Scientific Peer Review of the Sage-Grouse Conservation Objectives Draft Report

October 2012

This page intentionally left blank

FORWARD

Atkins, North America, hereafter referred to as Atkins, was retained by the U.S. Fish and Wildlife Service (USFWS or Service) to facilitate an independent scientific review of the Sage-Grouse Conservation Objectives Draft Report (COT Report). The five reviewers on this panel read the report carefully, and have produced thoughtful, informed and well-argued evaluations. Atkins believes that these analyses will be useful to the USFWS and others charged with evaluating the COT Report. However, Atkins also notes all reviewers provided additional interesting (and potentially useful) comments and information beyond the scope of the review, which may exceed the narrow needs of the Service in determining whether the report is useful and constitutes "best available science."

For example, some reviewers commented on decision-making processes and the role of information in such processes, notably the importance of monitoring. Atkins agrees that this is a critical area and one where a more fully integrated framework for decision-makers to interact with scientists and managers would be very useful. It would then, for instance, be possible to determine whether an adaptive management approach or a goal-oriented approach is best in either the short (pre-listing decision) or longer term. While agreeing with all of these comments, Atkins believes that this review is more narrowly focused in scope. Hence, Atkins believes that the review results should be considered as largely supporting the work of the Conservation Objectives Team and its report. The reviews should allow the authors and USFWS to either make necessary adjustments or to interpret the existing draft appropriately.

However, Atkins also believes the comments of the reviewers should be considered in a broader context and are of value beyond the scope of improving the document. Atkins recommends that USFWS consider as "public comment" those aspects of the reviews that go beyond the narrow scope of the review, but which are still of value.

This page intentionally left blank

TABLE OF CONTENTS

This page intentionally left blank

1.0 INTRODUCTION

On December 9, 2011, the Secretary of the Interior co-hosted a meeting with Governor Mead of Wyoming to identify conservation solutions for the Greater sage-grouse (*Centrocercus urophasianus*; hereafter, sage-grouse), a candidate for listing under the Endangered Species Act (ESA) of 1973, as amended. The U.S. Fish and Wildlife Service (USFWS or Service) was tasked by the Secretary of the Department of Interior to lead an effort to clarify, to the greatest extent possible, the actions and outcomes likely to be needed to support a future decision that listing the sage-grouse was not necessary. The Service expanded this task to identify the long-term conservation objectives needed to ensure the sage-grouse will persist for many future decades. To accomplish these tasks, the Service established the Conservation Objectives Team (COT) – an interagency team composed of sage-grouse experts from across the species' range – to advise the Service on identifying quantifiable long-term conservation objectives for the sage-grouse.

The COT developed a scientifically-based assessment of the degree to which threats to the sage-grouse must be ameliorated to ensure the sage-grouse, and its distinct population segments (DPS), remain viable into the foreseeable future. The intent of the COT was to produce a report that not only informs Service listing determinations, but also outlines the necessary conservation actions to ensure the long-term persistence of healthy populations of the sage-grouse for the foreseeable future. The written report will be used by the Service to inform its species' status review and is anticipated to form the basis of conservation decisions and actions for sage-grouse management by agencies and individual organizations for many years.

1.1 Purpose and Scope of Peer Review

Given the long-term conservation implications of the Sage-Grouse Conservation Objectives Draft Report (COT Report) and its influential information, the Service requested an independent scientific peer review be conducted before distribution of the draft report.

The Service asked that panel members review the approach of adapting the NatureServe's ranking system to characterize the degree of threat by population, and assess the sufficiency of conservation goals, objectives or criteria derived from the COT's review of population projections and threats. In this review the Service was not seeking comments on any new technical analysis (other than the use of a fairly basic threat ranking system). The peer review was limited to the information and analysis contained within the COT Report, and was not intended to be a review of the status of the sage-grouse or the habitats upon which it relies.

Specifically, the Service requested panel members consider and respond to the questions listed below, at a minimum, in their reviews.

1. Are the methods and assumptions used in deriving conservation objectives for the sage-grouse clearly stated and logical? If not, please identify the specific methods and assumptions that are unclear or illogical.

2. Are the results presented in the COT Report reasonable? If not, please identify those that are not and the specifics of each situation.
3. Do the authors of the COT Report draw reasonable and scientifically sound conclusions from the scientific information presented in the COT Report? Are there instances in the COT Report where a different but equally reasonable and scientifically sound scientific conclusion might be drawn that differs from the conclusion drawn by the Service? If any instances are found where that is the case, please provide the specifics of that situation.
4. Does the COT Report base its interpretations, analyses and conclusions upon the best available science? If any instances are found where the best available science was not used, please provide the specifics of each situation.
5. Are there any significant peer-reviewed scientific papers that the COT Report omits from consideration that would enhance the scientific quality of the document? Please identify any such papers.
6. Is the scientific foundation of the COT Report reasonable and how can it be strengthened? Please identify any options to strengthen the scientific foundations.

2.0 PEER REVIEW PROCESS

Atkins, North America, hereafter referred to as Atkins, was retained by the Service to facilitate the peer review process. The terms of the contract include the following:

- Organizing, structuring, leading and managing the scientific review;
- summarizing the individual peer reviews and preparing a summary report for the Service;
- facilitating specific follow-up questions/answers between the Service and the reviewers, without attribution; and
- preparing and submitting a final report and official record to the Service.

2.1 Selection of Reviewers

As part of its proposal, Atkins was required to submit the names and resumes of three to five well-qualified, independent reviewers whose expertise includes the following:

1. A Ph.D. in wildlife ecology, wildlife science, conservation biology, or related field.
2. Demonstrated experience working with endangered species issues and in setting conservation objectives or recovery goals for endangered species.
3. Expert knowledge of grouse biology and population dynamics of lekking birds.
4. Experience as a peer reviewer for scientific publications.

In addition, Atkins was instructed to ensure panel members had no financial or other conflicts of interest with the outcome or implications of the COT Report.

Atkins confirmed three potential reviewers who met the criteria listed above and were willing and available to participate in the review. Their names and resumes were submitted as part of the proposal and were confirmed by the Service with acceptance of the proposal, along with a request to identify two additional reviewers of similar expertise. The final panel composition was:

- Dr. Jeffrey L. Beck, University of Wyoming
- Dr. Matthew J. Holloran, Wyoming Wildlife Consultants, LLC
- Dr. Terry A. Messmer, Utah State University
- Dr. Kerry P. Reese, University of Idaho
- Dr. James S. Sedinger, University of Nevada, Reno

The qualifications of each reviewer are included in Appendix A. One lead reviewer was selected to compile the individual reviews and ensure there was no attribution prior to sending to Atkins.

2.2 Document Review and Report Development

Upon selection, reviewers were provided with the Sage-Grouse Conservation Objectives Draft Report (submitted August 1, 2012) along with instructions for conducting the review. Atkins held a brief teleconference with the panel on August 21, 2012 to describe the review process and schedule and ensure that the panel did not release any information regarding this peer review or respond to any inquiries for information. The panel requested a version of the COT Report with line numbers to facilitate their review. Once received from the Service, Atkins forwarded the report to the peer reviewers.

Reviewers conducted their independent desk reviews of the COT Report between August 15, 2012 and September 12, 2012. All comments were submitted to the lead reviewer as individual memoranda; the lead reviewer compiled all of the reviews in the order in which they were received and labeled them as "Reviewer 1, Reviewer 2, etc." to comply with the Service's direction to provide unattributed reviews. The compiled individual reviews are included in this document as Appendix B. In the Results section of this draft peer review report, Atkins summarized the key thematic comments and responses to the six questions posed to the reviewers.

3.0 RESULTS

The reviewers applauded the effort of the COT in preparing the report, acknowledging that it was a difficult task. Several commented that it is well written and is based on sound science, and constitutes an initial framework to be used when evaluating state and range-wide sage-grouse conservation efforts. Others agreed with its call for additional, directed research, given uncertainties that limit the ability to prioritize conservation actions, such as those concerning effective habitat restoration/management and the effects of potential impacts on sage-grouse population dynamics. However, the majority of reviewers found that the report fell short of meeting its stated goals in several important areas, and they identified opportunities to better achieve those goals and improve its utility for decision making, which are summarized in the sections below.

3.1 Key Comments

Several themes emerged from the individual reviewers' comments, which are summarized below. Many of these pertain to the specific questions the reviewers were directed to address (Section 3.2); however, the amount of attention given to these topics and the consistency with

which they were discussed (i.e., by two or more reviewers) warranted their inclusion as "Key Comments." This summary is not intended to be inclusive of all reviewer comments; see Appendix B for reviewers' individual comments.

3.1.1 Resiliency and Resistance

The topic of *resiliency* and *resistance* as conservation parameters was the most common topic discussed in the reviewers' individual comments. Reviewer 1 found the two terms to be redundant and suggested that if *resistance* continues to be used, it should be modified as *spatial resistance*. Similarly, Reviewer 2 noted that *resistance* cannot be measured independently and seems to be adding "another layer of theoretical complexity." Furthermore, Reviewer 2 questioned how the two concepts are used in the report (i.e., in evaluating the priority conservation areas [PACs]), and how they are evaluated and measured in practice. Reviewer 2 concluded that these two concepts provide "little substantive information" and may "actually detract from the focus on improved habitat and bird population sizes." Reviewer 3 noted that the discussion of the two concepts provides a review of activities that may negatively influence a population, but they are never actually quantified. Reviewer 4 wrote use of these terms (as well as *redundancy* and *representation*) in the report obscures the relationships of most interest (e.g., between habitat features/disturbance and demography/population dynamics).

3.1.2 Measuring Objectives

Reviewer 1 indicated that the stated objectives are not quantifiable objectives, but rather components of the COT goal (i.e., *strategies*), and recommended that the report include an explanation of why specific objectives are difficult to establish, along with a clarification that establishing absolute objectives was not the goal of this report. Reviewer 1 added that the action items (specific conservation strategies) may constitute the actual objectives and recommended they be renamed as such. Additionally, Reviewer 1 stressed the need for the USFWS to better coordinate with states and, more specifically local working groups, to define site-specific metrics which can be extrapolated range wide. Reviewer 2 also stated that the objectives' weakness is their generality and lack of specifics. However, Reviewer 5 stated that these objectives are based on sound reasoning, driven by science, and facilitate the formation of scientific hypotheses and predictions for future research.

3.1.3 Feasibility of Habitat Restoration

Reviewer 1 noted that restoration may be prohibitive, in terms of costs, timeframes and effects of climate change, and asked that habitat protection mechanisms to protect the "best of the best areas" (i.e., those with the greatest potential for resilience and resistance) be given further consideration. Reviewer 2 questioned the success of past efforts to restore PACs, citing the limited success of sage-grouse translocations (Baxter et al. 2008). Reviewer 3 noted that the report underscores the uncertainty, difficulty and expense of sagebrush habitat restoration and suggested emphasizing prevention of the spread of invasive annual plants, which is critical for sage-grouse conservation. Reviewer 4 also noted the paucity of large-scale sagebrush habitat restoration examples and suggested governmental agencies (state and federal) be realistic about costs associated with this type of management action.

3.1.4 Definition and Use of Terms

Reviewers 1 and 2 noted threat ranks should be clearly defined and used consistently throughout the report. Other terms requiring more explicit definition include *fragmentation* and *habitat condition*.

3.1.5 Monitoring and Adaptive Management

Reviewers 2 and 3 both stressed the importance of monitoring restoration actions and proactive habitat treatments, writing that the importance of monitoring cannot be overstated or over-emphasized. Reviewer 2 noted monitoring activities must be quantitative and part of a scientific monitoring approach in order to assess the effectiveness of the methods employed. Reviewer 4 agreed that monitoring is critical; however, he suggested removal of the term *adaptive management* as it has a technical meaning unlikely to be fulfilled in most sage-grouse conservation. Similarly, Reviewer 1 described the components and requirements for an effective adaptive management approach (i.e., computer models to build synthesis, embodied ecological consensus) and stated that the data collection and reporting requirements "may be beyond the scope and duties of the contemporary wildlife manager." Accordingly, Reviewer 1 suggested replacing *adaptive management* with *objectives-based management*, wherein stakeholders define and agree on site-specific objectives and develop a plan to accomplish those objectives.

3.1.6 Use of Information for Decision-Making

There are two separate elements to this topic: use of information for listing decisions and use of information for managers' decision making. Following on comments made above, Reviewer 2 questioned how useful the concept of resistance is to either sage-grouse biologists and wildlife managers or the USFWS in its pending listing decision. Furthermore, Reviewer 2 noted that the short-term recommendations in the report are only applicable to the January 2015 listing decision and questioned how the report would influence the Bi-State DPS listing decision (due September 2013). Reviewer 3 added that the COT might consider developing some specific conservation goals/actions and including them in the report, in light of the upcoming Bi-State DPS listing decision.

3.1.7 Threat Amelioration

Reviewers 2, 3 and 5 indicated the report does not evaluate the degree to which threats need to be ameliorated to conserve sage-grouse, even though this is one of its stated objectives. Furthermore, the report does not provide direction or specific actions to ameliorate recognized threats. Reviewer 2 acknowledged it may not be possible to define these aspects in a report such as this, but they are necessary for a more detailed plan to ensure conservation of the species.

3.2 Responses to Questions

Below are brief summaries of the individual reviewers' responses to the six questions posed by the USFWS. For additional details see Appendix B.

Question 1: Are the methods and assumptions used in deriving conservation objectives for the sage-grouse clearly stated and logical? If not, please identify the specific methods and assumptions that are unclear or illogical.

In general, reviewers found the methods and assumptions to be clearly stated and logical with some exceptions. Reviewer 1 found the methods and assumptions to be based largely on peer-reviewed scientific publications, giving them scientific validity; however, some assumptions need further clarification (e.g., sagebrush as sage-grouse habitat; use of *resiliency* and *resistance*; use of 500 breeding birds vs. 200 males). Similarly, Reviewer 2 requested clarification on the application of *resiliency* and *resistance* to the PACs, which is inconsistent, and noted instances where values in Table 2 were not fully explained. Reviewer 3 also noted that the methods to establish risk status of each population should be more structured and the report should elaborate on the information and assumptions used for generating values for Severity, Scope and Immediacy by factor and by population in order to increase transparency. Reviewer 4 also commented that the use of *redundancy*, *resiliency* and *representation* was not especially useful because the concepts are "ambiguously defined" and "not necessarily tied directly to targets of potential management actions;" however, he concurred with the overall conservation objective developed by the Western Association of Fish and Wildlife Agencies (WAFWA).

Question 2: Are the results presented in the COT Report reasonable? If not, please identify those that are not and the specifics of each situation.

Overall, the reviewers found the results to be reasonable and that Table 2 of the draft report provides a good summary; however, individually they noted a few exceptions. Reviewer 1 noted the risk level of the Parker Mt. unit should be changed to C4 to reflect data showing it to be a robust population without the threat of invasive weeds and conifers. Reviewer 2 identified two examples where risk levels may need to be reconsidered based on the information presented (i.e., North Park and Emery). Following comments on Question 1, Reviewer 3 noted that, although the results appear reasonable, not enough information was provided to assess the threat ranking by impact factor. Reviewer 4 suggested that the risk levels in the southern and western Great Basins may be optimistic as lek counts are declining in both areas, while increased mining activity, fire and limited late brood-rearing habitat pose threats. Other shortcomings noted by Reviewer 4 were the lack of description of seasonal habitats required by sage-grouse, and the need to report preliminary results from current wind energy impact studies. Reviewer 5 found the results to be reasonable, supported by a wealth of information in Appendix A and strengthened by the use of time projections comparable to common timeframes used for climate change projections.

Question 3: Do the authors of the COT Report draw reasonable and scientifically sound conclusions from the scientific information presented in the COT Report? Are there instances in the COT Report where a different but equally reasonable and scientifically sound scientific conclusion might be drawn that differs from the conclusion drawn by the Service? If any instances are found where that is the case, please provide the specifics of that situation.

Reviewers ascertained that the conclusions drawn in the COT Report are reasonable and scientifically sound, given the uncertainties and caveats provided, but did offer additional observations and recommendations. Reviewer 1 suggested that the authors consider adding a summary or overall conclusion regarding the conservation status of the sage-grouse if the COT's recommendations are implemented, based on an analysis of how persistence probabilities would be altered if threats were addressed. Reviewer 4 noted he was skeptical that the PAC approach would be successful in the West, and identified a statement regarding mitigating the effects of predation that was based on speculation not empirical evidence. Reviewer 5 stated that the report leaves some reasonable doubt that the information provided (i.e., risk ratings, threat rankings) may hold true.

Question 4: Does the COT Report base its interpretations, analyses and conclusions upon the best available science? If any instances are found where the best available science was not used, please provide the specifics of each situation.

The reviewers concluded that the report bases its interpretations, analyses and conclusions on the best available science, relying primarily on Garton et al. (2011) and expert opinion. Reviewer 3 added that the report should better explain how the scientific sources were used to establish risk, as noted above in response to Question 1. Reviewer 4 noted several exceptions, three of which were previously described in responses to questions above. Other exceptions mentioned by Reviewer 4 are related to (1) the limited (or lack of) direct relationships between specific habitat characteristics and demographic parameters or population change and (2) the degree of uncertainty about demographic response to threats. Reviewer 5 acknowledged the framework provided by the report identifies threats based on local knowledge, not scientific models; however, he is "convinced that solid science provides the underpinnings of the COT Report to recognize significant threats to individual PACs."

Question 5: Are there any significant peer-reviewed scientific papers that the COT Report omits from consideration that would enhance the scientific quality of the document? Please identify any such papers.

Reviewers 1, 4 and 5 list a total of 15 additional publications that would enhance the scientific quality of the report.

Question 6: Is the scientific foundation of the COT Report reasonable and how can it be strengthened? Please identify any options to strengthen the scientific foundations.

In responding to this question, the reviewers echoed several of their previous comments, summarized in the sections above. In general, they found the scientific foundation of the report to be reasonable and offered recommendations for how it can be enhanced. Reviewer 1 reiterated that the report could be enhanced if it provided specific examples of how persistence probabilities would change if the suite of conservation practices were implemented. Reviewer 3 referred to previous recommendations to (1) better structure and explain the methods used to establish each population's risk status, (2) emphasize the importance of managing the expansion of invasive annuals and (3) address improvements to habitat quality in addition to habitat loss and fragmentation. Reviewer 4 recommended that planning be refocused on direct linkages

between habitat quality and demographic responses by sage-grouse. Reviewer 5 offered that the report could be strengthened by explaining how the framework for the threat analysis was implemented by COT members (i.e., how it was organized and how decisions were implemented).

4.0 REFERENCES

Baxter, R.J., J.T Flinders, and D.L. Mitchell. 2008. Survival, movements and reproduction of translocated Greater Sage-Grouse in Strawberry Valley, Utah. The Journal of Wildlife Management 72(1): 179-186.

Garton, E.O., J.W. Connelly, J.S. Horne, C.A. Hagen, A. Moser, and M. Schroeder. 2011. Greater sage-grouse population dynamics and probability of persistence. Pp. 193-382 in S.T. Knick and J.W. Connelly (editors). Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology (vol. 38). University of California Press, Berkeley, CA.

5.0 APPENDICES

Appendix A: Reviewer Curricula Vitae
Appendix B: Individual Reviewer Comments

This page intentionally left blank

APPENDIX A: REVIEWER CURRICULA VITAE

This page intentionally left blank

Jeffrey L. Beck

2005 AG – 1000 E. University Avenue, Dept 3354 – Laramie, WY 82071
(307) 766-6683 – FAX (307) 766-6403 – jlbeck@uwyo.edu

EDUCATION

PhD	University of Idaho	Forestry, Wildlife & Range Sci.	2003
MS	Brigham Young University	Wildlife and Range Resources	1996
BS	Brigham Young University	Wildlife and Range Resources	1993

PROFESSIONAL EXPERIENCE

2007–Present	Asst Professor	Wildlife Hab Restoration Ecol	University of Wyoming
2006–2007	Postdoc Scientist	Habitat Modeling Analyst	University of Wyoming
2005–2006	Avian Scientist	Sagebrush Steppe Wildlife	Colorado Div of Wildlife
2005	Postdoc Scientist	Forest Wildlife Monitoring	University of Wyoming
2004–2005	Postdoc Scientist	Upland Game Ecology	University of Idaho
1996–1997	Wildlife Biologist II	Lands (Habitat)	Utah Div of Wildlife

RESEARCH PUBLICATIONS

Peer-Refereed Journal Articles

1. Hess, J. E., and **J. L. Beck**. 2012. Disturbance factors influencing greater sage-grouse lek abandonment in north-central Wyoming. J*ournal of Wildlife Management 76:In press*.

2. Dinkins, J. B., M. R. Conover, C. P. Kirol, and **J. L. Beck**. 2012. Greater sage-grouse (*Centrocercus urophasianus*) select nest-sites and brood-sites away from avian predators. *The Auk* 129:*In press*

3. **Beck, J. L.**, J. W. Connelly, and C. L. Wambolt. 2012. Consequences of treating Wyoming big sagebrush to enhance wildlife habitats. *Rangeland Ecology and Management* 65:444–455. doi: 10.2111/REM-D-10-00123.1

4. Fedy, B. C., C. L. Aldridge, K. E. Doherty, M. O'Donnell, **J. L. Beck**, B. Bedrosian, M. J. Holloran, G. D. Johnson, N. W. Kaczor, C. P. Kirol, C. A. Mandich, D. Marshall, G. McKee, C. Olson, C. C. Swanson, and B. L. Walker. 2012. Interseasonal movements of greater sage-grouse, migratory behavior, and an assessment of the core regions concept in Wyoming. *Journal of Wildlife Management* 76:1062–1071. doi: 10.1002/jwmg.337

5. Kirol, C. P., **J. L. Beck**, J. B. Dinkins, and M. R. Conover. 2012. Microhabitat selection for nesting and brood-rearing by the greater sage-grouse in xeric big sagebrush. *The Condor* 114:75-89. doi: 10.1525/cond.2012.110024

6. Hess, J. E., and **J. L. Beck**. 2012. Burning and mowing Wyoming big sagebrush: do treated sites meet minimum guidelines for greater sage-grouse breeding habitats? *Wildlife Society Bulletin* 36:85-93. doi: 10.1002/wsb.92

7. **Beck, J. L.**, R. D. Mealor, B. W. Hess, G. E. Moss, and S. L. Lake. 2011. Case study: effect of cattle and sheep grazing on stocking rate and botanical composition of subirrigated pasture. *Professional Animal Scientist* 27:500–504.

Peer-Refereed Journal Articles (continued)

8. Davies, K.W., C.S. Boyd, **J.L. Beck**, J.D. Bates, T.J. Svejcar, and M.A. Gregg. 2011. Saving the sagebrush sea: an ecosystem conservation plan for big sagebrush plant communities. *Biological Conservation* 144:2573–2584. doi:10.1016/j.biocon.2011.07.016

9. Doherty, K. E., **J. L. Beck**, and D. E. Naugle. 2011. Comparing ecological site descriptions to habitat characteristics influencing greater sage-grouse nest site occurrence and success. *Rangeland Ecology and Management* 64:344–351.

10. **Beck, J. L.**, R. C. Skorkowsky, and G. D. Hayward. 2011. Estimating occupancy to monitor northern goshawk in the central Rocky Mountains. *Journal of Wildlife Management* 75:513–524.

11. **Beck, J. L.,** D. C. Dauwalter, K. G. Gerow, G. D. Hayward. 2010. Design to monitor trend in abundance and presence of American beaver (*Castor canadensis*) at the national forest scale. *Environmental Monitoring and Assessment* 164:463–479.

12. **Beck, J. L.**, J. W. Connelly, and K. P. Reese. 2009. Recovery of greater sage-grouse habitat features in Wyoming big sagebrush following prescribed fire. *Restoration Ecology* 17:393–403.

13. **Beck, J. L.**, K. P. Reese, J. W. Connelly, and M. B. Lucia. 2006. Movements and survival of juvenile greater sage-grouse in southeastern Idaho. *Wildlife Society Bulletin* 34:1070–1078.

14. **Beck, J. L.**, J. M. Peek, and E. K. Strand. 2006. Estimates of elk summer range nutritional carrying capacity constrained by probabilities of habitat selection. *Journal of Wildlife Management* 70:283–294.

15. Reese, K. P., **J. L. Beck**, P. Zager, and T. E. Heekin. 2005. Nest and brood site characteristics of mountain quail in west-central Idaho. *Northwest Science* 79:254–264.

16. **Beck, J. L.**, and J. M. Peek. 2005. Great Basin summer range forage quality: do plant nutrients meet elk requirements? *Western North American Naturalist* 65:516–527.

17. **Beck, J. L.**, K. P. Reese, P. Zager, and T. E. Heekin. 2005. Simultaneous multiple clutches and female breeding success in mountain quail. *Condor* 107:891–899.

18. **Beck, J. L.**, and J. M. Peek. 2005. Diet composition, forage selection, and potential for forage competition among elk, deer, and livestock on aspen-sagebrush summer range. *Rangeland Ecology and Management* 58:135–147.

19. **Beck, J. L.**, and J. M. Peek. 2004. Herbage productivity and ungulate use of northeastern Nevada mountain meadows. *Journal of Range Management* 57:376–383.

20. **Beck, J. L.**, D. L. Mitchell, and B. D. Maxfield. 2003. Changes in the distribution and status of sage-grouse in Utah. *Western North American Naturalist* 63:203–214.

21. **Beck, J. L.**, and D.L. Mitchell. 2000. Influences of livestock grazing on sage grouse habitat. *Wildlife Society Bulletin* 28:993–1002.

Peer-Refereed Book Chapters

1. Beck, J. L., and L. H. Suring. 2009. Wildlife habitat–relationships models: description and evaluation of existing frameworks. Pages 251–285 *in* J. J. Millspaugh, and F. R. Thompson, III, editors. Models for Planning Wildlife Conservation in Large Landscapes. Elsevier Science, Amsterdam, Netherlands.

Symposia Proceedings

1. **Beck, J. L.**, J. G. Klein, J. Wright, and K. P. Wolfley. 2011. Potential and pitfalls of prescribed burning big sagebrush habitat to enhance nesting and early brood-rearing habitats for greater sage-grouse. Pages 27–32 *in* C. L. Wambolt, S. G. Kitchen, M. R. Frisina, B. F. Sowell, R. B. Keigley, P. K. Palacios, and J. A. Robinson, compilers. Proceedings – Shrublands: Wildlands and Wildlife Habitats, Bozeman, Montana, June 17–19, 2008. Utah State University Natural Resources and Environmental Issues Volume 16, article 5.

2. **Beck, J. L.** 2009. Impacts of oil and natural gas on prairie grouse: current knowledge and research needs. Pages 66--87 *in* R. I. Barnhisel, editor. 2009 Joint Conference: 26th Annual Meeting of the American Society for Mining and Reclamation and 11th Billings Land Reclamation Symposium. Billings, Montana, USA.

3. **Beck, J. L.**, J. T. Flinders, D. R. Nelson, C. L. Clyde, H. D. Smith, and P. J. Hardin. 1998. Diet selection and importance of management indicator species to elk and domestic sheep in a north-central Utah aspen ecosystem. Pages 131–137 *in* James C. deVos Jr., editor. Proceedings of the 1997 Deer/Elk Workshop, Rio Rico, Arizona. Arizona Game and Fish Department, Phoenix, USA.

4. **Beck, J. L.**, J. T. Flinders, D. R. Nelson, and C. L. Clyde. 1996. Dietary overlap and preference of elk and domestic sheep in aspen-dominated habitats in north-central Utah. Pages 81–85 *in* K.E. Evans, compiler. Sharing common ground on western rangelands: Proceedings of a livestock/big game symposium. General Technical Report INT-GTR-343. USDA Forest Service, Intermountain Research Station, Ogden, Utah.

Experiment Station and Cooperative Extension Service Bulletins

1. **Beck, J. L.**, C. W. LeBeau, A. M. Mason, and K. R. Simpson. 2010. Reducing impacts of energy development to sagebrush wildlife habitats in Wyoming. University of Wyoming, Cooperative Extension Service, Laramie, Wyoming, USA. Bulletin B-1209 (October 2010). 12 pp.

2. Beck, J. L., and J. D. Reed. 2001. Tannins: anti-quality effects on forage protein and fiber digestion. Pages 18–22 *in* K. Launchbaugh, editor. Anti-quality factors in rangeland and pastureland forages. Bulletin 73. Idaho Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow.

GRADUATE STUDENT INVOLVEMENT

Graduate Students Advised (Chair)

1. **Clay B. Buchanan** (PhD) – Ecology, Department of Ecosystem Science and Management. Started: August 2008. Expected graduation date: December 2013. Dissertation topic: *Elk disturbance risk related to coalbed methane development*

2. **Justin G. Clapp** (MS) – Rangeland Ecology and Watershed Management, Department of Ecosystem Science and Management. Started: August 2012. Expected graduation date: August 2015. Thesis topic: *Habitat ecology and effects of habitat alteration for bighorn sheep translocated to the Seminoe Mountains, Wyoming*

3. **R. Scott Gamo** (PhD) – Rangeland Ecology and Watershed Management, Department of Ecosystem Science and Management. Started: January 2012. Expected graduation date: December 2015. Dissertation topic: *Evaluation of the conservation benefits of the Wyoming Governor's Sage-Grouse Executive Order for sage-grouse and mule deer*

4. **Aaron C. Pratt** (PhD) – Ecology, Department of Ecosystem Science and Management. Started: August 2011. Expected graduation date: August 2016. Dissertation topic: *Migration ecology and response of greater sage-grouse to bentonite mining*

5. **Kurt T. Smith** (PhD) – Ecology, Department of Ecosystem Science and Management. Started: August 2010. Expected graduation date: December 2015. Dissertation topic: *Greater sage-grouse population response to big sagebrush habitat enhancement treatments*

6. **Kaitlyn L. Taylor** (MS) – Rangeland Ecology and Watershed Management, Department of Ecosystem Science and Management. Started: January 2011. Expected graduation date: December 2013. Thesis topic: *Pronghorn response to wind energy development on crucial winter range*

Graduate Students Completed (Chair)

1. **Chad W. LeBeau** (MS) – Rangeland Ecology and Watershed Management, Department of Ecosystem Science and Management. Started: January 2010. Graduated: August 2012. Thesis title: Evaluation of greater sage-grouse reproductive habitat and response to wind energy development in south-central, Wyoming

2. **Christopher P. Kirol** (MS) – Rangeland Ecology and Watershed Management, Department of Ecosystem Science and Management. Started: August 2008. Graduated: May 2012. Thesis title: Quantifying habitat importance for greater sage-grouse (*Centrocercus urophasianus*) population persistence in an energy development landscape

3. **Jennifer E. Hess** (MS) – Rangeland Ecology and Watershed Management, Department of Ecosystem Science and Management. Started: August 2008. Graduated: May 2011. Thesis title: Greater sage-grouse (*Centrocercus urophasianus*) habitat response to mowing and prescribed burning Wyoming big sagebrush and the influence of disturbance factors on lek persistence in the Bighorn Basin, Wyoming.

COURSES TAUGHT

- Rangeland Ecosystem Assessment and Monitoring (REWM 4330) – fall semester
- Range Judging (REWM 3390) – spring semester
- Rangeland Vegetation Management Techniques (REWM 4850) – spring semester
- Wildlife Habitat Ecology (REWM 5830) – spring semesters odd years
- Wildlife Habitat Restoration Ecology (REWM 4750/5750) – spring semesters even years

EDUCATIONAL/OUTREACH/SERVICE ACTIVITIES

- 57 abstracts
- 37 invited research presentations
- 75 contributed research presentations
- 8 popular press articles
- 23 invited guest lectures (2 invited teaching seminars)
- 41 peer-reviewed manuscript reviews
- 2012 – Extension bulletin co-author. Owyhee Initiative, University of Idaho, Moscow, ID
- 2011 – Research Scientist Grade Evaluation panel member – USDA Animal and Plant Health Inspection Service, Wildlife Services, National Wildlife Research Center, Fort Collins, Colorado
- 2011 – Compiler. Research summaries for 25 sage-grouse and habitat studies being conducted in Wyoming. For Wyoming Game and Fish Department
- 2010 – Abstract reviewer, 2010 annual meeting for The Wildlife Society
- 2010 – Invited panelist, USDA Rangeland Research Program, Cooperative State Research, Education, and Extension Service, Washington, DC
- 2010 – Organizer/moderator for a symposium session titled "Threats to Shrubland Wildlife Habitats: Impacts and Restoration Opportunities." Shrub Research Consortium, 16th Wildland Shrub Symposium "Threats to Shrubland Ecosystem Integrity: Linking Research and Management." Utah State University, Logan, Utah, USA. 18–20 May 2010
- 2008–2010, and 2012 – Graduate student poster reviewer, Society for Range Management annual meetings
- 2007–to present – University of Wyoming, Society for Range Management Student Chapter, Undergraduate Range Management Exam Coach
- 2006–2008 – Associate Editor, *Western North American Naturalist*

PROFESSIONAL CERTIFICATIONS

- 2005 – Certified Wildlife Biologist, The Wildlife Society
- 1996 – Associate Wildlife Biologist, The Wildlife Society

PROFESSIONAL SOCIETY MEMBERSHIPS

- Society for Range Management – since 1992
- The Wildlife Society – since 1992

Matthew J. Holloran
Vitae

January 2012

PERSONAL

Office Address:	Wyoming Wildlife Consultants LLC
	1612 Laporte Avenue No. 9
	Fort Collins, CO 80521
Office:	970.221.1206
Cell:	307.399.6885
Email:	matth@wyowildlife.com

EDUCATION

2005	Ph.D., Zoology and Physiology with Wildlife Management concentration, University of Wyoming, Laramie, WY, USA. Dissertation: *Greater sage-grouse* (Centrocercus urophasianus) *population response to natural gas field development in western Wyoming*. Dr. Stanley H. Anderson, advisor.
1999	M.S., Zoology and Physiology, University of Wyoming, Laramie, WY, USA. Thesis: *Sage grouse* (Centrocercus urophasianus) *seasonal habitat use near Casper, Wyoming*. Dr. Stanley H. Anderson, advisor.
1991	B.S., Biology, Colorado College, Colorado Springs, CO, USA.

RECENT POSITIONS HELD

2005 – present	Principal and Senior Ecologist, Wyoming Wildlife Consultants, LLC.
2003 – 2005	Doctoral Researcher, Wyoming Cooperative Fish and Wildlife Research Unit; with Dr. Stanley H. Anderson, University of Wyoming.
1999 – 2003	Research Scientist, Wyoming Cooperative Fish and Wildlife Research Unit; University of Wyoming.

PROFESSIONAL EXPERIENCE

2005 – present: **Principal and Senior Ecologist; Wyoming Wildlife Consultants, LLC.**
Partner: John Dahlke; Principal Wyoming Wildlife Consultants LLC; 207 West Pine Street, Pinedale, WY 82941; (307) 367-2765.

Project Specific Information:

• Principal investigator: *Holistic greater sage-grouse management on a ranch destined for wind development*. Project designed to investigate the following objectives: (1) develop quantified predictions of population-level response of sage-grouse to wind energy developments; and (2) develop quantified and detailed wildlife habitat suitability focused state-and-transition models for the ecological sites occurring on the Pathfinder Ranch. ($847,900)

• Co-Principal investigator: *Greater sage-grouse telemetry study for the Simpson Ridge Wind Resource Area; Carbon County, Wyoming.* Project designed to compile pre-treatment sage-grouse information necessary to effectively document sage-grouse population response to wind development. ($621,260)

• Co-Principal investigator: *Documenting structural and spatial characteristics of sage-grouse nesting and early brood-rearing habitat suitability at selected ecological sites in the Wyoming Basin.* Project designed to correlate ecological site information with habitat requirements of sage-grouse. ($317, 590)

• Principal investigator: *Greater sage-grouse winter habitat selection in the Upper Green River Basin, Wyoming*. Project to determine whether natural gas development influenced habitat

selection of wintering greater sage-grouse in southwestern Wyoming. Probability-of-occurrence differences between distinct patches of habitat relative to the proximity of those patches to natural gas field infrastructure being investigated. (≈$800,000)
• Initiator: *Identifying habitats for greater sage-grouse population persistence on Atlantic Rim, Rawlins, Wyoming: A process of protecting specific areas within a developing natural gas field critical for population sustainability in an adaptive management framework*. Study designed to identify source breeding season habitats through seasonal risk-assessment modeling and to generate areas-of-critical-conservation-concern maps based on limiting seasonal habitats, risk assessment, multi-seasonal occurrence, and seasonal juxtaposition. (*Study being conducted by University of Wyoming*) ($75,000)
• Principal investigator: *Habitat mitigation planning for greater sage-grouse in the Upper Green River Basin, Wyoming*. Project designed to compile the wildlife and vegetative information, and establish the landowner contacts required to effectively prepare allotment scale habitat management plans focused on enhancing areas for greater sage-grouse. ($478,000)
• Principal investigator: *Recruitment by greater sage-grouse in association with natural gas development in western Wyoming*. Study designed to establish the reaction of yearling greater sage-grouse males and females to natural gas field development. (*Study a continuation of a master's project (University of Wyoming) completed in 2006, and completed August 2007*)
• Principal investigator: *Pygmy rabbit block survey of EnCana Oil & Gas (USA) Inc. proposed 2007 drilling locations in the Jonah Infill Drilling Project Area*. Project identified habitats utilized by pygmy rabbits within the Jonah natural gas field in southwestern Wyoming. (*Project completed April 2007*)
• Principal investigator: *EnCana offsite habitat manipulation project at Arambel Reservoir*. (*Project completed February 2007*)

2002 – 2005: **Ph.D. Candidate; University of Wyoming.**
Advisor: Dr. Stanley H. Anderson (deceased); Leader, Wyoming Cooperative Fish and Wildlife Research Unit, University of Wyoming, Laramie, WY 82071; Dr. Matt Kaufman (*current contact*), (307) 766-5415.

Doctoral researcher for the study: *Greater sage-grouse* (Centrocercus urophasianus) *population response to natural gas field development in western Wyoming*. Determine if and how the development of natural gas resources was influencing greater sage-grouse populations in the upper Green River Basin of southwestern Wyoming.

1999 – 2003: **Research Scientist; Wyoming Cooperative Fish and Wildlife Research Unit.**
Supervisor: Dr. Stanley H. Anderson (deceased); Leader, Wyoming Cooperative Fish and Wildlife Research Unit, University of Wyoming, Laramie, WY 82071; Dr. Matt Kaufman (*current contact*), (307) 766-5415.

Project Specific Information:
• Initiated the study: *Grazing system and linear corridor influences on greater sage-grouse* (Centrocercus urophasianus) *habitat selection and productivity*. Study determined the effects of differing cattle grazing practices on sagebrush dominated landscapes as they relate to greater sage-grouse seasonal habitat selection and productivity. (*A master's student (University of Wyoming) assumed the study in 2002; the study was completed August 2004*)
• Initiated the study: *Sage-grouse* (Centrocercus urophasianus) *use of different-aged burns and the effects of coyote control in southwestern Wyoming*. Study determined temporal effects to greater sage-grouse survival and productivity of prescribed fire by quantifying use of different aged sagebrush burns. (*A master's student (University of Wyoming) assumed the study in 2001; the study was completed December 2003*)

• Principal investigator for the study: *Greater sage-grouse seasonal habitat selection and survival in Jackson Hole, Wyoming*. Study documented greater sage-grouse seasonal habitat selection and survival, identified limiting seasonal range(s), and quantified habitat conditions associated with sustainable and increasing productivity. (*Study completed August 2004*)

RECENT PEER-REVIEWED PUBLICATIONS

Holloran, M. J., B. C. Fedy, and J. Dahlke. *In Review.* Winter habitat selection of greater sage-grouse relative to activity levels at natural gas well pads.

Johnson, D. H., M. J. **Holloran**, J. W. Connelly, S. E. Hanser, C. L. Amundson, and S. T. Knick. 2011. Influences of environmental and anthropogenic features on greater sage-grouse populations, 1997-2007. pp. 407-450 in S. T. Knick and J. W. Connelly (editors). Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology (vol. 38), University of California Press, Berkeley, CA, USA.

Naugle, D. E., K. E. Doherty, B. L. Walker, H. E. Copeland, M. J. **Holloran**, and J. D. Tack. 2011. Sage-grouse and cumulative impacts of energy development. pp. 55-70 in D. E. Naugle (editor). Energy development and wildlife conservation in western North America. Island Press, Washington, DC, USA.

Naugle, D. E., K. E. Doherty, B. L. Walker, M. J. **Holloran**, and H. E. Copeland. 2011. Energy development and greater sage-grouse. pp. 489-503 in S. T. Knick and J. W. Connelly (editors). Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology (vol. 38), University of California Press, Berkeley, CA, USA.

Holloran, M. J., R. C. Kaiser, and W. A. Hubert. 2010. Yearling Greater Sage-grouse Response to Energy Development in Wyoming. Journal Wildlife Management 74:65-72.

Kiesecker, J. M., H. Copeland, A. Pocewicz, N. Nibbelink, B. McKenney, J. Dahlke, M. **Holloran**, and D. Stroud. 2009. A framework for implementing biodiversity offsets: selecting sites and determining scale. BioScience 59:77-84.

Thompson, K. M., M. J. **Holloran**, S. J. Slater, J. L. Kuipers, and S. H. Anderson. 2006. Early brood-rearing habitat use and productivity of greater sage-grouse in Wyoming. Western North American Naturalist 66:332-342.

Holloran, M. J., and S. H. Anderson. 2005. Spatial distribution of greater sage-grouse nests in relatively contiguous sagebrush habitats. Condor 107:742-752.

Holloran, M. J., and S. H. Anderson. 2005. Greater sage-grouse population response to natural gas development in western Wyoming: are regional populations affected by relatively localized disturbances? Transactions North American Wildlife and Natural Resources Conference 70:160-170.

Holloran, M. J., B. J. Heath, A. G. Lyon, S. J. Slater, J. L. Kuipers, and S. H. Anderson. 2005. Greater sage-grouse nesting habitat selection and success in Wyoming. Journal Wildlife Management 69:638-649.

GROUP INVOLVEMENT

• Wyoming statewide greater sage-grouse working group (*Wyoming greater sage-grouse conservation plan*).
• Wyoming Game and Fish Department greater sage-grouse management and livestock grazing technical team.
• Wyoming Game and Fish Department greater sage-grouse working group.
• Wyoming State Governor's greater sage-grouse conservation task force.
• Wyoming Chapter of The Wildlife Society (President)

References Available upon Request

VITAE

Terry Allan Messmer, Ph.D., Professor
and Extension Wildlife Specialist
Director, Utah Community-Based Conservation Program
Quinney Professor for Wildlife Conflict Management
Associate Director, Outreach and Extension, Jack H. Berryman Institute

Utah State University Extension
College of Natural Resources
Department of Wildland Resources
Jack H. Berryman Institute
Utah State University, Logan, UT 84322-5230
(435) 755-9159 (home)
(435) 797-3975 (work)
E-mail – terry.messmer@usu.edu

Terry A. Messmer is a Professor and Extension Wildlife Specialist in the Department of Wildland Resources, Utah State University. Logan. He also is the Director of the Jack H. Berryman Institute, holds the Quinney Professorship of Wildlife Conflict Management in the College of Natural Resources, and is the director of the Utah Community-Based Conservation Program at Utah State University. He received B.S. degrees in Fisheries and Wildlife Management and in Biology from the University of North Dakota, Grand Forks; M.S. degrees in Natural Resource Management/Botany and in Regional and Community Planning; and a Ph.D. in Animal and Range Science from North Dakota State University, Fargo. His research, teaching, and extension activities include identification, implementation, and evaluation of conservation strategies, technologies, and partnerships that can benefit agriculture, wildlife, and resource stakeholders. He is particularly interested in the reevaluation of contemporary fisheries and wildlife management policies and paradigms regarding the contributions private lands to natural resource conservation, wildlife and livestock interactions, and the abatement of human-wildlife conflicts. As CBCP director he, his staff, and graduate students work closely with Utah's sage-grouse local working groups to identify implement, and evaluate the effects of management actions on sage-grouse conservation. He has served as the major professor for over 25 graduate students (5 Ph.D. and 20 MS) studying sage-grouse ecology in Utah. He is a member of the Utah Governors Greater Sage-grouse Task Force where he serves as the scientific advisor. He is a member of the Society for Range Management and The Wildlife Society, past President of the North Dakota Chapter, Utah Chapter, and Central, Plains, Mountain Section of The Wildlife Society (TWS), a member of the TWS Wildlife Damage Management Working Group and currently chairperson of the Public Conservation Education and Extension Working Group. He is the past Editor-in-chief of The Wildlife Society Bulletin, and a currently an Associate Editor for the Journal of Wildlife Management and the Wildlife Society Bulletin.

EDUCATION

B.S.	University of North Dakota 1977 (Fish and Wildlife Management)
B.S.	University of North Dakota 1979 (Biology)
M.S.	North Dakota State University 1985 (Natural Resource Management)
M.S.	North Dakota State University 1986 (Community and Regional Planning)
Ph.D.	North Dakota State University 1990 (Animal and Range Sciences)

ACADEMIC, PROFESSIONAL, AND ADMINISTRATIVE EXPERIENCE

Program Chair, 2010 Annual Conference of The Wildlife Society (2009-Present). Responsible for developing and ensuring the scientific quality the 2010 annual conference program to include supervision and coordination of 6 subcommittees and over 100 peer-reviewers. Utah will host this conference in 2010.

Director, Utah Community-Based Conservation Program. Responsible for developing, implementing, and evaluating regional and statewide adaptive resources management local working group plans, actions, and programs. Fund, supervise, and evaluate 4 staff positions (2000- Present)

Associate Director, Extension and Outreach, Jack H. Berryman Institute, Department of Wildland Resources. Responsible for developing, implementing, and evaluating national outreach and extension programs designed to manage and mitigate human-wildlife conflicts (1994-Present)

Professor and Extension Wildlife Specialist, Department of Forest, Range, and Wildlife Sciences, College of Natural Resources, Utah State University, Logan (2002-Present). Member of College and Departmental Transition Team and Faculty Senate. (Department name changed to Department of Wildland Resources in June 2006).

Quinney Professor of Wildlife Conflict Management, College of Natural Resources, Utah State University, Logan (1998-Present). Responsible for identification, planning, funding, implementing, and evaluating state, regional, and national programming that lead to adoption of new technologies and strategies to better address human-wildlife conflicts and facilitate species conservation.

Associate Professor and Extension Wildlife Specialist, Fisheries and Wildlife Department, Utah State University, Logan (1997-2001). Member of department graduate and undergraduate advisory, undergraduate curriculum committee, and teaching faculty. Advisor to the student chapter of The Wildlife Society. Member of the College of Natural Resources Workload and Reward, Space and Facilities, Curriculum Core, and Extension Committees.

Assistant Professor and Extension Wildlife Specialist, Department of Fisheries and Wildlife, Utah State University, Logan (1991-1996). Member of departmental graduate and undergraduate advisory and undergraduate curriculum committees and teaching faculty. Advisor to the student chapter of The Wildlife Society. Responsible for planning, developing, funding, implementing, and evaluating state, regional, and national programs to identify and evaluate conservation strategies and technologies to achieve sustainable agricultural and urban environments through community-based approaches.

Faculty, Natural Resources and Environmental Policy Program (1999-Present). Responsible for teaching a course and advising students enrolled in the natural resource policy program.

Faculty, Jack H. Berryman Institute, Utah State University, Logan (1993- Present). Responsible for conducting state, regional, and national extension, research, and academic programs to identify and implement innovative approaches to better manage human-wildlife conflicts.

Faculty, Conservation Biology Program, Department of Fisheries and Wildlife, Utah State University, Logan (1992-2003). Responsible for advising graduate students and conducting research, extension, and teaching programs that contribute to species conservation.

Faculty, Wildlife Damage Management Program, Department of Fisheries and Wildlife, Utah State University, Logan (1991-2002). Responsible for developing, implementing, and evaluating state, regional, and national public outreach programs in wildlife damage management and policy.

Assistant Professor and Extension Wildlife Specialist, North Dakota State University, Fargo (1990-91). Responsible for conducting statewide extension fisheries and wildlife programs addressing wildlife policy, wetland and endangered species management, rangeland wildlife research and management, 4-H, environmental education programs, public outreach, aquaculture, wildlife management on private lands, and wildlife damage management.

Extension Wildlife Specialist, North Dakota State University Extension Service, Fargo (1984-90). Responsible for conducting a statewide wildlife extension and communication programs to identify, implement, and evaluate conservation strategies and technologies to ensure profitable agriculture and abundant wildlife.

Co-coordinator Project Wild North Dakota, North Dakota Game and Fish Department, Bismarck (1985-91). Conducted teacher training workshops for over 1,000 elementary and secondary education teachers. Supervised 70 volunteer workshop facilitators. Responsible for planning, developing, and conducting teacher and facilitator training.

Editor-in-Chief, *The Wildlife Society Bulletin* (2005-2006). The Bulletin was an official

publication of The Wildlife Society. As editor-in-chief I was responsible for ensuring the scientific quality of the publication and that manuscripts received are reviewed in a timely fashion. I also coordinated production of the Bulletin with Alliance Press, Lawrence, Kansas. In this capacity, I supervised 3 staff assistants, 40 Associate Editors and over 400 reviewers.

Chairman, Public Conservation, Education and Outreach Working Group (1999-Present). This working group is chartered by The Wildlife Society. The working group conducts activities that are designed to increase stakeholder awareness of conservation issues. The group conducts workshops and symposiums for wildlife professionals to enhance their ability to work with an increasingly diverse constituency.

Member, Sage-grouse Range-wide Issues Forum (2005). This forum was sponsored by the Western Association of Fish and Wildlife Agencies. The purpose of Forum is to contribute to the preparation of a comprehensive sage-grouse conservation strategy. The forum was convened by the U.S. Institute for Environmental Conflict Resolution to facilitate the collaborative development of approaches that could be implemented range-wide to reduce the risk of listing the species. Thirty-five individuals representing diverse backgrounds, interests, and expertise were invited by the Institute to participate in the forum.

Member, Wildlife Resources Policy Committee and Human Wildlife Conflict Task Force, Association of Fish and Wildlife Agencies. As a member of these committees, I work with wildlife professionals throughout the world to identify international and national issues affecting wildlife management and implement programs to increase stakeholder involvement in conservation programs.

Research Associate, Botany Department, North Dakota State University, Fargo (1982-84). Conducted research on grazing/wildlife interactions.

Garrison Diversion Biologist, North Dakota Game and Fish Department, Bismarck (1982). Conducted field work to evaluate the effects habitat projects that were completed to mitigate the environmental impacts associated with the Garrison Diversion Project.

Natural Resource and Mitigation Biologist, North Dakota Department of Transportation, Bismarck (1979-82). Prepared natural resources sections of various environmental documents, developed highway impact mitigation plans, supervised, managed, and evaluated mitigation projects. Conducted water and air quality, hazardous waste, and noise monitoring. Prescribed best management practices to ameliorate the impacts of highway construction, operation, and maintenance on the environment.

Ex-offcio Member, Mule Deer Working Group (1995-Present). This working group is sponsored by the Western Association of Fish and Wildlife Agencies. The group advises state and provincial wildlife agencies directors regarding matters related to mule deer conservation and management.

Recent Peer-viewed Publications

Boyd, C., S. Petersen, W. Gilgert, R. Rodgers, S. Fuhlendorf, R. Larsen, D. Wolfe, K. C. Jensen, P. Gonzales, M. Nenneman, R. Danvir, D. Dahlgren, and T. A. Messmer. 2011. Looking toward a brighter future for lekking grouse. Rangelands. 34-6:1-11.

Peterson, C. and T. A. Messmer. 2011. Biological consequences of winter feeding of mule deer in developed landscapes in northern Utah. Wildlife Society Bulletin. 35:252-260.

Thacker, E. T., D. R. Gardner, T.A. Messmer, M.R. Guttery, and D. A. Dahlgren. 2011. Using gas chromatography to determine winter diets of greater sage-grouse in Utah. Journal of Wildlife Management. 75:1-5.

Peterson, C. and T.A. Messmer. 2010. Factors influencing public perceptions of Utah's mule deer winter-feeding policies. Journal of Wildlife Management. 74:1588-1594.

Dahlgren, D., T.A. Messmer, M. C. Guttrey, and E. Thacker. 2010. Evaluation of brood detection techniques: Obtaining better estimates of greater sage-grouse production. Western North American Naturalist 70:233-237.

Dahlgren, D., T.A. Messmer, and D. Koons. 2010. Achieving better estimates of greater sage-grouse chick survival in Utah. Journal of Wildlife Management. 74:1286-1294.

Prather, P., and T. A. Messmer. 2010. Raptor and corvid responses to power distribution lines perch deterrents in Utah. Journal of Wildlife Management. 74:796-800.

Messmer, T. A. 2009 Human-wildlife conflicts: emerging challenges and opportunities. Human Wildlife Conflicts. 3:10-17.

Messmer, T. A. and D. R. Messmer 2008. Deer-vehicle collision statistics and mitigation information: online sources. Human Wildlife Conflicts. 2:131-135.

Elmore, R. D., T. A. Messmer, and M. W. Brunson. 2007. Perceptions of wildlife damage and species conservation: lessons learned from the Utah prairie dog. Human-Wildlife Conflicts. 1:78-88.

Jimenez, J. E., M. R. Conover, R. D. Dueser, and T. A. Messmer. 2007. Influence of patch size characteristics on the success of upland duck nests. Human-Wildlife Conflicts. 1:244-256.

Peterson, C., and T. A. Messmer. 2007. Effect of winter feeding on mule deer herds in northern Utah. Journal of Wildlife Management. 71:1440-1445.

West, B. C., T.A. Messmer, and D. C. Bachman. 2007. Using predator exclosures to protect ground nests from red fox. Human-Wildlife Conflicts. 1:24-26.

Dahlgren, D. R. Chi, and T. A. Messmer 2006. Greater sage-grouse response of managing sagebrush in Utah. Wildlife Society Bulletin 34:975-986.

Lupis, S., T. A. Messmer, and T. Black. 2006. Gunnison sage-grouse use of Conservation Reserve Program fields and their response to emergency grazing. Wildlife Society Bulletin. 34:957-962.

Recent Research Contracts, Grants and Gifts

2012 Sage-grouse Evaluations in Rich County
Amount: $5,000
Sponsor: Rich County Commission

2011 Sage-grouse Translocation- Anthro Mt
Amount: $25,000
Sponsor: Berry Petroleum, LLC

2011 Sage-grouse Response to Livestock Grazing
Amount: $400,000
Sponsor: Natural Resources Conservation Service

2011 Monitoring Sage-Grouse Response to Conservation Actions
Amount: $50,000
Sponsor Bureau of Land Management

2011 Ecology of greater sage-grouse in Box Elder County
Amount: $130,000
Sponsor: Utah Watershed Initiative

2010 Monitoring Sage-Grouse Response to Conservation Actions
Amount: $50,000
Sponsor Bureau of Land Management

2010 Ecology of the Bear Lake Plateau Greater Sage-grouse Population
Amount: $90,000
Sponsor: Idaho Game and Fish Department

2009 Monitoring Sage-Grouse Response to Conservation Actions
Amount: $50,000
Sponsor Bureau of Land Management

2009 Effects of Tall Structures on sage-grouse
Amount: $35,000
Sponsor: PacificCorp
Utah Wildlife in Need Foundation

2009 Sage-grouse Lek Attendance

Amount: $200,000
Sponsor: Utah Division of Wildlife Resources

2008 Monitoring Sage-Grouse Response to Conservation Actions
Amount: $360,000
Sponsor Bureau of Land Management

2008 Ecology of the Wildcat Knoll and Big Horn Mountain Greater Sage-grouse Populations: Mitigating the Effects of Underground Coal Extraction
Amount: $154,000
Sponsors SUFCO Coal LLC
U.S. Forest Service
Utah Division of Wildlife Resources

2008 Effects of energy development on greater sage-grouse (PI – 100% allocation)
Amount: $85,000
Sponsors: Andarko Petroleum LLC
Enduring Resources LLC.

2007 Gunnison sage-grouse response to irrigation and grazing CRP and native rangelands (PI-100% Allocation)
Amount: $200,000
Sponsors: Natural Resources Conservation Service
Utah Endangered Species Mitigation Fund

2006 Evaluation of Raptor Research Discouragers (PI- 100% Allocation)
Amount: $48,000
Sponsors: PacifiCorp
Avian Powerline Interaction Committee

2006 Retrospective Evaluation of Energy Infrastructure on Sage-grouse Leks (Co-PI)
Amount: $48,000
Sponsors PacifiCorp
Avian Powerline Interaction Committee

2006 Evaluation of the effect of creating mesic sites on Gunnison sage-grouse habitat-use (PI-100% Allocation).
Amount: $95,000
Sponsor: Bureau of Land Management

2005 Sage-grouse Restoration Project (PI – 100% allocation)
Amount: $300,000
Sponsor: Natural Resource Conservation Service

C U R R I C U L U M V I T A E - Past 5 Years

University of Idaho
Moscow, Idaho 83844-1136

NAME: Reese, Kerry Paul
DATE: July 2012
RANK OR TITLE: Professor of Wildlife Resources and Department Head
DEPARTMENT: Fish and Wildlife Sciences
OFFICE LOCATION: CNR Building, 104
OFFICE PHONE: (208) 885-6434
DATE OF FIRST EMPLOYMENT AT UI: August 1983
EMAIL: kreese@uidaho.edu
DATE OF TENURE: July 1, 1989
DATE OF PRESENT RANK OR TITLE: August 1, 1995

EDUCATION:

Ph.D., Wildlife Science, 1983, Utah State University

EXPERIENCE:

Administration:

Head, Department of Fish and Wildlife Sciences, 1 June 2004 - present

Teaching and Research:

1995-present, Professor of Wildlife Resources, University of Idaho
1989-95, Associate Professor of Wildlife Resources, University of Idaho
1984-89, Assistant Professor of Wildlife Resources, University of Idaho
Courses Taught:

NR 102 Introduction to Natural Resources, Wlf 101 Introduction to Wildlife Professions
Wlf 204 Introduction to Natural Resources, Wlf 316 Wildlife Ecology II
Wlf 314 Wildlife Ecology, Wlf 390 Principles of Fish and Wildlife Ecology
Wlf 445 Nongame Management, Wlf 448 Fish and Wildlife Population Ecology
Wlf 492 Wildlife Management, Wlf 495 Wildlife Seminar
Wlf 501 Graduate Seminar, Wlf 542 Waterfowl Management, Wlf 546 Upland Game Ecology

Completed Graduate Students:

Thompson, T. 2012. Dispersal ecology of greater sage-grouse in northwestern Colorado: evidence from demographic and genetic methods. Ph.D. Dissertation, 378 pp.

Baumgardt, J. 2011. Probability of attendance and sightability of greater sage-grouse on leks: relating lek-based indices to population abundance. Ph.D. Dissertation, 122 pp.

Stevens, B. 2011. Impacts of fences on greater sage-grouse in Idaho: collision, mitigation, and spatial ecology. M.S. Thesis, 196 pp.

Stephenson, J. 2008. Ecology of translocated mountain quail in western Idaho and eastern Washington. M.S. Thesis. 162 pp.

Kilpatrick, D. 2007. Translocating trumpeter swans from the Rocky Mountain Population: Habitat, movement, and survival. M.S. Thesis.

Martens, A. 2007. The importance of canopy cover: grounds for development of a new model of mountain quail (Oreortyx pictus) breeding habitat in their eastern range. MS Report for Environmental Science. 39 pp.

Shepherd, J. 2006. Modeling landscape-scale habitat use by greater sage-grouse in southern Idaho. Ph.D. Dissertation, 202 pp.

36 additional graduate students advised to completion

Extension and Service:

2012, external reviewer for Brigham Young University Department of Plant and Wildlife Sciences, February
2012, reviewed manuscripts for Wilson Journal of Ornithology, Journal of Wildlife Management, Wildlife Biology
2011, external reviewer for promotion and tenure of assistant professor at University of Montana
2011, reviewed BLM Conservation Measures for Proposed Planning Decisions for Greater Sage-grouse,

National Technical Team
2011, reviewed NSF MRI Instrumentation proposal on a platform for radio-telemetry for large birds
2011, reviewed manuscripts for Journal of Field Ornithology, Wildlife Biology, Vector Ecology, Journal of Wildlife Management, and Canadian Field Naturalist
2010, Moderated panel discussion on 'Hunting a Candidate Species: The Science and Policy' at the 27th Western Agencies Sage and Columbian Sharp-tailed Grouse Workshop, Twin Falls, ID, March
2010, reviewed manuscripts for Wildlife Biology, Journal of Wildlife Management, Western North American
Naturalist, book chapter for Historical Environmental Variation in Conservation and Natural Resource Management, a pre-proposal for the BLM, and a PowerPoint video for the Office of Sponsored Research,
University of Idaho on 'Responsible Conduct of Research'
2009 reviewed manuscripts for Landscape Ecology, Wilson Journal of Ornithology
2008, reviewed two manuscripts for Journal of Wildlife Management
2007, reviewed manuscript for World Pheasant Association

PUBLICATIONS:

Refereed Publications:

Stevens, B. S., K. P. Reese, J. W. Connelly, and D. D. Musil. 2012 in press. Greater sage-grouse and fences: does marking reduce collisions? Wildlife Society Bulletin.

Stevens, B. S., J. W. Connelly, and K. P. Reese. 2012 in press. Multi-scale assessment of greater sage-grouse fence collision as a function of site and broad-scale factors. Journal of Wildlife Management.

Stephenson, J. A., K. P. Reese, P. Zager, P. E. Heekin, P. J. Nelle, and A. Martens. 2011. Factors influencing survival of native and translocated mountain quail in west-central Idaho and eastern Washington. *Journal of Wildlife Management* 75:1315-1323.

Stevens, B.S., K.P. Reese, and J.W. Connelly. 2011. Survival and detectability bias of avian fence collision surveys in sagebrush steppe. *Journal of Wildlife Management* 75:437-449.

Shepherd, J.F., J.W. Connelly, and K.P. Reese. 2011. Modeling nest and brood habitats of greater sage-grouse. Pp. 137-150 *in* B. K. Sandercock, K. Martin, and G. Segelbacher (editors). Ecology, conservation, and management of grouse. *Studies in Avian Biology* (vol. 39), University of California Press, Berkeley, CA.

Shepherd, J.F., K.P. Reese, and J.W. Connelly. 2011. Landscape fragmentation and non-breeding greater sage-grouse. Pp. 77-88 *in* B. K. Sandercock, K. Martin, and G. Segelbacher (editors). Ecology, conservation, and management of grouse. *Studies in Avian Biology* (vol. 39), University of California Press, Berkeley, CA.

Reese, K.P., and J.W. Connelly. 2011. Harvest management for greater sage-grouse: a changing paradigm for game bird management. Pp 101-111 *in* S. T. Knick and J. W. Connelly (editors). Greater Sage-grouse: Ecology and Conservation of a landscape species and its habitats. *Studies in Avian Biology* (vol. 38), University of California Press, Berkeley, CA.

Connelly, J.W., S.T. Knick, C.E. Braun, W.L. Baker, E.A. Beaver, T.J. Christiansen, K.E. Doherty, E.O. Garton, C.A. Hagen, S.E. Hanser, D.H. Johnson, M. Leu, R.F. Miller, D.E. Naugle, S.J. Oyler-McCance, D.A. Pyke, K.P. Reese, M.A. Schroeder, S.J. Stiver, B.L. Walker, and M.J. Wisdom. 2011. Conservation of greater sage-grouse: a synthesis of current trends and future management. Pp 549-563 *in* S. T. Knick and J. W. Connelly (editors). Greater Sage-grouse: Ecology and Conservation of a landscape species and its habitats.

Studies in Avian Biology (vol. 38), University of California Press, Berkeley, CA

Beck, J.L., J.W. Connelly, and K.P. Reese. 2009. Recovery of greater sage-grouse habitat features in Wyoming big sagebrush following prescribed fire. Restoration Ecology 17:393-403.

Haines, A.M., M. Leu, L.K. Svancara, J.M. Scott, and K.P. Reese. 2008. A theoretical approach to using human footprint data to assess landscape level conservation efforts. Conservation Letters 1:165-172.

Beck, J.L., K.P. Reese, J.W. Connelly, and M.B. Lucia. 2006. Survival of juvenile greater sage-grouse in southeastern Idaho. *Wildlife Society Bulletin* 34:1070-1078.

PAPERS PRESENTED AT SCHOLARLY MEETINGS:

2012, Assessing the quality of CPR lands as habitat for Columbian sharp-tailed grouse and the accuracy of lek counts obtained with aerial infrared imagery. 28th Western Agencies Sage and Columbian Sharp-tailed Grouse Workshop, Steamboat Springs, Colorado. Gillette, G. L., K. P. Reese, J. M. Knetter, and J. W. Connelly.

2012, Mapping sage-grouse fence collision risk: spatially-explicit modles to efficiently target conservation implementation. 28th Western Agencies Sage and Columbian Sharp-tailed Grouse Workshop, Steamboat Springs, Colorado. Stevens, B. S., D. Naugle, B. Dennis, J. W. Connelly, T. Griffiths, and K. P. Reese.

2012, Effects of juniper encroachment on sage-grouse lek trends and occupancy in eastern Oregon. 28th Western Agencies Sage and Columbian Sharp-tailed Grouse Workshop, Steamboat Springs, Colorado. Severson, J. P., J. S. Evans, K. P. Reese, C. A. Hagen, D. Naugle, and J. Maestes. poster

2011, How to get into graduate school. Invited talk to Xi Sigma Pi, University of Idaho. K. P. Reese.

2011, Fences and greater sage-grouse: an experimental test of marking as a mitigation method to reduce collision risk in breeding areas. The Wildlife Society 18th Annual Meeting, Waikoloa, Hawaii. Stevens, B., K. Reese, J. Connelly, and D. Musil.

2011, Fences and greater sage-grouse: an experimental test of marking as a mitigation method to reduce collision risk in breeding areas. Idaho Chapter of The Wildlife Society Annual Meeting, Idaho Falls. Stevens, B., K. Reese, J. Connelly, and D. Musil.

2011, Greater sage=grouse fence collision: a multi-scale assessment of collision risk as a function of site and broad-scale factors. Idaho Chapter of The Wildlife Society Annual Meeting, Idaho Falls. Stevens, B., K. Reese, and J. Connelly.

2011, A method for estimating the population sex ratio of sage-grouse from fecal DNA. Idaho Chapter of The Wildlife Society Annual Meeting, Idaho Falls. Baumgardt, J., C. Goldberg, K. Reese, D. Musil, E. Garton, J. Connelly, and L. Waits.

2011, Factors influencing survival of native and translocated mountain quail in west-central Idaho and eastern Washington. Idaho Chapter of The Wildlife Society Annual Meeting, Idaho Falls. J. Stephenson, K. P. Reese, P. Zager, P. E. Heekin, and A. Martens.

2010, Estimating greater sage-grouse fence collision rates in breeding areas: preliminary results. 27th Western Agencies Sage and Columbian Sharp-tailed Grouse Workshop. Twin Falls, ID. Stevens, B.S., K.P. Reese, and J.W. Connelly.

2010, Integrating genetics and GIS to determine the impact of anthropogenic disturbance on greater sage-grouse. 27th Western Agencies Sage and Columbian Sharp-tailed Grouse Workshop. Twin Falls, ID. Bush, K., N. Kazor, and K. Reese.

2010, The genetic structure of greater sage-grouse populations in northeastern California. 27th Western Agencies Sage and Columbian Sharp-tailed Grouse Workshop. Twin Falls, ID. Davis, D., K. Reese, and S. Gardner.

2010, Predicting the attendance probability of greater sage-grouse at leks. 27th Western Agencies Sage and Columbian Sharp-tailed Grouse Workshop. Twin Falls, ID. Baumgardt, J., K. Reese, E. Garton, J. Connelly, D. Musil, and M. Evans.

2010, Estimating greater sage-grouse fence collision rates in breeding areas: preliminary results. Idaho Chapter of The Wildlife Society Annual Meeting, Boise. Stevens, B S., K.P. Reese, and J.W. Connelly.

2009, How to get into graduate school. Xi Sigma Pi. Moscow, November. K. P. Reese.

2009, From the nest to the lek: survival, natal dispersal, and recruitment of juvenile greater sage-grouse in northwestern Colorado. Idaho Chapter of The Wildlife Society Annual Meeting, Moscow. Thompson, T.R., K.P. Reese, and A.D. Apa.

2009, Movement patterns and population dynamics of greater sage-grouse in Mono County, CA. Idaho Chapter of The Wildlife Society Annual Meeting, Moscow, March. Wiechman, L.A., K.P. Reese, and S.C Gardner.

2009, Mountain quail research in the eastern portion of their range: what have we learned? Mountain Quail Workshop, Roseburg, OR, February. K.P. Reese, J. Stephenson, and P. Zager.

2008, From the nest to the lek: survival, natal dispersal, and recruitment of juvenile greater sage-grouse in northwestern Colorado. 11th International Grouse Symposium, Whitehorse, Yukon, Canada, September. T. Thompson, K. Reese, and A. Apa.

2008, Lek counts to abundance estimates: predicting attendance probability of greater sage-grouse leks. 11th International Grouse Symposium, Whitehorse, Yukon, Canada, September. J.A. Baumgardt, K.P. Reese, E.O. Garton, J.W. Connelly, D. Musil, and M. Evans.

2008, Population structure of greater sage-grouse in northeastern California: a preliminary assessment of a declining fringe population. 11th International Grouse Symposium, Whitehorse, Yukon, Canada, September. D.M. Davis, K.P. Reese, and S.C. Gardner.

2008, Predicting the attendance probability of greater sage-grouse at lek sites in south-central Idaho: preliminary analysis. 26th Western Agencies Sage and Columbian Sharp-tailed Grouse Workshop, Mammoth Lakes, CA, June. J.A. Baumgardt, K.P. Reese, E.O. Garton, J.W. Connelly, D. Musil, and M. Evans.

2008, Evaluation of assisted brood amalgamation in sage-grouse: can adding domestically-hatched chicks into wild broods support a population? 26th Western Agencies Sage and Columbian Sharp-tailed Grouse Workshop, Mammoth Lakes, CA, June. T. Thompson, K. Reese, and A. Apa.

2008, From the nest to the lek: survival, natal dispersal, and recruitment of juvenile greater sage-grouse in northwestern Colorado. 26th Western Agencies Sage and Columbian Sharp-tailed Grouse Workshop, Mammoth Lakes, CA, June. T. Thompson, K. Reese, and A. Apa.

2008, Population structure of greater sage-grouse in northeastern California: a preliminary assessment. 26th Western Agencies Sage and Columbian Sharp-tailed Grouse Workshop, Mammoth Lakes, CA, June. D.M. Davis, K.P. Reese, and S.C. Gardner.

2008, Movement patterns and population dynamics of greater sage-grouse in Mono County, Ca. 26th Western Agencies Sage and Columbian Sharp-tailed Grouse Workshop, Mammoth Lakes, CA, June. Wiechman, L.A., K.P. Reese, and S.C. Gardner.

2008, Evaluation of assisted brood amalgamation in sage-grouse: can adding domestically-hatched chicks into wild broods support a population? Northwest Section of The Wildlife Society Annual Meeting, Spokane, WA, March. T. Thompson, K. Reese, and A. Apa.

2008, Ecology of translocated mountain quail (Oreortyx pictus) in western Idaho and central Washington. Idaho Chapter of The Wildlife Society Annual Meeting, Boise, ID, March. J. Stephenson, K.P. Reese, P. Zager, and A. Martens.

2008, Predicting the attendance probability of greater sage-grouse at lek sites in south-central Idaho: a preliminary analysis. Idaho Chapter of The Wildlife Society Annual Meeting, Boise, ID, March. J.A. Baumgardt, K.P. Reese, E.O. Garton, J.W. Connelly, D. Musil, and M. Evans.

2008, Evaluation of assisted brood amalgamation in sage-grouse: can adding domestically-hatched chicks into wild broods support a population? Idaho Chapter of The Wildlife Society Annual Meeting, Boise, ID, March. T. Thompson, K. Reese, and A. Apa.

2007, Invited Presentation: Tips for Graduate School. UI College of Graduate Studies, March. K.P. Reese.

2007, Landscape use by greater sage-grouse: effects of habitat fragmentation. Idaho Chapter of The Wildlife Society, Pocatello, March. J. F. Shepherd, K. P. Reese, and J. W. Connelly.

2007, Ecology of translocated mountain quail in western Idaho and eastern Washington. Idaho Chapter of The Wildlife Society, Pocatello, March. J. Stephenson, K. Reese, P. Zager, and A. Martens.

2007, A new mountain quail breeding season habitat model for their eastern range. Cooper Ornithological Society, Moscow, ID, June. A. Martens, and K.Reese.

2007, Ecology of translocated mountain quail in western Idaho and eastern Washington. Cooper Ornithological Society, Moscow, ID, June. J. Stephenson, K. Reese, P. Zager, and A. Martens.

2007. Recovery of greater sage-grouse habitat features in Wyoming big sagebrush following prescribed fire. Wyoming Chapter of The Wildlife Society, Lander, WY, March. J.L. Beck, J.W. Connelly, and K.P. Reese.

GRANTS AND CONTRACTS:

From 1984 through July 2012, total funding equals $5,149,923 plus $1,200,000 in-kind support.

2012-2013, US protected are data aggregation and analysis to inform critical conservation and land management decisions. Subaward from BSU from USGS. $178,442.

2011-2012, Content editing – website work for IDFG. $3924. IDFG.

2010-2013, Evaluating greater sage-grouse response to landscape level removal of encroaching juniper. Total project to date: $229,950. Natural Resource Conservation Service via University of Montana. $129,956. First 2 years of multi-year project. Plus $99,994 from Pheasants Forever for second year funding.

2010-2013, Columbian sharp-tailed grouse ecology in CRP and native habitats. IDFG, $54,549.

2009-2010, Sage-grouse genetics research in Canada. World Wildlife Fund. $5,000. For Post-doctoral research of Dr. Krista Bush.

2009 -2010, Sage-grouse genetics research in Canada. Rocky Mountain CESU, Montana BLM. $35,000. For Post-doctoral research of Dr. Krista Bush.

2009-2010, Genetic diversity analysis of southern Alberta plains sharp-tailed grouse, endangered sage-grouse, and their hybrids. Alberta Conservation Association. $17,665. For Post-doctoral research of Dr. Krista Bush.

2009- 2010, Sage grouse use of China Ridge. IDFG. $11,000.

2008-2011, Sage-grouse fence collisions: an under-reported source of mortality. IDFG. $96,530.

2006-2011, Population dynamics, dispersal and productivity of greater sage-grouse in California. California Department of Fish and Game. $350,177 plus $250,000.

2006-2011, Lek attendance patterns and vital rates in sage-grouse: implications for monitoring and management. IDFG. $255,203 with E.O. Garton.

HONORS AND AWARDS:

2012 Arthur S. Einarson Award from the Northwest Section of The Wildlife Society for Outstanding Service to the Wildlife Profession.
2007 Hamerstrom Award from the Prairie Grouse Technical Council for exemplary contributions to prairie grouse conservation.
2003 Outstanding Teacher Award, College of Natural Resources, University of Idaho.
Alumni Award for Faculty Excellence, 1984, 1991, 1992, 2000.
Sigma Xi Faculty Research Paper Award, University of Idaho, 1987.
Professional Wildlifer of the Year Award from the Idaho Chapter of The Wildlife Society for 1993.
Ted Trueblood Communications Award for Best Professional Presentation at the Idaho Chapter of TWS Annual Meeting, 1995, 1996, 2002.

CURRICULUM VITA

JAMES STONE SEDINGER

PERSONAL

Office Address
Dept. of Natural Resources
And Environmental Science
University of Nevada Reno
Reno, NV 89557
Phone: (775) 784-6556
FAX: (775) 784-4583
Email:jsedinger@cabnr.unr.edu

EDUCATION Ph.D. University of California, Davis, Ecology (1983)
B. S. (Cum Laude) University of Washington, Electrical Engineering (1971)

PROFESSIONAL EXPERIENCE/EMPLOYMENT

Director, Program in Ecology, Evolution and Conservation Biology, University of Nevada Reno (2007-2011)

Professor, Natural Resources and Environmental Science, University of Nevada Reno (2002-present)

Associate Professor, Environmental and Resource Sciences, University of Nevada Reno (2001-2002)

Interim Director, Institute of Arctic Biology, University of Alaska Fairbanks (1998-2001)

Professor of Wildlife Ecology, University of Alaska Fairbanks (1994-2001)

Associate Professor of Wildlife Ecology, University of Alaska Fairbanks (1990-1994)

Assistant Professor of Wildlife Ecology, University of Alaska Fairbanks (1986-1990)

Adjunct Assistant Professor of Wildlife Ecology, University of Alaska Fairbanks (1985-1986)

Research Wildlife Biologist, U.S. Fish and Wildlife Service, Anchorage, AK (1984-1986)

Graduate Research Assistant, Division of Wildlife and Fisheries Biology, University of California, Davis, CA (1977-1982)

Electrical Engineer, Bonneville Power Administration, Portland, OR (1972-1974)

Electronic Technician, College of Forestry, University of Washington, Seattle, WA (1972)

TEACHING (Last 5 years)

Formal Teaching:

Courses	Date	Enrollment
NRES 488 Dynamics and Management of Wildlife		

	Populations	Fall 2011	25
NRES 488/688	Dynamics and Management of Wildlife Populations	Fall 2010	25
NRES 488/688	Dynamics and Management of Wildlife Populations	Fall 2009	14
NRES 488/688	Dynamics and Management of Wildlife Populations	Fall 2008	21
NRES 488/688	Dynamics and Management of Wildlife Populations	Fall 2007	12
NRES 780	Analysis and Modeling of animal Populations	Fall 2011	4
NRES 780	Analysis and Modeling of Wildlife Populations	Fall 2010	5
NRES 701	Seminar in Dynamics and Management of Wildlife Populations	Fall 2009	7
NRES 701	Seminar in carryover effects	Fall 2008	4
NRES 701	Seminar in Dynamics and Management of Wildlife Populations	Fall 2008	7
NRES 701	Seminar in Dynamics and Management of Wildlife Populations	Fall 2007	2

GRANTS AND CONTRACTS (Last 5 years)

2012. Population response of kangaroo mice to solar development in Smoky Valley, NV. (co-PI). Tonopah Solar Energy LLC. $199,921.

2011. Population dynamics of Sage-grouse. Nevada Department of Wildlife. (PI). $90,000.

2011. REU Supplement. National Science Foundation. (PI). $8,583.

2010 Implementation of the Nevada Wildlife Action Plan. Bureau of Land management/Nevada Department of Wildlife. (co-PI). $40,029.

2009 Analysis of Black Brant population Data. (PI). U. S. Fish and Wildlife Service. $20,831.

2009. Demography of Common Goldeneyes in interior Alaska. U. S. Fish and Wildlife Service. (PI). $33,722.

2009 Demography of Greater Sandhill Cranes in Northeastern Nevada. Nevada Waterfowl Association. (PI) $63,220.

2009 Ecology of Wood ducks in Lahontan Valley, Nevada. Nevada Waterfowl Association. (PI) $60,301.

2009. Analysis of banding data for Pacific Black Brant. U. S. Fish and Wildlife Service. (PI) $9,811.

2008 Lifetime fitness consequences of reproductive strategies. National Science Foundation. (PI) $599,220.

2008 Effects of artificial water on mule deer in Mohave National Preserve. Safari club International. (co-PI) $62,200.

2008 Effects of high voltage transmission lines on dynamics of sage grouse populations. Bureau of Land Management. (PI) $40,000.

2007 Demography of Lahontan cutthroat trout in Walker Lake, Nevada. U.S. Fish and Wildlife Service. (PI) $98,575.

PUBLICATIONS (Last 5 years)

Morano, S., K. M. Stewart, J. S. Sedinger, C. Nicolai, and M. Vavra. 2013. Life-History Strategies of North American Elk: Tradeoffs Associated with reproduction and Survival. Journal of Mammalogy:in press.

Blomberg, E. J., J. S. Sedinger, M. T. Atamian, and D. V. Nonne. 2012. Characteristics of climate and landscape disturbance influence the dynamics of greater sage-grouse populations. Ecosphere 3:1-20.

Lemons, P. R., J. S. Sedinger, C. A. Nicolai, and L. W. Oring. 2012. Sexual dimorphism, survival, and parental investment in relation to offspring sex in a precocial bird. Journal of Avian Biology 43:published on line.

Singer, H. V., J. S. Sedinger, C. A. Nicolai, A. W. VanDellen, and B. T. Person. 2012. Timing of adult wing molt in Black Brant (*Branta bernicla nigricans*). Auk 129:239-246.

Sedinger, J. S., and M. P. Herzog. 2012. Harvest and dynamics of duck populations. Journal of Wildlife Management 76:1108-1116.

Sedinger, J. S., E. J. Blomberg, A. W. VanDellen, and S. Byers. 2012. Environmental and population strain effects on survival of Lahontan Cutthroat Trout in Walker Lake, Nevada: a Bayesian approach. North American Journal of Fisheries Management 32:515-522.

Schamber, J. L., J. S. Sedinger, and D. H. Ward. 2012. Carry-over effects of winter location contribute to variation in timing of nest initiation and clutch size in Black Brant. Auk 129:205-210.

Nicolai, C. A., and J. S. Sedinger. 2012. Trade-offs between offspring fitness and future reproduction of adult female black brent. Journal of Animal Ecology 81:798-805.

Nicolai, C. A., and J. S. Sedinger. 2012. Are there trade-offs between pre- and post-fledging survival in black brent geese? Journal of Animal Ecology 81:788-797.

Nicolai, C. A., J. S. Sedinger, D. H. Ward, and W. S. Boyd. 2012. Mate loss affects survival but not breeding in Black Brant geese. Behavioral Ecology 23:643-648.

Sedinger, J. S., J. L. Schamber, D. H. Ward, C. A. Nicolai, and B. Conant. 2011. Carryover effects associated with winter location affect fitness, social status, and population dynamics in a long distance migrant. American Naturalist 178:E110-E123.

Sedinger, B. S., J. S. Sedinger, S. Espinosa, M. T. Atamian, and E. J. Blomberg. 2011. Spatial-temporal variation in survival of harvested Greater Sage-Grouse. Pp. 317–328 in B. K. Sandercock, K. Martin, and G. Segelbacher (editors). Ecology, conservation, and management of grouse. Studies in Avian Biology 39.

Sedinger, J. S., and C. A. Nicolai. 2011. Recent trends in first-year survival for Black Brant breeding in southwestern Alaska. Condor 113:511-517.

Gergans, N., W. W. Miller, D. W. Johnson, J. S. Sedinger, R. F. Walker, and R. R. Blank. 2011. Runoff water quality from Sierran upland forest, transition ecotone, and riparian wet meadow. Soil Science Society of America Journal 75:1946-1957.

Fondell, T. F., P. L. Flint, J. S. Sedinger, C. A. Nicolai, and J. L. Schamber. 2011. Intercolony variation in growth of Black Brant goslings on the Yukon-Kuskokwim Delta, Alaska. Journal of Wildlife Management 75:101-108.

Lemons, P. R., J. S. Sedinger, and P. S. Randle. 2011. Egg size mimicry by an intraspecific brood parasite. Behavioral Ecology 22:696-700.

Crampton, L. H., W. S. Longland, D. D. Murphy, and J. S Sedinger. 2011. Food abundance determines distribution and density of a frugivorous bird across seasons. Oikos 120:65-76.

Lemons, P. R., J. S. Sedinger, and P. S. Randle. 2011. Detecting conspecific brood parasitism using egg morphology in Black Brant. Journal of Avian Biology 42:282-288.

Crampton, L. H., and J. S. Sedinger. 2011. Nest habitat selection by the Phainopeplas: congruence across spatial scales but not habitat types. Condor 113:209-222.

Atamian., M. T., J. S. Sedinger, J. S. Heaton, and E. J. Blomberg. 2010. Landscape level assessment of brood rearing habitat for Greater Sage-grouse in Nevada. Journal of Wildlife Management 74:1533-1543.

Sedinger, J. S., G. C. White, S. Espinosa, E. T. Partee, and C. E. Braun. 2010. An approach to assessing compensatory versus additive harvest mortality: an example using Greater Sage-grouse *Centrocercus urophasianus*. Journal of Wildlife Management 74:326–332.

Lemons, P. R., J. S. Sedinger, M. P. Herzog, P. S. Gipson, and R. L. Gilliland. 2010. Landscape effects on diets of two canids in northwest Texas: a multinomial modeling approach. Journal of Mammalogy 91:66-78.

Atamian, M. T., and J. S. Sedinger. 2010. Balanced sex ratio at hatch in a Greater Sage-grouse (*Centrocercus urophasianus*) population. Auk 127:16-22.

Kolada, E. J., J. S. Sedinger, and M. L. Casazza. 2009. Nest site selection by greater sage-grouse in Mono County, California. Journal of Wildlife Management 73:1333-1340.

Kolada, E. J., M. L. Casazza, and J. S. Sedinger. 2009. Ecological factors influencing nest survival of greater sage-grouse in Mono County, California. Journal of Wildlife Management 73:1341-1347.

Ward, D. H., C. P. Dau, T. L. Tibbitts, J. S. Sedinger, B. A. Anderson, and J. E. Hines. 2009. Change in abundance of Pacific brant wintering in Alaska: evidence of a climate warming effect. Arctic 62:301-311.

Loupe, T. M., W. W. Miller, D. W. Johnson, J. S. Sedinger, E. M. Carroll, J. D. Murphy, and C. M. Stein. 2009. Effects of mechanical harvesting plus chipping and prescribed fire on Sierran runoff water quality. Journal of Environmental Quality 38:537-547.

Glass, D. S., Johnson, D. W., Miller, W. W., Blank, R. R., Sedinger, J. S. 2008. Factors Affecting Mineral Nitrogen Transformations by Soil Heating: A Laboratory Simulated Fire Study. Soil Science 173: 387-400.

Nicolai, C. A., J. S. Sedinger, and M. L. Wege. 2008. Differences in growth of Black Brant goslings between a major colony and outlying breeding aggregations. Wilson Journal of Ornithology 120: 755–766.

Sedinger, J. S., N. D. Chelgren, M. S. Lindberg, and D. H. Ward. 2008. Fidelity and breeding probability related to population density and individual quality in black brent geese (*Branta bernicla nigricans*). Journal of Animal Ecology 77:702-712.

Matchette, E. L., and J. S. Sedinger. 2008. A change in waterfowl species composition in the Honey Lake Valley, California. California Fish and Game 94:44-52.

Johnson, D. W., D. E. Todd, Jr., C. F. Trettin, and J. S. Sedinger. 2007. Soil carbon and nitrogen changes in forest of the Walker Branch watershed, 1972 to 2004. Soil Science Society of America Journal 71:1639-1646.

Schamber, J. L., J. S. Sedinger, D. H. Ward, and K. R. Hagmeier. 2007. Population structure and body size of Black Brant during winter. Journal of Field Ornithology 78:74-82.

Sedinger, J. S., C. A. Nicolai, C. J. Lensink, C. Wentworth, and B. Conant. 2007. Harvest, density dependence and survival in black brant: a record of population dynamics. Journal of Wildlife Management 71:496-506.

Sedinger, J. S., and N. D. Chelgren. 2007. Survival and breeding advantages of larger Black Brant goslings: within and among cohort variation. Auk.124:1281-1293.

Lee, D. E., J. M. Black, J. E. Moore, and J. S. Sedinger. 2007. Age-specific stopover ecology of Black Brant at Humboldt Bay, California. Wilson Journal of Ornithology 119:9-22.

Eichholz, M.W. and J. S. Sedinger. 2007. Survival and recovery rate of Canada Geese staging in Interior Alaska. Journal of Wildlife Management 71:36-42.

APPENDIX B: INDIVIDUAL REVIEWER COMMENTS

This page intentionally left blank

Sage-grouse Conservation Objectives Draft Report
Peer Review
September 17, 2012
Submitted to: Rebecca E. Burns with Atkins via Email

REVIEWER 1:

Peer-review of the Sage-grouse Conservation Objectives – Draft Report dated 1 August 2012.

I was asked to address the following questions in completing my review.

1. Are the methods and assumptions used in deriving conservation objectives for the sage-grouse clearly stated and logical? If not, please identify the specific methods and assumptions that are unclear or illogical.

2. Are the results presented in the COT Report reasonable? If not, please identify those that are not and the specifics of each situation.

3. Do the authors of the COT Report draw reasonable and scientifically sound conclusions from the scientific information presented in the COT Report? Are there instances in the COT Report where a different but equally reasonable and scientifically sound scientific conclusion might be drawn that differs from the conclusion drawn by the Service? If any instances are found where that is the case, please provide the specifics of that situation.

4. Does the COT Report base its interpretations, analyses and conclusions upon the best available science? If any instances are found where the best available science was not used, please provide the specifics of each situation.

5. Are there any significant peer-reviewed scientific papers that the COT Report omits from consideration that would enhance the scientific quality of the document? Please identify any such papers.

6. Is the scientific foundation of the COT Report reasonable and how can it be strengthened? Please identify any options to strengthen the scientific foundations.

General Comments

First and foremost, I applaud the efforts of the COT team to develop this document. It constitutes an initial framework for the USFWS to use when evaluating state and range wide sage-grouse conservation efforts. The goal of the COT is well established. However, the objectives stated are not objectives, but rather components of the COT goal. As written, they do not provide the user of this document with metrics to measure outcomes. To be quantifiable, objectives must state how much, where, when, and who will be accountable. I believe the users of the document will be looking for these types of end states (i.e., how much is enough).

Realizing these are fluid targets and largely at the purview of the states, I recommend the COT team clearly state why it will be difficult to establish specific objectives and that the document was developed to serve as a sage-grouse conservation toolkit rather than an absolute. Thus, to avoid any confusion, the objectives in the COT should be renamed – strategies.

Many of the strategies identified in the COT were included in the Greater Sage-grouse Comprehensive Strategy (Stiver *et al.* 2006). This document provided both strategies and reasonable examples of conservation objectives to include time frames, responsible entities, and budgets. I am not aware if WAFWA has conducted a follow up analysis of the strategy to determine what has been accomplished. This may be something both WAFWA and the USFWS should complete.

The action items identified as specific conservation strategies beginning on line 805 may constitute the COT's actual objectives. I recommend they be renamed as such. The action items stated are somewhat measurable and as such each state can report their trajectory toward completion to the USFWS in annual status reports.

If these changes are made, I believe the stated purpose of the COT; "to develop conservation objectives by defining the degree to which the threats need to be ameliorated to conserve the sage-grouse so that it is no longer in danger of extinction or likely to become in danger of extinction, by 2013 for the Bi-state Distinct Population Segment (DPS), and 2015 for the Greater sage-grouse range-wide" will be realized.

Question 1. Are methods and assumptions valid?

Comment: The methods and assumptions used by the conservation team in building the conservation objectives are based largely on the peer-reviewed published scientific literature. This approach establishes scientific validity for the range-wide effort. However, there are some assumptions which may need further clarification. For example:

Line 154 – Sagebrush habitat and sage-grouse

Sage-grouse are dependent on large areas of contiguous sagebrush (Patterson 1952; Connelly *et al.* 2004; Connelly *et al.* 2011a; Wisdom *et al.* 2011) and large-scale characteristics (e.g. agricultural conversions) within surrounding landscapes influence sage-grouse habitat selection (Knick and Hanser 2011) and population persistence (Aldridge *et al*. 2008; Wisdom *et al*. 2011). Sagebrush is the most widespread vegetation in the intermountain lowlands in the western United States (West and Young 2000); however, sagebrush is considered one of the most imperiled ecosystems in North America due to continued degradation and lack of protection (Knick *et al.* 2003; Miller *et al.* 2011, and references therein).

Comment: Although there is no doubt sage-grouse depend on sagebrush habitats, not all sagebrush constitutes sage-grouse habitat. From a range wide perspective, environmental organizations frequently equate the stated range wide loss of sagebrush to the magnitude of sage-grouse declines stating that range-wide, populations have declined over 90%. Although, there is no doubt that the loss and fragmentation of sagebrush habitats has contributed to declining populations, acknowledgement that we do not truly know the magnitude of the population declines may be more appropriate.

Line 198 - Principles of conservation biology used in this report

The COT authors use three conservation parameters (parameters) identified in the scientific literature, redundancy, resiliency, and representation which are also used by the USFWS in listing decisions, to serve as indicators of the conservation status of a species (Naeem 1998;

Redford *et al*. 2011). In addition to the parameters described above, the COT also identified **"resistance"** as an additional conservation parameter. They defined resistance as the ability of a population or habitats to withstand a threat without experiencing negative consequences. They used the analogy of the immune system to respond to an initial assault from an offending pathogen as an example of resistance. They further stated the "resistance of a population depends on the health of the population and associated habitats and the severity of the threat. When resistance of a population is lost, the ability of the population to persist is then a function of its resilience.

*Comment: I found the use of the term resistance to be redundant with resiliency. The analogy of using the human immune system may also be questionable unless the authors are using the term in the evolutionary sense that draws on Darwin's original definition of evolution as descent with modification. The modern synthesis of evolution reinforces contemporary ideas of heritability (*Mayr 2001*). But the use of the term in the context of COT implies rather a spatial dimension (i.e., a distance from a disturbance – buffer zone) than a behavioral modification favored by natural selection where the organism, in this case sage-grouse, may evolve to adapt to a disturbed environment. It is clear from the example of antibiotic resistance, however, that natural selection does not favor one species or population, but rather acts at the individual level.*

The question then becomes, are some populations of sage-grouse or individuals in a population inherently more tolerant of disturbance, or is tolerance to disturbance more a function of habitat quality or other environmental parameters? If the first scenario is true, how would managers select for this trait? Is it heritable? I argue the second is more plausible.

If the term resistance is to continue to be used in the COT, consider using a modifier such as spatial resistance. The catchiness of the 4-Rs alliteration, although intriguing syntax, may be lost on stakeholders who will implement COT recommendations.

Line 245 – Population definition

In the COT the authors define populations as a group of individuals occupying an area of sufficient size to permit normal dispersal and/or migration behavior in which numerical changes are largely determined by birth and death processes (Berryman 2002).

Comment: This definition should be stated earlier in the COT – possibly the introduction and purpose.

Line 259 – Time frame

The COT considered how the redundancy, representation, and resiliency of sage-grouse could be conserved in the long-term. We examined threats and probability of persistence over several time frames (up to100 years) to classify population risk levels (see Framework for the COT's Threat Analysis below). The time frames were consistent with time frames provided in the population viability analysis in Garton *et al*. 2011; common timeframes used for climate change projections (e.g. Bradley *et al*. 2009); and because sagebrush ecosystem restoration can take decades or centuries, depending on the species of sagebrush, its understory component, presence of nearby invasive species, a variety of environmental conditions, and the financial resources that are invested in restoration (Knick *et al*. 2003, and references therein; 75 FR 13910). The concepts of "resiliency", "redundancy," "representation" and "resistance" are not mutually

exclusive, as populations that contribute to the resiliency of a species may also contribute to its redundancy or representation…..

Comment: The authors did not include "resistance" in their consideration and analysis of conservation period. If resistance can be equated to protecting the best habitat and populations (i.e., fee title, conservation easements, buffer zones, zoning and ordinances) by mitigating the threat level, could this not become a major contributing factor in population persistence? This consideration – protecting the best of the best – which is the basis for several state wildlife agency action plans thus seems to be discounted. However, I do not question the time frame the authors used, but rather ask that habitat protection mechanisms be given further consideration given the time frames and increasing costs of restoration.

Question 2. Are the results reasonable?

Comment: Given the level of uncertainty identified by the COT authors, the conclusions stated are reasonably valid. It is my experience that contemporary wildlife managers and decision makers grasp the habitat needs of sage-grouse and how habitats must be managed to achieve species conservation. What they have not realized is the effect that climate change may have on this management paradigm. Thus managers and policy makers are managing for what they know, not what they don't know. The COT should guide them in this direction.

Below are some specific examples exerted from the COT which may require additional consideration from both state and range wide perspectives.

Line 227 - Identification of redundancy and representation

The authors state, "individual states have already undertaken considerable efforts to identify key habitats necessary for sage-grouse conservation in the development of their state management plans for this species. Not all state maps of these key habitats were created explicitly considering the conservation parameters as discussed above. Nevertheless, after review of these maps and discussions with state biologists and others responsible for their creation, the conclusion of the COT was that state-based mapping efforts designating key habitats identified redundancy and representation for each state, even though mapping techniques varied (Table 1). These data sets were developed or updated by the state agencies between 2010 and 2012 and thereby represent the most current information available. Each state used differing terminology for key habitat areas (e.g. core, priority, habitat). In order to avoid confusion between the recommendations of this report, and individual state and Federal land management agency conservation plans, the COT has termed these key habitats as *priority areas for conservation* (PACs).

*Comment: PACs **must** be based on the dynamic state mapping efforts and not rest with the committee's contemporary interpretation. This has been emphasized repeatedly in the COT. Several states are updating sage-grouse area maps as new information becomes available. These maps will no doubt differ from Figure 1. However Figure 1 must accurately reflect the most current maps produced by the states as this may become the baseline the USFWS uses to measure conservation progress or failure.*

For example, in the case of Utah, Figure 1 suggested the existence of a contiguous corridor in the center of the state linking southern to northern populations. This corridor does not exist.

The figure included non-habitat areas which birds must fly over to connect with other populations.

Additionally, tribal lands that may link populations in the center of the state to those in the northeastern corner of the state have been excluded. The COT must address the issue of tribal lands – a crucial issue in Utah. Tribal lands provide important sage-grouse habitat. To deny or ignore this fact is contradictory to the conservation principles previously stated. Wyoming does include tribal lands as part of the state core-area mapping process. If tribal lands are to be excluded, how might this affect COT implementation and ultimately the USFWS forthcoming decision?

Line 321 – Effect of potential loss of a PAC

The COT states - the potential loss of a PAC increases the value of other PACs for retention of redundancy, representation, and management flexibility of anthropogenic activities.

Comment: How so? Define the term value? Is this a species conservation, population persistence, or tangible mitigation value? Will this open the door for USFWS and other federal agency recognition of increased use of in-kind, off-site mitigation? Thus could a PAC in a state that is permanently protected be used to offset (i.e., mitigate) the loss of a PAC in another state? Does this come down to making the preverbal decision – how much is enough?

Line 338 - Inclusive of all PACS

The COT states, the primary difference between these two efforts, however, is that the maps considered by the COT include all PACs, regardless of surface or subsurface ownership.

Comment: This statement is incorrect. Tribal lands have been excluded in Utah. The USFWS must recognize how tribal lands which contain occupied sage-grouse habitat will be addressed under the Endangered Species Act (ESA). This must be clarified in the COT.

Line 392 - Development

Continued development within sage-grouse range may cause further habitat fragmentation. Although data are limited, impacts resulting from renewable energy development are expected to have similar effects on sage-grouse populations and habitats due to their similarity in supporting infrastructure (Becker *et al.* 2009; Hagen 2010; USFWS 2012).

Comment: Define infrastructure? Roads, powerlines, tall structure – the effects of this infrastructure on sage-grouse population vital rates may be more related to the level of disturbance relative to habitat quality than mere presence.

Line 408 – Impact of threats

The COT states, additionally, the impact of threats on local sage-grouse populations vary based on the resistance, and subsequent resilience of that population and its associated habitats. Healthy, robust sagebrush habitats with few or no other threats are likely to be more resistant or resilient than habitats already experiencing a high level of threats, or in poor condition.

Comment: What is the relationship of resistance to habitat quality? Are species in better quality habitat more resistant disturbances? Here the authors use the term resistance and resilience interchangeably? Research in Nevada regarding the effect of Falcon-Gondor transmission lines on sage-grouse suggested that habitat quality was more important in nesting success than the proximity to the transmission. Some citations and/or description of case studies may be appropriate. For example, Beck et al. (2006) demonstrated the potential effect of habitat quality on juvenile seasonal movements and survival.

Line 420 – Regulatory mechanisms

The COT stated, "Wyoming's Governor Dave Freudenthal was among the first to enact regulatory mechanisms to protect core sage-grouse areas through Executive Order 2010-4. Governor Mead signed an updated version of the Sage-Grouse Core Area Protection Executive Order in 2011 (Executive Order 2011-5). The probability for the successful amelioration of the primary threats to sage-grouse and their habitat can be enhanced through the development and implementation of sufficient regulatory mechanisms."

Comment: This is a good example of one state's effort to implement mechanisms to address one of the USFWS listing factors. I recommend the COT summarize the efforts of other states where similar efforts have been initiated and/or completed. The point here is that each state is attempting to address the USFWS concerns.

Line 429 – Federal programs

"the loss of Conservation Reserve Program (CRP) lands. Some of these threats may be …."

Comment: For Gunnison sage-grouse in Utah loss of the CRP would be a major impact. If USDA (NRCS/FSA) eliminates the program, this could constitute as taking under ESA. The USFWS needs to clarify its position regarding these and other federal programs which may be subject to federal funding. The USFWS is currently writing draft rules for a proposed listing of the Gunnison sage-grouse for protection under the ESA. See Lupis et al. 2006. (Lupis, S., T. A. Messmer, and T. Black. 2006. Gunnison sage-grouse use of Conservation Reserve Program fields and their response to emergency grazing. Wildlife Society Bulletin 34:957-962.)

Line 506 - Clarify use of terms

A = Substantial, imminent threat. Threat is moderate to severe and imminent for most (> 60 percent) of the population or area.

B = Moderate and imminent threat. Threat is moderate to severe and imminent for a significant proportion (20-60 percent) of the population or area.

C = Substantial, non-imminent threat. Threat is moderate to severe but not imminent (> 10 years) for most of the population or area.

D = Moderate, non- imminent threat. Threat is moderate to severe but not imminent for a significant portion of the population or area.

E = Localized substantial threat. Threat is moderate to severe for a small but significant proportion of the population or area.

F = Widespread, low-severity threat. Threat is of low severity but affects (or would affect) most or a significant portion of the population or area.

G = Slightly threatened. Threats, while recognizable, are of low severity, or affecting only a small portion of the population or area.

H = Unthreatened. Threats if any, when considered in comparison with natural fluctuation and change, are minimal or very localized, not leading to significant loss or degradation of populations or area even over a few decades' time. (Severity, scope, and/or immediacy of threat considered Insignificant.)

U = Unknown. The available information is not sufficient to assign degree of threat as above. (Severity, scope, and immediacy are all unknown, mostly [two of three] unknown, or not assessed.)

Comment: Consistently use and define most (> 60%), significant (20-60%), and small (no parameter provided).

Line 546 – Use of 500 breeding birds vs 200 males

Additionally, the COT determined that populations and management areas containing fewer than 200 males or 500 breeding birds could not be ranked higher than a C2. This is because small populations are inherently more vulnerable to extinction from unpredictable environmental 200 males or 500 breeding birds could not be ranked higher than a C2.

Comment: The COT used the 200 males or 500 breeding bird interchangeably throughout the document and Table 2. This usage suggests that somehow the two numbers are related (i.e., if one counts 200 males – on leks - you have at least 500 breeding birds). I am not aware of any studies that establish a standardized range-wide conversion factor. Although, there are acknowledged problems with using lek counts to determine population trends, the use of 500 breeding birds may be more problematic. I recommend any reference to or use of 500 breeding birds in Table 2 and the use of any population levels as baselines in Appendix B either be deleted from the COT or the authors clarify how these estimates should be extrapolated from lek count data.

Question 3. Do the COT authors draw reasonable conclusions based on the scientific information?

Comment: One of the items I was looking for in the COT was some type of summary statement or overall conclusion of the authors regarding their perspective of the conservation status of greater sage-grouse if the COT recommendations were implemented range-wide. In Appendix B, the COT authors summarize the threats by management zone, but fail to describe how the COT may "turn the tide" and stop the declines. Similarly, in Table 2 the authors offer a thorough review of the threats and population persistence based on Garton et al. 2011. However, what seems to missing is an analysis of how, if the threats are addressed, this might alter the persistence probabilities. This may beyond the scope of the COT, but I encourage the authors to at least consider providing one example of this type of analysis as an Appendix.

The only attempt at providing a summary statement can be found in line 618 of the document which is provided below.

Line 618 – Use of adaptive management principles

"Based on the threat analyses and the uncertainties of successful restoration, the COT has concluded that all PACs be managed for conservation to the **maximum extent practicable** in order to enhance management flexibility and adaptive management principles for the long-term conservation of the sage-grouse.

Comment: This statement essentially tells the reader to do everything you can and hold on for the ride, and just maybe we can realize long-term species conservation. Throughout the COT, the authors emphasize the need to protecting the best habitats because of the prohibitive costs of restoration. One scenario to consider would be the species conservation impact and costs savings accrued if 20% of the highest priority PACs could be protected by conservation easements as opposed to restoring the same habitat base. Subsequently, what impact would this action have on population persistence probabilities? Additionally, how would a range-wide moratorium on any sagebrush treatment in a PAC affect population persistence? These are actions within the regulatory authority of state and federal agencies.

The authors cite the need for management flexibility and the role of adaptive management principles in long-term species conservation. Adaptive management has largely become a default mechanism for resources decision-making under uncertainty. Adaptive management is linked to pre-determined temporal and spatial scales and retains a focus on statistical power and control. It requires the use of computer models to build synthesis and an embodied ecological consensus to evaluate strategic alternatives. These alternatives are then communicated to the political arena for negotiation of a selection. Unfortunately, adaptive management often requires data collecting and reporting which may be beyond the scope and duties of the contemporary wildlife manager.

I suggest the authors replace adaptive management with objective-based management. Under this approach, stakeholders define and agree on site-specific objectives and develop a plan needed to accomplish them. It includes the participative goal setting, choosing course of actions, and decision making inherently practiced in local sage-grouse working groups. Participants understand their roles and responsibilities and how activities relate to the achieving the specific objective (i.e., protecting x acres through conservation easements). Objective-based management places an importance on fulfilling the personal needs of stakeholders by involving them in the entire discovery process – problem identification, research question and design, funding for management, communications, and education. Objective-based management increases stakeholder satisfaction and commitment, facilitates trust, and commitment to objectives.

Line 631 - Fragmentation

"Other areas within the range of sage-grouse have a high uncertainty for continued population persistence (Wisdom *et al.* 2011) due to fragmentation from anthropogenic impacts."

Comment: The authors should define the use of the term fragmentation. Some habitats exhibit a high degree of "natural fragmentation" and yet sage-grouse populations continue to persist.

Fragmentation relative to anthropogenic impacts include accompanying disturbances such as increased human presence, associated noise, subsidizing predators, etc. See Fahrig, L. 2003. Effect of Fragmentation on Biodiversity. Annual Review of Ecology and Evolution Systems. 34:487-515.

Line 681 PAC restoration

"across the sage-grouse range, greatly increasing the risk of local extirpation and reducing management options, including restoration. If PACs are lost, the COT recommends that appropriate restoration efforts be implemented. If restoration is not possible, then efforts should be made to restore the components lost within the PAC (e.g., redundancy or representation) in other PACs or non-PAC habitats such that there is no net loss of sage-grouse or their habitats. However retention of PACs should be priority over replacement."

Comment: Given increasing effects of climate change, restoration may be prohibitive – stress protection of the best of the best areas that demonstrate the greatest potential for resistance and resilience.

Line 695 - New information

"PACs should be adjusted based on new information regarding habitat suitability and refined mapping techniques, new genetic connectivity information, and new or updated information on seasonal range delineation. By maintaining 'living' maps of the habitat areas necessary to provide redundancy and representation, threat amelioration plans can be more accurately implemented, or modified if appropriate."

Comment: This action should be retained as a major premise of the COT. The USFWS must not adopt Figure 1 as the baseline for PACs.

Question 4. Does the COT Report base its interpretations, analyses and conclusion based on the best available science?

Comment: The COT authors are conversant and knowledgeable of the greater sage-grouse scientific literature. Thus, the report interpretations, analyses, and conclusions are well supported by the best available science.

Question 5. Are there any significant peer-reviewed scientific papers that the COT Report omits from consideration that would enhance the scientific quality of the document?

Comment: I have included some other paper citations under the various sections that may enhance the scientific quality of the COT Report. The authors cite Taylor et al. 2012 (see below) when describing the factors affecting the viability of greater sage-grouse in the Powder River Basin (Appendix B).

Taylor, R.T., D.E. Naugle, and L.S. Mills. 2012. Viability analysis for the conservation of sage-grouse populations: Buffalo Field Office, Wyoming. Final Report. 27 February 2012. Prepared for the BLM. 46 pp.

The authors have recently published a range-wide sensitivity analysis that incorporates demographic data from 50 sage-grouse studies. The citation is:

Taylor, R. L., B. L. Walker, D. E. Naugle, and L.S. Mills. 2011. Managing multiple vital rates to maximize greater sage-grouse population growth. Journal of Wildlife Management 76:336-347.

Question 6. Is the scientific foundation of the COT Report reasonable and how can it be strengthened?

Comment: The scientific foundation of the COT Report is reasonable. I do believe the application of the COT Report could be enhanced if the authors considered developing and providing some specific examples of how the probabilities of PAC population persistence may change if a specific suite of conservation practices were implemented. These types of modeling exercises would breathe life in to the COT Report. See comments under line 618 above.

Table 2. Specific comments

Table 1 in the COT report provides population persistence value for combined greater sage-grouse management units along with a designation of threat levels. In several cases, I argue the assigned values and threat designation require further consideration.

For example on page 21, the Parker Mt. unit is combined with Panguitch and the Bald Hill units for Utah. Long-term data on vital rates and lek data from the Parker Mt. unit (Dahlgren 2009, Guttery 2011) clearly indicate the population lambda exceeds 1. This is a robust population which has been identified as a distinct Utah PAC. The major management consideration in this unit is to sustain periodic treatments to enhance later brood-rearing habitats. Because it is a high elevation plateau, the threat of invasive weeds and conifers are non-existent. Thus risk level for the Parker Mt. should be changed to C4.

REVIEWER 2:

The Report is generally well-written, uses adequate scientific literature and presents considerable information on threats to sage-grouse and their relative strengths in a non-quantitative manner. Use of the results of Garton et al. (2011) for probabilities of population persistence at specific population levels is solidly based in strong science. The ranked threats for each PAC can be incorporated into more local plans that seek to ameliorate the more critical threats which is a strong aspect of the Report. However, the Report provides little to suggest concrete actions to ameliorate specific threats. The Report is partially successful in meeting its goals. Specific points to improve the document will be detailed in this review.

Line 82-84: This is a landscape level look at the issues so it will lack details. This is fine but limits usefulness of the Report.

Line 158: Aldridge et al. 2008 is not in the literature cited.

Line 215: While the concepts of redundancy and representation are useful in the conservation framework and are possible to quantify (hence are mentioned often in the Report), resiliency is a bit less focused. Resiliency is "defined as the ability of the species to recover from periodic disturbance." While conceptually correct, how can this be evaluated and measured? Is it quantifiable other than through observations that a population has fluctuated around a central size over time? Could the degree of density dependence be a measure of this for each PAC? A population exhibiting strong density dependence would be more resilient than one only weakly density dependent. I believe that Garton et al. (2011) actually estimated density dependence for the overall population of sage-grouse, so is this what the authors are suggesting be done for each PAC? To my knowledge this analysis has not been conducted for any PAC. What percentage reduction in a population is expected to result in that population bouncing back if the population is said to be resilient? What % reduction is considered too large for a resilient population to recover? How does habitat condition influence resiliency? Is there a time element (number of years to recover) to the concept that is not being used in the Report? Analysis of density dependence might shed light on the time period needed for recovery to pre-disturbance population levels. What is really being added to the central questions and goals of the Report by inclusion of this concept?

Line 221: Resistance is the "ability of a population or habitats to withstand a threat without experiencing negative consequences…." While conceptually interesting, how is this to be evaluated? How is it to be measured or quantified? Are there characteristics of a species (r-selected? broad niche width? occupancy in a remote habitat? wide food habits?) that make it likely to be resistant? Are sage-grouse considered to be a resistant species relative to other species? Are there characteristics of a habitat that might do the same for the species and/or the habitat? How does the concept really help managers and biologists with respect to specific populations and habitats of sage-grouse and aid the USFWS in the listing decision given that it is not quantifiable at this time?

Line 224: Resistance of the population depends on the health of the population and associated habitats and severity of the threat. What is health in this case? Large population size is implied. Is the population resistant if it is declining but still large? Small but stable? I wish the concept

were more fully developed in a more applicable manner so that managers could apply it in a more rigorous way.

Line 374: no need to italicize "and"

Line 389: delete the comma after 'by'

Line 350: Sage-Grouse Status and Threats: Resistance and Resiliency – generally there is very little in here about resistance and resiliency – perhaps these should be included in a separate section and/or de-emphasized in the Report.

Line 432: add "of" between population southwestern

Line 441: correct word is spelled synanthropic

Line 409-415: The entire section does a fine job of reviewing the threats but does not indicate how resistance and resiliency are used in the Report. For example, on line 431-435 the North Dakota population is described as having declined in 2008 and then undergone partial recovery by 2012. In the section on the Dakotas population (lines 1295-1310) there is no mention of resistance or resiliency. Is it assumed that a C1 population is not resistant or resilient? Is 4 years not enough time to assess this? The fuzzy nature of a useful way to apply these concepts to the real world may not be adding clarity.

Line 448-464: Both concepts of resistance and resiliency of a species/population have a habitat component (see the definitions above). In this section on habitat restoration the words resistance and resiliency are not used. Why is that? The COT Report is correct when it states that very little sagebrush remains undisturbed or unaltered from its pre-European settlement period, and that restoration of disturbed areas is very difficult. Are habitats not being considered as resistant or resilient in the Report? Are there any resistant and/or resilient habitats left for sage-grouse? If not, what does this suggest about the resistant or resilient nature of the populations that remain? How can habitat resiliency be measured? I think the concepts have real value that has not been explored well in the Report.

The link between sage-grouse populations and habitats could be more forcefully presented in this section. Sage-grouse populations are likely no more resistant or resilient than their habitats (or even specific seasonal habitats). The bird is not likely to adapt to significant changes in its habitat, nor evolve to occupy other habitats regardless of how much of its genetic variability is conserved. Habitat must be the central focus of conservation efforts for the species.

Line 488-489: confused wording.

Line 492-496: How is scope evaluated? Was this based on breeding populations at leks? If so, this is a very small physical area but a major disturbance on the leks could impact >60% of the total population, or was scope largely based on % of the PAC area? More info on this would be worthwhile.

Line 506: A=moderate, imminent threat. I assume that severe in this case means high severity but this is not clear. Imminent must be high immediacy. Correct? Use of terms should be consistent.

Perhaps a simple table might be useful for these A through U rank value categories.

	Severity	Scope	Immediacy
A =	a or b	a	a
B =	a or b	b	a
C =	a or b	a	c
D =	Etc.		

Line 530: The term "habitat condition" is used. What is meant by this and how was it assessed – literature for an area or expert opinion? Most descriptions in Appendix B are based on Garton et al. (2011) and expert opinion by COT members with a small dose of additional literature. This should be stated explicitly.

Line 547-548: Good point.

Line 581: add "in" between "occurs Management".

Lines 575-586: The resiliency point here is confusing. It sounds like C3 and C4 populations are resilient because of their status, that is, their population size and geographic size. Line 606-609 reinforces this idea. Which comes first – it seems like resiliency is a consequence of large population size and geographic area, not the reverse.

I examined the PACs in Appendix B for some mention of resiliency. Those PACs where the word resilient or resiliency was used included only 14 PACs: Eagle-South-Routt, Rich-Morgan-Summit, North Park, Northwest Colorado, Sheeprock, Bald Hills, Nevada, Ibapah, Baker, Central Oregon, Klamath, Western Great Basin, Yakima Training Center, and Parachute-Piceance Roan. Five of these have risk levels of C1, 3 are C2, 3 are C3, and 2 are C4. I don't see a pattern of how the concept is being applied to PACs in any risk category or across the PACs. The term is not used in the written description of the other 35 PACs. The Report makes a major point of trying to include the concept of resilience but applies it only sparingly to the PACs. Why is the concept not applied to more than 14 PACs? Is not enough known about the populations in the 35 PACs? I doubt this is the case, so can this lack of use or selective use of resilience be more fully explained?

The review will now address issues with items in Table 2. While overall this is a well done component of the Report, there are several PACs that seem to be labeled in an inconsistent manner.

Table 2, page 17: The values in the purple for Management Zone 1 - 9.5 (5.9) 11.1 (5.8) etc are not explained. The table should stand alone as an understandable entity so please explain those values in a footnote to keep the reader from having to seek out Garton et al. (2011) for understanding.

Table 2, page 19: North Park (WY Basin in CO). Risk level is C4. With widespread sagebrush eradication (F), moderate and imminent energy development (B), moderate and imminent infrastructure (B), moderate and imminent urbanization (B), all in a small area where 29% of the

land is leased for energy development, it seems like a C4 is too optimistic. For example, the Yellowstone Watershed has fewer risks and is a C3. Perhaps the risk level for North Park should be reconsidered.

Table 2, page 20: Emery. Risk level is C2. Why not C1? The probabilities in the table are very high, 77.7%, 100%, 99.2% and 100%, 30 males (line 1649) is the population of males, 4 threats are moderate and imminent (B), the population is smaller than Jackson Hole with a C2 risk, and there are 3 times more birds in Eagle-South-Routt with only 3 threats which are moderate and imminent (B) with a C1 risk level. Perhaps this PAC risk level should be reconsidered.

Line 635-637: "The conservation strategies identified below are targeted at threat amelioration through adequate regulatory mechanisms …" but in lines 416-426 "…regulatory mechanisms are not addressed in this report…". The sentence continues as …"and proactive conservation actions, thereby addressing the conservation parameters of resistance and resiliency." However, these last 2 parameters were not really addressed for the large majority of the PACs. Resistance was mentioned very little in any section of the Report. The reader assumes that these 2 parameters, resistance and resiliency, will improve for each population if factors impacting habitat loss and fragmentation are removed. The reality of this claim, while theoretical, has been neither demonstrated nor evaluated in the Report or in any literature cited therein. Perhaps returning to a habitat and population based evaluation and focus would be more fruitful in threat evaluation and amelioration.

Line 649-654: "The COT wanted to identify ways to incorporate a fourth parameter, resistance, which would indicate that populations and habitats are healthy and robust even in the presence of threats." This was not done in the Report. Basically, if a population is numerous and its habitat is in good condition, it will be assessed as resistant. Why not just assess the population size and the habitat – then conclude that the population is likely to be resistant or not. Since resistance cannot be measured independently of these two, why add another layer of theoretical complexity? Why continue to mention resistance and resiliency in the text of the Report when there is little, if any, evidence for either concept described for any population discussed in the Report?

Line 671-673: This statement is not a biological idea but an opinion on a political and economic topic. Delete it.

Line 683-686: What are the appropriate restoration efforts mentioned here? Is there any history of success doing this if a PAC has been lost? Translocations of sage-grouse are notoriously difficult (papers by Baxter et al. 2008. Journal of Wildlife Management 72:179-186 and references therein) with a very limited range of successes. Why would the Report suggest that restoration of a PAC is anything but remotely possible?

Line 704-706: The long-term conservation goal is clear and includes two strategies to succeed – threat amelioration and restoration. We reviewers were "not required to provide a review of how the conservation objectives will be met." (the quote is from Attachment A: Scope of Services, second page under item 3). I assume that another group at another time in another forum will do this, otherwise the species will remain in peril.

Line 710: regulatory – add the "y"

Line 709-727: The 3 overall conservation objectives can be summarized as no more degradation or loss of populations and habitats; beneficial, active habitat management where needed; and engaging all stakeholders to buy into and support the first 2 objectives. If all this is successful, chances are the species will be well-distributed, vital and connected in multiple populations across its range. Is there any level of confidence among the authors of the Report that these are achievable?

Line 744-745: Avoiding impacts to habitats is essential. The 4 uncertainties are well phrased and are not likely to be resolved in the near future if at all (with the exception of the first – range-wide genetics). Avoiding impacts must be a central objective of the Report, minimization and mitigation must be viewed as second best in efforts to keep the bird from being listed.

Line 759-763: The "appropriate level of continued management" implies that management actions are currently underway in an appropriate manner. In many PACs adequate management is not being implemented. COT should be urging for enhanced, improved and additional management actions because the "continued" is not adequate as is across most of the species range.

Line 763-780: To maximize resiliency and move towards resistance is conceptually logical. Any idea how to do this in a quantitative way? Other than management that results in a larger population in a good habitat, how will we know if this general conservation strategy is successful? The idea of moving PACs to less threatened status and not spending all resources on just the C1 and C2 PACs is the correct approach. How to do this still remains a central question.

Line 781-783: All stakeholders working cooperatively is a worthwhile strategy. Implementation and costs?

Line 789-791: Is this funding to monitor the development and implementation of the threat amelioration plans or for monitoring of the species populations which will be needed to help assess the success of the plans? Not clear to me. Having plans is great but meaningless unless there is assessment of the results of the plans, which should be increased numbers of birds (or stable numbers) and better or stable habitats.

Line 792-794: Very good point but the COT must realize that any new research (unless analysis of existing data) will not be completed in time to help inform the listing decision due in 9 months, and minimally useful for the one due in 2015. However, such research will be important in assisting with management decisions in the future regardless of the outcome of the listing decisions.

Line 800-802: This is a good idea, especially the idea that these efforts will continue into the future.

Line 807-808: Is there anything in the Report that will actually influence the Bi-State DPS listing decision due in a mere 9 months? These short-term recommendations are really only applicable to the January 2015 decision, a timeframe 28 months in the future.

Line 810-815: I understand that plans are underway in each state and I assume also by each federal agency. The COT should strongly support, within the plans being developed, "clear mechanisms for ameliorating the threats" in a manner that also stresses quantifiable, data-driven,

evaluations of the success of the mechanisms. These are needed for an adaptive management approach to management of the species and its habitat.

Line 816-821: These are very difficult to do and to quantify but useful to consider.

Strategies 3-5 are fine. Line 839-842 is vital. Restoration activities must be monitored quantitatively through a scientific monitoring approach, not through a "windshield biology" method sometimes conducted by agencies with limited funding and minimal staff. Otherwise the effectiveness of the methods and the results of the methods will be challenged and any contributions towards actual restoration negated or minimized.

Line 858: better to change "temporarily ameliorate threats until" to "temporarily ameliorated until"

Line 864-865: Good point. A monitoring plan that is actually implemented cannot be overstated as essential.

Line 866-873: These strategies all revolve around funding (as they all do to a point). Line 873: "Continue funding and support for existing efforts" should include the idea of support for new efforts as well.

Conclusions: I consider if the Report has met the 6 items suggested in the Attachment A: Scope of Work.

1. "Identify the long-term conservation objectives that are needed to ensure that sage-grouse will persist." In a very general way the Report does this through the 3 objectives listed in lines 708-727. The weakness in these 3 is their generality and lack of specifics.

2. The COT was tasked to identify quantified long-term conservation objectives for sage-grouse. No heading in the Report was termed "Long-term Conservation Objectives" but there were General Conservation Strategies (lines 729-803) and later there were "Long-term Recommendations" (lines 876-890). Earlier comments in this review addressed these. Here the emphasis is on the concept of "quantified" objectives. If quantified is potentially limited to moving PACs from high risk to lower risk levels (C1 to C2, C3 to C4) then this is minimally met. However, in all other aspects of the Report this very difficult task of the COT fails to be accomplished.

3. The Report is to inform the species status review. The Report does this with respect to PACs, review of the Garton et al. (2011) probabilities of persistence in an easily understood format, and through prioritizing threats to each PAC. This is the strongest component of the Report.

4. The Report is to outline the necessary conservation actions to ensure the long-term persistence of healthy sage-grouse for the future. In a very general way the Report does this but provides no roadmap or directions for accomplishing this.

5. The Report may form the basis of conservation decisions and actions for sage-grouse by agencies and organizations. Agencies and organizations may be able to use the threats and their priorities for developing actions plans for specific PACs.

6. The Report synthesized the existing threats. Yes, it did this in a general way as displayed in Table 2.

To end: The Report uses science in its presentation of the general biology and status of the species. It relies largely on the Garton et al. (2011) publication supplemented with limited literature specific to individual PACs and "expert opinion" to derive the threat prioritization and Risk Level (C1-C4). This is the strongest part of the Report. Inclusion of resiliency and resistance provides little substantive information and may, in some ways, actually detract from the focus on improved habitat conditions and bird population sizes, the ultimate goals of the agencies and organizations working to prevent a listing. The long-term conservation objectives are necessary for success as the Report recommends, yet there are no specifics on how to achieve success. Early in the Report (lines 70-73) the COT was to define "the degree to which the threats need to be ameliorated to conserve the sage-grouse so that it is no longer in danger of extinction….". There is nothing in the Report that evaluates the degree to which threats need to be ameliorated to maintain the species. There are no comments for any population that states that Threat A must be reduced by 50% and Threat B by 20% to reach a point where the population is "no longer in danger". Perhaps this is simply not possible in such a Report, but it is needed for a defined plan to ensure continued populations of the species.

REVIEWER 3:

This report represents a ton of hard work by multiple individuals – the task that was undertaken was very difficult and I applaud the COT their efforts. A focus in several areas of the report on the importance of monitoring and adaptive management in my opinion cannot be over-emphasized when implementing proactive habitat treatments. I also agree with a focus across the range of the species instead of towards "high risk" populations. Finally, the focus on directed research I think critical, especially given the lack of knowledge on issues such as effective habitat restoration/management, population response to renewable energy development, a lack of management action in areas where expansion of invasive annual grasses is occurring, etc. The report is generally well written and flows well. Below I focus my review on overriding thoughts pertaining to the approach and focus of the report. I conclude with my thoughts on the 6 questions posed in Attachment A: Scope of Services.

General Comments:

1. In my opinion the methods used to establish risk status of each population (C1-C4) should be more structured. As a suggestion: initially define what is meant by each factor considered (i.e., those factors listed on the right-hand side of Table 2), and use the "open forum deliberation" (lines 552-562) process to establish the levels considered for Severity, Scope and Immediacy for each of these factors for each population. As these discussions are taking place, define what the COT considers the level for each (e.g., energy development currently impacts X% of the area important for this population, and X% of the non-developed area is leased; this level of impact and potential impact results in Severity, Scope and Immediacy values of X for the "Energy" factor for this population – in this way consistency of evaluation across populations can be established/checked *post hoc*). The establishment of threat ranking (the A through U designation) and the risk level assignment (C1 through C4) should then be established in a systematic manner across factors and populations (respectively) based on repeatable "formulas" or processes. These formulas or processes should be defended (i.e., establish in Appendix B the information considered to reach Severity, Scope and Immediacy values) and transparent (i.e., explicitly described in report).

For example: on the first page of Table 2 there appears to be little difference in the assessment of the Dakotas population and the Yellowstone Watershed population. Neither population is less than 200 males, and probability of decline past thresholds (at least to the 500 bird threshold) are essentially the same. In terms of risk factors assessed, the Dakotas are isolated and have higher infrastructure risk while the Yellowstone Watershed has a higher agriculture conversion risk – other values across the list of factors are basically the same. Yet the Dakotas are high risk (C1) whereas the Yellowstone Watershed is relatively secure (C3). How was this difference between the populations established? What are the resistance/resiliency issues associated with each population that led the COT to their final risk level assignment? Although I do not disagree the ranking of the 2 populations, the difference in risk rank should be obvious from the methods employed and the reader should be able to follow the COT's logic in establishing the level of risk.

The COT may consider including "resiliency" and "resistance" in the assessment and definitions of Severity, Scope and Immediacy (e.g., establish the level of each in terms of resiliency/resistance instead of or in addition to the time/percent approach employed). As the

report is written, the in-depth discussion of resistance and resiliency was essentially a review of activities that may negatively influence a population. Resistance/resiliency, although alluded to as the conclusion derived from the threat assessment, were never actually quantified. What does the COT consider a resistant/resilient population and why? The COT concluded redundancy and representation were adequately captured at range-wide scales (lines 313-315). Therefore, the COT focuses management of the species towards implementing activities that increase the resistance/resiliency of a population (i.e., moving a population from C1 to C2, C2 to C3, etc. requires increasing resistance/resilience of the population). Give those that will use/implement this report an idea of what they are striving for from a management perspective by explicitly establishing what the COT considers a resistant/resilient population across risk factors.

2. I recognize (and agree) that this report is not the correct forum for specifics in terms of actions to implement by population, but are there not some specifics that need to be addressed at range-wide spatial scales? As examples: Do the PACs as developed incorporate all seasonal habitats required by sage-grouse (Doherty et al. methods are lek-centric; see Fedy et al. 2012 [Journal of Wildlife Management 76:1062-1071] and Wyoming's core areas)? Which C1 populations are especially important to maintaining redundancy and representation at the range-wide scale (e.g., does the COT think that E-Central ID may be important for connectivity between Beaverhead and WY basin)? Are there areas to concentrate restoration for the benefit of connectivity (e.g., expand the UT example)? What is the effectiveness of current regulatory actions for some of the factors investigated in Table 2 (e.g., core area management strategy in WY) and does the COT recommend a similar approaches (i.e., reduced surface disturbance) be employed elsewhere? etc.

3. Although I completely agree that sagebrush habitat restoration is not well understood, difficult and expensive (lines 448-464 in addition to other references throughout report), emphasizing this in the report may result in managers not addressing the issue (i.e., result in a "what can we do" sort of reaction leading to no action). Invasive annuals need to be proactively managed especially in areas where these species are currently becoming widespread and may become more widespread due to climate change (much of MZ II in particular). Preventing the spread of invasive annuals is critical for conservation of sage-grouse in many areas and in my opinion should be as emphasized in this report as the difficulty and expense of restoration.

4. The focus on habitat loss and fragmentation in the report – although I agree are essential to "stop the bleeding" as indicated – discounts the potential importance of the effects of habitat degradation on populations. In my opinion it is a mistake to focus on managing anthropogenic activities at the expense of researching and implementing actions to improve the quality of sagebrush ecosystems. Improving quality may be the single best way to address resistance/resiliency of sage-grouse populations across much of the species' range, as well as a potential means of managing the expansion of invasive annuals.

5. The purpose/objective of the report as established in the report was as follows: develop conservation objectives by defining the degree to which threats need to be ameliorated to conserve sage-grouse (lines 70-72) by providing a conservation framework for local efforts (lines 93-94). The "degree to which threats need to be ameliorated" was not established in the report. Additionally, the conservation framework established was essentially to implement regulatory actions at the local level that reduce population risk (starting on line 703). According to Stiver (2011; Studies in Avian Biology no. 38), over 60 local sage-grouse conservation plans have been

developed – and in many instances implemented – across much of the species' range. How do the recommendations by the COT change these efforts? Has implementation of any of the locally-developed plans succeeded in increasing populations/habitats? For the plans that have not succeeded, where did these groups fail and how could the information provided in the report be used to increase probability of success? I agree that this report should not provide specifics in terms of actions to implement at the population level, but given that the recommendation by the COT of developing and implementing local conservation plans to stem population/habitat declines (which is generally the goal of any conservation effort) has been and is being pursued, should not the success of that framework be assessed prior to recommendation?

6. Given the short window for the Bi-state DPS listing decision (lines 51-52), it might be worth developing some specific conservation goals/actions that if implemented (or at least on the road to implementation) would satisfy the COT.

Specific Comments:

Line 115: fidelity to seasonal habitats limits movement of individuals from impacted habitats, not sure the connection to adaptability (i.e., is movement from an impact the only form of "adaption"?).

Line 158: Aldridge et al. 2008 not in lit cited.

Lines 171-182: Leu and Hanser (2011; Studies in Avian Biology no. 38) have an interesting take on spatial scales required based on sage-grouse adaption to a scale of natural fragmentation in sagebrush habitats.

Lines 222-223: The immune system analogy not really comparable (e.g., withstand vs. respond).

Lines 252-253: The "charge" of the COT was "to define the degree to which threats need to be ameliorated to ensure long-term conservation of sage-grouse across its range." Degrees were not defined in the report.

Lines 313-315: This establishes that management within PACs focus on increasing resilience/resistance of populations.

Line 357: Not sure these are mechanisms – what is the reason for reduced lek persistence, lek attendance, etc. Also, the literature cited here is all gas related – there are other fragmentation activities resulting in reduced lek persistence and attendance (in particular) – most outlined in chapters in SAB no. 38.

Line 396: Probably presumptive to say "similar effects"; concluding that there will probably be negative effects that I think can be supported by multiple literature sources indicating similar responses of populations to different anthropogenic activities (e.g., conventional gas, CBM, oil, I-80 [SG Conservation Assessment], and coal).

Line 473: There are no "range-wide PACs" – probably need a comma.

Table 2 White Mountains (CA, NV) population: Populations with <200 males cannot have a higher risk value than C2?

Lines 608-609: How does the loss of management options influence population resiliency?

Lines 671-673: Is this statement relevant or pertinent in the document?

Line 719: In several instances the report focuses on the fact that techniques to effectively restore habitats are essentially unknown and prohibitively expensive, yet one of the overriding objectives of this plan is to restore habitats. How does the COT think this effort should move forward (e.g., where should research focus)?

Lines 853-855: Adaptive management should always be implemented.

Line 858: Something wrong with wording.

Line 861: delete "with."

Line 1045: Wrong citation – Holloran, M. J., and S. H. Anderson. 2004. Greater sage-grouse seasonal habitat selection and survival in Jackson Hole, Wyoming. Job Completion Report, Wyoming Game and Fish Department, Cheyenne, WY, USA.

The following questions were outlined specifically in the Scope of Services:

1. Are the methods and assumptions used in deriving conservation objectives for the sage-grouse clearly stated and logical?

I could not recreate the results established in Table 2 given the information presented in the report. As mentioned previously (general comment 1), I think a structured approach necessary from open forum deliberation to risk level assignment. Elaboration in Appendix B as to the information used and assumptions made to generate values for Severity, Scope and Immediacy by factor and by population would increase transparency.

2. Are the results presented in the COT Report reasonable?

The results appear reasonable (i.e., there were no populations that were "obviously" ranked incorrectly in Table 2/Figure 2). However, not enough information was presented to assess threat ranking by impact factor (A through U designations).

3. Do the authors of the COT Report draw reasonable and scientifically sound conclusions from the scientific information presented in the COT Report?

Cited literature was not misinterpreted.

4. Does the COT Report base its interpretations, analyses and conclusions upon the best available science?

The literature presented in the report included the most up-to-date information. A better explanation of how that science was used to establish risk is needed. As Appendix B reads, the decisions (e.g., analyses) appeared to rely heavily upon expert opinion and Garton et al. 2011.

5. Are there any significant peer-reviewed scientific papers that the COT Report omits from consideration that would enhance the scientific quality of the document?

Not that I know of.

6. Is the scientific foundation of the COT Report reasonable and how can it be strengthened?

See General Comments 1, 3 and 4.

REVIEWER 4:

I understand that the COT had a difficult task, attempting to balance political and economic pressures against the conservation needs of sage-grouse, under the cloud of a potential listing decision, all with a substantial ignorance of the actual mechanisms driving much of the decline. We can certainly identify negative influences in some circumstances (e.g. oil and gas in Wyoming) but I contend that our understanding of more diffuse impacts (e.g, livestock, predation) are still mostly in a state of untested hypotheses.

Generally, I applaud the call for more research. I believe we are limited in prioritizing conservation actions in many cases by our lack of a clear understanding of mechanisms linking potential impacts to the dynamics of sage-grouse populations. Along these lines, I would caution that traditional genetic approaches to assessing connectedness among populations are unlikely to be adequate to assess demographic connectedness. Dispersal rates adequate to maintain panmictic populations are well below those that are demographically important.

The need for more research, of course, should not delay moving forward with our best guess about appropriate action. We should recognize, however, that some efforts will be less efficient or less successful than we might want because of our ignorance.

Generally, the PAC approach may be successful across much of the range of sage-grouse. I am skeptical, however, that this approach will be successful in the west, where important threats include fire, invasion by exotic grasses and potential influences of nonnative ungulates. State and federal agencies have been largely unsuccessful in addressing these impacts to date, and I haven't seen evidence that resources will be adequate to do so in the future. Thus, while PACs are necessary for conservation of sage-grouse, establishment of PACs should not be viewed as sufficient by themselves.

More detailed comments:

Lines 179-181. Variation among sage-grouse populations in the extent of seasonal movements is a continuum and the distinction between migratory and non-migratory populations is arbitrary and not particularly descriptive. I suggest abandoning this terminology.

Lines 188-189. Sage-grouse are still abundant and broadly distributed, albeit less than historically.

Lines 190-193. It seems awkward to say that "causes remain on the landscape...". I suggest rewording.

Lines 209-237. I don't find the use of the terms redundancy, resiliency, representation or resistance especially helpful. In fact, these terms to some extent obscure the relationships we are really interested in, which include the relationships between habitat features, disturbance, etc. and demography and population dynamics.

Lines 269-276. This text doesn't make much sense as written. I think I understand what the authors are trying to say but I don't think they have actually said it. This text, to some extent, represents the fuzziness produced by use of the "conservation biology" terms.

Lines 324-334. To some extent this text seems inconsistent with earlier text indicating that not all sage-grouse would be conserved. It also seems that peripheral populations are most likely to be in marginal habitat and certainly are less well connected (on average) to other populations. Either factor is likely to make these populations more vulnerable to extirpation, which should be recognized in a conservation plan.

Lines 357-361. These aren't really mechanisms but the result of mechanisms. For example, increased predation as a result of fragmentation would be a mechanism explaining lower nest success in fragmented landscapes.

Lines 369-384. Emphasis on fire in the western portion of the range is important; 700,000 acres have burned in Nevada this year alone.

Lines 384-390. Tom Whitham believes that much of conifer expansion is associated with the fact that 1950-2000 were the wettest 50 years in the west in the last 2000 years.

Lines 393-399. I'm not sure we can extrapolate from nonrenewable to renewable energy at present. We should report preliminary results from current wind energy impact studies. Additionally, will the footprint of renewable projects be comparable to footprints of oil and gas developments?

Lines 411-415. One shortcoming so far is the lack of a description of seasonal habitats required by sage-grouse. Some of these, e.g. late brood-rearing habitat, may not actually be sagebrush habitat. A description of these seasonal habitats and the ability of PACs, as defined, to include these seasonal habitats, seem important. I realize this will not be possible for the entire range but what do we know about the ability of the proposed PAC approach to include all seasonal habitats, where the data exist to do an assessment?

Lines 442-443. I believe the statement "the most effective method to mitigate the effects of predation is to maintain quality habitat with good connectivity" is speculation without any empirical basis. That doesn't mean I don't believe habitat management isn't important or that predators are the cause of population decline; I don't believe we have the data.

Line 473. I believe a comma should follow "Range-wide"; are there range-wide PACs?

Table 2. I suggest that risk levels in the southern and western Great Basins may be optimistic. Lek counts are declining in both areas. Mining is expanding rapidly in the southern (and northern) Great Basin. While mine footprints are limited, so is late brood-rearing habitat and in some cases the two coincide. Atamian et al. (2010) estimated that late brood habitat represented < 3% of the landscape. Additionally this area is severely impacted by drought. Hundreds of thousands of acres have burned in the western Great Basin and may have already extirpated some local populations in California.

Lines 611-621. I would add here that direct relationships between specific habitat characteristics and demographic parameters or population change (λ) are either very limited or lacking entirely. This severely limits our ability to predict the response of sage-grouse populations to changes in their habitats.

Lines 684-686. Is it really possible to replace components lost in one PAC by management action in another PAC? This doesn't seem likely to me and I wonder whether this language should be included in the COT.

Lines 715-721. I haven't seen many examples of large-scale habitat restoration in sagebrush habitats. I suppose it's OK to have this as an objective but the states and federal government need to be realistic about the cost.

Lines 730-743. I would add to this list a lack of understanding of the effects on sage-grouse of most of the potential risks (grazing, predation, hunting, renewable energy, transmission lines, etc.). I would rank ignorance of genetics-based connectivity analyses well below the lack of understanding of demographic response to widespread threats.

Lines 744-752. These objectives will be difficult to accomplish, given my previous statement.

Lines 772-780. This was already supposed to have been done with respect to wildfire in the western Great Basin. The current fire season is pretty clear evidence that the effort was unsuccessful.

Line 789. I agree that monitoring of activities is critical. However, adaptive management has a technical meaning that is not likely to be fulfilled in most sage-grouse conservation. I suggest dropping "adaptive management". I concur that adequate funding is needed to monitor conservation activities.

Lines 792-794. This is essential. We have a poor empirical basis for understanding most potential impacts on sage-grouse.

Lines 795-803. I concur that adequate funding for voluntary conservation activities is important. It is also important that adequate funding is provided to land management agencies. Rehabilitation of fires in the western part of the range over the past decade will require several tens of millions of dollars.

Line 858. Should read "at least temporarily ameliorated until such time as…".

Line 861. Delete "with".

Lines 866-869. This was supposed to have already been done in Nevada and California; the current fire season indicates that it either wasn't done or wasn't effective.

Lines 807-873. I hate to be cynical and I understand the COT was tasked with an impossible job but I just do not find the list of short-term recommendations convincing. Most of this stuff was identified as important more than a decade ago. Nevada has had a conservation plan on the books since 2004. None of the conservation initiatives were funded (including aggressive rehabilitation of the millions of acres of sagebrush that burned), BLM has been slow to adopt any restrictions on mining, renewable energy development, no research exists on grazing or other important impacts, etc., etc. The threat of listing has hung over the state the entire time. Why should we expect a different outcome this time?

Responses to Six Questions:

1. Are the methods and assumptions used in deriving conservation objectives for the sage-grouse clearly stated and logical? If not, please identify the specific methods and assumptions that are unclear or illogical.

I assume this question addresses use of redundancy, resiliency and representation in establishing conservation objectives. I don't find use of this approach to be especially useful as it introduces a set of relatively ambiguously defined concepts that are not necessarily tied directly to targets of potential management actions. I generally concur with the overall conservation objective developed by WAFWA, "to produce and maintain neutral or positive trends in populations and 627 maintain or increase the distribution of sage-grouse in each Management Zone."

2. Are the results presented in the COT Report reasonable? If not, please identify those that are not and the specifics of each situation.

I'm not quite sure what is being asked here as the COT report reviews existing knowledge and proposes an approach for conserving sage-grouse. The COT report doesn't really report results. Generally, review of existing knowledge is reasonable. Shortcomings in review of existing knowledge include:

a. There is a lack of description of seasonal habitats required by sage-grouse. Some of these, e.g. late brood-rearing habitat may not actually be sage-brush habitat. A description of these seasonal habitats and the ability of PACs, as defined, to include these seasonal habitats, seem important.
b. I'm not sure we can extrapolate from nonrenewable to renewable energy at present. We should report preliminary results from current wind energy impact studies. Additionally, will the footprint of renewable projects be comparable to footprints of oil and gas developments?

3. Do the authors of the COT Report draw reasonable and scientifically sound conclusions from the scientific information presented in the COT Report? Are there instances in the COT Report where a different but equally reasonable and scientifically sound scientific conclusion might be drawn that differs from the conclusion drawn by the Service? If any instances are found where that is the case, please provide the specifics of that situation.

My principal concern is the apparent general lack of appreciation for the need for active management within proposed PACs, especially in the western part of the range. In my view, protection of large patches of habitat will not, by itself, be adequate in the face of increased fire and cheat grass.

4. Does the COT Report base its interpretations, analyses and conclusions upon the best available science? If any instances are found where the best available science was not used, please provide the specifics of each situation.

Generally, the COT report is based on the best available science. Important exceptions, in my view include:

a. I'm not sure we can extrapolate from the impacts of nonrenewable energy to those of renewable energy at present. Studies of impacts of wind development are currently underway and should be considered;
b. a description of these seasonal habitats and the ability of PACs, as defined, to include these seasonal habitats, seem important, but is largely lacking;
c. the statement "the most effective method to mitigate the effects of predation is to maintain quality habitat with good connectivity" is speculation without any empirical basis;
d. direct relationships between specific habitat characteristics and demographic parameters or population change (λ) are either very limited or lacking entirely, which severely limits our ability to predict the response of sage-grouse populations to changes in their habitats;
e. I would rank ignorance of genetics-based connectivity analyses well below the lack of understanding of demographic response to potential widespread threats, such as energy development, predation, grazing, hunting, etc.

5. Are there any significant peer-reviewed scientific papers that the COT Report omits from consideration that would enhance the scientific quality of the document? Please identify any such papers.

Atamian., M. T., J. S. Sedinger, J. S. Heaton, and E. J. Blomberg. 2010. Landscape level assessment of brood rearing habitat for Greater Sage-grouse in Nevada. Journal of Wildlife Management 74:1533-1543.

Blomberg, E. J., J. S. Sedinger, M. T. Atamian, and D. V. Nonne. 2012. Characteristics of climate and landscape disturbance influence the dynamics of greater sage-grouse populations. Ecosphere 3:1-20.

Kolada, E. J., J. S. Sedinger, and M. L. Casazza. 2009. Nest site selection by greater sage-grouse in Mono County, California. Journal of Wildlife Management 73:1333-1340.

Kolada, E. J., M. L. Casazza, and J. S. Sedinger. 2009. Ecological factors influencing nest survival of greater sage-grouse in Mono County, California. Journal of Wildlife Management 73:1341-1347.

Sedinger, B. S., J. S. Sedinger, S. Espinosa, M. T. Atamian, and E. J. Blomberg. 2011. Spatial-temporal variation in survival of harvested Greater Sage-Grouse. Pp. 317–328 in B. K. Sandercock, K. Martin, and G. Segelbacher (editors). Ecology, conservation, and management of grouse. Studies in Avian Biology 39.

Sedinger, J. S., G. C. White, S. Espinosa, E. T. Partee, and C. E. Braun. 2010. An approach to assessing compensatory versus additive harvest mortality: an example using Greater Sage-grouse Centrocercus urophasianus. Journal of Wildlife Management 74:326–332.

Taylor, R. L., B. L. Walker, D. E. Naugle, and L. S. Mills. 2012. Managing multiple vital rates to maximize greater sage-grouse population growth. Journal of Wildlife Management 76:336-347.

6. Is the scientific foundation of the COT Report reasonable and how can it be strengthened? Please identify any options to strengthen the scientific foundations.

My principal recommendation here would be to refocus planning on direct linkages between habitat quality and demographic responses (survival, recruitment, movement, rate of population change) by sage-grouse. After all, conservation success depends directly on such demographic responses; why not use such responses as conservation objectives and measures of success.

REVIEWER 5:

Review of the Sage-Grouse Conservation Objectives Draft Report, prepared by the Sage-Grouse Conservation Objectives Team (COT) of the U.S. Fish and Wildlife Service and submitted on August 1, 2012.

I think that this report provides a reasonable approach to meet the purposes set forth by the Task Force charged with recommending how best to identify conservation objectives to assist in conserving greater sage-grouse. I prepared my review in two sections. The first section includes answers to 6 questions that were posed to each reviewer by Atkins. The second section provides minor comments to further improve the report. Where needed I provided short literature cited sections to provide citations for articles I refer to in my response to questions.

My Response to Questions Posed in Attachment A: Scope of Services

Question 1. Are the methods and assumptions used in deriving conservation objectives for the sage-grouse clearly stated and logical? If not, please identify the specific methods and assumptions that are unclear or illogical.

My Response to Question 1

The COT is based on a number of assumptions and uses a framework to rank threats. The framework driving conservation objectives is based on 3 principles of conservation biology (page 5):

Redundancy – multiple, geographically dispersed populations and habitats across a species range. Redundancy allows for a margin of safety for sage-grouse to weather catastrophic events such as fire or threats such as climate change that have high uncertainty and low predictability

Representation – retention of genetic, morphological, physiological, habitat, or ecological diversity of the species so its adaptive capabilities are conserved

Resiliency – the ability of a species to recover from periodic disturbance. It is recognized that a species resiliency tends to be higher when large populations are conserved in high quality habitats that are dispersed across the species distribution.

The COT also identified Resistance as a fourth parameter to include in framing conservation thresholds.

Resistance – is the ability of a population or habitats to withstand a threat without experiencing negative consequences. The COT compared this to the ability of an immune system to respond to an initial assault from an offending pathogen. The resistance of a population depends on the health of the population and associated habitats and the severity of the threat. When resistance of a population is lost, the ability of the population to persist is then a function of its resilience.

There are 3 Objectives listed on page 31:

Objective 1: *Stop the decline*. The COT recognizes the need to stop the erosion of populations and habitats to ameliorate the stressors that are impacting and will impact sage-grouse populations in the future.

Objective 2: *Target management and restoration*. The COT acknowledged that some sage-grouse populations may warrant more than simply ameliorating impacts and require active intervention to maintain range-wide resiliency, redundancy, and/or representation.

Objective 3: *Engage all stakeholders in conservation through threat amelioration*. It is recognized that the success of conserving sage-grouse populations depends on the voluntary and regulatory implementation of threat amelioration, regardless of the size, type, ownership, or location of the threat impact. Attention must be given by all stakeholders to assist in sage-grouse conservation.

I believe that the objectives for the COT Report are based on sound reasoning. The COT used professional knowledge to identify threats that important populations (deemed priority areas for conservation [PACs]) encounter as well as the risks these populations face. Results provided in tables and figures within the COT Report seem to be focused more on the threat framework that is provided on lines 466-562 than on the principles of conservation biology discussed above. The application of principles of conservation biology such as resiliency and resistance were qualitatively examined within the text (see section 5). I am not sure that is a weakness of the COT Report, but rather the reality of providing results with the underlying principles of conservation biology driving the result-making process.

The COT clearly indicated that past conservation recommendations that supported maintaining or restoring populations to specific levels would not be sustainable given the current and projected stressors to sage-grouse populations. On lines 625-631 the COT Report states "The overall conservation objective identified in the Western Association of Fish and Wildlife Agencies' (WAFWA) 2006 Greater Sage-grouse Comprehensive Conservation Strategy (Stiver *et al*. 2006) was "…**to produce and maintain neutral or positive trends in populations and maintain or increase the distribution of sage-grouse in each Management Zone**." Analyses conducted by Knick and Hanser (2011) concluded that the WAFWA conservation objective may no longer be possible due to natural and anthropogenic threats that are degrading remaining sagebrush habitats." Rather, the COT Report makes a clear assumption that maintaining large populations as well as strategic connections between populations is the best way to ensure the long-term redundancy and representation of sage-grouse populations across the species' range—this in light of the recognition that some populations and habitats will be compromised or disappear in time and the resiliency of specific populations will be related to the quality of habitats that these populations depend on. This is a significant departure from the 2006 WAFWA Conservation Strategy. In particular, the COT Report indicates that the majority of remaining sage-grouse occur in Management Zones I, II, III, IV, and V in populations ranked as C3 or C4 (i.e., Northern Montana, Yellowstone Watershed, Northern, Southern, and Western Great Basins, Snake Salmon Beaverhead, and the Wyoming Basin; lines 581-584) and focuses on maintaining grouse and grouse habitat in these areas as well as moving potential risk (C3) populations to the low risk (C4) population status in an attempt at conservation triage, rather than spending undue effort with peripheral high risk (C1) populations.

Literature Cited

Knick, S.T. and S.E. Hanser. 2011. Connecting pattern and process in greater sage-grouse populations and sagebrush landscapes. Pp. 383 – 406 *in* S.T. Knick and J.W. Connelly (editors).

Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian biology (vol. 38). University of California Press, Berkeley, CA.

Stiver, S.J., A.D. Apa, J. Bohne, S.D. Bunnell, P.Deibert, S.Gardner, M. Hilliard, C. McCarthy, and M.A. Schroeder. 2006. Greater sage-grouse comprehensive conservation strategy. Unpublished Report, Western Association of Fish and Wildlife Agencies, Cheyenne, Wyoming. 444 pp.

Question 2. Are the results presented in the COT Report reasonable? If not, please identify those that are not and the specifics of each situation.

My Response to Question 2

I think that the results presented in the COT Report are reasonable. I was particularly impressed by the compilation of results in Table 2. Table 2 provides a summary of predicted population persistence from the Garton et al. (2011) analysis for each Management Zone and population as well as the 1–4 risk value for each population and the resiliency rank value for 17 specific threats (e.g.,. conifers, disease, fire, energy development, sagebrush elimination) that occur across the species' range. In addition, the narratives in Appendix B that describe each population and the threats they face provide a wealth of information that should be of great value for future studies and conservation planning. The time projections that the analysis was based on are also comparable to common time frames for climate change projections (Bradley et al. 2009), which I believe adds some strength to the results given the pending uncertainty about climate change effects on sagebrush systems and sage-grouse populations.

Literature Cited

Bradley, B.A., M. Oppenheimer, and D.S. Wilcove. 2009. Climate change and plant invasions: restoration opportunities ahead? Global Change Biology 15:1511-1521.

Garton, E.O., J.W. Connelly, J.S. Horne, C.A. Hagen, A. Moser, and M. Schroeder. 2011. Greater sage-grouse population dynamics and probability of persistence. Pp. 293 – 382 1017 *in* S.T. Knick and J.W. Connelly (editors). Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian biology (vol. 38). University of California Press, Berkeley, CA.

Question 3. Do the authors of the COT Report draw reasonable and scientifically sound conclusions from the scientific information presented in the COT Report? Are there instances in the COT Report where a different but equally reasonable and scientifically sound scientific conclusion might be drawn that differs from the conclusion drawn by the Service? If any instances are found where that is the case, please provide the specifics of that situation.

My Response to Question 3

I think that the authors of the COT Report left some reasonable doubt that some of the information provided for current populations such as risk ratings and threat rankings may or may not hold true. I believe this is why the COT adapted NatureServe's threat ranking system to characterize the degree of threat, by population, which considered existing and foreseeable threats. Because the conclusions are based on findings stemming from professional opinion, the

door is open that some of the potential threats may or may not occur to populations. However, in an effort to not over reach with their conclusions, the COT Report states on lines 86-88 "Nothing in this report should be construed as limiting the application of additional conservation efforts for the sage-grouse or sagebrush ecosystems beyond what is recommended in this report, nor should this report be used to curtail or eliminate any conservation efforts for sage-grouse." I think this was a wise caveat to include in the report so that biologists will continue to work with all populations and their habitats to encourage sound conservation and population persistence and not solely rely on the conclusions in this report to decide which conservation efforts to use or which populations to target or discontinue focusing on. In addition, on lines 667-670, the COT Report acknowledged that areas outside the identified PACs (see Figure 1 for map of PACs and general habitat identified by individual states) "provide key conservation parameters necessary for the long-term persistence of the sage-grouse, we also agree that sage-grouse habitat outside the PACs has value in sage-grouse conservation. These areas may provide connectivity between PACs, maintain flexibility for restoration, and potentially provide key habitat components that have not yet been identified." This was a critical acknowledgment, however, other than mentioning the importance of these other areas the COT Report does not directly provide a way to incorporate or provide threat amelioration for these populations.

Question 4. Does the COT Report base its interpretations, analyses and conclusions upon the best available science? If any instances are found where the best available science was not used, please provide the specifics of each situation.

My Response to Question 4

It could be argued that the COT Report should have utilized existing landscape and genetic modeling results to determine risks affecting range-wide populations (see Aldridge et al. 2008) as well as genetic connections across landscapes (see Oyler-McCance et al. 2005). Or, alternatively, the COT Report could have been commissioned to be conducted by a scientific entity such as a university or research-based consulting firm. Instead, the COT Report pursued its analysis through the lens of expert knowledge, underpinned by principles of conservation biology, and guided by current scientific knowledge about the threats that greater sage-grouse populations and habitats face. Pursuing an analysis that identifies the threats to populations is consistent with the process that the U. S. Fish and Wildlife Service follows in determining listing decisions (lines 588-590). Further, the COT Report acknowledges that "we lack robust, range-wide genetics-based connectivity analyses (line 733)," suggesting that genetics information is lacking to base a range-wide analysis for population connectivity. According to lines 70-74 the purpose of the COT "was to develop conservation objectives by defining the degree to which the threats need to be ameliorated to conserve the sage-grouse so that it is no longer in danger of extinction or likely to become in danger of extinction, by 2013 for the Bi-state Distinct Population Segment (DPS), and 2015 for the Greater sage-grouse range-wide." I think that the stated purpose more or less exempts the COT from relying solely on existing large-scale analyses such as Aldridge et al. (2008) and Oyler-McCance et al. (2005) or other analyses (e.g., Knick and Hanser 2011) that have been conducted at the range-wide scale or in pursuing new research analyses. When I assessed the entire document I came to a realization that the COT Report provides a framework to identify current and future threats for PACs, which are based on local knowledge, not scientific models, yet I am convinced that solid science provides the underpinnings for the COT Report to recognize significant threats to individual PACs.

The COT Report provides 6 general conservation objectives (lines 729-803), 9 specific short term conservation objectives (lines 805-873), and 4 specific long-term recommendations (lines 876-890) at the end of the Report. It is obvious that these objectives and recommendations are driven by science and are very helpful in terms of framing the direction that conservation should proceed. A number of scientific hypotheses and predictions can be framed from the objectives and recommendations set forth in these portions of the COT Report providing many potentially fruitful lines of research for scientists in the future.

Literature Cited

Aldridge, C.L., S.E. Nielsen, H.L. Beyer, M.S. Boyce, J.W. Connelly, S.T. Knick, and M.A. Schroeder. 2008. Range-wide patterns of greater sage-grouse persistence. Diversity and Distributions 14:983-994.

Knick, S.T. and S.E. Hanser. 2011. Connecting pattern and process in greater sage-grouse populations and sagebrush landscapes. Pp. 383 – 406 *in* S.T. Knick and J.W. Connelly (editors). Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian biology (vol. 38). University of California Press, Berkeley, CA.

Oyler-McCance, S.J., S.E. Taylor, and T.W. Quinn. 2005. A multilocus population genetic survey of the greater sage-grouse across their range. Molecular Ecology 14:1293-1310.

Question 5. Are there any significant peer-reviewed scientific papers that the COT Report omits from consideration that would enhance the scientific quality of the document? Please identify any such papers.

My Response to Question 5

I could recommend numerous papers to provide a more thorough literature review, but I think that the intent of the COT Report was not to provide a thorough literature review, but rather to provide a framework for conservation objectives for the greater sage-grouse. However, I found 3 instances where specific peer-reviewed scientific papers will enhance the scientific quality of the document. Below I identify these instances and subsequently provide the requisite references.

1. Lines 134-135. The late brood-rearing period should be better defined, at least by referring to a few references that provide biological information indicating when brood-rearing periods should be defined. Thomson et al. (2006) and Connelly et al. (2008, 2011) and references therein are good references to define the timing of early and late brood-rearing life stages.

Connelly, J.W., H.W. Browers, and R.J. Gates. 1988. Seasonal movements of sage grouse in southeastern Idaho. Journal of Wildlife Management 52:116−122.

Connelly, J.W., E.T. Rinkes, and C.E. Braun. 2011. Characteristics of greater sage-grouse habitats: a landscape species at micro- and macroscales. Studies in Avian Biology 38:69–83.

Thompson, K.M., M.J. Holloran, S.J. Slater, J.L. Kuipers, and S.H. Anderson. 2006. Early brood-rearing habitat use and productivity of greater sage-grouse in Wyoming. Western North American Naturalist 66:332−342.

2. Lines 142-146. Fedy et al. (2012) provides the most recent and arguably the most extensive analysis for sage-grouse migration.

Fedy, B. C., C. L. Aldridge, K. E. Doherty, M. O'Donnell, J. L. Beck, B. Bedrosian, M. J. Holloran, G. D. Johnson, N. W. Kaczor, C. P. Kirol, C. A. Mandich, D. Marshall, G. McKee, C. Olson, C. C. Swanson, and B. L. Walker. 2012. Interseasonal movements of greater sage-grouse, migratory behavior, and an assessment of the core regions concept in Wyoming. Journal of Wildlife Management 76:1062–1071.

3. Line 163. Sagebrush has been shown to live longer than 150 years. For instance, see Ferguson and Humphrey (1959) and Ferguson (1964) report sagebrush taxa living up to 216 years.

Ferguson, C. W. 1964. Annual rings in big sagebrush: *Artemisia tridentata*. Papers of the Laboratory of Tree-Ring Research, No. 1. Tucson, AZ, USA: The University of Arizona Press. 95 p.

Ferguson, C. W. and R. R. Humphrey. 1959. Growth rings of sagebrush reveal rainfall records. *Progressive Agriculture in Arizona*. 1959:3.

Question 6. Is the scientific foundation of the COT Report reasonable and how can it be strengthened? Please identify any options to strengthen the scientific foundations.

My Response to Question 6

Overall I found the report to be well written and to provide a reasonable framework based on scientific reasoning for sage-grouse conservation objectives. I note that the COT was formed by the U.S. Fish and Wildlife Service from sage-grouse biologists employed by state wildlife agencies, some of which are widely respected and some of which are new to the field (see Appendix A for a list of team members). Forming a group of individuals from state wildlife agencies makes sense because each state has a vested interest in the conservation of the greater sage-grouse and biologists from within those states are excellent sources of knowledge regarding the current status and particular conservation threats that individual populations and their habitats face. Moreover, the COT Report was prepared with different cultures, ecosystems and issues in mind, rather than trying to develop prescriptive species or habitat actions across the species' range (lines 90-94). There is always an inherent risk in making conservation decisions based on professional opinion rather than empirical evidence, however, I believe much of the information provided by individual states was driven by research findings from studies within those states as well as lek and harvest monitoring data collected and synthesized by the various state agencies. Furthermore, as was indicated on lines 67-68, the state agencies have management expertise and retain management authority over greater sage-grouse, which was recognized in the task force (Conservation Objectives Team) that was formed to draft the COT Report.

I think that one way the scientific foundation of the COT Report could be strengthened would be to briefly indicate how the framework for the COT Threat Analysis was actually implemented by the members of the COT. For instance, did biologists from each state consider the magnitude and immediacy of threats (see lines 466-526) through discussions with local biologists who work with identified PACs and then track their decisions/rankings in a spreadsheet matrix? Some of

this detail would strengthen the understanding of how the threat framework was organized and decisions implemented.

MINOR COMMENTS

Line 13. Principles "of" Conservation Biology

Line 156. I think that "large-scale characteristics" is an odd term. Perhaps replace with "large-scale disturbances?"

Line 158. Aldridge et al. (2008) is missing from the Literature Cited

Line 221. Please insert "the" …defined as the ability…

Line 240. I thought it was 1 disturbance per 640 acres. Please verify that it is not 1 per 699 acres.

Line 345. Would it be a good idea to delete "the" so it reads …by most states… or would that lose the intended meaning?

Line 432. populations, not population

Line 457. I am not certain how one restores sagebrush "ecology." Perhaps delete this instance of "ecology" or replace with communities.

Line 581. Please insert "in" before Management Zones

Table 2. Please define the numbers and numbers in parentheses given for each Management Zone in the heading for Table 2

Table 2. Tooele, not Toole

Line 665. Mechanisms

Line 857. Delete "in order"