BEFORE THE UNITED STATES DEPARTMENT OF THE INTERIOR,
DATA QUALITY OFFICIAL

WESTERN ENERGY ALLIANCE )
GARFIELD COUNTY, COLORADO )
GRAND COUNTY, COLORADO )
JACKSON COUNTY, COLORADO )
MOFFAT COUNTY, COLORADO )
RIO BLANCO COUNTY, COLORADO )
EUREKA COUNTY, NEVADA )
MONTANA ASSOC. OF OIL, GAS AND )
COAL COUNTIES )
UTAH ASSOCIATION OF COUNTIES )
UTAH MULTIPLE USE COALITION )
AMERICAN PETROLEUM INSTITUTE )
INDEPENDENT PETROLEUM ASSOC. )
OF AMERICA )
PETROLEUM ASSOCIATION OF MONTANA )
PETROLEUM ASSOCIATION OF WYOMING )
PUBLIC LANDS COUNCIL )
INT’L. ASSOC. OF DRILLING CONTRACTORS )
COLORADO MINING ASSOCIATION )
COLORADO WOOL GROWERS ASSOC. )
NEVADA MINING ASSOCIATION )
AMERICAN EXPLORATION AND MINING )
ASSOCIATION )

[AND OTHERS?]

Petitioners )
v. )

U.S. DEPARTMENT OF )

Agency.

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CHALLENGE OF WESTERN ENERGY ALLIANCE, ET AL.
PURSUANT TO THE DATA QUALITY ACT

Senior Science Advisor
Office of the Science Advisor
[[ADDRESS?? SUBMITTAL ELECTRONICALLY??]]
**Formal Request for Correction**- If informal requests for correction are not sufficient to resolve the concern, affected persons may also file a challenge with FWS by mail at:

Correspondence Control Unit  
Attention: Information Quality Correction Request Processing  
U.S. Fish and Wildlife Service  
1849 C Street, NW, Mail Stop 3331-MIB  
Washington, D.C. 20240

I. Introduction


In March of 2010, the FWS issued a listing decision on greater sage-grouse (“GRSG”) under the Endangered Species Act (“ESA”).\(^2\) The FWS cited an alleged inadequacy of existing

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1 Available at:  http://www.fws.gov/informationquality/topics/InformationQualityGuidelinesrevised6_6_12.pdf  
regulatory mechanisms as a factor in its warranted but precluded decision. Pursuant to a settlement agreement with activist litigants, the FWS agreed to consider listing the species under the ESA by September 30, 2015. The COT Report was prepared by five representatives from the FWS and ten from State agencies in a collaborative effort to develop range-wide conservation objectives for GRSG and to inform USFWS’ upcoming ESA listing decision. The COT Report is a one hundred thirteen (113) page document with conclusions on wildlife ecology, wildlife science, conservation biology, GRSG biology, and GRSG population dynamics.

The COT Report acknowledges uncertainty nearly one hundred (100) times in the document. It concedes there is a shortage of established research, credible conservation results and a lack of clear patterns with regard to GRSG. Population numbers, habitat, range, threats and viability are all acknowledged uncertainties. While the COT Report’s stated purpose is to, “to define the degree to which threats need to be reduced or ameliorated to conserve sage-grouse so that it is no longer in danger of extinction or likely to become in danger of extinction in the foreseeable future,” it lacks the scientific quality, integrity, objectivity and utility required by the DQA, the Guidelines and the additional authority cited herein.

FWS Director Ashe recognized the importance of the document and its shortcomings in his March 22, 2013, letter accompanying the public release of the COT Report. According to Director Ashe, the COT Report acknowledges the uncertainty associated with issuing such a report, but aims to “stimulate discussions” regarding the GRSG and planning efforts. There was

5 COT Report at 5.
6 Id.
7 Id.
no opportunity for public review or comment on this highly influential document prior to its release.

As referenced below, Petitioners have reviewed the COT Report and found it to be inaccurate, unreliable, and biased in violation of the DQA and the Guidelines.

The DQA, Section 515 of the Treasury and General Government Appropriations Act of FY 2001 (Public Law 106-554), requires Federal agencies to ensure and maximize the quality, objectivity, utility, and integrity of information, including statistical information, disseminated by Federal agencies on or after October 1, 2002. Agencies are required to review the quality of information before its dissemination and treat information quality as integral to every step.

The OMB government-wide guidelines impose three core responsibilities on the agencies:

- First, the agencies must embrace a basic standard of “quality” as a performance goal, and agencies must incorporate quality into their information dissemination practices. OMB’s guidelines explain that “quality” encompasses “utility” (usefulness to its intended users), “integrity” (security), and “objectivity.” “Objectivity” focuses on whether the disseminated information is accurate, reliable, and unbiased as a matter of presentation and substance.

- Second, the agencies must develop information quality assurance procedures that are applied before information is disseminated.

- Third, the OMB government-wide guidelines require that each agency develop an administrative mechanism whereby affected parties can request that agencies correct poor quality information that has been or is being disseminated. If one is dissatisfied with the initial agency response to a correction request he or she may file an administrative appeal.

The COT Report qualifies as information disseminated by FWS, or in the alternative, as FWS-sponsored information.8 “The intent of the COT was to produce a report that not only informs the Service listing determinations, but also outlines the necessary conservation actions to

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8 FWS Guidelines II-2; III-1 and III-2.
ensure the long-term persistence of healthy populations of the sage-grouse for the foreseeable future.”

Because DOI agencies are considering Land Use Plan Amendments based upon the COT Report, and it may be utilized in a listing decision for GRSG under the ESA, the COT Report is “highly influential” information subject to even higher standards of quality. The COT Report is not subject to any exclusion from the DQA nor from the Guidelines.

We have identified a number of serious flaws with the COT Report that, if implemented, will have enormous social and economic consequences in the West without commensurate benefits to local GRSG populations and habitat. While the FWS characterizes the Report as “guidance only,” its recommendations are being incorporated into Land Use Plan Amendments that will affect some 60 million acres of public land in the West.

FWS must rectify these issues and recognize that state and local conservation efforts are already underway and are more effective than the top-down, one-size-fits-all federal approach in the COT Report. Therefore, Petitioners request FWS retract the COT Report and all reliance thereon in agency decisions on permits, authorizations and the listed status of GRSG under the ESA. Alternatively, the FWS could issue an amended COT Report that uses sound analytical methods and the best data available (including specifically the information omitted in the current Report and referenced herein), ensuring transparency and objectivity in the information disseminated.

The best available science indicates that COT should be much more flexible and adaptive in its approach to GRSG. Among other things, COT should incorporate and adopt state GRSG conservation plans and local and private conservation efforts consistent with the DQA, the

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10 FWS Guidelines III-10.
11 See, e.g. FWS Guidelines II-3.
12 See COT Report at 5.
Guidelines, DOI and Presidential orders, and its statutory multiple use mandates discussed herein.

The information disseminated information should be corrected upon consideration of the most recent or thorough information from stakeholders, the public and the scientific community. The FWS recognizes that objectives in the COT report are “subject to modification as dictated by new findings, changes in species’ status, and the completion of conservation actions.” This challenge constitutes the most recent and thorough information such that the FWS should retract or amend the COT Report accordingly.

II. The Petitioners

Petitioners have a direct interest in the quality and integrity of agency science and decision making, including how the COT Report affects GRSG and public lands management in the West. The management restrictions, regulatory measures and closures recommended in the COT Report will have a direct impact on the Petitioners, the economy and the future viability of scores of communities, local governments, family businesses, family ranches, mining enterprises and oil and natural gas development in the West.

- Western Energy Alliance represents more than 430 companies engaged in all aspects of environmentally responsible exploration and production of oil and natural gas in Utah, Wyoming and across the West.

- API is a national trade association representing over 500 member companies involved in all aspects of the oil and natural gas industry. API’s members include producers, refiners, suppliers, pipeline operators, and marine transporters, as well as service and supply companies that support all segments of the industry.

- IPAA represents thousands of independent crude oil and natural gas explorers and producers and is dedicated to ensuring a strong, viable domestic oil and natural gas industry, recognizing that an adequate and secure supply of energy is essential to the national economy.

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13 COT Report at ii.
American Exploration & Mining Association (formerly known as the Northwest Mining Association until 2013) (“AEMA”) is a 119 year-old, 2,300 member non-profit, non-partisan trade association based in Spokane, Washington. AEMA is a national association representing the hardrock mining industry with members residing in 43 U.S. states, 9 Canadian provinces or territories, and 6 other countries.

And others…

The Petitioners primary representatives can be reached at the following addresses:

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III. The DQA Applies to the COT Report

The U.S. Department of the Interior (“DOI”) issued its Guidelines to ensure high quality information is generated, used, and disseminated; and to comply with OMB’s charge that each agency adopt DQA Guidelines.14 “The Department’s methods for producing quality information will be made transparent, to the maximum extent practicable, through accurate documentation, use of appropriate internal and external review procedures, consultation with experts and users, and verification of its quality.”15 Information released by DOI will be reproducible to the extent possible and influential information shall be produced with “a high degree of transparency about data and methods.”16 “Analytic results shall generally require sufficient transparency about data and methodology that an independent reanalysis could be undertaken by a qualified member of the public resulting in substantially the same results.”17

15 DOI Guidelines, II.
16 Id.
17 Id.
A. Information Dissemination Product

The OMB Guidelines define “Information Dissemination Product” as “any books, paper, map, machine-readable material, audiovisual production, or other documentary material, regardless of physical form or characteristic, an agency disseminates to the public. This definition includes any electronic document, CD-ROM, or web page.”18

The COT Report was disseminated electronically by FWS. Accordingly, it meets the definition of “information dissemination product.” The intended users of this information include the FWS, the BLM, the U.S. Forest Service, state and local governments, domestic energy producers, agricultural producers, public land managers, local and state governments and the general public.

B. Dissemination

OMB Guidelines define “Dissemination” as “agency initiated or sponsored distribution of information to the public.”19 The COT Report was disseminated by the FWS. The FWS has represented the NTT Report as, and used it in support of, an official position of the agency in such a way that the Guidelines apply.20 Neither the authors of the COT Report nor the FWS have disclaimed that the COT Report is not information subject to correction or retraction under the DQA. The FWS has disseminated the COT Report by, among others, publication on its website.21

C. Third Party Information

To the extent the FWS considers the COT Report, third-party information, the DQA and its Guidelines still apply. Certain third-party information that an agency makes public is also

20 AVAILABLE AT: http://www.whitehouse.gov/omb/fedreg_reproducible
subject to the Data Quality and the Guidelines. “If third-party submissions are to be used and disseminated by Federal agencies, it is the responsibility of the Federal Government, under the Data Quality Act, to make sure that such information meets relevant information quality standards.”

The Guidelines state third party information endorsed, adopted, disseminated or relied upon, must meet the quality, objectivity, utility and integrity standards required by the Data Quality Act and should be subject to DQA correction. The DOI Guidelines expressly apply to non-Departmental parties that develop scientific and technical information on its behalf.

D. If Uncorrected, the COT Report Will Cause Substantial Harm

Here, the FWS issued no disclaimers to explain that it did not or will not use, rely upon or endorse the information disseminated. Many DOI and FWS employees contributed to the COT Report. Accordingly, the DQA and the Guidelines clearly apply.

Reliance on uncertainties, inaccuracies, bias and misrepresentation in the COT Report will result in dramatic changes across millions of acres of public lands. To avoid actual harm to the Petitioners, the Western States, local governments, private landowners and stakeholders, the FWS must timely respond to this DQA challenge and retract statements and conclusions based on uncertainties and correct bias and misrepresentation of the information disseminated.

Where, as here, Petitioners have provided “significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts,” FWS should use existing mechanisms to remedy the situation “such as re-proposing a rule or supplementing a NEPA analysis.”

Corrective action in this case should include a retraction of the COT Report and its withdrawal from consideration in alternatives in Land Use Plan Amendments and any listing decision on GRSG.

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23 DOI Guidelines II.4; DOI Guidelines V.
24 DOI Guidelines III.
E. The COT Report is Highly Influential Information

The information disseminated here readily qualifies as influential information. As OMB states, “[T]he more important the information, the higher quality standards to which it should be held . . . .” Ordinary information is distinguished from “influential” information -- that is, scientific, financial and statistical information having a clear and substantial impact on important public policies or important private sector decisions. “Influential” information is subject to higher standards of quality and should be reproducible by qualified third parties. The information disseminated in the COT Report is information of extreme importance to states, landowners, user groups and local conservation efforts.

The OMB Guidelines define “influential” requests for correction as those of a substantive nature, which sought “something more than a straightforward webpage or data fix. “Influential” has also been defined to mean “that the agency can reasonably determine that dissemination of the information will have or does have a clear and substantial impact on important public policies or important private sector decisions.”

The information disseminated in COT Report is information of extreme importance. It qualifies under the Guidelines as substantive notices, policy documents, studies and guidance relied upon by the agency to make decisions that could affect multiple federal and state agencies, local governments, Tribes and private individuals in eleven Western States and on tens of millions of acres of public lands. . The COT Report is intended to inform the BLM in its revision of its LUPs. As such, BLM relied upon and disseminated, flawed information found in the COT Report. Much of the NEPA analyses developed by BLM in their land use plan amendments relied on FWS’ COT Report to describe the “Affected Environment,” and to a

certain degree to describe the “Purpose and Need.” Many of the action alternatives were developed to address FWS’ criticism and finding that BLM’s regulatory mechanisms were inadequate to protect GRSG.

The conservation measures in Land Use Plan Amendments were developed by the Sage-Grouse National Technical Team which included staff and scientists from BLM, FWS, U.S. Geological Survey (“USGS”), Natural Resources Conservation Service, and state fish and game agencies. Their work culminated in the NTT Report. Many of the action alternatives in the 98 Land Use Plan Amendments were largely derived from the COT Report.27

This information is clearly “influential scientific, financial, or statistical information” that crosses state and agency boundaries and affects private and public decisions under the DQA and the Guidelines. The FWS Guidelines define influential information to be that which “will have or does have a clear and substantial impact on important public policy or private sector decisions, and thus, a decision or action to be taken by the Director.”28 “As a general rule,” the document notes, “FWS considers an impact clear and substantial when a specific piece of information or body of information is a principal basis for a FWS position.”29 In this case, the COT Report is the principal basis on which the FWS will judge threats to GRSG and measures designed to address them.

An even higher level of scrutiny is applied to highly influential scientific assessments. Highly influential scientific assessments are those that “the agency or the [OMB Office of

27 BLM, Federal Agencies Announce Initial Step to Incorporate Greater Sage-Grouse Conservation Measures into Land Management Plans (Dec. 8, 2011) (last visited Jan. 4, 2015 at 10:31 AM) (“Greater sage-grouse currently use as much as 47 million acres of land managed by the BLM, and about nine million acres of land managed by the USFS. As many as 98 BLM Resource Management Plans address greater sage-grouse, while the USFS expects to evaluate conservation measures into as many as nine Land and Resource Management Plans considered high priority for the conservation of sage-grouse.”).
29 Id.
Administrator determines . . . could have a potential impact of more than $500 million in any one year on either the public or private sector or that . . . is novel, controversial, or precedent-setting, or has significant interagency interest.”30 Such is clearly the case here. BLM and the Forest Service are implementing some 98 Land Use Plan Amendments across eleven western states in substantial reliance upon the COT Report. The economic impact of these regulatory changes will last for potentially decades and will far exceed $500 million. These are clearly controversial, novel, precedent-setting issues of significant interagency and public interest.

F. The Petitioners are “Affected Person(s)” Qualified to bring a DQA Challenge

OMB’s Guidelines also require each agency to establish administrative mechanisms that allow “affected persons” to seek and obtain the correction of information that does not meet the OMB Guidelines.31 OMB makes clear that the purpose of the administrative mechanism is to "facilitate public review" of agency compliance with the Guidelines.32 The OMB Guidelines concluded that “affected persons are people who may benefit or be harmed by the disseminated information. This includes persons who are seeking to address information about themselves as well as persons who use information.”33 Such a definition provides the public with a right to agency-disseminated information that meets high DQA standards; and with a right to correct any publicly disseminated information that does not meet these standards. The FWS Guidelines provide that any individual or person “who may use, benefit from, or be harmed by the disseminated information with a material impact to their interests” is an “affected person.”34

32 Id.
34 See FWS Guidelines III-5.
Petitioners are “affected persons” within the meaning of the Guidelines. Petitioners and their members or constituents have a distinct interest in the conservation of GRSG and rely upon public and private lands within the range of the GRSG for the production of natural resources, agricultural goods and products, for revenues distributed to the states and local governments, for recreation and for wildlife conservation. Petitioners have a reasonable likelihood of suffering actual harm from dissemination of the COT Report unless the FWS resolves this complaint prior to the final agency actions and information products at issue herein. There is no separate process or mechanism by which Petitioners can raise these issues or seek redress regarding the fundamental flaws and shortcomings of the COT Report.

Petitioners have used, and will use, the information disseminated to better inform and to guide in their business decisions. Their members and/or constituents are affected by information regarding GRSG numbers, dispersal and distribution as well as alleged threats to the species. Where the species is located, how it disperses, and where it is distributed could have strict regulatory consequences to those that produce agricultural products and energy and natural resources from public lands that could be affected. In addition, the local governments rely upon continued access to public lands for natural resources and recreation and the tax and other revenues they generate. Accordingly, Petitioners could be benefited by, or be harmed by the faulty information at issue.

Petitioners are coordinating an extensive campaign across the West to save the GRSG from these unfounded regulatory restrictions and from a listing under the ESA. These grassroots efforts include the collection of data and the compilation of ongoing state, local and private conservation efforts for the GRSG. Petitioners have established their interests in ensuring that
their members and constituents, as well as the public at large, has the opportunity for open and robust debate regarding the information disseminated.

IV. The COT Report Violates the Quality, Objectivity, Utility and Integrity Standards of the DQA and its Guidelines

The COT Report: (1) was developed with unsound research methods resulting in a partial and biased presentation of information; (2) ignores studies that do not support its theses; (3) jumps to conclusions that are not scientifically supported but are pure conjecture; and (4) disseminates information that is not objective or reliable and that lacks scientific integrity. Accordingly, this Challenge asks the FWS to correct, retract or supplement information referenced in the COT Report and also seeks to ensure that all information disseminated by the FWS meets the quality, objectivity, utility and integrity requirements of the DQA and the Guidelines.

The OMB Guidelines implement § 3504(d)(1) of the Paperwork Reduction Act (PRA). 44 U.S.C. § 3516. Section 3504 (d)(1) requires that “with respect to information dissemination, the [OMB] director shall develop and oversee the implementation of policies, principles, standards, and guidelines to apply to Federal agency dissemination of public information, regardless of the form or format in which such information is disseminated....”

Both the DQA and the Guidelines require agencies to “ensure and maximize” the quality, objectivity, utility, and integrity of information disseminated by federal agencies. “Utility” refers to “the usefulness of the information to its intended users, including the public.” For the reasons discussed herein, the COT Report fails to meet quality, objectivity, utility and integrity standards of the DQA, the Guidelines and the additional authorities cited herein. See Exhibit A:

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The COT Report Fails to Meet DQA Standards at pages 6-11; see also Exhibit B: Studies Cited in the COT Report Fail to Meet DQA Standards at pages 4-7.

A. The COT Report Fails the Substantial Reproducibility Standard for Highly Influential Information

The COT Report fails to meet DQA standards for quality. The OMB Guidelines provide a higher standard than even peer review applies to influential information, namely a “substantial reproducibility standard.”38 The DOI and FWS have adopted, and indeed must adopt, the OMB Guidelines. The FWS Guidelines define “reproducibility” as “information [is] capable of being substantially reproduced, subject to an acceptable degree of precision.”39 In appropriate cases, OMB encourages the agencies to consider “confirmation” as a standard in assessing the objectivity of original and supporting data.40 “The more important the information, the higher the quality standards to which it should be held, for example in those situations involving ‘influential scientific, financial or statistical information’” ….41

In this case, the COT Report is influential in that it, “will have or does have a clear and substantial impact on important public policy or private sector decisions, and thus, a decision or action to be taken by the Director, FWS….”42 The COT Report also qualifies as a highly influential scientific assessment such that even more rigorous standards apply.43 The COT Report is novel, controversial and precedent-setting with significant interagency interest44 as BLM and the Forest Service are implementing some 98 Land Use Plan Amendments across

39 FWS Guidelines at III-12.
41 OMB Guidelines V(3)(b)(ii).
42 See FWS Guidelines III-10.
eleven western states in substantial reliance upon the COT Report. The economic impact of these regulatory changes will last for potentially decades and will likely far exceed $500 million.

Unfortunately, the COT Report fails to meet the substantially reproducible standard required under the DQA and the Guidelines. See Exhibit A at pages 1, 4-6, and 14; see also Exhibit B at page 14. For example, the COT Report places undue reliance on the database NatureServe for its ranking of threats. NatureServe comes with a glaring disclaimer:

All documents and related graphics provided by this server and any other documents which are referenced by or linked to this server are provided "as is" without warranty as to the currentness, completeness, or accuracy of any specific data....

The FWS has not identified several sources in the COT Report and has not disclosed the supporting data and models for the public to assess the objectivity of the Report. The models relied upon are quite complex. However, because the underlying data used in many of them has not been fully released, nor provided to peer reviewers for independent analysis, they are neither transparent nor reproducible. The peer reviewers, journal editors, or scientific and regulatory audience cannot independently evaluate the quality and potential biases in the data and studies. Accordingly, the studies relied upon fail to meet the DQA nor the Guidelines.

As an initial matter, the data has been collected by different people in different states using different standards and levels of effort—all of which have changed over time. Moreover, the data are not properly curated and maintained in a central repository. Metadata to describe precisely how the data was collected, recorded and summarized along with quality and control assurances are undocumented. Additionally, depending upon the state or federal agency, key variables have not been released. Simply put, the raw data and methods that one could potentially use to reproduce the final data sets used in analyses are not available either because
they are not released, undocumented, or may no longer exist. Again, this violates the DQA and the Guidelines.

For these reasons, the information disseminated violates the “objectivity” standard and the "utility" standard therein because they are not useful to the public because they are made without giving the public access to the underlying information. This prohibits the public from assessing the value and usefulness of the information.

The COT Report is not a scientific document, as there are no original data or quantitative analyses used in developing the report, nor is there a comprehensive and unbiased review of all of the available scientific literature about conservation of the species. Instead, the COT Report provides a limited and selective review of the scientific literature and unpublished reports on GRSG as a basis for its conservation objectives and proposed actions. As a result, outdated information and beliefs are perpetuated in the COT Report in violation of the DQA, the Guidelines and the additional authorities cited herein. See Exhibit A at page 4; see also Exhibit B at page 7. For example, the COT states, “[O]ther factors associated with habitat loss and fragmentation are summarized by Knick et al. (2011) and include conversion of sagebrush habitats for agriculture, the expanding human populations in the western United States and the resulting urban development in sagebrush habitats, vegetation treatments resulting in the alteration or removal of sagebrush to enhance grazing for livestock, and impacts from wild ungulates and free-roaming equids (horses and burros).”45 As noted in Exhibits A and B herein, this study significantly misrepresents works cited therein.

Further, in reliance on Knick et al. 2003, the COT Report states, “…sagebrush is considered one of the most imperiled ecosystems in North America due to continued degradation

45 COT Report at 10.
and lack of protection….”

6. The Report goes on to say, “[v]ery little extant sagebrush is undisturbed, with up to 50 to 60 percent having altered understories or having been lost to direct conversions (Knick et al. 2003).” This is not based on actual data.

Distribution and historical range estimates presented by Knick et al. are largely based on anecdotal historical reports and outdated modeling. Finally, the FWS claims, “[L]arge seasonal and annual movements emphasize the need for large, functional landscapes to support viable sage-grouse populations (Knick et al. 2003; Connelly et al. 2011a).” This is not supported by data and relies on the invalid assumption that GRSG cannot bypass unsuitable or fragmented habitat during seasonal movements. Actually, as addressed elsewhere herein, GRSG are known to fly over great distances.

B. Transparency and Reproducibility

The COT Report fails to meet quality and utility standards of the DQA and the Guidelines. OMG Guidelines require a high degree of transparency for influential information such as the NTT Report. Transparency equates to disclosure of the “data and methods of analysis” such that replication of results could be achieved. Peer-review of original and supporting data and results “does not necessarily imply that the results are transparent and replicable.” The many shortcomings of the NTT Report related to peer review are discussed in detail below.

OMB has recognized the benefits of transparency extend beyond the ability to spot errors in government work. Far more important is the ability to assess the extent to which results hinge

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46 COT Report at 8.
47 Id.
49 OMB Guidelines V(3)(b)(ii).
50 AVAILABLE AT: http://www.whitehouse.gov/omb/fedreg_reproducible
upon an agency’s choices in analysis.51 “Agency guidelines shall, however, in all cases, require a disclosure of the specific data sources that have been used and the specific quantitative methods and assumptions that have been employed.”52 OMB explains that: “[i]n assessing the usefulness of information that the agency disseminates to the public, the agency needs to consider the uses of the information not only from the perspective of the agency but also from the perspective of the public. As a result, when transparency of information is relevant for assessing the information's usefulness from the public's perspective, the agency must take care to ensure that transparency has been addressed in its review of the information.”53 As discussed herein, the COT Report was far from transparent.

The Alliance had to undergo great lengths to obtain relevant information about peer reviews on the NTT and COT Reports, and other studies. The Alliance filed five Freedom of Information Act (“FOIA”) requests; two FOIA follow-up letters; three FOIA appeals, three FOIA lawsuits and three targeted DQA requests for information against the BLM, FWS and USGS for information that should have already been in the public domain pursuant to the DQA, its Guidelines and presidential and secretarial memoranda and orders discussed further herein.

FOIA requires an agency to respond to such requests within twenty (20) business days. In all but one instance above, the DOI agencies refused to disclose all of the information requested by the Alliance in these FOIA requests until the Alliance initiated litigation. In the case of the Alliance’s FOIA cases against BLM and the FWS, it took more than seven months to receive the information requested. It took nearly eighteen (18) months before the USGS ultimately disclosed information the Alliance requested in that case. These actions ultimately

51 AVAILABLE AT: http://www.whitehouse.gov/omb/fedreg_reproducible
52 OMB Guidelines V. (emphasis added).
resulted in the disclosure of more than 1,500 pages of relevant information that should have been disclosed and open for public review and comments.

Had the FWS complied with the aforementioned authorities, many of the Alliance’s extensive legal efforts would have been unnecessary and the public could have timely ascertained whether these documents were scientifically sound and substantially capable of replication.

To the extent the agency believes it cannot disclose certain information in the COT Report, but which are material to information that the agency does disclose, robustness checks are required for ensuring compliance with the DQA because the public will not be afforded any other mechanism for determining the objectivity, utility, and reproducibility of this non-disclosed information. In fact, the “agencies shall apply especially rigorous robustness checks to analytic results and document what checks were undertaken.”54 DOI and FWS Guidelines mirror this requirement.55 The COT Report underwent no such rigorous checks.

OMB explained in its February 22nd agency-wide guidelines that the “general standard” for these robustness checks is “that the information is capable of being substantially reproduced, subject to an acceptable degree of imprecision.”56 “For example, a qualified party, operating under the same confidentiality protections as the original analysts, may be asked to use the same data, computer model or statistical methods to replicate the analytic results reported in the original study.”57 Here, the COT Report, and many of the most influential studies and models it relies upon, are neither transparent nor reproducible. See Exhibit A at pages 1, 4-6, and 14; see also Exhibit B, gen. The FWS Guidelines provide:

54 OMB Guidelines V3.b.ii.B.ii (emphasis added).
55 FWS Guidelines IV-3.
57 AVAILABLE AT: http://www.whitehouse.gov/omb/fedreg_reproducible
Transparency about research design and methods is pivotal to reproducibility. With regard to analytical results, we will generally require sufficient transparency about data and methods that a qualified member of the public could undertake an independent reanalysis. These transparency standards apply to our analysis of data from a single study as well as to analyses that combine information from multiple studies.\(^\text{58}\)

In this case, the COT Report violates the Guidelines in that it does not contain sufficient transparency about data and methods to enable reanalysis. “The purpose of the reproducibility standard is to cultivate a consistent agency commitment to transparency about how analytic results are generated: the specific data used, the various assumptions employed, the specific analytic methods applied, and the statistical procedures employed.”\(^\text{59}\) “Reproducibility’ means that the information is capable of being substantially reproduced, subject to an acceptable degree of imprecision.”\(^\text{60}\) Again, the more important the information disseminated, the more rigorous the standard.\(^\text{61}\)

The highly influential COT Report does not meet these rigorous standards. Unfortunately, the COT Report and many of the studies upon which it relies have significantly flawed assumptions, questionable analytic models and questionable statistical procedures. \textit{See Exhibit A, gen.; see also Exhibit B at pages 7-11, 16-18, and 20.} Moreover, the underlying data behind many of the studies has not been publicly released.

Virtually all of the significant studies relied upon in the COT Report utilize models. \textit{See Exhibit B at pages 1, 9-11, 24, and 27.} For example, the COT Report relies extensively upon these models (even models built upon models) to evaluate the alleged human footprint on sagebrush habitat and alleged GRSG population responses. \textit{See Exhibit B at pages 9-11.} In

\(^{58}\) FWS Guidelines IV-3.
\(^{59}\) AVAILABLE AT: http://www.whitehouse.gov/omb/fedreg_reproducible
\(^{60}\) See OMB Guidelines V10; see also FWS Guidelines III-12.
\(^{61}\) OMB Guidelines V10.
contravening the Guidelines, the FWS has not demonstrated to OMB that there is no other option than to use the many third-party models disseminated in the COT Report.

While federal agencies often use various models developed by third parties to formulate policies based upon influential scientific information, the Guidelines require that influential scientific information be reproducible. This reproducibility standard generally requires that the models, data used to develop the models, and computer code used to develop such information be publicly available. As a result, the robustness checks required by the DQA and the Guidelines are missing or inadequate. See Exhibit A at pages 1, 4-6, 10, and 14; see also Exhibit B at page 14.

Moreover, the models themselves often exhibit a complete lack of transparency and reproducibility. See Exhibit B at page 14. What little background presented to the public regarding the models is presented in a confusing fashion with only vague references to the assumptions upon which it was based. For all of these reasons, the models and the conclusions based thereon in the information disseminated in the COT Report fail to meet the standards under the DQA and the Guidelines and require correction or retraction.

For all but a handful of studies, neither the Petitioners nor the public have access to information that is integral to these studies and the models upon which they depend. For example, states within the range of the GRSG collect annual counts on sage grouse leks. Integral to understanding the science of GRSG is the means upon which to count their populations and to predict potential trends. Agency biologists have cherry-picked lek count data from the states to form the basis of opinions memorialized in the key reports utilized by BLM, FWS and USGS. See Exhibit A at pages 6 and 12-16; see also Exhibit B at pages 11-12, 15, 17, and 19-20.
The modeling efforts within these studies form the backbone of the federal, top-down and one-size-fits approach.

Without the underlying data, these reports are neither transparent nor reproducible. The Alliance has requested lek count data from the states to ensure it has access to the best available science and the ability to test the hypotheses and results of these studies. Some states have been helpful in providing this information. While the Alliance has offered to execute nondisclosure agreements, other states are unwilling to share this data.

In the rare instances in which data has been surrendered, there are very serious data quality issues with the lek count data used in many of the cited studies. The quality issues are ignored by authors like Knick et al. 2013, Knick and Hanser 2011, Garton et al. 2011 and others, who summarize these data for use in GIS analyses that look very sophisticated. However, the majority of the underlying data, especially those before the late 1990s, are nearly worthless as is more than a little of the more recent data (i.e. undocumented methods, mixed methods, suspect values, satellite leks, incorrect datums, single counts, biased counts, and uncertainty that is never acknowledged). Not only are the data for these studies not public, but the methods used to arrive at the final data are not described with a level of detail that would allow them to be reproducible, rendering the entirety of the lek count data inoperative.

Federal and state agencies should not hold a monopoly on data that will be integral to land use decisions (or a listing decision) on GRSG. Nor should this information form the basis of Land Use Plan Amendments without adequate public scrutiny and transparency as required by the DQA, the Guidelines and DOI and supplemental authorities cited herein.

Accordingly, the FWS has insufficiently disclosed data sources and methodology in the information disseminated in the COT Report in violation of the DQA and the Guidelines. For
example, Garton et al. 2011, WAFWA 2008 and Connolly 2004 all modeled population trends using the same lek data. However, each reached different conclusions, because of how the lek data was interpreted (i.e. definition of a lek). Thus, it is clear that the information is subjective, not reproducible.62

C. The COT Report Does Not Comply with the President’s Direction on Scientific Integrity and Transparency

The COT Report also falls short of the President’s direction to executive departments and agencies. On March 9, 2009, President Obama issued a Memorandum setting forth principles “for ensuring the highest level of integrity in all aspects of the executive branch’s involvement with scientific and technological processes.”63 When scientific or technological information is considered in policy decisions, the information is to be subject to well-established scientific processes, including peer review where appropriate. Agencies are directed to appropriately and accurately reflect that information in complying with relevant statutory standards.64 Such was not the case here. For example, the COT Report relies heavily on Garton et al. 2011 which, itself, is fraught with issues including significant mathematical errors. E.g. Exhibit B at page 3.

President Obama committed to “an unprecedented level of openness in Government,” by “work[ing] together to ensure the public trust and establish a system of transparency, public participation, and collaboration.”65 President Obama believes that “[o]penness will strengthen

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62 Center for Environmental Science, Accuracy and Reliability (CESAR). (2012). Science or Advocacy? Ecology and Conservation of Greater Sage-Grouse: A Landscape Species and its Habitats: An analysis of the four most influential chapters of the monograph (Each group employed different methods, including undocumented and subjective methods, for defining what constituted a “lek” and including/excluding lek counts obtained from them).


64 Id.

our democracy and promote efficiency and effectiveness in Government.”66 The importance of
government transparency cannot be overstated, as “transparency promotes accountability and
provides information for citizens about what their Government is doing.”67 President Obama
intends for his Administration to “disclose information rapidly in forms that the public can readily find and use.”68 Executive departments and agencies are explicitly instructed to “harness
new technologies to put information about their operations and decisions online and readily
available to the public. Executive departments and agencies should also solicit public feedback
to identify information of greatest use to the public.”69

In this case, the COT Report has been far from transparent. The FWS failed to disclose
virtually any information relative to transparency and the COT Report until forced to do so by
the Alliance’s FOIA litigation.

President Obama reaffirmed his commitment to scientific integrity as part of his second
term’s scientific agenda in 2012.70 More specifically, the president stated that he had “directed
the White House Office of Science and Technology Policy to ensure that our policies reflect
what science tells us without distortion or manipulation,” because the President has “insisted that
we be open and honest with the American people about the science behind our decisions.”71
Because, “only by ensuring that scientific data is never distorted or concealed to serve a political
agenda, making scientific decisions based on facts, not ideology, and including the public in our
decision making process will we harness the power of science to achieve our goals – to preserve

66 Id.
67 Id. (emphasis added).
68 Id.
69 Id.
71 Id.
our environment and protect our national security; to create the jobs of the future, and live longer, healthier lives.”72

As discussed herein, the COT Report presents a distorted and biased view of threats to GRSG and mechanisms proposed to protect them. The COT Report is rife with misrepresentation, misuse of citations and reliance on opinion rather than the scientific method. See Exhibits A and B, gen.

For all of the reasons addressed herein, the COT Report fails the transparency and reproducibility standards of the DQA, the Guidelines, and the presidential direction to agencies on scientific integrity and transparency.

D. The COT Report Fails to Comply with DOI Scientific Integrity Standards

The COT Report also runs afoul of DOI direction on scientific integrity. The Departmental Manual (“DOI Manual”)73 implemented a secretarial order: Integrity of Scientific and Scholarly Activities (effective Jan. 28, 2011). The Manual defines “scientific and scholarly integrity” to mean, “[t]he condition resulting from adherence to professional values and practices, when conducting and applying the results of science and scholarship, that ensures objectively, clarity, reproducibility, and utility.”74 Unfortunately, the COT Report suffers from a lack of objectivity, clarity, reproducibility and utility. See Exhibits A and B, gen.

On December 16, 2014, DOI updated and strengthened the policy to “ensure that all Interior employees and contractors uphold the principles of scientific integrity.”75 The policy is to establish the expectations for how scientific and scholarly information is considered and used:

72 Id.
73 Available at: http://clips.doi.gov/clips/browse.aspx. [VERIFY CITATIONS TO REFLECT DECEMBER UPDATE]
74 Id.
75 U.S. Department of the Interior, Press Release: Interior Department Announces Strengthened Scientific Integrity Policy for Employees and Contractors,
Scholarly information considered in Departmental decision making must be robust, of the highest quality, and the result of as rigorous scientific and scholarly processes as can be achieved. Most importantly, it must be trustworthy. This policy helps us to achieve that standard.\textsuperscript{76}

Further, the policy is to ensure that:

- Decisions are based on science and scholarship are respected as credible;
- Science is conducted with integrity and excellence;
- Has a culture of scientific and scholarly integrity that is enduring;
- Scientists and scholars are widely recognized for excellence; and
- Employees are proud to uphold the high standards & lead by example.\textsuperscript{77}

The policy applies to DOI employees as well as, “contractors, cooperators, partners, permittees, leasees, grantees, and volunteers, when they engage in, supervise, manage, or influence scientific and scholarly activities, or communicate information about the Department's scientific and scholarly activities, or utilize scientific and scholarly information in making agency policy, management or regulatory decisions.”\textsuperscript{78} Adherence to these DOI standards is to ensure, “objectivity, clarity, reproducibility, and utility of scientific and scholarly activities and assessments and helps prevent bias, fabrication, falsification, plagiarism, outside interference, censorship, and inadequate procedural and information security.”\textsuperscript{79}

For the reasons expressed herein, the COT Report does not meet the standards of quality and robustness required. It was hardly as “rigorous scientific and scholarly process[es] as can be achieved.” \textbf{See Exhibit A at page 6.} In addition, the COT Report has been far from transparent. The FWS failed to disclose virtually any information relative to transparency and the COT Report until forced to do so by the Alliance’s FOIA litigation.

\textsuperscript{76} 305 DM 3.4.; I:\Western Energy Alliance\DQA Challenge\Research\Interior Dept. New Policy\Integrity of Scientific and Scholarly Activities.html (emphasis added).
\textsuperscript{77} I:\Western Energy Alliance\DQA Challenge\Research\Interior Dept. New Policy\Integrity of Scientific and Scholarly Activities.html
\textsuperscript{78} I:\Western Energy Alliance\DQA Challenge\Research\Interior Dept. New Policy\Integrity of Scientific and Scholarly Activities.html
\textsuperscript{79} 305 DM 3.5.
Finally, the FWS has also failed to meet its charge in OMB Circular A-130, “[A]gencies should inform the public as to the limitations inherent in the information dissemination product (e.g., possibility of errors, degree of reliability, and validity) so that users are fully aware of the quality and integrity of the information.” The COT Report has clearly glossed over limitations inherent in the report and the studies cited therein. See Exhibits A and B, gen.

E. The COT Report Did Not Undergo Adequate nor Open Peer Review

The COT Report failed to undergo adequate peer review as required by the DQA, the Guidelines and the presidential and secretarial orders and memoranda discussed herein. Notably, this is not the first time the FWS peer-review process has been criticized. On December, 15, 2014, Majority Staff for the House Natural Resources Committee issued a report: Under the Microscope: An examination of the questionable science and lack of independent peer review in Endangered Species Act listing decisions (the “House Report”). The House Report detailed systemic flaws and inconsistencies with the peer review process employed by the FWS.

Peer review is a process by which something proposed (as for research or publication) is evaluated by a group of experts in the appropriate field. Peer review is used to ensure work meets appropriate standards, and ensure and maximize that the quality, objectivity, utility, and integrity of provided information meets the standards of the scientific and technical community. Reviewers are not to be selected from among the authors’ close colleagues, students, or friends.

1. Peer Review Planning was Incomplete or Nonexistent

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80 http://www.whitehouse.gov/omb/circulars_a130
81 http://naturalresources.house.gov/uploadedfiles/esa_peer_review_science-staff_report.pdf
83 Id.
84 http://www.cio.noaa.gov/services_programs/pdfs/OMB_Peer_Review_Bulletin_m05-03.pdf
85 http://www.apsanet.org/content_43805.cfm; http://www.elsevier.com/journals/journal-of-molecular-biology/0022-2836/guide-for-authors
DOI’s Information Quality Mission Statement provides, in pertinent part:

In order to ensure the accuracy and integrity of its published scientific information, DOI follows a robust peer review process wherein the information undergoes internal peer review and is subject to public scrutiny. DOI, its bureaus and offices, and the National Invasive Species Council maintain the highest standards possible for published information to ensure integrity and transparency.86

Given the charge of the reviewers of the COT Report, we question how “robust” the peer review process actually was. In addition, peer review of the COT Report was not subject to any public scrutiny whatsoever.

In this case, the FWS has failed to meet the applicable peer review planning standards.87

The DOI Guidelines require not only that information be consistent with the Guidelines, but that the agency maintain an administrative record of review proceedings.88 Further, for influential information, DOI commits to provide “more rigorous review of the conclusions than the review performed by the originating office.”89 The FWS has not issued any such records for the COT Report and has certainly provided no evidence of the rigorous review required.

Depending on the aim and purpose of the peer reviews, the criteria for selecting peers and the methods employed may vary. Editors of scientific journals use reviewer comments to help determine whether a draft scientific article is of sufficient quality, importance, and interest to a field of study to justify publication. Research funding organizations often use peer review to evaluate research proposals. Some federal agencies make use of peer review to obtain evaluations of draft information that contains important scientific determinations.90

The government-wide guidance to peer review of government science is established in the “Final Information Quality Bulletin for Peer Review” issued by the Office of Management

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88 DOI Guidelines II.5.
89 Id.
90 See Id. at 3.
and Budget (OMB) of the Executive Office of the President (the “OMB Peer Review Bulletin”).\textsuperscript{91} The OMB Peer Review Bulletin provides detailed guidelines for peer review of influential scientific information and applies more stringent peer review requirements to highly influential scientific assessments. It includes guidance on what information is subject to peer review, the selection of appropriate peer reviewers, opportunities for public participation, and related issues. Such is clearly applicable to the COT Report.

According to the OMB Peer Review Bulletin, the peer review shall be solely of scientific and technical matters.\textsuperscript{92} Peer review typically evaluates 1) the clarity of hypotheses, 2) the validity of the research design, 3) the quality of data collection procedures, the robustness of the methods employed, 4) the appropriateness of the methods for the hypotheses being tested, 5) the extent to which the conclusions follow from the analysis, and 6) the strengths and limitations of the overall product.\textsuperscript{93}

The OMB Peer Review Bulletin’s guidelines require that reviewers are selected based upon 1) expertise: to ensure that the selective reviewer has the knowledge, experience, and skills necessary to perform the review, 2) balance: to represent a diversity of scientific perspective relevant to the subject, 3) independence: to ensure that the reviewer was not involved in producing the draft document to be revised, 4) conflict of interest: to examine prospective reviewers’ potential financial conflict including significant investments, consulting arrangements, employer affiliations, and grants/contracts.\textsuperscript{94}

As discussed below, the rigorous review required by the DQA, the Guidelines and the OMB Peer Review Bulletin was not completed for the COT Report.

\textsuperscript{91} Id.
\textsuperscript{92} http://www.nrc.gov/public-involve/ml051600303.pdf
\textsuperscript{93} See Id. at 3.
\textsuperscript{94} http://www.cio.noaa.gov/services_programs/pdfs/OMB_Peer_Review_Bulletin_m05-03.pdf
2. **Conflicts of Interest in the COT Report and its Peer Review**

A small number of GRSG specialist-advocates have had a disproportionate influence on formulating federal policy including their overlapping participation in preparation the NTT and COT Reports as well as the highly influential GRSG Monograph and peer reviews thereon. More diverse expertise and viewpoints are clearly needed. More importantly, these issues exhibit serious conflicts of interest in contravention to the DQA, the Guidelines and the presidential memoranda and DOI orders cited herein.

As a result (and only as a result) of the Alliance’s FOIA litigation, the FWS ultimately disclosed data and information relative to peer review of the COT Report. Specifically, FWS released a document titled, “Scientific Peer Review of the Sage-Grouse Conservation Objectives Draft Report.” From that disclosure, we understand the FWS retained Atkins, North America (“Atkins”) to perform the review. Atkins solicited five reviewers: 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, and Dr. James S. Sedinger, University of Nevada, Reno. Atkins was asked to solicit well-qualified and independent reviewers with certain expertise and to ensure they had no financial or other conflicts with the outcome or implications of the COT Report.

However, peer review failed to meet the applicable standards. Among the deficiencies were: authorship with three COT Report team members; grant support from the FWS and USGS; significant financial support for GRSG research (Drs. Holloran, Messmer and Reese

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95 Western Energy Alliance submitted a FOIA request to the FWS on May 2, 2013. When the FWS failed to respond, Western Energy Alliance filed a FOIA suit against the FWS on October 15, 2013. On October 24, 2013, the FWS provided some of the documents requested.

96 Scientific Peer Review of the Sage-Grouse Conservation Objectives Draft Report at 3.

97 *Id.* at 2.
listed over $10 million); authorship with NTT members; and authorship with other influential GRSG authors including Doherty, Naugle, and Knick. For example:

Reese and Connelly (an author of the COT Report and author of many cited papers in the COT Report) published eight papers together, including two papers in 2012 and four papers in 2011. All of these were included in Greater Sage-Grouse Ecology and Conservation of a Landscape Species and its Habitats (the “GRSG Monograph”) which Connelly edited (similar conflicts exist with Connelly and Garton on the population persistence chapter). Dr. Reese participated in no fewer than eleven presentations with Connelly, four with Gardner (another COT Report author) and four with Garton. Garton et al. 2011 forms the very basis of the COT Report and is the most frequently cited paper therein. Dr. Reese also discloses a $255,203 grant with Garton in 2011 and over $1.3 million in sage-grouse funding including $178,442 from the USGS (the funding agency on the GUSG Monograph).

Beck has two papers with Connelly. Dr. Beck authored numerous papers with other sage-grouse biologists including Naugle (an author of the NTT Report). No financial support is listed, but given that Beck has published 12 papers on sage-grouse, such support could be expected to be significant.

Holloran is one of the most cited papers in the COT Report. He authored a 2011 Monograph paper with Connelly, and another with Connelly and Knick (NTT Report authors and editors of the GRSG Monograph). Dr. Holloran also authored three papers with Connelly in 2006, 2009, and 2012. Dr. Holloran’s Ph.D. dissertation concluded “currently imposed [natural gas] developmental stipulations are inadequate to protect the greater sage-grouse, and that stipulations need to be modified to maintain populations within natural gas fields.” Note the amount of financial support on six recent grants and contracts on sage-grouse totaled more than $3.1 million. Funding sources were not listed. This indicates a bias by Dr. Holloran that calls into question his ability to perform an independent peer review. Holloran also coauthored a USGS Science Summary paper with Manier, Wood and Oyler-McCance of the USGS.

Messmer reported no authorship conflicts with COT Report team members; however, he listed financial support for some 18 recent grants and contracts on sage-grouse totaling more than $2.3 million.

Sedinger was an author with COT Report team member Espinosa (on a 2011 Monograph chapter and a 2010 paper). Grant and contract support includes $40,000 on sage-grouse from BLM, and five grants and contracts totaling $252,939 from the FWS.

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98 Reese listed over $6.3 million in funding and in-kind contributions, but failed to account for precisely how much can be attributable to sage-grouse.
99 Scientific Peer Review of the Sage-Grouse Conservation Objectives Draft Report, Appendix A
These are indicative of serious conflicts of interest.101 The DOI Manual defines a conflict of interest as “any personal, professional, financial, or other interests that conflict with the actions or judgments of those covered by this policy when conducting scientific and scholarly activities or using scientific and scholarly data and information because those interests may: (1) significantly impair objectivity; (2) create an unfair competitive advantage for any person or organization; or (3) create the appearance of either.”102

DOI’s Manual defines a conflict as, “[A]ny personal, professional, financial, or other interests of those covered by this policy … that is prohibited by an applicable law or policy, which may include federal ethics requirements, applicable standards issued by the Office of Government Ethics, federal acquisition requirements, and the prevailing practices of the National Academy of Sciences as adopted by OMB.”103 The DOI Manual also prohibits department employees, volunteers, contractors, etc. from “engaging in activities that put [them] or others in an actual or apparent conflict of interest.”104 The same employees, volunteers, contractors, etc. are required to “clearly differentiate among facts, personal opinions, assumptions, hypotheses, and professional judgment in reporting results…” and “not withhold information that might not support the conclusions, interpretations, and applications [he or she] make[s].”105

The COT Report, and peer review thereon, was rife with such conflicts. As discussed herein, the NTT was rife with conflicts. For example, Knick was the author and editor of his

103 305 DM 3.5(E).
104 Id. at 3.7(A)(5).
105 Id. at 3.7(A)(7) – (9).
own work, which he then cites and uses in the NTT Report. The Center for Environmental Science, Accuracy & Reliability exposed these and other issues in its scathing review of the Monograph.  

The OMB Peer Review Bulletin requires agencies to adopt or adapt the National Academy of Sciences policy and procedures depicted in the “Committee Composition and Balance and Conflicts of Interest”. According to this policy, it is essential that the work of committees of the institution used in the development of reports not be compromised by any significant conflict of interest. For this purpose, the term "conflict of interest" means any financial or other interest which conflicts with the service of the individual because it (1) could significantly impair the individual's objectivity or (2) could create an unfair competitive advantage for any person or organization. Such is clearly the case here.

Extensive citations to Braun must be discarded due to conflicts of interest pursuant to the laws and policies referenced herein. Dr. Braun was a paid consultant to the activist groups that petitioned to list GRSG and an active proponent for listing. Braun is quoted in a press release threatening a federal listing of the species if the BLM did not undertake management changes in line with his views.

Naugle (cited frequently by the FWS) served as his own editor for Naugle et al. 2011a. His co-authors on the study included Doherty, Walker, Copeland, Holloran and Tack. Doherty et al. 2008 was cited 6 times in the NTT Report and once in the COT Report. Naugle and Walker were co-authors on Doherty et al. 2008. Doherty co-authored at least three other papers with Naugle (Doherty et al. 2010a, Doherty et al. 2010b, and Doherty et al. 2011). Doherty and

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106 https://www.hightail.com/download/UW14OU1VMVh0TWxYd3NUQw.
107 See Id. at 10.
108 http://www.nationalacademies.org/coi/bi-coi_form-0.pdf
Holloran have been co-authors on at least one other paper. Walker et al. 2007 was cited nine (9) times in the NTT Report and two (2) 2 times in the COT Report. Walker and Naugle 2011 was cited once in the NTT Report. Holloran 2005 was cited twelve (12) times in the NTT Report, two (2) times in the COT Report and nineteen (19) times in the 2010 FWS listing decision on GRSG. Tack was cited three (3) times in the NTT Report.

Knick et al. 2003 was cited once in the NTT Report and 14 times in the COT Report. Knick and Hanser 2011 was cited six (6) times in the NTT Report, eight (8) times in the COT Report and 38 times in the 2010 GRSG listing decision. Knick et al. 2011 was cited six (6) times by the NTT Report and two (2) times by the COT Report. Leu and Hanser 2011 was cited in the USGS Monograph and three (3) times in the COT Report. Skagen, another USGS employee, and Espinosa were listed as reviewers on the paper. Oyler-McCance has long been a listing advocate for GRSG and Gunnison-sage grouse.

A number of the relevant regulations and guidance stress the importance of independence\(^{110}\) and the need to avoid conflicts of interest.\(^{111}\) Among other things, independence means that a peer reviewer may not have been a contributor to the work product leading to the listing of a species and the peer reviewer has not been influenced by funding considerations. The National Academy of Sciences (“NAS”) considers financial interests, access

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to confidential information, reviewing one’s own work, public statements and positions, and employees of sponsors as problems to be avoided in its conflicts policy. Again, the 2005 OMB Peer Review Bulletin directs agencies to use the NAS policy.

Such reliance on such a select group of advocates is clearly contrary to the DQA, its implementing Guidelines, the DOI Manual, NAS policy and secretarial orders and presidential memoranda discussed herein.

3. **Peer Review Failed to Undergo Public Comments**

In this case, the FWS failed to produce an administrative record and DOI provides no evidence that it rigorously reviewed the COT Report as required. Neither did the FWS submit peer reviews on the COT Report to the public for review and comment. As referenced above, only upon commencement of FOIA litigation did FWS divulge the information requested relative to peer review on the COT Report. This information should have already been publically available.

The OMB Peer Review Bulletin established government-wide guidance to improve the peer review of scientific documents, providing specific requirements for “influential scientific information” and “highly influential scientific assessments.” Under these definitions, the reports in question clearly necessitate higher minimum requirements with respect to public transparency. These requirements include; peer review prior to dissemination, by reviewers with expertise, balance, independence, and no conflict of interest. Also, “[t]he agency shall disclose the names of the reviewers and their organizational affiliations in the report.” Above and beyond these requirements, “an agency conducting a peer review of a highly influential scientific assessment must ensure that the peer review process is transparent by making available to the public the

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112 Available at: http://www.nap.edu/openbook.php?isbn=0309059437&page=9
114 Id. (emphasis added).
written charge to the peer reviewers, the peer reviewers’ names, the peer reviewers’ report(s), and the agency’s response to the peer reviewers’ report(s).”

If the peer review process is challenged under the DQA, as it was here, the peer reviewer’s name(s), the peer reviewer’s report(s), and the agency’s response to the peer reviewer’s report(s) must be made public. In regards to transparency for influential scientific information, the FWS Guidelines state that the agency, “will not conduct anonymous peer reviews of influential information.” In fact, “[r]eviewers of influential information will be advised that their independent reviews, including their names and affiliations, and how the FWS responded to their comments will (1) be included in the official record for this review, and (2) once all the reviews are completed, will be available to the public.” Again, the FWS failed to do so in this case until the Alliance pursued FOIA litigation. Even then, the FWS chose to provide only unattributed reviews in contravention of the DQA. This is directly contrary to OMB Peer Review Bulletin and the DOI and FWS Guidelines.

In reference to its peer review planning process requirements, DOI directs readers to links to its agencies’ websites. Notably, the FWS peer review link contains absolutely no

115 Id.
116 See BLM, Data Quality Guidelines/Bulletin for Peer Review, http://www.blm.gov/wo/st/en/National_Page/Notices_used_in_Footer/data_quality.html (last visited Dec. 23, 2014 at 8:46 AM); see also Bureau of Land Management, Information Quality Guidelines, http://www.blm.gov/style/medialib/blm/national/national_page.Par.7549.File.dat/guidelines.pdf (updated February 9, 2012) (last visited Dec. 22, 2014 at 5:13 PM) (“The BLM is issuing these guidelines to comply with the standard of quality by ensuring and maximizing objectivity, utility, and integrity of disseminated information. In accordance with the OMB guidelines, objectivity, integrity, and utility are defined. ‘Objectivity’ focuses on whether the disseminated information is being presented in an accurate, clear, complete, and unbiased manner, and as a matter of substance, is accurate, reliable, and unbiased. ‘Integrity’ refers to the protection of information from unauthorized access or revision, to ensure that the information is not compromised through corruption or falsification. ‘Utility’ refers to the usefulness of the information to the intended users, including the public.”).
117 Id. at 15.
118 Id.
119 Draft Scientific Peer Review of the COT Report at 3.
120 It should be noted that the most recent Peer Review Report referenced by DOI in its link for “Information Quality and Peer Review Reports,” was from FY2010.
reference to peer review on the COT Report. On a related note, we question whether the FWS demonstrated in a Paperwork Reduction Act submission to OMB that the proposed collection of information in the COT Report was collected, maintained and used consistent with the DQA Guidelines. Please confirm.

4. Other Flaws with Peer Review

The OMB guidelines state that information will generally be presumed to be objective if data and analytic results have been subjected to formal, independent peer review; however, this presumption is rebuttable “based on a persuasive showing by a petitioner in a particular instance.” The issue is what will be considered a “persuasive showing” that will overcome the presumption of objectivity under the proposed agency guidelines. When technical information is subject to “formal, independent, external peer review, the information may generally be presumed to be of acceptable objectivity.”

An example of such a review is the process used by scientific journals. However, even journal peer review does not necessarily equate to quality. As OMB has recognized, there are well-documented examples of flawed science published in respected journals. Accordingly, the presumption is rebuttable. In this case, the significant conflicts of interest and failure to adhere to DQA standards overcome such a presumption.

For influential information, DOI committed to a high degree of transparency about data and methods to facilitate reproducibility. In this case, the FWS has not met the applicable standards for peer review. The FWS refused to even disclose information on peer review of the

122 DOI Guidelines VI.
124 AVAILABLE AT: [http://www.whitehouse.gov/omb/fedreg_reproducible](http://www.whitehouse.gov/omb/fedreg_reproducible)
125 Id.
126 AVAILABLE AT: [http://www.whitehouse.gov/omb/fedreg_reproducible](http://www.whitehouse.gov/omb/fedreg_reproducible)
127 Id.
128 DOI Guidelines VII.3.b.ii.
COT Report until forced to disclose via FOIA litigation. It solicited only unattributed reviews on
the COT Report. Finally, serious conflicts issues abound with regard to the reviewers of the
COT Report. Moreover, the FWS failed to address several comments and issues raised by peer
reviewers in the COT Report. See Exhibit A at pages 4-5.

Scientists and scholars are required to “place quality and objectivity or scientific and
scholarly activities and reports ahead of results or personal gain or allegiance to individuals or
organizations.”129 Scientists and scholars are further required to “welcome constructive criticism
of [their] scientific and scholarly activities and … be responsive to their peer review” and
“provide constructive, objective, and professionally valid peer review of the work of others, free
from any personal or professional jealously, competition, non-scientific disagreement, or conflict
of interest.”130 In this case, significant issues raised during the peer review process were either
ignored or not adequately addressed in the final COT Report. See Exhibit A, gen.

For example, more than one reviewer cited real uncertainties regarding management and
potential impacts on GRSG populations. In fact, “…the majority of the 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.…”131
Reviewers identified an astonishing lack of reference to at least 15 relevant scientific papers.132

Fundamentally, the COT Report did not meet its stated objectives with regard to the
degree to which threats need to be ameliorated.133 Risk levels may need to be reconsidered and
there was doubt expressed that threat ratings were credible.134 One reviewer noted that it was

129 Id. at 3.7(B)(1).
130 Id. at 3.7(B)(5) – (6).
131 Scientific Peer Review of the Sage-Grouse Conservation Objectives Draft Report at 3.
132 Id. at 7.
133 Id. at 5.
134 Id. at B-16.
questionable how scientific sources were used to establish risks and that there were limited (if any) direct relationships between habitat characteristics and population change.\(^\text{135}\) For example, the COT Report cited Knick et al. 2003; Connelly et al. 2011a for the proposition that large seasonal and annual movements emphasize the need for large, functional landscapes to support viable populations.\(^\text{136}\) Knick et al. 2003 was cited an astonishing fourteen (14) times in the COT Report. The very title of this piece evidences extreme bias, “Teetering on the edge or too late?...” In addition, the authors complain about a lack of political agenda and advocate that public lands be “Protect[ed] from economic use.”

Perhaps it should be no surprise that Knick was an NTT member as well as editor of the highly influential sage grouse monograph and author of nine papers within it. See Exhibit B at pages 8-9. This raises serious issues about the lack of independence of the COT Report and the validity of the scientific information that the COT Report relied upon to formulate recommendations. Moreover, Knick et al. 2003 is not supported by data and relies on the invalid assumption that GRSG cannot bypass unsuitable or fragmented habitat during seasonal movements. See Exhibit B at page 6-7, and 11. Actually, as addressed elsewhere herein, GRSG are known to fly over great distances. Connelly et al. 2011 is fraught with similar errors of omission and inaccuracies.

Reviewer 2’s comments indicate a bias in favor of listing and his belief that existing regulatory mechanisms are inadequate for sage-grouse. Reviewer 2 complained that they were not required to review how conservation objectives would be met, “I assume that another group at another time in another forum will do this, otherwise the species will remain in peril.”\(^\text{137}\) He further stated, “COT should be urging for enhanced, improved and additional management

\(^{135}\) Id. at 7.
\(^{136}\) COT Report at 8-9.
\(^{137}\) Id. at B-16.
actions because the “continued” is not adequate as is across most of the species range.” 138 Reviewer 2 praised Garton, along with “limited” scientific references and expert opinion as the “strongest part” of the COT Report. 139 This raises the question of whether Reviewer 2 was one of the reviewers that has worked very closely with Garton.

Some terms, like fragmentation, were not well defined. 140 Resistance and resilience were never quantified causing some to label them redundant, of little use, and little substance. 141 Reviewers also cited generalities, uncertainties, and questions regarding whether some recommendations were feasible or practicable.

Reviewer 1 admonished the COT Report to acknowledge that we truly do not know the magnitude of population declines of GRSG. 142 Some concepts were ambiguously defined and not enough information was provided to assess threat ranking. 143 A lack of transparency in the threats analysis was a common theme. Reviewer 3 could not even replicate the results of the analysis (Table 2) with the information provided. 144 This evidences failure to meet the transparency and reproducibility requirements of the DQA, the Guidelines and the additional authorities cited herein.

The COT Report ignored evidence that GRSG may adapt to a disturbed environment. For example, highly naturally fragmented habitats have GRSG persistence. Some reviewers commented that genetics-based connectivity was over-emphasized and should be considered a much lower priority. 145 One reviewer commented that the COT Report failed to take into account that effects of infrastructure may be more related to the level of disturbance relative to

138 Id. at B-17.
139 Id. at B-19.
140 Id. at 5.
141 Id. at 4.
142 Id. at B-4.
143 Id. at B-23.
144 Id. at B-23.
145 Id. at B-27.
habitat quality rather than mere presence.\textsuperscript{146} The COT Report did not analyze how, if threats are addressed, population persistence may be altered.\textsuperscript{147} Incredibly, Reviewer 3 recognized the COT Report could not acknowledge what effective habitat management was. He also noted the COT Report failed to address the effectiveness of existing regulatory measures. Reviewer 3 remarked, “[I]n 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.”\textsuperscript{148}

The COT Report discounts established strategies to protect the “best of the best” habitat along with many of the significant conservation efforts currently utilized by the states. Reviewer 1 stated the COT Report should be seen as a tool rather than an absolute.\textsuperscript{149} He also noted that management actions were largely at the purview of the states.\textsuperscript{150}

The COT Report does not recognize the latest state and local habitat mapping efforts. For example, some areas defined as habitat in the COT Report do not exist. Reviewer 1 explained the COT Report also ignored that tribal lands provide and protect significant habitat for GRSG in Utah.\textsuperscript{151} Reviewer 2 noted several priority areas seem to have been labeled in an inconsistent manner.\textsuperscript{152} Descriptions of seasonable habitat were also lacking.

Reviewer 4 questioned how the footprint of renewable energy development might differ from nonrenewable energy development\textsuperscript{153} and that statements in the COT Report about predation were speculative with no empirical basis.\textsuperscript{154} Reviewer 4 pointed out that direct relationships between specific habitat characteristics and population change are limited, if not

\begin{flushright}
\textsuperscript{146} Id. at B-7.
\textsuperscript{147} Id. at B-9.
\textsuperscript{148} Id. at B-21.
\textsuperscript{149} Id. at B-3.
\textsuperscript{150} Id. at B-3.
\textsuperscript{151} Id. at B-7.
\textsuperscript{152} Id. at B-15.
\textsuperscript{153} Id. at B-28.
\textsuperscript{154} The COT Report suggests the best way to mitigate predation is to maintain quality habitat with good connectivity.
\end{flushright}
lacking entirely. 155 The COT Report fails to capture an understanding of effects on GRSG from most of the potential risks referenced. “We have a poor empirical basis for understanding most potential impacts on sage-grouse,” said Reviewer 4. 156 He continued, “[T]his severely limits our ability to predict the response of sage-grouse populations to changes in their habitats.” 157 Similarly, Reviewer 5 remarked that conclusions in the threats analysis were based upon findings stemming from professional opinion. 158

Given these issues, DOI should retract or correct the COT Report. To do otherwise would be inconsistent with the DQA and the Presidential and DOI memoranda and orders referenced above. The FWS clearly failed to address these fundamental shortcomings with the COT Report and failed to adequately explain assumptions, limitations and bias in the information disseminated. See Exhibit A, gen.; see also Exhibit B at pages 1, 6-16, and 19. Garton et al. 2011, Holloran 2005 and Blickley et al. 2012 also provide relevant examples. Accordingly, the COT Report falls short of the DQA, the Guidelines and the OMB Peer Review Bulletin. It also contradicts the FWS’s own policy on peer review. [cite]

F. Robustness Checks Are Missing or Inadequate

The COT Report failed to undergo adequate robustness checks to meet the DQA standards of quality, objectivity, utility and integrity. See Exhibits A and B, gen. For example, there are substantial technical errors in the COT Report including many misleading citations. E.g. Exhibit B at page 18. This makes it difficult to provide scientific verification of the COT Report’s claims. The COT Report is also guilty of misleading use of authority. 159 See also Exhibit B at page 18. Pyke et al. 2011 is but one example. Furthermore, by making

156 Id. at B-27.
157 Id. at B-29.
158 Id. at B-33.
159 Id.
recommendations, and then seeking scientific support for them, the COT was in effect backing into their preferred conclusions rather than providing a comprehensive and objective treatment of alternatives.

These issues evidence bias and a lack of transparency and reproducibility in contravention to the DQA and the Guidelines. They also violate Executive Order 13563, which calls for “objectivity of any scientific and technical information and processes used to support [an] agency’s regulatory actions.”160 As a result, the public has not been afforded the opportunity to determine the objectivity, utility, and reproducibility of the COT Report in contravention of the DQA, the Guidelines and the additional authorities referenced herein.

G. The COT Report Was Not Based on the Best Available Science

The COT Report failed to meet DQA standards for the best available data. Agencies are directed161 to adopt congressional standards of scientific integrity stemming from the Safe Drinking Water Act (“SDWA”),162 For agency action based on science, the SDWA standards must entail:

   (i) the best available, peer-reviewed science and supporting studies conducted in accordance with sound and objective scientific practices; and (ii) data collected by accepted methods or best available methods (if the reliability of the method and the nature of the decision justifies use of the data).163

This standard is not subject to agency discretion but for application to various types of risk assessment.164 The DOI Guidelines further commit, to the extent practicable, to:

   (a) Use the best available science and supporting studies conducted in accordance with sound and objective scientific practices, including peer-reviewed studies where available.

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161 OMB Guidelines V3.b.ii.B.ii.C.
163 AVAILABLE AT: http://www.whitehouse.gov/omb/fedreg_reproducible
164 Id.
(b) Use data collected by standard and accepted methods or best available methods (if the reliability of the method and the nature of the decision justifies the use of the data).

(c) In the dissemination of influential scientific information about risks, ensure that the presentation of information is as comprehensive as possible, informative, and understandable. In a document made available to the public, specify, to the extent practicable:

(i) Each population addressed by any estimate of applicable effects
(ii) The expected risk or central estimate of risk for the specific populations affected
(iii) Each appropriate upper bound or lower-bound estimate of risk
(iv) Each significant uncertainty identified in the process of the risk assessment and studies that would assist in reducing the uncertainty
(v) Any additional studies, including peer-reviewed studies, known to the Department that support, are directly relevant to, or fail to support the findings of the assessment and the methodology used to reconcile inconsistencies in the scientific data. DOI Guidelines II.4 (emphasis added).

Here, the COT Report and the studies cited therein fail to meet the best available science standards. See Exhibit A at pages 2-3, 8, and 14. The information disseminated fails to meet DQA standards for quality, objectivity, integrity and utility. Significant uncertainties are ignored and conjecture and opinion are presented as facts, ie the presence and intensity of threats, and their impacts to GRSG.

Executive Order 13562 also requires that regulations “must be based on the best available science:**

(b) … each agency must, among other things:

(1) propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify);
(2) tailor its regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations;
(3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental,

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public health and safety, and other advantages; distributive impacts; and equity);

(4) to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public.

(c) In applying these principles, each agency is directed to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. Where appropriate and permitted by law, each agency may consider (and discuss qualitatively) values that are difficult or impossible to quantify, including equity, human dignity, fairness, and distributive impacts.\[^{166}\]

In this case, the FWS cannot possibly justify the alleged benefits of measures recommended in the COT Report against the dramatic societal costs they would entail. The FWS is directed to select approaches that impose the least burden on society and to identify alternatives to direct regulation. Here, the FWS did not even attempt to do so.

The onerous regulatory measures recommended in the COT Report are far from justified. In fact, they impose an incredible burden on the Petitioners and the public without scientific justification.

1. The COT Report Fails the Scientific Method

While scientific integrity and transparency in agency decision making are clearly enumerated priorities for this administration, the COT Report falls far short of these goals. See Exhibit A at pages 4, and 9-10. The COT Report description of “science” makes no mention of hypothesis testing or potential falsification. Accordingly, it runs counter to the DOI Manual on Scientific Integrity as well as the DQA and its Guidelines. The DOI Manual defines the scientific method as, “[A] method of research in which a problem is identified, relevant data are gathered, a hypothesis is formulated from these data, and the hypothesis is empirically tested in a

\[^{166}\] Id. (emphasis added).
manner specified by documented protocols and procedures.” The COT Report relies on a subjective interpretation of results which is a clear departure from the scientific method. The fact that the COT started with their preferred conservation measures, and then sought to justify them, reveals that it misused the scientific method in order to reverse-engineer their recommendations. Further, the justification for recommending avoidance or little to no development within PACs across types of use is not based on tested hypotheses. Rather these overly restrictive recommendations are purely speculative in terms of effectiveness, based on subjective interpretation of results, do not address the primary cause and effect mechanisms limiting sage-grouse, and will likely do nothing for the sage-grouse by promoting passive rather than active management.

H. Bias and Lack of Objectivity in the COT Report

The COT Report failed to meet DQA standards for quality and integrity. The DQA requires agencies to issue guidelines ensuring and maximizing the “objectivity” of all information they disseminate. The OMB guidelines implementing the legislation define “objectivity,” and that definition includes a requirement that information be “unbiased” in presentation and substance. “Objectivity,” along with “unbiased,” is correctly considered to be, under the OMB guidelines, an “overall” standard of quality.\footnote{67 Fed. Reg. 8452, 8458 (Feb. 22, 2002).}

The COT Report is biased by the use of policy-driven assumptions, inferences, and uncertainties that are not supported by scientific data. It inadequately treats uncertainties through presumptive interpretations of data and inaccurate portrayal of threats through differential treatment of environmental factors. For example, the COT Report fundamentally and erroneously assumes GRSG populations are in decline; and that declines in lek attendance equate

\footnote{305 DM 3.5(N).}
to population declines.\textsuperscript{169} It also concedes to a near-total lack of knowledge on how GRSG respond to anthropogenic disturbance, yet proposes multitudes of unfounded regulatory restrictions to address them.

The COT Report is not presented in an accurate, clear, complete and unbiased manner pursuant to OMB Guidelines.\textsuperscript{170} \textit{See Exhibits A and B, gen.; see also Exhibit C.} For example, the modeling and assumptions in studies cited in the Report fail to meet the standards of the DQA, the Guidelines or the additional authorities cited herein. \textit{See Exhibits A, B and C, gen.} These issues evidence bias and a lack of transparency and reproducibility in contravention to the DQA. They also violate Executive Order 13563, which calls for “objectivity of any scientific and technical information and processes used to support [an] agency’s regulatory actions.”\textsuperscript{171}

DOI commits that its bureaus shall adapt the SDWA science standards.\textsuperscript{172} The FWS incorporates these standards in regards to analysis of risks to human health, safety and the environment.\textsuperscript{173} Given the COT Report’s purpose, the “best available” standard clearly applies. Here, the FWS has sought only selective input in a way that likely violates FACA as well as the DQA and its Guidelines.

1. The COT Report and the Studies Cited Violate the Standards of Quality, Objectivity, Integrity and Utility in the DQA, the Guidelines and the Additional Authorities Cited Herein

1. Standards for Sagebrush Canopies are Unsupported

The COT Report also alleges little sagebrush within the range of the GRSG remains undisturbed (citing primarily Knick et al. 2003) and goes on, without citation or support, to state

\textsuperscript{169} See Ramey, Thurley and Ivey 2014.
\textsuperscript{170} See OMB Guidelines V(3)(a).
\textsuperscript{171} Available at: \url{http://www.gpo.gov/fdsys/pkg/FR-2011-01-21/pdf/2011-1385.pdf}.
\textsuperscript{172} DOI Guidelines VII.3.b.
\textsuperscript{173} FWS Guidelines IV-3.
disturbed or altered habitats have “less resilience than intact habitats.” Serious issues with Knick et al. 2003 are discussed herein in Exhibit B at page 18.

While the FWS concedes there is little information available regarding minimum sagebrush patch size required to support populations of sage-grouse, it goes on to recommend needless one-size-fits all regulations based upon suspect or faulty bases. The best available scientific research has refuted the belief that there is a widely-accepted or “magic” number, in terms of habitat patch size or population number, that can defensibly be used to identify a "viable" population of any species, much less GRSG.

For example, recommendations for management of priority habitat were made without any definition or quantification of priority habitat themselves. The COT presents no data showing that hypothetical migration and connectivity corridors actually exist or that 70% sagebrush cover in Priority Habitat is: 1) scientifically defensible, 2) achievable, 3) would result in stable sage grouse populations, and 4) would not result in irreparable harm to other species, and 5) would not negatively affect local economies.

In this case, there are significant issues with the COT Report itself and the supporting studies upon which it relies. See Exhibits A and B, gen.

While the FWS concedes sagebrush is the most widespread vegetation in the intermountain lowlands of the western United States (citing West and Young 2000); it mischaracterizes it as “one of the most imperiled ecosystems in North America due to continued degradation and lack of protection.” For this mistaken proposition, the COT Report primarily

175 See COT Report at 8.
cites Knick et al. 2003. Again, Knick et al. 2003 cannot be relied upon for such an allegation.

**Exhibit B at page 18.** The COT Report also improperly alleges (with no citation to any scientific authority) that the intentional removal or treatment of sagebrush (using prescribed fire, or any mechanical and chemical tools) contributes to habitat loss and fragmentation which are a primary factor in the [alleged] decline of GRSG populations.

Moreover, as discussed herein, more than 773 conservation measures have been documented for GRSG. To assert that habitat is a substantial limiting factor to sage grouse is questionable at best. Rather, the COT Report should recognize the quality of the habitat and the very real impact of predation, hunting and competition from other species on GRSG populations.

2. **Restrictions on Infrastructure are Unsupported**

The proposed restrictions in the COT Report are based upon the opinions of authors, and selective citation of information rather than data. *See Exhibit A at pages 1, 4, 5, 13, and 15-16; see also Exhibit B at pages 1, 6-8, 11, 18, 21 and 23-24, 27.* The FWS cannot rely on the biased opinions and selective presentation of information to support a recommendation that is unsupported by data. Moreover, the COT Report presented no scientific data that these proposed restrictions are: (1) scientifically defensible; (2) achievable; (3) would result in stable GRSG populations; (4) would not result in irreparable harm to other species; and (5) would not unnecessarily have a negative effect on local economies. *See Exhibits A and B, gen.*

The COT recommendations are driven by policy considerations rather than defensible biological criteria and do nothing to mitigate specific cause and effect threats to GRSG. There is no data that show proposed exclusion areas (including NSO buffers) would address any specific threat to GRSG or result in any quantifiable benefit to GRSG. *See Exhibit, gen.*

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177 COT Report at 8.
178 COT Report at 44.
179 Ramey NTT Review p. 2.
With little credible support, the COT mandates, “no new development of infrastructure corridors within PACs.”\footnote{COT Report at 51.} Even designated, but not yet built, infrastructure corridors would be re-located outside of PACs unless they will have “no impacts” or positive impacts on GRSG populations.\footnote{Id.} Such unsupported mandates violate the DQA, the Guidelines and the additional authorities cited herein. Moreover, the FWS failed to consider that the agencies which authorize rights-of-ways (“ROWs”) are multiple-use agencies. Prohibiting ROWs within PACs is inconsistent with statutory multiple-use mandates, is not implementable, and thus, will not satisfy FWS policy under PECE (certainty of implementation). Recommendations of this kind are unreasonable, unachievable and are not based in fact or science.

The FWS has not utilized accepted methods or best available methods along with sound and objective scientific practices in the COT Report. Rather, the COT Report represents a partial presentation of scientific information to justify a narrow range of preferred conservation measures and policies. Significant flaws in the COT Report include mandates with respect to habitat requirements and threshold values, use restrictions and prohibitions, issues of scale and failure to adequately recognize and incorporate existing regulatory and conservation efforts.\footnote{See COT Report at 11.}

3. **Development Does Not Equal Population Declines**

Key assertions in the COT Report are both biased and in error, especially the frequently repeated, but erroneous assumption, that a temporary decrease in lek counts immediately adjacent to active wells is equivalent to a population decline. The COT Report presents a biased view of oil and gas operations and then selectively presents information in support of its conclusions, while ignoring contrary information.\footnote{COT Report at 43.} Data shows GRSG population increases
despite intensive energy development that has occurred in Jonah, Labarge, and Pinedale Anticline within four miles of active leks.184

These assertions in the COT Report are founded on the erroneous assumption that a temporary disturbance of sage grouse from a local area equates to a population decline. The COT Report mistakenly presumes, “[A]dult sage-grouse rarely switch from these habitats once they have been selected, limiting their ability to respond to changes in their local environments (Schroeder et al. 1999).”185

While surface disturbance from oil and gas had local negative effects on male sage grouse lek attendance, it did not result in significant effects at a population level.186 In Pinedale, predictions of population level declines have failed to come true.187 Rather, the Pacific Decadal Oscillation (“PDO”) a climate index derived from sea surface temperatures in the North Pacific accounted for 78% of population variations in Pinedale and 67% in Wyoming GRSG working groups.188 This is highly significant because if the primary climate drivers of sage grouse populations are not taken into account, which the COT and cited studies do not acknowledge, then management prescriptions recommendations will be based on erroneous information.

With no credible scientific support (nor any citation) the COT Report blindly states that development results in GRSG population declines.189 The COT Report does cite Walker et al. 2007 for the mistaken proposition that GRSG populations can be significantly reduced, and in some cases locally extirpated, by non-renewable energy development activities, even when

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184 Ramey, Thurley and Ivey 2014; See also Wyoming Game and Fish Department, *Wyoming Sage-Grouse Population Lek Count Data* (2013); Wyoming Oil and Gas Conservation Commission *Well Data*; Disturbance Data from PAPO, JDMIS, and PDMIS databases.
185 COT Report at 6.
186 Ramey, Thorley and Ivey 2014.
187 Ramey and Ivey 2014.
188 Ramey, Thorley and Ivey 2014.
189 COT Report at 43.
mitigation is implemented. But reliance on Walker et al. 2007 is untenable. See Exhibit B at pages 11, and 19-20.

In addition, Holloran 2005, Blickely et al. 2012 and other studies cited, grossly exaggerate the potential impacts of energy development and GRSG despite the findings that there is little overlap between energy development (and potential for development) and GRSG habitat. E.g. Exhibit B at page 11-17.

The FWS describes energy development as one of the greatest threats to GRSG. As one example, Garton et al. 2011 and Knick and Hanser 2011 (Knick and Hanser were cited eight (8) times in the COT Report, six (6) times NTT Report and 38 times in the 2010 GRSG listing decision) claim populations in the Colorado Plateau have a 96% chance of declining below 200 males by 2037 due primarily to threats from oil and gas. Such assertions are without basis given the status of GRSG populations today. Garton et al. 2011 and Knick and Hanser 2011 are no longer the best available science.

Similarly, statements made by the FWS in the 2010 listing decision, based upon Garton 2009, pers. comm., are both factually incorrect and misleading. There, the FWS stated, “Population stability may also be compromised if cycles in sage-grouse populations are lost, which current analyses suggest, minimizing the opportunities for population recovery if habitat were available (Garton 2009, pers. comm.).” This statement has key significance to the listing decision because it cites unspecified analyses that suggest GRSG populations have been lost and that this loss can compromise population stability. However, there are no data or analyses attributable to Garton to support these statements. Garton was cited 62 times in the listing

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190 COT Report at 10.
192 The cited personal communication is listed in the Literature Cited for the 2010 listing decision as: "Telephone interview. Dr. Oz Garton, Professor, University of Idaho, in Moscow, ID (December 18, 2009)."
decision. However, the record reveals that neither Garton nor his coauthors (in Garton et al. 2009, or in Garton et al. 2011), ever conducted or reported on analyses to test for the loss of population cycles in GRSG. Nor did they test the role that a loss of population cycles could have on population stability or for the effects of oil and gas on the GRSG.

The publicly available lek count data from states show that GRSG population cycles have not been lost. Instead, lek counts, even in areas of oil and gas development, show a pattern of synchronous cycling (Wyoming Game and Fish 2012). Additionally, several published research papers and recently-released analyses have shown that GRSG population cycles are driven by regional variation in climate; but not specifically drought.

Garton et al. 2009, 2011 did not include any analysis of population cycles, or their potential drivers, into their population reconstructions, statistical analyses, or population persistence models. Nor did Garton (2009, 2011) analyze the potential effects of oil and gas development on GRSG population trends. There are no published studies that have shown that oil and gas development has affected sage grouse population cycles. In its 2010 listing decision, the FWS relied, at least in part, on a document in support of scientific statements that is an indecipherable scrawl written in incomplete sentences, with an utter lack of detail and references. Therefore, the FWS may not rely upon Garton 2009, pers. comm. without violating the DQA and the Guidelines. To do otherwise would be factually incorrect and misleading.193

193 A copy of Garton 2009, pers. comm. is attached as Exhibit F, but the text of that personal communication reads as follows (uncertain text is indicated with a question mark):

Oz Garton’s
Pers. comm. 12/18/09
long-term data shows major fluctuations
related to pred[?], age of development
drought is most imp[ortant ?] - assoc. in big fluctuations
cycles have vanished [underscored twice]
peaks are gone
as result of O&G fire
Oz’s data show time delay vscale[?]
Reliance on Connelly et al. (2004) and Garton et al. (2011) to analyze the lek count data is also misplaced. In fact, Table 2 in the COT Report (threats) are based entirely on Garton et al. 2011.\textsuperscript{194} As discussed herein, Garton et al. 2011 has been thoroughly discredited. \textit{See Exhibit A at pages 1, 4-5, 7, 13-14, and 18-19; see also Exhibit B at pages 3, and 8.} This threats analysis was alleged based upon, “known occurrence of threats, existing management strategies, and \textit{professional experience}.”\textsuperscript{195} At least the COT Report acknowledges, “[N]ot all threats or conservation needs are known with certainty.”\textsuperscript{196} However, this fails to meet the standards of quality, objectivity, integrity and utility required by the DQA, the Guidelines and the additional authorities cited herein.

Frequently cited studies regarding energy infrastructure and disturbance on GRSG are also outdated. Kirol et al., Ramey, Brown and Blackgoat 2011, and Applegate and Owens 2014, have demonstrated technological advances and mitigative methodologies help to minimize impacts to GRSG. In addition, all of the cited studies were conducted in heavily developed energy fields which did not utilize today’s technology. Thus, the studies were not representative of various “human activities.” Rather, they represent a small fraction of the range of GRSG only in heavily developed energy fields in Wyoming and Alberta. Conservation measures for energy development are replete of citations but for (Doherty et al. 2010) for the proposition that energy development should be avoided in priority areas of conservation (“PACs”) and Blickley et al. 2012 for the proposition that development should minimize use of tall structures.\textsuperscript{197} But reliance on these studies is also misplaced. \textit{See Exhibit A at pages 12, 15, 18.}

\begin{footnotesize}
\begin{enumerate}
\item \textsuperscript{194} COT Report at 16.
\item \textsuperscript{195} COT Report at 14 (emphasis added).
\item \textsuperscript{196} \textit{Id.}
\item \textsuperscript{197} COT Report at 43.
\end{enumerate}
\end{footnotesize}
These citations in the COT Report are not supported by hard data. While avoidance might occur due to heavily developed oil and gas fields, the intensive down-hole development of yesteryear at Pinedale is not representative of a typical field today. Notably, many of these areas developed prior to widespread use of directional drilling and clustered development. Accordingly, impacts from oil and gas development today are likely to be even smaller. Further, Pinedale GRSG populations have not reacted as these authors have presented. Rather, GRSG populations have remained stable or increased.198

None of the cited studies were representative of the Great Basin birds. The study area used by Aldridge and Boyce 2007199 is not representative of GRSG range-wide. And the Alberta population is small and has minimal suitable habitat available as a result of ecology and geologic formations. Therefore, any impact on this population will appear heightened compared to what may happen to other, more robust populations.

The COT Report omits numerous scientific papers and reports on oil and gas mitigation measures, mitigation of raven predation, and the fact that GRSG traverse (fly) over or around roads, agricultural areas, and oil and gas development.200 See Exhibits A and B, gen. While the COT acknowledged GRSG, “dispersal (permanent moves to other areas) is poorly understood (Connelly et al. 2004) and appears to be sporadic (Dunn and Braun 1986),”201 it omits reference to the best science that indicates GRSG disperse over much greater distances than previously thought. See Exhibit B at pages 4-27.

198 See Ramey, Thurley and Ivey 2014; see also WY Fish and Game population summaries.
199 Interestingly, the data in Aldridge and Boyce 2007 suggest the majority of the late brood rearing habitat is already on land that is regulated by BLM.
201 COT Report at 8 (emphasis added).
For all of these reasons, the FWS has not adequately addressed these significant issues in the COT Report in contravention of the DQA, the Guidelines and the aforementioned additional authority cited herein.

4. The COT Report Fails to Recognize New Technologies

The COT Report also failed to acknowledge lower impact technologies and mitigation currently in use by the oil and gas industry, including specifically those detailed in Ramey, Brown, and Blackgoat 2011. In fact, the COT would impede the use of this new technology by limiting activities including year-round oil and gas development and its associated benefits such as 3809 regulations found under FLPMA, and BLM’s Manual 6840. See Exhibit C. Other errors of omission in the COT Report include numerous scientific papers and reports on oil and gas and mitigation measures. See Exhibit B at pages 4-21, 24, 27.

Similarly, with regards to mining, the COT Report claims (with no citations nor support) that facilities within GRSG habitat result in the direct loss of habitat, habitat fragmentation, and indirect impacts from disturbance and that current reclamation activities do not always consider GRSG habitat needs and might take decades to restore.202 However, the COT fails to recognize that just 3.6 percent of potential GRSG habitat is impacted by leasable, salable, and locatable minerals.203 COT also fails to recognize the myriad of regulations concerning reclamations such Similarly, with no citation whatsoever, the FWS claims that climate change could expand the importance of fire and invasive plans.204

These bald assertions fail to meet the DQA, the Guidelines or the additional authorities cited herein. Other alleged threats cited with no citations nor authority include recreational

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202 COT Report at 49.
203 Manier at 71.
204 COT Report at 10.
activities, ex-urban development, and development of infrastructure “for any purpose” results in habitat loss, fragmentation, and may cause GRSG habitat avoidance.

The COT fails to acknowledge that this situation has substantially changed due to the advent of advanced reclamation, methods to limit surface disturbance, and other protective measures that are now mainstream in development that takes place in habitat areas. Oil and natural gas development activities are by nature temporary disturbances. The highest level of surface disturbance associated with development occurs during the construction drilling and completion phases, which can last from a few weeks to a few months. Once production is achieved, the surface disturbance that results from these activities shrinks dramatically and long-term disturbances represent only a small fraction of the initial disturbance.

5. **Noise Restrictions in the COT Report are Unsupported and Unreasonable**

The COT’s treatment of noise and oil and gas operations violates the DQA and the Guidelines. Recommendations were based on the subjective opinions of the authors of cited studies rather than data. *See Exhibit A at pages 1, 4, 5, 13, and 16; see also Exhibit B at pages 1, 6-8, 11, 18, 21, 23-24, and 27.* The cited studies, all performed by one research group, used substandard equipment and employed methods that were inconsistent with professional data collection and reporting standards in the industry that are used to ensure unbiased and systematic data collection. The underlying data in the cited noise studies is not public and not reproducible. What is being proposed for noise thresholds is an impossible standard to achieve found in an idyllic wilderness setting; and described with non-standard equipment and unaccepted techniques; BLM land that is administered for multiple uses is not pristine wilderness.

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205 COT Report at 49-50.
206 COT Report at 51.
These studies do not support the proposition for which they are cited. They do not report population-level effects to GRSG. Rather, temporary avoidance was observed under very specific circumstances with no evidence of deleterious effects on fitness. See Exhibits A and B, gen. Moreover, the authors, and the COT Report, fail to examine whether noise could have positive effects on GRSG—such as interference with predation or whether daily motorized trips to noise monitoring stations to replace batteries may have interfered with test results.

Here, the most recent science indicates GRSG use greater variances in habitat (Reinhart et al. 2013) and that noise tolerances and habitat selection in areas of high road density are greater than previously documented.207 Moreover, topographic roughness appeared to be a much stronger indicator of habitat avoidance than anthropogenic disturbances.208

The COT’s treatment of noise is completely inconsistent with the previous background of 39 dBA background plus the 10 decibel threshold. This overly restrictive threshold is based on a questionable study referenced directly in the COT Report and will be difficult, if not impossible to achieve. Specifically, noise studies cited in the COT provided no evidence that noise resulted in a GRSG decline. See Exhibit B pages 21-25. There is no peer reviewed data that supports a background at dawn for a 20-24 background level. The FWS needs to replace these flawed recommendations with the 39 dBA which is currently in use when assessing noise considerations in GRSG habitat.

The COT Report claims that it, “delineates reasonable objectives, based upon the best scientific and commercial data available at the time of its release….”209 However, the COT objectives are neither reasonable nor based on the best science available. Further, the research

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207 Patricelli et al. (2012).
208 See Id.
209 COT Report at ii.
that auspiciously supports these onerous prescriptions does not represent current development scenarios.210

The FWS has not produced any data to demonstrate that the targets for GRSG populations and leks are achievable or how the targets will allegedly enhance genetic connections, especially when the role of female grouse in the population monitoring is completely ignored. Without such scientifically defensible data and analyses, the COT Report does not withstand the standards of the DQA, the Guidelines or the presidential or secretarial orders described herein.

6. No Evidence of Genetic Declines in GRSG

A recent study, Zink 2014, found no genetic evidence of population declines in GRSG. See Exhibit D: Zink 2014. Moreover, GRSG populations have increased since the mid-1990s but not to some previous levels.211 For example, in Utah, the number of leks counted has increased from a low of 125 to 361 currently.212 With regards to males counted, the increase is even more dramatic: 1,555 males in 1996 to 5,973 in 2006 (280 percent).213 While current numbers are not quite that high, differences in methodologies and inaccuracies inherent in lek counts must be considered.

Zink “compare[d] genetic variability measures with quantitative estimates of population trends to determine whether the effects of population declines can be observed at two geographic scales in the microsatellite and mitochondrial DNA data…” See Exhibit D. Populations in decline should show reduced genetic diversity. And reduced genetic variability can also pose a risk to population persistence. But for GRSG, “the expected population genetic signatures of

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210 D. Applegate, N. Owens, Oil and gas impacts on Wyoming’s sage-grouse: summarizing the past and predicting the foreseeable future, Human-Wildlife Interactions 8(2):284-290, Fall 2014; see also Exhibit D.
211 DEIS 3.2.1 at 3-7.
212 Id.
213 Id.
differences in population size were not observed.”214 Dr. Zink concluded, “[T]here is no clear evidence that the population genetic variability of the greater sage-grouse has been influenced by range reduction and fragmentation” and that “there is no evidence of heightened inbreeding in smaller populations.”215

In addition, Ramey et al. 2013 detected several errors in the calculations of Garton et al. 2011 that dramatically skew probabilities to estimated declines over time. See Exhibit E: Ramey et al. 2013.216 Because Ramey et al. 2013 and Zink 2014 constitute the best available science on these topics, the FWS should retract or correct the COT Report accordingly.

It should be noted that the FWS and USGS convened a closed-door workshop on October 22-23, 2014 in Ft. Collins, Colorado entitled “Expert Elicitation Workshop on the Genetics of Greater-Sage Grouse” (the “Workshop”). The aim of the Workshop was auspiciously to work on “specific technical questions.” The way in which the agencies convened this Workshop also drew sharp rebukes and calls for transparency from eighteen (18) Members of Congress in an October 16, 2014 letter to Interior Secretary Sally Jewell.217 Petitioners believe the way the Workshop was convened and conducted likely violates FACA, the DQA and its Guidelines as well as presidential memoranda and DOI orders on scientific integrity and transparency. We caution the FWS not to adopt or incorporate any alleged findings from this closed-door Workshop.

7. GRSG Population Sizes Already Negate Alleged Threats

214 Id.
215 Id.
216 Ramey, Wehausen and Brown 2013(open source peer-reviewed manuscript) Peer Review and Information Quality Breakdown in an Endangered Species Act Decision: the Case of the Greater Sage Grouse.
The FWS also fails to acknowledge the size of the GRSG population sufficiently negates threats. In fact, many species have been delisted or removed from candidate status with far less significant population numbers and ranges:

- The FWS withdrew the black-tailed prairie dog (“BTPD”) from candidate status despite significant variations in certain populations. In the 12-month finding for the BTPD, the FWS noted that urbanization represents a locally substantial loss of occupied habitat, but in a range-wide context, it is not significant. The FWS further stated, given population estimates in Colorado and elsewhere, urbanization cannot be considered a threat at present or in the foreseeable future, either in Colorado or range-wide, despite the fact that “considerable effects due to this factor have occurred in the past.”

- The FWS removed the peregrine falcon from the list of endangered and threatened species with only 1,650 peregrine breeding pairs in the United States and Canada.

- The FWS withdrew its proposal to list the mountain plover where the current total population of mountain plovers was estimated to be between 5,000 and 11,000 individuals.

- Due to the size of the current Aleutian Canada goose population (37,000 individuals) and the management practices on currently used goose habitats, the FWS found that potential threats such as development, variable market conditions, changing agricultural practices, and adverse climactic conditions did not threaten the continued survival of the species. The FWS stated it believed that the size of the population was such that it would have time to intervene on behalf of the subspecies should any of these become threats to the continued survival of the subspecies.

- In its 2014 Candidate Notice of Review, the FWS lowered its listing priority number for Sprague’s pipit despite alleged threats from energy development due to its large population size.

Moreover, the primary objective for sage-grouse is to produce stable to increasing populations. For the majority of the subpopulations, and strongholds, this objective has already been achieved.

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8. **The COT Report Fails to Use the Best Available Mapping**

While the COT Report, in some cases, relied upon state mapping to delineate Priority Areas for Conservation (“PACs”), it has failed to include mapping at an appropriate local scale. For instance, Garfield County developed a Greater Sage-Grouse Conservation Plan (“the Plan”) based on the best available science and a tailored approach to private and public land management to benefit the species. In recognition of the County’s unique habitat characteristics (i.e. extreme topographic variation and naturally fragmented suitable habitat patches), Garfield County commissioned an in-depth analysis of its 2,956 square miles, revealing that nearly seventy (70) percent of Garfield County is not suitable for the GRSG. However, there are small but important patches of suitable GRSG habitat in Garfield County, amounting to at least 70,000 acres.

While the COT does recognize the efficacy of using local data (albeit with caveats for peer review requirements) related to habitat conditions, fire and successful restoration activities, it should also recognize that state and local conservation efforts have proven more accurate and effective than the top-down, one-size-fits-all, federal approach. Here, the practical effect of the restrictions proposed in the COT Report would be to “protect” vast areas of non-habitat and marginal habitat with no demonstrable benefit to sage grouse populations. See Exhibit B at pages 2, 4, 17, 22, 26. Land Use Plan Amendments are incorporating COT

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225 Id. at pages 10-17, and 35-37 (the Plan utilized highly sophisticated and peer reviewed habitat modeling completed in November of 2014 that proved a 67% decrease in potentially suitable habitat from Colorado Parks and Wildlife’s model, indicating that CPW and BLM over-mapped 147,000 acres of private and public land).
226 Id. at pages 7-8, 16-18, and 25-26 (acreage includes suitable habitat for all range of GRSG lifespan behavioral requirements).
227 As noted herein, the FWS itself has failed to comply with peer review requirements for the COT Report.
228 COT Report at 39, 41.
Recommendations as seasonal four-mile NSO buffers around active leks during lekking, nesting and early brood rearing in all designated habitat. However, the buffers proposed are far more extensive than necessary because of the reliance on suspect data, assumptions, and modeling.

The COT Report recommendations are unnecessarily restrictive, are not supported by scientific information, and do not address specific cause and effect mechanisms that are known to be deleterious to sage grouse. Despite the lack of scientific support, the COT Report proscribes land management actions such as: prevent fire in GRSG habitat; manage for sagebrush; manage land uses; improve grazing “systems,” and close rangelands that are highly susceptible to fire to OHV use during the fire season.

In clear violation of the DQA, the Guidelines and the additional authorities referenced herein, the FWS would have these measures implemented without any tracking and testing of the effectiveness of the multitudes of currently required best management practices (“BMPs”) for GRSG. For example, a study prepared by SWCA Environmental Consultants catalogued an astonishing 773 conservation measures and an average of 6.5 Conditions of Approval (COA) or conservation measures to protect GRSG per project.

Accordingly, the information disseminated in the COT Report does not meet DQA standards for objectivity and integrity and must therefore be retracted or corrected. Moreover, by acting on flawed measures in the COT Report, FWS has committed itself to an action before

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229 See NW CO GRSG DEIS at 161-165; The dates for nesting/early brood-rearing habitat vary by field office. Every field offices’ nesting/early brood-rearing habitat starts on March 1 except for the White River Field Office which starts on April 15. All of the field offices’ nesting/early brood-rearing habitat ends on June 30 with the exception of White River which ends on July 8. However, BLM statewide dates for nesting/early brood-rearing habitat are March 1 – July 15.

230 COT Report at 41.

231 See Id. at page 5; see also List of NEPA Documents Reviewed beginning at page 35.
making a final decision. This could be construed as pre-decisional and an irreversible, irretrievable commitment of resources contrary to NEPA.232

For all the reasons herein, the FWS must retract or reject the proposed restrictions in the COT Report in favor of a more realistic approach that deals with the specific cause and effect mechanisms that underlay demonstrable threats to GRSG in each local population.

J. The COT Report is Not Accurate Nor Complete in Violation of the DQA, the Guidelines and the Additional Authorities cited herein

The FWS must incorporate and rely upon the most recent information in the COT Report. To do otherwise would be inconsistent with the best available science standard under the ESA, the information quality standards of the Data Quality Act and the standards of scientific integrity required by presidential and Interior Department memoranda and orders referenced herein. Here, the COT recommendations rely on older research that fails DQA standards and fails to qualify as the best available science.

The COT Report acknowledged only three real uncertainties with regard to GRSG conservation:

1. The lack of robust, range-wide genetics-based connectivity analyses;
2. The ability to successfully restore lower-elevation and weed-infested habitats (citing Knick et al. 2003 and Pyke 2011); and
3. The effect of climate change on the amount and distribution of future habitat.233

Incredibly, in light of these uncertainties, its recommendations were unequivocal:

“impacts to sage-grouse and their habitats should be avoided to the maximum extent possible….”

Somehow, the FWS equates this ubiquitous proscription to “management flexibility.”234

232 See 40 C.F.R. § 1502.2(g).
234 Id.
Similarly, in regard to allegations of climate change, the COT Report went on to direct land use agencies to incorporate its potential impacts into their planning efforts.\textsuperscript{235}

1. The COT Fails to Properly Consider Population Trends and Persistence

While conceding there is little published research on the topic, the FWS describes energy development as one of the greatest threats to GRSG. As one example, Knick and Hanser 2011 (Knick and Hanser were cited eight (8) times in the COT Report, six (6) times in the NTT Report and 38 times in the 2010 GRSG listing decision) claim populations in the Colorado Plateau have a 96\% chance of declining below 200 males by 2037 due primarily to threats from oil and gas. Such assertions are without basis given the status of GRSG populations today.\textsuperscript{236} For example, Utah’s 2009 Greater Sage-Grouse Management Plan states that Utah has 429 known leks, 304 of which have been active in the past five (5) years. Some 328 leks are occupied. Moreover, Garton et al. 2011 and Knick and Hanser 2011 are no longer the best available science, as discussed in detail herein.

The COT’s reliance on Connelly et al. (2004) and Garton et al. (2011) is particularly misplaced. \textit{See Exhibit A at pages 1-6, 9-10, 12, and 13-17; see also Exhibit B at pages 1-14, 16-17, 19-21, and 25-27}. The FWS has not produced any data to demonstrate that the targets for GRSG populations and leks are achievable or how the targets will allegedly enhance genetic connections, especially when the role of female grouse in the population monitoring is completely ignored. Without such scientifically defensible data and analyses, the COT Report does not withstand the standards of the DQA or the Guidelines.

A recently published study showed that there is no evidence of the purported population declines and isolation. Dr. Robert Zink, “compare[d] genetic variability measures with

\begin{footnotesize}
\begin{itemize}
\item[235] \textit{Id.} at 39.
\item[236] See Ramey, Thorley and Ivey 2014.
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quantitative estimates of population trends to determine whether the effects of population declines can be observed at two geographic scales in the microsatellite and mitochondrial DNA data…”  See Exhibit D: Zink 2014. Populations in decline should show reduced genetic diversity. Reduced genetic variability can also pose a risk to population persistence. But for GRSG, Dr. Zink found, “the expected population genetic signatures of differences in population size were not observed.”  Dr. Zink concluded, “[T]here is no clear evidence that the population genetic variability of the greater GRSG has been influenced by range reduction and fragmentation” and that “there is no evidence of heightened inbreeding in smaller populations.” In addition, Ramey et al. 2013 detected several errors in the calculations of Garton et al. 2011 that dramatically skew probabilities to estimated declines over time.  See Exhibit E: Ramey, Brown and Blackgoat 2013.237

It should be noted that the FWS and USGS convened a closed-door workshop on October 22-23, 2014 in Ft. Collins, Colorado entitled “Expert Elicitation Workshop on the Genetics of Greater-Sage Grouse” (the “Workshop’). The aim of the Workshop was auspiciously to work on “specific technical questions.” The way in which the agencies convened this Workshop also drew sharp rebukes and calls for transparency from eighteen (18) Members of Congress in an October 16, 2014 letter to Interior Secretary Sally Jewell.238 Petitioners believe the way the Workshop was convened and conducted likely violates FACA, the DQA and its Guidelines as well as presidential memoranda and DOI orders on scientific integrity and transparency. We caution the FWS not to adopt or incorporate any alleged findings from this closed-door Workshop.

The COT Report mischaracterizes the health of GRSG populations. Zink 2014 found that despite reported population declines, populations were not experiencing genetic decline typically associated with imperiled species.

2. **The COT Report Fails to Acknowledge GRSG Populations Naturally Fluctuate**

While the COT concedes, “[T]he actual decline in the number of sage-grouse from pre-settlement times is unclear as estimates of greater sage-grouse abundance were mostly anecdotal prior to the implementation of systematic surveys in the 1950s (Braun 1998),”\(^{239}\) it fails to recognize that populations of any given species naturally fluctuate. This significant error of omission violates quality, objectivity and integrity standards of the DQA, the Guidelines and the additional authority cited herein.

Populations of any given species are known to be extremely dynamic. It is critical to understand the trends in population dynamics and the factors responsible for population variability to properly evaluate and manage species. Understanding natural fluctuations in abundance and the population dynamics of individual and range-wide populations is also essential for the proper status assessment of a species.

Here, the COT Report fails to take into account that populations of species are responsive to such factors as seasonal and long-term fluctuations in regional weather conditions, short-term weather extremes and stochastic events, intra- and inter- species competition for resources, intra- and inter- species behavioral competition, predator-prey relationships, and subtle or severe changes in habitat quality. As discussed above, climactic patterns associated with the PDO greatly influence GRSG populations in Wyoming.\(^{240}\) These and other factors may influence a

\(^{239}\) COT Report at 6.

\(^{240}\) See Ramey, Thorley and Ivey 2014, *infra.*
species greatly, and may mask or prevent a correct interpretation of direct and indirect anthropomorphic factors.

GRSG populations characteristically exhibit multi-annual fluctuations in abundance (Appendix 1, Figure 1 and 2), indicating that some mechanism or combination of mechanisms are causative factors.\textsuperscript{241} Factors influencing GRSG abundance may include weather patterns and the composition and abundance of predators that influence nesting success (Montana GRSG Working Group 2005) Nesting success and chick survival is considered to be the most significant parameter affecting population dynamics.\textsuperscript{242}

Published studies of factors affecting nest success and GRSG chick survival have focused on micro-scale habitat factors such as percent coverage and height of forbs and grasses and availability of arthropods.\textsuperscript{243} These studies follow logically from previous research on GRSG brood habitat selection (Sveum et al. 1998, Drut et al. 1994a, Wallestad 1971, Klebenow 1969) and chick diets (Drut et al. 1994b, Johnson and Boyce 1990, Peterson 1970, Klebenow and Gray 1968). Collectively, these studies clearly demonstrate that nesting GRSG typically select relatively mesic habitats with abundant forbs and arthropods and that chick survival is highly correlated with these factors. Chick survival has been shown to be an important determinant of population growth rates, yet relatively little is known about chick survival at the population level relative to large-scale abiotic factors such as regional variation precipitation and temperature.

Guttery et al. 2013 reported that climatic variables play a primary role in determining GRSG reproductive success and the study demonstrated that temperature and precipitation have significant effects on chick survival. Similarly, Blomberg et al. 2012 found strong correlation between multiple climatic variables and GRSG population dynamics (see Appendix 1, Figure 3

\textsuperscript{242} Schroeder et al. 1999.
\textsuperscript{243} Aldridge and Boyce 2007, Dahlgren et al. 2010, Gregg and Crawford 2009.
and Figure 4). Annual recruitment of GRSG was higher in years with higher precipitation, based on annual precipitation, annual rainfall, and average winter snow depth. Likewise, GRSG population growth was positively correlated with annual rainfall and mean monthly winter snowpack in the study area. Annual survival of adult male GRSG was negatively affected by high summertime temperatures (i.e. higher survival rates occurred in years with relatively low maximum temperatures). These results are consistent with the hypothesis that water balance in sagebrush systems is important to GRSG populations and led the authors to conclude that the stability of GRSG populations is dependent upon stable annual survival rates and occasional large inputs of new individuals into the population when climatic conditions are favorable for chick and juvenile survival.

Extended periods of below normal precipitation and shorter term severe drought may reduce the abundance and duration of herbaceous cover at nest sites, and result in a reduction in the quantity and quality of food resources available to hens and chicks, which, if severe, could jeopardize GRSG survival.244 Prolonged drought during the 1930’s and mid- 1980’s to early 1990’s coincided with declining GRSG populations throughout much of the species’ range (Patterson 1952, Fischer 1994, Hanf et al. 1994, Connelly and Braun 1997, Braun 1998). From 1985 through 1995, the entire range of GRSG experienced severe drought (as defined by the Palmer Drought Severity Index) with the exceptions of north-central Colorado and southern Nevada (USFWS 2013). Heath et al. 1997 concluded that drought conditions during spring and summer 1994 in Wyoming resulted in impaired productivity and decreased survival of GRSG, most likely because of subsequent decreases in forb production and increased predation resulting from a lack of sufficient cover.

The amount and timing of spring and summer rainfall affects annual plant production and influences population dynamics of GRSG, causing short term fluctuations (i.e., < 10 years) in GRSG abundance. Wet springs often result in increased green-up and an increase in the variety of forbs, and consequently insects, on the sage-steppe thereby increasing chick survival. Wyoming Game and Fish Department 2009 reported increases in GRSG numbers in Wyoming during the late 1990’s with some individual leks seeing three-fold increases in the number of males between 1997 and 1999. This increase was synchronous with increased spring precipitation over the period. The return of drought conditions in the early 2000’s appeared to have led to decreases in chick production and survival, thus resulting in declining populations. Conversely, extreme precipitation during spring and summer caused widespread flooding in 2011 in southeastern Montana and increased GRSG nest failure and depressed hatch rates.

Cold, wet weather or extremely low temperatures during the hatching period can result in loss of chicks and young birds to hypothermia. Measures of drought, precipitation, and temperature can be correlated to winter snow pack which is known to be a major driver of vegetation dynamics throughout much of the mountainous regions of western North America. Long, cold winters with deep snows that cover sagebrush plants on winter ranges can be a threat to survival because GRSG are totally dependent upon sagebrush as food during winter months.

Until recently, there was no evidence that severe winter weather affected GRSG populations unless sagebrush habitat had been greatly reduced (Connelly et al. 2000); however,

245 Eustace 2002.
247 Foster et al. year unknown.
such an effect was reported recently in several studies. Danvir 2002 recorded declines in a GRSG population following deep snow winters of 1985-86 and 1992-93 in Wyoming. The theory being that the GRSG survival rates declined because the species became more visible, and vulnerable to predation, and that there was increased competition with jackrabbits, mule deer, and other grouse for the sagebrush foliage available above the snowpack. Moynahan et al. 2006 found that a severe winter affected survival of GRSG in Montana from 2001 to 2004. Similarly, Anthony and Willis 2009 reported strong evidence that severe weather (i.e., mean daily min. temp, extreme min. temp, snow depth) affected survival of female GRSG in southeastern Oregon.

The effects of both annual and long-term fluctuations in weather patterns on the nest success and survival of GRSG have been well documented. Short-term fluctuations in weather patterns are significant factors contributing to the annual and near future population status, while long term weather patterns have a greater effect on condition of habitats occupied by the population and play a larger role in determining the long term trends of the population.\textsuperscript{251}

Recent efforts to develop range-wide conservation and mitigation objectives for the GRSG resulted in several documents proposing specific strategies or actions. The COT Report proposed that the effectiveness of restoration activities must be demonstrated prior to receiving any credit for mitigating losses, and that the effectiveness must be determined by GRSG use resulting in a positive population trend within the restored areas. \textit{See Exhibit A at pages 1-6, 9-10, 12, and 13-17; see also Exhibit B at pages 1-14, 16-17, 19-21, and 25-27.} Although the counts of male GRSG on leks has been, and continues to be, the primary mechanism for collecting data about the relative abundance and population trends of GRSG, the COT Report does not acknowledge that lek counts provide only a crude, nonrandom, and statistically invalid

\textsuperscript{251} McCarthy and Kobriger 2005.
estimates of population trends. Even though there is little to no statistical confidence in existing male lek count data or how it is currently analyzed, the USFWS prepared the GRSG Range-Wide Mitigation Framework in 2014 and proposes that this information can be used as a starting point for evaluating the effectiveness of GRSG mitigation programs.

Critical information on natural population fluctuations and the factors that drive them such as weather patterns and survival rates are glaringly omitted in the COT Report. Taking into account natural fluctuations in GRSG population and their primary drivers, using explicit, data-driven population models (i.e. Bayesian hierarchical state-space models) must be included in any objective and statistically rigorous evaluation of the population status. An accurate assessment of GRSG population dynamics and fluctuations are also critical to proper species management and developing effective conservation and mitigation strategies.

The COT Report lays the groundwork for an improper regulatory threshold that GRSG populations must be stable or increasing in all cases. This fundamental flaw violates the DQA, the Guidelines and the secretarial and presidential orders and memoranda discussed herein.

3. The COT Report Fails to Adequately Consider Predation and Predator Control

The COT Report ignores substantive threats to GRSG in favor of pre-conceived notions of human impact in violation of the DQA and the Guidelines. Predation is the most common cause of direct mortalities of the GRSG. GRSG eggs are preyed upon by red foxes (Vulpes vulpes), coyotes (Canis latrans), American badgers (Taxidea taxus), common ravens (Corvus corax), and black-billed magpies (Pica hudsonia). Common predators of juvenile and adult GRSG are golden eagles (Aquila chrysaetos), prairie falcons (Falco mexicanus), other raptors, coyotes, American badgers, and bobcats (Lynx rufus). Younger birds, especially broods, are

252 Walsh et al. 2004; Ramey et al. 2014.
253 Coates et al. 2014.
preyed upon by common ravens, red foxes, northern harriers (*Circus cyaneus*), weasels (*Mustela sp.*), and various species of ground squirrels and snakes.

Of these predators, the common raven is the most abundant and has the greatest impact on the survivorship of the GRSG. Raven populations have increased an estimated 300% in the past 27 years in the United States (Sauer et al. 2008) with reports of 1,500% increases within a 25-year period in some areas of the West. The COT Report virtually ignores this critical fact.

While not migratory species, crows and ravens are inexplicably protected under the Migratory Bird Treaty Act ("MBTA"). Nowhere does the COT Report call out that the primary predator of GRSG is protected by the MBTA such that predator control efforts that would benefit GRSG are subject to regulatory red-tape--including FWS approvals.

Mortality due to predation during the first few weeks after hatching was estimated to be 82 percent. In regards to Gunnison sage-grouse, “survival of juveniles to their first breeding season was estimated to be low (10 percent).” The COT Report alleges nest success and survival studies are impacted by predation only where poor land management (i.e. gazing) is an issue. **Exhibit A at pages 15-17.** This clearly exhibits bias. Moreover, nothing is presented to quantify the habitat conditions that are purported to increase the significance of predation and nothing to identify the significance those conditions to sage grouse habitat throughout their range in the COT Report.

The common raven is clever and highly adaptable, which allows them to opportunistically exploit food resources provided by human activities. They routinely forage at landfills, in dumpsters, and at livestock operations and they commonly scavenge on carcasses of

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254 Boarman 1993.  
255 50 C.F.R. § 20.100.  
256 Gregg *et al.* 2007.  
animals killed by vehicle strikes. The explosive increase in raven abundance has resulted in large increases in predation, and has contributed to the severe decline of many species including the desert tortoise (Gopherus sp.), marbled murrelet (Brachyramphus marmoratus), least tern (Sternula antillarum), California condor (Gymnogyps californianus), and GRSG.

While many scientific studies have found that GRSG nest predation is related to the amount of herbaceous cover surrounding nest sites and that nesting success is correlated with vegetation structure and composition, suggesting that the quantity and condition of breeding habitat is the most important factor that dictates the productivity of GRSG (Connelly et al. 1994, Braun 1998, Schroeder and Baydack 2001, Coates 2007, Hagen 2011), the COT Report ignores substantial evidence indicating that most GRSG nests are lost to predators such as red foxes, badgers, coyotes, black-billed magpies, and common ravens, even in excellent GRSG habitat. See Exhibit B at page 5-13 (“human subsidized predators”).

The negative effects of predation and raven abundance on nest success have been well documented. GRSG nests are subject to varying levels of predation. Predation can be total (all eggs destroyed) or partial (one or more eggs are destroyed). However, in either case, hens abandon the nests. Re-nesting efforts may partially compensate for the loss of nests due to predation (Schroeder 1997) but may not completely offset the losses. Additionally, the presence of high numbers of predators within a GRSG nesting area may negatively affect GRSG productivity without causing direct mortality. Loss of breeding hens and young chicks to predation can influence overall GRSG population numbers, as these two groups contribute most significantly to population productivity.

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259 Coates 2007.
According to Valkama et al. (2005), predation may influence grouse population dynamics by reducing nest success, survival of juveniles especially during the first few weeks after hatching, and annual survival of breeding age birds. Similarly, others found that nest predation can be a limiting factor for GRSG population sustainability.\textsuperscript{261} Moynahan et al. (2007) reported that 54% of nest failures were caused by predation. Gregg et al. (2007) estimated that GRSG mortalities due to predation were as high as 82% during the first few weeks after hatching.

Raven abundance was strongly associated with GRSG nest failure in northeastern Nevada, resulting in negative effects on GRSG reproduction.\textsuperscript{262} The study associated increased raven abundance with a reduction in the time spent off the nest by female GRSG, thereby potentially compromising the ability to secure sufficient nutrition to complete the incubation process. Similarly, high corvid abundances attributed to increased GRSG nest and brood failure in western Wyoming (Bui 2009). Coates and Delehanty (2010) found that GRSG nest failure and observed raven predation of GRSG nests were associated with indices of raven abundance. Decreases in daily survival rate (DSR) of GRSG were attributed to increased raven abundance.

Unlike other population limiting factors (e.g., habitat, weather, and drought), predation can realistically be reduced by applying appropriate management measures.\textsuperscript{263} Management of some predator populations, especially raven populations occurring in areas where GRSG mortality is high, is needed to ensure that GRSG populations are not depressed by a known and easily mitigated source of mortality.

In 2001, the U.S. Department of Agriculture (USDA) Animal Plant Health Inspection Service (APHIS) Wildlife Services (WS) initiated a systematic raven management program in Nevada to reduce raven numbers in GRSG habitat. The primary method of raven removal was

\textsuperscript{262} Coates 2007.  
\textsuperscript{263} Cote and Sutherland 1997.
through chicken egg baits treated with DRC-1339 (3-chloro- toluidine hydrochloride). Coates and Delehanty (2004) observed that GRSG nest success near these raven removal activities was significantly greater (73.6%) than the mean nest success (42.6%) based on 14 studies from 1941 to 1997. They also observed that raven numbers in treated areas declined from a high of 5/km² to low of 0.31/km² over a period of five month.

In 2007, the USDA/APHIS/WS began testing the effects of the removal of common ravens using baits treated with DRC-1339 to livestock depredation in southern Wyoming. This program provided additional information of the potential effects of raven removal on GRSG nest success. It was found that the nest success of GRSG was reduced when ravens were present within 550 meters of a nest. The study also reported that the abundance of ravens can be substantially reduced at a relatively large scale (15-km radius or 706.5 km²) by using DRC-1339; raven densities decreased by 61% at removal sites compared to an increase of 42% at non-removal sites. In areas occupied by ravens, average GRSG nest survival was estimated at 22%; and in areas absent of ravens, nest survival was estimated at 41%. This suggests that areas with high raven populations may contribute to lower GRSG population growth rates (Dinkins 2013). Cote and Sutherland (1997), using meta-analytic techniques, found that predator removal has a large, positive effect on post breeding population size and hatching success for several species of game birds.

Results of these raven removal efforts suggest that well-designed raven management strategies could substantially increase GRSG nest survival rates in areas where raven predation is a substantial contributing factor to nest failure. Long-term solutions to reduce artificially high raven abundances are necessary to address the detrimental effects of raven predation on GRSG and other imperiled species. Reducing raven abundance has been shown to be effective using

264 Schroader et al. 1999.
some lethal means, and reducing numbers may also be possible using other as yet untested lethal and non-lethal means. Effective lethal control might be accomplished by shooting, removal of raven nests and eggs, and poisoned baits. Effective non-lethal control might be accomplished by reducing or eliminating nesting structures and/or making subsidized food resources (road-kill, dead livestock, and garbage) unavailable. Despite the research and application of these methods for raven management, the NTT selectively chose to disregard them.

The negative effects of predation on the nest success of the GRSG have been well documented and should be included in any objective and complete analysis of threats to GRSG. The FWS GRSG listing decision (USFWS 2010) recognized predation as a primary threat to the GRSG and devoted three pages of discussion to this issue.265 Despite this, some recent efforts to develop range-wide conservation objectives for the GRSG [and to inform the public of the upcoming 2015 listing decision] failed to recognize and address predation as a primary threat to the species. Neither the NTT Report nor the FWS’s COT Report recognizes predation as the single most important factor affecting the abundance of the GRSG.

Both the NTT and COT reports virtually ignored the topic of predation and the major body of scientific literature on raven predation and experimental data on predator management. Substantial and critically important information on these topics is available from a variety of sources including Boarman 1993; Boarman 2003; Boarman et al. 1995; Boarman and Heinrich 1999; Boarman et al. 2006; Bedrosian and Craighead 2010; Bui 2009; Cagney et al. 2010; Christiansen 2011; Coates 2007; Coates and Delehanty. 2004; Coates et al. 2008; Coates and Delehanty 2010; Conover et al. 2010; Cote and Sutherland 1997; DeLong 1995; Gregg et al. 1994; Heinrich et al. 1994; Moynahan et al. 2007; Preston 2005; Ramey, Brown, and Blackgoat 2011; Schroeder and Baydack 2001; Snyder et al. 1986; Sovada et al. 1995; Watters et al. 2002;

265 75 FR 13910.
and Webb et al. 2009. Finally, recent work Baxter et al. 2013 shows even bottlenecked GRSG populations can see marked population improvements following predator control efforts.²⁶⁶

The COT report ignored the body of literature relevant to raven predation on GRSG, including its deleterious effect on survivorship and recruitment, and most importantly, the integrated management strategies that can reduce losses of GRSG. Only two references related to predation on GRSG were cited (Greg et al. 1994 and Hagen 2011) and the word “raven” was mentioned only once, at page 63. The COT Report did not mention predator management that could benefit GRSG within high risk areas and instead, viewed predation as a byproduct of human activities that could be regulated (i.e. land health assessments and emphasizing vegetation cover as a means to measure and mitigate livestock use; or increasing landscape level habitat connectivity). This extremely passive and scientifically untested approach is speculative at best and therefore would not result in a reduction of the short-term or long-term threats caused by high raven abundances.

Even though the COT Report contends that predation impacts are solely related to habitat condition, there is no information to suggest that habitat conditions alone will compensate for excessively high predator populations. The information disseminated concludes that, regardless of habitat conditions, predation does not affect GRSG populations in general. However, the removal of predators was a primary factor in the recovery and delisting of the Aleutian Canada goose in North America.²⁶⁷ In delisting the Aleutian Canada goose, the FWS also recognized the

removal of predators benefited not only that species, but many other bird species on the islands, including puffins, murrelets, and auklets. 268

The COT Report provides limited and selective evaluations of threats to GRSG, and ignore the major body of scientific literature that is available on raven predation and experimental predator management. In order to comply with the DQA and the Guidelines, the FWS needs to address and incorporate this information on the effects of predation and predator control into the COT Report.

4. The COT Report Does Not Adequately Address Hunting

The COT Report also virtually ignores hunting as a threat to GRSG. Some 207,430 GRSG were harvested during hunting seasons between 2001 and 2007. 269 A summary of population information found that GRSG lived longer, have higher winter survival rates, lower rates of reproduction, and are more migratory over greater distances than previously thought. 270 As a result, ongoing hunting is likely a contributor to declines in GRSG populations or avoidance of human activities in GRSG populations.

Additionally, new data and research published by Gibson et al. 2011 have refuted the frequently repeated belief that there is a no additive demographic effect of hunting on GRSG populations. Thus, the hunting of some populations will have an effect not only on those

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populations but also on nearby populations that are not hunted (but are genetically and demographically linked by dispersal).  

The FWS must address and incorporate up-to-date information on threats to GRSG from hunting in the COT Report to comply with the DQA and the Guidelines.

5. **The COT Report Fails to Recognize West Nile Virus is not a Threat**

The COT Report fails to acknowledge mosquitoes are already sufficiently managed and there are new technologies other than larvicides that have been proven effective to controlling mosquito populations. According to data from the Centers for Disease Control (“CDC”) the risk to avian species from West Nile virus (“WNV”) has declined to virtually nothing since 2003. This is an example of where only a portion of the available information is used to address the impacts, in this case of WNV on GRSG, resulting in onerous and unfounded mitigation requirements.

The FWS must incorporate up-to-date information on WNV in the COT Report to comply with the DQA and the Guidelines.

6. **The COT Report Fails to Recognize Existing Regulatory Mechanisms**

The March 2010 finding determined GRSG were warranted for listing based primarily on the present or threatened destruction, modification or curtailment of habitat or range and the alleged inadequacy of existing regulatory mechanisms. The COT Report sets forth strategies to address resilience focused on habitat. However, the COT Report also recognized that adequate regulatory mechanisms are essential to addressing habitat concerns. While the COT


273 COT Report at 38.

274 *Id.*
dimly acknowledges BLM and Forest Service Land Use Plan Amendments and the development
and implementation of individual state management plans for GRSG, it fails to grasp the depth
and breadth of these efforts. This glaring error of omission violates the DQA, the Guidelines and
the additional authorities discussed herein.

Moreover, a study prepared by SWCA Environmental Consultants found that most major
oil and gas companies have more stringent standards in place than agency regulatory measures.
Of the 103 NEPA documents reviewed and summarized in the report, 773 conservation measures
were catalogued and an average of 6.5 Conditions of Approval (“COAs”) or conservation
measures to protect GRSG per project were committed to in the NEPA decision records. 275 The
Western Governor’s Association also has good information on existing conservation efforts. 276

Implemented measures for the GRSG focused on: monitoring existing populations,
restricting human activities to protect leks, interim and final reclamation, noxious weed control,
dust suppression through application of water or chemical suppressant to roadways, enforcing
speed limits, seeding of all disturbed areas that are not used during the well production phase,
NSO buffers to protect wetlands, and general noise abatement. 277 Companies like EnCana Oil
and Gas, Yates Petroleum Corporation, EOG Resources, Exxon, Fidelity Exploration &
Production Company, and Anadarko, among others, have performance standards in place to
proactively reduce threats to the GRSG. 278 More specifically, the oil and gas industry has made
concerted efforts to reduce human-subsidized GRSG predators, and access to wastewater pits to
prevent GRSG oiling and drowning. 279

275 See Id. at page 5; see also List of NEPA Documents Reviewed beginning at page 35.
276 http://www.westgov.org/.
277 Id. at page 7-8.
278 Id. at page 23.
279 Id. at page 18; see also 139 (Exxon Mobile: “It will be the responsibility of the operator to effectively preclude
migratory bird access to, or contact with, reserve pit contents that possess detrimental properties (i.e., through
ingestion or exposure) or have potential to compromise the water-repellent properties of birds’ plumage”).
Ultimately, SWCA Environmental Consultants determined that when appropriate conservation and mitigation measures are used, NEPA is a valid regulatory mechanism to protect and conserve the GRSG, as there is certainty that each COA or conservation measure will be implemented. The effectiveness of the NEPA process is enhanced when coupled with monitoring performed by oil and natural gas operators as well as state and federal agencies.

The FWS has ignored these, and other, extensive existing regulatory mechanisms in the COT Report in violation of the DQA, the Guidelines and the additional authorities cited herein.

7. The COT Report Fails to Consider the Importance of Grazing and Private Lands to GRSG

The COT Report fails to recognize the best available science on grazing and private lands conservation in violation of DQA standards for quality, objectivity and integrity. Relying on the COT Report as guiding philosophy despite the fact it lacked public input and justification for changing the existing regulatory mechanisms for livestock grazing and range management violates the DQA, the Guidelines and the presidential and secretarial memoranda and orders described herein.

The COT asserts “[I]mproper livestock management” per local ecological conditions, may have negative impacts on GRSG seasonal habitats. While the primary focus is on PACs, the COT calls for changes to grazing management “across all sagebrush habitats” including even private lands. In addition, the Report recommends removing, modifying or marking fences. The COT Report recommends the avoidance of infrastructure at all within PACs. These

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280 Id. at page 27.
281 Id. at page 31.
282 COT Report at 44-45.
283 COT Report at 45.
284 COT Report at 52.
285 Id. (emphasis added).
assertions are not based upon the best available information and, thus, violate the DQA, the Guidelines and the additional authorities cited herein.

Instead of focusing on the negative impacts of historic grazing (some citations in the COT Report to alleged threats from grazing are decades old)\textsuperscript{286} the agency should be evaluating the application of and results of modern proper grazing management.\textsuperscript{287} Historic grazing and research reports of specific grazing practices are immaterial to the question of how modern grazing management practices affect sage grouse habitat.

A 1990 US-DOI BLM report shows that Good condition rangeland increased by 100% and poor condition rangeland decreased by 50% between 1936 and 1989. In the years since, there has been extensive progress in the implementation of proper grazing management on Federal, State and private lands. Furthermore, it is more important and useful to consider rangeland trends rather than current condition. Regardless of current ecological status, rangelands that are in an upward ecological trend also have improving sage grouse habitat.

It is well established that “In the 1960s and 1970s, Idaho had large numbers of sage grouse and extensive livestock grazing. This suggests that healthy sage grouse populations and livestock grazing are compatible. In short, livestock grazing that results in rangeland in good ecological condition also provides acceptable sage grouse nesting, chick rearing and winter habitat.”\textsuperscript{288}

Two elements of the COT Report are clearly contradictory where in one case they suggest grazing has an impact on predation that may affect bird populations and in the second case conclude that predation does not affect bird populations. Moreover, the Wyoming

\begin{footnotesize}
\begin{enumerate}
\item See COT Report at 46.
\item See Launchbaugh 2012; Mosley and Brewer 2006; Briske et al. 2011.
\item Idaho Sage Grouse Management Plan (1997).
\end{enumerate}
\end{footnotesize}
Department of Agriculture has strongly stated livestock grazing has no negative effects on the GRSG.\textsuperscript{289}

According to the U.S.D.A. National Agricultural Statistics, Wyoming sheep numbers were at or near all-time highs the same year greater sage grouse numbers were at or near all time highs (1969).\textsuperscript{290} Sheep numbers have dropped precipitously over the last several decades in Wyoming and other Western States.\textsuperscript{291} Predator numbers have increased accordingly. In fact, the Wyoming Department of Agriculture stated, “[H]abitat alteration caused by livestock grazing (mosaic creation), as well as the predator control offered by livestock producers, have improved and benefited [sic] sage grouse.”\textsuperscript{292}

The FWS wholly failed to analyze the effectiveness of current livestock grazing and range management frameworks, standards, and guidelines and failed to consider site-specific considerations to provide case-by-case determinations of effective regulatory mechanisms actually needed for a location. Schutlz 2004 (specific herbaceous height and cover values across the range of GRSG are inappropriate). The FWS explicitly stated in the 2010 listing decision that it “lack[ed] the information necessary to assess how [the implementation of rangeland health assessments] effects sage-grouse conservation.”

The COT Report failed to consider that livestock grazing benefits GRSG habitat and that regulatory restrictions on grazing could threaten the viability of ranching in the West. This is contrary to the DQA, its Guidelines and the best interests of the GRSG.

\textsuperscript{289} Letter from Jim Schwartz, Wyoming Department of Agriculture, to Dr. Pat Diebert, U.S. Fish and Wildlife Service (July 30, 2004) (on file with the Wyoming Department of Agriculture).
\textsuperscript{290} \url{http://www.nass.usda.gov:81/ipedb/report.htm}.
\textsuperscript{291} \textit{Id}.
\textsuperscript{292} Letter from Jim Scwharz, Wyoming Department of Agriculture, to Dr. Pat Deibert, U.S. Fish and Wildlife Service (July 20, 2004) (on file with Wyoming Department of Agriculture).
The COT Report also undercuts the balanced grazing program passed by Congress as the Taylor Grazing Act (“TGA”). Congress intended TGA land be used primarily for grazing. The NTT Report advocates single-use management in direction contravention to existing laws such as the TGA. Accordingly, the COT Report, as implemented through Land Use Plan Amendments and/or a potential listing of GRSG, will result in significant economic and social impacts. Federal agency demands for current conservation efforts fail to provide a true holistic approach to managing multiple ownership lands in an economically sustainable manner.

The COT report did not include input from any affected stakeholders or interdisciplinary experts aside from state and federal scientists and specialists. It ignores regional variances in GRSG needs, and does not present a comprehensive representation of the literature and research surrounding livestock grazing. For example, the COT Report ignored Cagney et al. 2010 which demonstrates positive attributes of grazing in Wyoming for nesting and early brood rearing habitat.

The COT Report fails to recognize that grazing is a key contributor to GRSG habitat and conservation and omits the many positive impacts of grazing. Grazing is integral to reducing fuels.293 Without grazing, GRSG habitat would suffer greatly in the West.294 The many contributions of grazing and ranching, which are largely ignored or understated in the COT Report, include:

- Preservation of open space;
- Noxious weed and invasive species eradication and containment;
- Production of forb growth that is preferred by GRSG to non-grazed areas;
- Wildfire prevention and controlled burn efforts;
- Development of wildlife watering sources, including placement of bird ladders in troughs; and

294 See Launchbaugh 2012; Mosley and Brewer 2006; Briske et al. 2011.
Predator control.

Even the federal government’s Sage Grouse Initiative has recognized the importance of private lands to GRSG conservation. Irrigation on private land provides an important link to GRSG leks which are often located on drier public lands. As The Progressive Rancher reported, hundreds or more small homesteads covered large portions of Nevada in the late 1800s to the mid-1900s. The homesteads were nearly always located on a spring or stream that the owners used to irrigate meadows. The homesteaders also vigorously shot and trapped predators, such as coyotes, ravens and badgers. As the Reason Foundation summarized, “[T]he result, according to the article, was a higher sage grouse population than exists today and a distinct geography to the grouse’s high quality water-dependent habitat: lots of it in small pockets scattered widely across the landscape.”

Contrary to some assertions, federal regulation of private land is not conducive to continued conservation. Rather, federal regulation has a significant chilling effect on local, state and private conservation efforts. For example, when the FWS proposed listing the Gunnison GRSG despite over $50 million in state investment and 65,000 acres of private lands protected by conservation easements, county officials felt deeply betrayed. Commission Chair Paula Swenson said she was “furiously frustrated” and Commissioner Jonathan Houck, former mayor of the town of Gunnison, said he felt “cut off at the knees.” Upon listing the Gunnison

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GRSG, Colorado Governor John Hickenlooper, in a significant bipartisan press release with Members of Colorado’s Congressional Delegation, stated:

We are deeply disappointed the U.S. Fish and Wildlife Service chose to ignore the extraordinary efforts over the last two decades by the state, local governments, business leaders and environmentalists to protect the Gunnison sage grouse and its habitat. This sends a discouraging message to communities willing to take significant actions to protect species and complicates our good faith efforts to work with local stakeholders on locally driven approaches. In short, this is a major blow to voluntary conservation efforts and we will do everything we can, including taking the agency to court, to fight this listing and support impacted local governments, landowners and other stakeholders.²⁹⁹

In response to the Gunnison listing decision, the Colorado Cattlemen’s Association issued a release titled, “Lawsuit-Inspired Listing Ends 20 Years of Conservation Efforts.”³⁰⁰ These assertions are backed by sound evidence. Similarly, in a letter to Interior Secretary Sally Jewel, the Western Governor’s Association expressed deep disappointment in one-size-fits-all regulatory restrictions proposed for GRSG and that coordination with the states was “treated more as an afterthought.”³⁰¹

According to the NRCS, private conservation efforts declined by 95% when the FWS proposed listing the bi-state population of GRSG. Even worse, private landowners understandably manage their lands specifically to avoid the presence of species once they have been listed under the ESA.³⁰²

³⁰⁰ http://us8.campaign-archive2.com/?u=8f5fe0c71eb61a94f0da35e3f&id=7432815534
³⁰² Brian Seasholes of the Reason Foundation has provided an excellent summary of landowner reactions to the perverse disincentives of the ESA: http://reason.org/blog/show/the-state-of-the-birds-2014-report (emphasis added).
In ignoring the benefits of grazing and private lands conservation to GRSG in the COT Report, the FWS has violated the DQA, the Guidelines and the presidential and secretarial memoranda and orders discussed herein.

8. The COT Report Fails to Acknowledge State and Local Conservation Efforts

The COT Report also fails to recognize the states have undertaken significant efforts to conserve GRSG. State conservation plans\(^{303}\) are preferable alternatives to the misdirected management protocols in the Reports. Federal agencies can rely upon state, regional, and local plans in their consideration of environmental impacts under NEPA\(^ {304}\). The FWS has not adequately considered state and local GRSG conservation planning efforts pursuant to 43 CFR § 1610. [[check cite]]

As Utah Governor Herbert has pointed out, state plans better balance future economic activities with robust protections for GRSG, and were developed using a bottom-up process with input from diverse stakeholders, rather than the top-down approach taken by the agencies\(^ {305}\).

The Reports also fail to adequately consider the states’ primary authority over wildlife management and their central role in managing GRSG populations and habitat within their borders. The states are better suited than the federal government to manage GRSG as such action falls within their traditional jurisdiction and professional expertise. Active consultation between the states and federal agencies (as well as local governments and local GRSG working groups) is a more effective approach than the top-down, one-size-fits-all restrictions in the Reports.

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\(^{305}\) See attached Exhibit A.
9. **The COT Report Violates Statutory Multiple Use Mandates**

The COT Report conflicts with statutory multiple use mandates. Implementation of the COT Report in Land Use Plans Amendments will impede the statutory missions of land management agencies and will adversely affect agriculture, recreation, local governments, utilities, mining and the ability to explore for, produce, and transport domestic energy on public lands.

In enacting the Federal Land Policy and Management Act in 1976 (FLPMA, 43 U.S.C 1701 et seq), Congress directed the Secretary of the Interior to consider a broad range of resource issues, land characteristics, and public needs and values in determining how public lands should be managed. FLPMA directs BLM to manage public lands for multiple uses and to consider a wide range of resource values – including the need to protect wildlife and quality of habitat – in the context of the Nation’s needs for minerals, energy, food, fiber, and other natural resources. Section 102(a)(8) requires BLM to manage the public lands in a “manner that will protect the quality of scientific, scenic historical, ecological, environmental…values” (U.S.C. 1701(a)(8)). Section 102(a)(7) establishes multiple use and sustained yield land management directives and requires the Secretary to develop “… goals and objectives [that are] established by law as guidelines for public land use planning, and that management be on the basis of multiple use and sustained yield unless otherwise specified by law” (U.S.C. 1701(a)(7)). In defining the term “multiple use” FLPMA § 103(c) directs the Secretary to ensure:

…the management of the public lands and their various resource values so that they are utilized in the combination that will best meet the present and future needs of the American people; making the most judicious use of the land for some or all of these resources…to conform to changing needs and conditions; the use of some land for less than all of the resources; a combination of balanced and diverse resource uses that takes into account the long-term needs of future generations for renewable and nonrenewable resources, including, but not limited
to, recreation, range, timber, minerals, watershed, wildlife and fish, and natural scenic, scientific and historical values. (43 U.S.C § 1702(c), emphasis added).

Therefore, under the multiple use requirements, wildlife and other uses are on equal footing. Consequently, FWS must strike an appropriate balance between potentially competing interests and land management objectives, while considering the needs of all species – including the needs of humans for minerals. This balance is to be achieved in the Section 102 land use planning process and the resulting RMPs. *FLPMA does not authorize the subordination of any of these uses in preference for a single land use such as sage-grouse habitat conservation.* FWS must also consider how the GRSG centric management contained in the COT Report and the resulting land use plan amendments, discussed below is appropriate in the context of other special status species. The FWS must resolve these issues and explain how the COT Reports recommendations by way of land use restrictions, prohibitions, and withdrawals achieve the required balance in managing the public lands. If the recommendations found in the COT are not implementable than the COT Report itself lacks the requisite “usefulness” or utility pursuant the DQA.


V. Conclusion
The FWS should rely upon data of the highest integrity and accuracy in the COT Report. Unfortunately, the most frequently cited sources in the Report contain fundamental flaws including gaps in crucial data, data that are not public, recurrent uncertainties, methodological bias, selective presentation of information, misrepresentation of cited studies and suspect peer reviews. See Exhibit A, see also Exhibit B, gen. Opinions must not be represented as fact nor dictate decisions that are required to be based on scientific data.

The COT Report violates the Data Quality Act, the Guidelines as well as the secretarial, presidential and other authorities cited herein. Much of what the Report presents as “science” has no basis in scientific design or scientific evidence. Notably, the COT Report provides no original data or quantitative analyses. It fails to provide a comprehensive and unbiased review and perpetuates outdated information and beliefs.

The COT Report is not presented in an accurate, reliable and unbiased manner. The COT Report cherry-picked what scientific papers it wished to discuss, presented misleading information, and presented much information out of context.

The COT Report does not represent the best available science as required to meet the standards of quality, objectivity and integrity required in the DQA. Rather, the COT Report is comprised of assumptions built upon assumptions. The COT Report fails to address the limitations of the underlying data and studies used to reach its conclusions and fails to acknowledge that circumstantial evidence rather than scientific evidence underlies most of the information presented.

The FWS cannot rely on the biased opinions and selective presentation of information to support recommendations that are unsupported by data. The FWS not only violates BLM’s multiple use mandate, but elevates GRSG concerns above human health, safety, and scientific
transparency and integrity. Because the information disseminated in the COT Report is not
objective, it also fails to have any utility for those persons making management decisions
regarding multiple uses of the public lands. As detailed in the text herein and in Exhibits A and
B, the COT Report failed to:

- Use sound analytical methods in carrying out scientific analyses and in preparing risk
  assessments.

- Use reasonably reliable and reasonably timely data and information (e.g., collected data
  such as from surveys, compiled information, and/or expert opinion).

- When using the best available data obtained from third parties, ensure transparency in its
  dissemination by identifying known sources of error and limitations in the data.

- Evaluate data quality and, where practicable, validate the data against other information
  when using or combining data from different sources.

- Ensure transparency of the analysis, to the extent possible, consistent with confidentiality
  protections, by
  
  o Presenting a clear explanation of the analysis to the intended audience.
  o Providing transparent documentation of data sources, methodology, assumptions,
    limitations, uncertainty, computations, and constraints.
  o Explaining the rationale for using certain data over other data in the analyses.
  o Presenting the model or analysis logically so that the conclusions and
    recommendations are well supported.

- Clearly identify sources of uncertainty affecting data quality.

- For quantitative assessments, clearly state the uncertainty of final estimates to the extent
  practicable. Data and data collection systems should, as far as possible, be of sufficient
  quality and precision that uncertainty in the final estimates is appropriately reproducible.

- For qualitative assessments, provide an explanation of the nature of uncertainty in the
  analysis.

The errors contained in the COT Report are improperly influencing BLM and Forest
Service decision making about management of the public lands. Reliance on this biased and
faulty information in has and will continue to harm the Petitioners and their members. In
addition to the damage to the Petitioners, the public, GRSG and the economy will be negatively impacted based upon the errors in the COT Report.

The Petitioners respectfully request the FWS retract the COT Report and all reliance thereon in existing and subsequent Land Use Plans Amendments, as well as applicable decisions on listed status of GRSG and/or on permits and authorizations. Alternatively, FWS could, as required by the DQA and the Guidelines, issue an amended COT Report that uses sound analytical methods and the best data available while ensuring transparency and objectivity. Any amended Report should incorporate all reliable information, not just the data supporting false hypothesis. It should also identify the limitations of data used rather than stating assumptions as fact. Finally, any amended Report should use and include the best available data as discussed herein.

Respectfully submitted this ____ day of ___________, 2015.

Holsinger Law, LLC

[Signature]

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Attorney for Petitioners
COT Report DQA Challenge
Outline
January 5, 2015

I. Introduction

II. The Petitioners

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   A. Information Dissemination Product
   B. Dissemination
   C. Third Party Information
   D. If Uncorrected, the COT Report Will Cause Substantial Harm
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J. The COT Report is Not Accurate Nor Complete in Violation of the DQA, the Guidelines and the Additional Authorities cited herein

1. The COT Fails to Properly Consider Population Trends and Persistence
2. The COT Report Fails to Acknowledge GRSG Populations Naturally Fluctuate
3. The COT Report Fails to Adequately Consider Predation and Predator Control
4. The COT Report Does Not Adequately Address Hunting
5. The COT Report Fails to Recognize West Nile Virus is not a Threat
6. The COT Report Fails to Recognize Existing Regulatory Mechanisms
7. The COT Report Fails to Consider the Importance of Grazing and Private Lands to GRSG
8. The COT Report Fails to Acknowledge State and Local Conservation Efforts
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V. Conclusion

Exhibit A: The COT Report Fails DQA Standards
Exhibit B: Studies Cited in the COT Report Fail DQA Standards
Exhibit C: Ramey, Brown and Blackgoat 2011
Exhibit D: Zink 2014
Exhibit E: Ramey et al. 2013
Exhibit F: Statements Made by the Service
Exhibit A:  
The COT Report Fails to Meet DQA Standards

Data Quality Issues in the U.S. Fish & Wildlife Service’s  
*Greater Sage-grouse (Centrocercus urophasianus) Conservation Objectives: Final Report* (Dated February 2013)

Dr. Rob Roy Ramey II  
Wildlife Science International, Inc.  
Prepared for Western Energy Alliance  
October 16, 2013

**Executive Summary**

**The COT overstates some threats to sage grouse while downplaying others**

The COT Report's approach elevates hypothetical threats that have never been shown to cause sage grouse population decline to the level of real threats, while selectively ignoring well-documented sources of high sage grouse mortality, including predation and hunting. The COT Report's limited and selective evaluation of threats ignores a major body of scientific literature on predation (especially predation by ravens) and experimental data on predator management.

**The population predictions used in the COT threats analysis were based on an analysis that contains methodological bias and error**

The COT Report's threats analysis, population definitions, current and projected numbers of males, and probability of population persistence, are entirely based on the paper by Garton et al. (2011). However, there are serious methodological biases and mathematical errors in this paper. The data and programs used in that highly influential paper are not public, and therefore, the results are not reproducible.

**The COT's ranking of threats to populations and Sage Grouse Management Zones is subjective**

There is no evidence of any reproducible, quantitative methodology used in assigning rankings to threats in each population and sage grouse management zone, or in discussion of specific Priority Areas of Conservation (PAC) in Appendix 1. Instead, the ranking of threats in the COT Report is entirely subjective.

**Population trends are to be determined using substandard data and methods**

The COT proposes that no credit be received for restoration efforts until there is demonstrated sage-grouse use or positive population trend. The COT Report does not
acknowledge the well-documented finding that male lek counts provide only a crude non-random, statistically invalid estimate of population trends. That lack of resolution in the data translates into the potential for no credit to be given for restoration and mitigation efforts.

The COT proposes calling out the Air National Guard and other measures to protect sage grouse habitat and hypothetical "connectivity corridors"

The COT proposes to prioritize suppression of fire in sage brush including, "policy changes that allow access to more fire suppression resources, such as Air National Guard Mobile Airborne Firefighting Units" to "immediately suppress fire in all sagebrush habitats." This includes the suppression of fires in so-called "identified connectivity corridors." However, these corridors are hypothetical only and have not been documented in the wild. If implemented, this policy change would represent an arbitrary, capricious, and scientifically unreasonable agency action.

The COT proposes "enforceable temporary measures"

The COT proposes that if adequate regulatory mechanisms cannot be implemented by specific deadlines, "then enforceable temporary measures should be considered in order to ensure threats will be at least temporarily ameliorated until such time that an effective regulatory mechanism can be implemented." However, the COT fails to mentions what those "enforceable temporary measures" would include, which agency would be charged with enforcing them, if they would be enforced on private land, or the criteria that would be used to determine if they are an "adequate regulatory mechanism." An unintended consequence of the COT Report is that it provides an administrative record which litigants can then use in court to argue that additional regulation is needed for sage grouse or to challenge agencies that have not enacted “enforceable temporary measures.”

The ESA requires that decisions must be based upon best available scientific and commercial data, and not "best available science"

The COT states that, "All proactive voluntary conservation efforts should use the best available science." However, to be consistent with the ESA and the IQA, this language needs to be changed to best available scientific and commercial data.

The COT uses new, subjective terms to evaluate risks to sage grouse

The COT Report uses new, subjective terms from the Significant Portion of the Range Policy to qualitatively describe the status of populations of a species being considered for ESA listing: redundancy, resiliency, and representation. To this list, the COT added a new, subjective term: resistance. None of these terms are quantifiable and all are open to broad interpretation. Others have also recognized this deficiency and have pointed it out to the USFWS.
Opened-ended research funding and conflicts of interest

The COT team calls for additional "key research" to resolve "uncertainties" in sage-grouse management and for "effecting sage-grouse and sagebrush persistence." However, without a list of specific questions and how the answers would change management decisions, this is simply a carte blanche request for research funding, and subverts a conservation program into a long-term research program with no mention of how the research will be funded or who will decide how funding is to be allocated.

The COT does not evaluate any of its proposed conservation actions under PECE

The COT proposed that sage-grouse conservation strategies undertaken by state agencies should consider using the criteria identified in the Policy for Evaluation of Conservation Efforts (PECE), but does not state whether any of its proposed conservation actions meet the requirements of PECE (certainty of implementation and effectiveness). The USFWS cannot recommend that new conservation measures and regulations be imposed without first ensuring that they meet the PECE requirement.

The COT Report erroneously evaluates threats using a single category for all energy production, despite substantial differences in the type and permanence of impacts

The COT Report does not acknowledge the fact that renewable energy projects have a uniformly permanent impact on the landscape while oil and gas development has a mix of temporary and permanent impacts. Blending these two vastly different types of energy production into one threat category is contrary to the best available scientific and commercial data, and counter-productive to sage-grouse conservation.

The COT Report relies on erroneous information for priority habitat mapping, evaluation of threats, and population risk assessments

This report also highlights a number of problems with the evaluation of threats and population risk assessments in the Colorado Plateau Management Zone, Power River Basin, and associated PACs discussed in the COT Report's Appendix A - Management Zone And Population Risk Assessments.
Exhibit A: The COT Report Fails to Meet DQA Standards

The Sage Grouse Conservation Objectives Team Report (COT Report) was prepared by five representatives from the U.S. Fish and Wildlife Service (USFWS) and ten from State agencies in a collaborative effort to develop rangewide conservation objectives for the sage-grouse, and to inform the upcoming 2015 Endangered Species Act (ESA) listing decision. A settlement agreement, rather than a transparent public process, determined the date of that decision. Moreover, there was no opportunity for public input or comment on the Sage Grouse Conservation Objectives Team Report.

1) The COT Report is not a scientific document.

1.1) The COT Report is not a scientific document, as there are no original data or quantitative analyses used in developing the report, nor is there a comprehensive and unbiased review of all of the available scientific literature. Instead, the COT Report provides a limited and selective review of the scientific literature and unpublished reports on sage grouse as a basis for its conservation objectives and proposed actions. As a result, outdated information and beliefs are perpetuated in the COT Report (i.e. purported impacts are not necessarily representative of actual impacts due to less intensive energy development, newer technologies, and required mitigation measures).

1.2) As this is not a scientific document, it is incongruous that it was submitted for "scientific peer review." To date, copies of these peer reviews have been requested under the Freedom of Information Act (FOIA) but have not been made public by the USFWS.

2) The COT overstates some threats to sage grouse while downplaying others.

2.1) The COT Report made a number of dramatic statements about the status of sage grouse, however, it failed to acknowledge that in the 2010 ESA-listing decision, data from states revealed that there were an estimated 535,542 sage grouse occupying 13 states and provinces in western North America. Moreover, the COT Report omits any mention of hunting as the most well documented source of sage grouse mortality, with a documented 207,433 sage grouse killed between 2001 and 2007, and on-going sage grouse hunting continues to this day. In contrast, proposals are put forth to regulate activities that have never been shown to cause sage grouse population decline. The COT Report's approach elevates hypothetical threats to the level of real threats while selectively ignoring known sources of sage grouse mortality.

3) The population predictions used in the COT Report's threats analysis were based on an analysis that contains methodological bias and error.

3.1) The COT Report's threats analysis, population definitions, current and projected numbers of males, and probability of population persistence, are entirely based on the paper by Garton et al. (the 2009 and 2011 versions of this paper are virtually identical). It is the most frequently cited paper in the COT Report and the basis of population predictions in the USFWS 2010 listing decision, where it was cited it 62 times. Other
scientists who have reviewed Garton et al. (2009, 2011) have reported serious methodological biases and mathematical errors in that paper (see reviews commissioned by the Colorado Division of Wildlife and summarized by CESAR 2012; copies of the reviews and report by CESAR are attached). It is unconscionable, and indicative of an inadequate peer review and editorial process, that all of the reviewer comments were ignored by the USFWS in the 2010 listing decision and in the final published version of Garton et al. (2011). The data and programs used in that highly influential paper are not public, and therefore, the results are not reproducible.

4) The COT Report’s ranking of threats to populations and Sage Grouse Management Zones is subjective.

4.1) There is no evidence of any reproducible, quantitative methodology used in assigning rankings to threats in each population and sage grouse management zone (Table 2), or in discussion of specific PACs in Appendix 1. Instead, the ranking of threats in the COT Report is entirely subjective.

4.2) The ranking of threats in the draft COT Report was initially determined by a vote count of opinions of COT members, with the treats ranked from A through H, depending upon the presumed "severity" of the threat and how "imminent" the threat was (Table 1, below). "Unknown" was a category used in both reports for the cases of inadequate information. In the final COT report however, the ranking system changed. In most, but not all, cases the draft COT threat rankings of A to D (or "substantial, imminent" to "moderate, non-imminent"), and F to G (or "widespread, low severity" and "slight threat", were collapsed in the final COT Report of "Y" (or the "threat is present and widespread"). The draft COT Report threat ranking of "E" (or threat "localized, substantial" was made equivalent to "L" (or "threat present but localized") in the final COT Report. And a draft COT Report ranking of "H" (or "unthreatened") became "L" (or "threat present but localized").

<table>
<thead>
<tr>
<th>Draft COT Report</th>
<th>Final COT Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>A = Substantial, Imminent</td>
<td>Y = threat is present and widespread</td>
</tr>
<tr>
<td>B = Moderate, Imminent</td>
<td>Y = threat is present and widespread</td>
</tr>
<tr>
<td>C = Substantial, non-imminent</td>
<td>Y = threat is present and widespread</td>
</tr>
<tr>
<td>D = Moderate, Non-imminent</td>
<td>Y = threat is present and widespread</td>
</tr>
<tr>
<td>E = Localized, Substantial</td>
<td>Y = threat is present and widespread</td>
</tr>
<tr>
<td>F = Widespread, Low Severity</td>
<td>Y = threat is present and widespread, or</td>
</tr>
<tr>
<td>G = Slight threat</td>
<td>L = threat present but localized</td>
</tr>
<tr>
<td>H = Unthreatened</td>
<td>L = threat present but localized, or</td>
</tr>
<tr>
<td>U = Unknown</td>
<td>U = Unknown</td>
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</tbody>
</table>
4.3) The COT Report does not present any data that could be used in a rigorous evaluation of the threats. There is no evidence that any quantitative methodology was used to assign rankings in the final COT Report such that an independent reevaluation of the rankings would be reproducible. Moreover, these new rankings were not consistently applied. For example, the new ranking of "L" ("threat present but localized") in the final COT Report was applied to the Wyoming Basin population for the threats of mining, and conifers, even though the previous category was "H" ("unthreatened"). This arbitrary reassignment of threat ranking between drafts elevated the perceived threat level to this population and others. Similarly, the final COT Report assigned the previous threat category of "G" ("slight threat") to either "Y" ("threat is present and widespread") or to "L" ("threat present but localized").

If threats are to be evaluated objectively for each population, then data and reproducible methodologies are required, rather than subjective assessments used in COT Report.

5) Population trends are to be determined using substandard data and methods.

5.1) The COT proposes that no credit be received for restoration efforts until there is demonstrated sage-grouse use or positive population trend. However, the COT says nothing about: 1) how many years of monitoring will be required to show positive trends, 2) how much of a population increase would be required, 3) how these data would be adjusted for natural population fluctuations and the uncertainty of statistically invalid trends estimated from only counting males at a nonrandom sample of leks.

5.2) Of the three issues above, the most critical one that the COT does not acknowledge is the fact that male lek counts provide only a crude, non-random, and statistically-invalid estimate of population trends. These issues are well documented (Walsh et al. 2004; WAFWA 2008). Statistically robust alternative methods exist for estimating population trends (i.e. the sentinel lek count method or stratified random sampling, as proposed and tested by Garton et al. 2007); however, the COT makes no mention of this superior method or alternatives. The continued use of this substandard method for gathering data and estimating population trends compromises the ability of any interested party to objectively evaluate the effectiveness of conservation measures undertaken to benefit sage grouse. That lack of resolution translates into the potential for no credit to be given for restoration and mitigation efforts (because the resolution is inadequate to determine if these conservation measures result in positive changes to sage grouse populations).

6) The COT proposes calling out the Air National Guard to protect sage grouse habitat and hypothetical "connectivity corridors."

6.1) The COT proposes: "Implement policy changes that allow access to more fire suppression resources, such as Air National Guard Mobile Airborne Firefighting Units" to "immediately suppress fire in all sagebrush habitats." This includes the suppression of fires in so-called "identified connectivity corridors." However, these corridors are hypothetical only and have not been documented in the wild. If implemented, this policy change could represent an arbitrary, capricious, and scientifically unreasonable agency
action. Moreover, such a misallocation of resources could elevate the protection of sagebrush above the health and safety of humans. It is also contrary to the Air National Guard's stated peacetime mission, which is to, "provide protection of life, property and preserve peace, order and public safety."

6.2) The COT also recommends other agency actions to prioritize suppression of fire in sage brush, without evaluation of the annual cost or the degree to which they would compromise the protection of human health and safety. These actions would unreasonable if they do not explicitly put human health, safety, and property first. The proposed actions include:

"b. Re-allocate fire response resources (crews, equipment, etc.) to important sage-grouse habitats. Identify where resources are lacking and provide those resources to decrease response time to fires in sage-grouse habitats." With firefighting resources unquestionably stretched thin across the western United States, it is both unreasonable and irresponsible for the COT to propose that these critical resources be allocated to protecting sage-grouse habitat.

"c. Establish defensible fire lines in areas where: (i) effectiveness is high, (ii) fire risk is likely, and (iii) negative impacts from these efforts (e.g. fragmentation) are minimized. Avoid use of any vegetative stripping in healthy, unfragmented habitats, unless fire conditions and local ecological conditions so warrant." This is another unreasonable and irresponsible COT recommendation. Wildland fire containment primarily occurs as a result of cutting firelines (removing vegetation) with machinery and hand tools, except in cases where natural features such as roads, or in rare cases, wetline can be used to contain the fire or set backfires.

"d. Carefully consider the use of backfires within PACs to minimize the potential for escape and further damage to sage-grouse and sagebrush habitats." This is another unreasonable and irresponsible COT recommendation. The decision to set backfires as a control measure during a wildland fire is the responsibility of the Incident Commander, whose primary objectives are extinguishment and the protection of life and property, not sage-brush.

"f. Remove pinyon-juniper stands which are highly flammable (stands where trees are the dominant vegetation and the primary plant influencing ecological processes (Phase 3; Miller et al. 2008)) in low elevation sagebrush habitats." This is a worthwhile objective, although primarily from the perspective of increasing the availability of sage grouse habitat in areas that have been limited by pinyon-juniper encroachment (Miller et al. 2011).

"h. Provide incentives for suppressing fires in sagebrush habitats." The COT provides no examples of what such incentives would include.

"i. Federal land management agencies should consider placing additional
firefighting
resources and establish new Incident Attack Centers in or adjacent to PACs." This is another unreasonable and irresponsible COT recommendation that would result in the reallocation of wildland firefighting resources away from locations where they have been sited to protect human health, safety, and property.

7) The COT Report proposes "enforceable temporary measures."

7.1) The COT Report proposed that if adequate regulatory mechanisms cannot be implemented by specific deadlines, "then enforceable temporary measures should be considered in order to ensure threats will be at least temporarily ameliorated until such time that an effective regulatory mechanism can be implemented." However, the COT Report fails to mention what those "enforceable temporary measures" would include, which agency would be charged with enforcing them, if they would be enforced on private land, or the criteria that would be used to determine if they are an "adequate regulatory mechanism." The language of the COT Report is similar to that of activists and litigants, who in 2012, called upon the Western Governors for an "enforceable interstate compact to effectuate their collective commitment to sage-grouse conservation" and "regulate private land uses that threaten Sage-grouse." And that these enforceable measures be imposed "to ensure that private land owners meet their stewardship obligations for sage-grouse."

7.2) An unintended consequence of the COT Report is that it provides an administrative record that litigants can then use in court to argue that additional regulation is needed for sage grouse. The fact that the COT fails to provide any detail on enforceable measures leaves open their interpretation to the Court. The COT, by failing to provide detail and guidance, has effectively abrogated its stated responsibility to "serve as guidance for federal land management agencies, state sage-grouse teams, and others in focusing efforts to achieve effective conservation for this species."

8) The ESA requires that decisions must be based upon best available scientific and commercial data, and not "best available science."

8.1) The COT states that, "All proactive voluntary conservation efforts should use the best available science." However, to be consistent with the ESA and the IQA, this language needs to be changed to best available scientific and commercial data.

8.2) Although the COT makes the claim that it lists, "sources of data used by states to develop Priority Areas for Conservation (PAC) maps for each state," no details on the data files were provided. Lacking are the location of where these data are archived, who is responsible for curation, the conditions under which those data were shared with the COT, and attributes of these data (i.e. methods of collection and associated metadata). In short, while the COT makes claims about how "this report delineates reasonable objectives, based upon the best scientific and commercial data available at the time of its release," none of the cited sources of data are publicly accessible. It is a violation of the IQA that the underlying data used in such a highly influential document are not specified,
or available for independent analysis by informed members of the public.

9) **The COT uses new, subjective terms to evaluate risks to sage grouse.**

9.1) The COT Report uses new, subjective terms from the *Significant Portion of the Range Policy* to qualitatively describe the status of populations of a species being considered for ESA listing: *redundancy*, *resiliency*, and *representation*. To this list, the COT added a new, subjective term: *resistance*. None of these terms are quantifiable and all are open to arbitrary interpretation. Others have also recognized this deficiency and have pointed it out to the USFWS.

For example, the following is an excerpt from Alaska Oil and Gas Association and American Petroleum Institute's comments on *Draft Policy on Interpretation of the Phrase “Significant Portion of its Range” in the Endangered Species Act’s Definitions of “Endangered Species” and “Threatened Species,”* Docket No. FWS-R9-ES-2011-0031:

**Develop and Incorporate Quantifiable and Objective Standards**

The Draft Policy does not provide a uniform or quantifiable standard for interpretation of the SPR language, including the term “significance.” Instead, the Services have chosen to rely on qualitative criteria:

We evaluate biological significance based on the principles of conservation biology using the concepts of redundancy, resiliency, and representation (Schaffer and Stein 2000). These concepts also can be expressed in terms of the four viability characteristics used more commonly by NMFS: Abundance, spatial distribution, productivity, and diversity of the species. Resiliency (abundance, spatial distribution, productivity) describes the characteristics of a species that allow it to recover from periodic disturbance.

76 Fed. Reg. at 76994. API and AOGA are concerned that proposed SPR Policy may purposefully avoid quantifiable standards and thresholds, using definitions that fail to provide objective, repeatable method(s) for evaluating listing decisions. In our view, this approach puts species conservation at a disadvantage, results in unnecessary litigation, and places a heavy burden on society. The Services have an opportunity here to define the criteria by which species are listed more precisely, place more limited and quantifiable definitions on disputable terms, and insure that ESA listing decisions are based on scientific evidence.

This concern is shared by scientists and agency staff, including those involved in listing decisions (D’Elia and McCarthy 2010). Those authors clearly articulated the problem:

The imprecision of terms leaves broad latitude for determining which species fit into a particular category. That latitude, although seen by some as providing flexibility to address a wide variety of individual circumstances, can result in subjective rather than repeatable or transparent decisions (USDOI 2007). Failure
to clearly articulate how vulnerability assessment decisions are made undermines their credibility and erodes public confidence in the agencies responsible for developing the assessments (Shelden et al. 2001, USDOI 2007). Moreover, this lack of clarity can result in litigation (e.g., Western Watersheds Project v. Jeffrey Foss and Gale Norton, 2005), diverting resources from the implementation of species recovery actions, ultimately to the detriment of species conservation efforts.¹

The scientific commentators also provided specific recommendations to address this issue. “To increase transparency and efficiency in imperiled species categorization systems, we recommend that the FWS and NMFS establish quantitative criteria (including both time horizons and risk of extinction) for categorizing species as threatened or endangered (e.g., Gerber and DeMaster 1999, IUCN 2001, DeMaster et al. 2004) through policy or regulation.” Id. Their specific recommendations for the development of these criteria are briefly listed below:

1. Establish time horizons based on explicit probabilities of endangerment.
2. Develop guidelines for using population viability analysis in categorization decisions.
3. Consider the desirable characteristics of species categorization systems.
4. Use a team approach and consult experts.

The authors conclude: “A case-by-case approach to explicitly defining analysis time horizons [as is done now] is likely to be plagued by inconsistencies in time horizons selected and the rationales for them. These inconsistencies increase the likelihood of capricious decision making and legal vulnerability (Office of the Solicitor 2009).” Id. And, “[e]stablishing an explicit framework for making categorization decisions gives a level of certainty and credibility to a process that is otherwise subject to political and socioeconomic influences.” Id.

We urge the Services to act upon their recommendations before issuing a final SPR Policy.

9.2) We follow this analysis with a request to the USFWS: please provide quantitative definitions for "redundancy," "resiliency," and "representation" for use in the COT Report.

10) The COT Report promotes opened-ended research funding without acknowledgement of ongoing conflicts of interest.

10.1) The COT team calls for additional "key research" to resolve "uncertainties" in sage

grouse management and for "effecting sage-grouse and sagebrush persistence." However, without a list of specific questions and how those answers would change management decisions, this is simply a carte blanche request for research funding. It subverts a conservation program into a long-term research program with no mention of how the research will be funded or who will decide how funding is to be allocated.

10.2) This issue is further exacerbated by the fact that much of the "science" being relied upon by the USFWS and BLM in decision making on sage grouse was produced by a small number of sage grouse researchers. These researchers write papers together and review each other’s work (including their own) and subsequently serve on the highly influential NTT and COT teams (CESAR 2012). This is inconsistent with accepted scientific practice and the Department of Interior's information quality guidelines. Instead, the COT needs to foster greater independence by suggesting "key research projects" and then allowing an independent scientific and policy team to prioritize and solicit competitive proposals. Such an approach would avoid any appearance of cronyism.


11.1) To date, the USFWS has avoided mention of which conservation measures would meet the PECE requirement or any quantitative criteria by which they could be objectively evaluated. This leaves open to question the effectiveness of numerous conservation actions that have been recommended by the COT (and the NTT).

The COT report is notable (in comparison to the NTT Report) in recommending that conservation plans should "use local data on threats and ecological conditions, including status of local sage-grouse populations and their associated habitats." However, the COT Report fails to acknowledge the practical limitations of obtaining population trend data and how such data limitations could ultimately have the unintended consequences of justifying "enforceable temporary measures," or preventing the allocation of credit for mitigation effort, simply because the data do not provide sufficient resolution (or statistical confidence) to detect increasing trends. It is scientifically unreasonable for the COT to require population monitoring as the basis of regulation, when it knows full well that the data and methods for estimating population trends are inadequate for the task.

11.2) The COT Report's proposed objective to "Develop and implement proactive, voluntary conservation actions," is consistent with numerous papers by ESA scholars. The COT also proposes that "Sage-grouse conservation strategies should consider using the criteria identified in the FWS/NOAA Fisheries Policy for Evaluation of Conservation Efforts (PECE) when Making Listing Decisions (Federal Register/Vol. 68, No. 60/Friday, March 28, 2003; Appendix B) to help evaluate its likely implementation and effectiveness." However, the COT Report does not provide a single example of a sage grouse conservation plan that is consistent with the PECE Policy. Nor does it appear than any sage grouse conservation plans have been approved by the USFWS. To date, the
USFWS has not provided specific comment on conservation plans (that this reviewer was able to find), such that local agencies may at least be assured of approval under PECE if the plans are modified in specific ways to suit the USFWS. Thus, there is no reasonable assurance that the substantial investments that state and local governments, or private landowners, have undertaken can be expected to secure a PECE approval.

Similarly, there is no assurance from the USFWS that specific conservation measures recommended in the COT or NTT reports (both of which include USFWS staff as authors), if adopted, would meet the PECE policy.

12) **The COT Report erroneously evaluates threats using a single category for all energy production, despite substantial differences in the type and permanence of impacts.**

12.1) The COT Report does not acknowledge the fact that renewable energy projects (wind, solar, and geothermal) have a uniformly permanent impact on the landscape (solar arrays and wind turbines), while oil and gas development has a mix of temporary and permanent impacts. Blending these two vastly different types of energy production into one threat category is contrary to the best available scientific and commercial data, and counter-productive to sage grouse conservation (because specific threats and their underlying cause and effect mechanisms are not adequately addressed).

12.2) Furthermore, while projected oil and gas development were based on actual well data, known oil and gas deposits, and lease sales that overlap sage grouse habitat, wind development is primarily based on undeveloped and unleased commercial wind potential (i.e. as in Doherty et al. 2011). Thus, it is erroneous for the COT Report to base its threats ranking, and for the USFWS to base its policy decisions, on a combined analysis of two vastly different types of energy development, one of which is primarily based on speculation.

12.3) In order to be unbiased, the COT Report should have analyzed the two types of energy development separately, then overlaid their projected impacts to sage grouse in a common unit that reflects each development's impact(s) to sage grouse.

12.4) The COT Report purports that dust from surface mining activities indirectly impact sage-grouse. No such study has been conducted on the relationship between dust and sage-grouse. The FWS should be compelled to provide such data or remove this erroneous and unsupported statement from the COT Report.

13) **Two examples are provided below of erroneous information used in the COT Report's Appendix A - Management Zone And Population Risk Assessments.** This appendix detailed the threats to each PAC and population listed in Table 2 of the COT Report. The issues raised in the following examples apply to other populations as well.

As an initial matter, both of the cited papers, Garton et al. (2011) and Taylor et al. (2012) were modeling exercises based upon lek count data (discussed previously in this review), and as a result, estimates derived from those data have extremely large errors and low statistical confidence. Garton et al. (2011) made predictions for sage grouse populations across the West, 30 and 100 years into the future, starting from 2007. However, the models used to develop these predictions had extremely low resolution. For example, the 26 models used by Garton et al. (2011) had adjusted $r^2$ values ranging from 0 to 0.682, and the next closest value was 0.498, and the average $r^2$ was only 0.257. This indicates that the models, on average, did not explain 75% of the variation in the data sets. (In the case of the Powder River Basin the $r^2$ was only 0.315). Adding to this error, neither Garton et al. (2011) nor Taylor et al. (2012) accounted for the effect of documented population fluctuations that are the result of climatic fluctuations (i.e. Wyoming Game and Fish 2012b; Blomberg 2012) on their trend estimates.

Taylor et al. (2012) used data from 2003 to 2009, a period of population fluctuation that peaked in 2006 and then declined (a fact not mentioned by Taylor et al. (2012) nor acknowledged by the COT Report). This omission is relevant because the study period began in 2003 during the low point of a population fluctuation, continued through a population peak in 2006, and ended with a downward trend in 2009, potentially biasing results.

It is also significant that Taylor et al. (2012) contains a number of overstatements and omissions. For example, "Findings reflect the status of a small remaining sage-grouse population that has already experienced an 82% decline within the expansive energy fields (Walker et al. 2007a), a level of impact that has severely reduced options for delineating core areas that are large enough and in high enough quality habitats to sustain populations." However, while this statement is dramatic, the reality of the situation is quite different. Walker et al.’s (2007) estimates had confidence intervals so large that they render the estimates meaningless (i.e., a rate of increase in coal bed methane fields of 0.65 with a 95% confidence interval between 0.34 and 1.25, as 34 to 125% annual increase). Furthermore, although male lek counts declined from 2001 through 2004, they rebounded in 2005. This was an observation not acknowledged in Taylor et al. (2012) but consistent with sage grouse population fluctuations statewide (Wyoming Game and Fish 2012b).

COT Report stated that, "Garton et al. (2011) reported a minimum male count for this population at 3,042." However, Garton et al. (2011) included two different numbers for male sage grouse counted in the Powder River Basin in 2007, a discrepancy: "The Gompertz model with declining time trend implies the Powder River population of sage-grouse will fluctuate around carrying capacity which will decline from 3,042 males attending leks in 2007 to only 312 males attending leks in 2037 to going extinct with only two males attending leks in 2107 if this trend continues at the same rate in the future. The 2007 count of 5,397 males is estimated to be about 2,000 males higher than the carrying capacity of the region."
Both Garton et al. (2011) and Taylor et al. (2012) used model selection procedures. As described by Taylor et al. (2012) in simple terms, their results were derived "using a statistical technique (AIC) that is akin to using a dial to tune a radio to pick up the strongest signal." However, in equally simple terms it can be argued that model selection procedures, like the strongest signal on a radio dial, is not necessarily where the most accurate information comes from.

13.2) How the COT Report relies on erroneous information for priority habitat mapping and evaluation of threats: An example from the Colorado Plateau Management Zone and associated PACs.

Regarding the Colorado Plateau Management Zone and Parachute-Piceance-Roan PAC, the COT Report states, "Priority habitats are well mapped and include all high use habitat (which includes breeding, summer, and winter habitat within 4 miles of all known leks) and linkage zones to Management Zone 2 to the north. There is no known connectivity with Utah (Management Zone 3 to the west) due to natural habitat fragmentation and large areas of nonhabitat." This is in error. There are genetic data that provide evidence of connectivity to Utah contained in Apa (2010). And, as discussed below, the priority habitats are not “well-mapped” but mapped at low resolution and contain large areas of non-habitat and marginal habitat.

The COT Report states, "The Parachute-Piceance-Roan Basin population appears to be captured within priority areas for conservation, and representation appears to be captured adequately. Priority areas for conservation capture 60 percent of the occupied range in this population and also include 100 percent of all known active leks and all habitats that were modeled "high probability of use" within four miles of alek that has been active in the last 10 years." This statement is a misrepresentation of the best available scientific and commercial data. First, the COT does not mention the fact that the PAC contains large areas of marginal habitat and non-habitat in a naturally fragmented landscape produced by dense conifer and aspen stands, shrubs, meadows, and rugged topography. High-resolution vegetation mapping (hyperspectral data) and modeling of the PPR sage grouse habitat (using habitat parameters specific to the PPR population) by Garfield County (2012), and previously by Heather Sauls in Garfield and Rio Blanco Counties (2008), both concur with this conclusion. These two habitat-mapping efforts were based on best available data in the public domain. When compared to the low resolution PAC map for the PPR population, these analyses show that approximately 80% of the mapped PAC is non-habitat. Second, the location data upon which the low-resolution Preliminary Priority Habitat Map is based (produced by the Colorado Parks and Wildlife), are not in the public domain, and there is no written assurance that they ever will be accessible for independent review and reanalysis. Furthermore, requests for these data under legally binding data-share and non-disclosure agreements have been met with refusal by CPW. Thus, the CPW maps of the PPR and northwestern Colorado used by the COT, and by the BLM in its RMP revisions (including maps based upon Rice et al. 2012 where the data are scaled down to 1-km grid cells resulting in a massive 4,000% loss of information, are not reproducible). Use of these maps by federal agencies as a basis for decision-making is a clear violation of the Information Quality Act.
requirements.

The COT Report fails to mention the inconsistency in definition of an "active lek" between that used in the scientific literature and that used to map the PPR PAC. The scientific literature defines an active sage grouse lek as locations where two or more males have been observed and documented actively courting females in the last two years (Doherty et al. 2011). The "active lek" criteria applied to the PPR for habitat maps used by the COT is: a site where at least one male was observed lekking within the past 10 years (whether the lek was surveyed or not before or following that observation).

Moreover, the COT Report does not acknowledge that the CPW lek-count and lek location data set for the PPR contain numerous missing cells, and that even locations where a single male was observed 7 years ago, with three years of missing data before that, is still considered an "active" lek. It is arbitrary, capricious, and scientifically unreasonable for federal agencies to use inconsistent definitions as a basis for regulatory decisions, and for it to rely on such an arbitrarily low threshold. To further emphasize this point, if no males were in attendance at a lek for potentially nine years, then just how were the un-bred female sage grouse going to produce eggs and nest within 4 miles of that "active" lek? Clearly, immaculate conception has not been documented to occur in sage grouse.

The COT Report states, "Redundancy is not captured within this population because it is relatively small (three year running average number of males is 93) and somewhat isolated." The COT Report provides no genetic or dispersal data with which to conclude that this population is isolated from other nearby populations. The COT does not provide any quantifiable definition of "redundancy," nor any data with which to conclude that the population lacks "redundancy." However, genetic data and analyses do exist for northwestern Colorado and Utah that are contrary to this assertion. Those data have an especially large sample size for the PPR population (n=65). Those data and results (Apa 2010), not mentioned by the COT Report, reveal that levels of genetic diversity in mitochondrial DNA and microsatellite markers are comparable to other populations in Colorado, and there is extensive shared variation among populations. That study reported,

"This analysis of the PPR population compared with 5 other Greater Sage-grouse populations in Colorado revealed that the genetic make-up of PPR is generally consistent with the other 5 populations. Using mtDNA sequence data, 5 of the 8 haplotypes found in PPR (66% of the PPR birds) were also found in the other populations in Colorado."

"The mtDNA neighbor-joining network (Fig. 2), which was constructed using Fst genetic distances among populations, suggests that PPR is more closely related to North Park, Cold Springs, and Blue Mountain, than to Middle Park and Eagle. The fact that PPR is not shown to have branch lengths longer than the other Colorado populations suggests that it is not genetically distinct from all other Colorado Greater Sage-grouse populations."

Additionally, the levels of genetic variation are comparable to those in other populations in Colorado, and indistinguishable when the most appropriate measure; expected heterozygosity is used (as DNA obtained from feathers are more likely to contain closely related individuals and bias results towards heterozygote deficiency, making expected heterozygosity based on allele
The COT Report states, "There is some potential for connectivity to the north to the Wyoming Basin population in Management Zone 2. Linkage habitats have been included in mapping efforts." The data, however, are contrary to assertions made in the COT Report in justification of its arbitrary linkage habitat maps. Instead, the data reveal a broader genetic linkage, including nearby populations and in Utah. This conclusion is more consistent with recent genetic and GPS tracking studies that show sage grouse can disperse over much greater distances and over/around land uses that were previously thought to contribute to fragmentation (i.e. Bush 2009; Bush et al 2011; Tack et al. 2011; Thompson 2012). As noted previously in this review, linkage habitat maps used by the COT Report are purely speculative and cannot be relied upon as a basis for decision-making.

Data on lek locations and attending male numbers from Colorado Parks and Wildlife (CPW) show that currently active (2012) sage grouse leks occur on, or immediately adjacent to, roads, pipeline corridors, and well pads in the area. This is a direct contradiction to, and refutation of, assertions in the COT Report that, "Representation and redundancy are at risk within this population due to its small size, energy development and the associated infrastructure, especially road development." And, "Advances in drilling technology and rapid natural gas demand and subsequent rising prices have led to a significant increase in natural gas drilling activity. Road and infrastructure are also ranked high as they are closely related to energy production." While oil and gas development can contribute to sage grouse avoidance and mortality in specific ways (see review by Ramey, Brown, and Blackgoat 2011), it is counter-productive to conservation efforts for the COT Report to make wholesale negative assertions.

The COT states, "A large majority of PACs are privately owned, mostly by energy companies. Energy and mineral development is the highest ranked threat to sage-grouse in this area." However, the fact that much of the land in the PPR is privately owned by energy companies means that adequate funding is available for implementation of mitigation and habitat restoration efforts to benefit sage grouse populations. This has been the case for the Pinedale Planning Area of Wyoming, where oil and gas development, mitigation, and sage grouse numbers have all increased (lek count data from Wyoming Game and Fish). These are facts not acknowledged by the COT.

**Literature Cited**


Bedrosian, B and D. Craighead 2010. Anthropogenic influences on Common Ravens in the Greater Yellowstone Ecosystem. Unpublished poster presentation. Available at:


Sharp-tailed Grouse Technical Committee, provided to  K. E. Mayer, Chair, Bird Committee, Western Association of Fish and Wildlife Agencies, Cheyenne, WY.


Exhibit B:
Studies Cited in The COT Report Fails to Meet DQA Standards

Aldridge et al. 2008.1 This study is cited three times between the COT Report and NTT Report in support of the flawed presumption that disturbance leads to extirpation. This study is also mis-cited in support of the 50-70% sagebrush threshold in the NTT Report.

Aldridge, C. L., and M. S. Boyce. 2007.2 The NTT and COT Reports cite this study for the flawed proposition that limited source habitats appear to be the main reason for poor nest success (39%) and low chick survival (12%). It is questionable that this study of GRSG in Alberta can have utility outside of that limited area. The Alberta population is small and has minimal suitable habitat available irrespective of human influence. Rather, ecology and geologic formations are the primary limiting factors in Alberta. Therefore, any impact on this population will appear heightened compared to other populations.

The authors claim many GRSG populations are at risk of extirpation. Aldridge and Boyce 2007 at 509. However, the authors proffer no citations nor authority for that proposition. In their modeling, the authors chose a subjective suite of variables related to habitat or human disturbance that they felt may be important.3 Such an analysis is readily subject to bias.

Further, they used a 1-km2 window which may be so large as to be meaningless as it is over 33 times larger than the 30m grid size used by the 2001 National Land Cover Data (NLCD 2001, http://www.epa.gov/mrlc/nlcd-2001.html). The 30m grid size has long been in use to develop qualitative models for endangered species critical habitat because it is the resolution of many digital elevation models (e.g. Turner et al. 2004). Some conservation GAP analyses use data with a resolution of 10m. While data resolution may limit analyses in some regions, a more focused evaluation of sage grouse core areas that utilizes a more informative grid size (e.g. industry standards of 90, 30, or 10 m) would be a more appropriate basis for policy decisions and conservation measures than that offered in this paper.

The authors grossly assume that roads and power lines affect productivity and chick survival saying little more than the generalization that “mortality associated with power lines and roads occurs year-round.” The authors cite absolutely no support for this assertion.4 This is clearly inappropriate to extrapolate to chick success and the COT reliance upon this proposition should be withdrawn. Moreover, citations to Aldridge and Boyce 2007 are inappropriate for the proposition that energy development leads to declines.

3 Id. at 510.
4 See Messmer Tall Structure Synthesis at 10.
Cassaza et al. 2010. This study is mis-cited in the COT Report in support of the proposition that pinon juniper needs to be reduced to no more than 5 percent of the landscape. Given the authors considered brood-rearing habitat, it is inappropriate to rely upon this study for the COT Report’s recommendation that this proposed pinon juniper threshold be applied across all GRSG habitat.

Doherty et al. 2008. This paper is cited 6 times in the NTT Report and once in the COT Report for support of surface use restrictions. This paper is largely based upon professional judgment rather than science. Even then, the NTT Report mischaracterizes the study as support for its recommended 3% disturbance threshold, 4-mile buffers and prohibition on leasing in priority habitat. With regard to the proposed 4-mile buffer, Doherty et al. 2008 did not test whether 4-mile buffers are necessary, or whether GRSG would respond positively to a 4-mile buffer. The authors do say that current management is insufficient to protect winter habitat (.5 mile lek buffer.), but do not suggest a wholesale prohibition on leasing. This study did not look at population trends, rather it examined habitat selection and variables impacting it.

The study examined 24 predictor variables over two years to predict female GRSG winter habitat selection. Table 1. For variables that were strongly correlated the authors chose to keep variables they “felt” were strong predictors, and dismissed the others. After deciding on a habitat model the authors conducted a bootstrap analysis (n=5,000) to quantify change in odds of use with the introduction of CBM wells. The bootstrap analysis was repeated to quantify how the amount of sagebrush (4 square km) affected the odds of use with or without wells. However, instead of conducting analysis with varying degrees of development, the authors assumed full build out at 12.3 wells/km square versus 0 wells/km square. This only provides insight into a worst-case scenario which is not representative of actual conditions or variables across the vast range of GRSG, or newer technologies undertaken in later phased (POD) developments. Topography and sagebrush cover were the best predictors of GRSG use. Ultimately, the authors found that female sage-grouse are more likely to avoid winter habitats with intensive (full build out) energy CBM development.

While it is well known that GRSG are positively correlated with the amount of sagebrush cover, and Doherty et al. 2008 found that percent cover was a good predictor of occurrence at a coarse (4km sq) scale, the authors improperly state “[C]onversion of sagebrush negatively influences sage-grouse populations” without supporting data. Id. at 193. The negative influence that the authors found was avoidance by GRSG. However, the presumption that avoidance leads to population level impacts has not yet been proven, as discussed elsewhere in this DQA Challenge.


Importantly, the authors state “[E]xamination of ecological processes at the landscape scale does not eliminate the need to understand habitat relationships at local scales; rather, it will likely require a combination of scales to completely understand how sage-grouse respond to their environment.” Id. at 194. This statement undermines the NTT’s broad one-size-fits-all landscape approach to the exclusion of local data.

**Doherty et al. 2010.** The NTT Report cited Doherty et al. 2010 twice in support of a 50-70% sagebrush thresholds. However, the Literature Cited section lists two Doherty et al. 2010 studies and fails to differentiate which one stands for the proposition alleged. Diminishing the usefulness and utility of the NTT Report.

**Garton et al. 2011.** This study is cited 15 times in the COT Report to allegedly demonstrate population declines, existing conditions, and expected persistence. There are significant issues with this study as discussed in detail elsewhere in this DQA Challenge. See Exhibit C.

**Knick et al. 2011.** This lengthy (162 page) paper presents another cumulative effects analysis that covers nearly every conceivable deleterious human activity on sagebrush and sage grouse. This study is cited a total of eight times between the two reports (NTT/6, COT/2). The NTT’s use of this study is the most problematic and is generally cited in support of the proposition that various anthropogenic disturbances results in population declines. It is also cited in support of withdrawals, and suggests draconian restrictions are necessary because increased development on private lands, is not subject to mitigation, thus there is “greater need for conservation of sage-grouse and sagebrush on public lands (Knick et al. 2011).” NTT Report at 12.

Notably absent from this one-sided analysis is any mention of the effects of hunting harvest, even though this is a major, documented source of sage grouse mortality (with 207,430 grouse killed just between 2001 and 2007, and higher annual take in the preceding years). Instead, the authors devote pages of attention to a number of hypothetical effects:

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Even activities, such as hiking and mountain biking, which often are perceived as low impact or benign, have an influence on wildlife (Miller et al. 1998, Taylor and Knight 2003). Any human activity of high frequency along established roads or corridors, whether motorized or non-motorized, can affect wildlife habitats and species negatively through habitat loss and fragmentation, facilitation of exotic plant spread, population displacement or avoidance, establishment of population barriers, or increased human-wildlife encounters that increase wildlife mortality (Gaines et al. 2003). These effects appear to be common across a variety of habitats and species that span the full range of forested to arid terrestrial environments (Gaines et al. 2003, Ouren et al. 2007).

However, when one looks closely at the cited literature, these supposed population-level effects are speculative. The omission of documented sources of mortality and inclusion of speculative sources, indicate a less than objective analysis.

To quantify the influence of human activities on patterns and processes of sagebrush habitats and sage-grouse populations, the authors rely on the previously designated Sage-Grouse Conservation Area or the pre-settlement distribution of sage-grouse buffered by 50 km (Connelly et al. 2000; Schroeder et al. 2004). As noted in the reviews of Schroeder et al. (2004), the pre-settlement distribution was a subjective assessment of pre-European sage grouse distribution that included both habitat and non-habitat, and selectively excluded some areas of documented sage grouse occupancy. The widening of the pre-settlement range by a 50km "buffer" (by Knick et al.) inflates the size of the area affected by human activities, even though sage grouse may have never occurred there.

As with other disturbances in sage grouse habitat, Knick et al. quantify the "effect area" that surrounds any kind of development based on other studies. In the case of oil and gas wells, the effect area includes a 3km buffer around each well pad, and the affected area of a pipeline was 3km in total width because of presumed spread of invasive plants (although Table 16 shows in many cases the authors used a higher figure). A 3km effect area was also applied to all transmission lines. These effect areas were applied across the study area, substantially inflating the effects of these activities, even if mitigation, such as conservation offsets, had been implemented. However, the cited paper for oil and gas construction (Lyon and Anderson 2003) made no such 3km recommendations. They simply recommended that the BLM regulations in place at the time be "reexamined." Knick also misrepresented cited studies regarding the affected area of roads, pipelines, and transmission lines. Examples are provided below:

1) Lyon and Anderson (2003)\(^{10}\) also reported observations contrary to the one-size-fits-all effect areas used by Knick et al. For example, Lyon and Anderson (2003) reported that:

On the Pinedale Mesa, potential disturbances associated with natural gas

\(^{10}\) Discussed in detail below.
development were restricted to vehicular traffic on the pre-existing main haul road. All males from the 3 disturbed leks in our study strutted either on or within 15 m of this road. However, the mean number of vehicles using the mesa road in a 24-hour period during spring and summer of 1998 and 1999 was <12.

2) Instead of reporting a 3km effect area, Bradley and Mustard (2006) instead reported the following limited effects from roads and transmission lines, "In 2001, cheatgrass was 20% more likely to be found within 3 km of cultivation, 13% more likely to be found within 700 m of a road, and 15% more likely to be found within 1 km of a power line."

3) Similarly, instead of finding a 3km effect area, Gelbard and Belnap (2003) reported:

…we observed anecdotally that sites isolated (1000 m) from roads tended to contain fewer exotic species than sites near (50 m from) road. We found a significant effect of road improvement on both exotic and native species richness in interior communities 50 m beyond the edge of the road cut, suggesting that road improvement influences the distribution of both exotic and native species in lands beyond the influence of roadside disturbance. Exotic species richness tended to be greater and native species richness tended to be lower next to more improved roads, although we caution that our measurements of richness were a snapshot.

Knick et al. stated:

We used an ecological rationale for estimating the area around points, lines, or polygons from which land use potentially influenced land cover or sage-grouse populations. Estimates for effect sizes into surrounding areas were based on foraging movements of human-subsidized predators, distance of exotic plant species spread, or on distribution data relative to land use.

However, because of the misrepresentations detailed above, other "effect sizes" and "ecological rationale" used by Knick et al. should be closely reexamined by the FWS and BLM.

According to Knick et al. "All nonproprietary and nonsensitive spatial data sets used in our analysis are available for download on the SAGEMAP website http://sagemap.wr.usgs.gov; United States Department of the Interior 2001a). Each data set is accompanied by a metadata record documenting original source and GIS procedures." It is presently unknown how much of the data are proprietary or sensitive.

“Human land use, including tillage agriculture, historic grazing management, energy development, roads and power line infrastructure, and even recreation have contributed both individually and cumulatively to lower numbers of sage grouse across the range (75 FR 13910, Knick et al. 2011).”

11 See, e.g. NTT at 6.
grouse numbers, Knick et al. 2011 quantified effect size—percentage of area impacted by a given activity—and do not report population numbers. The COT Report misrepresents the findings of the study and attempts to tie effect size to population decline which was not tested. Knick et al. do attempt to tie effect size to distribution of GRSG, however, the assumed historical distribution is based on flawed studies which subjectively calculate historic distribution.

Knick et al. 2003. The very title of this piece evidences extreme bias, “Teetering on the edge or too late?....” This study is cited 15 times between the two reports (NTT/1, COT/14). Both the NTT and COT Reports cite this paper in support of the proposition that sagebrush ecosystems are beyond recovery thresholds and the amount of habitat lost or degraded as a result of human settlement. There is a likely conflict of interest as Schroeder, a co-author is a COT team member, and Knick is an NTT member.

This paper lacks any useful scientific findings and seems basically a biased call to arms for environmental groups. For example, the authors complain about a lack of political agenda and advocate that public lands be “Protect[ed] from economic use.” Other incredibly biased statements include, “[O]ur primary challenge, presented over a quarter of a century ago (Braun et al. 1976), may be to convince our society of the intrinsic value of sagebrush ecosystems and their unique biodiversity. This change in mindset will have to be followed by a firm commitment by federal and state agencies to provide the resources necessary to resolve issues presented in this paper. Only with this concerted effort and commitment can we afford to be optimistic about the future of sagebrush ecosystems and their avifauna.” Further, the purpose of this study is said to be to “emphasize the urgency for conservation and research actions, and synthesize existing information...” It is clear that this study was not designed objectively, and it is truly an opinion paper of where the authors perceive there to be gaps in research. There is no hypothesis testing, and no real data collection.

While reflected in the NTT and COT Reports for mistaken propositions on hindrances to restoration, this paper represents the opinions of the authors and is not based on actual data or hypothesis testing. The authors provide no evidence for their assertion that “disruption” leads to the inability to restore habitats, and does not present data to support its assertions that restoration could take decades or centuries. Knick et al. do not indicate whether their assertions are based on passive or active restoration, and most importantly fails to recognize that there are many factors that impact resilience and thus restoration of habitats. Numerous publications suggest that restoration is possible, but it takes active management opposed to passive management.

Furthermore, even if it does take decades or longer to fully recover sagebrush habitats Knick et al. assume that sage grouse require climax communities in all life stages and seasons, and also assumes that after loss of a patch there is none available for sage

grouse to disperse to. Sage grouse can walk and fly and bypass unsuitable habitats for suitable habitat.

Knick et al. (and the COT Report) continues to espouse and assume that because not all sagebrush can be effectively restored this equates to an overall lack of effectiveness of restoration efforts. This notion is false. The authors (and the FWS) have not quantified the amount of habitat that has reached a change in state that precludes effective restoration- it may be small. There have been numerous studies published as part of the Sagebrush Steppe Treatment Evaluation Project (SageSTEP) that have demonstrated how proper management, and different restoration methods can positively influence resilience in a cost effective manner. For instance, transplanting sagebrush is significantly more effective and is also significantly cheaper than seeding. Others have shown that if seeding is chosen then it is significantly more effective if it is covered with organic matter, and has shown that by seeding with herbs after a fire or pinyon juniper treatment, it can suppress the spread and establishment of cheatgrass.

Because this is a review of existing conditions—in 2003—the information is outdated. Significant work and conservation efforts have taken place since the publication of this paper which have reduced threats. Throughout the paper the authors make the assertion that habitat has been disturbed or disrupted “beyond a threshold at which natural recovery is unlikely” a bold and biased statement which is not supported by data but reflects the opinions of the authors and those they cite (many of which are also outdated).

The authors cite anthropogenic disturbances like mining, grazing, oil and gas, infrastructure as fragmenting and degrading habitat. West and Young 2000 (advocates of listing Gunnison sage) are frequently cited in support of the amount of habitat lost since pre-European settlement and that most of the range is beyond what can be restored. The authors then go on to cite Braun 1997, 1998, (a paid consultant to listing proponents and a biased advocate of listing Gunnison and GRSG) as well as Connelly, and Schroeder et al. 2000, in support of their mistaken view of long term population declines:

- “numbers of sage-grouse (Centrocercus spp.) have continued to decline throughout their range (Connelly and Braun 1997, Braun 1998, Connelly, Schroeder, et al. 2000) and individual populations have become increasingly separated (Schroeder, Hays, Livingston, et al. 2000, Beck et al. 2003).” This evidences bias and has been refuted by Zink 2014.
- “In addition to the challenge of understanding shrub-steppe bird-habitat dynamics, conservation of sagebrush landscapes depends on our ability to recognize and communicate their intrinsic value and on our resolve to conserve them.” This shows serious lack of objectivity.

Knick, S.T. and S.E. Hanser. 2011. This study is cited a total of 14 times between the two documents (NTT/6, COT/8). The NTT cites this study in the context of the

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importance of connectivity, which wrongly assumes (as discussed elsewhere herein) that sage-grouse cannot bypass unsuitable habitat, but rather habitat must be expansive and connected. Connectivity is also a common theme, but it wrongly assumes disturbance influences habitat selection thus population persistence.

A fundamental problem with this [Knick and Hanser] analysis is that lek persistence data are used in lieu of actual population data, and the analysis rests on the critical assumption that population persistence and lek persistence are strongly correlated. For example, if leks had simply moved because of disturbance (e.g. fire) then the analysis would treat the lek as extirpated when the subpopulation birds that comprise it were not extirpated.

Although the data were originally at a 30m resolution, the authors resampled at a 540m resolution, claiming that they "were able to detect relatively fine-scale patterns at this resolution when considered at the spatial extent of the SGCA." The authors do not acknowledge that this rescaling could be expected to inflate the effects of disturbance.

The authors' belief that "little is known about the connectivity and ability for spatially structured populations to exchange individuals," is contrary to the abundant field and genetic data showing ongoing long distance dispersal (>18km). (This aspect is discussed extensively in the reviews of Chapter 16 of the monograph, Garton et al.)

The authors were "unable to identify a specific source of human disturbance because the score represented a summed influence of all anthropogenic features." Thus, they concluded that "the cumulative effect of human activities may have a greater influence on persistence of sage-grouse populations than single land uses." This ignores the relative influence (effect size) of specific types of disturbance on sage grouse populations and assumes that they all contribute to sage grouse decline, when in fact some do not. This is not a sound epistemological basis for informed management decisions.

A more robust analysis would include a logistic regression approach to model population presence/absence. If lek presence/absence data were substituted, then the analysis could only refer to factors leading to the extirpation of leks, and that would best be done at a more limited, regional scale (e.g. sage grouse management zone). Results would be compared to a range wide analysis. Ideally, the variables selected for analysis should be winnowed down on the basis of plausible cause and effect mechanisms, and those likely to have the largest effect sizes. In that way, variables can be treated as testable hypotheses.

Leu and Hanser 2011.14 This study is cited three times in the COT Report in support that fragmentation is the primary cause of population declines/primary threat, and that sage-grouse avoid anthropogenic disturbances opposed to natural disturbances. This is

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something that Knick 2013 (the study which claims disturbance should be limited to less than 3%) wrongly suggests.

This paper utilizes a complex spatial analysis to predict impact of the "human footprint" on sagebrush habitat (termed "sagebrush landscape" by the authors). This is the same approach used previously to describe the "human footprint" across the west, by two of the same authors as Leu et al. (2008). The third author of Leu et al. (2008), is Knick, also an editor and frequent contributor to this sage grouse monograph.

The paper contains considerable jargon, making a comprehensive read a time-consuming task.

The model used to study the "human footprint" is dependent upon the inputs of other models, but the error associated with these inputs, and their effect on results, were not addressed by Leu and Hanser. Use of the terms "error," "uncertainty," and "confidence interval" are absent from this paper. The authors did not appeal to us statistical methods that deal with stochastic variation to estimate the magnitude of the error variance and propagate it through to the confidence intervals.

The significance of this paper lies in its likely utilization by the USFWS for a range wide or regional "cumulative effects analysis" of various human land uses and activities on sage grouse. Therefore, a more in-depth review of this paper may be desirable. The authors describe their approach as: "The cumulative effects of human actions on landscapes, the human footprint, can be delineated as the physical and/or ecological human footprint."

In this paper, as with Leu et al. (2008) no hypotheses are tested. Instead, the authors rely on a post hoc interpretation of results and make recommendations derived from their complex spatial analysis. That paper interprets the results using a descriptive, storytelling approach. The authors recommend that certain landscapes in a given human footprint class be "carefully evaluated," although the criteria by which such an evaluation would be objectively conducted is not described. The results are deemed supportive of those obtained by other authors in the monograph, however no criteria were provided that would potentially falsify previous conclusions. The authors believe raven control to be ineffective and suggest that all future transmission lines follow existing high impact corridors, an expensive proposition to be based on surmise.

The size of the affected area surrounding each type of land use was developed from one or few studies, and applied across the range of sage grouse. This is a questionable one-size-fits-all approach to quantifying potential disturbance. For example, the corvid (e.g. raven, crow, and magpie) and domestic cat and dog predator risk models (regressions of probability of occurrence vs. distance from human habitations) were based on extremely limited data (4, 2, and 3 data points respectively) and with no tests of significance or confidence intervals. Such poorly supported inferences cannot be viewed as reliable. (The impact of oil and gas wells is treated as a disturbance area around fixed points and their supporting infrastructure (roads and transmission lines) is quantified separately.)
The authors provided a handful of citations including an unpublished masters thesis in support of data used to develop input models.

The authors analysis rests on the use of fractals (as opposed to Euclidean geometry) and modeled artificial landscapes, to summarize aspects of habitat fragmentation, including patch shape, edge, and size in terms of lacunarity. A concise definition of lacunarity used in ecology may be found in Halley et al. (2004):

In general terms, however, lacunarity is an index of texture or heterogeneity [of a fractal object]. Highly lacunar objects possess large gaps or low-density holes, while low-lacunarity objects appear homogeneous. Thus, for example, in observations of vegetation cover using quadrats, lacunarity is low if we find very similar levels of cover in every quadrat (Plotnick et al. 1993). More precise definition of lacunarity has been problematic.

Leu and Hanser's rationale for using this method is as follows:

We analyzed artificial landscapes due to the lack of previous research evaluating lacunarity in natural landscapes demarcated by convoluted patch boundaries and to aid interpretation of lacunarity analyses from natural landscapes (Elkie and Rempel 2001).

Lacunarity has several advantages over other more common fixed-scale landscape metrics because it consists of a single metric evaluated at multiple scales, is not influenced by edge effects, nor restricted to landscapes with high occurrence of habitat of interest (Plotnick et al. 1993). Lacunarity metrics can also be used to assess degree of relative fragmentation across diverse landscapes (Wu et al. 2000).

Despite its ease in calculation, lacunarity analyses have been rarely used to study patterns of natural landscapes (but see Wu et al. 2000, Derner and Wu 2001, Elkie and Rempel 2001) perhaps, because interpretation of lacunarity curves can be difficult. However, we found that using lacunarity analyses of simulated landscapes, where degree of fragmentation and proportion of land cover reflect the range of values of landscapes studied, greatly aids in the interpretation of lacunarity functions of landscape patterns.

Other authors have raised issues as to whether these models accurately represent real-world situations, and the conditions under which its use may be questionable. The uses and abuses of fractals in ecology are thoroughly discussed in Halley et al. (2004).

The original paper (Leu et al. 2008), a general description of the approach used in this paper, and data appendicies may be found at the following websites:

- http://www.esapubs.org/archive/appl/A018/039/default.htm
Fedy et al. 2012. This study is cited two times in the COT Report, once in support that areas outside PACS may need to be maintained. This is just one example of the FWS mistaken assumption that GRSG are unable to bypass unsuitable habitat during migration or other seasonal movements.

Holloran 2005. This study is cited 14 times between the two reports (NTT/12. COT/2) in support of several flawed propositions and conservation measures, including alleged population declines associated with energy development and the allegation that fragmentation impacts use and ultimately persistence. Further discussion is included in Exhibit A.

Key assertions in the COT report are both biased and in error:

The primary potential risks to sage grouse from energy and mineral development are:

1) Direct disturbance, displacement, or mortality of grouse.
2) Direct loss of habitat, or loss of effective habitat through fragmentation and reduced habitat patch size and quality.
3) Cumulative landscape-level impacts (Bergquist et al. 2007, Walston et al. 2009, Naugle et al. 2011). There is strong evidence from the literature to support that surface disturbing energy or mineral development within priority sage grouse habitats is not consistent with a goal to maintain or increase populations or distribution.

None of the published science reports a positive influence of development on sage grouse populations or habitats. Breeding populations are severely reduced at well pad densities commonly permitted (Holloran 2005, Walker et al. 2007a). Magnitude of losses varies from one field to another, but findings suggest that impacts are universally negative and typically severe.

These statements are not supported by the data. Instead, they are based upon:

a) A subjective interpretation of results by the authors of the cited studies (i.e., where no hypothesis testing was used).
b) The frequently repeated but erroneous assumption that a temporary decrease in lek counts immediately adjacent to active wells is equivalent to a population decline (The alternative hypothesis, that displacement from affected leks is temporary or that birds, particularly juveniles, relocate elsewhere, was not considered).


The COT Report cannot cite statistically valid population estimates from multiple populations that show declines specifically due to oil and gas development because no such data exist.

The COT Report does not present any credible description of the specific mechanisms that explain why sage grouse could be affected to the point that population declines could occur. This is a key issue addressed in the scientific review published by Ramey, Brown and Blackgoat 2011. In that paper, the authors articulate the specific cause and effect mechanisms that underlie each threat, as well as the experimental data required to test them, and the specific types of mitigation required to ameliorate them. The COT report, in contrast, made unsupported blanket statements and regulatory prescriptions that did not address specific threats and their underlying mechanisms.

Contrary to assertions made in the COT report, data and analyses from the State of Wyoming show that population trends across that state synchronously fluctuate, showing peaks in male lek attendance in 2000 and 2007. Additionally, the most heavily developed region, the Upper Green River Basin (Pinedale Planning Area) has consistently been above state-wide trends in male lek attendance (Wyoming Game and Fish 2012). Additionally, the earliest study cited in support of the blanket approach (Holloran 2005) did not acknowledge that the BLM had intentionally waived stipulations on the Pinedale Anticline in order to facilitate research on impacts without these stipulations.

Therefore, the impacts reported by Holloran (2005) do not correspond to impacts under stipulations required at the time, nor account for current (and dramatically reduced) impacts under more recent and stringent stipulations. And finally, Holloran's (2005) population scenarios and predictions of population decline have simply failed to come true (see additional discussion of this issue in Section 6 below), yet the COT Report continues to rely on this falsified information. If conservation measures are to be science-based, all evidence must be taken into account, including contrary evidence. The COT Report has failed in this most basic requirement of science.

The COT Report fails to mention several key facts about the Holloran (2005) study that are contrary to this statement. As an initial matter, Holloran (2005) was an unpublished dissertation that did not employ any hypothesis testing. Instead, Holloran (2005) used subjective interpretations of his results, or the equivalent of creating "just so stories" to explain results in light of a particular viewpoint. That is not science, it is subjective opinion. Additionally, the following data quality issues are identified in the study by Holloran (2005) that are relevant to the FWS’s continued reliance on it as a basis for decision making:

Holloran (2005) only speculated on potential causal mechanisms of population decline, as his data and study design were focused only on localized effects. Additionally, Holloran admitted that, "Identifying causes of population declines has remained elusive." And the "displacement theory" favored by Holloran (2005) does not provide any test of the hypothesis that local, temporary displacement of yearling sage grouse from areas under intensive development has led to population-level declines.
Holloran (2005) does not provide any data that population declines have occurred, or that density-dependent effects have occurred in nearby areas, only that the results suggest that these might occur or have the potential to occur. He wrote:

The results from this study suggest that dispersal from developed areas could be contributing to population declines. Although the proportion of potentially displaced adult and yearling males and yearling females breeding and nesting in areas removed from gas field infrastructure is unknown, offsite populations could be artificially enhanced by gas development. Because of potential density-dependent influences on breeding and nesting success probabilities (LaMontagne et al. 2002, Holloran and Anderson 2005), maintenance of these enhanced populations could require increasing the carrying capacity of offsite habitats.

Holloran (2005) also wrote that:

Adult male displacement and low juvenile male recruitment appear to contribute to declines in the number of breeding males on impacted leks. Additionally, avoidance of gas field development by predators could be responsible for decreased male survival probabilities on leks situated near the edges of developing fields (i.e., lightly impacted leks). Although site-tenacious adult females did not engage in breeding dispersal in response to increased levels of gas development, subsequent generations avoided gas fields, as suggested by the temporal shift in nesting habitat selection and differences in habitat selection by yearling and adult females. This suggests that the nesting population response is delayed avoidance of natural gas development. The results suggest that male and female greater sage-grouse displacement from developing natural gas fields contributes to breeding population declines.

As one can readily see, this work relied upon by the COT Report depends upon speculation, hypothetical worst-case scenarios coming true, and creating just-so-stories to explain results. It does not rely on hypothesis testing.

The COT Report makes no mention of the fact that Holloran (2005, page 82, Table 2) reported that the probability of survival was predicted to be higher (61.5 +6.4%) in disturbed areas than in less impacted areas (29.6 +18.1%) or control areas (48.5 +14.4%). This result is contrary to Holloran's (2005) own assertions regarding supposed population impacts.

The COT Report makes no mention of the fact that Holloran's (2005) predicted population declines (-8.7 to -24.4% annually) have simply failed to come true. Recent analysis of male lek-attendance trends by the State of Wyoming has instead found that the sage grouse population has been increasing since 1990, a clear refutation of Holloran's predictions of population decline. It is the litmus test of science that when such predictions fail to come true, the hypotheses/theories they are based upon are simply wrong (Platt 1964). The FWS cannot rely on studies cited that have been so clearly falsified.
The purported impacts reported by Holloran (2005) were not based on full disclosure of the facts. Holloran (2005) did not acknowledge that the BLM had intentionally waived required mitigation stipulations on the Pinedale Anticline in order to facilitate his research on impacts to sage grouse without stipulations. It is a serious error of omission for the NTT and COT Reports to uncritically cite Holloran's (2005) conclusion that stipulations on the Pinedale Anticline were ineffective, when the stipulations were not actually in place. The FWS cannot rely on information that contains such errors of omission.

The COT Report omits any mention of the fact that more recent and stringent stipulations are found in the Pinedale Planning Area, along with:

1) more extensive mitigation and restoration efforts in the Pinedale Planning Area (see http://www.wy.blm.gov/jio-papo/index.htm for a list of mitigation projects and data on surface disturbance and reclamation efforts),
2) advances in technology and efficiency documented in Ramey et al. (2011) and the BLM presentations to the NTT, ”Managing Oil and Gas” and ”Best Management Practices“ (available in Appendix 5, pp 48-55 of the August 29 to September 2, 2011 meeting summary) have been implemented since Holloran's (2005) study was conducted (from 1997 to 2003).

All of the information above was available to the NTT, including copies of Ramey et al. (2011). It is a violation of the DQA for the FWS to base recommendations of the COT Report upon information containing such errors of omission.

The COT failed to mention that Holloran (2005) did not provide any data that had shown a deleterious, population-level effect across the Pinedale Planning Area (i.e., Upper Green River Basin portion of the Wyoming basin population); nor any data showing consistently lower level of fitness for birds that nested father from roads.

The COT Report also failed to mention that Holloran (2005) made very specific recommendations regarding one well per section that were not based upon his testing of that threshold in his analysis. Holloran (2005) wrote, “[M]aintaining well densities of ≤1 well per 283 ha (approximately 1 well per section) within 2 mi of a lek could reduce the negative consequences of gas field development.” However, Holloran (2005) did not test impacts at this density versus other well densities. Instead, he reported on leks affected by different numbers of impacts in each of four quadrants in the cardinal directions, and predictions based upon correlations at a scale of 3 km. Data, significance tests, and scatterplots of those correlative analyses were not reported by Holloran (2005), making the scientific rationale for his one-well-per-section not reproducible. The FWS cannot rely on unsupported opinion and irreproducible analyses as the basis for recommendations made in the COT Report.

No mention is made in the COT Report of the fact that five years after the original Holloran study was released (Holloran 2005), Holloran et al. (2010) did not document
any population loss, only temporary displacement of sage grouse. Holloran et al. (2010) wrote the following about their results:

Leks that recruited more than the expected number of males were significantly farther from drilling rigs, producing well pads, and main haul roads compared to leks that recruited fewer males than expected (Table 1). Additionally, leks that recruited more males than expected were significantly farther from main haul roads than leks that recruited the same number of males as expected.

In other words, only leks near the drilling rigs were affected and males from those leks tended to move to leks farther from active development. These missing males did not die off and the population did not crash, no negative demographic effect on the population was found. The FWS cannot rely on studies that purport to document a negative effect (i.e. Holloran 2005), yet consistently fail to do produce data that show such a negative effect.

However, there has been no decline in the sage grouse population in the Pinedale Planning Area (Upper Green River Basin). Instead, data and analyses performed by the Wyoming Department of Game and Fish reveal that between 1990 and 2012 there has been a consistent increase in sage grouse (measured in male lek attendance and male density per square mile; Wyoming Game and Fish 2012). The information relied upon by the COT Report is simply wrong.

Additionally, Holloran 2005, did not acknowledge that the BLM had intentionally waived stipulations on the Pinedale Anticline in order to facilitate research on impacts without these stipulations. Therefore, the impacts reported by Holloran (2005) do not correspond to impacts under stipulations required at the time, nor account for current impacts under more recent stipulations and BMPs. Finally, none of the authors cited in support of this professional judgment had removed the artifact of a natural cyclical population fluctuation that repeatedly occurs over a broad area during the course of this and other studies. If conservation measures adopted by the FWS are to be science-based, all evidence must be taken into account, including contrary evidence.

**Kaiser 2006.** 17 This study is cited four times between the two reports (NTT/3, COT/1). The NTT Report cites this study in the context that birds avoid habitat that might otherwise be suitable and this thus could lead to lek abandonment. The COT Reports wrongly concludes this study proves populations decline as a result of oil fields. As discussed extensively herein, lek avoidance does not equate to population declines.18 Further, Kaiser 2006 uses just one year of data and an extremely small sample size, thus, the conclusions drawn from this data is not reliable.

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18 See Ramey, Thurley and Ivey 2014.
Kiesecker et al. 2011. While Kiesecker et al. mention that ecological zoning is an admission that conservation of all habitat is improbable (See p. 167), but this does not capture what the paper is about. Kiesecker et al. propose what they believe to be a better way to implement, track, assess the mitigation hierarchy, which they assert will be more effective at conserving key habitat, while “allowing” continued energy development.

The authors propose offsets (mitigation) is ecologically equivalent to impacts resulting in net neutral or positive outcomes but fail to suggest how this would be measured. In addition, the authors fail to recognize the many uncertainties and variables within GRSG habitat. The Authors proposed strategy for accounting for offsets will punish those who seek offsets in restoration activities opposed to protective offsets, by making the cost of restorative offsets more costly. Obviously, this deters any incentive to restore habitat, but it also forces an increase in areas that would be off limits to future development.

As part of the accounting approach when deciding on the appropriate ratio, the probability of success must be determined, this on its face seems reasonable. However, if for example the scientific literature is lacking or uncertain on restoration activities/success, then the cost of offsets will increase. In other words, if a given restoration practice is only marginally successful, this would be favored in the calculation over newer innovative technology because the new methods success odds are not yet proven. This will stifle technological advances in restoration and ultimately would harm habitat by preventing any incentive to try and improve it.

While the NTT Report does not cite this paper, it should be noted that the NTT Report virtually ignores the entire concept notwithstanding the depth of mitigation already required. In fact, as discussed in the body of this DQA Challenge, SWCA identified some 732 conservation and mitigation measures for GRSG.

Lyon and Anderson 2003. This study is cited 7 times in the NTT Report at 6.1 in alleged support of 4-mile NSO buffers and 3% surface disturbance thresholds based on the erroneous assumption that a temporary disturbance of sage grouse from a local area under development equates to a population decline. It is incorrect for the NTT Report to claim that the cited studies "present the most complete picture of cumulative impacts and provide a mechanistic explanation for declines in populations" when these studies never documented a population decline.


However, the COT Report omitted the fact that Lyon and Anderson's (2003) data were inadequate for: 1) achieving statistical significance in comparisons of nest initiation and nest success in disturbed versus undisturbed areas, and 2) demonstrating a population decline. Instead, the presumed biological significance of their statistically insignificant results were based upon belief, as the following excerpt from Lyon and Anderson (2003) shows: "[F]inally, even though nest initiation between disturbed and undisturbed hens was not statistically significant, we believe lower initiation rates for disturbed hens were biologically significant and could result in lower overall sage grouse productivity."

Lyon and Anderson (2003) also stated that, "Hens captured on disturbed leks demonstrated greater movements from capture lek to nest than hens from undisturbed leks. Hens from disturbed leks nested approximately twice as far from capture leks as did hens from undisturbed leks. Our random nest vegetation analysis indicated no significant differences in nesting habitat between disturbed and undisturbed areas, suggesting that nest habitat was not influencing sage grouse hen movements." This is expected, as animals that are disturbed by human activity will sometimes move away from it. However, it does not mean that the result will be a population decline. The COT Report failed to mention that there has been no deleterious, population-level effect reported by these authors (i.e., decline in male lek attendance or overall abundance across the Pinedale Project Planning Area where most of the cited research occurred).

The COT Report also fails to mention that Holloran (2005), using much larger sample sizes (n=213 vs. n=77), reported nest success that was virtually identical and not significantly different between disturbed and undisturbed areas, compared to Lyon and Anderson's (2003) results. The DQA requires that information used by agencies be based upon verifiable and repeatable data, and not based upon opinion.

The COT Report cannot selectively use results from Lyon and Anderson (2003) to support its recommendations, while failing to state that they were statistically insignificant and contrary to more recent and comprehensive data.

Pyke, D.A. 2011. This study is cited four (4) times in the NTT Report and five (5) times in the COT Report. The COT Report mis-cites Pyke 2011 four of these five times. Pyke discusses both the pros and cons of grazing, and discusses when grazing might be a benefit, and when reduction or removal would be better. Pyke discusses appropriately that grazing is not black and white and that appropriate grazing during certain times of the year may maximize the benefits in reducing invasive species.

The COT Report states, “Pyke (2011) estimated that greater than 4,000 ha (9,884 ac) was necessary for population sustainability; however, Pyke did not indicate whether this value considered groups of birds that moved long distances between seasonal habitats versus those who can meet all necessary seasonal requirements within a local area, nor if this

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22 Pyke 2011 at 538-539.
included juxtaposition of all seasonal habitats.”

But Pyke is misrepresented here as the author did not look at patch size; instead the statements regarding habitat goals focus on life history needs and how to restore/rehabilitate with these needs in mind.

The COT Report states, “[N]ot all areas previously dominated by sagebrush can be restored because alteration of vegetation, nutrient cycles, topsoil, and living (cryptobiotic) soil crusts has exceeded recovery thresholds.” This statement seems to be somewhat misrepresentative. Pyke does indicate that some habitats if significantly altered would not likely be restored without human intervention. In other words passive restoration is not possible. However, Pyke is clear that temporal, successional, and spatial dynamics must be considered—that is habitats are not stagnant, “[E]cosystems lacking resilience may cross ecological thresholds leading them to alternative stable communities; alternative communities differ considerably in structure and function from the original. Returning to original communities will not likely occur without human intervention, including control of undesirable species or reintroduction of previously dominant species (Briske et al. 2006). Severe alterations to original ecosystems, ranging from soil erosion to dominance of competitive invasive plants, may require introduction of new plants that provide similar structure and function, resulting in an alternative yet desirable ecosystem (Aronson et al. 1993).”

The COT Report states:

[I]n developing conservation objectives for the sage-grouse we identified the following uncertainties that limit our ability to prescribe a precise level of threat amelioration needed to conserve redundancy, representation and resilience to ensure long-term conservation of sage-grouse, especially on a range-wide level…The ability to successfully restore lower-elevation and weed-infested habitats is currently limited by a lack of complete understanding of underlying ecological processes, and in some areas because alteration of vegetation, nutrient cycles, topsoil, and living (cryptobiotic) soil crusts has exceeded recovery thresholds (Knick et al. 2003; Pyke 2011).

Additionally, resources for restoration activities are often limited; and…

This is misleading and does not accurately represent Pyke. While it is true that some areas are degraded to the point where recovery is uncertain or costly, it is the exception—not the rule; also, it is not as clear cut as FWS purports.

While restoration in some areas may be more difficult, it is a result of multiple compounding factors, which are not necessarily present across the range of the species. Further, it is over simplistic and inaccurate to say that restoration is too difficult or unsuccessful- restoration and the factors that limit restoration are far too complicated to

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23 COT at 8.
24 Pyke 2011 at 540.
25 COT at 9 citing Knick et al. 2003; Pyke 2011.
26 Pyke at 532.
27 COT at 31.
make such a blanket statement. Pyke is quite clear that several factors must be considered prior to making any decision on how or whether to restore/rehabilitate. To make the above assertion is premature. Pyke also indicates that depending on the habitat component that needs restoring, it may only take 3-5 years, in some instances.

Finally, with regards to restoration generally, and restoration after fire, the reason for difficulty in restoration seems to be land manager choices in seed mix (as Pyke describes). It follows that it is inaccurate to claim that restoration is impossible as suggested in the COT Report. Moreover, the primary recommendation made in Pyke is that native seed mixes should be used, and when there is limited native seed mix then non-native seeds can be used. If land managers simply shifted their seed mixture to that of natives, and the land was managed to control the invasives as discussed in Pyke, then it could be hypothesized that the restoration would be more successful. Based on what Pyke reports as current policy, the restoration practices are flawed.

Walker, et al. 2007. This paper is cited eight (8) times in the NTT Report and two (2) times in the COT Report in support of lek buffers, impacts to habitat selection, and the discredited proposition that energy development leads to declines in population numbers. However, neither the NTT nor the COT Report mentions the methodological issues with these studies or the fact that none reported a population-level decline in sage grouse (rather than a localized effect on rates of male lek attendance near the disturbance).

The authors concede speculation as the premise for their alleged conclusions even in the abstract of the paper. The paper suffers from subjective interpretation of results, ie where no hypothesis testing was used. Avoidance of disturbance is not uniform among locations as the authors suggest. Rather, it can be site-dependent for factors such as density of development and age of the oil and gas field. The impact of the oil and gas operations on GRSG is not as clear-cut, nor as negative, as the authors of this paper and the NTT report claims. Second, data show that GRSG behavior can be affected by certain types of anthropogenic disturbance more than others, which can result in localized avoidance, but the effect of any of these disturbances or development on migration rates is unknown. Data from Lyon 2000) Bush 2009, Tack et al. 2011, and more recent papers, all reveal that GRSG traverse (fly) over or around roads, agricultural areas, and oil and gas development, and distances up to 300 km from their natal leks.

However, Walker et al. 2007 advocates for disturbance caps notwithstanding valid existing rights, the authors did not test any percent disturbance caps. Instead they modeled response in lek attendance in terms of distance(s) from potential sources of disturbance. Therefore, Walker et al.’s 2007 support for a 3% disturbance cap, represents nothing more than the opinions of the authors. The FWS cannot rely on the biased opinions and selective presentation of information to support a recommendation that is unsupported by data. Despite the COT’s citation to this paper, there have been no declines in GRSG populations in the Pinedale Planning Area. Instead, data and analyses

29 Harju et al. 2010; Taylor et al. 2010; Ramey, Brown and Blackgoat 2011.
performed by the Wyoming Department of Game and Fish reveal that between 1990 and 2012 there has been a consistent increase in sage grouse (measured in male lek attendance and male density per square mile; Wyoming Game and Fish 2012). The information relied upon by the COT Report is simply wrong.

Further, the COT Report does not mention that Walker et al. 2007 used model selection procedures that were not statistically reliable because they used nine predictor variables, with just nine years of data, to compare 19 models, in an attempt to identify combinations of predictor variables that would potentially explain patterns in the data. However, for model selection to work properly, the number of predictor variables must be smaller in comparison to the number of observations (in this case, the number of years of data).

Additionally, for model selection to be scientifically defensible, the predictor variables are best narrowed down in advance based on plausible cause and effect mechanisms and tests for independence among variables, procedures that Walker et al. 2007 did not employ. Finally, the results of Walker et al. 2007 were confounded by the obvious location of at least 9 out of 35 inactive leks immediately adjacent to Highway 14, Highway 16, and Interstate 90. Therefore, the COT reliance on Walker et al. 2007 as a basis for very precise predictions about GRSG population responses is not scientifically sound. This is hardly sufficient evidence to support the draconian land use and timing restrictions proposed.
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OIL AND GAS DEVELOPMENT AND GREATER SAGE GROUSE (*CENTROCERCUS UROPHASIANUS*): A REVIEW OF THREATS AND MITIGATION MEASURES

Rob Roy Ramey II, Laura M. Brown, and Fernando Blackgoat*

Introduction

Concern exists over the demonstrated and potential deleterious effects of oil and natural gas development on greater sage grouse (*Centrocercus uropha-"

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Laura MacAlister Brown received a master’s degree in wildlife ecology from Yale University and a Ph.D. in conservation biology from Cornell University. Her doctoral dissertation addressed the effects of habitat fragmentation on tropical forest bird populations. She was formerly a research assistant at the Bioacoustics Research Program at the Cornell Laboratory of Ornithology and is currently a writer, editor, and consultant on endangered species issues with Wildlife Science International, Inc.

Fernando Blackgoat holds a B.S. in geology from Northern Arizona University. He has been in the energy industry his entire professional life, first as a geologist and later as an advisor on federal lands issues, including leasing and land-use planning; the National Environmental Policy Act (NEPA); state and federal oil and gas regulation and land-use legislation; endangered species actions, and project planning. His portfolio includes the Bureau of Land Management, U.S. Forest Service, U.S. Fish and Wildlife Service, and state and national oil and gas trade associations. He is currently USP Piceance Environmental Advisor, ExxonMobil Production Company, in Houston, Texas.

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sianus) populations in the intermountain region of the western United States. Numerous studies have been undertaken to assess the impacts of this development, and agencies have implemented policies and regulations that have the potential to minimize deleterious effects on sage grouse.\(^1\) In 2010 the U.S. Fish and Wildlife Service (USFWS) found that sage grouse are warranted as a “threatened” species under the U.S. Endangered Species Act (ESA) but are currently precluded by other priorities.\(^2\) This “warranted but precluded” ESA decision has resulted in additional regulations, mitigation measures, and conservation efforts.

To date, research on the impacts of oil and natural gas development has focused on quantifying the number of male sage grouse counted at leks (i.e., mating display areas), survivorship of juveniles and adults, and/or distribution of sage grouse relative to development.\(^3\) The majority of this published research has focused on changes in lek attendance by male sage grouse each spring. These data have been used in predictive models to assess lek persistence (and presumably population persistence) under various development scenarios. Male lek counts are the most prevalent data on sage grouse currently available, which may explain the volume of research that utilizes them. Authors assessing lek counts typically have assumed that sage grouse avoidance of energy development leads to sage grouse population declines.\(^4\) However, to date population-level impacts have not been demonstrated, in part due to the limitations of lek count data for inferring population number. That is, lek counts of males may not reflect the overall population numbers as they do not reflect numbers of males in non-lek habitats, females, and young.\(^5\)

Research on the effects of oil and gas development primarily has emphasized the patterns of grouse response to intensive development in the immediate and surrounding area (i.e., declining lek counts, avoidance of infrastructure, and, in some cases, lower survivorship). Generalized models have been developed and used to predict outcomes of development scenarios on various time horizons.\(^6\) Some of this body of research has been used as a basis for policy and regulations to minimize impact to sage grouse populations.\(^7\) It also has been proposed as a basis for “conservation trade-offs,” where companies forfeit their development rights in exchange for rights elsewhere, and to justify “landscape-level” management (i.e., large scale).\(^8\)

Recent calls for prioritization of conservation efforts and trade-offs based on set-back distances from oil and gas infrastructure to sage grouse leks do not take into account the specific causes of sage grouse avoidance, mortality, or potential population-level effects.\(^9\) Recent agency permit requirements and land management practices have been predicated on set-back distances from oil and gas infrastructure to sage grouse leks. The focus on set-back distances provides only a finite set of options for land managers and permittees alike. Because this approach does not take into account the specific causes of sage grouse avoidance, mortality, or potential population-level effects, it is of limited effectiveness to sage grouse conservation and management. A more comprehensive approach should
incorporate performance standards that are based on an understanding of specific cause and effects of oil and gas infrastructure impacts on sage grouse (i.e., noise, predation, disease), as well as consideration of habitats other than leks (i.e., nesting, brood rearing, and winter habitats).

One recent author, M. Holloran, is of the opinion that stipulations to mitigate the effects of oil and gas development on sage grouse only are effective if the sage grouse exhibit zero response to the development (i.e., their response is identical to control area grouse). Several others have suggested that we must assume that sage grouse avoidance of oil and gas development leads to population-level impacts, even if data are lacking. These precautionary approaches imply that the threats posed by the oil and gas industry to sage grouse are not well understood and that it is difficult to achieve effective mitigation. Applying decision theory or risk analysis to this situation offers a potentially useful way to overcome this uncertainty.

The purpose of this paper is to move beyond the description of sage grouse responses to energy development and review current information in an attempt to understand why these responses may occur. To achieve this objective, we review previous research that identified the general threat categories of oil and gas development to sage grouse. We selected six direct and indirect threats from oil and gas to sage grouse, based on a review of published information as well as plausible cause-and-effect mechanisms (table 1). The six threats include: noise, human activity, predation, habitat fragmentation and/or loss, strike hazards, and West Nile virus. We give special attention to noise because it has not been addressed in detail elsewhere. For each of these threats we (1) identify the specific sources of each threat, (2) the likely cause-and-effect mechanisms that could lead to a behavioral and/or demographic impact, and (3) recommend specific mitigation measures that could be implemented to minimize these effects in an adaptive management framework (table 1). Next, we treat the specific sources of threats (number 1 above) as working hypotheses in terms of their congruence (or lack thereof) with existing data or, where there are currently little or no data, their plausible effect on sage grouse populations. We then propose experimental approaches that could be used to test the efficacy of potential mitigation (as suggested by D. Naugle et al.) and discuss the potential value of this and current mitigation measures.

The significance of this strategy to sage grouse conservation is threefold. First, it allows for a more efficient allocation of conservation effort by focusing on threats that matter most to the conservation of local populations affected by oil and gas development. Second, it allows for the design of mitigation that is tailored to the circumstances, rather than relying on one-size-fits-all buffer zones or timing restrictions. And third, the effectiveness of mitigation measures can be evaluated using a hypothesis-testing approach, which is at the philosophical core of science-based adaptive management. In other words, are there additional ways in which mitigation measures could be implemented to minimize the impact of oil and gas developments on sage grouse?
<table>
<thead>
<tr>
<th>Presumed Threat</th>
<th>Source of Threat</th>
<th>Likely Mechanism of Impact</th>
<th>Potential Consequence to Sage Grouse</th>
<th>Potential Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Noise</td>
<td>Drilling operations (noise from: site prep., drilling, pumping and processing of drill mud, fracking, power generation)</td>
<td>Disruption of mating vocalizations and/or ability to detect predators, annoyance</td>
<td>Avoidance behavior, increased risk of predation</td>
<td>Noise modeling and mitigation, increase efficiency, reduce density, seasonal restrictions</td>
</tr>
<tr>
<td></td>
<td>Gas compressor facilities (compressor and cooling fan noise)</td>
<td>Disruption of mating vocalizations and/or ability to detect predators, annoyance</td>
<td>Avoidance behavior, increased risk of predation</td>
<td>Noise modeling and mitigation</td>
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<td></td>
<td>Traffic (noise from: equipment transport for site prep. and drilling, produced water disposal, crew rotation, maintenance)</td>
<td>Annoyance</td>
<td>Avoidance behavior</td>
<td>Noise modeling and mitigation in road design, increase efficiency to reduce road use, seasonal restrictions, lower speed</td>
</tr>
<tr>
<td>2) Human activity</td>
<td>Oil and gas crews/personnel (the largest number during drilling phase)</td>
<td>Annoyance, perceived as predators (due to hunting in area)</td>
<td>Avoidance behavior</td>
<td>Screening of activity from view, reduce amount of activity, restrict hunting in area</td>
</tr>
<tr>
<td></td>
<td>Refuse</td>
<td>Attracts scavengers that are potential predators</td>
<td>Avoidance behavior, increased risk of predation</td>
<td>BMPs to eliminate refuse, install anti-perch devices</td>
</tr>
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(continued)
### Table 1 (continued)

**ANALYSIS OF POTENTIAL THREATS TO SAGE GROUSE FROM OIL AND GAS DEVELOPMENT AND THEIR MITIGATION**

<table>
<thead>
<tr>
<th>Presumed Threat</th>
<th>Source of Threat</th>
<th>Likely Mechanism of Impact</th>
<th>Potential Consequence to Sage Grouse</th>
<th>Potential Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3) Predation</strong></td>
<td>Attracting avian and terrestrial predators (e.g., ravens, foxes, coyotes)</td>
<td>Increase in predators commensal with humans</td>
<td>Avoidance behavior, increased risk of predation</td>
<td>Remove refuse and roadkill, install anti-perch devices, sonic deterrents, predator control</td>
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<tr>
<td></td>
<td>Attracting prey species (e.g., rabbits and rodents)</td>
<td>Increase in prey abundance leading to an increase in predators</td>
<td>Avoidance behavior, increased risk of predation</td>
<td>Install anti-perch devices, sonic deterrents, predator control</td>
</tr>
<tr>
<td></td>
<td>Powerlines</td>
<td>Powerpoles act as predator perches</td>
<td>Avoidance behavior, increased risk of predation</td>
<td>Install anti-perch devices, bury powerlines in critical areas</td>
</tr>
<tr>
<td><strong>4) Habitat loss or fragmentation</strong></td>
<td>Access roads</td>
<td>Habitat degradation and removal</td>
<td>Reduced carrying capacity</td>
<td>Conservation tradeoffs, timing and seasonal restrictions in critical areas</td>
</tr>
<tr>
<td></td>
<td>Drilling and production pads</td>
<td>Habitat degradation and removal</td>
<td>Reduced carrying capacity</td>
<td>Conservation tradeoffs, restoration</td>
</tr>
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Table 1 (continued)
ANALYSIS OF POTENTIAL THREATS TO SAGE GROUSE FROM OIL AND GAS DEVELOPMENT AND THEIR MITIGATION

<table>
<thead>
<tr>
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</tr>
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<tr>
<td>5) Strike hazards</td>
<td>Traffic</td>
<td>Mortality</td>
<td>Reduced survival</td>
<td>Reduce speed and add signage in critical areas</td>
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<tr>
<td></td>
<td>Wire fences</td>
<td>Mortality</td>
<td>Reduced survival</td>
<td>Install fence markers, redesign fences</td>
</tr>
<tr>
<td></td>
<td>Powerlines</td>
<td>Mortality</td>
<td>Reduced survival</td>
<td>Increase visibility of powerlines (especially ground wires), bury powerlines,</td>
</tr>
<tr>
<td>6) West Nile virus</td>
<td>CBM ponds</td>
<td>Mosquito breeding</td>
<td>Reduced survival</td>
<td>Larvicides, reduce mosquito breeding habitat via pond design</td>
</tr>
</tbody>
</table>
The issue of sage grouse and oil and gas development is similar to that of caribou in the North Slope Alaska oil fields. Some local disturbance/displacement impacts initially were suspected. These were assumed to be definitive, and it was speculated that they would have population-level impacts. These perceptions persist, despite evidence that local disturbances to caribou can be effectively mitigated, and evidence that the Central Arctic caribou population has grown dramatically from an estimated 5,000 in 1978 to 66,772 in 2008, or since the oil fields were developed. Population fluctuations tend to be cyclic. It is important to note that there is no hunting in the oil fields, which may contribute to habituation of caribou to human activity. Comparative assessments with other species and other energy developments can provide insights that aid in the planning of sage grouse management.

Potential Threats to Sage Grouse from Oil and Gas Development

Anthropogenic Noise: C. Braun et al. and M. Holloran suggested that noise generated by oil and gas exploration and development may affect sage grouse lek attendance and rates of population increase, although they did not specify cause-and-effect mechanisms beyond potential avoidance of drilling, production facilities, and roads due to noise. M. Holloran reported that lower lek attendance occurred downwind of gas production facilities and therefore was likely due to noise generated by those facilities.

We believe it benefits the discussion to make the distinction between anthropogenic sound and noise. Not all sound is noise and the difference (at least among humans) can be subjective. Thus, we define noise as a subset of sound that causes consistent avoidance, interferes with a critical signal (e.g., detection of predators or selection of mates), or has a deleterious effect on the majority of individuals of a species. Anthropogenic sound and noise are generated by numerous human activities, including the process of oil and gas development and production. The effects of noise range from negligible to annoying, and at the extreme, impact the health of individuals. The effects of and responses to noise can vary among species and among individuals within a species. Responses to noise depend upon susceptibility to frequency, intensity, tone(s), and duration. Thus, sensitivity to noise depends upon more than how loud it is. Topography and environmental factors also play an important role in the attenuation and propagation of sound (and noise). These factors include wind speed, temperature, vegetation cover, and the medium through which the sound is propagating (e.g., air, ground, or water). For example, a strong prevailing wind will cause sound waves propagating upwind to be “bent” upwards, deflecting their energy, while sound waves propagating downwind will be “bent” downwards, thus increasing their effect at ground level over a greater distance.

Sound Measurement: The variable most commonly used to measure sound pressure levels and exposure, A-weighted decibels or dB(A), is based upon a
weighting that simulates the frequency range of human hearing (i.e., most sensitive in the range of 1,000 to 8,000 hertz (Hz) but audible between 20 to 20,000 Hz). Because dB(A) is measured on a logarithmic scale, a reduction of measured sound by 10 dB(A) results in sound being reduced by half. Although in widespread use (primarily in the United States), the dB(A) weighting gives a low weighting to sound below 500 Hz, and does not adequately account for acoustical energy below 20 Hz, making it a poor choice for evaluating exposure to low frequencies and infrasound (that has very long wavelengths). Also, since dB(A) is based upon human hearing response, it is not universally applicable to other species, which may be more sensitive to sound. As a result of these limitations, alternative measures such as C- or Z-weighting (which have a flatter response curve over the frequency range 10 to 20,000 Hz) are increasingly used in addition to A-weightings to measure sound exposure. When these sound pressure levels are graphed over the range of frequencies, at one-third octave band frequencies, an unbiased and complete picture of exposure may be obtained. Such a detailed analysis also is required to identify the type of sound that is considered to be noise (as per our definition): the presence of tones (tonal noise); the presence of low frequency noise; fluctuating, intermittent or periodic noise; and impulsive noise. In addition, time-averaged measures (Leq) are used to quantify exposure.

Two acoustic properties of sound are important to understanding the change in intensity as the distance between source and observer increases. First is the inverse square law: unobstructed sound intensity will decrease by a factor of four with each doubling of distance from its source. This means that sound intensity drops off relatively quickly and with each doubling of distance the resulting intensity drops by about 6 dB. This decrease continues until the sound is masked by ambient sounds of equivalent intensity and is no longer noticeable above background. For example, broadband noise produced by a heavily traveled freeway measured at 75 dB(A) may take 800 meters or more to diminish to near background levels across an open field.

The second acoustic property of note—the attenuation of pure tones (sound in a narrow frequency range) through air—is directly proportional to the square of its frequency (assuming humidity and temperature are held constant). Therefore, higher frequency sound is more quickly attenuated. Conversely, low frequency sound and infrasound (that has very long wavelengths) are least subject to attenuation and can travel far greater distances though the air, water, and ground. This makes sound in these frequency ranges more difficult and expensive to control. An everyday example of how low frequency sound and infrasound travel is the pounding of distant surf during a winter storm that is “felt” as much as it is heard.

Avian Hearing: In most cases, the range of hearing for many birds is thought to approximate that of humans, although there are some notable exceptions. For example, M. Theurich et al. reported that human sensitivity to sound frequencies above 3,000 Hz is greater and below 50 Hz is lower than that of guinea fowl.
(Numida meleagris) and pigeons (Columbia livia). These species were twice as sensitive as humans to pure tones below 10 Hz, and pigeons were almost 50 dB(A) more sensitive than humans in the region of 1 to 10 Hz. Guinea fowl were sensitive down to 2 Hz and pigeons down to 0.05 Hz.

**How Noise Could Affect Sage Grouse:** Noise from oil and gas operations may impact sage grouse in several ways. First, noise may mask display calls of male sage grouse, especially if it overlaps in frequency. Second, noise can mask the sound of approaching predators, thereby turning noisy areas into population “sinks” where sage grouse mortality is higher. Consequently, sage grouse will or may learn to avoid it. Third, broadband noise may be simply annoying above a certain threshold, causing sage grouse to avoid it or areas where there are annoying tones. And fourth, noise (and some otherwise benign anthropogenic sounds) may act as an environmental clue that an area poses a higher risk of predation (i.e., by species commensal with humans, or humans themselves in areas where sage grouse are hunted) or that individuals come to associate noise with other hazards such as the risk of being struck by vehicles. Each of these potential impacts can be treated as a potentially falsifiable hypothesis and tested against experimental data to refine our understanding of acoustic threats to sage grouse. It is possible that more than one of these factors is involved in sage grouse avoidance of areas where oil and gas development exceeds a certain threshold. It is important to keep in mind that different populations may have different responses to the same types and levels of noise, depending on local factors (e.g., topography, wind, food, cover, and other habitat features).

The behavioral or physiological sensitivity of sage grouse to different frequencies of sound has not been studied to the extent it has been in other birds. It is known, however, that male sage grouse produce sounds during courtship that could be masked by anthropogenic noise. These vocalizations both attract females to leks in the spring and serve in courtship displays at leks. As reported by M. Dantzker et al. and A. Krakauer et al., these vocalizations consist of mechanically generated wing “swishes,” two or three low-frequency “coos” (around 40 to 70 Hz), several broadband “pops” with a low frequency component (down to around 10 Hz), and two higher frequency whistles (600 to 3,200 Hz) that appear to function only over short ranges.

The fact that sage grouse are a ground-nesting and ground-feeding species makes them more vulnerable to mammalian predators. Consequently, they may be more sensitive to low frequency sounds and infrasound transmitted through the ground than arboreal bird species. Regardless of the specific mechanism, noise has the potential to decrease available habitat if sage grouse avoid it, and thus potentially lowers the carrying capacity of the population.

**Anthropogenic Sound and Noise from Oil and Gas Development:** To date, published information on the effects of oil and gas operations on sage grouse has not specifically addressed the potential effects of sound produced by various sources,
their frequency signatures, or intensities. In considering the effects of noise on sage grouse and its potential mitigation, it is important to separate it into its sources, frequencies, sound levels, and spatial arrangement. We therefore start by dividing potential major sources of noise in oil and gas operations into the following three categories: (1) drilling, casing, and hydraulic fracturing operations that are powered by large diesel engines, generators, and pumps; (2) compressor stations used to boost natural gas pressure obtained from wells for through transport pipelines; and (3) heavy equipment, trucks, and other traffic that are used to construct roads, pads, and facility sites, to transport materials, equipment, and staff, and to remove produced water and liquid hydrocarbons (condensate) from well sites.

We also acknowledge that gas flaring, pipelines that are above ground, and injection wells are potential sources of noise to sage grouse but consider them to be of secondary importance compared to the three primary and more prevalent sources listed above. Gas-processing facilities are another noise source but, because of their larger footprints (20 acres or more) and complexity, such facilities are typically located in areas outside sage grouse habitat, so noise from gas plants are of secondary importance.

All three of the major sources of noise produce broadband sound across a wide range of frequencies as well as low frequency sound (less than 1000 Hz) and infrasound (less than 20 Hz, which is felt as a low rumble or vibration, rather than heard). The latter of these can propagate long distances (i.e., several kilometers). Some diesel engines, compressors, or other machinery also may produce specific tones, which alone may be annoying and/or may interfere with acoustic communication among sage grouse.

Anthropogenic Sound and Noise from Drilling Operations: Prior to drilling a well(s), an access road and drilling pad are constructed and reserve pits are excavated. The duration of site and road construction ranges from a few weeks to several months due to topography, weather and permit conditions, and length of access roads. The drilling rig is then raised and infrastructure to power and support the drilling operation is installed. This involves numerous heavy trucks, dozens of staff, and up to two weeks to complete. Following this stage is around-the-clock operation of the drilling rig, during which time surface casing is set and cemented, and intermediate and bottomhole sections of wellbores are drilled and casing installed. Actual drilling may be limited to several weeks (for shallow or single bore holes) but can span more than 20 months if multiple wells are drilled from a pad. The advent of deviated (less than 20 degrees from vertical) and horizontal drilling (greater than 75 degrees from vertical) has meant greater efficiency (more wells can be drilled from one pad) and is an innovation that reduces the overall footprint—and impact—of gas field development.

The primary sources of sound and noise associated with oil and gas drilling operations are the large diesel motors and diesel-powered generators. These
motors power drill bits, drive mud pumps that circulate mud to lubricate the well bore, and remove rock chips, as well as power winches to pull and replace drill strings, pump casing cement, operate shaker tables (to remove rock chips from drilling mud), and provide lighting and power.

It is well known that large diesel engines produce high levels of broadband sound as well as low frequency sound and infrasound. The latter two are produced by diesel impulsiveness (knocking), cylinder-to-cylinder and individual cylinder firing variation, and mechanical vibration. The transmission of low frequency and infrasound is particularly acute if the source is not isolated from the ground.\textsuperscript{36}

An additional source of low frequency sound in drilling operations is the shaker tables that are attached rigidly to circulation tanks, which in turn serve as low frequency sound transducers. In other words, vibrations are transferred to the tank and the ground in much the same way that sound transducers operate in the audio industry. This source of low frequency sound can travel long distances (greater than 1 km).

**Anthropogenic Sound and Noise from Natural Gas Compressors:** Compressors are installed near wellheads, along gas lines, and at compressor stations to provide pressure for efficient transport in pipelines. Compressors and compressor stations vary widely in type (i.e., reciprocating, rotary screw, centrifugal, or axial), in size from tens to thousands of horsepower, and from single compressors near one or more wellheads to large mainline compressor stations in the distribution network. Therefore, they differ widely in frequency signatures and sound pressure levels. Some produce virtually no discernable sound.

Compressors are one of the more permanent and ubiquitous potential noise producers because of their continuous operation. However, compressors are not necessarily permanent fixtures: well pressures decline over time and line-pressure changes occur when other wells are taken off the distribution system or new production is added to the system. These variables may alter the type, size, or number of compressors at a location over time and the amount of noise generated. Compressors in natural gas production fields, such as those in sage grouse habitat, are primarily powered by natural gas-fired engines and are one source of continuous sound and potential noise that could affect sage grouse. Other sources include large cooling fans that are necessary to dissipate the substantial amount of heat generated by gas compressors. Very large cooling fans used on compressors of greater than 1,500 horsepower (hp) also can produce infrasound (perceived as a low beat). Moreover, compressors, cooling fans, and the power units that drive them produce pure tones and modulating frequencies, which are more likely to be annoying to humans than sound in the broadband spectrum. Electric motors are being used to drive compressors in some areas. Although the use of electric motors in these instances is driven by a need to reduce air emissions, electric motors may be effective for noise mitigation in fields that have electric power.
The fact that there is substantial variation in noise levels and frequency signatures produced by compressor stations means that the effects on sage grouse could vary widely among sites as well as near a single compressor site over time. Evaluating the impact of compressor stations on sage grouse leks or other sage grouse habitat based solely on their proximity yields an incomplete picture. Thus, an experimental approach that quantifies sage grouse responses to different anthropogenic sound signatures (frequencies, intensity, and tones) is therefore needed, along with a spatial and temporal analysis of sage grouse responses to compressor noise. If sage grouse are fitted with satellite global positioning system (GPS) transmitters (rather than traditional very high frequency (VHF) transmitters), higher resolution data could be obtained.

To date, four studies have measured local effects of sound (and noise) generated by natural gas compressor stations on passerines: one along a proposed pipeline route in the Canadian arctic, another in Canada’s boreal forest, and two in pinyon-juniper woodlands in northwestern New Mexico. The first study used artificial compressor noise to simulate 60 to 83 dB(C) noise and its effects on Lapland longspurs (*Calcarius lapponicus*). Observers found no significant effects of this sound source on clutch size or the density of breeding birds. The second study reported a one-third reduction in overall passerine bird density close to compressor stations. A related study by the same research group on ovenbirds (*Seiurus aurocapilla*) reported reduced pairing success and significantly more first-time breeders near compressor stations (75 to 90 dB(A) at the source). The authors conjectured that reduced avian diversity could have been due to some species being susceptible to masking of territorial defense calls or predator detection from noise generated by compressor stations. The third study found approximately the same number of species and total number of birds observed at control and compressor sites, although species varied in their response. Some species were negatively impacted, such as the spotted towhee, while others, such as house finch and juniper titmouse, were more abundant at compressor sites. The fourth study also found different responses of species to compressor noise, but reported decreased nest predation by scrub jays and nest parasitism by brown-headed cowbirds near compressors. These studies underscore the variation in response among species to sound (and noise) generated by compressor stations. They further underscore the lack of accounting for variation in compressor noise output, the spatial arrangement of compressors, or the mitigating effects of sound abatement measures (if they were installed). None of the studies were designed to address population level effects.

**Anthropogenic Sound and Noise from Traffic on Access Roads:** Sound and noise generated by field-related vehicle use is an inescapable but mitigatable consequence of oil and gas development and operations. The typical noise from heavy-laden diesel powered trucks on highways is further amplified/exacerbated by the
uneven, rough surface of gravel roads that results in excitation and deformation of tires and frames and subjects the vehicle to vertical oscillations that cause dynamic axle loads or “axle hop.” This source of noise increases with speed and load and, in turn, generates low frequency acoustic waves that propagate through the ground.\(^43\) This is in addition to noticeable diesel engine noise that is ubiquitous with truck traffic. Similarly, passenger vehicles that are used to shuttle personnel are another source of noise and, like heavy trucks, these generate more noise per vehicle on gravel roads than on pavement.

Frequent truck traffic is associated with roads, well pads, rig mobilization (and demobilization), and equipment assembly. In preparation for drilling, heavy trucks deliver drill rigs, drillpipe, well casing, cement, drilling and well completion fluids, diesel fuel, and other equipment and materials, most of which are removed from the site (outside of casing pipe and cement) after completion of the well. After production starts, wells frequently produce naturally occurring salt water along with the oil or gas. The produced water is stored above ground in tanks until it is moved by truck or pipeline to injection wells and it is pumped deep underground. Liquid hydrocarbons from gas wells and crude oil from oil wells also may be trucked or piped off site.

M. Holloran reported declining male sage grouse lek attendance with increased proximity of roads to leks (e.g., main haul roads within three kilometers of leks, and a length of more than five kilometers of main haul road within three kilometers of leks) and increasing truck traffic (as determined from axle counters).\(^44\) Furthermore, nesting yearling females showed avoidance of road-related disturbances when compared to adult females. A. Lyon and S. Anderson reported that females tended to nest farther from roads and that the primary impact of energy development was traffic-related; however, some female sage grouse nested near roads and producing gas wells, suggesting that avoidance of these features was not absolute.\(^45\) Avoidance appeared to be related to traffic levels and well density.

To quantify the effects on sage grouse, studies to date have utilized straight-line distances, length of road segment in proximity to sage grouse leks and nests, and whether or not a road was in sight. This is an area of study where sound modeling could greatly increase our understanding of the effects of traffic noise by taking into account topography, vehicle speed and load, variability (and periodicity) of traffic density and road configuration in the mapping of sound levels and sage grouse distribution in response to them.

**Testing the “Noise Hypothesis”:** We concur with the view of C. Braun et al. that “The effects of oil and gas developments on sage-grouse and other sagebrush-grassland avifauna are poorly understood because of the lack of replicated, well designed studies.”\(^46\) This need not be the case. That sage grouse may avoid oil and gas infrastructure because of noise from drilling, compressors, and/or traffic on access roads is a plausible hypothesis that could be tested against data obtained
from laboratory and field studies as well as results from adaptive management experiments. Recognizing that there is variation in the type, size, age, and duration of each of these types of infrastructure along with variation in topography and environmental conditions is a necessary part of any experimental design. In and around urban areas, where humans are impacted by oil and gas infrastructure, noise monitoring, modeling, and mitigation are well-established practices. These practices could be applied when testing the above hypothesis on sage grouse.

**Laboratory Studies:** As with other species of birds, the sensitivity of sage grouse to a range of frequencies—from infrasound to high frequency broadband sound—could be determined by measuring auditory-evoked potentials and quantifying behavioral responses to sound of differing frequencies and intensity in a controlled laboratory setting.\(^{47}\) The fact that sage grouse spend the majority of their time on the ground and are a ground-nesting species (as compared to passerine species that are primarily arboreal), laboratory experiments should include low frequency and infrasonic sound propagated through the ground (i.e., similar to that produced by some oil and gas infrastructure).

**Field Experiments:** Variation in the types of oil and gas infrastructure and observed variation in the responses of sage grouse to that infrastructure means that a one-size-fits-all approach to quantifying impacts to sage grouse is inappropriate.\(^{48}\) Noise monitoring and spatial noise modeling of infrastructure at multiple sites is therefore essential when quantifying the characteristics of noise and sage grouse response(s) to it.

To ascertain how sound generated from oil and natural gas development affects sage grouse behavior, we recommend that field experiments to compare sage grouse responses to noise-mitigated and unmitigated operations be conducted during both pre- and post-development periods. The information thus gathered could then be utilized in noise-modeling calculations to map the spatial and temporal intensity and dispersion of sound across the landscape. This could then be compared with data on sage grouse distribution (i.e., using high-resolution GPS transmitter data) and lek counts, to test how sage grouse distribution or abundance is affected. Alternatively, noise mitigation could be fitted to existing infrastructure (e.g., gas compressors) or to infrastructure in the process of installation (e.g., drilling rigs), and sage grouse responses measured to mitigated versus unmitigated infrastructure. This would require a departure from the current approach of monitoring for compliance of the installation. Presently, there is no central, publicly accessible database on mitigation measures employed by the oil and gas industry for sage grouse.

A combined laboratory and field approach is necessary for quantifying sage grouse responses to noise because of obvious confounding variables associated with oil and gas development: tall structures, human activity, lights, power lines, and potential attraction of predators to the area surrounding them. Similarly, the effectiveness of conditions of permit approval employed by state and federal agency managers could be tested.
Noise Mitigation in the Oil and Gas Industry Could be Applied to Drilling and Production in Sage Grouse Habitat: Noise mitigation approaches employed by the oil and gas industry have evolved due to industry’s experience in recent years with natural gas development in and near urban areas such as the Barnett Shale that underlies Fort Worth, Texas, and its environs. In such locations, mitigation efforts begin with base-line 24-hour ambient sound surveys to establish pre-development background levels. The results of these base-line surveys are used in combination with information on equipment used, the directionality of machine-generated noise, topography, prevailing wind, and temperature to provide input data for noise modeling to evaluate mitigated vs. unmitigated noise impacts and to develop a noise abatement plan. Noise mitigation measures carried out under a noise mitigation plan may include enhanced mufflers on diesel engines and gas compressor engines, acoustically engineered sound barrier blankets and sound walls to surround drilling and fracking operations, isolation of vibrating equipment from the ground (e.g., large diesel motors), isolation of shaker tables from holding tanks to prevent the latter from acting as a low frequency transducer, installing mufflers on compressors and surrounding them in sound walls or in soundproof buildings, adding silencers to compressor cooling fans, and scheduling truck traffic to reduce noise conflicts.

Directional and horizontal drilling techniques allow development of resources that might otherwise be foregone. Development utilizing multiple wells (up to 20 wellbores) on one wellpad and use of year round drilling are major innovations that eliminate the need for rig mobilizations and demobilizations and associated truck hauling (about 80 to 100 truckloads per rig move). The viability of drilling techniques is contingent on local geological conditions, drill depths, and reservoir characteristics. Overall footprint and impact of drilling in an area have been reduced significantly through enhanced drilling techniques, advanced well completion designs that allow greater recovery of resources from fewer wellbores, and comprehensive project planning that reduces surface disturbance and human presence (e.g., fewer drilling pads, access roads, centralized gas treatment plants, co-location of facilities, placement of pipelines in one right-of-way, buried power lines, transportation planning, and remote well monitoring and control). Additionally, newer generation drilling rigs and gas compressors tend to be more efficient and quieter than older models. Although the noise from compressors is continuous, the fact that compressors are semi-permanent means they may be one of the more easily mitigated sources of noise. Loud compressors can be muffled with soundproofing.

If thresholds for sage grouse tolerance to noise can be determined, then performance standards could be established. This would be similar to limits for broadband and low frequency noise that have been set for drill rigs and gas compressors in residential areas. The City of Fort Worth regulates noise generated by oil and gas operations as low as the 16 Hz octave band frequency (Ordinance No. 18399-12-2008).
**Human Activity:** What constitutes a human activity that causes disturbance? We narrowly define human activity associated with oil and gas development as the presence of humans working outside and on foot or on equipment (such as on a drill rig, site and pad construction, performing maintenance, or loading produced water at a site). This distinguishes it from human activities covered under other threats (e.g., traffic).

Most of the published literature that addresses human disturbance to sage grouse or other species assumes that if individuals avoid human activity or take flight in response to humans, then the activity will eventually lead to a deleterious effect on their populations. However, human disturbance is of importance to populations only if it has a demographic consequence, ultimately manifested as a lowering of carrying capacity. This occurs when the total area of available habitat is reduced (due to the species avoiding areas of human activity) or the density of animals that the habitat can support is reduced (due to a decline in habitat quality caused by the disturbance). In the case of sage grouse, reduction in male lek counts has been assumed to equate with population losses. To our knowledge, this hypothesis has not been tested with probability-based population counts.

If human activities are geographically predictable and non-threatening, then wildlife may habituate to them. Conversely, they may learn to associate humans with danger. One aspect of sage grouse management that has the potential to adversely condition them to human activity is sport hunting: a reported 207,433 sage grouse were harvested in the United States during 2001-2007. If sage grouse perceive humans as predators and associate them with danger (thus avoiding areas of human activity as a result), then the effects of human activity associated with oil and gas development will be amplified. Firearms are not allowed in oil and gas development areas for obvious safety reasons, but hunted sage grouse populations frequently overlap these areas and, therefore, can be expected to be conditioned adversely to human activity.

It is possible that un-hunted sage grouse populations would habituate to human activity and noise associated with oil and gas development more readily than hunted populations. This hypothesis is testable by comparing flight initiation distances (and habitat use near energy development) in hunted vs. un-hunted populations.

If greater avoidance of human activities is found in populations that are hunted, then mitigation for energy development is straightforward: either do not hunt grouse in these populations (similar to caribou hunting restrictions near Prudhoe Bay, Alaska) or screen human activities to the extent possible from sage grouse.

**Predation:** The extent to which oil and gas development may result in increased predation on sage grouse has not been quantified, but plausible cause-and-effect mechanisms exist because species such as ravens, foxes, and coyotes are commensal with, and frequently subsidized by, humans. A recent review of published
and unpublished research about predation on sage grouse concluded that all of the
predators on sage grouse are generalists, meaning that they prey on other species
as well. Sage grouse eggs have been preyed upon by red foxes (*Vulpes vulpes*),
coyotes (*Canis latrans*), badgers (*Taxidea taxus*), common ravens (*Corvus corax*),
and black-billed magpies (*Pica hudsonia*). Common predators of juvenile and
adult sage grouse include golden eagles (*Aquila chrysaetos*), prairie falcons (*Falco
mexicanus*) as well as other raptors, coyotes, badgers, and bobcats (*Lynx rufus*).
Younger birds are likely preyed on by common ravens, red fox, northern harrier
(*Circus cyaneus*), ground squirrels, snakes, and weasels. More recent data used
continuous video monitoring of sage grouse nests to quantify predation rates and
microhabitat parameters that favored predation. These authors documented
predation on nests by common ravens and American badgers and reported that an
increase in one raven per 10-kilometer transect survey was associated with a 7.4
percent increase in the odds of nest failure from raven predation. The probability
of predation by ravens and badgers also increased with reduced shrub canopy
cover, suggesting a negative synergism for sage grouse between increasing
predator density and decreasing cover.

To address predation, several strategies have been proposed. C. Hagen sug-
gested an untested, indirect approach: “The most effective long-term predator
management for sage-grouse populations may be through maintaining connec-
tivity of suitable habitats.” The author does not explain the mechanism by which
this could reduce predation on sage grouse. In contrast, P. Coates and D. Delehanthy
proposed a more specific approach, one that addresses the two primary mech-
anisms they identified as contributin g to sage grouse predation: (1) reduce
interactions between ravens and nesting sage grouse by managing raven pop-
ulations (i.e., reduce abundance of this predator that is commensal with
humans) and (2) restore and maintain shrub canopy cover in sage grouse nesting
areas to reduce the effectiveness of ravens and other predators on nesting
sage grouse. The approach of P. Coates and D. Delehanthy represents a more
integrated and science-based predator management strategy that addresses
specific cause-and-effect mechanisms, and could be tailored to specific cir-
cumstances involving other predators on sage grouse in areas affected by oil and
gas development.

Other mitigation measures that address specific cause-and-effect mechanisms
of predation include: (1) installation of anti-perch devices on power poles, fence
posts, structures, and equipment to discourage raptors and (especially) ravens from
perching in sage grouse habitat; (2) burial of power lines, thus completely elim-
inating perches for raptors and ravens in critical nesting areas; (3) trash control
measures to eliminate food subsidies and attractants to ravens, magpies, red foxes,
and coyotes (i.e., use of covered dumpsters with self-closing lids that cannot be
left open and clean worksite procedures); (4) discourage the use of oil and gas
infrastructure as den sites for mammalian prey (e.g., rabbits and rodents) that then
provide a subsidy to predators such as foxes and coyotes; and (5) removal of road killed animals that attract and provide a food subsidy to ravens, foxes, and coyotes.

Although the USFWS devoted an extensive discussion of this hazard in their 2008 Interim Status Update, current stipulations by the Bureau of Land Management and the State of Wyoming and best management practices (see http://www.oilandgasbmpps.org/) address these issues in a limited way. That mitigation measures such as those listed above could result in sage grouse being more tolerant of oil and gas infrastructure (due to a lower perceived risk of predation) is a testable hypothesis.

**Habitat Loss and Fragmentation:** Sage grouse habitat loss and fragmentation is of serious concern to federal land managers. Significant direct losses result from natural events such as lightning-caused fires and noxious weed infestations, among others. Federal land managers make concerted efforts to minimize habitat loss and fragmentation through activity siting and mitigation of potential impacts. Direct losses from oil and gas development include construction of roads, drilling pads, and facility sites for compressor stations and related infrastructure to support production operations. Indirect losses result from: habitat degradation, inadvertent creation of population “sinks” due to increased predation, and sage grouse avoidance of oil and gas infrastructure (described elsewhere in this paper). Clearly, the direct loss of habitat is more permanent because it involves substantial earthworks and is therefore the most challenging to mitigate.

**Spatial/Temporal Management:** Modeling of hypothetical oil and gas build-out scenarios and avoidance of sage grouse core areas (defined from lek location and count data) have been proposed as a means to prioritize the conservation of sage grouse habitat and thereby reduce direct and indirect impacts of habitat loss and fragmentation. This may include forgoing development in core areas until either the functional relationship between actual sage grouse population numbers and core habitat is better understood or more effective mitigation measures are developed. While these are important contributions in spatial analysis, a common limitation is the absence of temporal analysis. The latter is needed because the rate of development of oil and gas is highly variable and can be determined by conditions such as commodity prices, market conditions, new information about reservoir and production characteristics, and development of new drilling and well completion technologies. Further, the duration of oil and gas production is finite (generally assumed to be 30 years) and their impacts are not necessarily permanent to sage grouse. After development and resource extraction has passed, sage grouse populations have the potential to recover, especially if reasonable and prudent restoration efforts are undertaken.

An additional and significant limitation to these modeling efforts has been their failure to keep pace with technological advances. These advances have increased the efficiency of oil and gas drilling (fewer dry holes, fewer drill days, and
multiple-wellbores from one pad) and production (greater recovery using fewer wellbores), resulting in reduced surface footprints, less infrastructure, and reduced noise impacts. These advances have the potential to render obsolete those modeling efforts that were based on impact studies from a previous generation of oil and gas extraction technologies (circa 1970s and 1980s). Briefly, these technological advances include the following.

1. Directional drilling can reduce surface disturbance by drilling multiple wells from one drilling pad. This allows for a more efficient tapping of underground reservoirs of oil and gas (a 3.2 to 1 average production ratio compared to vertical drilling) and can reduce both well pad density on the surface and the volumes of drilling waste generated by the activity.\(^\text{65}\)

2. Steerable downhole motors and horizontal wellbores, that is, drilling multiple deviated wellbores (as many as 20 wellbores) from one pad, are feasible in some areas, such as the Piceance Creek Basin. Horizontal wells are used in many areas. Such applications greatly increase the effective radius of production from one wellpad.

3. Materials technology advances in drill bits have made them more efficient. This reduces drilling time and rates of equipment failure. For example, the latest-generation polycrystalline diamond compact bits drill at a rate that is 150 to 200 percent faster than similar bits just a few years ago. Small, mechanically assisted high-pressure water jet drills are in development.

4. Lightweight modular drilling rigs are deployed more easily and require a smaller footprint.

5. Technology that allows measurement while drilling provides precise, real-time down-hole drilling data to allow more efficient and accurate drilling.

6. Slim-hole drilling, micro-holes, and coiled tubing are more efficient than conventional drilling operations for extracting additional oil and gas from mature fields or tapping into complex reservoirs. This is accomplished by drilling smaller diameter holes (compared to a conventional 8-3/4 inch diameter hole) and using a more flexible, steerable, down-hole drilling apparatus. Drilling waste volumes are lower, surface footprints are up to 75 percent smaller, and noise impacts are reduced, e.g., at 1,300 feet a conventional well is around 55 dB(A), while a coiled tubing unit’s noise level at the same distance is about 40 dB(A).

The pace of technological improvements taking place in oil and gas development and their implementation in the field require that efforts to model potential impacts to sage grouse keep pace as well. To remain relevant, modeling efforts also need to acknowledge and incorporate information on new technology and more effective mitigation measures for sage grouse, rather than rely on simplifying assumptions regarding spatial scale of impacts (i.e., a one-size-fits-all approach to quantifying impacts).\(^\text{66}\)
Conservation Trade-Offs: One approach to mitigating direct loss of habitat is the use of conservation trade-offs. These include land trades, mitigation banks, conservation easements, lease buybacks, and other ways to set aside sage grouse habitat with a high-priority for conservation and management. While this does not alleviate direct and indirect impacts at specific sites or ensure that the level of off-site mitigation is equivalent to the level of on-site impact, it does provide a mechanism for land preservation that can benefit sage grouse populations elsewhere. The U.S. Fish and Wildlife Service, in its “Policy for Evaluation of Conservation Efforts,” has collected information for a database (PECE); however, these data and analyses derived from them have not yet been made public.

Another approach to conservation trade-offs, but more specifically aimed at reducing threats on private lands, is Candidate Conservation Agreements with Assurances (CCAs). This program is administered by the USFWS and designed to incentivize conservation efforts on private lands that will benefit a “candidate” species while providing assurances that no additional requirements will be imposed should a species subsequently be ESA-listed. (The 2010 “warranted but precluded” decision on sage grouse means this species is now officially a candidate for ESA-listing.) A similar program exists for public lands but does not provide assurances. Although these programs hold promise, we are unaware of any agreements having been implemented, owing to lack of alignment among parties and state and federal agencies.

Habitat Restoration: Where habitat disturbance has occurred as a result of oil and gas development, it can be offset by reclamation efforts, and more effective restoration approaches are under development. Although full reclamation is required after well fields have been abandoned, it also can be implemented on an interim basis in areas where development is still occurring. While sage grouse have repopulated areas previously abandoned, there has been a delay in the methods to: (1) encourage natural re-colonization, (2) enhance the success of translocations and augmentations, and (3) subsequently foster population growth. One aspect of restoration research that has been overlooked in recent years is the development of methods to attract sage grouse to (artificial) lek sites. This is an area of research that could benefit sage grouse conservation both in and near energy development. Suggestions that there is no evidence populations will attain their previous size and reestablishment may take 20 to 30 years appear to us as problems to be solved rather than inevitabilities to be accepted.

Strike Hazards: Wire strand and woven wire fences, road traffic, and distribution power lines are ubiquitous throughout the range of sage grouse and may be strike hazards for sage grouse. These hazards are sometimes associated with oil and gas development. Fencing around oil and gas facilities is required by some municipalities for public safety (Evanston, Wyoming) and may be erected along access roads to contain livestock. Power lines may be strung to provide electrical
power to infrastructure. Wire fencing and traffic are considered to be strike hazards because sage grouse typically fly low and fast to avoid predators. Power lines could pose a hazard to migrating sage grouse; however, the empirical evidence supporting power lines as a strike hazard is lacking. The mortality that each of these strike hazards inflicts upon sage grouse is difficult to quantify, and most accounts are based on scattered, unpublished incidents that researchers happened upon opportunistically. Once a carcass is scavenged, it is also difficult to distinguish between mortality from a strike versus other causes.

The level of mortality from each of these three hazards could be quantified through the labor-intensive process of walking fence lines and power lines and driving roads in search of dead sage grouse (at least daily). Such data are needed in areas where sound population data are available to quantify the proportion of the population annually lost to these hazards and the habitat parameters associated with those losses. Only then would it be possible to rank the degree of threat posed by these hazards and prioritize mitigation.

Mitigation for each of these hazards already exists. Inexpensive fence markers to increase visibility to sage grouse have been developed for wire strand fencing. Although the amount of fencing that could be marked is staggering, areas of highest risk could receive higher priority. Power lines in areas deemed of high strike risk to sage grouse could be buried or restrung on taller poles. This is a potentially expensive proposition, underscoring the need for quantifying the risk before prioritizing areas to be mitigated. And finally, in similar areas of high risk, vehicle traffic could be slowed and drivers alerted with training and signage.

**West Nile Virus:** In December 2009 the Bureau of Land Management (BLM) issued stipulations requiring comprehensive mosquito control at produced water ponds associated with energy development in areas where West Nile virus poses a threat to sage grouse.

This may include but is not limited to: a) the use of larvicides and adulticides to treat reservoirs; b) overbuilding ponds to create non-vegetated and muddy shorelines; c) building steep shorelines to reduce shallow water and aquatic vegetation; d) maintaining the water level below rooted vegetation; e) avoiding flooding terrestrial vegetation in flat terrain or low lying areas; f) constructing dams or impoundments that restrict seepage or overflow; g) lining the channel where discharge water flows into the pond with crushed rock, or use a horizontal pipe to discharge inflow directly into existing open water; h) lining the overflow spillway with crushed rock and construct the spillway with steep sides to preclude the accumulation of shallow water and vegetation; and i) restricting access of ponds to livestock and wildlife.

Subsequent to those policies, new recombinant larvicides have improved the efficacy of *Bacillus thuringiensis* subsp. *Israelensis* (Bti) to control mosquito larvae. Newly developed bacterial strains that are 10-fold more toxic to mosquito larvae than wild-type species of Bti and *Bacillus sphaericus* (Bs) are used in current commercial formulations.
Despite these advances in mitigating potential effects of West Nile virus on sage grouse (or eliminating them entirely), recent papers have made no mention of these advances and have continued to associate energy development with increased risk of West Nile virus.\textsuperscript{77}

Discussion

In this paper our first step was to distill the general threat of oil and gas development into specific threats to sage grouse, and then evaluate each threat based on its cause-and-effect mechanisms. This process establishes the credibility of each threat, and then addresses the question of why sage grouse could be affected by it. In some cases, additional research has been proposed to quantify aspects of the threat. Next, we identified specific mitigation measures that could be implemented in an adaptive management framework. This approach ensures that precautionary measures are reasonable, appropriately related to mitigation of a perceived threat, the level of risk (or reward) is quantified, and an experimental approach is used to fill in knowledge gaps.

Recent Regulations: Current stipulations and regulations for oil and gas development in sage grouse habitat are largely based on studies from the Jonah Gas Field and Pinedale anticline. These and other intensive developments were permitted decades ago, using older, more invasive technologies and methods. The density of wells is high, largely due to the previous practice of drilling many vertical wells to tap the resource (before the use of directional and horizontal drilling of multiple wells from a single surface location became widespread), and prior to concerns over sage grouse conservation. This type of intensive development set people’s perceptions of what future oil and gas development would look like and what its impact to sage grouse would be. These fields, and their effect on sage grouse, are not necessarily representative of sage grouse responses to less-intensive energy development.\textsuperscript{78} Recent environmental regulations and newer technologies have lessened the threats to sage grouse.

Two instructional memoranda issued by the BLM and an Executive Order issued by the Governor of Wyoming have sought to address potential impacts of surface-disturbing activities and disruptive activities to sage grouse both inside and outside identified sage grouse “Core Areas.”\textsuperscript{79} These documents lay out regulations that include timing, setback distance, and density restrictions to protect sage grouse leks as well as winter and brood-rearing habitat. For example, both BLM and Wyoming regulations limit development to one well pad or compressor station (“energy production and/or transmission structures”) per 640 acres, with a 5-percent limit on the amount of sagebrush habitat disturbance within those 640 acres.

Of these regulatory documents, only the Wyoming Executive Order includes actual performance standards, and only two of those performance standards
partially address the potential threats raised in this review: (1) power lines must be raptor-proof, either by burying them or by installing anti-perching devices (although no mention is made of limiting raven perches or discouraging mammalian predators, even though these cause the bulk of sage grouse nest mortality) and (2) the levels of new sources of noise are limited to 10 dB(A) above ambient at the perimeter of leks, with the acknowledgement that actual thresholds may be adjusted pending results of ongoing research (although for reasons cited above dB(A) is a scale inappropriate for quantifying low frequency noise). While these new regulations have potential to benefit sage grouse, they fall short in addressing the likely mechanisms behind the threats to sage grouse (discussed in this paper) and rely on adaptive management in a limited way. The Executive Order assesses success or failure of mitigation (and adaptive response) on a case-by-case basis using only monitoring data from the mitigated site (rather than utilizing data from multiple mitigation projects or pooling data for a meta analysis). Similarly, "adaptive management" is only mentioned once in the BLM Instructive Memoranda. The effect of this piecemeal approach is twofold. First, it provides a disincentive for cooperative efforts (i.e., multi-company, multi-agency, multi-partner) to coordinate, and report on, monitoring of mitigation measures for their effectiveness. And second, the limited (local) scope of this "adaptive management" strategy can stifle innovation.

Presently, there is no central repository of information on mitigation measures implemented on behalf of sage grouse, nor their outcomes. In our view, this is a critical data gap that hampers sage grouse conservation and the effective mitigation of oil and gas development in sage grouse habitat. It is difficult to learn from the experiences of others if those experiences are not shared.

To facilitate testing the effectiveness of mitigation measures, a more systematic approach is needed. Currently, when mitigation is required by governmental agencies, monitoring for compliance is customary. If greater effort were channeled towards monitoring the effectiveness of mitigation measures (i.e., sage grouse responses), it would allow for a more rapid development of conservation measures.

A Need for Spatial and Temporal Management: Several authors have stated that federal and state governments and industries need to implement solutions on a large scale (i.e., "landscape-level" management). They suggest that one approach is to forgo development in priority landscapes until new "best management practices" are implemented. This is reasonable, but implementation requires sharing of information and trust. However, J. Connelly et al. note that, although mining and oil and gas development can have negative impacts on sage grouse, populations can recover after the development has ceased. The critical point is that both temporal and spatial management is needed. Development with subsequent restoration of areas with oil and gas resources can occur over time to
maintain populations over the range of the species. Coupled with development of more effective mitigation and recent, less-invasive technologies, this approach would allow multiple objectives to be achieved without permanently excluding oil and gas extraction from large areas.

**Conclusion**

If sage grouse and energy development are to coexist successfully in the long term and effective management be developed in a timely manner, it is imperative that both threats and management actions be treated as potentially falsifiable hypotheses, rather than as certain knowledge.\(^8^5\) In other words, even hypothetical threats can be prioritized and subsequently investigated in a scientific manner. In cases where quantitative data are lacking, threats may be initially ranked based on their plausible cause-and-effect mechanisms and revised as additional data become available. In this process, mitigation measures that have been designed to address a specific threat may be treated as alternative hypotheses and their effectiveness tested against quantitative thresholds. These can be laid out in a series of “if-then” statements in adaptive management plans. This same strategy can be used to set “triggers” for additional or alternative management actions. Such a scientific approach to adaptive management increases the likelihood that conservation effort will be allocated in a way to provide the greatest benefit.

**NOTES**


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Comparison of Patterns of Genetic Variation and Demographic History in the Greater Sage-Grouse (*Centrocercus urophasianus*): Relevance for Conservation

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Abstract: The greater sage-grouse (*Centrocercus urophasianus*) was once widespread in western North America but its range has contracted by an uncertain degree owing to anthropogenic and natural causes. Concern over population declines has led to its proposed listing as threatened under the U.S. Endangered Species Act. Detailed genetic and demographic analyses of this species throughout its range are available but heretofore have not been compared. Reduced genetic variability is often taken as a proxy for declining populations, but rarely are there quantitative population estimates with which to compare. I compared published mitochondrial DNA (mtDNA) control region sequences, microsatellite allele frequencies at seven loci, and estimates of numbers of males per lek, number of active leks, percent decline in the best population models, and the probability (P) of Ne < 50 in 30 years and P(Ne < 500) in 100 years, at two spatial scales, 45 local population samples and 16 larger aggregates of samples. When excluding the populations from the Columbia Basin, which show little genetic diversity and are statistical outliers, there were no consistent relationships between estimates of genetic variation and demographic trends across the remainder of the range at either spatial scale. A measure of inbreeding derived from microsatellite data was also not related to population trends. Thus, despite habitat reduction and range fragmentation, the greater sage-grouse does not exhibit expected genetic signatures of declining populations. Possibly, the mtDNA and microsatellite data are insufficiently sensitive to detect population declines that have occurred over the span of a half century. Alternatively, only when populations are reduced to the levels seen in the Columbia Basin will genetic effects be seen, suggesting that the bulk of the range of the greater sage-grouse is not currently in genetic peril.

Keywords: conservation genetics, heterozygosity, inbreeding, microsatellite loci, mitochondrial DNA, population management, population structure.

INTRODUCTION

Many sources of biological information can guide management of threatened and endangered species. Measures of genetic variability and differentiation provide indirect historical information on whether populations have experienced bottlenecks or inbreeding, or have been isolated from exchanging individuals with other populations. Measures of demographic fluctuations through long-term population monitoring provide evidence on more recent population fluctuations. In theory, these two types of information should be complementary. Lower than average levels of genetic variability are typically inferred to be a result of population declines. Oyler-McCance et al. [1:1293] noted that such populations “can suffer from inbreeding effects and can be more susceptible to parasitic agents and disease.” Small populations can lose genetic diversity, which could hamper their ability to respond to new (or current) environmental challenges [2]. Furthermore, slightly deleterious alleles might increase in frequency and result in lower individual fitness. Given the potential for genetic and demographic information jointly to inform conservation efforts, it is surprisingly rare to be able to compare measures of genetic variation and inbreeding depression with quantitative estimates of demographic history, especially for species of conservation concern.

The greater sage-grouse (*Centrocercus urophasianus*), considered threatened (but precluded) under the U.S. Endangered Species Act [3], is an exception. Garton et al. [4] provided a detailed demographic study of greater sage-grouse population trends at two geographic levels, a broad, inclusive level that included the seven sage grouse management zones (SMZ, Fig. 1), and 30 smaller population units within these zones. Using data from 1965 to 2007 (in five-year intervals) on the number of active leks (display grounds) and males per active lek, they computed estimates of population trends, and estimated the probability of population persistence (P) at two levels (Ne < 50, 500) 30 and 100 years into the future. Ne refers to the genetic effective population size, which is a function of how males and females contribute to future generations, and not an estimate of the census size of a population. They concluded that some populations are in danger of falling below the putative minimum viable population sizes or 50 or 500, which some consider arbitrary [5]. This makes it appropriate to survey genetic variation to determine if populations estimated to be on downward trajectories also show reductions in levels of genetic diversity.
Oyler-McCance et al. [1] surveyed mitochondrial DNA control region (141 base pairs) variation and genotyped seven microsatellite loci for over 1000 greater sage-grouse from 45 populations (Fig. 1) throughout the same area as that analyzed by Garton et al. [4]. They provided measures of genetic variation within populations, and genetic differentiation among the same populations for which Garton et al. [4] tallied the number of active leks and number of males per individual populations. In addition Oyler-McCance et al.’s [1] genetic data can be summarized for six of the seven SMZs (only the Colorado Plateau was missing), and for 16 of the 30 larger populations for which Garton et al. [4] provided measures of long-term demographic fluctuations and P(\(Ne < 50; Ne < 500\)). In this paper I compare genetic variability measures with quantitative estimates of population trends to determine whether the effects of population declines can be observed at two geographic scales in the microsatellite and mitochondrial DNA data for this species of conservation concern. The available data sets also allow comparison of the extent to which mtDNA and microsatellites provide similar estimates of population genetic variability.

MATERIAL AND METHODOLOGY

Analyses were performed on two data sets. Data set I consisted of 45 population samples, each of which has microsatellite and mtDNA data [1] and data on the number of active leks and number of males/active lek [4]. Data set II included the 16 population groupings for which Garton et al. [4] estimated P(\(Ne < 50\) or \(Ne < 500\)) in the next 30 or 100 yr, and for which mtDNA and microsatellite data were available. In addition, I used the percent population change in Garton et al.’s [4] “best model” as a measure of population fluctuation. Populations for which Garton et al. [4] did not find a significant overall trend were considered stable over the time period. For both data sets, if the relationship between the number of individuals sampled and measures of genetic variability were significantly correlated, residuals from linear regression were used in place of actual values (no differences were found using residuals from other regression models).

For data set II I regrouped individuals’ mtDNA and microsatellite data and recomputed measures of genetic variability using Arlequin 3.5.1.3 [6]. Arlequin was also used to compute the Garza-Williamson [7] index (and a modified version) for both data sets (e.g., 16 and 45 population units), which compares the number of alleles at loci with the allelic range to provide an indication of whether populations exhibit effects of bottlenecks. I performed analyses with and without the samples from Yakima and Douglass/Grant (Moses Coulee, WA) representing the Columbia Basin, owing to the possibility that the low variation in these samples represents outliers that could bias analyses.

To evaluate the relationship among the variables, I computed a matrix of Pearson product-moment correlation coefficients. The computation of multiple coefficients runs the risk of spurious significance values. A standard approach is to apply a Bonferroni correction [8] that results in an experiment-wide lowering of the alpha level accepted for significance. For data set I, the level would be 0.05/21 (0.0024) and for data set II, 0.05/45 (0.0011). Many authors [e.g., 9, 10] have pointed out that this is extremely conservative and runs the opposite risk of failing to recognize significant values, especially if the relationship is weak but nonetheless significant and in studies with relatively small sample sizes. Because this is one of the first large-scale comparisons of genetic and demographic data, and is partly exploratory in nature, I assessed statistical significance using the standard of \(P < 0.05\), but it should be realized that some values are insignificant if the Bonferroni criterion is applied. Of course if a standard \(P\)-value is not significant, the Bonferroni correction is irrelevant. In addition, although comparisons among genetic variables or among demographic variables are
likely non-independent, comparisons between these two classes of variables are less so. For example, in data set I, there are eight comparisons between genetic and demographic variables, and one could consider the appropriate Bonferroni correction to be 0.05/8 or 0.0063.

To determine whether one might expect a genetic signature of population reductions, I constructed 10 random samples from the total pool of individuals with microsatellite data that matched the observed sample size for each of the 45 populations in Ouyler-McCanse et al. [1], and plotted the relationship between number of individuals and average number of alleles/loci. If there were no relationship, it would suggest there was not enough variability among samples to detect effects from demographic fluctuations.

Previous genetic analyses [1, 11, 12] documented the existence of two well-separated mtDNA clades that are currently geographically co-distributed over much of the range. To evaluate whether these might have once been allopatric and secondarily sympatric, and to provide historical perspective on the distribution and range displacements of greater sage-grouse, I computed ecological niche models for the present, Last Glacial Maximum (LGM; 21,000 ybp), and Last interglacial (LIG; 120,000 ybp). Locality records (n = 173) were obtained from Ornis2 (http://ornis2.ornisnet.org/); duplicate records (those <1 km apart) were eliminated. Correlative ecological niche models [13, 14] were constructed using MAXENT ver 3.2.2 [15] for the present and projected to the LGM (CCSM database). Climatic data (19 layers) were obtained from the Worldclim bioclimatic database [16], and trimmed so as to provide a buffer around each species’ range. Multiple methods exist to account for correlations among climate variables, none with clear superiority [17]. Based on an initial MAXENT run, climatic layers that contributed 5% or more to the model were chosen (layers 1 2 3 8 11 13 18) and MAXENT was rerun using these layers and all locality records for final maps. Each map was based on the average of five MAXENT runs (using all points) and plotted using DIVA-GIS ver. 7.1.7.2 [18]. Predicted distribution maps were coded as presence/absence using the logistic threshold for equal training sensitivity and specificity produced by MAXENT (value = 0.375). MAXENT outputs a threshold-independent measure of the overall performance of the model (Area Under the Receiver Operating Curve or AUC). An AUC value of 0.5 indicates the predictive model is no better than random, whereas higher AUC values indicate better predictive ability with a value of 1 indicating perfect prediction. MAXENT’s auto-features and the default regularization multiplier parameter (1.0) were used, and the number of iterations was increased to 1500 to allow the program to reach the default convergence threshold.

To explore further the recent evolutionary history of the two mtDNA clades of greater sage-grouse, DnaSP [19] was used to compute a mismatch distribution and associated statistics (k, average number of haplotypes; π, nucleotide diversity; h, haplotype diversity) independently for each clade.

RESULTS

Data Set I (45 Populations)

None of the measures of genetic variability (Table 1, Fig. S1) were significantly (P > 0.05) correlated with number of individuals per sample (Table 2). Measures of genetic variability were significant correlated for each type of genetic data, heterozygosity and number of alleles/locus (P < 0.001) for microsatellites, and haplotype and nucleotide diversity (P < 0.001) for the mtDNA data. Several measures of variability at microsatellite loci and mtDNA were significantly correlated, number of alleles/locus and haplotype diversity (P = 0.017), number of alleles/locus and nucleotide diversity (P = 0.05), heterozygosity and nucleotide diversity (P < 0.024), and heterozygosity and haplotype diversity (P < 0.001). There were no consistent or significant relationships between numbers of active leks, number of males/active lek, and heterozygosity, alleles/locus, mtDNA haplotype and nucleotide diversity (Fig. S1). Although microsatellite heterozygosity was significantly (P = 0.0395) correlated with the number of active leks, this relationship does not remain (P = 0.10) when the two samples from the Columbia Basin are omitted. The G-W index was not significantly (P > 0.05) related to measures of population trends (Fig. 2).

Data Set II (16 Populations)

Only the average number of alleles/locus was significantly correlated (P < 0.001) with number of individuals per sample, hence, residuals from the regression of these two variables were used subsequently (Table 3). Measures of genetic variability were significant correlated for each type of genetic data, heterozygosity and number of alleles/locus (P = 0.007) for microsatellites, and nucleotide and haplotype diversity for the mtDNA data (P < 0.001) (Table 4). Heterozygosity was correlated with haplotype diversity (P = 0.013), and number of alleles/locus was correlated with haplotype (P = 0.019) and nucleotide (P = 0.013) diversity. When the two samples from the Columbia Basin were omitted, no significant correlations remained. With one exception, no correlations were significant between measures of genetic variability and percent decline in best model, P(Ne) < 50 in 30 years or P(Ne) < 500 in 100 years (Figs. 3-4). The G-W index was not significantly (P > 0.05) related to measures of population trends (Fig. 5). Interestingly, there were no significant correlations between percent decline in best model, P(Ne) < 50 in 30 yrs, and P(Ne) < 500 in 100 yrs (Table 4). Random samples of microsatellite genotypes showed that the average number of alleles/locus varied from 6 to 12 (Fig. S2), suggesting that this genetic measure has the potential to reveal demographic declines.

Ecological Niche Models

Predicted current distribution agrees with the known historical distribution (Fig. 6) and the LGM predicted distribution (not shown); the AUC score of 0.947 estimated under current climate conditions indicates a very good ability to discriminate between presence and absence locations. The LGM distribution suggests two potential refugia, one in the southeast and the consisting of the remainder of the range. Although there is southward displacement at the LGM, much of the distribution, especially in the west, is similar to that found today, suggesting that the species was not greatly range-restricted especially in the western part of the range, at the LGM.
Table 1. Population samples, greater sage-grouse Management (SMZ) zones, number of active leks, number of males per active lek and measures of genetic variability at 7 microsatellite loci and mtDNA control region for 45 population samples1 [1, 4].

<table>
<thead>
<tr>
<th>Population</th>
<th>SMZ zone</th>
<th>No. active leks</th>
<th>No. males/active lek</th>
<th>No. males</th>
<th>HEave</th>
<th>Ave. No. alleles</th>
<th>G-W modified index</th>
<th>MtDNA h</th>
<th>MtDNA π</th>
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<th>No. males/active lek</th>
<th>No. males</th>
<th>HEave</th>
<th>Ave. No. alleles</th>
<th>G-W modified index</th>
<th>MtDNA h</th>
<th>MtDNA π</th>
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1Oyler-McCance et al. [1] show a locality “Owyhee, OR” on their Figure 5 that was not represented in their genetic data. Their locality point for “Weston WY” is actually for “Converse, WY” and there is no locality point for Weston, WY on their Figure 5.

2Although Garton et al. [4] list one lek with seven males, Oyler-McCance et al. [1] anlayzed 19 individuals for mtDNA and 22 individuals for the seven microsatellite loci, presumably as a result of sampling over years.


Table 2. Correlations among genetic [1] and demographic parameters [4] for 45 populations of greater sage-grouse. Asterisks indicate standard statistical significance levels (* P < 0.05, ** P < 0.01, *** P < 0.001); see text for significance levels if applying Bonferroni corrections.

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<th>No. active leks</th>
<th>No. males/active lek</th>
<th>No. males</th>
<th>Heterozygosity (ave)</th>
<th>Number alleles/locus (ave)</th>
<th>MtDNA h</th>
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Fig. (2). Plot of Garza-Williamson inbreeding index [7] versus number of males per active lek [4] in greater sage-grouse, showing a lack of a relationship.

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<th>N mtDNA</th>
<th>No. active leks</th>
<th>No. males per active</th>
<th>No. males</th>
<th>Heterozygosity</th>
<th>No. alleles/locus</th>
<th>Residuals No. alleles/locus</th>
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<th>decline in best model</th>
<th>P(No) &lt;50 in 30 yrs</th>
<th>P(No) &lt;500 in 100 yrs</th>
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<td>3021</td>
<td>0.64</td>
<td>7.29</td>
<td>-0.94</td>
<td>0.750</td>
<td>0.021</td>
<td>-0.10</td>
<td>0.0</td>
<td>78.0</td>
</tr>
<tr>
<td>Western Great Basin(^5) (27)</td>
<td>Northern Great Basin</td>
<td>158</td>
<td>122</td>
<td>175</td>
<td>28</td>
<td>4900</td>
<td>0.67</td>
<td>8.86</td>
<td>0.84</td>
<td>0.834</td>
<td>0.025</td>
<td>5.5</td>
<td>99.1</td>
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<tr>
<td>Snake-Salmon Beaverhead(^22)</td>
<td>Snake River Plain</td>
<td>36</td>
<td>20</td>
<td>207</td>
<td>23</td>
<td>4761</td>
<td>0.73</td>
<td>8.00</td>
<td>-1.49</td>
<td>0.754</td>
<td>0.016</td>
<td>4.2</td>
<td>26.8</td>
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<tr>
<td>Yellowstone Watershed(^4)</td>
<td>Great Plains</td>
<td>55</td>
<td>46</td>
<td>231</td>
<td>21</td>
<td>4851</td>
<td>0.65</td>
<td>7.71</td>
<td>-0.88</td>
<td>0.550</td>
<td>0.015</td>
<td>-4.50</td>
<td>0.0</td>
<td>59.8</td>
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<tr>
<td>Northern Great Basin(^23)</td>
<td>Snake River Plain</td>
<td>189</td>
<td>214</td>
<td>366</td>
<td>19</td>
<td>6954</td>
<td>0.65</td>
<td>11.14</td>
<td>0.25</td>
<td>0.804</td>
<td>0.022</td>
<td>-4.30</td>
<td>2.1</td>
<td>99.7</td>
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<tr>
<td>Wyoming Basin(^26) (8)</td>
<td>Wyoming Basin</td>
<td>268</td>
<td>254</td>
<td>807</td>
<td>33</td>
<td>26631</td>
<td>0.66</td>
<td>10.71</td>
<td>2.32</td>
<td>0.758</td>
<td>0.017</td>
<td>-3.40</td>
<td>0.0</td>
<td>10.7</td>
</tr>
</tbody>
</table>

Locations within major populations from Oyler-McCance et al. (2005): \(^1\)Wayne; \(^2\)Harding, Slope, Bowman; \(^3\)Valley, Phillips, Alberta; \(^4\)Big horn, Weston; \(^5\)Churchill, Nye; \(^6\)Beatty’s Butte, Steens, Wagon tire, Washoe, Sheldon, Lassen; \(^7\)Medicine Lodge; \(^8\)Rosebud, Fergus; \(^9\)Box Elder, Riddle, Curlew Valley, Magic Valley, White horse, Elko, Humboldt; \(^10\)Blue Mountain CO, Cold Springs, Rich, Diamond, Blue Mountain UT, Kemmerer, Farson, Rawlins, North Park, Eagle, Strawberry.

Recent Evolutionary History of Greater Sage-Grouse

Clades I and II exhibit different mismatch distributions (Fig. 7) and Clade I was consistently less variable (Clade I: \(k = 1.62, \pi = 0.0129, h = 0.76\); Clade II: \(k = 2.52, \pi = 0.019, h = 0.84\)). There is no evidence of two clades in the microsatellite data. However, because of the mode of inheritance of these bi-parental, nuclear markers, evidence of two clades would be erased with recombination and interbreeding.

DISCUSSION

Based on analyses of lek counts over several decades, greater sage-grouse have declined over much of their range [20], although the exact nature of the decline is unclear. Most assessments suggest population declines of from 17-47% [e.g., 21, 22] concluded from lek counts that the population declined by 2.0% per year from 1965 to 2003, and Schroeder et al. [23] suggested that the species currently occupies 56% of its pre-European settlement distribution. Given the lack of quantitative historical surveys that can be compared to current quantitative censuses, these estimates of range contraction are educated guesses. Nonetheless, it appears that not all regions have decreased to the same level, and some populations appear to be stable or increasing. The variability in degree of decline provides an opportunity for assessing the congruence of estimates of population trends and genetic variation. Oyler-McCance and Quinn [24] noted that estimates of population structure and gene flow in greater sage-grouse, i.e., connectivity of populations, as well as levels of genetic diversity “are paramount for...”
Table 4. Correlations among demographic and genetic variables for the 16 population units of greater sage-grouse described in [4]. Values in parentheses are for correlation coefficients excluding the two Columbia Basin populations. Asterisks indicate standard statistical significance levels (* P < 0.05, ** P < 0.01, *** P < 0.001); see text for significance levels if applying Bonferroni corrections.

<table>
<thead>
<tr>
<th></th>
<th>Number active leks</th>
<th>Number males/active lek</th>
<th>Total males</th>
<th>Het (ave)</th>
<th>Ave. No. alleles (resid)</th>
<th>mtDNA h</th>
<th>mtDNA π</th>
<th>Decline in best model</th>
<th>P(Ne) &lt; 50 in 30 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number males/active lek</td>
<td>0.492</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Total males</td>
<td>0.978**</td>
<td>0.568*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Het(ave)</td>
<td>0.353</td>
<td>0.265</td>
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<tr>
<td>Ave. No. alleles(resid)</td>
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<td>0.254</td>
<td>0.498</td>
<td>-0.468</td>
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<td></td>
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<tr>
<td>mtDNA h</td>
<td>0.324</td>
<td>0.374</td>
<td>0.274</td>
<td>0.614*</td>
<td>-0.197</td>
<td></td>
<td></td>
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<tr>
<td>mtDNA π</td>
<td>0.265</td>
<td>0.300</td>
<td>0.199</td>
<td>0.436</td>
<td>-0.078</td>
<td>0.873***</td>
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<tr>
<td>Decline</td>
<td>-0.373</td>
<td>0.054</td>
<td>-0.287</td>
<td>0.231</td>
<td>-0.136</td>
<td>-0.026</td>
<td>-0.030</td>
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<td></td>
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<tr>
<td>P(Ne) &lt; 50 in 30 yrs</td>
<td>-0.359</td>
<td>-0.411</td>
<td>-0.310</td>
<td>-0.737**</td>
<td>(-0.499)</td>
<td>0.399</td>
<td>-0.726**</td>
<td>(-0.257)</td>
<td>-0.558*</td>
</tr>
<tr>
<td>P(Ne) &lt; 500 in 100 yrs</td>
<td>-0.432</td>
<td>-0.744** (-0.733**)</td>
<td>-0.480</td>
<td>-0.295</td>
<td>0.09</td>
<td>-0.171</td>
<td>-0.084</td>
<td>0.009</td>
<td>0.463</td>
</tr>
</tbody>
</table>

Fig. (3). A) Plot of the residual number of alleles/locus for the seven microsatellite loci [1] versus the P(NE) < 50 in 30 yrs [4] for the 16 population samples of greater sage-grouse, showing a lack of a relationship. B) Plot of the residual number of alleles/locus for the seven microsatellite loci [1] versus the P(NE) < 500 in 100 yrs [4] for the 16 population samples of greater sage-grouse, showing a lack of a relationship.

Conservation efforts,” Oyler-McCance et al. [1:1308] stated that “genetic data used in conjunction with large-scale demographic and habitat data will provide an integrated approach to conservation efforts for the greater sage-grouse”. This is the tactic taken in this analysis.

Thousands of studies have been published that include “conservation genetics” in their key word section (Google Scholar search 16 February 2014). For the majority, there are no corresponding demographic data that can be used to compare with the genetic data. Hence, results from genetic analyses are often taken as proxies of past population demography. For example, Schmidt et al. [25] stated that lower mtDNA and microsatellite variation was associated with bottlenecked populations in the Eurasian lynx (Lynx lynx) although data on population histories consisted of verbal descriptions such as “The Scandinavian population...is believed to number up to 2000 individuals...is now large and appears to be growing rapidly.” Part of the lack of quantitative data on populations stems from the difficulty in observing lynx in the field, making more easily observable species such as the greater sage-grouse better suited to obtaining quantitative estimates of population demography. In fact, the genetic analyses [1] and the demographic results [4] represent one of the most extensive opportunities to compare these logically interrelated data sets.
Do Measures of Population Trends Explain Genetic Patterns of Variation or Reveal Inbreeding?

Levels of genetic variability should co-vary with long-term population fluctuations. Populations in decline ought to show reductions in heterozygosity, number of alleles/locus, and nucleotide and haplotype diversity. However, it is known that heterozygosity will only show a response to demographic declines if a bottleneck is severe and long term [26], whereas the number of alleles or haplotypes per locus is more sensitive to population fluctuations.

There was no evidence that average number of alleles or haplotypes per population co-varied with estimates of population trends (16 populations) or between measures of genetic variability and number of active leks or males/active lek (45 populations). Thus, the expected population genetic signatures of differences in population size were not observed. Importantly, the insignificant correlation between the G-W indices and measures of population trends suggests that populations, whether declining, increasing or stable, are not showing signs of inbreeding. This casts other studies of genetic variation alone in a different perspective, as one might not be able to infer that populations with low genetic variability are necessarily declining. In addition, Ramey et al. [27] detected several potential errors in the calculations of Garton et al. [4], although these errors would like result in less severe estimated declines and lower probabilities of populations being less than 50 or 500 in 30 or 100 years. Hence, analyses presented here potentially evaluated a “worst-case” scenario.

One clear genetic pattern is that the remaining populations in the Columbia Basin exhibit low levels of heterozygosity and numbers of alleles/locus. Although the remaining leks possess an average number of males, their isolation ap-
population. For example, the mtDNA estimate of gene flow (Slatkin’s N) averaged 15.4 among all populations excluding the two from the Columbia Basin, whereas an average of only 1.9 immigrants was exchanged between the Columbia Basin and the remaining populations. Hence, isolation from gene flow of the nature observed in Washington likely leads to reduced genetic variability and clearly poses a potential risk to population persistence. However, throughout the rest of the range, there are no similar situations, with the possibility of the population in Lyon/Mono (see below). In fact, in a small population in Alberta, Bush et al. [28:343] remarked: “Although the species is endangered in Alberta and occurs in fragmented habitat, it has maintained genetic diversity and connectivity.” This was explained as a result of successful dispersal of breeding individuals among leks. Given this level of connectivity at the northern fringe of the current range, it stands to reason that at least this much dispersal and gene flow exists in southern and more continuous portions of the range. It is possible that the lack of a relationship between estimated degree of population decline and levels of genetic variability is that there is still sufficient inter-area dispersal to counteract local population declines and genetic drift.

Populations with high probabilities of P(Ne) < 50 or 500 were already on a historically decreasing population trajectory, given that these calculations were based on lek counts over the past several decades. Possible reasons for a lack of expected genetic signatures include a high level of gene flow or an inability of available genetic measures to capture population declines owing to a lag effect [e.g., 29]. For example, although the Iberian lynx (Lynx pardinus) has decreased from a total population of 1100 individuals in the 1980s to 100 individuals distributed in two isolated populations today, Casas-Marce et al. [2] were unable to show genetic effects of bottlenecks in a sample of 36 polymorphic microsatellite loci. However, in randomly sampling from the 1181 individuals for which microsatellite data were available, there are strongly reduced levels of alleles/locus in population samples identical in size to those analyzed in this study (Zink, unpubl. data). Thus, the lack of a relationship between genetic and P(Ne < 50, 500) in greater sage-grouse is likely not an artifact of the sensitivity of the genetic markers compared.

Evolutionary History of Greater Sage-Grouse

An understanding of the past evolutionary history of a species can provide useful perspective on current populations and their distributions, and how the species might respond to future climate change scenarios. The two historically divergent mtDNA lineages (Clades I and II) might have originally corresponded to small-bodied (Clade I) and large-bodied (Clade II) birds. If these two clades had always been part of an interbreeding population, there should not be genetic differences between two clades from the same mtDNA genealogy. Based on differences in mismatch distributions (Fig. 7) and associated estimates of variability, these two clades likely represent once geographically and genetically independent lineages that retained the ability to interbreed. In my opinion there is no relevant calibration for a short section of mtDNA control region to determine the age at which these two clades last shared a common ancestor, but the degree of divergence (ca. 15%) is consistent with a Late Pleistocene, if not earlier, origin [30]. Niche models suggest a refugia for Clade II individuals in the southeastern portion of the range, and it would appear that these two clades were isolated as recently as the Last Glacial Maximum (Fig. 6). Post-glacial range expansion resulted in a pattern where members of each historical clade are now co-mingled over much of their range [1], owing to a northward spread of Clade II individuals, and an eastern expansion of clade I individuals. However, the low frequency of individuals bearing Clade I haplotypes in the northeastern part of the range (eastern Montana, Dakotas, northeastern Colorado) could mean that demographic equilibrium has not yet been reached. Alternatively, there could be an as yet unidentified adaptive reason for the nonrandom spatial distribution of haplotypes. Lastly, the potentially isolated refuge for Clade II individuals (Fig. 6B) might explain why current populations have relatively reduced levels of genetic variability.

Fig. (6). Map of niche models showing predicted distributions of greater sage-grouse at the A) present and B) Last Glacial Maximum (LGM; 21,000 ybp). Blackened circles show locality points used to develop climate niche model. The arrow on the right panel indicates a possible refugium for the Lyons-Mono population that is today genetically differentiated. This distribution of Clade II could correspond to populations today considered the Gunnison sage-grouse (Centrocercus minimus).
The projected LGM distribution (Fig. 6) indicates a southerly outpost of sage-grouse that might represent the current Lyon-Mono population. This population, which is more genetically differentiated from the rest of greater sage-grouse than greater sage-grouse is from the Gunnison sage-grouse (Centrocercus minimus), has been proposed as a distinct population segment [31]. However, despite the large number of unique alleles in the Lyon-Mono population, the level of genetic divergence is similar to that among other greater sage-grouse populations. The Lyon-Mono population has similar levels of variability relative to other populations, but not to the low extent found in the Columbia Basin populations (Tables 1, 3).

Thus, niche modeling suggests both stability (western) and range displacement (eastern) of greater sage-grouse over the past 120,000 years. They have survived the last glaciation and responded by shifting their ranges as climates ameliorated and associated vegetation was redistributed over western North America.

**Comparison of Molecular Markers**

Many authors have concluded that estimates of mtDNA variation and differentiation are insufficient to describe population variation or lineage divergence owing to stochasticity inherent in any single-locus [32, 33]. MitDNA has been used extensively over the past two decades in phylogeography and conservation genetics, and has been complemented by surveys of nuclear loci, either microsatellites or sequencing [34, 35]. In this study, mtDNA and microsatellites were available for the same 45 populations, and although the original authors [1] did not make explicit comparisons, it is noteworthy that the two markers gave similar estimates of levels of variation and population differentiation for data set I (Table 2) although less strongly for data set II (Table 4).

**CONCLUSION**

There is no clear evidence that the population genetic variability of the greater sage-grouse has been influenced by range reduction and fragmentation. The microsatellite data suggest that despite past population trends, there is no evidence of heightened inbreeding in smaller populations. Indeed, over deep evolutionary time, populations ebb and flow. Only in the case of the geographically isolated Columbia Basin populations is there a demonstrable effect of population declines and loss of genetic variability, but even in these populations there is no clear evidence of inbreeding. Because genetic variability is thought to be a proxy for population health, it does not appear that demographic declines have reached a point where genetic variation is affected in greater sage-grouse, with the exception of the Columbia Basin populations.

**CONFLICT OF INTEREST**

The authors confirm that this article content has no conflict of interest.

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**SUPPLEMENTARY MATERIALS**

Supplementary material is available on the publishers web site along with the published article.

**PATIENT’S CONSENT**

Declared none.

**REFERENCES**


Conservation Genetics and Demography of Greater Sage-Grouse


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Peer Review and Information Quality Breakdown in an Endangered Species Act Decision: The Case of the Greater Sage Grouse

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ABSTRACT
This paper discusses issues with the implementation of Information Quality Act guidelines in U.S. Endangered Species Act (ESA) listing decisions. These issues are illustrated by the key scientific paper and peer review processes that figured prominently in the decision to list the greater sage grouse (*Centrocercus urophasianus*) as "warranted" under the ESA as a threatened or endangered species in 13 states and provinces. We examine limitations of the data, errors and bias in the analyses and inferences based upon those analyses, and then explore why and how questionable data and analyses were used as the basis for such a far-reaching decision, even when independent peer review did not support the conclusions. We discuss policy implications and potential policy solutions, and how these checks and balances could reduce opportunities for various types of error and bias in the ESA decision-making process.
INTRODUCTION

The conservation of biodiversity is a worldwide concern, especially the conservation of threatened and endangered species and the habitats they depend upon. In the United States the protection of species threatened with potential extinction is provided by the Endangered Species Act (ESA) of 1973. The Act requires that the U.S. Fish and Wildlife Service (USFWS) make decisions to list species as threatened or endangered, "solely on the basis of the best scientific and commercial data available". The USFWS must determine whether a species, subspecies, or distinct population is likely to become threatened or in danger of extinction (endangered) in the reasonably foreseeable future, throughout all or a significant portion of its range. In making such decisions (and those that follow to aid the recovery of species), the USFWS is afforded substantial judicial deference in interpreting what constitutes best available scientific and commercial data, sometimes referred to as best available science (Hickey 2009). Although the ESA refers to data, the USFWS actually relies on published and unpublished studies, and professional opinion, rather than the underlying data. The USFWS assures the quality of the information which is used for its decisions by relying on the Information Quality Act (IQA), the bulletin (OMB 1999, 2002) implenting IQA, and the Department of Interior's Scientific Integrity policies (DOI 2011).

For many rare or declining species, there are only limited data available, and those data may be incomplete or inadequate for the purposes of assessing population numbers and trends. The problem is particularly acute in species that are not of commercial value. For example, data may have been collected over many years for other purposes and now applied to answer questions that were not originally anticipated. Or, the agencies monitoring the species may have been reluctant to change and adopt superior methods of data collection. Therefore, listing decisions and recovery actions may be made on the basis of limited or sub-optimal data, which can hinder the types of discriminating analyses and the inferences that can be drawn from them.

In other cases, underlying data used in studies may not be made public because agencies or researchers have withheld access to them. This may be because agencies or researchers consider the data proprietary, or they may not want to reveal the locations of endangered species. In either case, when data are not made public, it prevents independent reanalysis and review (Fischman and Meretsky 2001).

In this paper we explore these issues by examining the highly influential scientific paper by Garton et al. (2011), that figured prominently in the decision to list the greater sage grouse as "warranted but precluded" for threatened or endangered status under the ESA (USFWS 2010). We examine limitations of the data used by Garton et al. (2011), the analyses, inferences based upon those analyses, and then explore why and how such an important decision as an ESA listing could have been based on such questionable analyses of questionable data. This is of particular concern given that there was considerable independent peer review that did not support the conclusions of that analysis. We also discuss potential policy solutions to these shortcomings, and how these
checks and balances could benefit the conservation of species by reducing opportunities for various types of error in the research and decision making process.

SHORTCOMINGS OF THE APPLIED METHODOLOGY

The species in question, the greater sage grouse, is a large ground-nesting bird dependent upon sagebrush habitat in western North America. Each spring, sage grouse congregate at traditional sites (leks) where the males display in order to attract and mate with females. Thirteen states and provinces began counting the number of adult male sage grouse at prominent leks in the 1940's and 1950's as a potentially useful index of population size. Initially, male counts were made at a few large and easily located leks. Then, from 1965 to 2001, the number of counted leks increased approximately ten-fold. The data collection, however, continued to be a non-random sample of leks, but included no information on the number of leks that were not included in these counts.

Concern and repeated litigation over the status of sage grouse, and a desire to quantitatively estimate population sizes and trends, has motivated three different research groups to conduct analyses of male lek count data (Connelly et al. 2004; WAFWA 2008; Garton et al. 2011). The most recent and most ambitious of these studies, Garton et al. (2011), used 42 years of male lek count data (from 1965-2007) to estimate population trends, reconstruct estimates of past population sizes, and forecast population sizes and probabilities of persistence 30 and 100 years into the future, to 2037 and 2107 respectively.

The male lek count data used by Garton et al. (2011) and previous authors were collected by different states and provinces - some of which used different methods - and by many different individuals at thousands of locations. Data from different states and provinces were combined for analysis in Sage Grouse Management Zones (SMZs) and metapopulations. The authors claim that they carefully examined all data prior to analysis to ensure that they were obtained following appropriate procedures, but the authors also acknowledged that they "had to assume that the data were collected properly."

However, the number of cases where this assumption had to be made was not reported, nor did they report the number of leks that were deleted from the raw data.

After filtering the data, the analytical approach had multiple procedures:

(a) Male lek count data were used to develop annual estimates of the rate of change from the previous year to the present year for each lek with successive counts, and these were then averaged across each population.

(b) The reciprocal of those estimates was then used to back-calculate (reconstruct) breeding population sizes prior to 2007 (the terminal year in which the largest number of leks was counted). This effectively estimated how many male sage-grouse would have been counted in earlier years, if the maximum number of leks counted had been counted every year. A formula for estimating the compounding error of such a
procedure was applied to their reconstructed population data and 90 percent confidence intervals (CI) were reported.

(c) The reconstructed population sizes were then used to find "best fit" stochastic population models by considering 26 exponential and density-dependent growth models with varying numbers of parameters (including year, two time periods (1969-1987 and 1988-2007), and time lags). Model selection procedures were employed to evaluate models relative to each other. Additionally, the data were grouped in 5-year blocks, using averages and associated statistics for each block.

(d) The models developed in (c) were used for 30 and 100-year population forecasts as part of a population viability analysis (PVA). Extinction predictions were based on the proportion of replicate trajectories where the estimated effective population ($N_e$) sizes fell below 50 or 500, in which case populations were deemed "quasi-extinct."

Garton et al. (2011) reported that 44% of their models indicated declining carrying capacity through time, ranging from -1.8% to -11.6%. In other words, their results found that 56% of populations were stable, increasing, or had no significant trend. Also, 18% of the models incorporated lower carrying capacities from 1987 – 2007, compared to 1967-1987. Again, this could also be viewed as 72% of populations being stable, increasing, or having no significant trend. They also reported that 13% (3) of 24 populations for which they had sufficient data, had a high likelihood of declining below $N_e = 50$, and 54% (13) had a likelihood of declining below $N_e = 500$ within 30 years. On a 100-year time horizon, 75% of the populations and 29% of the SMZs were projected to decline below effective population sizes of 500. For 2007 they estimated a minimum of 88,816 male grouse. They assumed a ratio of 2.5 adult females per lekking male, yielding a minimum population estimate of 310,856 adult sage grouse. This number contrasts with an estimated population size of approximately 535,542 sage grouse, based on estimates provided by states and provinces (USFWS 2010).

The authors acknowledged the inherent inaccuracy of lek counts and several limitations of the data for inferring population abundance and trends, and conceded that they made no attempt to estimate true population abundance using lek counts. Yet, despite this caveat, Garton et al. (2011) subsequently used lek count data to create an index of historical abundance, population reconstructions, and probability of extinction forecasts for 30 and 100-year time horizons. They concluded by proposing that: "these forecasts will be useful in guiding decisions concerning the future of sage-grouse and the sagebrush communities upon which they depend."

Data limitations in the conservation of endangered species can lead to a policy dilemma analogous to the challenge of minimizing Type I and Type II statistical errors. Type I error occurs when conservation actions are based on an erroneous or exaggerated conclusion that a biologically meaningful and statistically valid risk threatens a species. Type II error may occur if conservation actions are not taken, based on the mistaken belief that little or no biologically meaningful and statistically valid risk threatens a species, when one actually does. Minimizing both types of error can be difficult, because
attempts to minimize one type of error can increase the probability of the other type of error.

In practice, the situation is more complex than this simple dichotomy for two reasons. First, Type I and II error scenarios assume that the basic data are sound, a condition that can be difficult to meet with endangered species. Because scientific uncertainty is anathema to government, scientists are encouraged to fill these information gaps as best they can with new analyses of existing data, or new data and analyses. Second, when one type of error is viewed as having more serious consequences than the other, the standard of proof becomes asymmetrical (MacCoun 1998). For the USFWS, one of the consequences of a decision that might result in a species decline (or extinction) is the threat of costly lawsuits brought by environmental groups. And once listed, the USFWS and other agencies have an additional consequence to consider: in 1978 the U.S. Supreme Court interpreted language of the ESA to conclude that “the value of endangered species is incalculable” and that a listed species must be protected “whatever the cost.” Such interpretations naturally lead to a precautionary approach and to increased potential for Type I error in listing decisions. Other errors, including errors of omission, selective interpretation, or confirmation bias (Nickerson 1998; Robertson 2009), may also contribute to either Type I or II error.

**Known issues with lek count data**

Numerous published papers have pointed out why male lek count data are unreliable and inappropriate for inferring population abundance and trends. These include: Jenni and Hartzler (1978), Emmons and Braun (1984), Walsh et al. (2004), Connelly and Schroeder (2007), Garton (2007), and Western Association of Fish and Wildlife Agencies (2008). There were also six publicly available peer reviews commissioned by the Colorado Division of Wildlife that specifically pointed out methodological issues with Garton et al. (2011). These include Conroy (2009), Noon (2009), Runge (2009), and three anonymous peer reviews (CDOW 2009). (Note: The version of Garton et al. that was reviewed in 2009 by Conroy, Noon, and Runge was the peer reviewed and accepted version that the USFWS relied upon in making its ESA listing decision in 2010 (Garton et al. 2009). The 2011 version of Garton et al. that we discuss here is virtually identical to the 2009 version, with just minor edits to text.)

Briefly, the issues identified by the authors and reviewers listed above include:

1) No demonstrated correspondence between male lek counts and actual population number or trends.
2) Data collection procedures were not standardized among states and sometimes varied within states over time.
3) Personnel monitoring leks and individual differences in methods and detection ability change over time, leading to *observer bias*.
4) Data sets from multiple states and provinces (i.e. data from two to six states) were combined for analysis of SMZs. (This problem is exacerbated by the fact...
that some states supplied data summaries while others provided raw lek count data.)

5) Data were not randomly collected by any state or province, and there are an unknown number of unsampled leks in each population. Therefore, it is impossible to know the extent to which sampling effort is representative of the distribution of sage grouse within populations or SMZs. This also affects the definition of dispersal distances which, in turn, are used to determine whether populations are isolated.

6) Only males were counted; there is no accounting for the number of females or juveniles in the populations sampled, their sightability, nor how these differ across different sagebrush habitats or decades.

7) The number of grouse counted at a lek depends upon the spatial definition of a lek: a more inclusive definition includes nearby satellite leks and results in a higher count, while a more restrictive definition results in more leks with fewer birds counted in each lek. Previous authors provided quantitative criteria for what constituted a lek. Connelly et al. (2004) considered all males within 2.5km of a lek to be part of that lek, while the Western Association of Fish and Wildlife Agencies (2008) used 0.5km as a cut-off. Garton et al. (2011) did not specify any cut-off distance.

8) A disregard for estimating the number of unknown leks makes it impossible to use male lek count data to estimate population number or trends.

9) A lek is not reported in databases until two or more male grouse are found using it. Consequently, counts at a lek start with a positive number and any lek that has become inactive or merged with another lek is followed by zero counts. This leads to negatively-biased trends.

10) The assumption that lek-attendance rates of adult male greater sage-grouse are high and constant is not supported by the data.

11) The number of sage grouse leks being counted has increased over time, but the non-random sampling of leks has not yet changed.

12) Small sample sizes and variation in sample sizes across years at each lek increases the statistical unreliability of reconstructed population estimates.

The low resolution of population reconstructions

Plots of population reconstructions and their 90% confidence intervals in the study by Garton et al. (2011) are so wide that no trend can be supported at that confidence level for many populations. (At 95%, the confidence intervals would be so wide that there would be nothing to discuss about the results.) The following illustrates the magnitude of the problem: First, the 90% CI for the Dakotas (Figure 2 in Garton et al. 2011): about 950 male sage grouse were estimated for 2005, but the 90% CI for 1968 was 400 - 9,250, thus a trend ranging between a 90% decrease and a 150% increase over that time period. Second, the east-central Idaho population, with only two leks counted in 1965-1969 and four leks in 2000-2007, had 90% CIs between zero and no upper limit across all years. Yet despite the enormous uncertainty surrounding these and other population reconstructions, Garton et al. (2011) were willing to make several remarkably precise
predictions about the future of some populations. For example, they stated that the Powder River Basin, Wyoming population "will fluctuate around carrying capacity which will decline from 3,042 males attending leks in 2007, to only 312 males attending leks in 2037, to going extinct with only two males attending leks in 2107 if this trend continues at the same rate in the future." That population had a 90% CI of 0 - 180,000 in 1968, 5,000 - 40,000 in 1987, and an estimate of about 8,000 in 2007.

Lack of accounting for error in population growth models and negative trend bias

It is important to recognize that the population growth models in Garton et al. (2011) were not fitted to observed lek count data but instead to reconstructed population estimates. These were calculated in such a way that the input and output variables share data, and therefore cannot be considered independent (i.e. the population reconstruction method depends upon quantities that appear on both the "prediction" and "predictor" side of the equation). One reviewer (Conroy 2009) reported that this resulted in "built in patterns" in the reconstructed population estimates, which in turn affected the population growth models and led to erroneous inferences. Similarly, one of the anonymous CDOW reviewers reported a negative trend bias when Garton et al's (2011) method was applied to simulated input data that deliberately had no trend. That reviewer reported that 34-40% of the simulated populations produced a statistically significant negative trend using Garton et al.'s (2011) methods. These reviewers also pointed out that sampling variation and statistical uncertainty from reconstructed population estimates were not carried over by Garton et al. (2011) into subsequent models of population growth and persistence.

These assessments are supported by results in Appendix 1 of Garton et al. (2011) where they list results for best models of their reconstructed population data: the 26 adjusted $r^2$ values range from 0 to 0.682, the highest of which is for a population with data for only 1996-2007, and the next closest value was 0.498, and average $r^2$ was only 0.257. This indicates that the models, on average, did not explain 75% of the variation in the data sets (i.e. low resolution).

The low statistical resolution of the reconstructed populations for which the models were developed suggests that a great deal of error accompanies the PVA forward projections. Similar to the issues with estimating population reconstructions in reverse time, errors will compound and grow exponentially. Garton et al. (2011) discuss this potential, but ultimately emphasize the literature that better supports their analyses. In reality, given the poor resolution of the reconstructed population data base and the growth models based upon it, the PVA projections incorporate a great deal of compounded error that renders projections at even 30 years meaningless. This leaves almost no clearly useful analytical results in what Garton et al. (2011) produced.

Mathematical error(s)
Garton et al's (2011) use of 20 males and 2.5 times that number of females to achieve an Ne of 50, is in error and should result in an Ne of 57.14 (using Wright's 1938 equation). Instead, only 17.5 breeding males would be needed for an Ne of 50 (assuming a ratio of 2.5 females per lekking male). Likewise, 175 males rather than 200 would be required for an Ne of 500. In other words, extinction risk was overestimated across all populations by setting the minimum number of breeding males higher than necessary for maintaining an Ne of 50 or 500. Although these differences may seem slight, they do establish different thresholds for generating extinction probabilities across all populations. (This was not a result of the formula error noted below.)

Garton et al. (2011) presented an incorrect equation for estimating effective population size: \( \text{Ne} = 1 / (1/N_m + 1/N_f) \), where \( N_m \) is number of breeding males and \( N_f \) is the number of breeding females in a population. The correct equation, from Wright (1938) is: \( \text{Ne} = 4N_mN_f/(N_m+N_f) \). The two equations would have been mathematically equivalent if Garton et al. (2011) had used a four instead of a one in the numerator. It is unknown whether this mistake carried over into the population viability analysis (in which case it would have overestimated extinction risk), or whether it was a typographical error in their paper. This question cannot be answered because the code and data used to perform the analysis are not publicly available.

Reliance on the 50/500 rule of thumb: an obsolete concept

The basic concept underlying minimum viable population size (MVP) and population viability analysis is that there must be some "minimum conditions for the long term persistence and adaptation of a species or population" (Soule 1987). An effective population size (Ne) of 50 was suggested as the minimum in the short term to limit the loss of heterozygosity through genetic drift and potential resultant inbreeding depression that could lead to a risk of population extinction (Soule 1980). An Ne of 500 was proposed as the minimum necessary to maintain the long-term adaptive potential of a population (Franklin 1980) based on a handful of studies of quantitative genetic variation in highly inbred lines of mice, maize and Drosophila (summarized by Lande 1976). None of those studies actually compared extinction risk with genetic variation or Ne.

Although the 50/500 rule of thumb is widely cited, field data, laboratory studies, and theory show that this rule of thumb is not a reliable predictor of extinction. Successful populations have been founded by few individuals, and populations with a much lower Ne than 50 have persisted long past when they should have gone extinct under the 50/500 rule of thumb (Krausman et al. 1993, 1996; Goodson 1994; Luikhart and Cornuet 1997; Wehausen 1999; Ramey et al. 2000; Frankham 2005). Criticism of the 50/500 rule of thumb was succinctly summarized by Boyce (1997): "Unfortunately, the 50/500 rule does not have a sound genetic or demographic basis. And there is no theoretical or empirical justification for basing MVP on an estimate of Ne... until such evidence becomes available, reliance on rules of thumb, such as the 50/500 rule is arbitrary and capricious."
In practical terms, the predictions of future sage grouse population sizes by Garton et al. (2011) are not falsifiable because they are simply probability statements about what might happen if environmental conditions are unchanged. While long-range predictions based on models are potentially useful heuristic tools, they are also notoriously inaccurate and can be easily over-applied (Pielke, Jr. and Conant 2003). Their lack of potential falsifiability effectively places decisions based upon them outside the realm of science.

**Hunting mortality: an error of omission in model development**

Garton et al. (2011) ignored the effects of sport hunting in their models, although it is the largest documented source of sage grouse mortality: 207,433 sage grouse harvested in the U.S. during 2001-2007 (Reese and Connelly 2011). We find it curious that Garton et al. (2011) ignored hunting mortality, while suggesting that other human activities must have reduced carrying capacity, specifically: expansion of cheatgrass and conifer woodlands, increased fire frequency, energy development, and spread of West Nile Virus.

If one accepts population estimates (88,816 male grouse in 2007 or a total population size of 310,856), then hunters removed 28,180 sage grouse or approximately 9 percent of the species in 2007 alone. In four of the six previous years, the take was even higher (up to 37,607 in 2006). These numbers do not include the number of grouse that were wounded and not recovered by hunters.

Regionally, the estimated percentage of sage grouse hunted may have been even higher in some years. For example, in 1992 an estimated 34,388 sage grouse were harvested by sport-hunters in Wyoming (Reese and Connelly 2011). Using the upper and lower 90% CI values of the estimated number of males in the Wyoming Basin SMZ and Powder River population in 2007 (and 2.5 adult females per male counted at leks), hunting loss would have amounted to 12 - 29% of the estimated adult population. This is the same SMZ where Garton et al. (2011) estimate a rate of decline between 3.4% and 10.5% annually. With this level of hunting mortality occurring annually, we question the assumption that there is no (additive) demographic effect (Gibson et al. 2011). The difficulty in establishing a link is in part due to the fact that sage grouse lek counts, the basis of hunting harvest, are not a reliable indicator of population number or trends (see discussion above). Clearly, more refined data and methods are needed to address this question.

**DISCUSSION**

Once a ESA listing is final, compliance is a costly endeavor. Compliance with regulations associated with listings usually involve a substantial allocation of conservation resources in order to be effective (Government Accountability Office 2006; Ferraro et al. 2007). Compliance can lead to secondary costs to local communities and regional economies (Wanger 2010), and is imposed with no regard to cost based on the...
Supreme Court's admonishment that ESA listed species must be protected "whatever the cost" (TVA v. HILL, 437 U.S. 153 (1978)).

Independent and detail-oriented peer reviews are important for prudent decision makers. Equally important is the availability of data and methods used to ensure the replicability of results and allow identification of errors, methodological biases, and potential for falsification of hypothesized population trends (Fischman and Meretsky 2001). This is recognized and required by IQA Guidelines issued by federal agencies. However, in the case of the greater sage grouse, the failure was not of the guidelines themselves, but of the agencies' failure to apply them.

In the case of the sage grouse decision, the question is: what were the checks and balances in the ESA listing process, and why did these fail to detect and filter out a study with numerous limitations, errors, and unfalsifiable predictions? We argue that the reason is largely due to reliance on an ineffective peer review process and acceptance of "scientific" information that has not been sufficiently scrutinized (e.g. due to data being withheld or reliance on population predictions with unreasonable margins of error).

Peer Review

Science is a human activity, therefore errors can and do occur, and peer review exists as a filter on information quality. However, there is no guarantee that papers being peer reviewed will be examined in depth, results replicated, or reviewer comments fully addressed and made public. Unless peer reviewers are provided the original data along with sufficient time and resources to adequately investigate the analyses, the reviewers are forced to assume that the data are sound.

Currently, the USFWS does not require that the data used in research that it cites be made publicly available, nor do they actively engage in or encourage replication of results in peer review. Since 2002 however, IQA guidelines set a higher standard for federal agencies, including the USFWS. They require that studies be reproducible and provide a rebuttable presumption that peer-review of the studies was adequate (OMB 2002). Additionally, the U.S. Department of Interior's information quality guidelines (US-DOI 2002) require that reproducibility "shall generally require sufficient transparency about data and methods that an independent reanalysis could be undertaken by a qualified member of the public." And USFWS (2007) guidelines state that, "higher levels of scrutiny are applied to influential scientific, financial or statistical information, which must adhere to a higher standard of quality." It is apparent that these requirements were not applied to their full extent by the USFWS in its consideration of Garton et al. (2011) because the raw data were unavailable, and valid criticisms of the data and methods made by reviewers outside of the production of this monograph series were clearly ignored by both the editors of the volume and the USFWS in its decision. This raises questions about the efficacy of the peer review process in the production of this highly influential paper, and with the peer review of the USFWS decision that cited the paper 62 times.

Exhibit E:
It also raises issues with the efficacy of the peer review of the recent USFWS and State-sponsored Conservation Objectives Team Report (COT 2013), which cited Garton et al. (2011) 61 times and based their population threats analyses, population definitions, current and projected numbers of males in each population, and probability of population persistence on Garton et al. (2011).

As long-time students of the ESA and peer reviewers of USFWS recovery plans and proposed rules, it has been our experience that peer reviewer and public comments on proposed rules are typically combined into broad categories, paraphrased, and summarized by the USFWS. Responses are then prepared to these summaries. Many valid criticisms and details are potentially lost in this process, diminishing the value of reviews and public comments. For example, valid issues raised in outside peer reviewer comments of Garton et al. (2011) were only discussed in a brief paragraph in the USFWS's "warranted but precluded" decision (USFWS 2010):

"We received these reviews and have reviewed them in the context of all other data we received in preparation of this finding. Their primary concern was about the applicability of analyzing and presenting future population projections in the manner done by Garton et al. (in press), based on the limitations of the data, the assumptions required, and uncertainty in the estimates of the model parameters. Garton et al. (in press) acknowledged these concerns, as several of the reviewers pointed out, and their analyses underwent peer review via the normal scientific process prior to acceptance for publication."

The last sentence of this summary also illustrates a key false assumption in the ESA decision-making process: that the "normal scientific peer review process" leading to publication is automatically a good filter on information quality. Empirical evidence and the collective experiences of many authors renders this assumption disputable (Mahoney 1977; Roy and Ashburn 2001; Hilborn 2006; McCook 2006; Sandström and Hällsten 2008; Casadevall and Fang 2009; Fang et al. 2012; and Ramey 2012). While traditional peer review is a useful tool, it is clearly an imperfect tool and applied with great variation. As a result, proposals have come forth on how to improve its effectiveness or adopt innovative alternatives (Weicher 2008; Suls and Martin 2009).

Despite variation in how peer-review is conducted, there are at least two well-justified standards that distinguish a rigorous peer-review process from a less than rigorous one. One is: required preparation of a detailed response to each of the peer review criticisms, and discussion of why the criticisms might not be considered valid and should be ignored. While the extent to which this occurred in production of the Studies in Avian Biology monograph (of which Garton et al. 2011 is one of 25 chapters) is unknown because reviews were confidential (itself a violation of the Information Quality Guidelines), the USFWS's response to outside peer reviewer's criticisms (see previous paragraph) is illustrative of a process that deviates from this standard.

The second standard is: the role of editorship and authorship need to be independent so that editors are not in a position to review and approve articles that they have authored. In
the case of Garton et al. (2011), one of the authors, J. Connelly, was also one of the two editors of the monograph that Garton et al. (2011) was published in. (Both editors were authors on multiple papers in this monograph.)

There is the need for greater accountability and a more comprehensive review process for highly influential scientific papers used in ESA listing decisions (and of the listing decisions themselves). However, it is questionable whether an additional round of peer review or the convening of expert panels would be adequate. An extensive social psychology literature points to the reasons why: even with intentions of neutrality, traditional peer review and expert panels may be unable to uncover the whole truth because of inherent cognitive and motivational mechanisms that contribute unintentionally to bias (e.g. strategy-based errors, confirmation bias, or majority amplification; see MacCoun 1998 for an extensive review).

**Better access to data**

In an ideal world, all of the data used to develop a highly influential scientific paper would be publicly available to allow for independent replication and ensure the potential for falsifiability. Therefore, it is worth asking: why is this not the case with Garton et al. (2011) and many similar, highly influential papers, especially given that "The [sage grouse] monograph is recognized by the USFWS and the Court as the primary source of science for the new review and listing determination." (USGS 2009b).

Until such time that underlying data of highly influential studies used in ESA decisions are mandated to be publicly available, few options exist to gain access to these data. While the option to obtain data under FOIA from federal agencies is available, and has been used for replication and publication of analyses (e.g. Turner et al. 2004, 2006), federal agencies must possess the data if they are to be obtained under FOIA. However, the little known OMB Circular A-110 provides a second option for public access to data under FOIA when studies are federally grant-funded (OMB 1999):

"(d) (1) In addition, in response to a Freedom of Information Act (FOIA) request for research data relating to published research findings produced under an award that were used by the Federal Government in developing an agency action that has the force and effect of law, the Federal awarding agency shall request, and the recipient shall provide, within a reasonable time, the research data so that they can be made available to the public through the procedures established under the FOIA."

Procedures are well established, as some agencies (such as the National Institute of Health) are familiar with the responsibilities of granting agencies and awardees. To our knowledge, no data requests under A-110 have yet been submitted to the USFWS.

A third potential remedy exists in the form of "requests for correction" under the IQA. This administrative procedure only allows for suggested corrections to the record and does not provide legal remedy should an agency fail to correct or provide information.
The remedy of last resort, costly and time consuming for all involved, but comprehensive in its potential depth, is the power of subpoena.

From our viewpoint, these remedies should not be necessary. It is in the best interests of biodiversity conservation, responsible agencies, and researchers, to provide ready access to data used in scientific papers and key decisions, either online or in publicly accessible archives.

CONCLUSIONS

It is our view that a scientifically critical review of the study by Garton et al. (2011) on greater sage grouse would have concluded that there was no scientific basis for a "warranted" decision (for a ESA threatened listing) because of fundamental problems with the available data as well as with the analyses. Instead, the decision should have called for development of better data collection, with the goal of revisiting the issue in 5 years, when the relationship of lek counts to actual population data might be better understood, or a probability-based census method implemented. This would have minimized Type I error without increasing Type II error.

We acknowledge that multiple studies have presented documentation of the loss of sagebrush in the western U.S. and Canada (i.e. Miller and Rose 1999; Schroeder et al. 2004), however, the extent to which this loss of habitat translates into loss of sage grouse, is not certain. Therefore, the policy-relevant questions about sage grouse should be: 1) are populations in decline; 2) if so, where; 3) why has it occurred; and 4) what can be done to insure the stability of these populations? In order to address these questions, reliable data on population numbers and trends are needed. Those data are currently lacking.

To their credit, Garton et al. (2011) called for establishment of range-wide, standardized methodologies based on probability sampling of leks, breeding males, and females, that would allow for more meaningful population analyses in the future (e.g. sentinel-lek and dual-frame sampling methods). Walsh et al. (2010) have recently proposed the application of mark–resight methods to estimate population size in sage grouse and other lekking species.

From our assessment, the data collected for more than 50 years by thirteen states and provinces are inadequate to answer the above questions regardless of the analysis applied. Repeated calls to reform this weak and outdated methodology, whose limitations have been clearly documented here and elsewhere, have not yet moved agencies into reforming their "business as usual" approach to counting male sage grouse on leks each spring. This puts the overall management of this species on a shaky database and will continue to hinder effective management until more biologically relevant and statistically defensible census methods are adopted.
The issues and potential solutions identified here also apply to the ESA listing of species outside of the U.S. (an increasing trend) and more broadly to endangered species laws of other nations (e.g. Australia’s Environment Protection and Biodiversity Conservation Act of 1999, Canada’s Species at Risk Act of 2002, and South Africa’s National Environmental Management: Biodiversity Act of 2004), as well as international treaties (e.g. the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) of 1973). Failure to implement changes will result in failure to adequately protect species that are truly at risk of extinction.
References


Exhibit E:


Krausman, P. R., Etchberger, R. C., Lee, R. M. Persistence of mountain sheep populations in Arizona. Southwestern Naturalist. 41: 399-402; 1996.


Exhibit E:

OMB (Office of Management and Budget). Guidelines for ensuring and maximizing the quality, objectivity, utility, and integrity of information disseminated by federal agencies. Final Guidelines; 2002.


Exhibit E:


Exhibit F:

Statements made by the Service in the 2010 listing decision, based upon Garton 2009, pers. comm., are both factually incorrect and misleading.

In the Service's 2010 listing decision on the greater sage grouse, the following statement is made: "Population stability may also be compromised if cycles in sage-grouse populations are lost, which current analyses suggest, minimizing the opportunities for population recovery if habitat were available (Garton 2009, pers. comm.)."¹ This statement is key significance to the listing decision because it cites unspecified analyses that suggest sage grouse population fluctuations have been lost and that this loss can compromise population stability. However, there are no data or analyses attributable to Garton to support these statements and these statements are wrong. The reasons are detailed below.

As an initial matter, information is attributed to E.O. Garton of the University of Idaho. Garton and coauthors published the paper on sage grouse population trends and extinction probabilities that was cited 62 times in the listing decision. However, the publicly available record reveals that neither Garton, nor he and his coauthors (Garton et al. 2009, 2011), ever conducted or reported on analyses to test for the loss of population cycles in sage grouse. Nor did he/they test the role that a loss of population cycles could have on population stability. And finally, neither did Garton and coauthors test for the effects of oil and gas on sage grouse.

Second, the publicly available lek count data from states show that sage grouse population cycles have not been lost. Instead, lek counts, even in areas of oil and gas development, show a pattern of synchronous cycling (Wyoming Game and Fish 2012). Additionally, several published research papers and recently released analyses have shown that sage grouse population cycles are present and are driven by regional variation in climate but not specifically drought (please refer to the attached review on sage grouse population fluctuations). Garton et al. (2009, 2011) did not include any analysis of population cycles, or their potential drivers, into their population reconstructions, statistical analyses, or population persistence models.

Third, according to the 2010 listing decision, this Personal Communication suggests that population cycles were lost due to oil and gas development. However, Garton and Garton et al. (2009, 2011) did not analyze the potential effects of oil and gas development on sage grouse population trends. Furthermore, there are no published studies that have shown that oil and gas development has affected sage grouse population cycles.

Fourth, it is unconscionable that Service would rely on a document in support of

¹ The cited personal communication is listed in the Literature Cited for the 2010 listing decision as: "Telephone interview. Dr. Oz Garton, Professor, University of Idaho, in Moscow, ID (December 18, 2009)."
scientific statements that appears to be an indecipherable scrawl written in incomplete sentences, with an utter lack of detail and references. A copy of Garton 2009, pers. comm. is attached. The text of that personal communication reads as follows (uncertain text is indicated with a question mark):

Oz Garton's
Pers. comm. 12/18/09
long-term data shows major fluctuations
related to pred[?], age of development
drought is most imp[ortant ?] - assoc. in big fluctuations
cycles have vanished [underscored twice]
peaks are gone
as result of O&G fire
Oz's data show time delay vscale[?]
[down] 3-5% [?] year -real trend
[?] result of [?] factors

Therefore, the statements made by the Service in the 2010 listing decision, based upon Garton 2009, pers. comm., are both factually incorrect and misleading.
long-term data shows major fluctuations
related to age, development

spring is most nip-ass by big fluctuations
grapes have vanished

6 peaks are gone.

As result of aging fire

Oj's data shows time change
1-3 years seem real trend
to result of hypothesi