REPORT IN RESPONSE TO SECRETARIAL ORDER 3353
August 4, 2017

I. EXECUTIVE SUMMARY

This report responds to Secretarial Order 3353, "Greater Sage-Grouse Conservation and Cooperation with Western States" (June 7, 2017) (the Order). In response to the Order, the Department of the Interior (DOI) appointed a DOI Sage-Grouse Review Team (DOI Team)[1] to address the elements of the order and produce a report. In developing the report and recommendations, the DOI Team sought input from the Eleven Western States[2] identified in the Order and coordinated with the U.S. Department of Agriculture Forest Service (USFS). The DOI Team respectfully requests the Secretary to direct the appropriate DOI bureaus to implement the recommendations and periodically report outcomes to the Deputy Secretary.

Together, the DOI Team, and managers and staff from the Bureau of Land Management (BLM), U.S. Fish and Wildlife Service (FWS), and U.S. Geological Survey (USGS), and the Sage-Grouse Task Force (SGTF)—made up of representatives of the Governors of each of the Eleven States—identified issues, options to address those issues, and next steps to implement the Order. The DOI Team and the SGTF are committed to a balanced approach that provides both responsible economic development and long term conservation of the Greater Sage-Grouse (GRSG)[3]. This commitment includes an interest by most States in retaining the 2015 GRSG Plans—using policy and clarifications initially to better align them with State plans and programs and to meet the purposes of the Order, while continuing joint engagement to further define consideration of potential targeted plan amendments. The Federal agencies and States are also committed to continue to work with partners to prioritize staff and funding to implement on-the-ground actions to conserve and restore GRSG habitat.

The DOI Team and the SGTF affirm that the issues and options identified in this report do not apply to each State, are not consensus opinions from all States, and are not "one size fits all." Pertinent issues and associated solutions should be tailored to each State's needs while ensuring conservation of the species. Whenever possible, the options identified by the DOI Team provide near-term opportunities to resolve concerns and issues and achieve the purpose of the Order, including development of policies, clarification, memoranda of understanding (MOUs), and training, many of which can be completed within 6 months (see Section IV and Appendix A). The DOI Team also identified longer term options, including potential plan amendments, which would be completed in accordance with applicable laws and policies (see Section IV and Appendix A).

---

[1] The DOI Team consists of co-leads Kathleen Benedetto, Special Assistant to the Secretary - BLM; John Ruhs, BLM Deputy Director of Operations; Casey Hammond, Special Assistant to the Secretary - Fish, Wildlife, and Parks; Gregory Sheehan, FWS Deputy Director; Anne Kinsinger, USGS Associate Director for Ecosystems; Cynthia Moses-Nedd, DOI Liaison to State and Local Government; Timothy Williams, DOI Deputy Director of External Affairs; Amanda Kaster, Advisor to the Secretary; and Vincent DeVito, Energy Counselor to the Secretary.

[2] The Eleven States are California, Colorado, Idaho, Montana, Nevada, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming.

[3] It should be noted that the States of Idaho and Utah have pending challenges to the 2015 Sage-Grouse Plans. While these States participated in identifying issues related to the Federal plans, these States do not waive or concede any of their legal arguments. The Nevada Attorney General also filed suit and does not waive or concede Nevada's legal arguments. Similarly, the federal agencies do not waive or concede any of their legal arguments.

This report recommends continued collaboration with the States, including both through the SGTF and between each Governor's office and the respective Bureau of Land Management (BLM) State Director and USFS Regional Forester, as well as key BLM and USFS national-level Directors. This report also recommends engagement on the issues and options identified in this report with Congressional delegations, counties, local governments, and tribes, as well as with ranchers, industry, conservation groups, and other stakeholders. This additional engagement would be used to refine the options and develop a plan for prioritized implementation of the options in this report.

The review conducted in response to the Order identified many opportunities, summarized in this report, to clarify the BLM's management under the 2015 GRSG Plans. Clarifications, policies, agreements, or training could: (1) address issues related to habitat assessment and monitoring, including the Habitat Assessment Framework, and grazing management; (2) take advantage of flexibility in the 2015 GRSG Plans to support energy, mineral, and other development; (3) increase consistency between the BLM and States on density and disturbance caps and mitigation; and (4) in some cases, allow adjustments to habitat boundaries and address issues with adaptive management.

The review also identified longer term options to consider some issues through a potential plan amendment process. This report recommends further investigation of potential plan amendments, including considering what combination of potential plan amendments would best balance continuing to conserve the GRSG and its habitat and supporting economic development, and whether to consider State-by-State or range-wide amendments. Potential plan amendments could be considered in some States to remove or modify sagebrush focal area (SFA) designations; address adjustments to habitat management boundaries; adjust responses to reaching adaptive management triggers; evaluate the compensatory mitigation standard; and provide additional flexibility in resource development.

The report identifies opportunities to improve coordination on fire, fuels, and invasive species management develop MOUs, increase data sharing, initiate new research, and incorporate new information into plan implementation. The report also includes recommendations on captive breeding, translocations, predator control, and setting population targets.

II. BACKGROUND

The GRSG is a State-managed species throughout its range with approximately half of its habitat managed by the BLM and USFS. State-led efforts to conserve the species and its habitat date back to the 1950s. For the past two decades, State wildlife agencies, Federal agencies, and many others in the range of the species have been coordinating efforts to conserve GRSG and its habitat.

In 2010, the U.S. Fish and Wildlife Service (FWS) found that the GRSG was warranted for listing under the Endangered Species Act (ESA) but precluded from listing due to other species with higher listing priority. In the 2010 finding, the FWS identified habitat loss and fragmentation and lack of regulatory mechanisms as the primary threats. In 2012, the FWS, in collaboration with the States, led an effort to identify conservation objectives for GRSG and its

habitat. The Conservation Objectives Team report, released in 2013, identified objectives for 14 potential threats to the GRSG including: fire, nonnative invasive plants, energy development, sagebrush removal, improper grazing, range management structures, wild horses and burros, pinyon-juniper expansion, agricultural conversion, mining, recreation, urbanization, infrastructure, and fences.

The BLM and USFS initiated land use planning processes to provide regulatory certainty in addressing the threats of habitat loss and fragmentation on Federal lands to conserve the GRSG and its habitat, avoid further population declines, and avoid the need to list under the ESA. Early in the process, the BLM and USFS collaborated with the States to pursue State-by-State land use planning. These State-by-State approaches were supplemented with range-wide decisions to increase consistency between the 2015 GRSG Plans and to respond to the issues addressed in the FWS's 2010 listing determination. Several States identified instances in which they did not believe the final approved BLM 2015 GRSG Plan was consistent with the applicable State plan, particularly with regard to range-wide decisions. There were also concerns that the records of decision and final approved 2015 GRSG Plans included decisions from alternatives other than proposed alternative (as described in the proposed plans and final environmental impact statements) and therefore differed from the State's expectations based on the collaborative planning efforts.

In September 2015, the BLM and the USFS adopted amendments and revisions to 98 land use plans (2015 GRSG Plans) across the ten[4] Western States addressing, in part, GRSG and its habitat. In September 2016, the BLM issued seven instruction memoranda (IMs; IMs 2016-139 through 2016-145) to provide guidance on certain elements of the 2015 GRSG Plans.

In October 2015, relying upon the conservation commitments and progress reflected in the 2015 GRSG Plans and other private, State, and Federal conservation efforts, the FWS published its determination that the GRSG did not warrant listing under the ESA. In making that finding, the FWS determined the 2015 GRSG Plans provided certain and effective measures for conservation of the species. The FWS also committed to work with State and Federal partners to conduct a GRSG status review in 5 years to determine if plan implementation was indeed conserving the GRSG and its habitat.

The BLM, USFS, Natural Resources Conservation Service (NRCS), FWS, State agencies, and other partners have been working collaboratively, to the extent practicable, to implement the Federal and State plans to conserve GRSG and its habitat. A particular focus has been placed on an all-lands approach, encompassing Federal, State, and private lands, to achieve habitat restoration, fire control, and fuels management. Through these efforts, hundreds of thousands of acres of sagebrush rangelands have been restored or are on their way to being restored.

III. PROCESS UTILIZED FOR REVIEW

In June 2017, the Acting BLM Director, the DOI Team, and DOI staff met with the SGTF to discuss the Order and establish a process for State input on the items identified in the Order. The

[4] While Washington is included in the review for the Order, the majority of the State was not part of the 2015 GRSG Plans. A BLM land use plan that will include GRSG conservation for the Spokane District in Washington is currently under development.

BLM, FWS, and USGS managers and staff also began working with each State to gather information related to the Order, including State-specific issues and potential options for actions with respect to the 2015 GRSG Plans and IMs to identify opportunities to promote consistency with State plans. The SGTF developed an initial list of issues and refined those issues and options on a State-by-State basis while working with the respective BLM State Directors. In July 2017, the Federal agencies and the SGTF met twice to further refine and validate the issues and options presented in this report.

The following actions were also completed to address specific sections of the Order:

- Section 4b(i), (iii), and (iv) of the Order: Each BLM State Director worked with their Governor's office(s) to review State plans and programs and the 2015 GRSG Plans.
- Section 4b(ii): DOI staff worked with the SGTF and individual Governor's offices to further examine invasive species and wildland fire issues.
- Section 4b(v): The Western Association of Fish and Wildlife Agencies (WAFWA) developed and submitted to the SGTF white papers on each of the topics described in this provision of the Order.
- DOI staff also worked with the SGTF and the individual Governor's offices to gather further information on data and science.

In these reviews, the need for MOUs and other agreements and training, as called for in Section 4a of the Order, and cooperative management and collaborative partnerships, as called for in Section 5c of the Order were also considered. These individual reviews were then rolled-up for further discussion with the SGTF and the DOI Team and staff. Based on these reviews, the SGTF and DOI Team identified issues, potential options, and next steps to include in this report in response to Section 5d of the Order.

IV. RECOMMENDATIONS

This section provides an overview of the issues identified and potential options to address those issues (see Appendix A), as well as recommendations on the topics of wildland fire and invasive species, wildlife management, and data and science (see Appendices B through D). Appendix E contains other issues identified that are not directly related to the 2015 GRSG Plans and that are not addressed in this report but may warrant further coordination between the BLM and the States. Appendix F contains white papers developed by WAFWA related to wildlife topics.

In regard to Washington, a new BLM land use plan for the Spokane District has not yet been issued. Based on the Order and the recommendations included in this report for the 2015 GRSG Plans, Washington and the BLM will review the BLM's preliminary draft plan to identify any further opportunities to increase compatibility with the State plan, address the elements of the Order, and consider issues and options included in this report. The BLM will work to issue the Spokane District draft plan for public comment as soon as practicable after this review is complete.

In discussions with the SGTF, there is general consensus that all partners are committed to effective and durable measures to provide for the conservation of GRSG to ensure there is no need to list GRSG under the ESA in the future. There is agreement that monitoring and reporting on conservation actions, habitat condition and trends, and economic development are essential.

Such monitoring is key to demonstrate the effectiveness of State and Federal GRSG Plans in addressing the threats, including habitat fragmentation, invasive species, and fire, as well as support for local economic opportunities and development.

This report includes short and long term approaches to address issues of concern through policy, clarification, and training (short term), as well as investigating potential targeted plan amendments (long term). Certain options are prioritized for further work to begin immediately, including: identifying options to incorporate updated habitat boundaries into habitat management areas; clarifying mechanisms to modify waivers, exceptions, and modifications in priority habitat management areas (PHMAs); modifying the fluid mineral lease prioritization policy; issuing or modifying policy and providing training on use of the habitat objectives tables from the 2015 GRSG Plans; identifying options for addressing hard trigger responses when applying adaptive management decisions; and researching the ability to streamline authorizations for activities with little or no impact on GRSG.

a. 2015 GRSG Plans and Policies (Addressing Sections 4b(i), (iii), and (iv) and 4a of the Order)

i. *Fluid Minerals (Stipulations, Waivers, Exceptions, Modifications, Leasing Prioritization) and Density and Disturbance*

There are multiple opportunities to be responsive to the Executive Order on "Promoting Energy Independence and Economic Growth" and the Secretarial Order on "American Energy Independence," while continuing a robust commitment to the conservation of GRSG. A cooperative DOI and State effort can provide the flexibility for responsible economic growth and at the same time ensure conservation of GRSG habitat.

The areas of leasing prioritization and the PHMA stipulation's waiver, exception, and modification language are suggested issues of focus for the BLM subsequent to the submittal of this report. Leasing prioritization options include policy clarification while developing the approach to revise IMs for leasing prioritization either nationally or State-by-State. For waiver, exception, and modification language for PHMA stipulations, options include investigating opportunities to provide additional waivers, modifications, and exceptions through policy or potential plan amendments, while adequately addressing the threats in the area, avoiding habitat loss or fragmentation, and ensuring effective and durable conservation, while providing for economic development.

For general habitat management areas (GHMAs), stipulations identified vary on a State-by-State basis. Options include developing State-specific policy or training to explain how to use existing flexibility or considering alternative stipulations.

For SFAs, longer term options include considering potential plan amendment(s) to modify or remove SFA fluid minerals stipulations.

The 2015 GRSG Plans define processes for calculating the amount of surface disturbance and the density of energy and mining facilities. The 2015 GRSG Plans recognized State processes, if they were in place prior to the plans being approved and if the data could be accessed to meet reporting requirements for density of development and acres disturbed

and reclaimed. Some States have developed or are in the process of developing new tools for density and disturbance calculations. For some States, there may be differences between the State plans and the 2015 GRSG Plans in the list of disturbances to count and the appropriate scale (project and biologically significant unit) where the disturbance and density caps should apply. Options include the BLM and the States identifying State-specific inconsistencies and evaluating the various processes and tools for (1) consistency between Federal and State approaches for calculating the amount of surface disturbance and the density of energy and mining facilities, (2) adequacy to conserve GRSG, and (3) the ability to report on disturbance associated with uses, as well as restoration actions that result in achieving conservation of the habitat.

ii. ***Mitigation and Net Conservation Gain***

There are concerns that the mitigation requirements in the 2015 GRSG Plans (including the net conservation gain standard and the need for a clear definition of that standard) may differ from requirements in some of the State plans. The States prefer consistency between State mitigation standards and the BLM mitigation standard and a definition that encompasses the various standards the States have adopted. The DOI is currently reviewing its mitigation policies and may issue revised policy, including consideration of various mitigation standards, such as one-to-one ratio, equivalent value, no net loss, or other standards. It was recognized during the review that if the States have permitting authority that includes compensatory mitigation requirements, applicants for uses on public lands may need to meet both State and Federal compensatory mitigation requirements. The DOI Team and the SGTF agree that consistent application of the mitigation hierarchy (avoid, minimize, and compensate), including compensatory mitigation standards and other requirements between State and Federal plans, policies, and procedures, is desirable. Additional coordination on the approach to mitigation and standards is a priority.

In 2015, the SGTF formed the Sage-Grouse Mitigation Workgroup to develop a report to provide for greater certainty of implementing mitigation across the range. The report, "Greater Sage-Grouse Compensatory Mitigation," was delivered to the SGTF in December 2016. The report identifies the key principles for successful compensatory mitigation efforts. This report may be helpful to further coordinate on mitigation. States have demonstrated, or are confident that as their mechanism(s) become available, that their mitigation approaches are or will be adequate to meet the principles in this mitigation framework while supporting economic development. States have indicated that compensatory mitigation to offset unavoidable impacts is an important tool, in addition to restrictions associated with avoid and minimize, to provide increased flexibility and options to authorize development and provide adequate conservation of the habitat.

In the short term, options identified to address concerns related to mitigation include defining "net conservation gain" and developing policy and MOUs with the States to ensure compensatory mitigation is commensurate with the project-specific residual impacts and coordinate and clarify options for use of each State's approach when applying mitigation, including meeting the net conservation gain standard. Longer term options could include a potential plan amendment to consider changes to the Federal

compensatory mitigation standard. Options to consider could include investigating using the State standards; setting a Federal standard as a minimum and using the State standards if they are equal or higher than the Federal standard; or using the Federal standard on public land and the State standard on private or State lands.

iii. ***Habitat Assessment, Habitat Objectives Tables, and Effectiveness Monitoring***

The SGTF and DOI Team discussed issues relating to confusion on the use and inconsistent application of the Habitat Assessment Framework (HAF); Assessment, Inventory, and Monitoring (AIM) data; other data; and the habitat objectives table that is included in each of the 2015 GRSG Plans. Clarifications on how information is collected and used will improve the way the BLM evaluates GRSG habitat and applies the data and habitat objectives tables to management decisions on public lands.

In the short term, options include providing additional training to field staff and partners on the use of HAF, AIM, other monitoring data, habitat objectives, and other tools and methods; revising the policies on habitat assessment and effectiveness monitoring as needed to clarify their use; and issuing new policy explaining how to use habitat objectives. Other short term options include investigating tools and methods to streamline gathering and reporting on habitats in good condition and focusing increased attention and time on degraded habitats or habitats at risk. In the longer term, new science and information may result in considering a potential plan amendment to revise the habitat objectives tables in the 2015 GRSG Plans to reflect best available science.

iv. ***Adaptive Management***

The SGTF and DOI Team identified two main issues: (1) responses instituted to respond to tripping a hard trigger prior to causal factor analysis may not address the threat identified in the analysis; and (2) the inability to revert to previous management when conditions improve after tripping and responding to a trigger.

In the short term, an option is to develop policy to clarify the implementation of the adaptive management process, including conducting causal analysis when either a soft or hard trigger is reached. However, most concerns with adaptive management can likely not be addressed through policy. Long term options include potential plan amendments to consider (1) removing automatic hard trigger management responses when population or habitat recovers above the original condition (the condition prior to a trigger being reached), and more restrictive hard trigger management responses are no longer required to conserve the GRSG or its habitat; and (2) providing flexibility to identify appropriate management responses based on a causal analysis when a hard trigger is reached, while still ensuring a rapid response to catastrophic population or habitat losses.

v. ***Livestock Grazing***

The SGTF and the DOI Team recognize that improper grazing is a threat to the conservation of GRSG, while proper grazing management is compatible with conserving GRSG habitat and, in some situations, may support or benefit habitat management. There is a perception of undue emphasis on livestock grazing in general, instead of a focus on

improper grazing. Issues include how to prioritize and process grazing permits and monitoring actions and provide additional flexibility in applying management appropriate to on-the-ground conditions at the BLM field office level.

In the short term, options include revising policy to: incorporate guidance on how to prioritize and complete grazing permit renewal and to emphasize where there are known impacts to GRSG habitat; clarify that habitat objectives are not used directly in permit renewal but instead are used to help inform land health (see Section IV(a)(iii) of this report); and clarify that thresholds and responses can vary in different habitat types. Additional short term options include developing a more collaborative approach with grazing permittees and other stakeholders and providing training to field staff and partners to ensure policy and existing procedures are correctly applied. Policies and training should clarify that proper livestock grazing is compatible with GRSG habitat and, in some cases, may be used to address threats to GRSG (e.g., controlling invasive exotic annual grass species). In addition, the BLM will continue to pursue (1) targeted grazing pilot projects to investigate the use of grazing to address excessive fuels and create strategic fuels breaks and (2) outcome-based grazing demonstration projects to investigate the use of flexible grazing permits to respond effectively to changing conditions while helping to improve habitat.

vi. ***Other Minerals, Energy, and Lands (e.g., rights-of-way)***

These discussions centered on four distinct topics: (1) concerns that broad exclusions and closure areas may not address the uses and associated threats to GRSG in a PHMA; (2) a need to clarify how to evaluate proposed actions in an avoidance area; (3) available flexibility on application of required design features (RDFs); and (4) lack of clarity on the application and size of lek buffers. The discussions varied according to the needs of each State, as there are complexities created by the various land ownership patterns (e.g., consolidated Federal ownership vs. scattered Federal ownership).

Options include evaluating each State's approach to identify how it differs from each 2015 GRSG Plan and to consider whether the State's mechanism, including compensatory mitigation, could adequately address the threats in the area, avoid habitat loss or fragmentation, and ensure effective and durable conservation, while providing for economic development. For example, if gravel pits are in an area closed to that use, and the State's mechanisms for managing gravel pits, including compensatory mitigation, may provide equivalent assurance for conservation of the species and its habitat, then this topic should be further investigated.

The topics of how to implement land use authorizations in avoidance areas, the application of RDFs, and the use of lek buffers all share the need for additional clarity or training, including sharing lessons learned across jurisdictional boundaries. In the short term, options include providing clarifications and policy on how to evaluate proposed uses in avoidance areas and how to use existing flexibility in applying RDFs and buffers. This includes the consideration of State-proposed RDFs or buffers, as well as local conditions and other factors. The DOI Team also recommends additional research to (1)

evaluate appropriate buffers for different uses and the effectiveness of various RDFs and (2) incorporation of new science into plan implementation as it becomes available.

vii. ***Habitat Boundaries - Sagebrush Focal Areas and Habitat Management Areas***
Concerns were identified with: (1) whether SFA designations and their associated decisions are necessary in some States or if underlying allocations (PHMAs, Important Habitat Management Areas, GHMAs, or others) and associated decisions are adequate to meet GRSG conservation, including effectiveness and durability; and (2) the BLM's ability to adjust habitat management area boundaries and associated decisions to incorporate revised habitat mapping by States. States regularly refine habitat maps delineating GHMAs and PHMAs through on-the-ground verification and incorporation of new information, and the concern was expressed that the 2015 GRSG Plans may not provide the flexibility to incorporate these updates.

In the short term, options include investigating each 2015 GRSG Plan to determine if there is flexibility to adopt revised habitat maps from the States to adjust habitat management area boundaries and develop a process and criteria for evaluating and adopting future habitat mapping corrections, which may include considering potential plan amendments in some States. In the long term, options include potential plan amendments to evaluate the need to remove or modify SFAs allocations in some States, including whether to retain, modify, or remove associated SFA management actions to achieve effective and durable GRSG conservation.

b. Wildland Fire and Invasive Species (Addressing Sections 4b(ii) and 4a of the Order)

Pursuant to the Order, the DOI Team examined the "Integrated Rangeland Fire Management Strategy" (IRFMS) to identify issues associated with preventing and controlling the proliferation of invasive grasses and wildland fire, including seeking feedback from States. Recommended additional steps are outlined in Appendix B.

The IRFMS provides a comprehensive approach to reduce the size, severity, and cost of rangeland fires, address the spread of cheatgrass and other invasive species that exacerbate the threat of fire, position fire management resources for more effective rangeland fire response, and restore burned rangelands to healthy landscapes. Feedback from the States and WAFWA demonstrated a strong history of Federal and State collaboration surrounding the goals and actions in the IRFMS.

The following recommendations will further enhance the implementation of the IRFMS:

- Continue to complete action items from the IRFMS; support ongoing State-led efforts, including the WAFWA "Sagebrush Conservation Strategy" and the Western Association of State Departments of Agriculture (WASDA) "Western Invasive Weed Action Plan"; implement the "National Seed Strategy for Rehabilitation and Restoration"; and implement action items from the Western Governors Association National Forest and Rangeland Management Initiative.
- Increase collaboration and outreach, including support for the SageWest communications initiative, joint prioritization and funding of projects, support for rangeland fire protection associations (RFPAs) and rural fire departments (RFDs),

establishment of wildfire protection agreements, and support for the "National Cohesive Wildland Fire Management Strategy."

- Conduct research and field trials to further streamline and increase success in restoration and fuels management activities, including pursuing new biocides and herbicides, accelerating Environmental Protection Agency registration and land management agency use of new tools, and investigation and use of targeted grazing.
- Work with the DOI and Congress to reinstate authorities to provide equipment to State and local cooperators for firefighting.
- Enhance multijurisdictional funding of projects on public and private lands and commit to multiyear funding of projects to increase likelihood of success.
- Complete risk-based budget allocation adjustments in the DOI to ensure fire and fuels funding is allocated to high-risk/high-value areas, including increasing the BLM's fire and fuels budget to be in line with identified fire risk to public lands.

c. Wildlife Management (Addressing Sections 4b(v) and 4a of the Order and Other Requests by the DOI Team)

As a State trust species, individual States exercise their authority to manage and conserve GRSG according to their own laws and policies. In response to the Order, the WAFWA developed four technical white papers (Appendix F) to summarize the current scientific literature and management experience on the issues of: (1) captive breeding, (2) population objectives, (3) predator control, and (4) hunting. As recognized by the Order, it is the prerogative of each individual State to conserve and manage State trust species and, thus, to determine whether a Statewide population target is appropriate and whether any of these management tools should be implemented within the respective States. In support of setting population targets, the DOI Team recommends support for developing tools and techniques to estimate and set population objectives, including (1) a State/Federal/academic partnership that is working to develop and refine techniques to better estimate range-wide populations over the next two years; and (2) USGS-supported research to improve the ability to find new leks, understand the percent of leks not counted because they are unknown, and increasing the accuracy of counts once leks are detected.

i. Captive breeding, as a wildlife management tool, is best suited to augmenting small, at-risk populations for short periods of time, while factors contributing to population declines are simultaneously addressed. Because captive breeding of GRSG has not yet proven effective, requires expenditures that would limit funding availability for other priority efforts and may require the removal of potentially viable eggs from the wild, further work is needed to fairly evaluate captive breeding. The DOI Team recommends that new captive breeding efforts continue to be investigated to improve effectiveness.

ii. While State wildlife agencies set population objectives routinely for big game and/or large carnivores based on species biology, landowner tolerance, public safety, habitat availability, and social factors, most States do not routinely establish Statewide population targets for avian species like GRSG. GRSG populations respond to climate, weather, and habitat conditions at different and, often, very fine scales. Thus, GRSG numbers vary widely in a relatively short period of time, within individual States and

across the range. States manage GRSG, in part, based on male lek counts as an indicator of habitat availability, condition, and other factors. While States support efforts to estimate and explain populations, fluctuations, and trends, any such effort must recognize and account for the relationship between the species and its habitat. Further, any population metric would have to reflect the natural range of variability, include confidence intervals, and be tied to habitat availability. Ultimately, the best method for determining GRSG viability will be to assess a combination of habitat availability and populations, which are inseparable. The DOI Team recommends that establishing a Statewide or range-wide GRSG population objective or target should be pursued.

iii. The primary issue relative to predation is the recent emergence of predation by species with which GRSG either did not evolve or did not confront in current numbers. Among these are corvid species, such as ravens. Excessive predation by avian and/or mammalian predators may be occurring in localized settings but is not a uniform pressure across the landscape or range-wide. Localized predation can be a significant threat for small, isolated, or reintroduced populations. Even in those circumstances, however, predator control should be simultaneous with efforts to address the underlying reasons for predator population growth or concentration in localized areas of concern for GRSG. Control of multiple factors that provide predator subsidies, such as open landfills or unneeded infrastructure that provides nesting or perching sites, is a low-cost, sustainable strategy. The SGTF requests the DOI work with the States to investigate options for corvid control, including streamlining approval and reporting requirements in compliance with current law and international treaties. It is important that predator control efforts be evaluated for effectiveness to inform future decisions about how to prioritize available funding.

iv. Hunting is an adequately regulated activity managed by States to avoid additive mortality (above and beyond natural annual mortality) so that it does not contribute to population declines. Common techniques implemented by States include short seasons, low limits of take, and permit-only hunt systems. Harvest strategies in many States can be considered more conservative than guidelines suggest. In addition to these conservative strategies, providing hunting opportunities, when appropriate and sustainable, provides an avenue to better help support the use of Pittman-Robertson wildlife restoration grant funding. In turn, this supports a multitude of conservation efforts related to GRSG, including inventory and monitoring, local conservation planning and project implementation, and research, among other endeavors, that provides States with much needed information on the status of the species.

Appendix C provides a summary of potential next steps for wildlife management.

d. Data Management and the Use of Science (Addressing Section 4a of the Order and Other Requests by the DOI Team

Addressing priority science needs of managers and sharing high-quality science and information, including locally collected monitoring and assessment data, among all entities can further the application of a data-driven approach to the conservation and management of

GRSG and the sagebrush ecosystem. Continued development and integration of local data and information, peer-reviewed science, and other high-quality information forms the foundation for management decisions and identifies the need for new science and information. Attributes to assess the quality and reliability of new science, data, and information include peer review, repeatability of methods and analyses, quality assurance, strength of evidence, and relevance to local conditions.

Increasing opportunities and reducing barriers for sharing science, information, and data can help facilitate ongoing GRSG and sagebrush management efforts. Data sharing currently is conducted through multiple mechanisms including one-on-one communication, agency-to-agency agreements, and online data catalogs (both public and private). Updating information sharing processes and procedures across organizations can improve the use of new information, increase the use of shared information during decision-making processes, reduce the potential for conflicting decisions for similar issues, and provide opportunities for inclusion of local and traditional ecological knowledge.

Following a review of submitted input and ongoing conversations with States, the DOI Team makes the following recommendations to increase the use of science and reduce barriers to data sharing (see also Appendix D):

- Implement the "IRFMS Actionable Science Plan."
- Coordinate research efforts among agencies and organizations, including science needs related to human dimensions and economics.
- Develop processes to use data from a variety of sources including peer-reviewed journals, agency data, and locally collected partner information.
- Work to provide policymakers and managers with science and data in a form most useful to decision-making.
- Continue to emphasize the need for locally relevant science and data to inform implementation of management actions.
- Establish data standards and data sharing agreements, resolve barriers to data sharing, and improve procedures for maintaining and updating data.
- Develop methods to gather and use local and traditional ecological knowledge.

V. NEXT STEPS

In addition to recommendations on specific actions, the DOI Team recommends the following next steps:

- Reaffirm DOI and State commitments to the SGTF to assist in coordination of State and Federal sagebrush conservation activities. Review and update the SGTF's charter as needed. Coordinate with individual States to determine the need for and, as appropriate, develop MOUs for plan implementation and mitigation.
- Work with the USFS to fully engage and evaluate the proposed recommendations in this report, considering the USFS's unique plans and associated decisions and laws and regulations. Work to align recommendations and future actions to the maximum extent possible.
- Continue to work with the States to further refine the options in this report and identify multistate or State-specific solutions as needed.

- In coordination with the SGTF, initiate additional discussions with Congressional delegations, counties, local governments, and tribes, as well as ranchers, landowners, industries, conservation organizations, and other interested parties, to review the issues and recommendations included in this report, and identify any additional issues or recommendations for consideration. The DOI Team recommends that this outreach begin as soon as practicable after the report is submitted, continuing for approximately 2 months.
- Develop the evaluations, policies, and clarifications identified as short term options in this report to address improvements that can be quickly implemented. Continue to work with the States and other partners to identify other clarifications or policy approaches that could address and resolve issues. This work is recommended to follow the public outreach phase.
- Further evaluate whether clarification and policy actions sufficiently address the issues identified by the States and other partners or if additional actions should be considered. For longer term options that include potential plan amendments, further refine the issues and potential solutions, including evaluating State-specific solutions and assessing potential additive effects of the proposed changes and the continued ability to achieve conservation of GRSG. This work is recommended to follow the public outreach phase.
- Review input from other partners, and make any further adjustments to recommendations at the SGTF meeting scheduled after the public outreach phase (estimated October or November 2017).
- Review short term actions and evaluate the need for additional short or long term actions, including potential plan amendments as appropriate, in collaboration with the SGTF (estimated in January 2018).

APPENDIX A – 2015 GREATER SAGE-GROUSE PLANS AND STATE PLAN CONSISTENCY REVIEW

TOPIC AREA: OIL AND GAS STIPULATIONS, LEASING IM, DENSITY AND DISTURBANCE				
Issue	**Discussion**	**Short-Term Option**	**Long-Term Option**	**Scale**
Sagebrush focal areas (SFAs) and no surface occupancy (NSO) stipulations	Determine if SFA designations are required through further work with each State to evaluate whether general habitat management area (GHMA) and priority habitat management area (PHMA) stipulations already provide for the durable and effective conservation of the species.	Complete a crosswalk analysis with the States.	If PHMA/GHMA provide needed durability, potential plan amendment to consider eliminating or reducing the SFAs and changes to stipulations. May be State-specific outcome.	Multistate
General habitat management area (GHMA) stipulations (vary by State)	On a State-by-State basis, complete an evaluation of the GHMA stipulation to determine if a stipulation provides for the conservation of the species, incentive to develop outside of priority habitat management area (PHMA), and informs industry of expectations.	Clarify management flexibility in applying stipulations, and issue State-specific policy as needed; determine if a controlled surface use (CSU) stipulation could be changed without a plan amendment action.	Depending on outcome of short term recommendation, a potential plan amendment to consider changing the CSU may be appropriate.	Multistate (Utah in particular)
Priority habitat management area (PHMA) no surface occupancy (NSO) and waiver, exception, and modification (WEM) language	Work with the States to develop new WEM language for PHMAs, which recognizes the State's mitigation hierarchy, maintains collaborative approach, and removes U.S. Fish and Wildlife Service (FWS) role in approving WEMs. Short term option to clarify which mechanism to modify WEMs is identified as an immediate action item. Then work with the States to engage with partners and stakeholders on the short term evaluation or potential adjustment process.	Determine if the modification of WEMs are plan maintenance or a plan amendment. Evaluate the efficacy of existing WEMs, and work with the States to adjust or add as necessary.	Depending on outcome of short term recommendation, a potential plan amendment to consider changing the WEMs may be appropriate.	Multistate

TOPIC AREA: OIL AND GAS STIPULATIONS, LEASING IM, DENSITY AND DISTURBANCE - CONTINUED				
Issue	**Discussion**	**Short-Term Option**	**Long-Term Option**	**Scale**
Lease prioritization instruction memorandum (IM)	Clarify to BLM staff that the plans currently allow leasing in all Greater Sage-Grouse habitat categories using GRSG plan lease stipulations. Short term option to clarify to staff leasing is not restricted in GRSG habitat. Identified as an immediate action item by some States.	Clarify that all habitat types are open for leasing. Modify and reissue IM to address other concerns	None at this time	Multistate
	Rescind the national IM. Then issue State-level IMs to address recommended changes to national IM and include State-specific solutions. Short term option identified as an immediate action item by some States.	Rescind the National IM, and develop BLM State-specific IMs that include all habitat types are open for leasing and other State-specific concerns.	If the BLM State-level IMs do not address the issues, then consider a potential plan amendment to address concerns.	Multistate
Density and disturbance	There is variation between the States on what counts as a disturbance and towards a density cap, the level of disturbance that is allowed, and the scales the caps apply to (project or biologically significant unit - BSU). There is a need for a consolidated (BLM/State) process so industry knows where to start and the steps to follow. On a State-by-State basis, develop a crosswalk to explore the potential to develop a density and disturbance process that recognizes State-specific issues and needed flexibilities. • Include recommendations based on science for the difference in calculation of the cap, or what counts for disturbance and density, and the appropriate scale (e.g., project or BSU).	If no inconsistencies, then solidify through BLM State-level IMs and MOUs to share disturbance data. Clarify/train staff and partners on what types of disturbances are included in the calculation. In cooperation with the State, investigate opportunity to accelerate restoration and recovery efforts in areas in which the caps are being approached.	If inconsistencies, then resolve through using best available science and/or initiate new research to further clarify disturbance and density requirements for different types of uses, which may require future consideration of a plan amendment process.	Multistate

TOPIC AREA: MITIGATION AND NET CONSERVATION GAIN				
Issue	**Discussion**	**Short-Term Option**	**Long-Term Option**	**Scale**
Inconsistent mitigation standards	BLM plans have a net conservation gain standard while the State mechanisms have adopted differing standards. There is confusion on the definition of net conservation gain. The States wish to use the State mitigation approach to achieve a seamless mitigation standard and approach across State, private, and Federal lands. States have various definitions for their mitigation standard including net gain, habitat assurance, no net loss, no net loss with conservation benefit, and others. Many of the State standards also account for the risk of the action to achieve the desired environmental benefit. Removing the net conservation gain language creates issues for some States as they have adopted that language as the standard for their State mitigation mechanism. States want to apply mitigation actions on Federal lands while meeting the mitigation principles in the Sage-Grouse Task Force (SGTF) GRSG compensatory mitigation report. Recognize that Federal land users must also comply with State requirements, when applicable. Recognize that the DOI is currently reviewing its mitigation policies, including the compensatory mitigation standards and may issue revised policy, including consideration of a 1:1 ratio, equivalent value, no net loss, or other standard.	Define net conservation gain for the BLM plans. Evaluate and document each State's mitigation approach to determine if it meets the intent of net conservation gain. Consider policy on options to use the State's mitigation standard if it meets the intent of the mitigation standard in the GRSG plans.	If policy does not address the concern, then consider a potential plan amendment to change the net conservation gain standard. Options to further evaluate could include using each State's standard (may vary by State), setting a minimum standard for public lands and using the State standard if it is higher, or setting a standard for public lands while the State standard applies to State and private lands. Evaluate need for plan modifications to comply with DOI policy on mitigation.	Multistate

TOPIC AREA: MITIGATION AND NET CONSERVATION GAIN - CONTINUED				
Issue	**Discussion**	**Short-Term Option**	**Long-Term Option**	**Scale**
State mitigation plans	Use the State mechanisms that conform to the SGTF, Sage-Grouse Mitigation Report to ensure consistency and application of mitigation requirements including the use of debit and credit calculations.	Complete an MOU with each State on application of the State mitigation approach if it is consistent with the BLM plans and meets the principles in the SGTF Mitigation Report and DOI policy If MOUs do not address the issues, develop policy providing direction on how to use each State's mitigation approach.	None at this time	Multistate
Regional mitigation strategies	In coordination with the States, determine where mitigation should occur based on what would be most beneficial for the species.	Include in the State Mitigation Plan MOU.	None at this time	Multistate

TOPIC AREA: HABITAT ASSESSMENT FRAMEWORK, HABITAT OBJECTIVE TABLE EFFECTIVENESS MONITORING				
Issue	**Discussion**	**Short-Term Option**	**Long-Term Option**	**Scale**
How are habitat objectives; plan effectiveness reporting; Assessment, Inventory, and Monitoring (AIM) data; and Habitat Assessment Framework (HAF) assessments related?	Clarify how to integrate habitat objectives, land health standards, and land use plan effectiveness. Clarify how to use existing data, legacy data, and other monitoring efforts, specifically AIM and HAF during the land health standards evaluation and management decisions. Clarification on scales and the appropriate data for use at each scale. HAF and AIM are one piece of the puzzle; money and effort needs to be allotted to other monitoring as well. Issuance of policy identified as an immediate action item by some States.	Issue IMs to provide additional clarification and training on using habitat objectives to inform evaluation of land health standards; use habitat objectives at the land use plan scale to evaluate plan effectiveness. Continue outreach and training on use of AIM data in conjunction with other data and monitoring information.	None at this time	Multistate
Implementation of the Habitat Assessment Framework (HAF)	Clarify how the field should prioritize HAF assessments (e.g., areas that have hit soft or hard triggers, lesser quality habitat). Clarify how to integrate relevant studies and supplemental data with AIM and HAF into land health standards. Clearly articulate the use of HAF for all resource decisions, not just grazing. Integrate training, including how to determine if adequate data is available, with the BLM, other agencies, and States, including the Department of Agriculture.	Issue new HAF IM to clarify the purpose of the HAF and the relationship between AIM and HAF, as well as how these relate to the habitat objectives table. Internal and external training once this relationship has been clarified.	None at this time	Multistate

TOPIC AREA : HABITAT ASSESSMENT FRAMEWORK, HABITAT OBJECTIVE TABLE EFFECTIVENESS MONITORING - CONTINUED				
Issue	**Discussion**	**Short-Term Option**	**Long-Term Option**	**Scale**
Implementation of the Habitat Assessment Framework (HAF) - Continued	Explore use of and continue the development of tools to streamline habitat assessments (e.g., remote sensing) for rapid assessment of habitat conditions. Issuance of new HAF IM identified as an immediate action item by some States.	Continue to learn from the pilot studies (e.g., Oregon State and Transition Model) and other tools to streamline habitat assessments, and advance or integrate outcomes into BLM's approach to HAF and related work through IM or other policy clarification and training.	None at this time	Multistate
Proper use of land use plan effectiveness data (AIM)	Provide transparency and ensure understanding of the intended use of AIM data. Review plan effectiveness policy to ensure that lessons learned are incorporated. Clarify that additional funding is set aside for AIM data collection so it is not taking money away from other monitoring efforts. Improve coordination between the National Operations Center (NOC) and field offices. Clarification was identified as an immediate action item by some States.	Issue clarification that addresses concerns; provide training.	None at this time	Multistate

TOPIC AREA : HABITAT ASSESSMENT FRAMEWORK, HABITAT OBJECTIVE TABLE EFFECTIVENESS MONITORING - CONTINUED				
Issue	**Discussion**	**Short-Term Option**	**Long-Term Option**	**Scale**
Adjusting the habitat objectives tables	Codify guidance issued on habitat objectives tables in an IM which clarifies the appropriate use, scale, and importance of the ecological site and the current ecological state of the monitoring site. Define a process to allow updates to habitat objectives tables as new information becomes available. Ensure objectives in habitat objectives tables are consistent with unique landscapes and habitat conditions (e.g., Utah captures variations through various delineations). Explore an option to match the habitat objectives with the States' plan, where available (not all States have quantitative objectives). Explore the possibility to remove the habitat objectives tables from the plans, and determine what would be required to address the habitat requirement, as described in 43 CFR 4180. Clarification was identified as an immediate action item by some States.	Policy and clarification on the intent, purpose, and use of habitat objectives tables, and flexibility provided in the plan and BLM processes to adjust the habitat objectives based on ecological site potential. Investigate opportunity for plan maintenance to further explain flexibility in plans.	Continue research on habitat requirements for GRSG, if new science warrants changes in habitat objectives beyond flexibility currently provided in plan. An amendment to consider updating habitat objectives may be appropriate.	Multistate

TOPIC AREA: ADAPATIVE MANAGEMENT				
Issue	**Discussion**	**Short-Term Option**	**Long-Term Option**	**Scale**
Causal factor analysis	Work with States to identify a causal factor analysis process for both hard and soft triggers.	Work with each State to complete a process for causal factor analysis. Clarify in IM that causal factor analysis is required for hard and soft triggers.	None at this time	Multistate
Reversion of trigger responses when conditions improve	Work with States on process to revert to previous management, or change the response based on positive habitat/population response.	Evaluate plans to determine which do not have a "reversion" clause and whether each plan provides any flexibility to address through policy.	Potential plan amendment to consider allowing reversion to less restrictive decisions when habitat/population recovers to above original trigger.	Multistate
Implementation of hard trigger responses	Work with States to develop a process to ensure responses to hard triggers are pertinent to the cause of the population or habitat decline. Short term option was identified as an immediate action item by some States.	Work with States on development of the process in the recommendation.	Potential plan amendment to consider options for alternative approaches to hitting a hard trigger, such as a temporary suspension of authorizations while causal analysis occurs and responses are developed, or implement hard trigger responses while causal analysis occurs and release those not needed to address the threat.	Multistate
Adaptive management policy (IM 2016-140):	Modify IM 2016-140 or issue BLM State-specific IM to address advance coordination with the States and partners beginning with Step 1 in the IM.	Modify the current IM.	None at this time	Multistate

TOPIC AREA: ADAPATIVE MANAGEMENT - CONTINUED				
Issue	**Discussion**	**Short-Term Option**	**Long-Term Option**	**Scale**
Research and data collection needs	Emphasize working with States and Federal partners to identify a rapid assessment process that could identify when a population or habitat trigger is being approached. Identify appropriate management actions to be taken immediately to address the decline in population or habitat and avoid the need to implement predefined plan adaptive management responses. Research could help identify multiprong impacts to populations. Clarify the requirements data. Must meet in order to be used to inform the causal factor analysis.	*Defer to "Data Management and the Use of Science" topic in the report for recommendation.*		
Sagebrush focal areas (SFAs) are inconsistent with the state plan	Clarify that adaptive management triggers should not be tied to SFAs in any way, and reiterate the habitat management hierarchy set forth in the Idaho State Plan.	Clarify triggers are not related to SFA boundaries.	Potential plan amendment to consider removing SFAs, as needed.	Idaho

TOPIC AREA: GRAZING				
Issue	**Discussion**	**Short-Term Option**	**Long-Term Option**	**Scale**
Need to clearly articulate that proper livestock grazing is compatible with enhancing or maintaining Greater Sage-Grouse (GRSG) habitat.	Modify language to communicate that properly managed grazing is compatible with GRSG habitat. Focus on identified threats (fire and invasive species/fragmentation). Should not be spending a lot of time monitoring and inspecting allotments that are providing good quality sagebrush habitat. Incorporate guidance for potential use of livestock grazing as a tool. Incentivize stewardship and grazing practices that result in improved conditions for GRSG.	Revise and clarify IMs related to grazing. Clearly articulate that proper livestock grazing is compatible with and can be beneficial to manage for quality GRSG habitat. Revise prioritization IM to develop methods to quickly assess and report conditions on areas where proper grazing is occurring and supporting quality habitat, and focus on problem areas. Continue to move forward with targeted grazing and outcome-based grazing pilots to further demonstrate methods to use grazing to control fuels and improve habitat condition. Clarify existing policy and regulations that allow animal unit months (AUMs) to increase based on forage availability.	None at this time	Multistate

TOPIC AREA: GRAZING - CONTINUED				
Issue	**Discussion**	**Short-Term Option**	**Long-Term Option**	**Scale**
Causal factor analysis must be completed and grazing determined to be a causal factor prior to making changes to grazing permits.	Follow current process to complete a causal factor analysis prior to modifying grazing permit.	Reinforce/offer training on how to modify a permit as described in current guidance.	None at this time	Multistate
Sagebrush focal area (SFA) prioritization strategy	Incorporate flexibility in the allotment prioritization process.	Revise allotment prioritization IM. Develop a strategy to use existing data for a rapid assessment in SFAs.	None at this time	Multistate
Removal of livestock grazing from research natural areas (RNAs)	The Oregon Approved Resource Management Plans and Amendments (ARMPA) identifies key RNAs that will be unavailable to livestock grazing. While the general issue of research within RNAs, including with varying levels of livestock use, is not something Oregon opposes, the State Action Plan does not include having RNAs unavailable for grazing. The State is concerned about potential loss of animal unit months (AUMs), economic losses, potential effects to habitat, and impacts to livestock operators on allotments containing RNAs that are subject to being unavailable for grazing, especially if unsupported by indications of adverse habitat impacts caused by livestock grazing management.	Work with Oregon to evaluate RNAs and grazing closures.	To be determined based on outcome of short term option.	Single State (Oregon)

TOPIC AREA: GRAZING - CONTINUED				
Issue	**Discussion**	**Short-Term Option**	**Long-Term Option**	**Scale**
Voluntary grazing permit relinquishment and relationship to future grazing, grass banks, or other uses.	When grazing permits or leases are voluntarily relinquished or where allotments otherwise become vacant, current Oregon ARMPA language would make retirement of permits an option under these circumstances. The steps BLM takes pursuant to current and ARMPA-adopted language at the point in time following voluntary relinquishment or vacancy should not run counter to State interests in working lands and habitat health.	Ensure LG/RM 15 language in the Oregon ARMPA is consistent with regulation and as needed develop State-specific policy on its use.	To be determined based on outcome of short term option.	Single State (Oregon)
Habitat objectives table is too rigid and prescriptive to cover the broad range of landscapes in the West.	*See "Habitat Assessment, Habitat Objectives Tables, and Effectiveness Monitoring" section in the report.*			
Lek buffers for range improvements may be inconsistent with State plans.	*See the "Other Minerals, Energy, and Lands" section in the report.*			

TOPIC AREA: EXCLUSION/AVOIDANCE LAND USE PLAN DESIGNATIONS				
Issue	**Discussion**	**Short-Term Option**	**Long-Term Option**	**Scale**
Designation of exclusion areas may sometimes differ from the State's approach.	States take various approaches to what activities to exclude from certain habitat types and in their exemption processes. Working with State partners, evaluate if the States' plans would provide durable and effective conservation while providing exceptions to activities.	On a State-by-State basis, complete an evaluation of State approaches and plan flexibilities.	If short term flexibilities do not resolve concerns, evaluate a potential plan amendment to consider adjusting exclusion boundaries and/or evaluate different restrictions for different uses based on threats and impacts.	Multistate
Maintenance and production activities	Need to provide clarification that maintenance and production activities for already authorized uses are allowed in the plans.	Provide IM to allow for maintenance of existing development.	None at this time.	Multistate
Mineral materials sales (sand and gravel)	Allow mineral material sales in priority habitat management areas (PHMAs) under the use of the State's stipulations.	Conduct an evaluation of mechanisms to provide conservation while accommodating need for mineral material sales.	Based upon the evaluation, a plan amendment may be necessary.	Multistate
Valid existing rights	Need to clarify under what circumstances or how the plans recognize valid existing rights.	Provide clarification to staff, partners, and industry so there is a clear and consistent understanding of application of plan actions to valid existing rights and existing authorizations.	None at this time.	Multistate

TOPIC AREA: EXCLUSION/AVOIDANCE LAND USE PLAN DESIGNATIONS - CONTINUED				
Issue	**Discussion**	**Short-Term Option**	**Long-Term Option**	**Scale**
Misinterpretation of "avoidance" in the field	Need to develop training and policy to ensure consistent interpretation and approval of activities in an avoidance area (see Colorado and Nevada for examples) that allows activities with the application of the mitigation hierarchy.	Provide clarification for the definition of avoidance area including resources that use different terminology. Issue State-specific policy as needed to explain avoidance criteria and how to evaluate the need to provide exceptions to allow uses. Provide training for staff and partners for how to implement avoidance areas.	Determine if existing management flexibility on avoidance areas are adequate without a potential plan amendment.	Multistate
Plans do not recognize the State's guidance that some activities are "de minimis" (negligible or no impact to GRSG).	Need to develop an approach that streamlines approvals for projects with negligible or no impact to GRSG. Long term option was identified as an immediate action item by some States.	Evaluate "de minimis" activities as defined in State plans, and evaluate against Federal plans, laws, and regulations. Determine if any tools are available for use in Federal processes to streamline approval of these activities. Possible development of templates and streamlined processes to standardize the evaluation of projects.	Development of programmatic National Environmental Policy Act (NEPA) documents to analyze the impacts for tiering of future projects. Identification of categorical exclusions for "de minimis" activities.	Multistate

TOIPIC AREA: REQUIRED DESIGN FEATURES (e.g., TIMING AND TALL STRUCTURES)				
Issue	**Discussion**	**Short-Term Option**	**Long-Term Option**	**Scale**
Need greater flexibility in using State-developed required design features (RDFs).	Need to streamline the process so that known and effective design features, outside those identified in the current plans, can be used without further analysis by the BLM. Design features selected should help to encourage development in lower quality habitat (e.g., in general habitat management areas instead of priority habitat management areas).	Clarify that the plans provide flexibility to select RDFs appropriate to project and to use other RDFs, including State RDFs, if they achieve equal or better conservation purpose.	None at this time	Multistate
Requirement to include discussion on all required design features (RDFs) in the project-level NEPA document	Need to allow the flexibility to only apply those design features that are appropriate to a project without having to justify why other design features were not used.	Evaluate need for templates and streamlined processes to standardize the evaluation of design features.	None at this time	Multistate
Lack of consistent application of required design features (RDFs) in the field.	Provide clarification to staff and external partners when and how to use RDFs (including timing and tall structures).	Provide guidance that RDFs are not a "one size fits all" and do not apply to all activities.	As evaluation of RDFs continues, a plan amendment may be considered to reflect which RDFs are commonly used, to align with measures in State plans, and avoid repeated consideration of RDFs that are never used.	Multistate

TOPIC AREA: LEK BUFFERS				
Issue	**Discussion**	**Short-Term Option**	**Long-Term Option**	**Scale**
Lek buffer distances are incompatible with State buffer distances for some types of development (e.g., range improvements).	Use the best available information to inform decisions in habitat, which could include using the lek buffer science as well as adjusting the size of the buffer based on local data and information. Suggest a two-step process of clarifying justifiable departures and then streamline the process using local information. Need to revisit the scientific literature pertaining to lek buffers ahead of initiating new science for buffers.	Provide clarification to staff and external partners regarding the use of lek buffers and justifiable departures. Evaluate each plan to ensure adequate flexibility to address project-specific information is available. Revisit the scientific literature pertaining to lek buffers.	If needed, initiate additional research to evaluate lek buffer distance requirements for applicable uses, and identify any potential changes to plans. If the developed policy does not provide the mechanism to address the issue, then evaluate a potential plan amendment or maintenance action to consider adjusting lek buffers based on new science and high quality information.	Multistate
Clarify how to apply lek buffers (e.g., distance for National Environmental Policy Act analysis vs. distance to restrict activities).	Provide clarification to staff and external partners for how the lek buffer appendix and record of decision (ROD) description should be used and to potentially adjust lek buffers noted in the plan based on project-specific information.	Develop policy to ensure consistent application and interpretation, and clarify language in ROD and plan. Evaluate need for templates, streamlined processes, and programmatic analysis to standardize the evaluation of lek buffers, including justifiable departures, in project-level analysis.	None at this time	Multistate

TOPIC AREA: HABITAT MANAGEMENT BOUNDARIES (INCLUDING SAGEBRUSH FOCAL AREAS)				
Issue	**Discussion**	**Short-Term Option**	**Long-Term Option**	**Scale**
Sagebrush focal area (SFA) designations	Remove all SFAs and the management actions tied to SFAs. Short term option was identified as an immediate action item by some States.	Determine the habitat type and associated management actions that would be applicable to the area to ensure durable and effective conservation of the species.	Potential plan amendment to consider removing SFA designation and either replace SFA management actions with the underlying habitat type (e.g., PHMA, IHMA, GHMA) and associated management actions, or change those SFA management actions as described elsewhere in this table.	Multistate
Need flexibility to change priority habitat management area (PHMA)/general habitat management area (GHMA) boundaries.	Habitat is being updated regularly based on additional on-the-ground surveys and improved understanding of GRSG habitat needs. Plans do not provide the flexibility to adopt these new habitat areas and apply the appropriate management actions to those habitats. Add flexibility for future updates when new science would cause changes, such as during the 5-year plan review cycle. Short term option was identified as an immediate action item by some States.	Evaluate the ability to adjust PHMA/GHMA boundaries and associated management decisions to match revised habitat maps without a plan amendment. Develop policy on how to apply management decisions, such as stipulations, waivers, exceptions, modifications, exclusion and avoidance, etc., in areas where PHMA or GHMA plan allocations do not match habitat maps.	Potential plan amendment to consider aligning PHMA, GHMA, IHMA, etc., and associated management actions to revised habitat maps and develop criteria for making future adjustments (e.g., when habitat maps have been adjusted through on-the-ground surveys, improved understanding of habitat needs, etc.) to habitat management area boundaries.	Multistate

TOPIC AREA: HABITAT MANAGEMENT BOUNDARIES (INCLUDING SAGEBRUSH FOCAL AREAS) - CONTINUED				
Issue	**Discussion**	**Short-Term Option**	**Long-Term Option**	**Scale**
General habitat management area (GHMA) is inconsistent with Utah's plan.	GHMA is unnecessary in Utah because the areas have few birds and leks and are already heavily impacted by development.	Evaluate the Federal plan to determine if durability and conservation of the species can be achieved without GHMA designations and associated GHMA management actions or with revised GHMA boundaries. Also, consider the application of the State mitigation plan to address concerns with habitat impacts in areas currently allocated as GHMA.	Based upon the short term outcome, may need to pursue a potential State-specific plan amendment.	Utah specific

APPENDIX B – WILDLAND FIRE AND INVASIVE SPECIES ISSUES

TOPIC: WILDLAND FIRE AND INVASIVE SPECIES	
Issue/Comment	**Recommended Additional Steps**
Not all affected States provided feedback.	Incorporate additional information received from States and other stakeholders.
Continue to address challenges and barriers to wildfire and/or invasive species management, and provide recommendations to improve management.	Continue work on unfinished/incomplete/ongoing "Integrated Rangeland Fire Management Strategy" (IRFMS) action items. Complete the Western Association of Fish and Wildlife Agencies (WAFWA) "Sagebrush Conservation Strategy."
Continue engaging other organizations in support of the "Integrated Rangeland Fire Management Strategy."	Support Intermountain West Joint Venture and others to implement the "Sagebrush Ecosystem Communications Framework" (SageWest). Support development and implementation of WAFWA's "Sagebrush Conservation Strategy." Support the development and implementation of Western Association of State Departments of Agriculture's (WASDA) "Western Invasive Weed Action Plan." Support implementation of the "National Seed Strategy for Rehabilitation and Restoration." Support the memorandum of understanding between the BLM, USFS, and NRCS to improve coordination with private landowners, and promote cross-boundary projects that address invasive species and wildland fire.
Increase support to wildland fire cooperators.	Reinstate grant authority and authority to surplus excess equipment to cooperators. Address the General Services Administration policy that prevents excess Federal firefighting equipment (e.g., engines, radios) from going directly to partners, such as rangeland fire protection associations (RFPAs) and rural fire departments (RFDs). Explore options for shared funded positions to enhance cooperative efforts (e.g., RFPA support). Continue to support and develop additional RFPAs.

TOPIC: WILDLAND FIRE AND INVASIVE SPECIES	
Issue/Comment	**Recommended Additional Steps**
Consider related Western Governors' Association (WGA) efforts that enhance implementation of the "Integrated Rangeland Fire Management Strategy."	Further action items in the WGA's National Forest and Rangeland Management Initiative, such as: expanding good neighbor authority use; developing comprehensive (wildland fire) protection agreements; applying consistent fire operations best management practices; coordinating Federal, State, and local partners fire response in sagebrush rangelands; and flexibilities in grazing management.
Improve coordination with States on fuel/vegetation treatments, wildfire response, and post-fire recovery.	Promote increased coordination and collaboration, including through the framework in the "National Cohesive Wildland Fire Management Strategy."
Ensure funding for fire, fuels, and restoration projects.	Explore options for multijurisdictional funding, multiyear funding, and shared funding across jurisdictional boundaries, including private and public lands for fuels/vegetation and post-fire recovery projects. Continue to move to a risk-based funding approach in the DOI. The risk-based funding modeling shows that the BLM receives substantially less funding in fuels and fire preparedness than its fire risk warrants. The BLM should be receiving between 65-75% of fuels and fire preparedness funding but is currently receiving only about 50%.
Streamline and improve restoration success.	Conduct research, testing, and implementation, particularly restoration projects (e.g., biopesticides and herbicides, seed coating technology, prescribed fire use). Continue investigating the use of targeted grazing and other tools to manage fuels and create fuels breaks.
Expedite use of emerging weed treatment technologies.	Work with appropriate Departments, agencies, offices, and companies to gain approval of concurrent Environmental Protection Agency (EPA) registration and field-testing of biopesticides and chemical herbicides to incorporate DOI-specific field testing needs into the early experimental testing conducted prior to registration. This would reduce the amount of time to use a pesticide or herbicide after receiving EPA registration

APPENDIX C – WILDLIFE MANAGEMENT

TOPIC: WILDLIFE MANAGEMENT	
Issue or Need	**Recommended Additional Steps**
Captive breeding and population augmentation	If captive rearing is pursued, efforts should use experimental design to build on already-available information and data, including addressing knowledge and data gaps, to effectively rear Greater Sage-Grouse (GRSG) in captivity for successful release or reintroduction into the wild. Adhere to all relevant State laws and other authorities for potential releases/reintroductions.
Predator control	Continue to communicate outcomes of past predator control efforts, including methods, species controlled, and the short- and long term results. Conduct additional research into both lethal and non-lethal predator control techniques.
Population targets and species management	Continue to support collaborative efforts with the States to develop rangewide, state-level, and local population estimates. Support development of a framework to assess GRSG population trends, determine biological effectiveness of management actions, and identify emerging issues to adaptively conserve the species and its habitat. Work collaboratively with the States and Federal partners to develop new or improve existing processes to evaluate GRSG population information, habitat conditions, and conservation efforts.

APPENDIX D – SCIENCE AND DATA ISSUES

TOPIC: SCIENCE AND DATA ISSUES	
Issue/Comment	**Recommended Additional Steps**
Address priority science needs, and increase opportunities for coordination and sharing of science and research efforts.	Implement the "Integrated Rangeland Fire Management Strategy Actionable Science Plan." Actions include: coordination of research efforts (prioritization, funding, implementation, and analysis) among State and Federal agencies and other organizations; implementation of research efforts, as funding allows; and development of a tracking mechanism for publications and products. In collaboration with the Western Association of Fish and Wildlife Agencies (WAFWA) Sagebrush Science Initiative and other similar efforts, identify and prioritize science needs related to human dimensions and economics in the sagebrush ecosystem, and address prioritized science needs, as funding allows. Develop processes to receive, aggregate, and review monitoring data and other information from entities other than Federal or State agencies to ensure it meets quality, reliability, and relevance standards for use. Develop processes to receive, aggregate, and review monitoring data to identify new potential science needs that can be addressed using formal experimental or other scientific investigations. Work to increase development of information products that translate and synthesize peer-reviewed science into more accessible formats for decision-makers, and improve access to peer-reviewed science journals for those who need that level of information. Continue to emphasize the need for locally relevant peer-reviewed science, high-quality information, and local on-the-ground data that is pertinent to implementation of management actions. Evaluate use of the Sage-Grouse Task Force (SGTF) as the coordinating body for the intersection of science with policy and management and to identify priority science and data needs to inform management and policy.

TOPIC: SCIENCE AND DATA ISSUES	
Issue/Comment	**Recommended Additional Steps**
Increase opportunities and reduce barriers to data sharing.	Establish data sharing agreements between Federal and State agencies, tribes, and other entities. Develop and maintain a multiagency directory of data stewards and technical experts to improve coordination and collaboration between Federal and State agencies, tribes, and other entities. Improve procedures for maintaining and updating data/information in a mutually developed data catalog(s), ensuring that nonproprietary/sensitive tabular or geospatial data can be shared and accessed. Increase use of common communications tools, such as SageWest and Great Basin Fire Science Exchange, to increase awareness of new information. Establish and communicate minimum data standards and information requirements for information included in shared data catalogs and information gathered by third party sources for potential inclusion in agency databases or use in decision-making. Identify multiscale spatial units that could be used to aggregate data to increase opportunities for use of information when raw data contains sensitive or proprietary information, when appropriate. Continue to work with the States and other partners to identify barriers to data sharing and options to remove those barriers. Work with the States and tribes to explore options to improve or develop data sharing mechanisms for capturing observations of species, as well as local and traditional ecological knowledge.

APPENDIX E – OTHER ISSUES IDENTIFIED NOT SPECIFICALLY RELATED TO THE 2015 SAGE-GROUSE PLANS

OTHER ISSUES IDENTIFIED NOT SPECIFICALLY RELATED TO THE 2105 SAGE-GROUSE PLANS				
Issue	**Discussion**	**Short-Term Option**	**Long-Term Option**	**Scale**
Reserve common allotments	Reserve common allotments are a tool available on public lands that could be used to provide alternative locations for grazing permittees/leases when their allotment is unavailable due to fire, restoration activities, or other reasons. However, there are concerns that designation of allotments as reserve common allotments could take those allotments out of regular use and result in economic loss. Further investigation with the BLM, Sage-Grouse Task Force (SGTF), ranchers, and other stakeholders is warranted to determine if and how reserve common allotments should be considered.	Engage with the SGTF, counties, Public Lands Council, ranchers, and other stakeholders to determine if and how reserve common allotments should be used.		Multistate
Water rights	There is concern that the BLM may be managing water rights they do not own by limiting new water development projects and modifications to existing developments. This may be a result of conflict between State water laws and BLM policy, but this issue is not expressed in the 2015 Sage-Grouse Plans.	Provide further investigation and clarification, as needed.		Multistate: Utah, Idaho, Nevada
Changes in grazing management following natural events	Clarify options for changes in grazing management following natural events if continuation of grazing would result in loss of habitat. Provide flexibility at the state, district, or field level.	Provide further investigation and clarification, as needed.		Multistate
Wild horse and burro: appropriate management level (AML) achievement	Verify that the BLM has the tools and funding to achieve AML across the West. Evaluate priorities (e.g., Priority given to sagebrush focal areas (SFAs) potentially limits funding and staff to initiate gathers in priority habitat management areas (PHMAs)).	BLM state offices reassess their 3-5 year gather plans to validate AML will be met. Collaborate with States. Elevate unresolved issue to management.	Legislative solution and additional increased funding is necessary for long term resolution.	Multistate
Herd management areas and associated appropriate management level (AML) may need to be analyzed for adjustments	Implement solutions for reaching current AML prior to reevaluating herd management areas and AML.	Implement solutions to reach current AML.	Analyze boundaries and AML adjustments in the future once current AML is reached.	Multistate

APPENDIX F: TECHNICAL WHITE PAPERS FROM THE WESTERN ASSOCIATION OF FISH AND WILDLIFE AGENCIES

White Paper Titles

1. Augmenting Sage-Grouse Populations through Captive Breeding and Other Means (3 pages)

2. Population and Habitat-Based Approaches to Management of Sage-Grouse (2 pages)

3. Predator Control as a Conservation Measure for Sage-Grouse (2 pages)

4. Hunting Sage-Grouse, Impacts and Management (2 pages)

5. Literature Cited in WAFWA Tech. Committee White Papers on Predator Control, Captive Breeding and Population and Habitat Management

Augmentation of sage-grouse populations has been a management strategy used by state wildlife agencies in limited circumstances since the 1930s. Augmentation has been employed to bolster small and isolated populations, to re-establish populations in historic habitats, or to establish new populations. Augmentation for these purposes has been conducted through transplants of adult and yearling birds, usually trapped on or near leks. Reese and Connelly (1997) reviewed published literature and unpublished reports describing 56 transplants of 7,200 individual sage-grouse conducted in seven states and one Canadian province prior to 1997. They concluded only transplants in Colorado, Idaho, and Utah appeared successful, and populations remained small. More recently, Colorado Parks and Wildlife (CPW) has demonstrated some success enhancing genetic diversity of small populations by translocating Gunnison sage-grouse from a source population in the Gunnison Basin to smaller satellite populations. The Utah Division of Wildlife Resources coupled predator control with a transplant of sage-grouse into a population near Strawberry Reservoir with some success (Baxter et al. 2007).

Reasons for relatively low success rates for transplants are complex and not well documented or necessarily understood. Commonly, large post-release movements can lead to high mortality, and hens may not breed or attempt to nest in the spring following release. In general, if environmental conditions that precipitated sage-grouse declines have not been mitigated, transplants of additional and locally naïve birds is not likely to succeed. Refinements to transplant protocols to address these issues, such as supportive predator control (Baxter et al. 2007), artificial insemination prior to release (Mathews et al. 2016), and transplants of juveniles or yearlings are being incorporated in augmentations and will likely increase success rates.

Sage-grouse have been maintained, hatched and bred in captivity successfully, but only in research settings (Pyrah 1961; Johnson and Boyce 1990, 1991; Spurrier and Boyce 1994, Huwer 2004; Oesterle et al. 2005; Huwer et al. 2008; Thompson et al. 2015; Apa and Wiechman 2015, 2016). Sage-grouse captured in the wild do not adapt well to captive conditions (Ligon 1946, Pyrah 1961, Oesterle et al. 2005). Many adult, and to a lesser degree juvenile, sage-grouse brought into captivity are flighty and stressed, which leads to high mortality rates (Remington and Braun 1988, Oesterle et al. 2005, Apa and Wiechman 2015). Consequently, the most effective approach to establishing a captive breeding flock would start with collection and incubation of eggs from wild nests. Large-scale, programmatic captive breeding efforts have never been attempted for sage-grouse. Attwater's prairie-chicken, listed as endangered since 1967, are sustained through a captive breeding (at seven facilities) and release program facilitated by the U.S. Fish and Wildlife Service. They have effectively been extirpated from almost all of their former range and persist on about 200,000 fragmented acres.

There has only been one published study that evaluated survival of sage-grouse chicks produced in captivity and released to the wild (Thompson et al. 2015). In this study, 1-10 day-old sage-grouse chicks produced in captivity from wild-collected eggs were released to radio-marked hens with an existing brood. Adoption rates overall were 89%; releases in the evening and of chicks younger than 5 days were the most likely to result in successful adoption. Survival of adopted chicks was comparable to that of wild chicks. Although successful, this technique is limited to situations where surrogate hens with broods are available and locatable at short notice (i.e., radio-marked). A more generally applicable approach would be to raise chicks to 12-16 weeks old and release them when they are capable of surviving without a brood hen. There has been no research conducted on survival rates of juvenile (12-16 week old) sage-grouse raised in captivity and released to the wild. Colorado Division of Wildlife did successfully rear Gunnison sage-grouse chicks in captivity to 5- and 7- weeks post-hatch when they were released to the wild,

however, none survived (T. Apa, pers. comm.). Survival of male and female wild juvenile sage-grouse in two study areas in Colorado was only 61% from 1 September to 31 March (calculated from Apa et al. 2017). Based on literature related to survival of juvenile ring-necked pheasant over-winter, survival of captive-bred juvenile sage-grouse is likely to be much lower than that of wild juveniles.

The number of sage-grouse or sage-grouse eggs needed to provide 50 sage-grouse for augmentation purposes (a relatively small number) at the beginning of the breeding season from translocation and captive rearing, and the number of birds or eggs required from source populations for each method can be estimated for illustrative and comparative purposes using published estimates of survival, hatchability, and re-nesting rates of wild hens (Table 1). A captive flock of 50 to 150 hens would be required to produce the 429-1,286 eggs needed to produce enough juveniles for release at 12 weeks of age that would result in 50 birds alive and able to breed in March. This estimate assumes post-release survival rates between 10% (based on experiences with game farm pheasants) and 30% (best case; based on Attwater's prairie-chicken long-term average survival given extended soft release protocol and supportive predator control). Establishing a captive flock of this size would require collecting 123 to 369 eggs from the wild, under the simplifying assumption that all birds surviving to 12 weeks survive to lay clutches (this likely greatly overestimates contribution of captive-reared birds to reproduction as Leif (1994) found that captive-reared hen pheasants contributed less than 10% of the reproductive output that wild hens did given much lower survival during the nesting and brood-rearing period and lower nest initiation/incubation rates. There is potential for impacts to source populations in the establishment of a captive flock large enough to provide the number of eggs needed (Table 1). This would be an initial impact that would not recur, although additional removals from source populations would be expected to offset inbreeding depression and loss of genetic diversity in captive flocks.

Number of Sage-grouse or sage-grouse eggs needed to result in 50 sage-grouse at start of breeding season (31 Mar)

Method	Hatchability	Survival to release	Post-release survival to 31 Mar.	Number of birds or eggs needed	Net Removal from source population
Spring transplant	NA	0.95	0.50	105 birds	105 birds
Collect wild eggs, release progeny ≤ 10 days old	0.745	0.792	0.22	378 eggs	239 eggs
Collect wild eggs, release progeny ~ 12 weeks old	0.745	0.52	0.1-0.3	429-1,286 eggs	272-816 eggs
Eggs from captive flock, release progeny ≤ 10 days old	0.565	0.792	0.22	498 eggs	443 eggs
Eggs from captive flock, release progeny ≥ 12 weeks old	0.565	0.52	0.1-0.3	565-1696 eggs	503-1508 eggs

It is likely that with experience, hatchability and chick survival in captive-rearing facilities could be improved, which would reduce the number of eggs needed somewhat. Sage-grouse are determinate layers, meaning each individual female will contribute only about 7-10 eggs per year. That, along with relatively high chick mortality and juvenile mortality following release suggests relatively large breeding flocks would need to be maintained and periodically augmented.

Other Considerations. Collection of eggs and/or adult sage-grouse would require permits from state wildlife agencies and, if taken from Federal land, from land management agencies. State regulations, laws and attitudes about private possession of wildlife vary, so this may or may not require regulatory change or legislative approval based on the state. Sage-grouse of all ages are very susceptible to West Nile Virus (WNv), so if a captive flock is established precautions should be taken to prevent exposure of birds to mosquitoes that may carry the WNv by physical exclosures or placement of the facility in areas where WNv is not prevalent. Captive sage-grouse also seem susceptible to salmonella, aspergillosis, and other bacterial, fungal, and viral diseases, so precautions should be taken to prevent introduction of these diseases into wild populations if captive birds are released. Captive breeding facilities for Attwater's prairie-chicken have experienced outbreaks of Reticulendotheliosis viruses (REV), which has resulted in transmission to wild birds upon release (Morrow 2017).

Conclusions

- Sage-grouse can be artificially incubated, hatched, reared, maintained, and bred, and will produce viable eggs in captivity.
- Relatively low hatchability and survival rates in captivity suggest egg collections from wild clutches could be substantial to produce a sizable captive flock for captive egg production.
- Release of 1-5-day old captive-reared chicks to existing brood hens is effective, but is not likely to be a strategy that could be scaled up. Survival of sage-grouse juveniles released at 8-12 weeks has not been evaluated but should be evaluated if releases at this age are contemplated.
- Techniques for captive rearing of sage-grouse are still in their infancy although significant strides have been made in the last 10 years. Methods associated with artificial insemination, controlling bacterial disease, disease prevention and control, and other aspects of husbandry need additional research. Zoos or other conservation partners with a similar mission, in collaboration with state or provincial wildlife agencies, may be in the best position to fund and staff this kind of research.
- Pending refinement and demonstration of the effectiveness of captive breeding and release of sage-grouse, other approaches to augmentation appear to be more certain and likely to be less costly and impactful to source populations.
- Sage-grouse population size varies substantially over time in response to environmental stochasticity. Augmentations by any means are not necessary for recovery from declines in relatively large contiguous habitats in good conditions. Augmentations are unlikely to have any success in small and isolated populations until and unless the environmental conditions that precipitated sage-grouse declines have been mitigated.

Literature cited can be found under the Sagebrush Ecosystem Initiative tab at wafwa.org

WAFWA
Western Association of Fish & Wildlife Agencies
Delivering conservation through information exchange and working partnerships

Interest in establishment of population goals, and use of population-based approaches for management of sage-grouse is high, but raises questions about feasibility, efficacy, and authorities. Sage-grouse are uniquely adapted to, and dependent on sagebrush habitats (Strategy 2006). Management approaches must include conservation of seasonal sagebrush habitats to be successful, a point emphasized in the Range-wide Sage-Grouse Conservation Strategy developed by the Western Association of Fish and Wildlife Agencies: "The overall goal of the range-wide Strategy is to maintain and enhance populations and distribution of sage-grouse *by protecting and improving sagebrush habitats and ecosystems that sustain these populations* (emphasis added).

When managing State or Federal trust species, a mix of habitat- and population-based approaches is typically employed. Population-based approaches are used in several situations. First, for species of economic importance where harvest is the predominant impact on populations: deer, elk, pronghorn, etc. Population objectives are typically set through some sort of public process and attempt to balance hunter demand with concerns relative to habitat or game damage. Population-based approaches are also used for many conservation reliant species, particularly endangered species with recovery plans. Typically, population and habitat goals are established, and potentially the full suite of habitat and population tools may be employed to overcome threats, including predator control and captive breeding. Attwater's prairie chicken are a good example of this. Finally, population-based tools are employed by states when recreational demand exceeds or creates demand, for example state (or private) game farm production and release of native or non-native species such as pheasants, rainbow trout, walleyes, etc.

Sage-grouse have become a conservation reliant species, at least to deter listing under the Endangered Species Act. Setting and monitoring progress towards state-level (or other) population goals (if technically feasible) could be an effective way to:

1. Ensure (through state public processes) public participation in setting population objectives and a transparent view of real and opportunity costs these goals represent
2. Prioritize investment of conservation dollars (to areas below population goals)
3. Explicitly define when conservation goals will be met, quantitatively assess progress towards goals, and inform adaptive management constructs so course corrections can be made

If population goals are set, they should recognize state and federal authorities in management of state public trust species. The Fish and Wildlife Conservation Act: (16 U.S.C. §§ 2901-2911, September 29, 1980, as amended 1986, 1988, 1990 and 1992) states "Nothing in the Act should be construed as affecting: the authority, jurisdiction or responsibility of the states to manage, control or regulate fish and resident wildlife under state law…" (WAFWA 2011). Establishment of population goals for sage-grouse are the responsibility of states. However, realization of these goals cannot be achieved without habitat management and restoration on private lands and on Federal lands, so collaboration with local working groups and Federal land management agencies in goal setting is paramount.

Setting and managing to population goals is not realistic unless we have the capability to estimate sage-grouse population size. Breeding population size and trends have been modeled for the bi-state population of greater sage-grouse from lek count data and estimates of survival, nest success and other demographic parameters from telemetry data (Coates et al. 2015). Data for this type of model are not presently available range-wide, but McCaffery et al.

(2016) have developed a modeling approach to correct for males not detected during peak counts and estimate total number of male sage-grouse, and an integrated population model (IPM) to estimate total population (of males and females) using available data (McCaffery and Lukacs 2016). WAFWA is working with researchers from the University of Montana, USGS, FWS, and state agencies to develop a secure platform where state agencies can estimate sage-grouse population size and trends using the best available data. Initial estimates of minimum population size and trend at state and range-wide scales are feasible within the next year or two, but additional work will likely be needed to estimate total population size, refine demographic estimates that are input to models, and account for leks that are currently unknown and therefore not counted.

Other Considerations. While setting and working towards specific sage-grouse population goals has utility, the value of population-level strategies such as captive breeding, predator control, and eliminating hunting is less certain (see companion WAFWA white papers on these topics). Population-based management strategies employed to benefit sage-grouse would also fall under state, and not federal authority. Any, or all of these strategies can only be effective if sufficient quantity and quality of habitat is maintained.

Conservation efforts for sage-grouse, a large-landscape obligate of sagebrush habitats, also provide habitat for many of the 350 species that depend on sagebrush habitats (Rowland et al. 2006, Hanser and Knick 2011, Copeland et al. 2014). Sagebrush is a critical component of migration corridors and winter range for big game populations (Copeland et al. 2014) in much of the west. Population level management actions to benefit sage-grouse don't provide benefits to other sagebrush dependent species, particularly if they are used to mitigate for loss or degradation of habitat. For this reason, any significant retraction of habitat-based protections afforded in BLM Land Use Plan Amendments or Forest Plan Revisions may lead to additional petitions on sagebrush species of conservation concern such as pygmy rabbits. Effects of lethal control of sage-grouse predators on other sagebrush dependent species would be highly variable, uncertain, and potentially negative.

Conclusions:

- Establishment of sage-grouse population goals through a collaborative process led by states has utility to clearly delineate what success looks like and to aid in prioritization of investments in conservation. This will be technically feasible in the next year or two. Goals should be population ranges that recognize and account for the large population fluctuations (cycles) typical for this species.
- Efforts to enhance, restore, and protect habitats from conversion and degradation will be necessary to achieve population goals that are in aggregate sufficient to deter listing. Habitat efforts will benefit other sagebrush obligates and make petitions and listing of these species less likely.

Literature cited can be found under the Sagebrush Ecosystem Initiative tab at wafwa.org

WAFWA
Western Association of Fish & Wildlife Agencies

Delivering conservation
through information exchange
and working partnerships

Predator control is a technique that has been applied in research settings and on a limited basis at local scales as a tool to benefit sage-grouse populations. The cause of mortality for most sage-grouse is predation (Bergerud 1988), whether as an egg, chick, juvenile or adult. What is relevant to the long-term sustainability of sage-grouse populations is not how birds die, but rather the rate at which mortality including predation occurs and whether recruitment exceeds mortality.

Sage-grouse are not the primary prey for any predator, but instead predators that typically prey on rodents, rabbits, and hares also take sage-grouse (Schroeder et al. 1999, Hagen 2011). Eggs, chicks, and males on leks are most vulnerable to predation (Hagen 2011). Females have their highest mortality during the breeding season (Davis et al. 2014). Predators of chicks and adult sage-grouse include coyotes, red fox, badgers, bobcats, and several species of raptors, while egg depredation is frequently attributed to weasels, raccoon, common ravens, black-billed magpies, coyotes, badgers, bobcats, and snakes (Baxter et al. 2007, Coates et al. 2008, Coates and Delehanty 2010, Hagen 2011, Lockyer et al. 2013, Orning 2014).

Sage-grouse have co-evolved with the normal complement of predators in sagebrush habitats. However, populations that are isolated due to habitat fragmentation or those in degraded habitats (Baxter et al. 2007) may be more vulnerable to predation. Predation on nests and chicks can be high where habitat is depleted or where predators are over abundant (Gregg et al. 1994, Aldridge and Brigham 2001, Schroeder and Baydack 2001, Coates 2007, Coates et al. 2008, Lockyer et al. 2013). Altered habitats influence distribution and abundance of predator populations in the following ways:

- Predators benefit from human-supplied food and water, such as road-killed carrion, artificial water sources, landfills, livestock carcasses, and cereal crops (Boarman et al. 2006, Baxter et al 2007, Bui et al. 2010, Esque et al. 2010, Newsome et al. 2013, Coates et al. 2016).
- Human structures provide denning, roosting, nesting, and perching sites that did not previously exist for predators in sagebrush landscapes (Coates et al. 2014a;b, Howe et al. 2014).
- Predators achieve greater hunting efficiency in fragmented or degraded landscapes (Vander Haegen et al. 2002, Coates et al. 2014a;b, Howe et al. 2014).
- Human subsidies are linked to increased raven populations which have increased an estimated $\geq$ 4-fold in the western U.S. over the last 40 years (Boarman et al. 2006, Sauer et al. 2011, Howe et al. 2014).
- Increases in red fox and raccoon have also been attributed to human-induced landscape changes and subsidies (Fichter and Williams 1967, Bunnell 2000, Connelly et al. 2000, Baxter et al. 2007).

Predator control activities to benefit sage-grouse have been implemented and evaluated on a limited basis by management agencies, usually in a small-scale research setting or to support a reintroduction or augmentation effort. Some significant sage-grouse predators are protected by Federal law and cannot be (easily) lethally controlled, such as great horned owls, golden eagles, and other raptors. Results of predator control efforts have varied. Coyote removal in Wyoming improved hen survival during the nesting period; however, annual hen survival remained unchanged and nest success was higher in untreated sites (Orning 2014). In another study in southwest Wyoming, there was no measurable effects on nest and chick survival between coyote removal and non-removal areas (Slater 2003). Sage-grouse reproductive success and survival improved during an 8-year study which removed both terrestrial (primarily red fox) and avian (corvid) predators in Strawberry Valley, Utah (Baxter et al. 2007). Several studies have evaluated raven control because of concern over increasing raven populations in sage-grouse habitats. Increased sage-grouse nest success has been documented after raven removal in some studies, but they lacked a comparison to control areas (Batterson and Morse 1948, Coates and Delehanty 2004, Baxter et al. 2007). In Wyoming, sage-grouse nest success was higher in areas of raven removal than in non-treatment areas, but raven numbers rebounded once control efforts ceased (Dinkins et al. 2014). A separate Wyoming study found that

sustained raven removal at high levels increased nest success and may increase sage-grouse populations (Peebles 2015).

Other Considerations. Lethal removal of predators is controversial and likely to engender local and broader opposition. Non-lethal control efforts such as aversive conditioning (Conover and Lyons 2003), hazing, or contraception are likely to have greater public acceptance but we are not aware of any studies that evaluated efficacy of any of these methods in reducing depredation on sage-grouse. Lethal removal of predators in large landscapes is not likely to be practical or cost effective (Willis et al. 1993), and complete removal of the target predator is unlikely. Predator populations are capable of rebounding quickly once removal stops (Gregg et al. 1994, Witmer et al. 1996, Côté and Sutherland 1997, Crooks and Soule 1999, Mezquita et al. 2006, Baxter et al. 2007, Clark 2014, Orning 2014, Dinkins et al. 2014, Dinkins et al. 2016), so control efforts must be sustained if benefits are to persist. Lethal removal may result in unintended consequences such as increases in other, potentially more effective predator species (Mezquida et al. 2006) which may shift predation to other predators or life stages rather than reducing it.

A predator management approach that could achieve long-term conservation goals would include; 1) addressing habitat conditions that ultimately limit sage-grouse production (e.g. hiding cover, food resources) and that provide advantages to predators (e.g. fragmented habitat, non-native vegetation); and 2) eliminating human subsides that artificially support predator populations. Predator removal, in conjunction with habitat improvement and elimination of predator subsidies could be an appropriate short-term management action to address localized and critical population declines or during sage-grouse translocation programs.

Conclusions:

- Large-scale, sustained lethal predator control programs for sage-grouse are likely to engender significant public opposition (Messmer et al. 1999), will be very expensive, and unlikely to be effective unless habitat deficiencies are corrected. In areas where seasonal habitats are in good condition, predator control is not likely to be needed to sustain desirable densities of sage-grouse.
- Predator removal programs can achieve short-term benefits, but their ultimate utility as a long-term conservation tool to increase sage-grouse populations is less well established (Côté and Sutherland 1997, Dinkins et al. 2014, Orning 2014, Conover and Roberts 2017).
- Predator removal may be useful as a short-term management tool to increase nest success and survival when localized sage-grouse populations are declining and have reached a critically low level (Baxter et al. 2007, Conover and Roberts 2017).
- In degraded habitats, sustained predator control and removal of predator subsidies may increase nest success and chick survival to prevent further population declines allowing time for habitat improvement (USFWS 2013).
- Lethal predator control prior to and after releases of sage-grouse may increase survival of translocated sage-grouse in reintroductions or augmentations of local populations. Translocated birds are more vulnerable to predation (Musil et al. 1993, Stephenson et al. 2011).

Literature Cited is available under the Sagebrush Ecosystem Initiative tab at the WAFWA website.

WAFWA
WESTERN ASSOCIATION OF FISH & WILDLIFE AGENCIES

Delivering conservation through information exchange and working partnerships

Ten of 11 states where Greater Sage-grouse occur allow hunting of sage-grouse. Sage-grouse have been state-listed as Threatened in Washington since 1998, and have not been hunted since 1990. Although sage-grouse were found not warranted for listing under the Endangered Species Act in 2015 (FR 80:59858-59942), concern over the potential consequences of a Federal listing have raised questions about the potential impact of hunting on sage-grouse populations. It is important to note that the Fish and Wildlife Service, in their assessment of threats in the 2015 not-warranted listing decision, did not view regulated hunting as a significant threat to the species, but described the need for continued close attention by state wildlife agencies to monitor population trends and adjust seasons if needed (FR 80:59924). This paper reviews scientific information pertaining to impacts of regulated hunting on sage-grouse populations and describes measures states have taken to minimize potential impacts of sage-grouse hunting.

Dinkins and Beck (personal comm.) analyzed sage-grouse lek data and harvest estimates from 1995-2013 provided by states and two Canadian provinces in an attempt to elucidate patterns between relative harvest and lek trends. While analysis of these data continues, they have concluded that discontinuing harvest in smaller populations did not result in positive lek trends; however, discontinuing hunting seasons with relatively higher harvest pressure in the largest population in their analyses resulted in higher population growth rates. They also concluded that State and provincial wildlife agencies were adept in changing harvest regulations to prevent hunting sage-grouse populations facing significant lek trend declines.

Historically, sport harvest of sage-grouse and other upland birds was viewed as compensatory mortality (meaning it replaced natural mortality and was not additive to it), and had little or no impact on subsequent population sizes (Connelly and Reese 2008). Recently the idea that all harvest of sage-grouse or other upland birds is compensatory has been replaced by the idea that low levels of harvest may be compensatory, but higher levels of harvest may be at least partially additive to natural mortality (Connelly et al. 2003, Reese and Connelly 2011). Based on a review of the literature, Connelly et al. (2000) suggested that no more than 10% of the autumn population be removed through harvest, and that populations of fewer than 300 birds (100 males counted on leks) should not be hunted. Sedinger et al. (2010), based on an analysis of 18 years of band recovery data in Colorado, found strong evidence that harvest rates near 10% were compensatory and not additive.

States have responded to concern about sage-grouse status and to declining populations by adopting more conservative approaches to regulating hunting based on the Connelly et al. (2000) guidelines (responses through 2007 reviewed in Reese and Connelly 2008). All states now evaluate sage-grouse seasons annually and make modifications, if needed, based on trends in counts of males on leks. Wyoming, which has more birds over larger areas than any other state, has shifted opening dates later, reduced season length from 31 to 11 days, and reduced bag limits from 3 birds daily and 6 in possession to 2 birds daily and 4 in possession in an effort to reduce potential impacts to sage-grouse. Wyoming also closes areas with fewer than 300 birds, and recommends more conservative seasons ranging from closures to reduced season lengths and bag limits if populations are declining. Colorado evaluates 3-year moving average high male counts (HMC) against triggers in local conservation plans to recommend closure or modifications of hunting seasons and bags, with a maximum season length of 7 days and bag of 2 and 4 compared to historical season lengths of 30 days and bags of 3 daily and 9 in possession. Idaho uses an explicit Adaptive Harvest Management (AHM) approach where season length and bag limits are either: Closed, Restrictive (7-day season, bag of 1 and 2), or Standard (21-day season, bag of 2 and 4) based on how 3-year average trends in HMC within each of 14 management zones relate to a baseline. Montana reduced sage-grouse season length from 62 to 30 days in 2014, and has implemented their conservative bag limit (2 daily,

4 in possession) since 2007. Hunting is closed in any unit where average HMC is 45% or more below the long-term average for 3 or more consecutive years. Oregon establishes a maximum harvest of 5% of a management unit population estimate, then issues limited tags to maintain harvest below the 5% threshold. California has closed hunting in the Bi-State population of sage-grouse, hunting permit numbers in other areas are adjusted based on male counts and fall population estimates. The California Fish and Game Commission responded to low lek counts this Spring and closed seasons for 2017 based on a recommendation from the California Department of Fish and Wildlife. Nevada has also closed hunting to Bi-State sage-grouse, seasons in other areas are adjusted to conform to the Connelly et al. (2000) guidelines. Nevada estimates statewide harvest of sage-grouse has been between 2% and 6% of the estimated fall population annually, and has closed sage-grouse seasons in five counties including 23 separate hunt units since 1997 in response to local, short-term declines. South Dakota issues limited permits with a bag and possession limit of 1, and closes hunting seasons when less than 250 males are counted on leks in the spring. The sage-grouse hunting season will be closed in 2017 in South Dakota. North Dakota has also closed sage-grouse hunting seasons for the past several years because the number of males on leks has fallen below levels that will support hunting.

Other Considerations. Sage-grouse hunters and sportsmen in general represent a constituency of sage-grouse and sagebrush advocates. Hunting license fees and matching Federal aid dollars are used by state wildlife agencies for conservation and restoration activities on sagebrush rangelands that benefit sage-grouse, sagebrush dependent wildlife and grazing interests. Sage-grouse hunting also represents an economic boost to local communities. In addition, sex and age-ratios obtained from hunter-collected wings provide information that will be critical to estimation of sage-grouse population size and trends now and in the future. State wildlife agencies have thresholds and other means to close hunting seasons when necessary to prevent impacts to sage-grouse populations which increases public confidence; widespread closures of hunting when not needed may send a message that populations are far more imperiled than they are, which could lead to further land use restrictions.

Conclusions:

- Sage-grouse hunting is managed conservatively by state wildlife agencies consistent with established and scientifically supported guidelines, including closures when populations decline below levels that can support hunting.
- Sage-grouse hunting, as currently regulated, is likely compensatory in most areas and therefore not likely to increase overall mortality rates.
- State wildlife agencies continue to support research on effects of hunting and will continue to incorporate new information into hunting season recommendations in the future.
- Sage-grouse hunters have been, and remain an important ally in sage-grouse conservation efforts with a vested interest in insuring populations remain not warranted for listing.

Literature Cited is available under the Sagebrush Ecosystem Initiative tab at the WAFWA website

WAFWA
WESTERN ASSOCIATION OF FISH & WILDLIFE AGENCIES
Delivering conservation through information exchange and working partnerships

Literature Cited in WAFWA Tech. Committee White Papers on Predator Control, Captive Breeding and Population and Habitat Management

Aldridge, C. L. and R. M. Brigham. 2001. Nesting and reproductive activities of greater sage-grouse in a declining northern fringe population. The Condor 103:537-543.

Apa, A. D., and L. A. Wiechman. 2015. Captive-rearing of Gunnison sage-grouse from egg collection to adulthood to foster proactive conservation and recovery of a conservation-reliant species. Zoo Biology 34:438-452.

Apa, A. D., and L. A. Wiechman. 2016. Captive-breeding of captive and wild-reared Gunnison sage-grouse. Zoo Biology 35:70-75.

Apa, A. D., T. R. Thompson, and K. P. Reese. 2017. Juvenile greater sage-grouse survival, movements, and recruitment in Colorado. Journal of Wildlife Management 81:652-668.

Baxter, R. J., K. D. Bunnell, J. T. Flinders, and D. L. Mitchell. 2007. Impacts of predation on greater sage-grouse in Strawberry Valley, Utah. Transactions of the 72nd North American Wildlife and Natural Resources Conference 72:258-269

Batterson , W. M., and W. B. Morse. 1948. Oregon sage grouse. Fauna Series Number 1. Oregon State Game Commission, Portland, OR.

Baxter, R. J., K. D. Bunnell, J. T. Flinders, and D. L. Mitchelll 2007. Impacts of predation on Greater Sage-Grouse in Strawberry Valley, Utah. Transactions of the 72nd North American Wildlife and Natural Resources Conference 72:258-269.

Bergerud, A. T. 1988. Mating systems in grouse. in A. T. Bergerud and M. W. Gratson, editors. Adaptive strategies and population ecology of northern grouse. University of Minnesota Press, Minneapolis, MN, USA.

Boarman, W., M. Patten, R. Camp, and S. Collis. 2006. Ecology of a population of subsidized predators: Common ravens in the central Mojave Desert, California. Journal of Arid Environments 67:248-261.

Bui, T.-V. D., J. M. Marzluff, and B. Bedrosian. 2010. Common raven activity in relation to land use in western Wyoming: implications for greater sage-grouse reproductive success. The Condor 112:65-78.

Bump, G., R. W. Darrow, F. C. Edminster, and W. F. Crissey. 1947. The ruffed grouse. Life history-propagation-management. 915 pp. State of New York Conservation Department, New York

Bunnell, K. D. 2000. Ecological factors limiting sage grouse recovery and expansion in Strawberry Valley, Utah. M.S. Thesis, Brigham Young University, Provo, UT

Clark, D. 2014. Implications of cougar prey selection and demography on population dynamics of elk in northeast Oregon. PhD, Oregon State University, Corvallis, Oregon USA.

Coates, P. S., and D. J. Delehanty. 2004. The effects of raven removal on sage-grouse nest success. Proceedings Vertebrate Pest Conference 21:17.

Coates, P. S. 2007. Greater Sage-Grouse (*Centrocercus urophasianus*) nest predation and incubation behavior. Dissertation, Idaho State University, Pocatello, Idaho, USA.

Coates, P. S., J. W. Connelly, and D. J. Delehanty. 2008. Predators of Greater Sage-Grouse nests identified by video monitoring. Journal of Field Ornithology 79:421-428.

Coates, P. S., B. E. Brussee, K. B. Howe, K. B. Gustafson, M. L. Casazza, and D. J. Delehanty. 2016. Landscape characteristics and livestock presence influence common ravens: relevance to greater sage-grouse conservation. Ecosphere 7:1-20.

Coates, P. S. and D. J. Delehanty. 2010. Nest predation of greater sage-grouse in relation to microhabitat factors and predators. Journal of Wildlife Management 74:240-248.

Coates, P. S., B. J. Halstead, E. J. Blomberg, B. Brussee, K. B. Howe, L. Wiechman, J. Tebbenkamp, K. P. Reese, S. C. Gardner, and M. L. Casazza. 2014. A hierarchical integrated population model for Greater Sage-Grouse (*Centrocercus urophasianus*) in the Bi-State Distinct Population Segment, California and Nevada. U.S. Geological Survey Open-File Report 2014-1165, 34 p., http://dx.doi.org/10.3133/ofr20141165..

Coates, P. S., K. B. Howe, M. L. Casazza, and D. J. Delehanty. 2014a. Common raven occurrence in relation to energy transmission line corridors transiting human-altered sagebrush steppe. Journal of Arid Environments 111:68-78.

_____. 2014b. Landscape alterations influence differential habitat use of nesting buteos and ravens within sagebrush ecosystem: Implications for transmission line development. The Condor 116:341-356.

Connelly, J. W., A. D. Apa, R. B. Smith, and K. P. Reese. 2000. Effects of predation and hunting on adult sage grouse *Centrocercus urophasianus* in Idaho. Wildlife Biology 6:227-232.

Connelly, J. W., C. A. Hagen, and M. S. Schroeder. 2011. Characteristics and dynamics of greater sage-grouse populations. in Greater Sage-Grouse: ecology and conservation of a landscape species and its habitat. Studies in Avian Biology 38. University of California Press, Berkeley, California, USA.

Conover, M.R., and A.J. Roberts. 2017. Predators, predator removal, and Sage-Grouse: A review. The Journal of Wildlife Management 81:7-15.

Copeland, H. E., H. Sawyer, K. L. Monteith, D. E. Naugle, A. Pocewicz, N. Graf, and M. J. Kauffman. 2014. Conserving migratory mule deer through the umbrella of sage-grouse. Ecosphere 5:117. http://dx.doi.org/10.1890/ES14-00186.1

Côté, I. M. and W. J. Sutherland. 1997. The effectiveness of removing predators to protect bird populations. Conservation Biology 11:395-405.

Crooks, K. R. and M. E. Soule. 1999. Meso-predator release and avifaunal extinctions in a fragmented system. Nature 400:563-566.

Davis, D.M., K. P. Reese, S. C. Gardner. 2014. Demography, reproductive ecology, and variation in survival of greater sage-grouse in Northeastern California. Journal of Wildlife Management. 78:1343-1355.

Dinkins, J.B., M.R. Conover, C.P. Kirol, J.L. Beck, and S.N. Frey. 2014. Effects of common raven removal and temporal variation in weather on greater sage-grouse nesting success. 29th Western Agencies Sage and Columbian Sharp-tailed Grouse Workshop. June 17-19, 2014, Elko, NV.

Dinkins, J. B., M. R. Conover, C. P. Kirol, J. L. Beck, and S. N. Frey. 2016. Effects of common raven and coyote removal and temporal variation in climate on greater sage-grouse nesting success. Biological Conservation 202:50–58.

Esque, T. C., K. E. Nussear, K. Drake, A. D. Walde, K. H. Berry, R. C. Averill-Murray, A. Woodman, W. I. Boarman, P. A. Medica, and J. Mack. 2010. Effects of subsidized predators, resource variability, and human population density on desert tortoise populations in the Mojave Desert, USA. Endangered Species Research 12:167-177.

Fichter E., and R. Williams. 1967. Distribution and status of the red fox in Idaho. Journal of Mammalogy. 48:219-230.

Gregg, M. A., J. A. Crawford, M. S. Drut, and A. K. DeLong. 1994. Vegetational cover and predation of sage grouse nests in Oregon. The Journal of Wildlife Management:162-166.

Hagen, C. 2011a. Predation on greater sage grouse: facts, process, and effects. in Greater Sage-Grouse: ecology and conservation of a landscape species and its habitat. Studies in Avian Biology 38. University of California Press, Berkeley, California, USA.

Hanser, S. E., and S. T. Knick. 2011. Greater sage-grouse as an umbrella species for shrubland passerine birds: a multiscale assessment. Studies in Avian Biology 38:475-488.

Howe, K. B., P. S. Coates, and D. J. Delehanty. 2014. Selection of anthropogenic features and vegetation characteristics by nesting Common Ravens in the sagebrush ecosystem. The Condor 116:35-49.

Huwer, S. L. 2004. Evaluating greater sage-grouse brood habitat using human-imprinted chicks. Thesis, Colorado State University, Fort Collins, USA.

Huwer, S. L., D. R. Anderson, T. E. Remington and G. C. White. 2008. Using human-imprinted chicks to evaluate the importance of forbs to sage-grouse. Journal of Wildlife Management 72:1622-1627.

Johnson, G. D., and M. S. Boyce. 1990. Feeding trials with insects in the diet of Sage-Grouse chicks. Journal of Wildlife Management 54:89-91.

Johnson, G. D., and M. S. Boyce. 1991. Survival, growth, and reproduction of captive-reared sage-grouse. Wildlife Society Bulletin 19:88-93.

Leif, A. P. 1994. Survival and reproduction or wild and pen-reared ring-necked pheasants. Journal of Wildlife Management 58:501-506.

Ligon J.S. 1946. Upland game bird restoration through transplanting. 108p. N. Mexico Dept. Game and Fish.

Lockyer, Z. B., P. S. Coates, M. L. Casazza, S. Espinosa, and D. J. Delehanty. 2013. Greater Sage-Grouse Nest Predators in the Virginia Mountains of Northwestern Nevada. Journal of Fish and Wildlife Management 4:242-255.

Matthews, S. R., P. S. Coates, M. L. Casazza, and D. J. Delehanty. 2014. Using artificial insemination to promote fertilization of translocated female Columbian sharp-tailed grouse. Transactions of the 29th Sage- and Columbian Sharp-tailed Grouse Workshop. Abstract only.

McCaffery, R., J. J. Nowak, and P. M. Lukacs, P. M. 2016. Improved analysis of lek count data using N-mixture models. Journal of Wildlife Management 80:1011–1021.

McCaffery, R., and P. M. Lukacs. 2016. A generalized integrated population model to estimate greater sage-grouse population dynamics. Ecosphere 7: e01585

Messmer, T. A., M. W. Brunson, D. Reiter, and D. G. Hewitt. 1999. United States public attitudes regarding predators and their management to enhance avian recruitment. Wildlife Society Bulletin 27:75-85.

Mezquida, E. T., S. J. Slater, and C. W. Benkman. 2006. Sage-grouse and indirect interactions: potential implications of coyote control on sage-grouse populations. Condor 108:747-759.

Morrow, M. E. 2017. Attwater's prairie chicken recovery, January 1 to December 31, 2016. Unpublished report, United States Fish and Wildlife Service. 51 pp.

Musil, D. D., J. W. Connelly, and K. P. Reese. 1993. Movements, survival, and reproduction of greater sage-grouse translocated into central Idaho. Journal of Wildlife Management. 57:85-91

Newsome, T. M., J. A. Dellinger, C. R. Pavey, W. J. Ripple, C. R. Shores, A. J. Wirsing, and C. R. Dickman. 2014. The ecological effects of providing resource subsidies to predators. Global Ecology and Biogeography.

Oesterle, P., R. McLean, M. Dunbar, and L. Clark. 2005. Husbandry of wild-caught greater sage-grouse. Wildlife Society Bulletin 33:1055-1061.

Orning, E. K. 2014. Effect of predator removal on greater sage-grouse (*Centrocercus urophasianus*) ecology in the Bighorn Basin Conservation Area of Wyoming. Thesis, Utah State University, Logan, Utah, USA.

Peebles, L.W. 2015. Winter ecology of common ravens in southern Wyoming and the effects of raven removal on greater sage-grouse populations. Thesis Utah State University, Logan Utah, USA.

Pyrah, D. B. 1961. Artificial propagation of sage grouse for experimental purposes. Federal Aid Project 125-R-1, Idaho Department of Fish and Game. 14 pp.

Reese, K. P, and J. W. Connelly. 1997. Translocations of Sage Grouse *Centrocercus urophasianus* in North America. Wildlife Biology 3:235-241.

Remington, T. E., and C. E. Braun. 1988. Carcass composition and energy reserves of sage grouse during winter. Condor: 90:15-19.

Rowland, M. M., M. J. Wisdom, L. H. Suring, and C. W. Meinke. 2006. Greater sage-grouse as an umbrella species for sagebrush-associated vertebrates. Biological Conservation 129:323-335.

Sauer, J. R., J. E. Hines, J. E. Fallon, K. L. Pardieck, D. J. Ziolkowski Jr., and W. A. Link. 2011. The North American breeding bird survey, results and analysis 1966-2009. USGS Patuxent Wildlife Research Center, Laurel, MD, USA.

Schroeder, M. A. and R. K. Baydack. 2001. Predation and the management of prairie grouse. Wildlife Society Bulletin 29:24-32.

Schroeder, M. A., J. R. Young, and C. E. Braun. 1999. Sage-grouse (*Centrocercus urophasianus*). in A. Poole and F. Gill, editors. The Birds of North America, Number 425. The Academy of Natural Sciences, Philadelphia, PA, USA.

Slater, S. J. 2003. Sage-grouse (*Centrocercus urophasianus*) use of different-aged burns and the effects of coyote control in southwestern Wyoming. M. S. Thesis, University of Wyoming, Laramie.

Spurrier, M. F., M. S. Boyce, and B. F. J. Manly. 1994. Lek behaviour in captive sage grouse *Centrocercus urophasianus*. Animal Behaviour 47: 303-310.

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

Thompson, T. R., A. D. Apa, K. P. Reese, and K. M. Tadvick. 2015. Captive rearing sage-grouse for augmentation of surrogate wild broods: evidence for success. Journal of Wildlife Management 79:998-1013.

U.S. Fish and Wildlife Service. 2013. Greater sage-grouse (*Centrocercus urophasianus*) conservation objectives: final report. U.S. Fish and Wildlife Service, Denver, CO, USA.

Vander Haegen, W. M., M. A. Schroeder, and R. M. DeGraaf. 2002. Predation on real and artificial nests in shrubsteppe landscapes fragmented by agriculture. The Condor 104:496-506.

Willis, M. J., G. P. Keister, Jr., D. A. Immell, D. M. Jones, R. M. Powell, and K. R. Durbin. 1993. Sage grouse in Oregon - Wildlife Research Report No. 15. Oregon Department Fish and Wildlife, Portland, OR, USA.

Witmer, G. W., J. L. Bucknall, T. H. Fritts, and D. G. Moreno. 1996. Predator management to protect endangered avian species. Transactions of the North American Wildlife and Natural Resources Conference 61:102-108.