

**Using the Best Available Science to Coordinate Conservation Actions that  
Benefit Greater Sage-Grouse Across States Affected by Oil & Gas Development in  
Management Zones I-II (Colorado, Montana, North Dakota, South Dakota, Utah,  
and Wyoming)**

### **Background**

Greater Sage-grouse are widely considered in scientific and public policy arenas to be a species of significant conservation concern. Loss, degradation and fragmentation of important sagebrush grassland habitats have negatively impacted sage-grouse populations. Much of this loss of habitat function is occurring in Sage-grouse Management Zones (MZ) 1 and 2 (Stiver et al. 2006) in Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming as a result of oil and gas development (Connelly et al. 2004). Oil and gas development is rapidly increasing within these areas. In response to those concerns, states and provinces are in various stages of completing or updating management plans in order to provide for long-term sage-grouse conservation. Special emphasis is being placed on oil and gas development as it rapidly spreads across much of the eastern range of sage-grouse.

The recent decision by B. Lynn Winmill, Chief U.S. District Judge (2007), which remands the original 2005 not warranted decision back to the USFWS for reconsideration, has highlighted the need for States to coordinate their application of best available science. Representatives from the state agencies with authority for managing fish and wildlife from the major sage-grouse and energy producing states comprising MZ 1 and 2 and sage-grouse researchers who have published new findings, met on January 8 and 9, 2008 in Salt Lake City. The objectives of the meeting were to better understand the application of most recent peer-reviewed science within the context of oil and gas development and coordinate and compare implementation of conservation actions utilizing that information.

### **Review Process**

The participants at this meeting represented technical science and management advisors from each of the states. Researchers having the most recently peer reviewed and published articles concerning sage grouse and oil and gas development were invited to present their findings and answer questions. State agency participants agreed that the goal was not to establish state or regional policy or to determine the management actions that will be implemented in any or all states within MZ 1 or 2. Rather, the goal was to reach agreement on the conservation concepts and strategies related to oil and gas development that are supported by current published peer-reviewed and unpublished literature. If implemented, these concepts and strategies likely will not eliminate impacts to sage-grouse populations that result from energy development. However, when used in combination with other conservation measures, these actions may enhance the likelihood that sage-grouse populations will persist at levels that allow historical uses such as grazing and agriculture and maintain their current distribution and abundance, thereby avoiding the need to list sage-grouse under the federal Endangered Species Act.

Each researcher was invited to present their findings and to answer questions posed by the states. Following this, each state provided an overview of their review of the science and their resulting management actions and recommendations. The group then collectively reviewed, debated and agreed on the concepts and strategies supported by that science. The focus of the meeting was on five key issues: core areas, no-surface-occupancy zones, phased development, timing stipulations, well-pad densities, and restoration. Scientific data are available to inform many other issues related to sage-grouse management and conservation that were not reviewed (e.g., BMPs).

### **Core Areas**

Identification and protection of core areas, sometimes also referred to as crucial areas, will help maintain or achieve target goals for populations including distribution and abundance.

Full field energy development appears to have severe negative impacts on sage-grouse populations under current lease stipulations (Lyon and Anderson 2003, Holloran 2005, Kaiser 2006, Holloran et al. 2007, Aldridge and Boyce 2007, Walker et al 2007, Doherty et al. 2008). Much of greater sage-grouse habitat in MZ 1 and 2 has already been leased for oil and gas development. These leases carry stipulations that have been shown to be inadequate for protecting breeding and wintering sage-grouse populations during full field development. (Holloran 2005, Walker et. al. 2007, Doherty et al. 2008) New leases continue to be issued utilizing these same stipulations. To ensure long-term persistence of populations and meet goals set by the states for sage-grouse, identifying and implementing greater protection within core areas from impacts of oil and gas development is a high priority.

In order to conserve core areas it is essential that they be identified and delineated. Sage-grouse populations occur over large landscapes comprising a series of leks and lek complexes with associated seasonal habitats. Therefore, core areas should capture the range required by a defined population to maintain itself. This concept is consistent with Crucial Wildlife Habitats recently endorsed by the Western Governor's Association (2007). Criteria that could be used to identify and map core areas include, but are not limited to: (1) lek densities, (2) displaying male densities, (3) sagebrush patch sizes, (4) seasonal habitats (breeding, summering, wintering areas), (5) seasonal linkages, or (6) appropriate buffers around important seasonal habitats.

Research indicates that oil or gas development exceeding approximately 1 well pad per square mile with the associated infrastructure, results in calculable impacts on breeding populations, as measured by the number of male sage-grouse attending leks (Holloran 2005, Naugle et al. 2006). Because breeding, summer, and winter habitats are essential to populations, development within these areas should be avoided. If development cannot be avoided within core areas, infrastructure should be minimized and the area should be managed in a manner that effectively conserves sagebrush habitats within that area.

### No Surface Occupancy (NSO)

At the scale that NSOs are established, they alone will not conserve sage-grouse populations without being used in combination with core areas. The intent of NSOs is to maintain sage-grouse distribution and a semblance of habitat integrity as an area is developed.

### *Breeding Habitat - Leks*

Research in Montana and Wyoming in coal-bed methane natural gas (CBNG) and deep-well fields suggests that impacts to leks from energy development are discernable out to a minimum of 4 miles, and that some leks within this radius have been extirpated as a direct result of energy development (Holloran 2005, Walker et al. 2007). Walker et al. (2007) indicates that the current 0.25-mile buffer lease stipulation is insufficient to adequately conserve breeding sage-grouse populations in areas having full CBNG development. A 0.25-mi. buffer leaves 98% of the landscape within 2 miles open to full-scale energy development. In a typical landscape in the Powder River Basin, 98% CBNG development within 2 miles of leks is projected to reduce the average probability of lek persistence from 87% to 5% (Walker et al. 2007). Only 38% of 26 leks inside of CBNG development remained active compared to 84% of 250 leks outside of development (Walker et al. 2007). Of leks that persisted, the numbers of attending males were reduced by approximately 50% when compared to those outside of CBNG development (Walker et al. 2007).

The impact analyses provided in Walker et al. (2007) are based on a 7-year dataset where probability of lek persistence is strongly related to extent of sagebrush habitat and the extent of energy development within 4 miles of the lek and the extent of agricultural tillage in the surrounding landscape. The estimated probabilities of lek persistence are only reliable for the length of the dataset, and it is not understood how other stressors (e.g., West Nile virus [Naugle et al. 2004], invasive weeds [Bergquist et al. 2007]) will cumulatively impact sage-grouse over longer time periods. While increased NSO buffers alone are unlikely to conserve sage-grouse populations, results from Walker et al. 2007 suggest they will increase the likelihood of maintaining the distribution and abundance of grouse and should increase the likelihood of successful restoration following energy development.

Additional information provided in Walker et al. (2007) allows managers and policy makers to estimate trade-offs associated with allowing development within a range of different distances from leks (Figures 1a and 1b). These probabilities will also need to be applied over larger landscapes in future analyses to better understand projected region- and state-wide population impacts under current and future development scenarios. Walker et al. (2007) studied lek persistence from 1997-2005 in relation to coal bed natural gas (CBNG) development in the Powder River Basin. These models are based on projected impacts of full-field development within (a) 2 miles and (b) 4 miles of the lek. We present results from these models (rather than models with impacts at smaller scales)

because development within 2 and 4 miles of leks are known to decrease breeding populations as measured by the number of displaying males (Holloran et al. 2005, Walker et al. 2007), and 52% and 74-80% of hens are known to nest within 2 and 4 miles of leks, respectively (Holloran and Anderson 2005, Colorado Greater Sage-Grouse Conservation Plan Steering Committee 2008). Sizes of NSO buffers required to protect breeding populations may be underestimated because leks in CBNG fields have fewer males per lek and a time lag occurs (avg. 3-4 years) between development and when leks go inactive. As a result, it is expected that not only will lek persistence decline, the number of males per lek will also decline. In contrast, sizes may be overestimated where high lek densities cause buffers from adjacent leks to overlap. Additional time is required to develop models demonstrating the probabilities of lek persistence at well-pad densities less than full development.

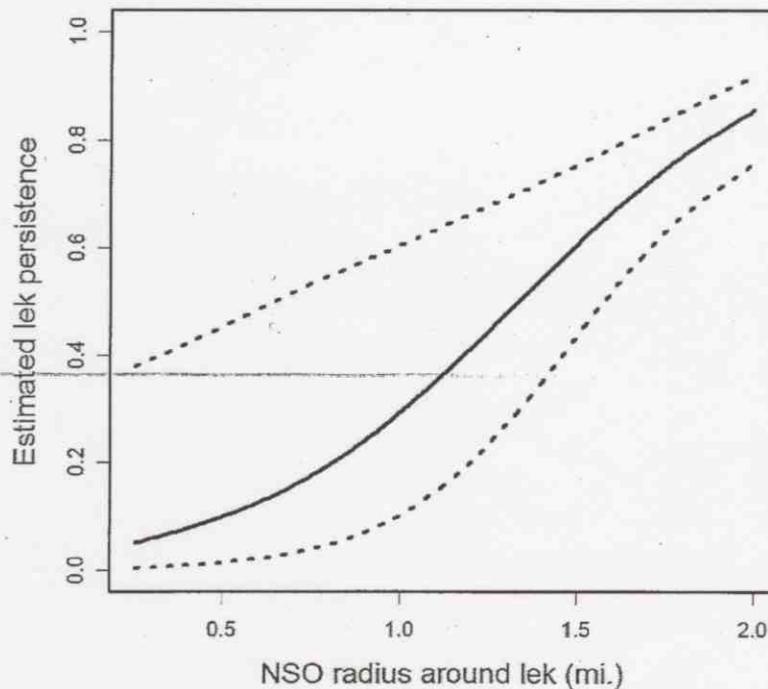


Figure 1a. Estimated probability of lek persistence (dashed lines represent 95% CIs) in fully-developed<sup>1</sup> coal-bed natural gas fields within an average landscape in the Powder River Basin (74% sagebrush habitat, 26% other habitats types) with different sizes of no-surface-occupancy (NSO) buffers around leks, assuming that only CBNG within 2 miles of the lek affects persistence. Buffer sizes of 0.25 mi., 0.5 mi., 0.6 mi., and 1.0 mi. result in estimated lek persistence of 5%, 11%, 14%, and 30%. Lek persistence in the absence of CBNG averages ~85%.

<sup>1</sup> Defined as entire area outside the NSO buffer, but within 2 miles, being within 350 meters of a well.

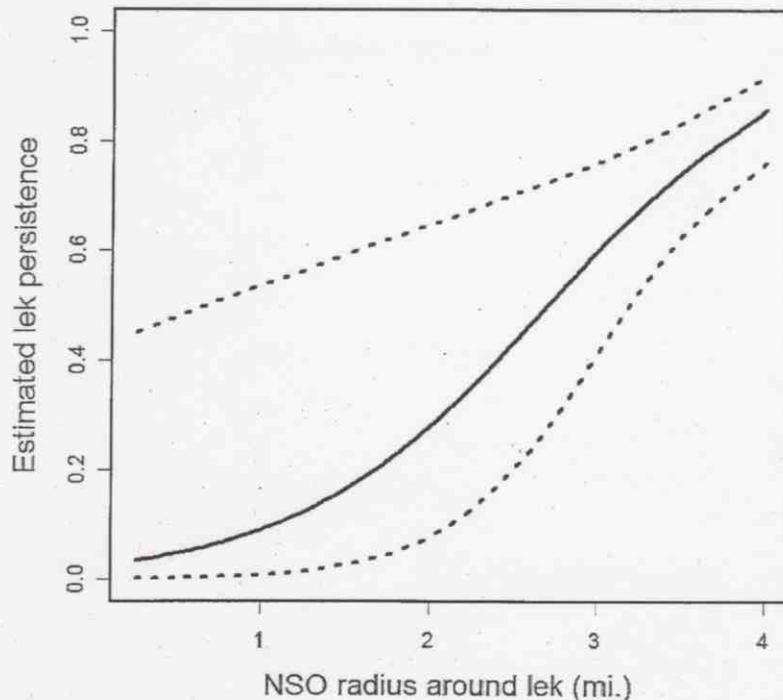


Figure 1b. Estimated probability of lek persistence (dashed lines represent 95% CIs) in fully-developed<sup>2</sup> coal-bed natural gas fields within an average landscape in the Powder River Basin (74% sagebrush habitat, 26% other habitats types) with different sizes of no-surface-occupancy (NSO) buffers around leks, assuming that only CBNG within 4 miles of the lek affects persistence. Buffer sizes of 0.25 mi., 0.5 mi., 0.6 mi., 1.0 mi., and 2.0 mi. result in estimated lek persistence of 4%, 5%, 6%, 10%, and 28%. Lek persistence in the absence of CBNG averages ~85%.

Figures 1a and 1b provide an illustration of the trade-offs between differing NSO buffers in relation to lek persistence in developing CBNG fields. The group does not offer a specific NSO recommendation but provides these graphs to guide decision-making.

#### *Breeding Habitat - Nesting and Early Brood-rearing*

Yearling female greater sage-grouse avoid nesting in areas within 0.6 miles of producing well pads (Holloran et al. 2007), and brood-rearing females avoid areas within 0.6 miles of producing wells (Aldridge and Boyce 2007). This suggests a 0.6-mile NSO around all suitable nesting and brood-rearing habitats is required to minimize impacts to females during these seasonal periods. In areas where nesting habitats have not been delineated, research suggests that greater sage-grouse nests are not randomly distributed. Rather, they are spatially associated with lek location within 3.1 miles in Wyoming (Holloran and Anderson 2005). However, a 4-mile buffer is needed to encompass 74-80% (Moynahan

<sup>2</sup> Defined as entire area outside the NSO buffer, but within 4 miles, being within 350 meters of a well.

2004, Holloran and Anderson 2005, Colorado Greater Sage-Grouse Conservation Plan Steering Committee 2008). These suggest that all areas within at least 4-miles of a lek should be considered nesting and brood-rearing habitats in the absence of mapping.

#### *Winter Habitat*

NSO or other protections may also need to be considered for crucial winter range. Survival of juvenile, yearling, and adult females are the three most important vital rates that drive population growth in greater sage-grouse (Holloran 2005, Colorado Greater Sage-Grouse Conservation Plan Steering Committee 2008). Although overwinter survival in sage-grouse is typically high, severe winter conditions can decrease hen survival (Moynahan et al 2006). Crucial wintering habitats can constitute a small part of the overall landscape (Beck 1977, Hupp and Braun 1989). Doherty et al. (2008) demonstrated that sage-grouse avoided otherwise suitable wintering habitats once they have been developed for energy production, even after timing and lek buffer stipulations had been applied (Doherty et al. 2008). For this reason, increased levels of protection may need to be considered in crucial winter habitats.

#### **Phased Development**

Population-level impacts and avoidance associated with energy development have been documented (Braun et al. 2002, Lyon and Anderson 2003, Holloran 2005, Kaiser 2006, Holloran et al. 2007, Aldridge and Boyce 2007, Walker et al 2007, Doherty et al. 2008). Phased development maximizes the amount of area within a landscape that is not being impacted by development at any one time, and can occur at multiple spatial scales (e.g., phased development of separate fields in a landscape, phased development of infrastructure within a single unit or field, or phased development within a single lease). Unitization, clustering, and geographically staggered development are all forms of phased development. As a tool to minimize impacts to sage-grouse, developing oil and gas resources by employing one of these phased methods may help maintain large, functional blocks of sage-grouse habitat.

#### **Timing Stipulations**

As with NSOs, at the scale that timing stipulations are established, they alone will not conserve sage-grouse populations without being used in combination with core areas. The intent of timing stipulations is to help maintain sage-grouse distribution and a semblance of habitat integrity as an area is developed. Timing stipulations are of lesser value at the scale of full-field development.

#### *Breeding Habitat - Leks*

Traffic during the strutting period when males are on a lek results in declines in male attendance when road-related disturbance is within 0.8 miles (Holloran 2005). The distance traveled by males from the lek during the breeding season has been reported in varying ways but generally averages 0.6 miles from a lek (Colorado Greater Sage-Grouse

Conservation Plan Steering Committee 2008 - see Appendix B). Additionally, females breeding on leks within 1.9 miles of natural gas development had lower nest initiation rates and nested farther from the lek compared to non-impacted individuals (Lyon and Anderson 2003), suggesting disturbance to leks influence females as well. Local variations may influence the application of specific dates, which are typically within a window of March 1 and May 31.

#### *Breeding Habitat - Nesting and Early Brood-rearing*

Often, timing stipulations (periods where no activity that creates disturbance are allowed) for breeding habitat have been applied using a radius around a lek. However, nesting and brood-rearing habitat is not uniformly distributed around the lek. Mapping of habitat would allow for more accurate application of this stipulation. Research on the distribution of nests relative to leks and on the timing of nesting indicates that timing stipulations to protect nesting hens and their habitat should be in place from March through June in mapped breeding habitat or (when nesting habitat has not been mapped) within 4 miles of active lek sites (Moynahan 2004, Holloran et al. 2005, Colorado Greater Sage-Grouse Conservation Plan Steering Committee 2008).

#### *Winter Habitat*

Research suggests that no surface occupancy should also be applied to important wintering habitats (Doherty et al. 2008), but if development occurs, impacts would be reduced if development activities were avoided between December 1 and March 15.

#### **Well-Pad Densities**

Leks tend to remain active when well-pad densities within 1.9 miles of leks are less than 1 pad per square mile (Holloran 2005) but leks tend to go inactive at higher pad densities (Holloran 2005, Naugle et al. 2006).

#### **Restoration**

The purpose of restoration in sage-grouse habitat should be the removal of infrastructure associated with energy development from the land surface and subsequent re-establishment of native grasses, forbs, and shrubs, including sagebrush, to promote natural ecological function. Restoration should reestablish functionality of seasonal habitats for sage-grouse. Thus a field should not be considered restored until sagebrush-grassland habitats have been reestablished.

#### **Future Needs**

Time did not allow for a detailed discussion of specific Best Management Practices for oil and gas development and restoration, seasonal habitat mapping, or future research. These topics are all recognized as needing action in the immediate future.

### Literature Cited

- Aldridge, C. L., and M. S. Boyce. 2007. Linking occurrence and fitness to persistence: a habitat-based approach for endangered greater sage-grouse. *Ecological Applications* 17:508-526.
- Beck, T. D. I. 1977. Sage grouse flock characteristics and habitat selection during winter. *Journal of Wildlife Management* 41:18-26.
- Bergquist, E., P. Evangelista, T. J. Stohlgren, and N. Alley. 2007. Invasive species and coal bed methane development in the Powder River Basin, Wyoming. *Environmental Monitoring and Assessment*. 128:381-394.
- Braun, C. E., O. O. Oedekoven, and C. L. Aldridge. 2002. Oil and gas development in western North America: effects on sagebrush steppe avifauna with particular emphasis on sage grouse. *Transactions North American Wildlife and Natural Resources Conference* 67:337-349.
- Colorado Greater Sage-Grouse Conservation Plan Steering Committee. 2008. The Colorado Greater Sage-Grouse Conservation Plan. Colorado Division of Wildlife. Denver, CO. Unpublished Report.
- Connelly, J. W., S. T. Knick, M. A. Schroeder, and S. J. Stiver. 2004. Conservation assessment of greater sage-grouse and sagebrush habitats. Western Association of Fish and Wildlife Agencies, Cheyenne, Wyoming, USA.
- Doherty, K.E., D.E. Naugle, B.L. Walker, J.M. Graham. 2008. Greater sage-grouse winter habitat selection and energy development. *Journal of Wildlife Management* *In Press*.
- Holloran, M. J. 2005. Greater sage-grouse (*Centrocercus urophasianus*) population response to natural gas field development in western Wyoming. Dissertation. University of Wyoming, Laramie, USA.
- Holloran, M. J. and S. H. Anderson. 2005. Spatial distribution of greater sage-grouse nests in relatively contiguous sagebrush habitats. *Condor* 107:742-752.
- Holloran, M. J., B. J. Heath, A. G. Lyon, S. J. Slater, J. L. Kuipers, and S. H. Anderson. 2005. Greater sage-grouse nesting habitat selection and success in Wyoming. *Journal of Wildlife Management* 69: 638-649.
- Holloran, M. J., R. C. Kaiser, and W. A. Hubert. 2007. Population response of yearling greater sage-grouse to the infrastructure of natural gas fields in southwestern Wyoming. Completion report. Wyoming Cooperative Fish and Wildlife Research Unit, Laramie, WY, USA.

- Hupp, J. W. and C. E. Braun. 1989. Topographic distribution of sage grouse foraging in winter. *Journal of Wildlife Management* 53: 823-829.
- Kaiser, R. C. 2006. Recruitment by greater sage-grouse in association with natural gas development in western Wyoming. Thesis. University of Wyoming. Laramie, USA.
- Lyon, A. G. and S. H. Anderson. 2003. Potential gas development impacts on sage grouse nest initiation and movement. *Wildlife Society Bulletin* 31:486-491.
- Moynahan B. J. 2004. Landscape-scale factors affecting population dynamics of greater sage-grouse (*Centrocercus urophasianus*) in northcentral Montana, 2001–2004. Dissertation, The University of Montana. Missoula, USA.
- Moynahan, B.J., M.S. Lindberg, and J.W. Thomas. 2006. Factors contributing to process variance in annual survival of female greater sage-grouse in north-central Montana. *Ecological Applications* 16:1529-1538.
- Naugle, D. E., C. L. Aldridge, B. L. walker, T. E. Cornish, B. J. Moynahan, M. J. Holloran, K. Brown, G. D. Johnson, E. T. Schmidtman, R.T. Mayer, C. Y. Kato, M. R. Matchett, T. J. Christiansen, W. E. Cook, T. Creekmore, R. D. Falise, E. T. Rinkes, and M. S. Boyce. 2004. West Nile virus: pending crisis for greater sage-grouse. *Ecology Letters* 7:704-713.
- Naugle, D. E., B. L. Walker, and K. E. Doherty. 2006. Sage-grouse population response to coal-bed natural gas development in the Powder River Basin: interim progress report on region-wide lek-count analyses. Unpublished Report, University of Montana, Missoula, USA.
- Stiver, S.J., A.D. Apa, J.R. Bohne, S.D. Bunnell, P.A. Deibert, S.C. Gardner, M.A. Hilliard, C.W. McCarthy, and M.A. Schroeder. 2006. Greater sage-grouse comprehensive conservation strategy. Western Association of Fish and Wildlife Agencies. Unpublished report. Cheyenne, Wyoming.
- Walker, B.L., D. E. Naugle, and K.E. Doherty. 2007. Greater sage-grouse population response to energy development and habitat loss. *Journal of Wildlife Management* 71:2644-2654.
- Western Governor's Association. 2007. Wildlife corridors initiative oil and gas working group report. <http://www.westgov.org/wga/publicat/OilGas07.pdf>. Accessed 15 January 2007.

Appendix 1.

**Participants (Alphabetical)**

Dr. Tony Apa, Colorado Division of Wildlife  
Mr. Joe Bohne, Wyoming Game and Fish Department  
Mr. Tom Christiansen, Wyoming Game and Fish Department  
Mr. Jeff Herbert, Montana Department of Fish, Wildlife and Parks  
Mr. Bill James, Utah Division of Wildlife Resources  
Mr. Rick Northrup, Montana Department of Fish, Wildlife and Parks  
Mr. Dave Olsen, Utah Division of Wildlife Resources  
Mr. Aaron Robinson, North Dakota Game and Fish  
Ms. Pam Schnurr, Colorado Division of Wildlife  
Mr. T.O. Smith, Montana Department of Fish, Wildlife and Parks  
Mr. Brett Walker, Colorado Division of Wildlife

**Invited Guests**

Dr. Matt Holloran, Wyoming Wildlife Consultants, LLC  
Dr. David Naugle, University of Montana