both the summary report AND your individual memos. As you know, the Service is working with the WY legislature to "refine" their bill (read: The Service is not happy with the draft bill). They would like you to respond to any questions they have for you.

There are not many comments for you to address, but please see those on the summary report and those on your individual memos. I think you'll find them interesting.

Please let me know your timetable for this. Like I said below, I don't think it will be more than a few hours of your time, but I do have a deadline to the Service to which I need to adhere.

Thanks!

p.s. If you have trouble viewing or responding to the comments on this PDF, please let me know. If you click on the Comments box at the upper right corner you can respond to the comment by right clicking the box and selecting 'Reply'.

Stephanie Lauer
Associate Project Manager

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Email: stephanie.lauer@atkinsglobal.com | Web: www.atkinsglobal.com/northamerica
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From: Lauer, Stephanie
Sent: Wednesday, November 23, 2011 8:45 AM
To: 'Dan Stark'; 'Dave Mech'; 'John Vucetich'; 'Layne Adams'; 'Scott Mills'
Cc: Vandam, Charlie
Subject: Draft report submitted, upcoming work

Gentlemen,

I have submitted the draft report to the Service for their review (attached). They will be compiling their comments into one document, and I have been told it will be comprised of general questions or clarifications AND potentially direct comments to an individual panelist asking for additional clarification on a specific comment. I don't anticipate that this will take more than a couple hours of your time to address, but please know it will be coming the week of December 5. I must get the final report to the Service no later than December 16, and at this time the report will be made public.

The Service has also requested (related to Item F of the Statement of Work, "Amended Peer Review Report, if necessary") that the panel review the State of Wyoming's house bill related to this PRIOR to the Legislature voting on it. What they would be looking for is a letter from Atkins stating whether or not the panel agrees that the bill is aligned with the commitments and protocols set forth in the Service's rule and the WGFD's plan. I don't have an exact date of when we would be given the bill to review, but I do know that they would need the letter from Atkins by January 6 so they have it by the close of the public comment period on the proposed rule.

Thank you again for your excellent work thus far. Have a great Thanksgiving and weekend!

Regards,

Stephanie Lauer
Associate Project Manager

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Consider the environment. Please don't print this email unless you really need to.[attachment "Atkins-Wolf Peer Review Report 11-21-11_comments to panelists only.pdf" deleted by Layne G Adams/BRD/USGS/DOI]

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