2011
GREATER SAGE-GROUSE
JOB COMPLETION REPORT

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June 1, 2011 – May 31, 2012

Wyoming Game and Fish Department
Cheyenne, WY

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Wyoming Sage-Grouse Job Completion Report

Conservation Plan Area: **Statewide Summary**
Period Covered: **6/1/2011– 5/31/2012**
Prepared by: **Tom Christiansen – Sage-grouse Program Coordinator**

INTRODUCTION

Sage-grouse data collection and research efforts across Wyoming began to increase in the early 1990s due to the increasing concerns for sage-grouse populations and their habitats (Heath et al. 1996, 1997). Monitoring results suggest sage-grouse populations in the Wyoming were at their lowest levels ever recorded in the mid-1990s. From 1996-2006 however, the average size of leks increased to levels not seen since the 1970s. Since 2006, average lek size has declined though not to levels recorded in the mid-1990s.

Primary issues of concern for sage-grouse in Wyoming include: energy development impacts, drought, livestock grazing practices, invasive plants and West Nile virus. Concerns expressed by some publics include effects of predation and hunting.

In March 2010 the U.S. Fish and Wildlife Service (Service) issued a decision of "warranted but precluded" for listing Greater Sage-grouse as threatened or endangered under the Endangered Species Act. This means the bird has become a "candidate" for listing but is precluded from immediate listing due to higher priorities. This status is reviewed annually by the Service.

In an unprecedented move to coordinate sage grouse conservation efforts across the State of Wyoming, then Governor Dave Freudenthal utilized the recommendations from his Sage-Grouse Implementation Team (SGIT) and released an Executive Order in August 2008 that directed state agencies to work to maintain and enhance greater sage grouse habitat in Wyoming. These actions constituted Wyoming's Core Area Strategy (CAS). Following the release of the new "warranted but precluded" listing decision by the Service in 2010, the Governor reconvened the SGIT to revise and update the CAS. Following the updates prepared during the spring and summer of 2010 by the Implementation Team, with the assistance of the local sage-grouse working groups, Governor Freudenthal issued a new Executive Order in August 2010 to replace that from 2008. Then, newly elected Governor Matt Mead issued the current Executive Order (Attachment A) on June 2, 2011 which reiterated and further clarified the intent of the CAS.

The 2012 Legislature approved the 2013-2014 biennium General Fund budget which again includes funding for the sage-grouse program. Allocation of over $1 million of these funds to local projects begins in mid-2012 and will continue through mid-2014.

Prior to 2004, Job Completion Reports (JCRs) for greater sage-grouse in Wyoming were completed at the WGFD Regional or management area level. In 2003, the WGF Commission approved the Wyoming Greater Sage-Grouse Conservation Plan (State Plan) and a Sage-Grouse Program Coordinator position was created within the WGFD. The State Plan directed local conservation planning efforts to commence. In order to support the conservation planning efforts, JCRs across the State changed from reporting by Wyoming Game & Fish Dept. regional boundaries to those of the eight planning area boundaries (Figure 1). The 2004 JCR reviewed and summarized prior years' data in order to provide a historical perspective since that document

was the first statewide JCR in memory. Additionally, Patterson (1952) provides an invaluable reference for sage-grouse, not only in Wyoming, but across the range of the species. A new publication, Knick and Connelly (2011), provides state of the art information on the ecology and conservation of Greater Sage-grouse.

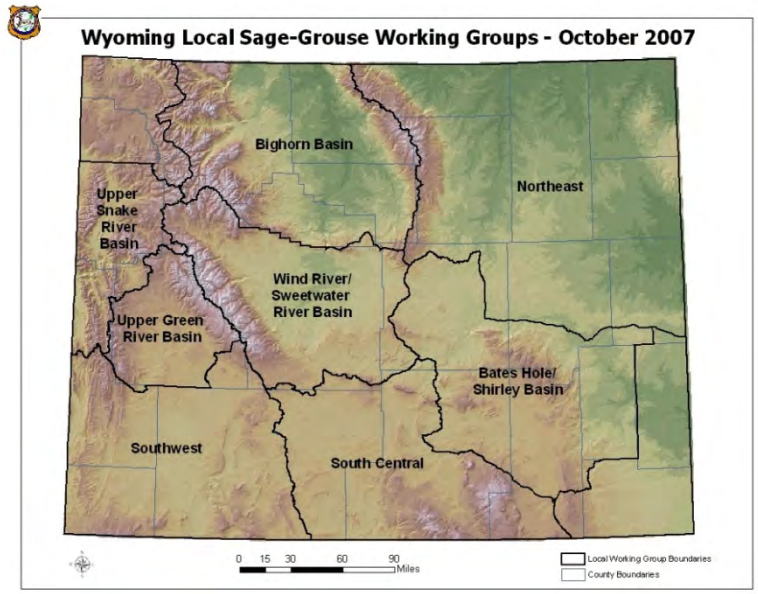


Figure 1. Wyoming Local sage-grouse working group boundaries.

BACKGROUND

The greater sage-grouse is the largest species of grouse in North America and is second in size only to the wild turkey among all North American game birds. It is appropriately named due to its year-round dependence on sagebrush for both food and cover. Insects and forbs also play an important role in the diet during spring and summer and are critical to the survival of chicks. In general, the sage-grouse is a mobile species, capable of movements greater than 50 km between seasonal ranges. Radio telemetry studies conducted in Wyoming have demonstrated that most sage-grouse populations in the state are migratory to varying extent. Despite this mobility, sage-grouse appear to display substantial amounts of fidelity to seasonal ranges. Sage-grouse populations are characterized by relatively low productivity and high survival. This strategy is contrary to other game birds such as pheasants that exhibit high productivity and low annual survival. These differences in life history strategy have consequences for harvest and habitat management.

Greater sage-grouse once occupied parts of 12 states within the western United States and 3 Canadian provinces (Figure 2). Populations of greater sage-grouse have undergone long-term population declines. The sagebrush habitats on which sage-grouse depend have experienced extensive alteration and loss. Consequently, concerns rose for the conservation and management of greater sage-grouse and their habitats resulting in petitions to list greater sage-grouse under the Endangered Species Act (see following ESA Status section). Due to the significance of this species in Wyoming, meaningful data collection, analysis and management is necessary whether or not the species is a federally listed species.

Sage-grouse are relatively common throughout Wyoming, especially southwest and central Wyoming, because sage-grouse habitat remains relatively intact compared to other states (Figures 2 and 3). However, available data sets and anecdotal accounts indicate long-term declines in Wyoming sage-grouse populations over the last six decades.

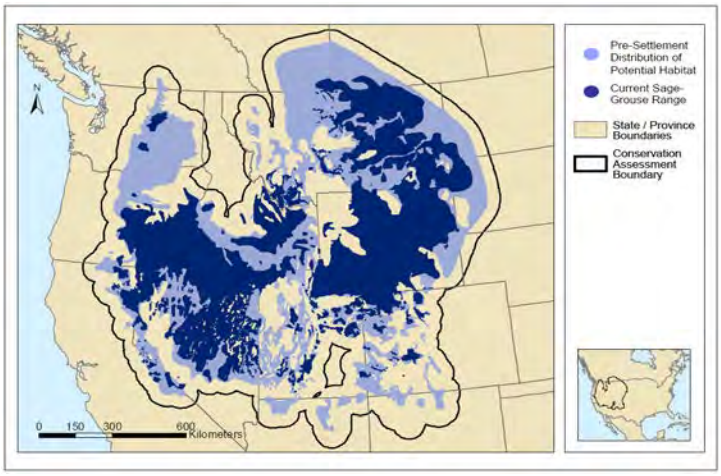


Figure 2. Current distribution of sage-grouse and pre-settlement distribution of potential habitat in North America (Schroeder 2004). For reference, Gunnison sage-grouse in SE Utah and SW Colorado are shown.

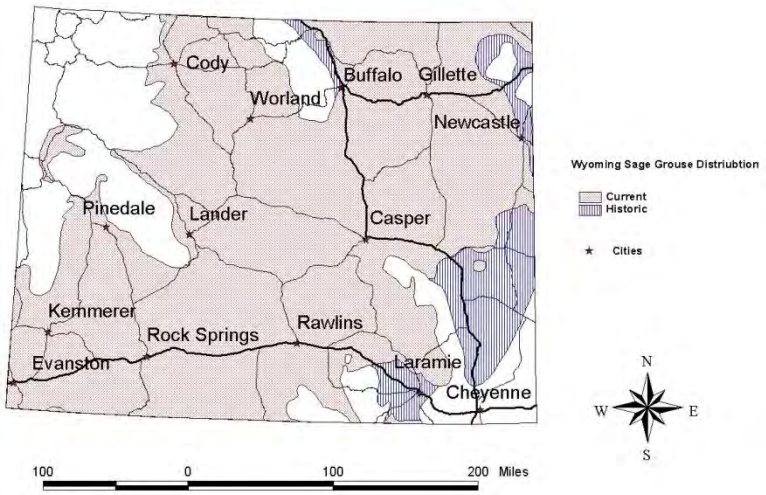


Figure 3. Sage-grouse distribution in Wyoming.

Past management of sage-grouse in Wyoming has included:

- Population monitoring via lek counts and surveys, harvest statistics, and data derived from wing collections from harvested birds. Lek counts and surveys have been conducted in Wyoming since 1949.

- The protection of lek sites and nesting habitat on BLM lands by restricting activities within ¼ mile of a sage-grouse lek and restricting the timing of activities within a 2-mile radius of leks. The Core Area Strategy (CAS – described below and in Attachment A) has expanded and strengthened these protections in core areas.

- The authorization and enforcement of hunting regulations.
- Habitat manipulations, including water development.
- Conducting and/or permitting applied research.

Endangered Species Act Status

In March 2010 the U.S. Fish and Wildlife Service (Service) issued a decision of "warranted but precluded" for listing Greater Sage-grouse as threatened or endangered under the Endangered Species Act. This means the bird has become a "candidate" for listing but is precluded from immediate listing due to higher priorities. This status is reviewed annually by the Service. The Department's reply to the Service's annual data call to assist in their annual review is attached (Attachment B).

In its decision document, the Service specifically cited Wyoming's Core Area Strategy (CAS - described below) as a mechanism that, if implemented as envisioned, should ensure conservation of sage-grouse in Wyoming and therefore help preclude a future listing.

The Wyoming Game and Fish Department and Commission maintain management authority over candidate species and management emphasis will continue to focus on implementation of the Core Area Strategy.

METHODS

Methods for collecting sage-grouse data are described in the sage-grouse chapter of the WGFD Handbook of Biological Techniques (Christiansen 2007), which is largely based on Connelly et al (2003).

RESULTS

Lek monitoring

While lek counts and surveys have been conducted in Wyoming since 1948, the most consistent data were not collected until the mid-1990s. The number of leks checked in Wyoming has increased markedly since 1949. However, data from the 1950s through the 1970s is unfortunately sparse and by most accounts this is the period when the most dramatic declines of grouse numbers occurred. Some lek survey/count data were collected during this period as the historical reports contain summary tables but the observation data for most individual leks are missing making comparisons to current information difficult. Concurrent with increased monitoring effort over time, the number of grouse (males) also increased (Figure 4). The increased number of grouse counted was not necessarily a reflection of a population increase; rather it was resultant of increased monitoring efforts.

The average number of males counted/lek decreased through the 1980s and early 90s to an all time low in 1995, but then recovered to a level similar to the late 1970s in 2006 (Figure 5). Again, fluctuations in the number of grouse observed on leks are largely due to survey effort not to changes in grouse numbers exclusively, but certainly the number of male grouse counted on leks has exhibited recovery since 1995 as the average size of leks has increased (Figure 5) and is

generally interpreted to reflect an increasing population. The same cannot be said for the most recent three-year period (Figure 7) during which the average number of cocks observed on leks declined, though not to levels documented in the mid-1990s. Thus, there has been a long-term decline, a mid-term increase and short-term decline in the statewide sage-grouse population. The mid- and short-term trends in statewide populations are believed to be largely weather related. In the late 1990s, and again in 2004-05, timely precipitation resulted in improved habitat conditions allowing greater numbers of sage-grouse to hatch and survive. Drought conditions from 2000-2003 and again later in that decade are believed to have caused lower grouse survival leading to population declines. These trends are valid at the statewide scale. Trends are more varied at the local scale. Sub-populations more heavily influenced by anthropogenic impacts (sub-divisions, intensive energy development, large-scale conversion of habitat from sagebrush to grassland or agriculture, Interstate highways, etc.) have experienced declining populations or extirpation. Figures 8 and 9 illustrate sage-grouse density changes between 2005-07 and 2010-12 based on peak male lek counts and surveys.

Recent analyses suggest grouse populations are cyclic (Fedy and Doherty 2010, Fedy and Aldridge 2011). While weather and climate undoubtedly influence sage-grouse population cycles such influences have not been quantified and factors other than weather (predation, parasites) may also play a role. It is important to acknowledge and control for the cyclic nature of sage-grouse when conducting impact studies and monitoring grouse response to management.

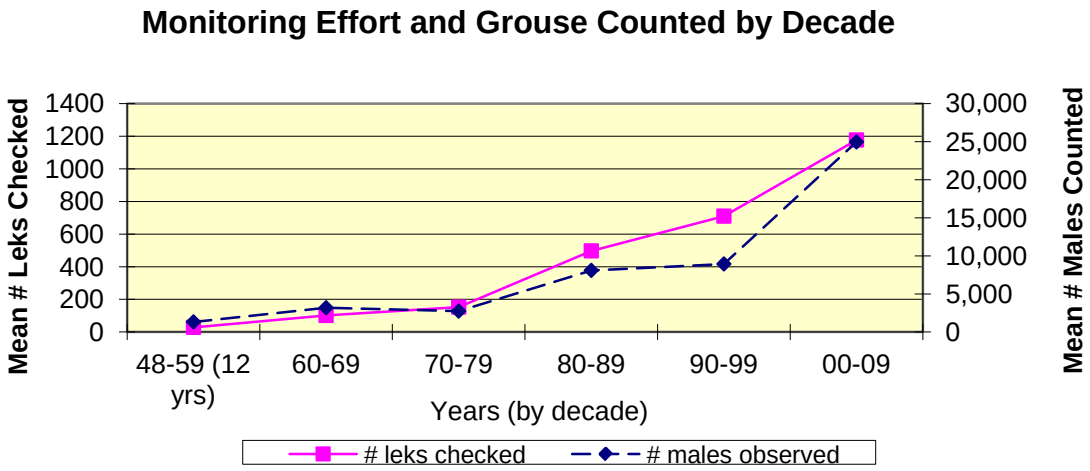


Figure 4. Mean annual numbers of leks checked (monitoring effort) and male grouse counted in Wyoming 1948-2009 by decade.

Lek monitoring data for the 2012 breeding season are summarized in Tables 1 a-b. Male attendance at all leks visited (counts and surveys) averaged 16.6 males per lek during spring 2012, a slight 7% decrease below the 17.2 males/lek observed in 2010 but a more meaningful 57% decline from the 38.9 males/lek observed in 2006. For the 10-year period (2003-2012), average male lek attendance ranged from 16.6 males/lek in 2012, the lowest average males per lek since 1997, to 38.9 males/lek in 2006, which was the highest average males per lek figure recorded since 1978. It is important to note that the number of leks sampled increased substantially over the 10-year period and the same leks were not checked from year to year. However leks that were checked consistently over the same period demonstrated the same trends except in some local areas as described in the local JCRs.

Small changes in the statistics reported between annual JCRs are due to revisions and/or the submission of data not previously available for entry into the database (late submission of data, discovery of historical data from outside sources, etc). These changes have not been significant and interpretation of these data has not changed.

While a statistically valid method for estimating population size for sage-grouse does not yet exist, monitoring male attendance on leks provides a reasonable index of relative change in abundance in response to prevailing environmental conditions over time. However, lek data must be interpreted with caution for several reasons: 1) the survey effort and the number of leks surveyed/counted has varied over time, 2) not all leks have been located, 3) sage-grouse populations cycle, 4) the effects of unlocated or unmonitored leks that have become inactive cannot be quantified or qualified, and 5) lek locations may change over time. Both the number of leks and the number of males attending these leks must be quantified in order to estimate population size.

Three independent analyses have assessed changes in long-term sage-grouse populations at rangewide, statewide, population and sub-population levels in recent years (Connelly et al. 2004, WAFWA 2008, Garton et al. 2011). The trends reflected by these analyses are generally consistent with each other and with that shown in Figure 5. These or similar methods of analysis should be incorporated into Wyoming's JCRs as they mitigate some of the limitations of using only average males/lek to determine population trend.

Table 1. Lek Attendance Summary

a. Leks Checked

Year	#Known	#Checked	Percent Checked	Peak Males	Avg Males / Lek
2003	1848	1354	73	18179	20.3
2004	1907	1346	71	20262	21.6
2005	1993	1457	73	35516	32.8
2006	2071	1618	78	44695	38.9
2007	2138	1664	78	43580	36.3
2008	2184	1613	74	35597	30.4
2009	2223	1681	76	30618	25.5
2010	2280	1735	76	25723	20.0
2011	2323	1749	75	21425	17.2
2012	2357	1713	73	20664	16.6

b. Lek Status

Year	Active	Inactive	Unknown	Known Status	Percent Active	Percent Inactive
2003	806	161	881	967	83.4	16.6
2004	839	179	889	1018	82.4	17.6
2005	1004	128	861	1132	88.7	11.3
2006	1085	150	836	1235	87.9	12.1
2007	1136	193	809	1329	85.5	14.5
2008	1104	216	864	1320	83.6	16.4
2009	1100	255	868	1655	81.2	18.9
2010	1122	261	897	1383	81.1	18.9
2011	1084	301	938	1385	78.3	21.7
2012	1092	294	971	1386	78.8	21.2

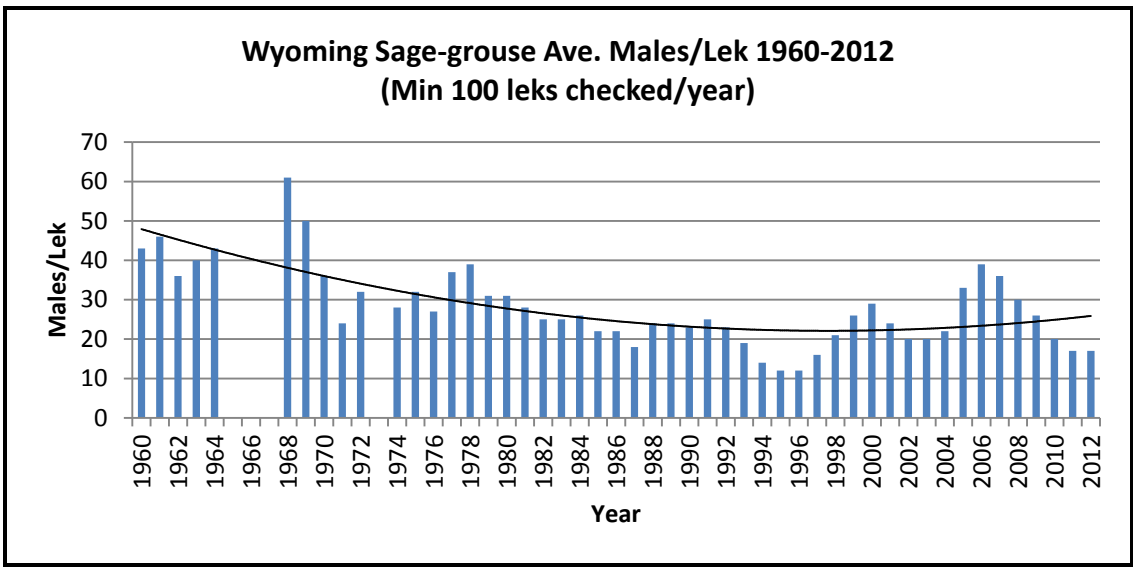


Figure 5. Average number of males per lek counted in Wyoming from 1960-2012 with a minimum of 100 leks checked each year.

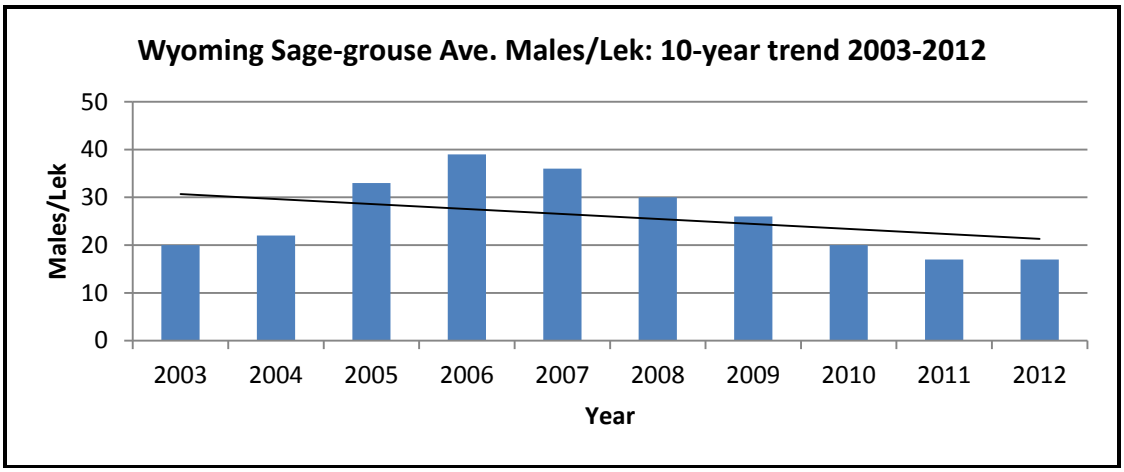


Figure 6. Average number of males per lek observed on leks in Wyoming from 2003-2012 with trend line.

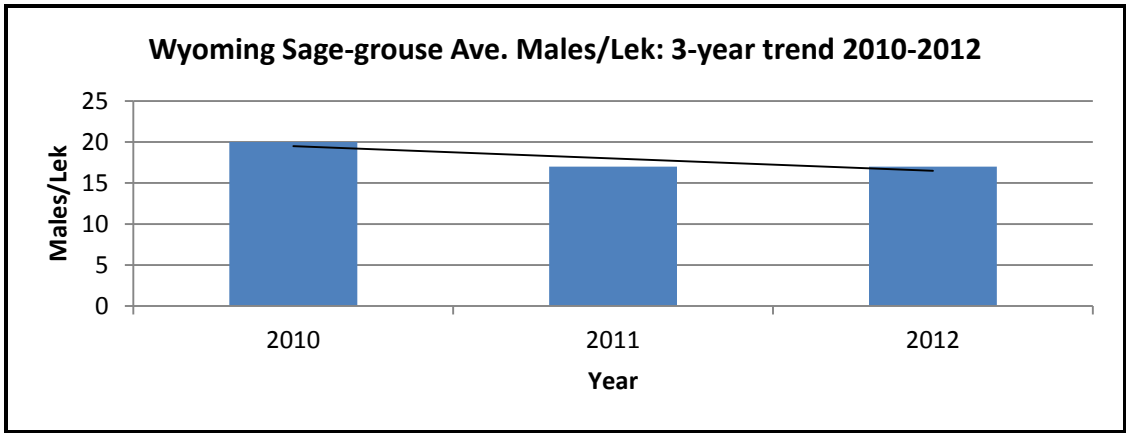
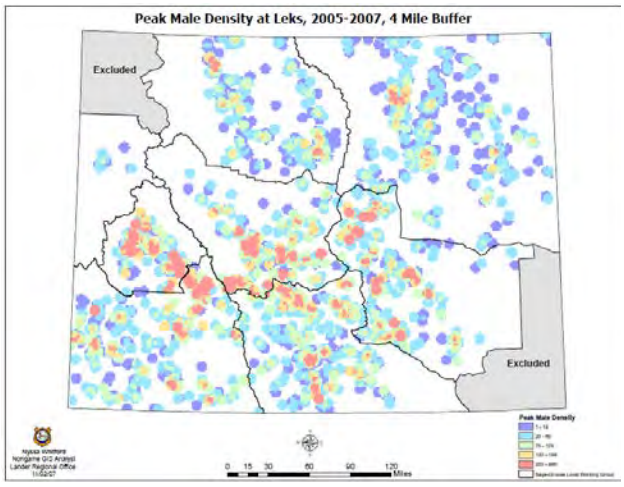
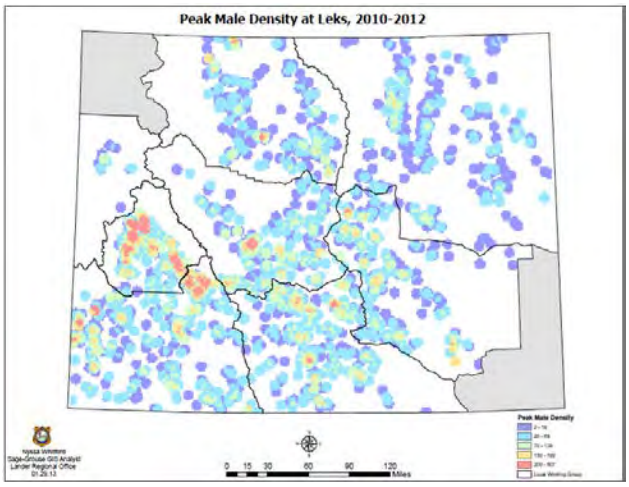


Figure 7. Average number of males per lek observed on leks in Wyoming from 2010-2012 with trend line.



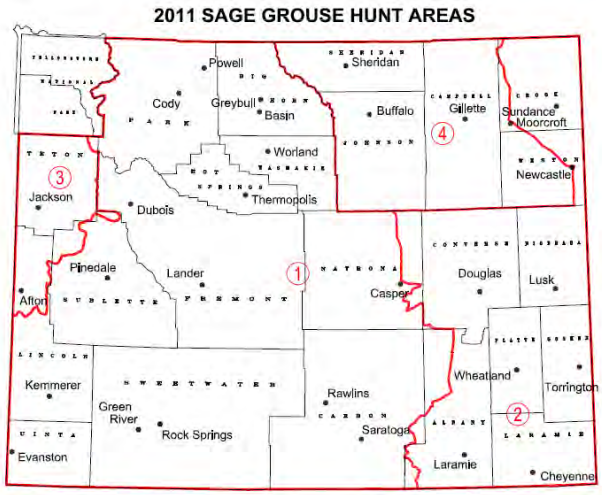


Figures 8 and 9. Relative sage-grouse density comparing 2005-2007 and 2010-2012 based on peak male lek counts and surveys.

Hunting season and harvest

As a result of concerns about the issue of hunting and its impact to sage-grouse a white paper was prepared in 2008 then revised in 2010 (Christiansen 2010), presented to the WGF Commission and distributed through the WGF web page. The science and public policy basis for managing sage-grouse harvest in Wyoming are covered in detail within that document. Similarly, the Western Association of Fish and Wildlife Agency directors adopted a policy statement on the topic in the summer of 2010 (Attachment D in Christiansen 2010).

No major changes were made to the 2011 hunting season (Figure 10, Table 1) compared to 2010.



Area	Season Dates	Daily/Poss. Limits	Falconry
1	Sept. 17-Sept. 30	2/4	Sept. 1-Mar. 1
2, 3	Closed	Closed	Closed
4	Sept. 17-Sept. 19	2/4	Sept. 1-Mar. 1

Figure 10 and Table 2. 2011 sage-grouse hunting season map and regulations.

Hunting seasons in Wyoming are shown in Table 3a. Due to concerns over low populations the statewide hunting season was shortened to nine days and the daily bag limit decreased to two sage-grouse in 2002 and has remained very conservative since that time. Two areas, eastern Wyoming and the Snake River Drainage in northwest Wyoming are closed to sage-grouse hunting (Figure 10).

Delaying and shortening the season and decreasing the bag limit dramatically decreased the numbers of sage-grouse hunters and their harvest in 2002 and 2003. Hunters were also sensitive to the plight of grouse populations and did not take the opportunity to hunt sage-grouse as much as they had in the past. But since 2004, hunter numbers and harvest have rebounded as a result of generally increased sage-grouse numbers. Hunter numbers and harvest declined modestly between 2010 (4,732 hunters/11,057 birds) and 2011 (4,568 hunters/10,290 birds). The 2011 harvest data were near the 10-year averages.

Table 3. Sage Grouse Hunting Seasons and Harvest Data

a. Season

Year	Season Start	Season End	Length	Bag/Possesion Limit
2003	Sep-27	Oct-5	9	2/4
2004	Sep-23	Oct-3	11	2/4
2005	Sep-23	Oct-3	11	2/4
2006	Sep-23	Oct-3	11	2/4
2007	Sep-22	Oct-2	11	2/4
2008	Sep-22	Oct-2	11	2/4
2009	1-Sep-19	Sep-30	12	2/4
	4-Sep-19	Sep-25	7	
2010	1-Sep-18	Sep-30	13	2/4
	4-Sep-18	Sep-20	3	
2011	1-Sep-17	Sep-30	14	2/4
	4-Sep-17	Sep-19	3	
2012	1-Sep-15	Sep-30	16	2/4
	4-Sep-15	Sep-17	3	

b. Harvest

Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2003	4835	2355	5705	0.8	2.1	2.4
2004	11783	5436	13229	0.9	2.2	2.4
2005	13178	5230	12175	1.1	2.5	2.3
2006	12920	5412	11981	1.1	2.4	2.2
2007	10378	5180	10699	1.0	2.0	2.1
2008	10302	4745	10065	1.0	2.2	2.1
2009	11162	4732	10812	1.0	2.4	2.3
2010	11057	4732	11434	1.0	2.3	2.4
2011	10290	4568	11186	0.9	2.3	2.4
2012	6361	2929	6994	0.9	2.2	2.4
Avg	10,227	4,532	10,428	1.0	2.2	2.3

The number of sage-grouse wings collected from hunters increased by 13% in 2011, which is contrary to the declining harvest figures reported above. In 2011, 2,425 wings were recorded (JCR Table 5), which is about 24% of the estimated harvest. This is near the 10-year average of 20% and the changes between years are minor.

The 2011 chick:hen ratio (based on harvested wing analysis) was 1.4 chicks per hen (Table 4 and Figure 11). This level of productivity is typically associated with a stable population. This is consistent with the 2012 lek data (all lek checks), which indicated a small 7% decrease in the average numbers of males on leks (Table 5). When average males per lek were increasing from 1997-2000 and 2005-2006, the proceeding years' chick:hen ratio averaged 2.1. Conversely, when the chick:hen ratio dropped to 1.1:1 in 2000, .8:1 in 2007, 1.1:1 in 2009 and .9:1 in 2010 the average males:lek decreased 20%,16%, 21% and 13% respectively. Relatively small changes in average males/lek observed in 2002 (+3%) and 2003 (+4%) were proceeded by chick:hen ratios of 1.6:1and 1.5:1 respectively, although similar chick:hen ratios resulted in declines of about 15% in both 2002 and 2008. The 57% increase in average males/lek observed in 2005 was preceded by a statewide chick:hen ratio of 2.4:1 in 2004. In general it appears that chick:hen ratios of about 1.5:1 result in relatively stable lek counts the following spring, while chick:hen ratios of 1.8:1 or greater result in increased lek counts and ratios below 1.2:1 result in declines. Additional data are required to strengthen the statistical strength of these analyses.

Prior to 1997, wing analysis results may be questioned in some parts of the state since most personnel were not well trained in techniques.

Table 4. Composition of Harvest by Wing Analysis

Year	Sample Size	Percent Adult		Percent Yearling		Percent Young		Chicks/ Hens
		Male	Female	Male	Female	Male	Female	
2002	1808	9.9	27.2	2.4	7.1	18.6	34.8	1.6
2003	1606	13.0	27.6	1.7	6.5	21.9	29.2	1.5
2004	2268	9.6	22.0	1.3	4.0	30.6	32.5	2.4
2005	2841	13.0	21.8	3.4	6.4	24.3	31.1	2.0
2006	2101	19.5	27.9	4.0	6.7	17.7	24.2	1.2
2007	2232	19.8	37.1	3.4	5.3	15.6	18.8	0.8
2008	2154	14.4	25.8	4.6	6.7	20.3	28.0	1.5
2009	2550	14.1	29.1	5.9	8.3	17.1	25.6	1.1
2010	2169	10.1	39.8	2.6	5.9	11.2	16.6	0.9
2011	2425	8.9	31.2	4.0	5.6	21.3	29.0	1.4

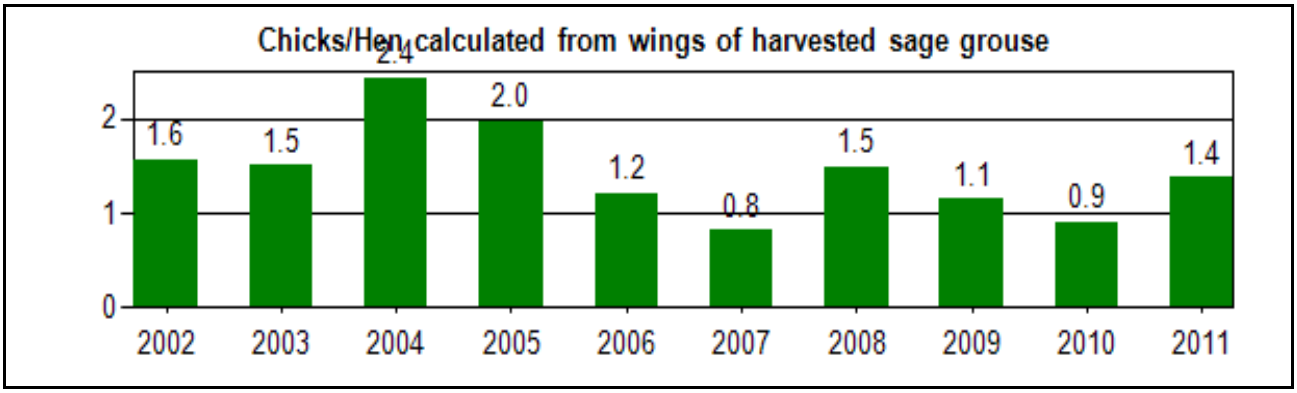


Figure 11. Chicks/Hen 2002-2011 based on wings from harvested grouse.

Year	Chicks:Hen (based on wings from harvested birds)	Change in male lek attendance the following spring
1997	1.9	+36%
1998	2.4	+21%
1999	1.8	+13%
2000	1.1	-20%
2001	1.6	-15%
2002	1.6	+3%
2003	1.5	+4%
2004	2.4	+57%
2005	2.0	+17%
2006	1.2	-5%
2007	0.8	-16%
2008	1.5	-16%
2009	1.1	-21%
2010	0.9	-13%
2011	1.4	-7%

Table 5. Potential influence of chick production, based on wings from harvested birds, on population trend as measured by male lek attendance.

As a result of continued bio-political concerns for sage-grouse population declines in northeast Wyoming, the Department proposed closing the hunting season in Area 4 in 2012. However, the proposal was met with valid opposition from various conservation and hunting groups and individuals from both within and outside the state, and the proposal was not implemented by the WGF Commission. This exercise should be used to inform future management when calls to close hunting seasons are put forth.

Weather and Habitat

Sage-grouse nest success and chick survival have been linked to habitat condition, specifically shrub height and cover, live and residual (remaining from the previous year) grass height and cover, and forb cover. The shrubs (primarily sagebrush) and grasses provide screening cover from predators and weather while the forbs provide food in the form of the plant material itself and in insects that use the forbs for habitat. Spring precipitation is an important determinant of the quantity and quality of these vegetation characteristics. Residual grass height and cover depends on the previous year's growing conditions and grazing pressure while live grass and forb cover are largely dependent on the current year's precipitation. Weather and climate have

been linked to sage-grouse population trends (Heath et al. 1997). Most of the Local Conservation Planning Area JCRs include sections on weather and sage-grouse relationships. In general spring precipitation is positively linked to chick:hen ratios, which are in turn, linked to the following year's lek counts of males. However, periods of prolonged cold, wet weather may have adverse effects on hatching success, plant and insect phenology and production and chick survival. Untimely late snow storms in May and early June of both 2009 and 2010 likely contributed to reduced nesting success and chick survival. Efforts to quantify/qualify these effects in a predicable fashion over meaningful scales have largely failed.

Habitat and seasonal range mapping.

While we believe that most of the currently occupied leks in Wyoming have been documented, other seasonal habitats such as nesting/early brood-rearing and winter concentration areas have not been identified. Efforts to map seasonal ranges for sage-grouse will continue by utilizing winter observation flights and the on-going land cover mapping efforts of the USGS, BLM, WGF, the Wyoming Geographic Information Science Center (WYGISC) of the University of Wyoming and others.

CONSERVATION STRATEGIES

Governor's Core Area Strategy (CAS) and Executive Order

In an unprecedented move to coordinate sage grouse conservation efforts across the State of Wyoming, then Governor Dave Freudenthal utilized the recommendations from his Sage-Grouse Implementation Team (SGIT) and released an Executive Order in August 2008 that directed state agencies to work to maintain and enhance greater sage grouse habitat in Wyoming. These actions constituted Wyoming's Core Area Strategy (CAS). Following the release of the new "warranted but precluded" listing decision by the Service in 2010, the Governor reconvened the SGIT to revise and update the CAS. Following the updates prepared during the spring and summer of 2010 by the Implementation Team, with the assistance of the local sage-grouse working groups, Governor Freudenthal issued a new Executive Order August 2010 to replace that from 2008. Then, newly elected Governor Matt Mead issued an Executive Order (Attachment A) on June 2, 2011 which reiterated and further clarified the intent of the CAS. See Attachment C *in* Attachment B for a list of projects that required conferencing/review under the CAS during calendar year 2011.

The Core Area Strategy addresses the threats (habitat loss and fragmentation and insufficient regulatory mechanisms) specifically identified by the Service in their 2010 listing decision. In a June 2011 letter to Governor Mead, the Service said, "In summary, the Service believes the Greater Sage-grouse Core Area Protection provides an excellent model for meaningful conservation of sage-grouse if fully supported and implemented. We believe that when fully realized, this effort could ameliorate many threats to the Greater sage-grouse in Wyoming."

The Core Area Strategy is being implemented across the state under the guidance of a state/federal interagency team of specialists which meets on a regular basis to discuss issues related to implementation of the strategy. A key component of the strategy's implementation is the Density and Disturbance Calculation Tool (DDCT). This tool was developed by agency GIS specialists and will be offered in July 2012 as an interactive, on-line application through the University of Wyoming's Geographic Information and Science Center. Training sessions will be provided to industry and agency staff required to use the DDCT.

Wyoming Game and Fish Department (2011) (protocols for treating sagebrush to be consistent with Wyoming Executive Order 2011-5; greater sage-grouse core area protection) was updated during this reporting period (see Attachment A *in* Attachment B).

The Bureau of Land Management (BLM) and the U.S. Forest Service (USFS) are working to adopt Wyoming's Core Area Strategy into their land management decision processes in Wyoming. A new WY-BLM sage-grouse instruction memorandum was issued in early 2012 (WY-BLM IM 2012-19). BLM Resource Management Plans (RMPs) and USFS Forest Plans across the state are being amended to incorporate Wyoming's Core Area Strategy and new BLM national sage-grouse policy (BLM-IM-2012-043 and 044).

Conservation Planning

In 2000, the WGFD formed a citizen/agency working group for the purpose of developing a statewide strategy for conservation of sage-grouse in Wyoming. The working group completed its task and in 2003 The Wyoming Greater Sage-Grouse Conservation Plan (WGFD 2003) was approved by the Wyoming Game and Fish Commission. The State Plan was largely reliant on implementation by local working groups. The state's eight LWGs all submitted final conservation plans between 2006 and 2008. In 2012, the local working groups began the process of updating their plans with current information to make them consistent with the Wyoming Core Area Strategy, address the Service's 2010 listing decision and incorporate new science. This effort should be complete in 2013.

From 2005-2009, Local Working Groups were allocated approximately $2.5 million to support implementation of local sage-grouse conservation projects. The source of this funding was the State of Wyoming General Fund as requested by Governor Freudenthal and approved by the legislature. Ninety-eight (98) projects were implemented, most of which included multiple cost-sharing partners. Projects include habitat treatments/restoration, improved range management infrastructure and grazing management plans, applied research, inventories, monitoring and public outreach. See the 2009-10 JCR for a list of these projects.

The 2010 Legislature approved the 2011-2012 biennium General Fund budget which included another $1.2 million for local projects. Allocation of these funds began in mid-2010 and the 35 individual projects approved are listed in Attachment C.

The 2012 Legislature approved the 2013-14 biennium General Fund sage-grouse program budget of $1.7 million (subsequently reduced to 1.5 million due to mandatory 8% budget cuts). Projects that will use these funds are now being developed and reviewed.

Natural Resources Conservation Service (NRCS) Sage-Grouse Initiative (SGI)

The NRCS has implemented its Sage-Grouse Initiative (SGI) across Wyoming and 10 other sage-grouse states. In 2010-2011 in Wyoming, the NRCS spent approximately $48 million on conservation easements and long-term rental agreements protecting approximately 135,850 acres from development through their Farm and Ranchland Protection Program (FRPP) and Grasslands Reserve Program (GRP). In addition, they have spent approximately $7.28 million on conservation practices and livestock management incentives on approximately 487,100 acres through their Environmental Quality Incentives Program (EQIP) and Wildlife Habitat Incentives Program (WHIP), now called Working Lands for Wildlife.

Statewide USFWS Candidate Conservation Agreement with Assurances (CCAA)

A mechanism to achieve the goals of the statewide sage-grouse conservation effort is development of statewide agreements (Candidate Conservation Agreements with Assurances (CCAA), Candidate Conservation Agreements (CCA), Memoranda of Agreement (MOA) and incentives to insure management actions on private and public lands will continue in a manner that is ecologically, economically, and culturally sustainable. These agreements provide a means for conserving species through proactive conservation measures that reduce the potential for additional regulatory requirements that result when species become listed as threatened or endangered. Currently, a CCAA and a CCA are being developed cooperatively by local, state, and federal resource agencies that will provide assurances or reduce the potential for additional regulatory requirements for Wyoming ranch operations in the event that the sage grouse is listed under ESA. Individual ranches will be able to participate in conservation practices appropriate to their ranch. According the Service, the CCAA will be published on the Federal Register in 2012 for a public comment period.

OTHER ISSUES

West Nile Virus

West Nile virus (WNv) was first confirmed in sage-grouse in 2003 in the northern Powder River Basin and is now considered a potential threat to sage-grouse populations. Research efforts have resulted in several published papers and theses that describe the disease and its potential impact to sage-grouse populations (Walker and Naugle 2011 and references therein).

Monitoring efforts in 2011 included: 1) intensive monitoring of radio-collared sage-grouse during the late summer on study sites across Wyoming, 2) WGF field personnel were directed to collect late summer sage-grouse mortalities and submit them for testing, and 3) press releases were distributed requesting the general public, especially landowners, to report late summer sage-grouse mortalities.

Results of the monitoring efforts in 2011 suggest WNv activity and mortality were not significant in Wyoming as no WNv mortality was documented. The Wyoming Department of Health received the fewest reports of human West Nile virus infection since the introduction of the disease in 2002.

Energy Development

The issue of energy development and its effects to sage-grouse and sagebrush habitats continues to be a major one in many portions of the state. The topic is of major interest in Local Working Group efforts and the JCRs for the local conservation areas contain additional detail on the issue. Research efforts continue to focus on this issue and during this reporting period several peer-reviewed manuscripts based on Wyoming research were released (Blickley et al. 2012, Dzialak et al. 2011, Dzialak et al. 2012, Taylor et al. 2012 and Webb et al. 2012).

On-going research examining energy development impacts to sage-grouse and sage-grouse habitat include University of Wyoming research on the effects of natural gas development in the Atlantic Rim area of Carbon County. A master's thesis (Kirol 2012) resulted from this result and peer reviewed publications based on this thesis are pending.

The results of these research efforts inform and guide management actions where energy development occurs in sage-grouse habitat (Wyoming Game and Fish Department 2010 and Bureau of Land Management 2012). The Wyoming Core Area Strategy (Attachment A) is reliant on research efforts.

PAST RESEARCH/STUDIES

See Attachment D and Attachment D *in* Attachment B.

MANAGEMENT RECOMMENDATIONS

1) Implement Governor Mead's Sage-Grouse Executive Order and Core Area Strategy.

2) Continue to update and implement local conservation plans in all 8 planning areas.

3) Continue to upgrade the sage-grouse database and Job Completion Report software to an internet application in order to reduce errors and increase efficiency.

4) Continue to map lek perimeters and integrate these data into the WGF lek database. Priority for this effort should be based on the lek size of lek and impending development actions that may impact leks.

5) Personnel monitoring leks should review and consistently follow established lek monitoring protocol each year.

6) Map seasonal habitats (nesting/early brood rearing, winter concentration areas) for sage-grouse using data from the on-going land cover mapping project and sage-grouse observations.

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Attachment A

MATTHEW H. MEAD
GOVERNOR

THE STATE OF WYOMING

STATE CAPITOL
CHEYENNE, WY 82002

Office of the Governor

STATE OF WYOMING
EXECUTIVE DEPARTMENT
EXECUTIVE ORDER

Order 2011-5
(Replaces 2010-4)

GREATER SAGE-GROUSE CORE AREA PROTECTION

WHEREAS, the Greater Sage-Grouse (Centrocercus urophasianus) inhabits much of the sagebrush-steppe habitat in Wyoming; and

WHEREAS, the sagebrush-steppe habitat type is abundant across the state of Wyoming; and

WHEREAS, the state of Wyoming currently enjoys robust populations of Greater Sage-Grouse; and

WHEREAS, the state of Wyoming has management authority over Greater Sage-Grouse populations in Wyoming; and

WHEREAS, the Greater Sage-Grouse has been the subject of several petitions to list the species as a threatened or endangered species pursuant to the Endangered Species Act; and

WHEREAS, the United States Department of the Interior has determined that listing the Greater Sage-Grouse as a threatened or endangered species is warranted over all of its range, including the populations in Wyoming; and

WHEREAS, the United States Department of the Interior has determined that listing the Greater Sage-Grouse as a threatened or endangered species is currently precluded by higher priority listing actions; and

WHEREAS, the Greater Sage-Grouse is currently considered a "candidate" species under the auspices of the Endangered Species Act; and

WHEREAS, the United States Department of the Interior is required to review the status of all candidate species every year; and

WHEREAS, the listing of the Greater Sage-Grouse would have a significant adverse effect on the economy of the state of Wyoming, including the ability to generate revenues from state lands; and

WHEREAS, the listing of the Greater Sage-Grouse would have a significant adverse effect on the custom and culture of the state of Wyoming; and

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WHEREAS, the Wyoming State Legislature and other agencies have dedicated significant state resources to conserve Greater Sage-Grouse populations in Wyoming; and

WHEREAS, the state of Wyoming has developed a "Core Population Area" strategy to weave the many on-going efforts to conserve the Greater Sage-Grouse in Wyoming into a statewide strategy; and

WHEREAS, members of the Sixtieth Legislature of the State of Wyoming signed a Joint Resolution recognizing "the Greater Sage Grouse Core Area Strategy [then embodied under Governor's Executive Order 2008-2] as the State of Wyoming's primary regulatory mechanism to conserve sage-grouse and preclude the need for listing the bird as a threatened or endangered species pursuant to the Endangered Species Act of 1973."; and

WHEREAS, on April 17, 2008, the Office of the Governor requested that the U.S. Fish and Wildlife Service review the "Core Population Area" strategy to determine if it was a "sound policy that should be moved forward" and on May 7, 2008, the U.S. Fish and Wildlife Service responded that the "core population area strategy, as outlined in the Implementation Team's correspondence to the Governor, is a sound framework for a policy by which to conserve greater sage-grouse in Wyoming"; and

WHEREAS, on November 10, 2010, the U.S. Fish and Wildlife Service again confirmed that "This long-term, science-based vision for the conservation of greater sage-grouse has set the stage for similar conservation efforts across the species range," and that "the Core Population Area Strategy for the greater sage-grouse provides an excellent model for meaningful conservation of sage-grouse is fully supported and implemented"; and

WHEREAS, several western states have adopted or are considering adopting the Wyoming Core Area Strategy, thus making the concept consistent across the species range; and

WHEREAS, new science, information and data continue to emerge regarding "Core Population Areas" and the habitats and behaviors of the Greater Sage-Grouse, which led the Governor's Sage-Grouse Implementation Team to re-evaluate the original "core population areas" and protective stipulations for Greater Sage-Grouse.

NOW, THEREFORE, pursuant to the authority vested in me by the Constitution and Laws of the State, and to the extent such actions are consistent with the statutory obligations and authority of each individual agency including those found in Title 9, Chapter 5, Article 3 of Wyoming State Statutes, otherwise cited as the Wyoming Regulatory Takings Act, I, Matthew H. Mead, Governor of the State of Wyoming, do hereby issue this Executive Order providing as follows:

1. Management by state agencies should focus on the maintenance and enhancement of Greater Sage-Grouse habitats, populations and connectivity areas identified in Attachment A. Absent substantial and compelling information, these Core Population Areas should not be altered for at least five (5) years.

2. Existing land uses within Core Population Areas should be recognized and respected by state agencies. It is assumed that activities existing in Core Population Areas prior to August 1, 2008 will not be managed under Core Population Area stipulations. Examples of existing activities include oil and gas, mining, agriculture, processing facilities, housing and other uses that were in place prior to the development of the Core Population Areas (prior to August 1, 2008). Provided these activities are within a defined project boundary (such as a recognized federal oil and gas unit, drilling and spacing unit, mine plan, subdivision plat, etc.) they should be allowed to continue within the existing boundary, even if the

use exceeds recommended stipulations (see Attachment B) recognizing that all applicable federal actions shall continue.

3. New development or land uses within Core Population Areas should be authorized or conducted only when it can be demonstrated that the activity will not cause declines in Greater Sage-Grouse populations.

4. Development consistent with the stipulations set forth in Attachment B shall be deemed sufficient to demonstrate that the activity will not cause declines in Greater Sage-Grouse populations.

5. Funding, assurances (including efforts to develop Candidate Conservation Agreements and Candidate Conservation Agreements with Assurances), habitat enhancement, reclamation efforts, mapping and other associated proactive efforts to assure viability of Greater Sage-Grouse in Wyoming should be focused and prioritized to take place in Core Population Areas.

6. To the greatest extent possible, a non-regulatory approach shall be used to influence management alternatives within Core Population Areas. Management alternatives should reflect unique localized conditions, including soils, vegetation, development type, predation, climate and other local realities.

7. For activities outside of Core Population Areas, no more than a one-quarter (1/4) mile no surface occupancy standard and a two (2) mile seasonal buffer should be applied to occupied leks. Incentives to enable development of all types outside Core Population Areas should be established (these should include stipulation waivers, enhanced permitting processes, density bonuses, and other incentives). Development scenarios should be designed and managed to maintain populations, habitats and essential migration routes where possible. It is recognized that some incentives may result in reduced numbers of sage-grouse outside of Core Population Areas.

8. Incentives to accelerate or enhance required reclamation in habitats adjacent to Core Population Areas should be developed, including but not limited to stipulation waivers, funding for enhanced reclamation, and other strategies. It is recognized that some incentives may result in reduced numbers of sage-grouse outside of the Core Population Areas.

9. Existing rights should be recognized and respected.

10. On-the-ground enhancements, monitoring, and ongoing planning relative to sage-grouse and sage-grouse habitat should be facilitated by sage-grouse local working groups whenever possible.

11. Fire suppression efforts in Core Population Areas should be emphasized, recognizing that other local, regional, and national suppression priorities may take precedent. However, public and firefighter safety remains the number one priority for all fire management activities.

12. State and federal agencies, including the U.S. Fish and Wildlife Service, Bureau of Land Management, U.S. Forest Service, and other federal agencies shall work collaboratively to ensure a uniform and consistent application of this Executive Order to maintain and enhance Greater Sage-Grouse habitats and populations.

13. State agencies shall work collaboratively with local governments and private landowners to maintain and enhance Greater Sage-Grouse habitats and populations in a manner consistent with this Executive Order.

14. It is critical that existing land uses and landowner activities continue to occur in core areas, particularly agricultural activities on private lands. For the most part, these activities on private lands are not subject to state agency review or approval. Only those activities occurring after August 1, 2008 which state agencies are required by state or federal statute to review or approve are subject to consistency review. This Executive Order in no way adds or expands the review or approval authority of any state agency. It is acknowledged that such land uses and activities could have localized impacts on Greater Sage-Grouse. To offset these impacts, Core Population Areas have been mapped to include additional habitat beyond that strictly necessary to prevent listing of the species. The additional habitat included within the Core Population Area boundaries is adequate to accommodate continuation of existing land uses and landowner activities. As a result, state agencies are not required to review most existing land uses and landowner activities in Core Population Areas for consistency with this Executive Order. Attachment C contains a list of existing land uses and landowner activities that do not require review for consistency.

15. It will be necessary to construct significant new transmission infrastructure to transport electricity generated in Wyoming to out-of-state load centers. New transmission lines constructed within Core Population Areas will be consistent with this Executive Order if they are constructed between July 1 and March 14 (or between July 1 and November 30 in winter concentration areas) and within one half (1/2) mile either side of existing (prior to Governor's Executive Order 2010-4) 115 kV or larger transmission lines creating a corridor no wider than one (1) mile. New transmission lines outside this one (1) mile wide corridor within Core Population Areas should be authorized or conducted only when it can be demonstrated that the activity will not cause declines in Greater Sage-Grouse populations.

16. For purposes of consistency with this Executive Order there is established a transmission line corridor through Core Population Areas in south central and southwestern Wyoming as illustrated on Attachment D. This two (2) mile wide corridor represents the state of Wyoming's preferred alternative for routing transmission lines across the southern portion of the state while reducing impacts to Core Population Areas and other natural resources. New transmission lines constructed within this corridor shall be considered consistent with this Executive Order if construction occurs within the corridor between July 1 and March 14 (or between July 1 and November 30 in winter concentration areas).

17. New distribution, gathering, and transmission lines sited outside established corridors within Core Population Areas should be authorized or conducted only when it can be demonstrated by the state agency that the activity will not cause declines in Greater Sage-Grouse populations.

18. State agencies shall strive to maintain consistency with the items outlined in this Executive Order, but it should be recognized that adjustments to the stipulations may be necessary based upon local conditions and limitations. The goal is to minimize future disturbance by co-locating proposed disturbances within areas already disturbed or naturally unsuitable.

19. The protective stipulations outlined in this Executive Order should be reevaluated on a continuous basis and at a minimum annually, as new science, information and data emerge regarding Core Population Areas and the habitats and behaviors of the Greater Sage-Grouse.

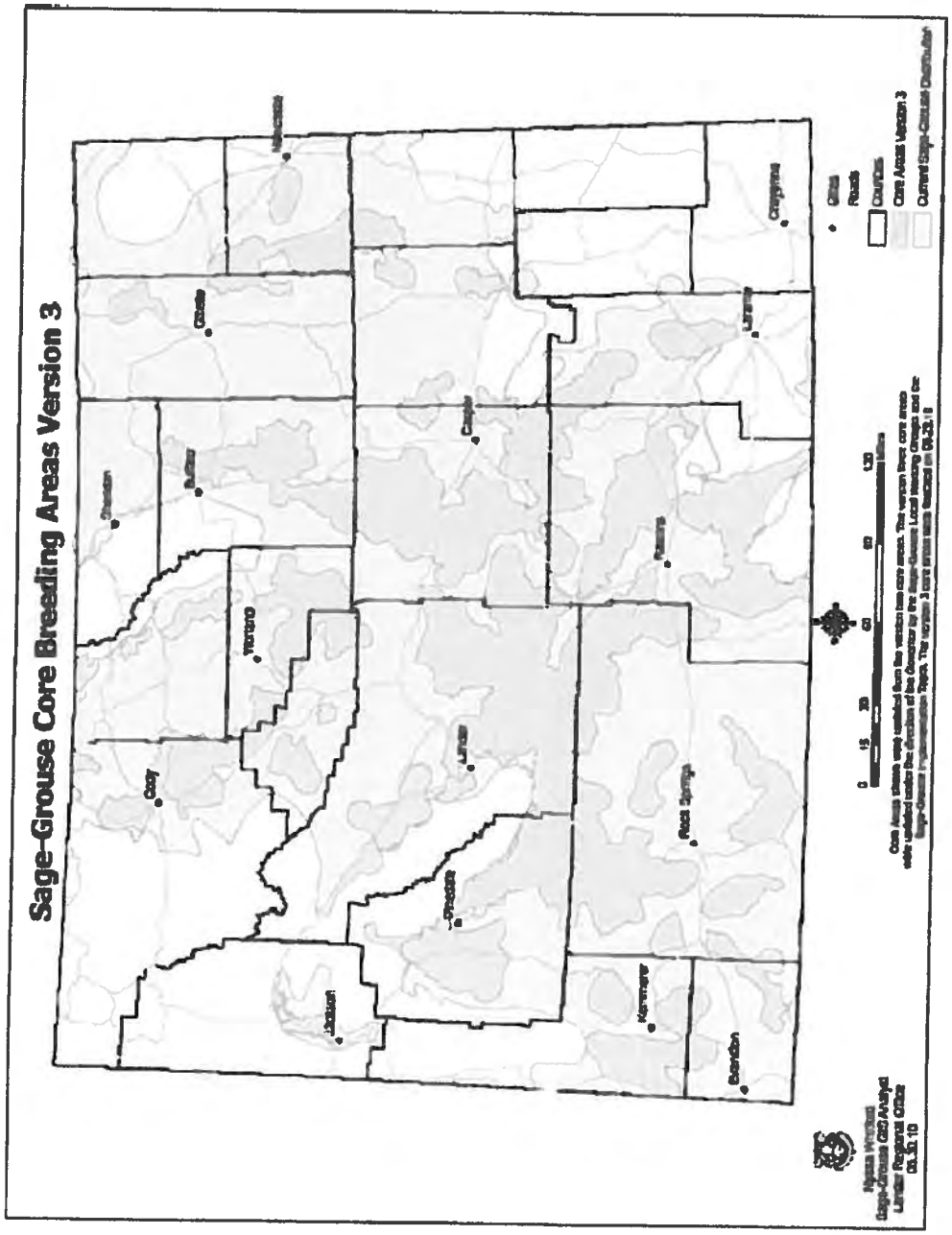
20. State agencies shall report to the Office of the Governor within ninety (90) days of signing and annually thereafter detailing their actions to comply with this Executive Order.

This Executive Order shall remain in effect until August 18, 2015, at which time all provisions of this Executive Order shall be reevaluated.

Given under my hand and the Executive Seal of the State of Wyoming this 2 day of June, 2011.

Matthew H. Mead
Governor

ATTACHMENT A



ATTACHMENT B

Permitting Process and Stipulations for Development in Sage-Grouse Core Areas

PERMITTING PROCESS

Point of Contact: The first point of contact for addressing sage-grouse issues for any state permit application should be the Wyoming Game and Fish Department (WGFD). Project proponents (proponents) need to have a thorough description of their project and identify the potential effects on sage-grouse prior to submitting an application to the permitting agency (details such as a draft project implementation area analysis, habitat maps and any other information will help to expedite the project). Project proponents should contact WGFD at least 45-60 days prior to submitting their application. More complex projects will require more time. It is understood that WGFD has a role of consultation, recommendation, and facilitation, and has no authority to either approve or deny the project. The purpose of the initial consultation with the WGFD is to become familiar with the project proposal and ensure the project proponent understands recommended stipulations and stipulation implementation process.

Maximum Disturbance Process: All activities will be evaluated within the context of maximum allowable disturbance (disturbance percentages, location and number of disturbances) of suitable sage-grouse habitat (See Appendix 1 for definition of suitable sage-grouse habitat and disturbance of suitable sage-grouse habitat) within the area affected by the project. The maximum disturbance allowed will be analyzed via a Density/Disturbance Calculation Tool (DDCT) process conducted by the Federal Land Management Agency on federal Land and the project proponent on non-federal (private, state) land. Unsuitable habitat occurring within the project area will not be included in the disturbance cap calculations.

1. Density/Disturbance Calculation Tool (DDCT): Determine all occupied leks within a core population area that may be affected by the project by placing a 4 mile boundary around the project boundary (as defined by the proposed area of disturbance related to the project). All occupied leks located within the 4 mile boundary and within a core population area will be considered affected by the project.

   A four-mile boundary will then be placed around the perimeter of each affected lek. The core population area within the boundary of affected leks and the 4 mile boundary around the project boundary creates the DDCT for each individual project. Disturbance will be analyzed for the DDCT as a whole and for each individual affected lek within the DDCT. Any portion of the DDCT occurring outside of core area will be removed from the analysis.

   If there are no affected leks within the 4 mile boundary around the project boundary, the DDCT area will be that portion of the 4 mile project boundary within the core population area.

2. Disturbance analysis: Total disturbance acres within the DDCT will be determined through an evaluation (Appendix 1) of:

   a. Existing disturbance (sage-grouse habitat that is disturbed due to existing anthropogenic activity and wildfire).

b. Approved permits (that have approval for on the ground activity) not yet implemented.

3. Habitat Assessment:

a. A habitat assessment is not needed for the initial DDCT area provided that the entire DDCT area is considered suitable.
b. A habitat assessment should be conducted when the initial DDCT indicates proposed project will cause density/disturbance thresholds to be exceeded, to see whether siting opportunities exist within unsuitable or disturbed areas that would reduce density/disturbance effects.
c. When a habitat assessment is conducted it should create a baseline survey identifying:
    i. Suitable and unsuitable habitat within the DDCT area
    ii. Disturbed habitat within the DDCT area
    iii. Sage-grouse use of suitable habitat (seasonal, densities, etc.)
    iv. Priority restoration areas (which could reduce the 5% cap)
        A. Areas where plug and abandon activities will eliminate disturbance
        B. Areas where old reclamation has not produced suitable habitat
    v. Areas of invasive species
    vi. Other assurances in place (CCAA, easements, habitat, contracts, etc.)

4. Determination of existing and allowable suitable habitat disturbance: Acres of disturbance within suitable habitat divided by the total suitable habitat within the DDCT area times 100 equals the percent of disturbed suitable habitat within the DDCT area. Subtracting the percentage of existing disturbed suitable habitat from 5% equals new allowable suitable habitat disturbance until plant regeneration or reclamation reduces acres of disturbed habitat within the DDCT area.

Permitting: The complete analysis package developed by consultation and review outlined herein will be forwarded to the appropriate permitting agency. WGFD recommendations will be included, as will other recommendations from project proponents and other appropriate agencies. Project proponent shall have access to all information used in developing recommendations. Where possible and when requested by the project proponent, state agencies shall provide the project proponent with development alternatives other than those contained in the project proposal.

Exempt Activities: A list of exempt ("de minimus") activities, including standard uses of the landscape is available in Attachment C.

GENERAL STIPULATIONS

These stipulations are designed to maintain existing suitable sage-grouse habitat by permitting development activities in core areas in a way that will not cause declines in sage-grouse populations. General stipulations are recommended to apply to all activities in core areas, with the exception of exempt ("de minimus") actions defined herein (Attachment C) or specifically identified activities. The specific industry stipulations are considered in addition to the general stipulations.

1. **Surface Disturbance:** Surface disturbance will be limited to 5% of suitable sage-grouse habitat per an average of 640 acres. The DDCT process will be used to determine the

level of disturbance. Distribution of disturbance may be considered and approved on a case-by-case basis. Unsuitable habitat should be identified in a seasonal and landscape context, on a case-by-case basis, outside the 0.6 mile buffer around leks. This will incentivize proponents to locate projects in unsuitable habitat to avoid creating additional disturbance acres. Acres of development in unsuitable habitat are not considered disturbance acres. The primary focus should be on protection of suitable habitats and protecting from habitat fragmentation. See Appendix 1 for a description of suitable, unsuitable habitat and disturbance.

2. **Surface Occupancy:** Within 0.6 miles of the perimeter of occupied sage-grouse leks there will be no surface occupancy (NSO). NSO, as used in these recommendations, means no surface facilities including roads shall be placed within the NSO area. Other activities may be authorized with the application of appropriate seasonal stipulations, provided the resources protected by the NSO are not adversely affected. For example, underground utilities may be permissible if installation is completed outside applicable seasonal stipulation periods and significant resource damage does not occur. Similarly, geophysical exploration may be permissible in accordance with seasonal stipulations.

3. **Seasonal Use:** Activity (production and maintenance activity exempted) will be allowed from July 1 to March 14 outside of the 0.6 mile perimeter of a lek in core areas where breeding, nesting and early brood-rearing habitat is present. In areas used solely as winter concentration areas, exploration and development activity will be allowed March 14 to December 1. Activities in unsuitable habitat may also be approved year-round (including March 15 to June 30) on a case-by-case basis (except in specific areas where credible data shows calendar deviation). Activities may be allowed during seasonal closure periods as determined on a case-by-case basis. While the bulk of winter habitat necessary to support core sage-grouse populations likely occurs inside Core Population Areas, seasonal stipulations (December 1 to March 14) should be considered in locations outside Core Population Areas where they have been identified as winter concentration areas necessary for supporting biologically significant numbers of sage-grouse nesting in Core Population Areas. All efforts should be made to minimize disturbance to mature sagebrush cover in identified winter concentration areas.

4. **Transportation:** Locate main roads used to transport production and/or waste products > 1 .9 miles from the perimeter of occupied sage-grouse leks. Locate other roads used to provide facility site access and maintenance > 0.6 miles from the perimeter of occupied sage-grouse leks. Construct roads to minimum design standards needed for production activities.

5. **Overhead Lines:** Bury lines when possible, if not; locate overhead lines at least 0.6 miles from the perimeter of occupied sage-grouse leks. New lines should be raptor proofed if not buried.

6. **Noise:** New noise levels, at the perimeter of a lek, should not exceed 10 dBA above ambient noise (existing activity included) from 6:00 p.m. to 8:00 a.m. during the initiation of breeding (March 1 – May 15). Ambient noise levels should be determined by measurements taken at the perimeter of a lek at sunrise.

7. **Vegetation Removal:** Vegetation removal should be limited to the minimum disturbance required by the project. All topsoil stripping and vegetation removal in suitable habitat

will occur between July 1 and March 14 in areas that are within 4 miles of an occupied lek. Initial disturbance in unsuitable habitat between March 15 and June30 may be approved on a case-by-case basis.

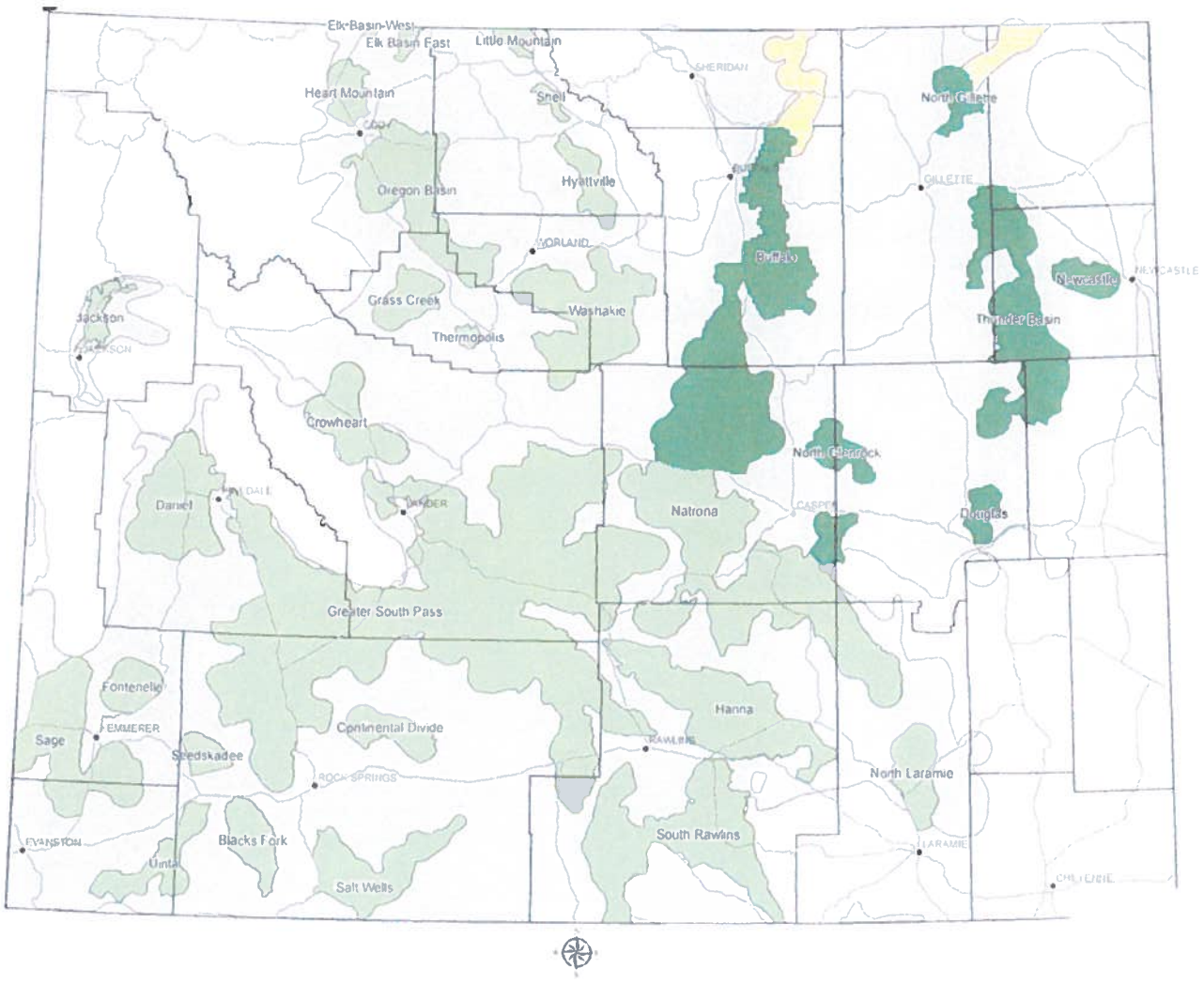
8. **Sagebrush Treatment:** Sagebrush eradication is considered disturbance and will contribute to the 5% disturbance factor. Northeast Wyoming, as depicted in Figure 1, is of particular concern because sagebrush habitats rarely exceed 15% canopy cover and large acreages have already been converted from sagebrush to grassland or cropland. Absent some demonstration that the proposed treatment will not reduce canopy cover to less than 15% within the treated area, habitat treatments in northeast Wyoming (Figure 1) should not be conducted. In stands with less than 15% cover, treatment should be designed to maintain or improve sagebrush habitat. Sagebrush treatments that maintain sagebrush canopy cover at or above 15% total canopy cover within the treated acres will not be considered disturbance. Treatments that reduce sagebrush canopy cover below 15% will be allowed, excluding northeast Wyoming (Figure 1), if all such treated areas make up less than 20% of the suitable sagebrush habitat within the DDCT, and any point within the treated area is within 60 meters of sagebrush habitat with 10% or greater canopy cover. Treatments to enhance sagebrush/grassland will be evaluated based upon the existing habitat quality and the functional level post-treatment.

9. **Monitoring/adaptive response:** Proponents of new projects are expected to coordinate with the permitting agency and local WGFD biologist to determine which leks need to be monitored and what data should be reported by the proponent. Certain permits may be exempted from monitoring activities pending permitting agency coordination. If declines in affected leks (using a three-year running average during any five year period relative to trends on reference leks) are determined to be caused by the project, the operator will propose adaptive management responses to increase the number of birds. If the operator cannot demonstrate a restoration of bird numbers to baseline levels (established by pre-disturbance surveys, reference surveys and taking into account regional and statewide trends) within three years, operations will cease until such numbers are achieved.

10. **Reclamation:** Reclamation should re-establish native grasses, forbs and shrubs during interim and final reclamation to achieve cover, species composition, and life form diversity commensurate with the surrounding plant community or desired ecological condition to benefit sage-grouse and replace or enhance sage-grouse habitat to the degree that environmental conditions allow. Seed mixes should include two native forbs and two native grasses with at least one bunchgrass species. Where sagebrush establishment is prescribed, establishment is defined as meeting the standard prescribed in the individual reclamation plan. Landowners should be consulted on desired plant mix on private lands. The operator is required to control noxious and invasive weed species, including cheatgrass. Rollover credit, if needed, will be outlined in the individual project reclamation plan.

Credit may be given for completion of habitat enhancements on bond released or other minimally functional habitat when detailed in a plan. These habitat enhancements may be used as credit for reclamation that is slow to establish in order to maintain the disturbance cap or to improve nearby sage-grouse habitat.

Figure 1. Wyoming Core Area with northeast Wyoming core (dark green) and connectivity areas (yellow).



11. **Existing Activities:** Areas already disturbed or approved for development within Core Areas prior to August 1, 2008 are not subject to new sage-grouse stipulations with the exception existing operations may not initiate activities resulting in new surface occupancy within 0.6 mile of the perimeter of a sage-grouse lek. Any existing disturbance will be counted toward the calculated disturbance cap for a new proposed activity. The level of disturbance for existing activity and rollover credit may exceed 5%.

12. **Exceptions:** Any exceptions to these general or specific stipulations will be considered on a case by case basis and must show that the exception will not cause declines in sage-grouse populations.

SPECIFIC STIPULATIONS (To be applied in addition to general stipulations)

1. Oil and Gas: Well pad densities not to exceed an average of one pad per square mile (640 acres) and suitable habitat disturbed not to exceed 5% of suitable habitat within the DDCT. As an example, the number of well pads within a two mile radius of the perimeter of an occupied sage-grouse lek should not exceed 11, distributed preferably in a clumped pattern in one general direction from the lek.

2. Mining

   a. For development drilling or ore body delineation drilled on tight centers, (approximately 100'X100') the disturbance area will be delineated by the external limits of the development area. Assuming a widely-spaced disturbance pattern, the actual footprint will be considered the disturbance area.
   b. Monitoring results will be reported annually in the mine permit annual report and to WGFD. Pre-disturbance surveys will be conducted as required by the appropriate regulatory agency.
   c. The number of active mining development areas (e.g., operating equipment and significant human activity) are not to exceed an average of one site per square mile (640 acres) within the DDCT.
   d. Surface disturbance and surface occupancy stipulations will be waived within the Core Area when implementing underground mining practices that are necessary to protect the health, welfare, and safety of miners, mine employees, contractors and the general public. The mining practices include but are not limited to bore holes or shafts necessary to: 1) provide adequate oxygen to an underground mine; 2) supply inert gases or other substances to prevent, treat, or suppress combustion or mine fires; 3) inject mine roof stabilizing substances; and 4) remove methane from mining areas. Any surface disturbance or surface occupancy necessary to access the sites to implement these mining practices will also be exempt from any stipulation.
   e. Coal mining operations will be allowed to continue under the regulatory and permit-specific terms and conditions authorized under the federal Surface Mining Control and Reclamation Act.

3. Connectivity:

   a. The suspension of federal and state leases in connectivity corridors (Figure 1) is encouraged where there is mutual agreement by the leasing agency and the operator. These suspensions should be allowed until additional information

clarifies their need. Where suspensions cannot be accommodated, disturbance should be limited to no more than 5% (up to 32 acres) per 640 acres of suitable sage-grouse habitat within connectivity corridors.

b. For protection of connectivity corridors (Figure 1), a controlled surface use (CSU) buffer of 0.6 miles around leks or their documented perimeters is required. In addition, a March 15 to June 30 timing limitation stipulation is required within nesting habitat within 4 miles of leks.

4. Process Deviation or Undefined Activities: Development proposals incorporating less restrictive stipulations or development that is not covered by these stipulations may be considered depending on site-specific circumstances and the proponent must have data demonstrating that the alternative development proposal will not cause declines in sage-grouse populations in the core area. Proposals to deviate from standard stipulations will be considered by a team including WGFD and the appropriate land management and permitting agencies, with input from the U.S. Fish and Wildlife Service. Project proponents need to demonstrate that the project development would meet at least one of the following conditions:

   a. No suitable habitat is present in one contiguous block of land that includes at least a 0.6 mile buffer between the project area and suitable habitat;

   b. No sage-grouse use occurs in one contiguous block of land that includes at least a 0.6 mile buffer between the project area and adjacent occupied habitat, as documented by total absence of sage-grouse droppings and an absence of sage-grouse activity for the previous ten years;

   c. Provision of a development/mitigation plan that has been implemented and demonstrated by previous research not to cause declines in sage-grouse populations. The demonstration must be based on monitoring data collected and analyzed with accepted scientific based techniques.

5. Wind Energy Development: Wind development is not recommended in sage-grouse core areas, but will be reevaluated on a continuous basis as new science, information and data emerges.

Appendix I
Suitable Sage-Grouse Habitat Definition

Sage-grouse require somewhat different seasonal habitats distributed over large areas to complete their life cycle. All of these habitats consist of, are associated with, or are immediately adjacent to, sagebrush. If sage-grouse seasonal habitat use maps do not exist for the project site the following description of suitable habitat should be used to determine areas of unsuitable sage-grouse habitat for development siting purposes. An abbreviated description of a complex system cannot incorporate all aspects of, or exceptions to, what habitats a local sage-grouse population may or may not utilize.

Suitable sage-grouse habitat (nesting, breeding, brood-rearing, or winter) is within the mapped occupied range of sage-grouse, and:

1) has 5% or greater sagebrush canopy cover as measured by the technique developed by interagency efforts. "Sagebrush" includes all species and sub-species of the genus Artemisia except the mat-forming sub-shrub species: frigida (fringed) and pedatifida (birdfoot); or
2) is riparian, wet meadow (native or introduced) or areas of alfalfa or other suitable forbs (brood rearing habitat) within 60 meters of sagebrush habitat with 10% or greater canopy cover and the early brood rearing habitat does not exceed 20% of the suitable sagebrush habitat present within the DDCT, Larger riparian/wet meadow, and grass/forb producing areas may be considered suitable habitat as determined on a case by case basis.

Transitional sage-grouse habitat is land that has been treated or burned prior to 2011 resulting in <5% sagebrush cover but is actively managed to meet a minimum of 5% sagebrush canopy cover with associated grasses and forbs by 2021 (by analysis of local condition and trend) and may or may not be considered disturbed. Land that does not meet the above vegetation criteria by 2021 should be considered disturbed.

Land treatments post 2010 must meet sagebrush vegetation treatment guidelines or the treatment will be considered disturbed. Following wildfire, lands shall be treated as disturbed pending an implementation management plan with trend data showing the area returning to functional sage-grouse habitat.

To evaluate the 5% disturbance cap per average 640 acres using the DDCT, suitable habitat is considered disturbed when it is removed and unavailable for immediate sage-grouse use.

The following items are guidelines for determining suitable habitat:

a. Long-term removal occurs when habitat is physically removed through activities that replace suitable habitat with long term occupancy of unsuitable habitat such as a road, well pad or active mine.
b. Short—term removal occurs when vegetation is removed in small areas, but restored to suitable habitat within a few years of disturbance, such as a successfully reclaimed pipeline, or successfully reclaimed drill hole or pit.
c. There may be additional suitable habitat considered disturbed between two or more long term (greater than 1 year) anthropogenic disturbance activities with a footprint greater than 10 acres each if the activities are located such that sage-grouse use of the suitable habitat between these activities is significantly reduced due to the close proximity (less than 1.2 miles apart, 0.6 miles from each activity) and resulting in cumulative effects of these large scale activities. Exemptions may be provided.

d. Land in northeast Wyoming (Figure 1 of Attachment B) that has had sagebrush removed post-1994 (based on Orthophoto interpretation) and not recovered to suitable habitat will be considered disturbed when using the DDCT.

ATTACHMENT C
Exempt ("de minimus") Activities

Existing Land Uses and Landowner Activities in Greater Sage-Grouse Core Population Areas That Do Not Require State Agency Review for Consistency With Executive Order No. 2011-02

1. Existing animal husbandry practices (including branding, docking, herding, trailing, etc).

2. Existing farming practices (excluding conversion of sagebrush/grassland to agricultural lands).

3. Existing grazing operations that utilize recognized rangeland management practices (allotment management plans, NRCS grazing plans, prescribed grazing plans, etc).

4. Construction of agricultural reservoirs and habitat improvements less than 10 surface acres and drilling of agriculture and residential water wells (including installation of tanks, water windmills and solar water pumps) more than 0.6 miles from the perimeter of the lek. Within 0.6 miles from leks no review is required if construction does not occur March 15 to June 30 and construction does not occur on the lek. All water tanks shall have escape ramps.

5. Agricultural and residential electrical distribution lines more than 0.6 miles from leks. Within 0.6 miles from leks no review is required if construction does not occur March 1 5 to June 30 and construction does not occur on the lek. Raptor perching deterrents shall be installed on all poles within 0.6 miles from leks.

6. Agricultural water pipelines if construction activities are more than 0.6 miles from leks. Within 0.6 miles from leks no review is required if construction does not occur March 15 to June 30 and construction is reclaimed.

7. New fencing more than 0.6 miles from leks and maintenance on existing fence. For new fencing within 0.6 miles of leks, fences with documented high potential for strikes should be marked.

8. Irrigation (excluding the conversion of sagebrush/grassland to new irrigated lands).

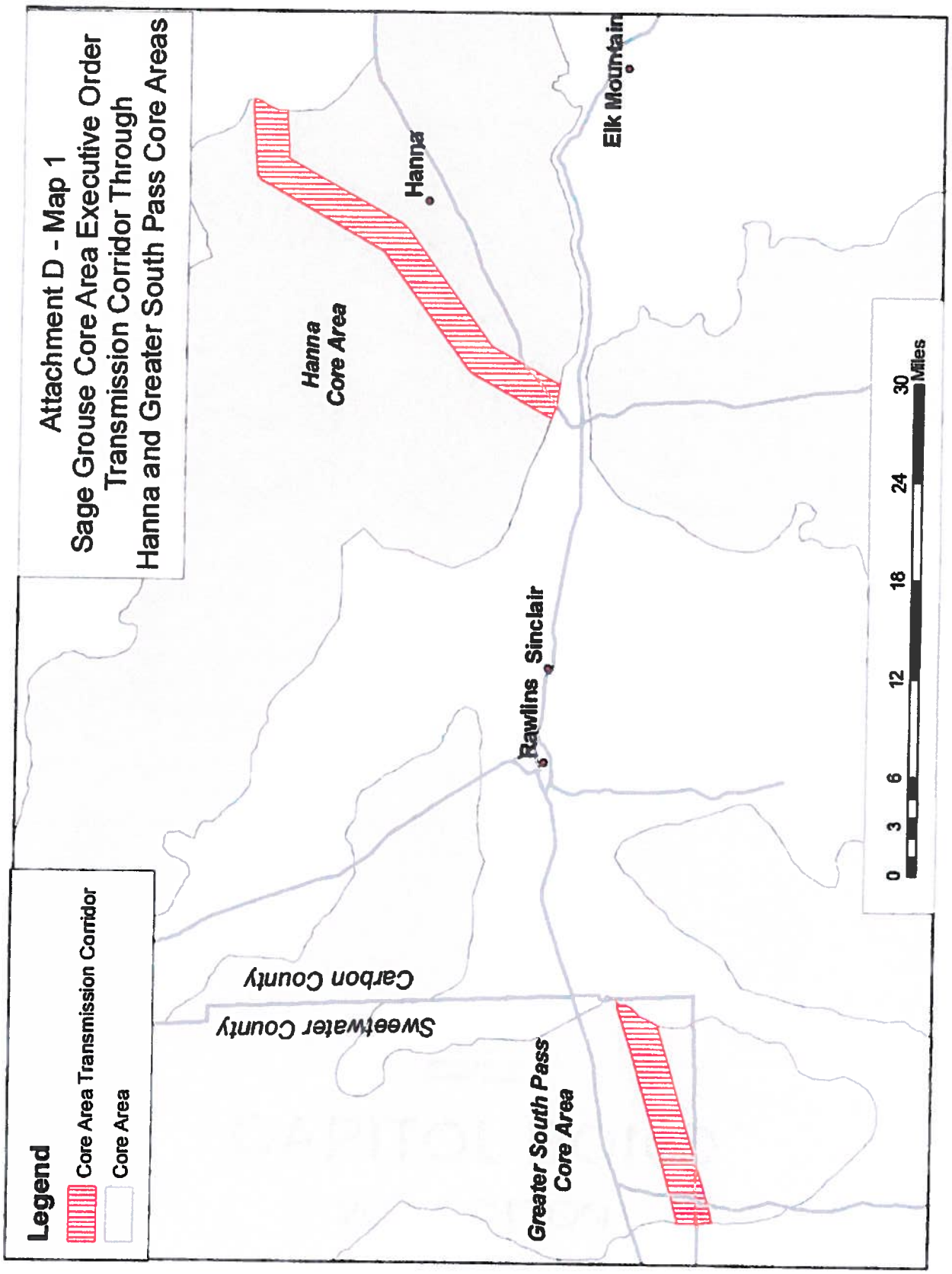
9. Spring development if the spring is protected with fencing and enough water remains at the site to provide mesic (wet) vegetation.

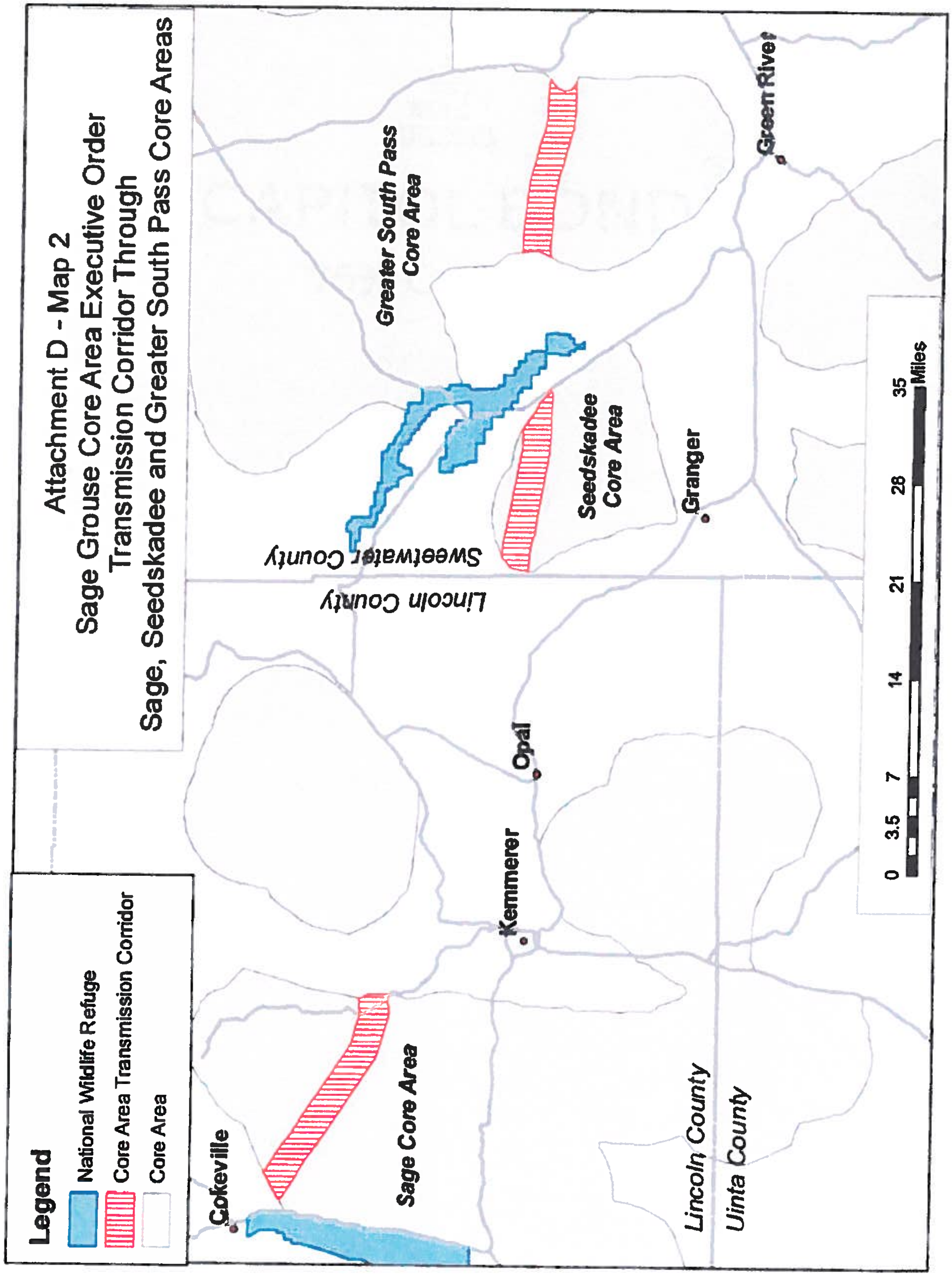
10. Herbicide use within existing road, pipeline and power line rights-of-way. Herbicides application using spot treatment. Grasshopper/Mormon cricket control following Reduced Agent-Area Treatments (RAATS) protocol.

11. Existing county road maintenance.

12. Cultural resource pedestrian surveys.

13. Emergency response.


Attachment D - Map 1
Sage Grouse Core Area Executive Order
Transmission Corridor Through
Hanna and Greater South Pass Core Areas
Legend
Core Area Transmission Corridor
Core Area
Hanna
Core Area
Hanna
Elk Mountain
Rawlins
Sinclair
Carbon County
Sweetwater County
Greater South Pass
Core Area
0
3
6
12
18
24
30
Miles


Attachment D - Map 2
Sage Grouse Core Area Executive Order
Transmission Corridor Through
Sage, Seedskadee and Greater South Pass Core Areas
Legend
National Wildlife Refuge
Core Area Transmission Corridor
Core Area
Greater South Pass Core Area
Seedskadee Core Area
Sage Core Area
Sweetwater County
Lincoln County
Lincoln County
Uinta County
Cokeville
Kemmerer
Opal
Granger
Green River
0 3.5 7 14 21 28 35 Miles

ATTACHMENT B

WYOMING GAME AND FISH DEPARTMENT

5400 Bishop Blvd. Cheyenne, WY 82006

Phone: (307) 777-4600 Fax: (307) 777-4699

Web site: http://gf.state.wy.us

February 27, 2012

WER 9433.06
U. S. Fish and Wildlife Service
Data Request for the Annual Review of the
Greater Sage-Grouse Candidate Status

U.S. Fish and Wildlife Service
Attention: Mark Sattelberg
5353 Yellowstone Road, Suite 308A
Cheyenne, WY 82009

Dear Mr. Sattelberg:

The U.S. Fish and Wildlife Service (Service) has initiated its annual review of the Greater sage-grouse (*Centrocercus urophasianus*) which was designated as a candidate species in March 2010, under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*).

As part of this annual review, the Service is soliciting new information regarding changes in the status of the bird, its habitats, or scientific understanding of the species and its habitats. The March 2010 finding for the Greater sage-grouse identified habitat loss and fragmentation and insufficient regulatory mechanisms as the primary factors for designating the species as warranted for listing. Therefore, the Service has indicated the annual review will primarily focus on any changes in these two factors. The Service is only requesting information we have collected between January 2011 and February 2012.

The formatting of our response was left to our discretion. We have chosen to follow the outline provided by the Service to ensure that we are addressing the specific needs identified by the Service. Many of the items are outside the scope of our agency and will need to be addressed by others. We have identified additional information sources where pertinent.

In summary, the most significant action taken since our 2011 response is the reaffirmation of the state's continuing commitment to implement the state's core area strategy. This strategy was first developed and implemented under the leadership of former Governor Freudenthal. Within six months of his 2011 inauguration, newly elected Governor Mead issued his own sage-grouse Executive Order (2011-5) which did not alter the path forward for the state's management of the bird. The Service continues to state that if Wyoming's Core Area Strategy is implemented as ordered, it has a good chance of effectively conserving greater sage-grouse and precluding the need to list. Other states have been encouraged to evaluate Wyoming's model as they develop their own strategies. The Governor's Sage-grouse Implementation Team chair, Mr. Bob Budd

has provided assistance to other states and was recently hired by the State of Utah to facilitate a similar effort there.

Additionally the Wyoming BLM recently issued new direction to its field offices in the form of an instruction memorandum (WY-2012-019) which significantly advances the Wyoming core area strategy as a regulatory mechanism. The Wyoming Game and Fish Department and other state agencies have aggressively sought to implement the Executive Order. Major items for the Service to consider in its review are: 1) the state's disproportionate role in the process, the result of supporting an estimated 35-40% of the known range-wide population of greater sage-grouse (Doherty et al 2010a), 2) the continued substantive efforts to conserve the species through the core area policy, and 3) little additional threat documented in 2010 as detailed below.

Data Request:
Population status, trends and numbers: This section is primarily directed towards State and Provincial agencies for response.

1. *What are the population trends for your State or Province? If describing by population, please use the population descriptions identified in the 2006 WAFWA Conservation Strategy.*

   Tables 1 and 2 contain sage-grouse lek data for Wyoming as a whole as well as that for the Wyoming portion of Management Zone 1 (northeast Wyoming) since 1995. Overall increases in the number of known leks are largely due to increased survey effort although we can document the establishment of new leks during cyclic peaks. The trends reflected in these data are similar to those calculated by Garton et al. (2011) in the recent Studies in Avian Biology sage-grouse monograph. Wyoming's statewide population trend since 2006 has been down but this is not unexpected based on the cyclic nature of sage-grouse populations (Fedy and Doherty 2010). If this cyclic pattern holds true, we should be at the bottom of the current cycle and within the range of natural variation. Wyoming's statewide population remains above that suggested by the data collected in the mid-1990s.

   Data from northeast Wyoming are presented in Table 2 due to the interest and scrutiny focused specifically on this area over the last 15 years. The population in northeast Wyoming declined, or grown more slowly depending on time period, for reasons demonstrated by published University of Montana research already known to and considered by the Service. Core area boundaries were drawn and revised with full knowledge of the consequences and consent of the Service. The addition of the connectivity areas and linkage of cores in northeast Wyoming during the 2010 revision process attempted to address these consequences of lower sage-grouse numbers and increased habitat fragmentation in the area.

The BLM has contracted the University of Montana to conduct a sage-grouse population viability analysis (PVA) for northeast Wyoming. The final PVA manuscript should be available in early 2012.

WGF has contracted to upgrade our sage-grouse database. This upgrade will be in use by the summer of 2012 and will provide for more detailed population trend analysis at various scales in the near future.

a. *Is the trend expected given weather conditions and population cycling?*

Yes (Fedy and Doherty 2010), on a statewide basis. As stated above, the northeast Wyoming population is more intensively subjected to other factors.

Year	Occupied Leks	Leks Checked	Percent Checked	Active Leks	Males/ Active Lek
1995	1339	705	52.7	432	12.1
1996	1353	710	52.5	440	11.8
1997	1363	727	53.3	436	15.7
1998	1402	737	52.6	492	21.4
1999	1447	872	60.3	599	25.8
2000	1503	1001	66.6	723	29.5
2001	1561	1005	64.4	718	23.6
2002	1593	1091	68.5	726	20.1
2003	1624	1224	75.4	807	20.6
2004	1690	1287	76.2	840	21.6
2005	1776	1387	78.1	1001	33.0
2006	1836	1507	82.1	1083	39.2
2007	1908	1588	83.2	1135	36.5
2008	1942	1528	78.7	1102	30.6
2009	1977	1604	81.1	1098	25.6
2010	2022	1643	81.3	1115	20.3
2011	2026	1603	79.1	1049	17.7

Table 1. Wyoming Greater sage-grouse lek data from 1995-2011.

Year	Leks Known	Leks Checked	Percent Checked	Active Leks	Males/ Active Lek
1995	216	119	55.1	39	6.4
1996	218	112	51.4	48	6.6
1997	223	104	46.6	45	7.8
1998	231	108	46.8	52	11.0
1999	247	137	55.5	70	12.9
2000	259	187	72.2	110	16.8
2001	293	172	58.7	121	13.4
2002	305	196	64.3	116	8.7
2003	329	199	60.5	121	8.7
2004	365	296	81.1	158	8.2

2005	417	311	74.6	210	15.3
2006	445	350	78.7	235	19.8
2007	464	408	87.9	249	19.2
2008	472	408	86.4	239	15.2
2009	474	406	85.7	221	9.1
2010	481	393	81.7	195	7.8
2011	481	398	82.7	169	6.5

Table 2. Northeast Wyoming greater sage-grouse lek data from 1995-2011.

2. *Has there been any significant change in the populations in your State or Province (more than normal annual fluctuations)?*

See above response regarding northeast Wyoming.

a. *If yes, do you know the cause of the population change? Please describe.*

See above.

Habitat status and trends: To the extent possible, for each of items listed below please provide locations, populations affected, acreage affected and geospatial data if available. The primary focus of these questions is directed at occupied habitats (at least during one season) or sagebrush habitats that are essential for long-term species persistence (e.g. connectivity corridors).

The Wyoming Game and Fish Department has little direct management authority over habitat manipulation. We anticipate most of these items will be addressed by the various land management or permitting agencies (e.g. 10,585 acre wildfire in the Newcastle BLM Field Office).

In order to remain consistent with Executive Order 2011-5, the WGF revised its habitat treatment protocol (Attachment A) for conducting treatments in sage-grouse habitats. The Wyoming BLM appended this document to its sage-grouse instruction memorandum (WY-2012-019).

See Attachment B for a list of projects that may have impacted sage-grouse conducted by the WGFD in 2011. It is not typically the WGFD's intent to manipulate habitat solely for the benefit of wild ungulates or a single species. On balance, these treatments should be viewed as positive or neutral rather than as loss of sage-grouse habitat. Little, if any, of the sagebrush treatments were conducted on sage-grouse winter habitats. Most were in late brood-rearing habitats that may also support some nesting and early brood-rearing. As our

efforts to development sage-grouse seasonal habitat models/maps are completed, and the provisions of Attachment A are implemented, we will be able to provide more specific data in this regard.

1. *Areas of sagebrush lost due to permanent conversion (e.g. agricultural lands, subdivisions). In addition to the information requested above, please identify the stage of loss (e.g. proposed, in NEPA review, completed).*
    a. *Please identify proposed areas of conversions that have a high certainty of occurrence.*
2. *Please identify areas that will be converted in association with Farm Bill Biomass Crop Assistance Program (BCAP).*
3. *For areas where CRP has/is providing habitat for grouse, have there been areas where the lands have been put back into production, resulting in a loss of habitat? If so, please estimate the number of acres potentially lost.*
4. *Acres of occupied sagebrush habitats that were lost to fire (either wild or prescribed fires).*

See Attachment B and reports from other agencies.

5. *Expansion of conifers or cheatgrass into sagebrush.*
6. *Incursion of other invasive species that affects habitat quality and utility for sage-grouse. Please identify the invasive species.*
7. *Proposed energy developments within occupied sagebrush habitats. In addition to the items requested above, please identify the type (oil, gas, wind, solar, hydropower, geothermal, uranium, etc.) and stage of development, well/turbine/development density, and life of project.*
8. *Please provide information regarding new, proposed, or expanded mining activities.*
9. *Transmission corridors for energy transmission. Include status (e.g. NEPA completed, under construction, proposed), and any efforts to minimize impacts to sage-grouse and sagebrush*
10. *Grazing impacts – any significant changes that affect habitat abundance and quality. We are particularly interested in sagebrush treatments that either remove sagebrush habitats or alter their ability to provide current seasonal habitats (e.g. converting winter habitat to more open canopies that may support brood-rearing).*
    a. *Please include treatments conducted for the benefit of wild ungulates.*

See Attachment B.

b. Please identify any changes in wild equid status.

Annual changes of ungulate populations are not meaningful in the context of the purpose of the data call. The WGFD continues to manage wild ungulate populations

by objective. Hunting seasons for elk and whitetail deer have become increasingly liberal in many parts of the state in an effort to reduce populations of these species to better align with habitat and human concerns. Elk winter ranges can overlap with important seasonal habitats of sage-grouse although the significance of this potential threat has not been measured.

11. *Please identify any known losses of habitat connectivity, both within and between populations.*

None known. We are cooperating with multiple partners to determine genetic connectivity across Wyoming and Montana. Results are not yet available but thousands of samples have been collected and genetic analyses have begun. As stated above, connectivity was at least partly addressed during the core area revision process conducted in 2010. Core areas were expanded and/or new connectivity zones created for this reason. In January 2012, a meeting of the Rangewide Interagency Sage-grouse Conservation Team was held in Denver, CO to discuss and plan expanding this genetic connectivity effort rangewide.

Changes in Regulatory Mechanisms: Regulatory mechanisms are those that are enforceable by either state or provincial statute, federal land management documents, etc. They do not include voluntary efforts. However, please provide information on any voluntary efforts that may be affecting sage-grouse and sagebrush habitats. If these efforts have not yet been implemented, or not yet shown to be effective, please identify those projects within the conservation efforts database.

1. *Identify the status of BLM RMP revisions that will affect sage-grouse or sagebrush (either positive or negative), if any.*

The Service is aware of and has participated in the on-going Wyoming BLM RMP revision process for sage-grouse. Additionally, the Wyoming BLM issued Instruction Memorandum (IM) No. WY-2012-019 in February 2012 which provides interim guidance to its field offices while RMPs are being revised. This IM, along with the RMP revision process, is the BLM's mechanism for incorporating Wyoming's core area strategy and Executive Order 2011-5 into their regulatory framework.

2. *Identify any changes in the status of regulatory mechanisms that will affect sage-grouse or sagebrush (positive or negative) on other Federal lands (e.g. FS, NPS, military lands).*

The USFS should report on their newly initiated efforts regarding regulatory mechanisms that will affect sage-grouse.

3. *Identify any new regulatory mechanisms that minimize impacts from fire, invasives, energy development, etc. If new regulatory mechanisms are being considered, you should also identify those, along with the certainty of application.*

4. *Any new State, Provincial, or other local (e.g. county) efforts to address threats?*

   The Service is very aware of and was intimately involved in the development of Wyoming's Core Area Strategy as implemented via Executive Order 2008-2 and revised and refined by Executive Orders 2010-4 and 2011-5. The Service articulated its qualified support for this policy in the listing decision document and in various communications between itself, the Governor's Office and WGF over the last three plus years.

   The WGFD has been coordinating the reviews of the Density/Disturbance Calculations as prescribed in the Executive Order 2011-5. A list of the DDCTs and subsequent outcomes is listed in Attachment C.

   Efforts also continued in 2011 to develop a statewide Candidate Conservation Agreement with Assurances (CCAA) for agricultural operations in Wyoming. The Service is the lead entity in this effort.

Hunting and other uses: (Please identify state or province)

1. *Have there been any changes to hunting regulations for sage-grouse?*

   Not in 2011.

   If so, please identify the reason behind the change, and if applicable, any results.

   The hunting season in northeast Wyoming was made more conservative in 2010 by reducing the season length from 7 days to 3. While the 2010 harvest of an estimated 129 declined from an estimated 311 in 2009, hunting pressure and harvest was minimal in both years relative to the scale of the area and numbers of birds in the population. The season changes were made primarily for social reasons and are not expected to result in measureable change in the sage-grouse population of the area. See Christiansen (2010) for additional information.

2. *Have there been any changes in recreational impacts (positive or negative) or in religious use of sage-grouse?*

   No

3. *Please identify current research projects on sage-grouse in your State or Province, and whether or not the project includes bird capture or collaring.*

   See Attachment D for abstracts of research being conducted in Wyoming in 2011. Wyoming regulates wildlife capture and research through a permitting process (process available on request). In 2011 there were 12 active Chapter 33 permits that allowed capture of up to 1,237 sage-grouse across the state. All but up to 100 of these were permitted for telemetry collaring. Most studies did not reach the limits of what they were allowed to capture. Study topics included a comparison of the use of VHF versus GPS telemetry technology, general distribution, habitat use and movement, effects of energy development (wind, natural gas), mining effects, raven control effects, predation and disease monitoring. All of those persons permitted to capture and handle sage-grouse in Wyoming were experienced in that regard. If requested we can provide copies of each Chapter 33 permit which summarizes the individual researcher's intent and what actions each permit allows.

   As a result of increasing concern for potential impacts of capture and marking to both individual birds and local populations the WGF is increasing its scrutiny of Chapter 33 permit applications and the studies associated with them. In 2011, one permit application was rejected and one permit was granted only after the permittee was required to obtain additional training prior to capture and marking birds and more qualified researchers were engaged to conduct the work in a more scientifically rigorous manner. In February 2012, the WGF coordinated research efforts across south-central Wyoming in order to minimize impacts to sage-grouse and strengthened future analyses via development and use of a common reference site (Attachment E). The WGF also developed a database in 2011 to better track and regulate permit holders and the results of their work.

Disease and Predation: (please provide locations where appropriate)

1. *Please report any West Nile virus outbreaks in 2010.*

   We did not detect West Nile virus in greater sage-grouse in Wyoming in 2011. Human cases (3) were the lowest reported in Wyoming since the virus arrived in the state a decade ago. Our normal monitoring efforts were in place. These consisted of requesting researchers with telemetered birds to monitor for mortality in late summer and attempt to recover and submit carcasses of dead birds to the Wyoming State Vet Lab for necropsy. We also asked field personnel, other agency personnel and the public (via press release), especially hay farmers, to report dead birds in a timely fashion.

2. *Are you aware of any new diseases/parasites that have population-level effects?*

   No, and due to increased awareness of disease in general due to the threat of West Nile virus, our overall disease surveillance efforts have intensified as described above.

3. *Do you have any data that suggests that predators may be limiting sage-grouse in any part of the range, independent of habitat conditions?*

   No, not "independent of habitat conditions". We do not have data suggesting predation is a threat beyond the bounds of natural variation inherent to any predator/prey relationship. Where sage-grouse habitat has been diminished or predator habitat enhanced due to anthropogenic causes, predation may be a secondary threat (see response to #4 below for new information).

4. *Do you have data that supports increases in predator populations that are affecting sage-grouse as the result of habitat alterations?*

   Yes. As reported last year, please see and review Bui et al. (2010). Two additional studies of predation are currently being conducted by Utah State University (see Attachment D).

Other Factors:
Do you have any new information regarding negative effects of pesticides, contaminants, recreational activities or other human disturbance, drought and other climatic conditions on the Greater sage-grouse?

Information regarding rangeland grasshopper and Mormon cricket control in Wyoming in 2011 can be secured from the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) office in Cheyenne.

Regarding "other human disturbance", please see and review the 2011 citations listed in the "Literature" section below.

Intuitively, it appeared that the cold wet conditions experienced across much of the state during the peak of the 2011 sage-grouse hatch likely reduced nest success and chick survival but the impacts did not drive populations outside the bounds of normal. Wings from approximately 2,000 hunter harvested birds indicated a statewide chick:hen ratio of 1.3:1 in the fall population. This ratio is typically suggestive of stable or very slight decreases in grouse numbers observed on leks the following spring.

We do not have data regarding specific impacts of recreation (aside from hunting) occurring during the period of interest.

Please report any new information on the impacts of climate change on sage-grouse or their habitats.

None to report.

Literature:

Please identify any pertinent literature you feel is important for our review. In addition to citations, if you have cited any literature above, please provide the page numbers of the actual citation.

The Service is already very aware of the Studies in Avian Biology monograph published in 2011 titled "Ecology and Conservation of Greater Sage-Grouse: A Landscape Species and Its Habitats". Additionally, the references in the following list of manuscripts released or published in 2011 are likely to have already been made available to the Service but we include them here to ensure that. The list is not meant to be exhaustive but represents what we have on file.

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(1):65-78.

Christiansen, T. 2010. Hunting and sage-grouse: a technical review of harvest management on a species of concern in Wyoming – revised September 2010. Unpublished report. Wyoming Game and Fish Department. Available on-line at: http://gf.state.wy.us/wildlife/wildlife_management/sagegrouse/index.asp

Doherty, K. E., J. L. Beck and D. E. Naugle. 2011. Comparing ecological site descriptions to habitat characteristics influencing greater sage-grouse nest site occurrence and success. Rangeland Ecology and Management 64(4):344-351.

Erickson, H. J. 2011. Herbaceous and avifauna responses to prescribed fire and grazing timing in a high elevation sagebrush ecosystem. Thesis. Colorado State University, Ft. Collins.

Fedy, B. C. and K. E. Doherty. 2010. Population cycles are highly correlated over long time series and large spatial scales in two unrelated species: greater sage-grouse and cottontail rabbits. Oecologia 165:915-924.

Fedy, B.C. and C.L. Aldridge. 2011. The importance of within-year repeated counts and the influence of scale on long-term monitoring of sage-grouse. Journal of Wildlife Management 75(5): 1022-1033.

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

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

Mandich, C. A. 2011. Seasonal habitat distribution and parasite survey of greater sage-grouse in western Natrona County, Wyoming. Thesis. University of Wyoming, Laramie.

Contact person(s):
Please provide us a contact(s) regarding all of the above requested data in case we have questions.

Tom Christiansen, Sage-Grouse Program Coordinator, 351 Astle Ave. Green River, WY 82935 307.875.3223 tom.christiansen@wyo.gov

Sincerely,

John M. Emmerich

John Emmerich
Deputy Director

JE/mf/gb

cc: Jerimiah Rieman, Governor's Policy Office
Steve Ferrell, Governor's Policy Office
Scott Talbott, Cheyenne
Brian Nesvik, Cheyenne
Tom Christiansen, Green River Region
Joe Bohne, Jackson Region
Bob Lanka, Cheyenne
Tom Ryder, Cheyenne

WYOMING GAME AND FISH DEPARTMENT PROTOCOLS FOR TREATING SAGEBRUSH TO BE CONSISTENT WITH WYOMING EXECUTIVE ORDER 2011-5; GREATER SAGE-GROUSE CORE AREA PROTECTION (7/8/2011)

Sagebrush treatments have been implemented or proposed with the assumption of benefiting sage-grouse. Research, monitoring and anecdotal observations suggest that treatments can result in beneficial, benign or harmful impacts to sage-grouse habitat depending on many known and unknown factors.

These protocols are to be used to guide the development of Wyoming Game and Fish Department (WGFD) sponsored or supported sagebrush treatments. The purpose of these protocols is to provide a framework for WGFD projects to ensure that they are consistent with sage-grouse core area and non-core area stipulations. This framework will not answer all questions associated with treatments. It is assumed that these protocols may be revisited as new science becomes available. Communication with the WGFD Director's Office or sage-grouse coordinator will be necessary for many situations.

Core Area Treatments:

The following sagebrush treatment protocols are designed to ensure future habitat treatments conform to the provisions of Executive Order 2011-5, to conserve sage-grouse and prevent population declines in core habitat areas. Treatments that will NOT reduce sagebrush canopy cover to less than 15% are NOT subject to the Density/Disturbance Calculation Tool (DDCT) step prescribed below. However, such treatment proposals should still follow the other steps outlined in order to determine and document purpose and need, appropriately apply stipulations and monitor results. In northeast Wyoming core areas (Figure 1), treatments that will result in sagebrush canopy cover being reduced to less than 15% should not be conducted.

1. Determine and document the purpose and need for the treatment (adapted from Wyoming Interagency Vegetation Committee 2002):

    A. Evaluate the juxtaposition, extent, importance and value of the sagebrush patch in the landscape (is this the only patch of sagebrush in the landscape?).
    B. Identify the sagebrush species/subspecies/variety and assess the ecological site potential and treatment effects.
    C. Determine the associated vegetation composition and condition (e.g. composition of desirable and non-desirable species and their response to treatment) and their contribution to wildlife habitat.
    D. Assess site potential and resilience of the site to recover.
    E. Assess other existing site influences (e.g., current grazing use, presence of noxious/exotic plant infestations, cumulative impacts, etc.).
    F. Evaluate past management history of the site.
    G. Establish post-treatment vegetation management objectives tiered to the management plan for the site.

H. Create a baseline for short-term/long-term post-treatment monitoring of the site.

2. If there is justified purpose and need, then utilize the Density/Disturbance Calculation Tool (DDCT) outlined in Executive Order 2011-5 and conduct the prescribed analysis.
    A. If the cumulative disturbance, including the proposed treatment, is less than 5% of suitable sage-grouse habitat as defined in the Executive Order, the project may proceed.
        i. Recognize any treatment reducing sagebrush canopy cover to less than 15% will be considered disturbance for future disturbance calculations (adapted from Connelly et al. 2000a, Stiver et al. 2010).
        ii. A project plan must be developed that considers, evaluates and appropriately applies the following stipulations:
            1. No treatment should occur within 0.6-mile of any occupied lek that results in less than 15% sagebrush canopy cover unless:
                a. The proposed treatment is necessary to maintain the viability of the lek such as removing conifers or sagebrush encroaching on the lek site.
            2. Treatment implementation should not occur within 4-miles of any occupied lek from March 15 – June 30 (Wyoming Game and Fish Dept. 2010).
            3. Treatment implementation should not occur in designated and/or mapped sage-grouse winter concentration areas from November 15 – March 14 (Wyoming Game and Fish Dept. 2010).
            4. Avoid the use of fire to treat sagebrush in less than 12-inch precipitation zones (Beck et al 2009, Connelly et al 2000b, WAFWA, 2009).
            5. Control and monitor noxious and/or invasive vegetation post-treatment.
            6. Rest the treated area from grazing for two full growing seasons unless vegetation recovery dictates otherwise.

    B. If the cumulative disturbance, including the proposed treatment, within the DDCT boundary, is greater than 5% of the suitable sage-grouse habitat and the goal of the treatment is to reduce sagebrush canopy cover to less than 15%, the project shall NOT proceed except when:
        i. Acreage of treatment is reduced so cumulative disturbance does not exceed 5% of suitable habitat.
        ii. The treatment is configured such that all treated habitat is within 60 meters of sagebrush habitat (adapted from Danvir 2002, Slater 2003, Wyoming Game and Fish Department 2003, Dahlgren et al. 2006) with 10% or greater canopy cover (Connelly et al. 2000a) and no more than 20% of

suitable sage-grouse habitat in the DDCT boundary is treated in this manner (adapted from Connelly et al. 2000a).

3. Refer to the BLM/WAFWA Sage-grouse Habitat Assessment Framework (HAF) when conducting habitat evaluations to determine the need to treat sagebrush to enhance sage-grouse habitat and when devising standardized monitoring protocols to assess the effectiveness of treatments (Stiver et al. 2010).

4. In stands with less than 15% sagebrush cover pretreatment, any proposed treatment should be designed to maintain or improve sagebrush habitat (within the limits of the ecological site).

Non-Core Area Treatments:

As is the case with industrial development outside of Core Areas, there will be greater flexibility to conduct sagebrush treatments outside of Core Areas. There can be more emphasis placed upon the habitat needs of species other than sage-grouse.

1. Determine and document the purpose and need for the treatment (adapted from Wyoming Interagency Vegetation Committee 2002):

    A. Evaluate the juxtaposition, extent, importance and value of this sagebrush patch in the landscape (is this the only patch of sagebrush in the landscape?).
    B. Identify the sagebrush species/subspecies/variety and understand the ecology and treatment effects.
    C. Determine the associated vegetation composition and condition (e.g. composition of desirable and non-desirable species and their response to treatment) and their effects on wildlife habitat.
    D. Consider site potential and resilience of the site to recover.
    E. Assess the existence of other potential site influences (e.g., current grazing use, presence of noxious/exotic plant infestations, cumulative impacts, etc.).
    F. Evaluate past management history of the site.
    G. Establish post-treatment vegetation management objectives tiered to the future management plan.
    H. Create a baseline for short-term/long-term post-treatment monitoring of the site.

2. Conduct the treatment.

3. Rest the treated area from grazing for two full growing seasons unless vegetation recovery dictates otherwise.

4. Monitor post treatment habitat conditions and grazing/browsing by ungulates to determine success.

5. Monitor and control noxious and/or invasive vegetation post-treatment.

Protocol Exceptions:

Exceptions for treatments in Core Areas will be considered only if it can be demonstrated by previous research the activity will not cause declines in sage-grouse populations. The demonstration must be based on monitoring data collected and analyzed with accepted scientific based techniques.

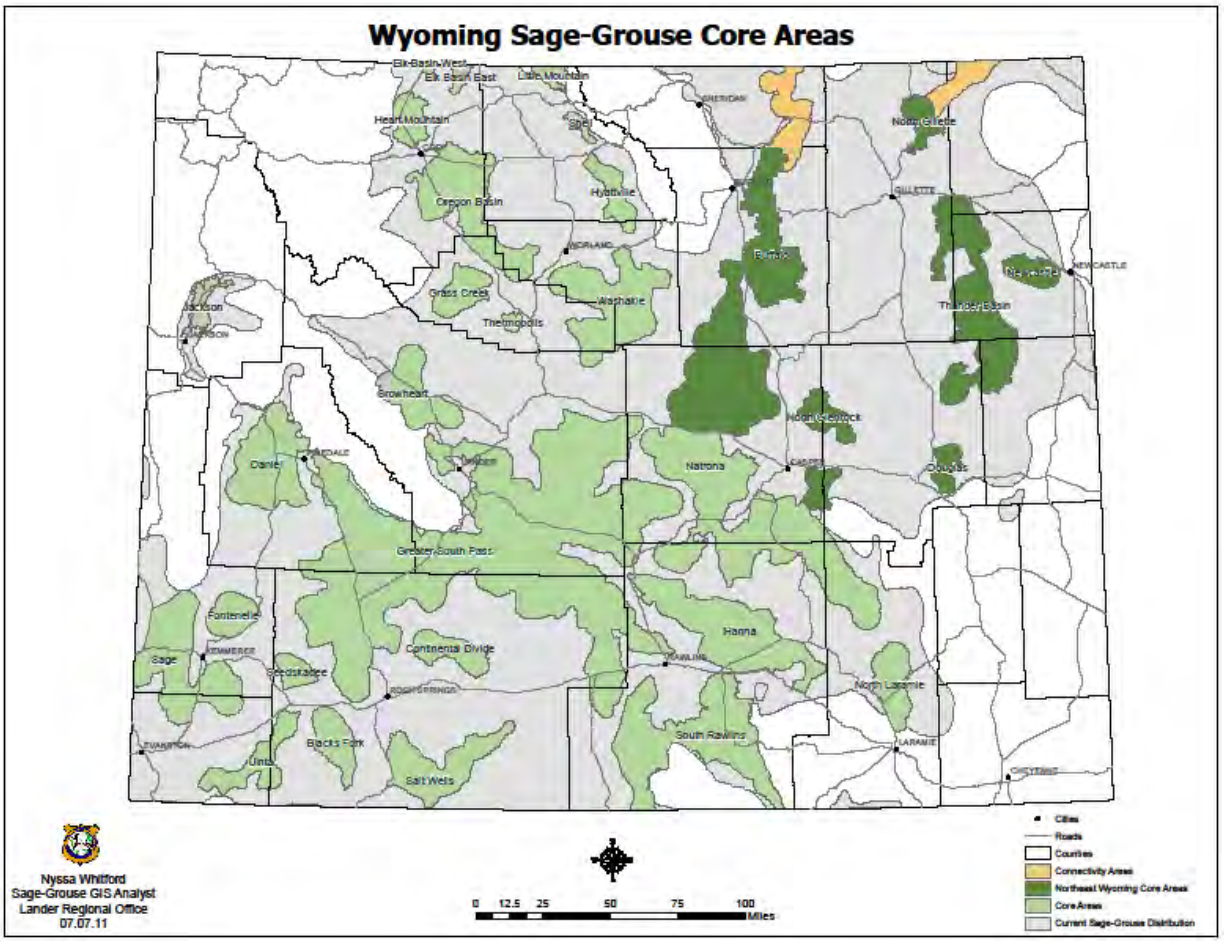


Figure 1. Wyoming sage-grouse core areas with northeast core areas differentiated.

Literature Cited:

Beck, J.L., J.W. Connelly, and K.P. Reese. 2009. Recovery of greater sage-grouse habitat features in Wyoming big sagebrush following prescribed fire. Restoration Ecology 17 (3):393-403.

Connelly, J. W., M. A. Schroeder, A. R. Sands, and C. E. Braun. 2000*a*. Guidelines for management of sage grouse populations and habitats. Wildlife Society Bulletin 28:967-985.

Connelly, J. W., K. P. Reese, R. A. Fischer, and W. L. Wakkinen. 2000*b*. Response of sage grouse breeding population to fire in southeastern Idaho. Wildlife Society Bulletin 28:90-96.

Dahlgren, D. K., R. Chi, and T. Messmer. 2006. Greater sage-grouse response to sagebrush management in Utah. Wildlife Society Bulletin. 34:975-985

Danvir, R. E. 2002. Sage grouse ecology and management in northern Utah sagebrush-steppe. Unpublished report. Deseret Land and Livestock Ranch and the Utah Foundation for Quality Resource Management. Woodruff, UT.

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

Stiver, S.J., E.T Rinkes, and D.E. Naugle. 2010. Sage-grouse habitat assessment framework. U.S. Bureau of Land Management, Idaho State Office, Boise.

Western Association of Fish and Wildlife Agencies Sage and Columbian Sharp-tailed Grouse Technical Committee. 2009. Prescribed fire as a management tool in xeric sagebrush ecosystems; is it worth the risk to sage-grouse? Unpublished report. Western Association of Fish and Wildlife Agencies. Cheyenne, WY. 22 pp.

Wyoming Game and Fish Dept. 2003. Wyoming greater sage-grouse conservation plan. Wyoming Game and Fish Department, Cheyenne. 97 pp.

Wyoming Game and Fish Department. 2010. Recommendations for development of oil and gas resources within important wildlife habitats - version 6.0. Wyoming Game and Fish Department, Cheyenne. 236 pp.

Wyoming Interagency Vegetation Committee. 2002. Wyoming Guidelines for Managing Sagebrush Communities with Emphasis on Fire Management. Wyoming Game and Fish Department and Wyoming BLM, Cheyenne. 53 pp.

Attachment B

USFWS Call for Sage-Grouse/Sagebrush Information.

Compiled by Bill Gerhart

During calendar year 2011 WGFD personnel were directly involved in projects within sage-grouse occupied habitat (both core and non-core) as follows by general Region:

Pinedale:

- Barnes Ranch CE and V Cross Cattle Co. CE being pursued totaling approximately 4,128 acres of land. Both support sage-grouse core habitats and work include development of conservation and management plans to conserve and enhance sage-grouse habitats.
- 406 acres of cheatgrass was sprayed to reduce its density, re-invigorate and increase native herbaceous cover and reduce wildfire risk in sagebrush grassland within occupied and core sage-grouse habitats in the Boulder area.
- Monitoring of the Monument Ridge Rx burn post 5-years following the burn in dense sagebrush communities revealed that mountain big sagebrush canopy coverage has returned to 15.8% and silver sagebrush canopy coverage has returned to 7.2%.

Green River:

- Assistance on development of a grazing management plan on about 2,200 acres was prepared with considerations for sage-grouse habitat conservation and enhancement.

Sheridan: Includes a small portion of the Casper Region in the Thunder Basin National Grassland Area too.

- Under the FSA/NRCS SAFE Program about 4,518 acres of previously tilled and go-back lands will be seeded to a mixture of grass, forb and shrub species. Within this acreage 420 acres will seeded with a 'heavy' mix of Wyoming big sagebrush seed to enhance sage-grouse habitat. These areas will not be grazed for the next 15 year period.
- Under NRCS SGI approximately 43,000 acres of rangeland inventory and drafting grazing management plans are being pursued with occupied and core sage-grouse habitats.
- A grazing management plan was drafted and awaiting final approval on about 2,000 acres of occupied sage-grouse habitat. It was partially designed to conserve and enhance sage-grouse habitat.

Casper:

- 499 acres of dense mountain big sagebrush were burned in the Bates Creek watershed in a mosaic pattern adjacent to aspen and riparian habitats. DDCT were completed. Prescribed grazing will be implemented and mid- to long-term benefits for sage-grouse were established for the project.
- 7,024 acres of cheatgrass was sprayed to reduce its density, re-invigorate and increase native herbaceous cover and reduce wildfire risk in sagebrush grassland within occupied and core sage-grouse habitats in the lower Bates Hole watershed area.

Cody:

- Assistance was provided on inventory information for NRCS SGI enrolled lands on 6 ranches totaling about 53,210 acres. Draft plans for grazing, cheatgrass control, juniper encroachment removal, and other actions to conserve and enhance sage-grouse habitat are being developed.
- 4,600 acres of cheatgrass was sprayed to reduce its density, re-invigorate and increase native herbaceous cover and reduce wildfire risk in sagebrush grassland with occupied and core sage-grouse habitats associated with the Black Mountain wildlife near Thermopolis. In addition, 7,000 Wyoming sagebrush container grown plants were planted in the area.
- 670 acres of juniper/mountain big sagebrush were prescribed burned. Treatments were done in a mosaic pattern with mid- and long-term goals to partially enhance sage-grouse habitat.

ATTACHMENT C

Wyoming State agencies have been implementing the Governor's Sage Grouse Executive Order 2011-5 (SGEO). Per the SGEO, proponents are directed to confer with WGFD concerning implementation of Attachment B. Below is a list of 2011 conferences.

As Wyoming's strategy evolves, all future DDCTs will be completed and the disturbance layer stored via a DDCT web application beginning in June 2012. Wyoming Geographical Information Services Center is housing the application and has hired a Data Steward to maintain data quality. The BLM IM (2012) directs their Field Offices to confer with one central WGFD contact, Habitat Protection Program.

Tracking Number	Date	Proponent	Activity	Location/ Name	Action
12274	4/11/2011	Office of State Lands and Investment (OSLI)	Temporary Use Permit (TUP) Access Road	Converse County	Letter to OSLI, Existing Road, Timing stips for upgrades, limit noise levels, March 1-May 15 6PM - 8AM.
12276	4/21/2011	OSLI	TUP Guided Float Trips	Carbon County	Letter to OSLI, Leks >0.6miles from permit. Using existing access.
12294	5/4/2011	OSLI	Improvements to Well and Storage Tank		Letter to OSLI, activities greater than 0.6 mile from lek. Activity to occur outside seasonal stips.
12288	5/6/2011	OSLI	Coal Lease	Sweetwater County	Letter to OSLI, If not covered by SMCRA, need to do a DDCT and comply with SGEO.
12289	5/6/2011	OSLI	Coal Lease	Sweetwater County	Letter to OSLI, if not covered by SMCRA, need to do a DDCT and comply with SGEO.
12290	5/6/2011	OSLI	Coal Lease	Sweetwater County	Letter to OSLI, if not covered by SMCRA, need to do a DDCT and comply with SGEO.

Tracking Number	Date	Proponent	Activity	Location/ Name	Action
12306	5/10/2011	OSLI	Improvements to Well and Storage Tank		Letter to OSLI, activities greater than 0.6 mile from lek. Activity to occur outside seasonal stips.
12307	5/10/2011	OSLI	TUP Guided Float Trips	Carbon County	Letter to OSLI, leks>0.6 miles from permit. Using existing access. Surface disturbance - seasonal stips.
12292	5/19/2011	OSLI	Improvements to Well and Storage Tank	Sheridan County	Letter to OSLI, activities greater than 0.6 mile from lek. Activity to occur outside seasonal stips.
12318	5/19/2011	OSLI	Road Easement	Fremont County	Letter to OSLI, existing road.
12202.01	5/20/2011	SEO/Chesapeake	Water Well	Converse County	Letter to SEO, Biological Assessment in compliance with SGEO.
12324	6/8/2011	OSLI	Renewal of all metallic and Non-Metallic Leases.	Albany County	Letter to OSLI, noncore stips applied. In a non-core area.
12339	6/8/2011	OSLI	Improvements to Well and Storage Tank	Carbon County	Letter to OSLI, Escape Ramp
12330	6/9/2011	OSLI	Coal Lease	Carbon County	Letter to OSLI, Must comply with Governor's SGEO.
12331	6/9/2011	OSLI	Coal Lease	Carbon County	Letter to OSLI, Must comply with Governor's SGEO.
12334	6/9/2011	OSLI	Coal Lease	Carbon County	Letter to OSLI, Must comply with Governor's SGEO.
12335	6/9/2011	OSLI	Coal Lease	Carbon County	Letter to OSLI, Must comply with Governor's SGEO.
12344	6/21/2011	OSLI	Improvements to Well and Storage Tank	Carbon County	Letter to OSLI, activities greater than 0.6 mile from lek. Activity to occur outside seasonal stips.

Tracking Number	Date	Proponent	Activity	Location/ Name	Action
12367	7/26/2011	BLM, Shane Gray, Chesapeake	Oil Well and Access Road	WYW-154911, Douglas core area	Letter to BLM. DDCT accurate, 4.23% Disturbance, .78 per 640 acres
12365	7/29/2011	OSLI	UR Lease	Natrona County	Letter to OSLI, development must comply with SGEO.
12378	8/4/2011	OSLI	TUP Road	Niobrara County	Letter to OSLI, existing 2-track, if improvements are made - need to comply with SGEO
12382	8/4/2011	OSLI	Bentonite	Johnson County	Letter to OSLI, Must comply with Governor's SGEO.
12285	8/10/2011	OSLI	TUP Road	Natrona County	Letter to OSLI, existing road, if improvements are made - need to comply with SGEO.
12366	8/18/2011	BLM, Shane Gray, Chesapeake	Oil Well and Access Road	WYW-154911, Douglas core area	Letter to BLM. DDCT accurate, 3.71% Disturbance, .7 per 640 acres
12368	8/19/2011	BLM, Shane Gray, Chesapeake	Oil Well and Access Road	WYW-174233, Douglas Core Area	Letter to BLM. DDCT accurate, 4.24% Disturbance, .60 per 640 acres
12397	8/22/2011	Tom Bell, UR Project	UR exploration	Bootheel Project	Letter sent to Tom Bell, Seasonal stipulations, 3.5% disturbance.
12300	8/26/2011	OSLI	3D Seismic	Campbell County	Letter to OSLI, Timing Stipulations.
12391	8/26/2011	OSLI	Water Pipeline	Sweetwater County	Letter to OSLI, Occurs in existing disturbance, and surrounded by disturbing activities.
12392	8/26/2011	OSLI	3D Seismic	Crook County	Letter to OSLI, Timing Stipulations.
12394	8/26/2011	OSLI	Precious Stone Lease	Fremont County	Letter to OSLI, Must comply with Governor's SGEO.

Tracking Number	Date	Proponent	Activity	Location/ Name	Action
12409	8/30/2011	Anadarko, Shawnee	Gas Well	Johnson County	Letter sent to Tom Clayson, Checklist was complete and accurate, DDCT was done correctly. 4.1% disturbance, .12 per 640.
12399	8/31/2011	OSLI	TUP Road	Carbon County	Letter to OSLI, existing 2-track, if improvements are made - need to comply with SGEO
12403	8/31/2011	OSLI	Prescribed Burn	Converse County	Letter to OSLI, Must comply with Governor's SGEO.
12406	9/1/2011	OSLI	TUP Cloud Seeding Generators	Sublette County	Letter to OSLI, Permit is for existing activity.
12407	9/2/2011	OSLI	TUP Cloud Seeding Generators	Carbon County	Letter to OSLI, Permit is for existing activity.
12408	9/2/2011	OSLI	TUP Cloud Seeding Generators	Sublette	Letter to OSLI, Permit is for existing activity.
463.07	9/12/2011	Bruce Lawson, Black Hills Bentonite		Powder River Core Area	Letter sent to Mr. Lawson, 2.98% Disturbance, .12 per 640 acres, lek by lek showed >5% for Lone Bear Flat lek. Proponent agreed to look for opportunities to reduce ground disturbance. Completed a Check list.
12303	9/12/2011	OSLI	UR Renewal	Sweetwater County	Letter to OSLI, Current project plan of development is in compliance with the SGEO.
12410	9/12/2011	OSLI	Precious Metals Lease	Campbell County	Letter to OSLI, Must comply with Governor's SGEO.
12412	9/14/2011	OSLI	TUP Energy Flux Towers	Sublette County	Letter to OSLI, Existing Tower, repairs should adhere to timing stipulations.
12417	9/14/2011	OSLI	TUP Road	Hot Springs County	Letter to OSLI, existing road, if improvements are made - need to

Tracking Number	Date	Proponent	Activity	Location/ Name	Action
					comply with SGEO.
12415	9/16/2011	OSLI	3D Seismic	Washakie County	Letter to OSLI, Timing Stipulations.
12416	9/16/2011	OSLI	TUP Road	Natrona County	Letter to OSLI, existing 2-track, if improvements are made - need to comply with SGEO
12424	9/16/2011	OSLI	Precious Metals Lease	Fremont County	Letter to OSLI, Must comply with Governor's SGEO.
12413	9/21/2011	OSLI	Coal Surveys	Campbell County	Letter to OSLI, Timing stipulations for soil survey activities.
12437	9/27/2011	Greg Johnson WEST	Proposed Reservoir (Douglas Draw)	Big Horn County	Letter sent to Greg Johnson, 1.75% Disturbance, .12 per 640 acres
12436	9/29/2011	OSLI	Gaging Station	Fremont County	Letter to OSLI, Existing facility/renewal. If any improvements are made follow the SGEO.
1108.02	10/3/2011	FMC Corporation	Groundwater Monitoring Wells	Sweetwater County	Letter sent to FMC, checklist complete, 4% disturbance, .28 per 640. Lek by lek showed disturbance >5% for two leks. Recommended reducing disturbance/reclamation.
12202.04	10/3/2011	SEO/Chesapeake	Water well	Converse County	Letter to SEO, Application does not comply.
12447	10/6/2011	OSLI	TUP Road	Sweetwater County	Letter to OSLI, existing road, if improvements are made - need to comply with SGEO.
11715	10/10/2011	Greg Johnson WEST	Propose Reservoir	Sublette County	Letter sent to Mr. West, 4.3% disturbance.
12450	10/11/2011	OSLI	3D Seismic	Converse County	Letter to OSLI, Timing Stipulations.

Tracking Number	Date	Proponent	Activity	Location/ Name	Action
12454	10/13/2011	Rocky Mt. Power.	Proposed Standpipe Substation	Hanna	Letter sent to RMP. Current DDCT Disturbance is 6.2% due to slow reclaimed mine sites. It was not and O&G or Mining so no disruption calculation. The project is adjacent to the intersection of HWY 30 and 72. The other locations would have fragmented additional habitat.
12500	10/18/2011	WOGCC	missed DDCTs	Carbon County	OSLI contacted WOGCC, who contacted Coleman about APD compliance with SGEO 11-5.
12120.02	10/27/2011	SEO	Reservoir	Sublette County	Letter to SEO, activity is DeMinimus
12502	10/31/2011	Vector Mineral	O&G well	Carbon County	Letter to Vector Minerals, DDCT correct but missing other SGEO compliance. 4.49% disturbance, .07 per 640 acres.
12452	10/31/2011	OSLI	Precious Metals Lease	Carbon County	Letter to OSLI, Must comply with Governor's SGEO.
12453	10/31/2011	OSLI	Precious Metals Lease	Carbon County	Letter to OSLI, Must comply with Governor's SGEO.
12458	11/3/2011	OSLI	TUP Road	Lincoln County	Letter to OSLI, existing road, if improvements are made - need to comply with SGEO.
12503	11/14/2011	Phillip Caines	LMO	Big Horn County	Letter to DEQ, All activity occurring in disturbed area and 0.6 miles from suitable habitat.
12120.05	11/14/2011	SEO	Well	Sweetwater County	Letter to SEO, application in compliance
12462	11/14/2011	OSLI	TUP Road	Fremont County	Letter to OSLI, existing 2-track, if improvements are made - need to comply with SGEO

Tracking Number	Date	Proponent	Activity	Location/ Name	Action
12465	11/14/2011	OSLI	Telecommunication Line	Johnson County	Letter to OSLI, activity restricted to existing ROW.
12505	11/21/2011	WYPDES/WYDOT	widen and overlay Weston Section of HWY 59	North Gillette Core Area	Letter to DEQ/correspondence to WYDOT, 3.52% disturbance, .64 per 640 acres.
12466	11/21/2011	OSLI	TUP Road	Sheridan County	Letter to OSLI, existing road, if improvements are made - need to comply with SGEO.
12456	11/21/2011	OSLI	TUP Road	Uinta County	Letter to OSLI, existing road, if improvements are made - need to comply with SGEO.
12479	11/22/2011	OSLI	3D Seismic	Natrona County	Letter to OSLI, Timing Stipulations.
12478	11/29/2011	OSLI	TUP Road	Washakie	Letter to OSLI, existing road, if improvements are made - need to comply with SGEO.
12506	12/5/2011	Williams	West Bear Draw Plan	Johnson County	POD is outside core, but a core lek is immediately adjacent to it. BLM did a DDCT on the POD capturing 15 known leks in 4 miles of the project area in Core. Disturbance was 1.27%, .42 per 640 acres. William agreed to a 0.6 mile NSO for core leks.
12508	12/12/2011	Greg Johnson WEST	Enlargement of Big Sandy Reservoir	Sublette/Sweetwater County	Letter to Mr. West. 5.91% disturbance.
12509	12/12/2011	RT Communications	Buried Fiber Optic Project	Johnson County	Letter to BLM who conducted a DDCT. 3.8% disturbance. A lek by lek shows > 5% for two leks, with only one lek being within 4 miles (3.5 miles) from project. BLM should apply timing stipulations.

Tracking Number	Date	Proponent	Activity	Location/ Name	Action
12510	12/19/2011	Camino Gravel Pit	Expansion of Gravel Pit	Buffalo, WY	Letter to Shell Valley Consulting
12512	12/20/2011	Farson/Eden Salinity	Salinity Control Project	Farson, WY	Letter to BOR/contractors
12516	12/20/2011	AML - DEQ	Restoration of Standpipe Draw	Hanna	Letter to DEQ, All activity occurring in disturbed area. Recommended Timing Stipulations
12511	12/20/2011	AML - DEQ	Big Ditch Reclamation	Carbon County	Letter to Contractor/AML. All activity occurs within urban environment. No seasonal stipulation.
12490	12/23/2011	OSLI	TUP Hot Mix	Weston County	Letter to OSLI, located in existing disturbance.
12491	12/27/2011	OSLI	Precious Metals Lease	Natrona County	Letter to OSLI, Must comply with Governor's SGEO.
12513	12/29/2011	McMurry Ready Mix/SEO	Water Well	Natrona County	Letter to McMurry/SEO, Well is located within Eagle Creek mine no additional analysis.
12514	12/29/2011	State Engineer	Additional irrigated acres	Weston County	Letter to SEO, Will improve a degraded site and be of benefit to sage grouse.

Compilation of Greater Sage-Grouse Research Conducted in Wyoming in 2011
Presented to Wyoming Game and Fish Department
Compiled by Dr. Jeff Beck, Department of Renewable Resources, University of Wyoming
November 7, 2011

Research studies are listed alphabetically by principal investigator. Please feel free to contact principal investigators with specific questions.

1. WIND ENERGY DEVELOPMENT IN CRITICAL WILDLIFE HABITATS: CONSIDERING CUMULATIVE IMPACTS AND THE MAINTENANCE OF SUSTAINABLE POPULATIONS

Contact: Argonne National Laboratory (Dr. Kirk LaGory); Phone: (630) 252-3169; Email: lagory@anl.gov

Argonne National Laboratory, Environmental Science Division, Drs. Kirk LaGory and Yuki Hamada

We developed a spatially explicit individual-based model to examine how wind energy development affects greater sage-grouse populations. The objective of Phase-I was to develop a model for Albany County, Wyoming, as a proof of concept. The model, based on published life history information, represents six major processes for seven age-sex classes of sage-grouse: seasonal movements, habitat selection, competition, body condition change, reproduction, and survivorship. The model estimates population size and distribution based on individual sage-grouse habitat selection and resultant reproduction and mortality rates that are based on habitat suitability. The results suggest a strong relationship between the location and configuration of development, the life-history function and suitability of the habitat in which development occurs, and the size and location of the sage-grouse population. The model has the potential to provide valuable information for planning, siting, and assessment of the cumulative impacts of extensive regional wind development on sage-grouse. Phase-II of the project, to begin in 2012, will include sensitivity analysis, validation, and incorporation of ongoing sage-grouse research results to improve its reliability and robustness.

Funding provided by U.S. Department of Energy, Energy Efficiency and Renewable Energy, Wind and Water Program

2. ASSESSING GREATER SAGE-GROUSE BREEDING HABITAT WITH AERIAL AND GROUND IMAGERY

Contact: Dr. Jeff Beck; E-mail: jlbeck@uwyo.edu; Phone: (307) 766-6863

Jeffrey L. Beck[1], D. Terrance Booth[2], and Carmen L. Kennedy[2]. [1]Assistant Professor, Department of Renewable Resources, University of Wyoming, Laramie, Wyoming 82071. [2]Rangeland Scientist and Biological Science Aide (GIS), USDA Agricultural Research Service, High Plains Grassland Research Station, Cheyenne, Wyoming 82009.

Agricultural expansion, housing and energy developments, wildfires, and weedy plant invasions have led to loss and fragmentation of sagebrush (*Artemisia* spp.) habitats within the Intermountain West. Sagebrush-dependent species such as greater sage-grouse (*Centrocercus urophasianus*) are vulnerable to these changes, emphasizing the importance of habitat inventory and monitoring to management. Existing habitat inventory methods are expensive, hindering data collection to support management decisions. Our study evaluated the feasibility of ground and aerial imagery to assess habitat structural features, vegetation associations, and sources of anthropogenic disturbance within a large landscape used by sage-grouse as breeding habitat (lekking, nesting, and brood-rearing). We surveyed ~526 km^2 of the upper Powder River watershed in Natrona County, Wyoming, USA, dominated by Wyoming big sagebrush (*A. tridentata wyomingensis*) upland communities interspersed with narrow riparian corridors. Our study area included 16 leks and provided year-round habitat to sage-grouse. In June 2010, we systematically-acquired 3,228 aerial images, additional aerial images in rapid-succession bursts where aerial transects crossed riparian areas, and 960 ground images. We used *SamplePoint* to quantify cover from images for important species and plant functional groups and color-infrared imagery to compare vegetation associations to those quantified from aerial images. Our findings included canopy cover of sage-grouse food forbs within 3.2 km of leks, which—as measured from ground imagery, ranged from 3 to 14% in riparian areas and 1 to 7% in the uplands. This and other image-derived archival data imply that image-based habitat surveys are cost-effective methods for monitoring changes in sagebrush habitats across large landscapes.

Funding provided by the Bureau of Land Management. Charlie Fifield was the BLM contact person for our cooperative agreement

3. IDENTIFYING HABITATS FOR GREATER SAGE-GROUSE POPULATION PERSISTENCE WITHIN THE ATLANTIC RIM, WYOMING

Contact: Dr. Jeff Beck; E-mail: jlbeck@uwyo.edu; Phone: (307) 766-6683

Christopher P. Kirol and Jeffrey L. Beck, Department of Renewable Resources, University of Wyoming, Laramie, Wyoming 82071

Landscapes undergoing energy extraction activities present challenges to the ability of wildlife populations to survive and reproduce. In our study, we sampled use locations and fitness parameters for 167 radio-marked female sage-grouse over the reproductive period in 2008 and 2009 in the 1,093 km^2 Atlantic Rim project area (ARPA). The ARPA is currently undergoing development of coalbed methane resources underlying sagebrush (*Artemisia* spp.) habitats used by an abundant population of sage-grouse. Our research goal is to spatially quantify habitat quality (i.e., sink and source habitats). In GIS we generated a suite of landscape scale variables representing anthropogenic disturbance and environmental characteristics informed by previous research and our hypothesized predictors of ecological relationships. We are using these variables and logistic regression to produce resource selection probability functions (RSPFs) predicting occurrence for nesting, early and late brood-rearing, and non-brooding adult females. With the same suite of variables and Cox proportional hazard survival analysis we are producing survival probability functions (SPFs) that predict nest, brood, and adult female summer survival. We are combining the SPF's with fixed demographic rates into a lambda equation that we projected back on the ARPA landscape. Our lambda layer thus predicts habitats that contributed to population surpluses or deficits. Finally, the occurrence layer and lambda layer are being combined and distributed into bins to predict primary and secondary source and sink habitats. This research will enable us to identify areas, if protected that have the highest potential to contribute to persistence of the ARPA sage-grouse population.

Funding provided by Anadarko Petroleum Corporation, USDI-Bureau of Land Management; Wyoming Game and Fish Department

Project Publications

Kirol, C. P., J. L. Beck, J. B. Dinkins, M. R. Conover. *Accepted.* Greater sage-grouse nesting and brood-rearing microhabitat selection in xeric big sagebrush. *Condor*

4. GREATER SAGE-GROUSE MIGRATION ECOLOGY AND RESPONSE TO BENTONITE MINING IN THE BIGHORN BASIN, WYOMING

Contact: Dr. Jeff Beck; E-mail: jlbeck@uwyo.edu; Phone: (307) 766-6863

Aaron C. Pratt, Department of Renewable Resources, University of Wyoming
Jeffrey L. Beck, Department of Renewable Resources, University of Wyoming
Lyndon Bucher, American Colloid Company, Belle Fourche, South Dakota
Tom Easterly, Wyoming Game and Fish Department, Greybull, Wyoming

Wyoming contains 70% of the world's bentonite clay deposits and mines in the Bighorn Basin produce >50% of Wyoming's annual supply of bentonite. Plans call for mining to increase in sagebrush habitat inhabited by greater sage-grouse in the Bighorn Basin. The primary objective of our study is to evaluate the fitness consequences and habitat selection patterns of sage-grouse occurring in an area with bentonite mining (Shell core area) compared to grouse that occur in a study area without bentonite mining (Hyattville core area). We initiated our study in spring 2011 through capturing and marking male (with GPS and band only) and female (with GPS and VHF) grouse in our study areas. Marked individuals will be used to monitor population demographics, movements, and macro- and micro-scale habitat selection patterns for both populations across 3 years (2011–2013). In 2011, we monitored 55 nests (Shell, n=16; Hyattville: n=39) and 19 broods (Shell, n=5; Hyattville, n=14) between the 2 study areas. We also sampled vegetation at microhabitat plots at all nests, at 37 early-brood locations (Shell, n =13; Hyattville, n=24), and at an equal number of paired random locations. Our second objective includes describing the migration ecology of these populations with GPS transmitters (n=20). Preliminary observations revealed a wide variety of migration behavior including differences between sex, proportion of population that is migratory, timing, distance, duration, destination, and differences among seasons. Funding for our study is provided by the American Colloid Company. Cooperators include WGFD, BLM, private land owners, and bentonite mining companies.

5. RESPONSE OF GREATER SAGE-GROUSE TO TREATMENTS IN WYOMING BIG SAGEBRUSH

Contact: Dr. Jeff Beck; E-mail: jlbeck@uwyo.edu; Phone: (307) 766-6683

Smith, Kurt, T.[1], Jeffrey L. Beck[1], Anna D. Chalfoun[2], Stan Harter[3], and Sue Oberlie[4]

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Wyoming big sagebrush (*Artemisia tridentata wyomingensis*) has been treated through chemical application, mechanical treatments, and prescribed burning to increase herbaceous forage species released from competition with sagebrush overstory. Originally intended to provide more grassy forage for livestock, these techniques have been applied to improve habitat for sagebrush wildlife species such as greater sage-grouse (*Centrocercus urophasianus*). Treatments are intended to rejuvenate sagebrush stands by killing older sagebrush plants to promote growth of younger sagebrush plants and increase herbaceous production. Studies evaluating sage-grouse response to habitat treatments have reported varied results and generally lack the spatial and temporal replication necessary for robust evaluation of demographic rates and fine-scale habitat use of sage-grouse in response to treatments. Our study, centered near Jeffrey City in Fremont County, Wyoming is designed as a Before-After Impact-Control study with 3 years of pre-treatment and 2 years of post-treatment data comparing demographic rates and habitat selection patterns within treated and non-treated sites. We initiated our study in spring 2011 by capturing female sage-grouse and affixing VHF necklace-mounted radio transmitters to measure pre-treatment nest and brood-rearing success and microhabitat use. We will attach GPS transmitters in spring 2012 to a sample of female grouse. Pre-treatment data will guide our selection of treatment sites with treatments implemented in fall 2013. Identifying positive, negative, or neutral sage-grouse demographic and habitat use responses will aid in determining the efficacy of treatments in Wyoming big sagebrush intended to enhance habitat for sage-grouse and other vertebrate species associated with the sagebrush biome.

Funding provided by Wyoming Game and Fish Department, Wyoming Sage-Grouse Conservation Fund, Wind River/Sweetwater River Local Sage-grouse Work Group, and Margaret and Sam Kelly Ornithology Research Funds.

6. WINTER HABITAT SELECTION BY GREATER SAGE-GROUSE INFLUENCED BY COALBED METHANE DEVELOPMENT IN SOUTH-CENTRAL WYOMING

Contact: Dr. Jeff Beck; E-mail: jlbeck@uwyo.edu; Phone: (307) 766-6683

Beck, Jeffrey L.[1], Jennifer E. Hess[1], Christopher P. Kirol[1], and Frank C. Blomquist[2],

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We compared winter habitat selection patterns for female greater sage-grouse (*Centrocercus urophasianus*) inhabiting a 6,979 km^2 study area with coalbed methane extraction that straddled northwestern Colorado and south-central Wyoming and a 1,546 km^2 reference study area lacking energy development in south-central Wyoming. Our objectives are to: 1) identify environmental landscape characteristics that influenced winter habitat selection, 2) map crucial winter habitat, and 3) evaluate whether energy infrastructure influenced winter habitat selection within crucial winter habitat. We used 1,027 locations from radio-marked birds obtained from 34 fixed-wing flights across 3 winters (2007–2008, 2008–2009, and 2009–2010) in binary logistic regression modeling to quantify selection by comparing grouse and available locations at 3 spatial scales. We used 6 environmental landscape predictor variables including snow accumulation, topography, and vegetation in our analysis. Grouse in the energy-development study area selected winter habitat with higher big sagebrush height within 1,226 m and areas with a lower topographic ruggedness index within 1,226 m compared to random locations. Grouse in our reference study area selected winter habitat with a lower topographic ruggedness index within 1,226 m and higher sagebrush canopy cover within 2,451 m compared to random locations. Approximately 90% of grouse winter locations occurred in 70% of the winter landscape. Our next step is to model the influence of anthropogenic infrastructure of sage-grouse within the identified crucial winter range. Our results indicate the importance of conserving large sagebrush landscapes characterized by low-to-moderate relief and adequate big sagebrush height and canopy cover for wintering sage-grouse.

Funding provided by the Bureau of Land Management.

7. GREATER SAGE GROUSE POPULATION GENETIC STRUCTURE PROJECT: FALL 2011

Contact: Bryan Bedrosian; E-mail: bryan@bswy.org; Phone: (307) 734-0581

Bryan Bedrosian, Craighead Beringia South, Jeff Johnson and Sarah Schulwitz, University of North Texas, Department of Biological Sciences

Changes in connectivity, or gene flow, between and within populations influence population viability. Our ability to discern these patterns has important implications concerning the management of natural population, certainly in geographic areas experiencing recent anthropomorphic habitat modification. In this study, we are using genetic methods (i.e., microsatellite frequency data) to quantify levels of population connectivity among and within Greater Sage Grouse populations that have experienced differing degrees of habitat modification. This work is being conducted in collaboration with Dr. Sara Oyler-McCance (USGS; Fort Collins, CO), with an agreement to share genetic data between studies. Both studies are using the same microsatellite markers (n=17), thereby allowing us to combine datasets and address additional questions in the future. Our project is focused on population connectivity in west Wyoming, particularly Jackson (n=57), Gros Ventre (n=16) and Pinedale (n=79) regions, with additional populations sampled from central (Casper, n=25) and northeast (Powder River Basin, n=100) Wyoming and southeast Montana (n=23). Our primary questions are to 1) determine the degree of connectivity *between* the Jackson, Gros Ventre and Pinedale populations and 2) investigate within population differentiation *within* the Jackson, Pindedale and Powder River Basin populations. Depending on our results, additional questions include those focused on genetic diversity and fitness related analyses. Laboratory work is nearly complete (DNA extraction, PCR and genotyping) and data analysis will commence thereafter.

Funding provided by the Bureau of Land Management, the Upper Snake River Sage-grouse Working Group (WYG&FD), and Big Horn Environmental Consultants (Tom Maechtle; Sheridan, WY)

8. EFFECTIVENESS OF SAGE-GROUSE CORE AREAS AS AN UMBRELLA FOR NON-GAME SAGEBRUSH SPECIES OF GREATEST CONSERVATION NEED

Contact: Dr. Anna Chalfoun; E-mail: achalfoun@uwyo.edu: Phone: (307) 766-6966

Jason Carlisle[1], Anna Chalfoun[1], Martin Grenier[2], Andrea Orabona[2], Susan Patla[2], Zack Walker[2], Tom Christiansen[2], Kurt Smith[3], Jeffrey Beck[3]

[1]Wyoming Cooperative Fish & Wildlife Research Unit, Department of Zoology & Physiology, University of Wyoming; [2]Wyoming Game and Fish Department; [3]Department of Renewable Resources, University of Wyoming

We are seeking to understand how effective Wyoming's Greater Sage-grouse Core Population Areas are at conserving sagebrush-associated wildlife species of greatest conservation need (SGCN). More specifically, we hope to determine the spatial scales at which core areas are a suitable surrogate for SGCN management; and whether or not SGCN will be benefited by streamlining management actions to focus on meeting sage-grouse needs in core areas. In order to rigorously test these questions, we have begun implementing a four-part approach, focusing on differing scales: 1) quantify overlap statewide between sage-grouse core areas and focal SGCNs' predictive spatial distribution models, 2) examine the occurrence of SGCN across gradients of sagebrush habitat and sage-grouse core areas (specific study locations not yet determined), 3) evaluate the reproductive success of three sagebrush-obligate passerine SGCN (Brewer's sparrow, sage sparrow, sage thrasher) across gradients of sagebrush habitat and sage-grouse core areas, and 4) examine the responses of SGCN to sagebrush-reducing experimental habitat treatments designed to benefit greater sage-grouse. In response to objective 1, we find that based on predictive species distribution models, the core areas are likely to play the greatest conservation role for SGCN which specialize on sagebrush habitats (e.g., the three sagebrush-obligate passerines listed above) and those with restricted ranges within the state (e.g., pygmy rabbit). Summer 2012 will be our first field season to explore objectives 2-4.

9. MEASURING THE VALUE OF CONSERVATION EASEMENTS TO ABATE FUTURE SAGE-GROUSE POPULATION DECLINES

Contact: Holly Copeland; E-mail; hcopeland@TNC.ORG; Phone: (307) 332-2971

Copeland, Holly[1], Amy Pocewicz[1], Doug Keinath[2], David Naugle[3], Jeffrey Evans[4], Jim Platt[5], Jody Daline[1], and Tim Griffiths[6]

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New energy and residential development is transforming landscapes of the Intermountain West. Of particular concern is the convergence of energy development and sage-grouse populations in Wyoming. To better understand the potential for conservation easements to protect sage-grouse, we developed build-out scenarios to quantify landscape change from projected future oil and gas, wind, and residential development and to identify how to best locate conservation easements to yield the greatest benefit for sage-grouse. Our analysis addressed the following questions: (1) Where would placement of conservation easements within these landscapes return the greatest benefit to sage grouse? and (2) What is the return-on-investment for sage-grouse populations associated with these conservation actions? (3) What is the future contribution of the statewide core area strategy to conservation of sage-grouse? Our results provide unbiased estimates of the impacts of future fragmentation on sage-grouse populations, the potential contribution of conservation easements at varying levels of funding, and the overall role and connection of the core area strategy to private land conservation. We envision that these estimates will guide the quantity and placement of future conservation work, so that organizations can support enough conservation in the right places to maintain large and functioning wildlife populations.

Funding provided by the USDA-NRCS Sage-Grouse Initiative.

10. IMPACTS OF RAVEN ABUNDANCE ON GREATER SAGE-GROUSE NESTING SUCCESS IN SOUTHWEST WYOMING

Contact: Dr. Mike Conover; E-mail mike.conover@usu.edu; Phone (435) 797-2436

Jonathan Dinkins and Michael Conover, Department of Wildland Resources, Utah State University, Logan, Utah, 84322-5230

Greater sage-grouse (*Centrocercus urophasianus*) distribution and abundance in western North America has declined over the last century. These declines recently led the U.S. Fish and Wildlife Service to conclude that sage-grouse are warranted for protection under the Endangered Species Act of 1973, but because threats were moderate in magnitude and did not occur across their range at an equal intensity, the listing was precluded in favor of other species under severe threat of extinction. Many factors have been attributed to this decline including: predation, habitat loss, and habitat fragmentation. Common raven (*Corvus corax*) predation of sage-grouse nests may be one of the most influential factors limiting sage-grouse productivity in some areas. We have studied sage-grouse nest success at 12 study sites around sage-grouse leks within two broad study areas in Wyoming: 1) Lincoln, Sweetwater, and Uinta counties, and 2) the Atlantic Rim Project Area south of Rawlins in Carbon County. In the Atlantic Rim Project Area and in northeast Sweetwater County, the Bureau of Land Management and the University of Wyoming monitored approximately 120 sage-grouse hens in 2008 and 2009, and Utah State University monitored approximately 65 sage-grouse hens in 2010 and 2011. Utah State University also monitored 48, 80, 115, and 115 sage-grouse hens in Lincoln, Sweetwater, and Uinta County study areas during 2008-2011 respectively. These sage-grouse hens were fitted with 17.5 g or 22 g necklace radio collars with mortality sensors. Raven abundance was monitored by establishing point-count locations near sage-grouse nests (100-200 m away from nests) and at random locations to assess raven and other avian predator abundance. Point-counts were surveyed during daylight hours weekly during sage-grouse breeding season and monthly the remainder of the year. Table 1 details the number of nests and random locations monitored for avian predators. United States Department of Agriculture, Animal and Plant Health Inspection Service, and Wildlife Services removed ravens from some locations within these study areas yearly. We are currently analyzing sage-grouse nesting success, brood success, and survival related to avian predators and vegetation parameters. Our data will also be analyzed at the same locations under normal conditions and under raven removal conditions.

Table 1. Approximate number of sage-grouse monitored, nests found, and random locations. All sage-grouse nests and random locations had 3-8 avian point-counts conducted per breeding season.

Year	Sage-grouse Monitored	# Nests	# Random Avian Predator Point-Count Locations
2008	**170**	**53**	**164**
2009	**200**	**77**	**177**
2010	**170**	**85**	**160**
2011	**180**	**110**	**170**

Funding provided by Anadarko Petroleum Corporation, Bureau of Land Management, Lincoln County Predator Management Board, Predatory Animal District of Sweetwater County, South-central Sage-grouse Local Working Group, Southwest Sage-grouse Local Working Group, Uinta County Predator Management Board, Wyoming Animal Damage Management Board, Wyoming Game and Fish Department, Wyoming Land Conservation Initiative

11. STATE-WIDE SEASONAL GREATER SAGE-GROUSE HABITAT MODELING FOR WYOMING

Contact: Dr. Brad Fedy; E-mail: fedyb@usgs.gov; Phone: (970) 226-9456

Dr. Brad Fedy, USGS Fort Collins Science Center and Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, Colorado

The conservation of animal populations requires the preservation of necessary habitats. The Governor of Wyoming endorsed a spatial conservation strategy that delineated breeding core areas using known lek locations. However, for breeding core areas to be successful in ensuring long-term Sage-grouse persistence, they should encompass all seasonal requirements that support breeding areas, including nesting, brood-rearing and wintering areas. The causes for conservation concerns regarding greater Sage-grouse are well documented and efforts at prioritization of habitats could benefit greatly from detailed understanding of the *what, where,* and *when* of habitat use by Sage-grouse. We are addressing these questions through the development of seasonal habitat selection models for greater sage-grouse. These models are being built using data from telemetry studies across the state and examine how landscape conditions at multiple scales influence habitat suitability. We have a manuscript in press that addresses sage-grouse movements and defines what habitats are available to individuals – a key first step in any habitat selection study. Our preliminary models have proved accurate at a state-wide scale. We have developed sage-grouse habitat models across three different seasons, capturing the species' needs for these critical life stages, including breeding, late summer, and winter seasons and we are currently writing up the results. These models will ultimately be used to associate habitat and genetic connectivity in combination with ongoing state-wide genetic analyses.

12. STATE-WIDE GENETIC CONNECTIVITY FOR GREATER SAGE-GROUSE IN WYOMING

Contact: Dr. Brad Fedy; E-mail: fedyb@usgs.gov; Phone: (970) 226-9456

Dr. Brad Fedy, USGS Fort Collins Science Center and Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, Colorado

Greater sage-grouse population connectivity has been identified as a priority management issue by multiple state and federal management agencies. We are currently working on a large-scale project to assess levels of population connectivity using genetic approaches. This project will assist in the delineation of related populations and describe possible sub-population boundaries that transcend all administrative boundaries. The research will also identify likely barriers to the movement of individuals among populations. The study will assist managers in understanding the relative importance of priority habitats and in accordance with policy, assist in the priority management of those habitats. One objective of the State's Game and Fish Agency is to maintain connectivity. To accomplish this, we must understand more about the genetic diversity and understand the likelihood and nature of impacts from any inbreeding that is identified and the association between the seasonal habitats of the species and the subpopulations that use them. We have almost completed the first stage of the project involving the collection of feather samples and the laboratory processing of the approximately 2000 feather samples from across Wyoming. This stage involves DNA isolation, the use of multiple molecular markers, and the development of the genetic data that will be used to quantify connectivity. The second stage of the project will comprise the analysis of the genetic data compiled from the first stage and produce the management-relevant products previously mentioned and will take place throughout 2012.

13. CHAIN LAKES SAGE-GROUSE STUDY IN THE GREAT DIVIDE BASIN IN SOUTH-CENTRAL WYOMING

Contact: Chad Olson; E-mail: chad@haydenwing.com; Phone: (307) 755-5663

Investigators: Chad Olson, Matt Dzialak, Stephen Webb, Seth Harju, Jennifer Hess, James Mudd, and Jeff Winstead (all affiliated with Hayden-Wing Associates, LLC).

In 2009, Hayden-Wing Associates, LLC initiated a research project on greater sage-grouse in south-central Wyoming. The study area extends from I-80 between Wamsutter and Creston Junction north to the Chain Lakes Wildlife Management Area. The objectives were to (1) quantify resource selection/avoidance in sage-grouse, (2) generate data-driven high-resolution maps of critical seasonal habitat at the landscape scale, and (3) document and describe the use of areas that receive habitat enhancement treatment such as application of pumped water and re-seeding and evaluate the need for other treatment areas. Between 2009 and 2011, we deployed as many as 32 solar-powered ARGOS/GPS PTT transmitters (30 g and 22 g; Microwave Telemetry, Inc.) on female sage-grouse for documenting spatial and temporal patterns of habitat use, and for identifying nesting and brood-rearing locations. To-date, we have recorded >100,000 GPS bird locations, 78 nest locations, and >10,000 brood locations among 67 female grouse. Monitoring and fieldwork is ongoing and only preliminary data analysis is planned for 2011. Pending budget approval, trapping and other fieldwork is tentatively planned to continue through 2013.

Funding was provided by BP America.

14. COOPERATIVE SAGE-GROUSE STUDY IN THE WIND RIVER BASIN IN CENTRAL WYOMING

Contact: Chad Olson; E-mail: chad@haydenwing.com; Phone: (307) 755-5663

Investigators: Chad Olson, Matt Dzialak, Stephen Webb, Seth Harju, James Mudd, and Jeff Winstead (all affiliated with Hayden-Wing Associates, LLC).

In 2008, Hayden-Wing Associates, LLC initiated a 3-year research project on greater sage-grouse in central Wyoming near the town of Lysite. The objectives were to generate science-based information on selection/avoidance of resources in all life-history phases, and (2) to generate high-resolution data-driven maps depicting critical seasonal habitat at the largest geographic extent possible. Between 2008 and 2010, we deployed as many as 42 30-gram solar-powered ARGOS/GPS PTT transmitters (Microwave Telemetry, Inc.) on male and female sage-grouse for documenting spatial and temporal patterns of habitat use, and for identifying nesting and brood-rearing locations. More than 220,000 GPS bird locations have been recorded among 50 male and 112 female grouse between 2008 and 2011. Also we have documented 112 nest locations and >12,000 brood locations. Trapping and redeploying of transmitters was discontinued in 2011. Although monitoring of existing birds is ongoing, 2011 was used mainly for data analysis and preparation of manuscripts. Analyses completed thus far include: (1) resource selection function (RSF) models for nesting and brood-rearing (*PLoS ONE 6(10): e26273*), (2) habitat connectivity RSF (*in review*), (3) nest survival (*accepted pending revision*), and (4) winter habitat use.

Funding was provided by ConocoPhillips, EnCana Corporation, and Noble Energy. The work was conducted in coordination with the Lander BLM and the Wyoming Game and Fish Department and the Lander Sage-Grouse Working Group provided six GPS transmitters.

Project Publications

Dzialak, M.R., C.V. Olson, S.M. Harju, S.L. Webb, J.P. Mudd, J.B. Winstead, and L.D. Hayden-Wing. 2011. Identifying and prioritizing greater sage-grouse nesting and brood rearing habitat for conservation in human-modified landscapes. PLoS ONE 6(10): e26273. doi:10.1371/journal.pone.0026273

15. A STUDY OF THE IMPACTS OF A WIND ENERGY DEVELOPMENT ON GREATER SAGE-GROUSE IN SOUTHEASTERN WYOMING

Contact: Dr. Matt Holloran; E-mail: matth@wyowildlife.com; Phone: (307) 367-2765

Dr. Matt Holloran and Dr. Ed Vasquez, Wyoming Wildlife Consultants, LLC; Gregory Johnson, Ryan Nielson and Dr. Trent McDonald, Western EcoSystems Technology, Inc.; Dr. Jeffrey Beck and Andrew Gregory, University of Wyoming Department of Renewable Resources.

In April 2011, Wyoming Wildlife Consultants, LLC, Western EcoSystems Technology Inc., and the University of Wyoming initiated a research project investigating the response of sage-grouse populations to a wind energy facility in southeastern Wyoming. The project is being conducted on the PacifiCorp Seven Mile Hill (SMH; treatment area) wind project, which is located approximately 15 km west of Medicine Bow, WY. The Horizon Wind Energy Simpson Ridge Wind Resource Area located directly south of the SMH development is being studied as a control. The objectives of the research are as follows: *Objective 1:*--Collect seasonal location and demographic information from radio-equipped female sage-grouse in treatment and control areas; *Objective 2:*--Sample vegetation and soils at greater sage-grouse use sites and random locations; *Objective 3:*--Collect avian predator (raptors and *Corvidae*) nest activity, productivity and abundance information; and *Objective 4:*--Collect seasonal location, breeding success and survival information from radio-equipped and banded male sage-grouse in treatment and control areas. We are using standard telemetry techniques on approximately 130 radio-equipped females to address Objective 1. We are collecting vegetation data at nesting, early brood-rearing and random locations to address Objective 2. Point counts and avian predator species nest monitoring are being conducted to address Objective 3. We will address Objective 4 starting spring 2012 using standard telemetry and lek monitoring techniques.

Funding provided by National Fish and Wildlife Foundation funds administered by the Bureau of Land Management as directed by the National Wind Coordinating Collaborative (NWCC) Sage-grouse Collaborative, the Agricultural Experiment Station and Wyoming Reclamation and Restoration Center at the University of Wyoming, the state of Wyoming as directed by the Bates Hole/Shirley Basin Local Sage-grouse Working Group, enXco (an EDF Energies Nouvelles Company), Iberdrola Renewables, and PacifiCorp.

16. SAGE-GROUSE MONITORING ON LOST CREEK *IN-SITU* URANIUM MINE

Contact: Dr. Matt Holloran; E-mail: matth@wyowildlife.com; Phone: (307) 367-2765

Eric Berg, LWR Consultants, Inc.; Matt Holloran and John Dahlke, Wyoming Wildlife Consultants, LLC.

In April 2010, Wyoming Wildlife Consultants, LLC and LWR Consultants, Inc. initiated a research project in south-central WY collecting pre-treatment (e.g., pre-development) data at a site with a proposed *in-situ* uranium mine. Sage-grouse lek and telemetry monitoring protocols designed to assess the effects of *in-situ* uranium mining activities on sage-grouse populations, seasonal habitat selection, and productivity within treatment (e.g., within 2 km of disturbance) and control areas are being implemented. The study is being conducted in south-central Wyoming approximately 20 miles north of Rawlins, WY and west of U.S. Highway 287. The objective of lek searches and lek counts is to track male breeding population size within treatment and control areas through the life of the Project. Lek counts and searches are being conducted following standard protocol. To determine the potential effects of mining activities on habitat selection, we are using standard telemetry techniques on approximately 50 radio-equipped females to identify seasonally selected habitats. The objective of seasonal habitat selection information is to build models quantifying the amount of habitat that may conservatively be assumed to be functionally influenced by mining activities on a seasonal basis (e.g., nesting, early brood-rearing, summering, and wintering habitats). We are using brood survey routes and wing surveys to assess potential impacts of mining activities on sage-grouse productivity (e.g., juvenile recruitment).

Funding provided by Lost Creek ISR, LLC.

17. GREATER SAGE-GROUSE RADIO-TRACKING PROJECT, POWDER RIVER BASIN, WYOMING

Contact: Tom Maechtle; E-mail: tom@bighornec.com; Phone: (307) 673-7571

Thomas L. Maechtle, President, Andrew Sutphin, Senior Biologist, Linette Sutphin, Senior Biologist/GIS Specialist, Jonathan Fredland, Biologist, Big Horn Environmental Consultants, P.O. Box 207 Sheridan, Wyoming 82801

Big Horn Environmental Consultants (BHEC), with the support of Anadarko Petroleum Corporation began a sage-grouse radio-tracking project in the Powder River Basin of Wyoming in 2008. We capture and radio-marked sage-grouse hens from six different lek complexes in Johnson County, Wyoming from 2008-2011.

We maintain a sample size of up to 100 radio-marked hens. All hens are aged, blood samples are obtained, and feathers are collected for genetics analysis and to test for WNv antibodies. Marked hens are monitored year-round with more intensive monitoring occurring during nesting, brood rearing and WNv seasons. Mortalities are sent to the Wyoming State Vet lab in Laramie for necropsies.

The primary objective for the study is to assess the response of sage-grouse to reduction of Coal Bed Natural Gas infrastructure (power lines, roads, human visitations, acres disturbed etc).

We have maintained a sample size of between 82 and 100 radio-marked hens since 2008. Our most notable discovery has been the percent of juvenile hens being captured at the leks. We have captured between 49% and 65% juvenile hens throughout the four capture seasons. These results suggest that these capture leks will persist through recruitment.

Funding provided by Anadarko Petroleum Corporation

18. EVALUATION OF THE RESPONSE OF GREATER SAGE-GROUSE TO WIND DEVELOPMENT ACTIVITIES ASSOCIATED WITH THE CHOKECHERRY AND SIERRA MADRE WIND ENERGY PROJECT, CARBON COUNTY, WYOMING

Contact: Dr. Josh Millspaugh; E-mail: MillspaughJ@missouri.edu; Phone: (573) 882-9423

Josh Millspaugh, University of Missouri; Scott Gamo, Wyoming Game and Fish Department; Mark Rumble, U.S. Forest Service Rocky Mountain Research Station; Jon Kehmeier, SWCA Environmental Consultants

Power Company of Wyoming (PCW) has proposed to construct the 1,000 turbine, 3,000 megawatt Chokecherry and Sierra Madre Wind Energy Project south of Rawlins. A before-after-control-impact design is being used to evaluate the impacts of wind energy development on greater sage-grouse. The research area consists of 2 treatment areas where wind energy development will occur and 3 control areas without any wind energy development. Generally, the research effort will evaluate pre-construction habitat selection, population demographics including cause-specific survival, general movement and distribution patterns, and lek attendance trends. In spring 2010, 40 rump-mounted GPS PTTs were deployed on female sage-grouse; recovered tags were redeployed in fall 2010. In January 2011, the research team was awarded a contract from the National Wind Coordinating Collaborative to expand the research effort to include male and juvenile sage-grouse. In spring 2011, the number of tagged females was increased to 55 (11 in each study unit); 20 GPS PTTs and 50 rump-mounted VHF tags were fitted on males. In fall 2011, all recovered tags were redeployed and an additional 50 VHF tags were deployed on juvenile grouse. Our design calls for maintaining at least 50 GPS tagged females, 50 GPS tagged males, and 100 VHF tagged males and juveniles distributed evenly among the 5 study units. It is anticipated that 2.5 to 3 years of pre-construction data will be collected prior to the initiation of wind development activities.

Funded provided by Power Company of Wyoming, Wyoming Game and Fish Department, U.S. Forest Service Rocky Mountain Research Station, and National Wind Coordinating Collaborative

19. WHAT POTENTIAL MITIGATION AND RESTORATION SITES HAVE THE MOST POTENTIAL BENEFIT FOR SAGE-GROUSE?

Contact: Dr. Melanie Murphy; E-mail: melanie.murphy@uwyo.edu; Phone: (307) 766-5295

Dr. Melanie Murphy, Department of Renewable Resources, University of Wyoming

Research goal. Our goal is to provide science-based management tools to prioritize sage-grouse mitigation and restoration efforts in relation to energy development.

Study areas. *Bighorn* (low oil/gas development) and *Powder River* (high oil/gas development) basins.

Objectives. Long-term landscape-level sustainability of Greater Sage-Grouse requires occupancy of habitat and functional connectivity through the landscape. Sage-grouse are known to decline with development. However, it is unclear if this decline is due to habitat loss, habitat configuration, noise or a combination of these factors.

- *Objective 1* – ***Predict site-level Sage-Grouse occurrence in relation to habitat loss, habitat configuration and noise around lek sites.*** We will use lek presence data to predict probability of occurrence across each basin.

- *Objective 2*- ***Estimate functional connectivity in relation to habitat loss, habitat configuration and noise between lek sites.*** We will collect feathers from lek sites and utilize landscape genetic techniques to produce quantitative, statistically-based estimates of sage-grouse functional connectivity in each basin.

- *Objective 3* **– *Predict occurrence & functional connectivity in future landscape scenarios.*** Occurrence (*Objective 1*) and functional connectivity (*Objective 2*) of sage-grouse will be integrated in a network framework to identify critical current and potential lek sites for sage-grouse population sustainability.

Progress. Initial funding has been secured (Wyoming Restoration and Reclamation Center, May 2011). A PhD student (Beth Fitzpatrick) started August 2011 and is drafting her research proposal (submit to EPA-STAR, November). Microsatellite markers are being optimized in collaboration with Drs. Oyler-McCance and Fedy (USGS) for compatibility with existing efforts. Field work will begin in April 2012.

20. LINKING SAGE-GROUSE NEST VEGETATION STRUCTURE DATASETS TO ECOLOGICAL SITES

Contact: Dr. Ginger Paige; E-mail: gpaige@uwyo.edu; Phone: (307) 766-2200 and Dr. Ann Hild; E-mail: annhild@uwyo.edu; Phone: 307-766-5471

Project 1: Formatting Vegetation Datasets for Display and Analysis: G. Shaffer, G. Paige, M. Holloran and A. Hild.

Managers using geo-referenced data from belt transects, line point intercept or gap intercept indicators may be able to recognize important spatial patterns in sagebrush steppe vegetation with close examination of shrub structure and arrangement on the landscape. The objectives of the study were to:1) format datasets from common field monitoring methods and display the datasets in ArcGIS, 2) set-up vegetation datasets for spatial analysis, and 3) develop a manual describing the methods used to format datasets for map display and spatial analysis. We conducted vegetation measurements on 60 sage-grouse nest sites near Pinedale, WY during the summer of 2009. Site characteristic were recorded on two 30 m transects at each site. Line-point intercept measurements were taken at every meter along both 30 m transects. Gaps (≥ 20 cm) between vegetation canopies and bases were measured for all vegetation (shrubs, grasses, annual forbs, and perennial forbs). Canopy gaps (≥ 20 cm) between shrubs only were also recorded. Shrub belt measurements were taken at one-meter increments along transects. Each shrub was assigned to one of four height classes (seedling, 10-50 cm, 50-100 cm, and >100 cm). GIS formatting methods are described in a manual. Spatial analysis formats are also described for line-point intercept, gap and shrub belt datasets. The geo-referenced transects provides a basis for visual display of the spatial data in ArcGIS. By characterizing the vegetation and site characteristics in this way, managers may be aided in efforts to conceive management actions and to better visualize and manage the landscape to meet management goals. The manual is available as hardcopy on request.

Project 2: Linking metrics of vegetation structure in sagebrush steppe to ecological site descriptions. G. Paige, A. Hild A. Wuenschel and K. Afratakhti.

Ecological sites (ES) document the management unit based on soil, climate landscape position and the associated vegetative community function. Because ES is an accepted management unit for many public land management agencies, it is a critical component of management to document and clarify the relationship of ES to wildlife habitat. This study expands on spatial analyses initiated in Project 1 (above), to document and model spatial relationships in sagebrush steppe in the same habitat resource areas near Pinedale, Wyoming. We revisited a subset of the 60 nest sites again in the summers 2010 and 2011 to record vegetation along transects using line point, gap and shrub belt monitoring methods. In addition, we delineated plot areas encompassing transects and collected ground-based LiDAR data to document vegetation distributions at a range of scales. Our objectives are to document and precisely capture

vegetative cover, relate the measures to less labor-intensive field measures commonly included in agency field methods and to examine the spatial relationships within vegetative components to ES. This portion of the research is currently underway.

21. EXAMINING THE EFFECTS OF NOISE FROM ENERGY DEVELOPMENT ON THE BREEDING BIOLOGY OF THE GREATER SAGE-GROUSE (*Centrocercus urophasianus*)

Contact: Dr. Gail Patricell; E-mail: gpatricelli@ucdavis.edu; Phone: 530.754.8310

Principal Investigator
Gail Patricelli, Associate Professor, Dept. Evolution and Ecology, University of California, Davis

Additional Investigators
Jessica L. Blickley, Ph.D. Candidate, Graduate Group in Ecology, UC Davis
Dr. Stacie L. Hooper, Postdoctoral Researcher, Dept. Evolution and Ecology, UC Davis

The overall goal of this project is to investigate the potential effects of noise from natural gas development on sage-grouse lekking behaviors. Sage-grouse are declining in areas of energy development and circumstantial evidence suggests that noise is a cause of this decline. This project has three major objectives: 1) Descriptive- characterization of sounds produced by energy development and by sage-grouse, 2) Experimental - playback of recorded noise to sage-grouse leks to determine whether noise impacts sage-grouse breeding behaviors, and 3) Predictive - landscape-level modeling of sound propagation in the sagebrush habitat. To fulfill these objectives, we monitored a variety of noise sources in Sublette and Campbell Counties that are associated with energy development, including drilling rigs, compressor stations, roads, and generators. We also conducted a noise playback experiment on leks in our study site in Fremont County from 2006-2009; this noise playback resulted in immediate and drastic declines in lek attendance by male sage-grouse relative to paired controls. Additionally, males remaining on noise leks had elevated fecal stress hormones compared to males on control leks. Currently, we are investigating the impact of noise on other breeding behaviors. Additionally, we used our measures of noise-source levels to adapt a landscape-level noise model (NMSim) to estimate and map the “acoustic footprint” of noise sources from natural gas development activities. This model of noise propagation is now being used to generate noise layers for the Pinedale Anticline from 1998-2005, which will be included in habitat-selection models predicting greater sage-grouse demography for the region over these years.

This research has been funded by grants from the Bureau of Land Management, the Wyoming Sage-grouse Conservation Fund (via the Sage-grouse Local Working Groups), the Tom Thorne Sage-Grouse Conservation Fund (via the Wyoming Community Foundation), the National Fish and Wildlife Foundation, the National Parks Service, the National Science Foundation and the University of California, Davis

22. THUNDER BASIN SAGE-GROUSE STUDY

Contact: Dave Pellatz; E-mail: dave@rswyoming.com; Phone: (307) 359-1328

Dave Pellatz, Thunder Basin Grasslands Prairie Ecosystem Association; Bill Vetter & Amanda Hohnhorst, ICF International; Gwyn McKee, Thunderbird Wildlife Consulting; Matt Holloran, WY Wildlife Consultants; Nate West, Bureau of Land Management; Tim Byer, USDA-Forest Service

Thunder Basin Grasslands Prairie Ecosystem Association began a pilot study in 2011 to determine if a team of scientists dedicated to capture could successfully equip with radio-transmitters a sample of female sage-grouse large enough to warrant the pursuit of further research objectives. An adequate sample is considered 35 to 40 radio-equipped females. The project area encompasses portions of southern Campbell County, northern Converse County, western Weston County, and northwestern Niobrara County, Wyoming.

Assuming the targeted number of grouse are collared, three research objectives have been identified: 1) Determine sage-grouse seasonal use of sites treated to manage cheatgrass and how those treatments influence sage-grouse demographics, 2) Determine the spatial arrangement (i.e., size and juxtaposition) of sagebrush patches required for sage-grouse selection and success; and 3) Determine managerially-effective spatial relationships of habitat types across a landscape being managed for "competing" wildlife species such as sage-grouse and mountain plovers.

Results from the 2011 trapping, along with more isolated sage-grouse capture efforts conducted by Powder River Coal over the last several years, confirm that females are difficult to locate and trap in the general area of study. Thirty grouse were collared in 2011, but of these, only eight were female. Tracking will continue through the winter and additional birds will be collared next spring to see if we can reach the target of 35 to 40 radio-equipped females.

Funding/In-Kind: Cloud Peak Energy, Powder River Coal, NE Wyoming Sage-grouse Working Group, Thunder Basin Grasslands Prairie Ecosystem Association, Bureau of Land Management, WY Wildlife Consultants

23. CONTAINER STOCK SAGEBRUSH ESTABLISHMENT USING COPPER TREATMENT, AND WATER RETENTION CRYSTALS ACROSS THREE SITE CONDITIONS

Contact: Dr. Catherine Tarasoff; E-mail: ctarasof@mtu.edu; Phone: (906) 487-2396

Catherine Tarasoff, School of Forest Resources and Environmental Science, Michigan Technological University, Houghton, Michigan

Our general objective is to develop a protocol for reestablishing sagebrush on restored bentonite mines.

Research Questions

1. Can we improve transplant survival and subsequent growth by using copper coated containers to grow our seedlings?
2. Can we improve summer drought survival and subsequent growth by amending the immediate transplant area with water retention crystals?
3. How does site condition affect survival and growth?

We are comparing sagebrush treated transplant, summer drought and winter survival and growth across three mined site conditions:

1. Newly prepared for restoration with excellent soil condition (live cast)
2. Newly prepared for restoration with moderate soil condition (5-10 yr old soil)
3. Old restoration site that has failed restoration efforts

The treatments will be:

1. Control – untreated container grown sagebrush seedling
2. Copper – Container grown sagebrush seedling treated with cupric carbonate
3. Untreated + crystals - untreated container grown sagebrush seedling with hydrogel added at transplant
4. Copper + crystals - cupric carbonate treated seedling with hydrogel added at transplant

We have had very high survival rates across all treatments and results to date (spring and summer measurements) indicate that site condition is the most important factor influencing plant survival and growth.

Project support has come from M-I Swaco, American Colloid, Wyoming Wildlife and Natural Resource Trust Fund, Wyoming Sage-grouse Conservation Fund

24. USING GPS SATELLITE TRANSMITTERS TO ESTIMATE SURVIVAL, DETECTABILITY ON LEKS, LEK ATTENDANCE, INTER-LEK MOVEMENTS, AND BREEDING-SEASON HABITAT USE OF MALE GREATER SAGE-GROUSE IN NORTHWESTERN COLORADO AND SOUTHWESTERN WYOMING

Contact: Dr. Brett Walker; E-mail: brett.walker@state.co.us; Phone: (970) 255-6125

PRINCIPAL INVESTIGATOR: Brett L. Walker, Avian Research Program, Colorado Parks and Wildlife, 711 Independent Ave., Grand Junction, Colorado 81505

There is a crucial need to evaluate the reliability of current lek-based population monitoring and management strategies for greater sage-grouse in oil and gas fields that overlap sage-grouse core areas. Colorado Parks and Wildlife (CPW) is color-banding and deploying GPS PTT transmitters on male greater sage-grouse in and near the Hiawatha Regional Energy Development project area on the boundary between northwestern Colorado and southwestern Wyoming. Objectives are to track GPS males to locate and verify new leks; compare survival and display rates of males with and without GPS transmitters; estimate age-specific male lek attendance, inter-lek movements, detectability; and document diurnal and nocturnal habitat use around leks during the breeding season. These data in turn will allow us to quantify how unexplained variation in these parameters affects lek-count data and resulting trend estimates and to quantify the effectiveness of NSO/RSO lease stipulations for protecting male breeding habitat. Capture efforts in both Colorado and Wyoming from Oct 2010 – March 2011 resulted in 32 adult and 19 yearling color-banded GPS males and 42 adult and 5 yearling males with color-bands only. In spring 2011, field crews located and verified 3 new leks and conducted 83 standard lek counts, 58 double-observer counts, and 92 lek-days of resighting. Four GPS males made 30-70 km movements out of the study area prior to spring 2011. We detected no difference in mean display rate on leks between males with and without GPS transmitters. Other parameters (male survival, lek attendance, inter-lek movement, and detectability) are still being analyzed.

Funding provided by Colorado Parks and Wildlife.

25. MORTALITY, PREDATION, AND SPACE USE OF GREATER SAGE-GROUSE IN BIGHORN BASIN

Contact: Dr. Julie Young; E-mail: julie.young@usu.edu; Phone: (435) 797-1348

Beth Orning-Tschampl, Graduate Research Assistant, Utah State University, Logan, Utah, and Julie K. Young, Ph.D., USDA-WS, National Wildlife Research Center – Predator Research Facility and Utah State University, Logan, Utah

We are evaluating effects of predation on greater sage-grouse survival and nest success. Our objectives are to: (1) provide data on the types and impacts of predators on sage-grouse and their nests and (2) provide managers with additional information beyond habitat improvements that could enhance sage-grouse management. We studied sage-grouse predation at two complexes within the Bighorn Basin Conservation Area in 2011: Oregon Basin (OB) and Polecat Bench (PB). Two more sites will be added in 2012: Fifteen Mile (FM) and Major Basin (MB). Twenty-five hens were captured via rocket nets from four leks, fitted with VHF radio collars, and monitored from April – August 2011. Infrared trail cameras were used to monitor and document nest predations. Terrestrial and avian predator abundance surveys were conducted using scent stations, trail cameras, and road transects. We documented 22 hens initiating nests; two hens were depredated prior to nesting (OB) and one hen left the study area post-capture (PB). Of the failed nests, nest predation was 67% in OB (n=9) and 57% (n=7) in PB. Chick survival to 35 days was 44% at OB (n=25 chicks) and 3 of 5 chicks at PB from one brood. We were unable to observe the other PB brood at 35 days. The data from 2011 provide a baseline to guide the design of experimental manipulations of predators in 2012.

Funding/support provided by Meeteetse Conservation District, USDA-Wildlife Services, USDA-WS-National Wildlife Research Center, Wyoming Animal Damage and Management Board, and Wyoming Game and Fish Department.

Attachment E

WYOMING GAME AND FISH DEPARTMENT

5400 Bishop Blvd. Cheyenne, WY 82006

Phone: (307) 777-4600 Fax: (307) 777-4699

Web site: http://gf.state.wy.us

February 20, 2012

MEMORANDUM

TO: Carol Havlik, Permitting Officer

FROM: Tom Christiansen, Sage-grouse Coordinator

COPY TO: Oakleaf, Lanka, Ryder, Choma, Edberg, Nesvik, Zornes

SUBJECT: Sage-grouse research Chapter 33 permitting

Earlier this month you expressed some concern about the number of sage-grouse telemetry studies being conducted in the state and whether they were all necessary and in the best interest of the bird. Your concern is valid and we are hearing similar concerns being expressed by some external constituents. In addition, the issue of "scientific use" is a key component of the U.S. Fish and Wildlife Service's "5 Factor Analysis" in determining threatened or endangered species status. I'm providing the following to serve as background and follow up. I agree that we need to continue to increase scrutiny of permit applications and annual reporting to ensure permit compliance, research need and validity, and adequate safeguards to local sage-grouse populations.

The new WGFD permitting database, housed in Fish Division, indicates that in 2011 there were 13 active Chapter 33 permits that allowed capture of up to 1,337 sage-grouse across the state. All but up to 100 of these were permitted for telemetry attachment. Most studies did not reach the limits of what they were allowed to capture. WGF supports and is involved in most of the sage-grouse research underway. Study topics included a comparison of the use of VHF versus GPS telemetry technology, general distribution, habitat use and movement, effects of energy development (wind, natural gas), mining effects, raven control effects, predation and disease monitoring.

In 2011, one permit application to capture and telemeter sage-grouse was rejected and one permit was granted only after the permittee was required to obtain additional training prior to capture and marking birds and more qualified researchers were engaged to conduct the work in a more scientifically rigorous manner. Over the past two years, through your office, we have increased reporting requirements to include both capture and relocation data.

Coincident to your concern being expressed, a permit application was recently submitted which included plans for a new "reference area" north of Wamsutter. However, there is an existing reference area (Stewart Creek) not far away being used by other studies. Having a common reference site cooperatively managed between the researchers would minimize impacts to sage-

grouse and strengthen future analyses. On February 17, 2012 I hosted a conference call that included Mr. Chad Olsen of Hayden-Wing Associates, Dr. Jeff Beck of the University of Wyoming, Dr. Matt Holloran of Wyoming Wildlife Consultants, LLC, Mr. Chris Kirol, University of Wyoming graduate student and Mr. Jon Dinkins, Utah State University graduate student. The result of this call was that the parties agreed that the existing reference area would serve Mr. Olsen's research needs and that they would agreed to share past and future data to the benefit of all. Mr. Olsen will be submitting a revised permit application soon.

Moving ahead I recommend:

1) We continue to seek cooperative research opportunities as detailed above.
2) We continue to require greater specificity in annual permit reporting.
3) We increase our scrutiny of the reports to ensure the permittees are in compliance.
4) We clarify permit language regarding the number of grouse allowed to be captured. In some permits the permittee is allowed to maintain a certain sample size of telemetered birds, which could mean substantially higher numbers of birds being captured if either capture related or natural mortality levels are high.
5) We develop and require a simple annual mortality summary to be included with each annual report. This would enable us to more efficiently address the questions about capture related mortality and its impacts.
6) Finally, have we come to a firm policy regarding the security of annual report data as it relates to academic rights and publication?

Thank you for your concern and efforts. I look forward to continuing to work with you on this issue.

Attachment C. Wyoming Sage-Grouse Projects Supported with 2011-2012 General Fund Budget							
Project Name	**Budget Biennium**	**Local Working Group**	**Total Cost**	**SG $**	**Project Description**	**Partners**	**Status**
99 - Cheatgrass mapping - Upper Green River Basin Phase I (see also #132)	2011-12	Upper Green River Basin	$71,390	$55,000 requested/approved/ spent	Cheatgrass mapping and spot control	Sublette Co. Weed & Pest/GR Basin Coordinated Weed Mgt Association	Complete
100 - West Slope Bighorn Mtns Cheatgrass Control	2011-12	Big Horn Basin	$20,000	$10,000 requested/approved/ spent	Cheatgrass control	BLM - Cody FO	Complete
101 - Albert Creek Grazing Mgt	2011-12	Southwest	$25,000	$12,500 requested/approved/ spent	Grazing management and infrastructure	Horseshoe Spear Cattle Co., BLM, WGFD	Complete
102 - ACC Cheatgrass Control	2011-12	Big Horn Basin	$150,000 (multiyear)	$20,000 requested/approved, $17,100 spent	Cheatgrass control and effectiveness monitoring	Big Horn Co. Weed & Pest, American Colloid Co.	Complete
103 - Emergency Wildfire Restoration	2011-12	Northeast	$53,774	$33,250 requested/approved, $30,257 spent	Restoration of wildfire area in the Buffalo sage-grouse core area	Lake DeSmet Conservation District, private landowner, WGFD	Complete
104 - Jackson Hole SG Habitat and Movement Modeling (see also #30 & 75)	2011-12	Upper Snake River Basin	$24,000	$16,000 requested, $8,000 approved/spent	Develop sage-grouse habitat selection and home-range models using data from prior work.	Craighead Beringia South	Complete
105 - Black Mountain Cheatgrass Control and Sagebrush Restoration	2011-12	Big Horn Basin	$260,000	$105,000 requested, $96,000 approved	Cheatgrass control and sagebrush seedling establishment and planting in wildfire area. See also project #86.	WGFD, BLM, Wildlife and Nat. Res. Trust	On-going
106 - Crooked Crk and Rome Hill Juniper Treatment (see also #60, 140 and 141)	2011-12	Big Horn Basin	$90,000	$22,500 requested/approved	Mechanical juniper removal from sage-grouse habitat	BLM - Worland FO	On-going
107 - Grand Teton NP lek monitoring	2011-12	Upper Snake River Basin	$11,369	$4,032 requested/approved/ spent	Hire technicians to conduct lek monitoring in Grand Teton National Park	Grand Teton National Park, WGFD	Complete

Attachment C. Wyoming Sage-Grouse Projects Supported with 2011-2012 General Fund Budget

Project Name	Budget Biennium	Local Working Group	Total Cost	SG $	Project Description	Partners	Status
Invasive Species Mapping and Control in BTNF & GTNP	2011-12	Upper Snake River Basin	$53,000	$12,000 requested, $6,500 approved	Invasive/noxious weed mapping and control.	Teton Co. Weed & Pest, Grand Teton National Park, Nat'l Elk Refuge, Bridger-Teton NF, Jackson Hole Airport	On-going
108 - Restoration of SG habitat on mined sites (see also #145)	2011-12	Big Horn Basin	$36,026	$21,053 requested/approved	Research to test methods to improve sagebrush seedling vigor and survival for mineland reclamation	Michigan Technical University, MI SWACO, American Colloid, BLM	On-going
109 - Fence marking in SW Wyoming	2011-12	Southwest	$18,091	$10,000 requested/approved	Volunteer construction and placement of fence markers to prevent/mitigate sage-grouse fence collisions	BLM, Utah's Hogle Zoo	On-going
110 - Impacts of Ravens on SG nests in southern WY	2011-12	South-Central & Southwest	not provided by applicant	$102,892 requested/approved	Research to determine raven impacts and raven control to sage-grouse	Utah State University	On-going
111 - Noxious weed control in Spring Crk/Big Ridge BTNF	2011-12	Upper Snake River Basin	$22,000	$7,500 requested, $3,883 approved	Noxious weed control on Bridger-Teton NF lands	Lincoln Co. Weed & Pest, Wildlife and Nat. Res. Trust, RMEF, USFS	On-going
112 - Improving SG habitat in the Cottonwood Crk drainage (see also #143)	2011-12	Big Horn Basin	$630,000 (multiyear)	$99,809 requested, $30,195 approved	LWG $ to provide spring protection aspect of larger habitat restoration project	The Nature Conservancy, WYDEQ, Wildlife & Nat. Res. Trust, LU Ranch, Hot Springs Weed & Pest, Exxon Mobil, Marathon Oil, WGFD, Spring Gulch Cattle Co.	On-going
113 - Kelly Hayfields restoration Phase II (see also #95)	2011-12	Upper Snake River Basin	$140,181	$52,647 requested; $31,585 approved	Restore native vegetation to abondoned smooth brome hayfields.	Grand Teton National Park, NRCS	On-going
114 - Impacts of wind energy development in SE Wyo (see also #84)	2011-12	Bates Hole/ Shirley Basin & South-Central	$1,320,798 (multiyear)	$110,000 requested, $85,000 approved	Research to establish the short-term effects of wind development to sage-grouse	National Wind Coordinating Collaborative, Western Assoc. of Fish & Wildlife Agencies	On-going

Attachment C. Wyoming Sage-Grouse Projects Supported with 2011-2012 General Fund Budget

Project Name	Budget Biennium	Local Working Group	Total Cost	SG $	Project Description	Partners	Status
115 - Sharpnose sagebrush treatment Unit 2	2011-12	Wind River/ Sweetwater	$53,700	$8,200 requested/approved/ spent	Fine-grained mosaic sagebrush mowing to improve age diversity and increase herbaceous production.	Bureau of Indian Affairs, Wind River Reservation	Complete
116 - Response of SG to sagebrush treatments	2011-12	Wind River/Sweetwater, South-Central, Southwest, Bates Hole/Shirley Basin	$539,800 (multiyear)	$189,800 requested/approved	Research to determine sage-grouse demographic and habitat use response to sagebrush treatments	Univ. of Wyoming Coop Unit, WGFD	On-going
117 - Estimating noise impacts for habitat selection modeling (see also #17, 46 & 77)	2011-12	Wind River/Sweetwater, South-Central, Southwest, Bates Hole/Shirley Basin, Northeast, Upper Green River Basin	$69,415	$49,335 requested/approved/ spent	Research to develop a noise model and determine noise exposure thresholds.	Univ. California-Davis	On-going
118 - Identifying restoration and land-use priorities	2011-12	Northeast	$207,376	$37,922 requested/approved	Research using genetic techniques to map population connectivity	Univ. of Wyoming	On-going
119 - SG core areas as umbrella for non-game species	2011-12	Southwest & Wind River/Sweetwater	$249,724	$30,000 requested; $8,000 approved	Research to determine the conservation effectiveness of sage-grouse core areas for non-game species	Univ. of Wyoming Coop Unit	On-going
120 - Thunder Basin Sagebrush Mapping	2011-12	Northeast	$350,000	$50,000 requested/approved	Develop an accurate sagebrush map using 1' aerial photography	Thunder Basin Grasslands Prairie Ecosystem Assoc.	On-going
121 - Thunder Basin SG collaring	2011-12	Northeast	$100,000	$25,000 requested/approved	Seasonal distribution and habitat use study	Thunder Basin Grasslands Prairie Ecosystem Assoc.	On-going

Attachment C. Wyoming Sage-Grouse Projects Supported with 2011-2012 General Fund Budget

Project Name	Budget Biennium	Local Working Group	Total Cost	SG $	Project Description	Partners	Status
122 - Henderson Draw cheatgrass treatment	2011-12	Bates Hole/Shirley Basin	$78,000-$87,000	$50,000 requested/approved	Cheatgrass control	BLM - Casper FO	On-going
130 - Seven Mile Gulch Exclosure	2011-12	Southwest	$29,800	$21,600 requested/approved	Spring and associated habitat protection fencing	Unita Development Co., WGFD, volunteers	On-going
131 - Buckhorn Flowing well fencing	2011-12	Southwest	$19,000	$5,000 requested/approved	Flowing well and associated habitat protection fencing	WY Landscape Conservation Initiative,	On-going
132 - Cheatgrass mapping & control - Sublette Co. Phase II (see also #99)	2011-12	Upper Green River Basin & Southwest	$92,719	$92,719 requested/approved	Cheatgrass mapping and spot control	Sublette Co. Weed & Pest/GR Basin Coordinated Weed Mgt Association	On-going
133 - Sublette Co. raven control 1	2011-12	Upper Green River Basin	$5,810	$5,810 requested/approved	Lethal raven pair control	USDA APHIS Wildlife Services	On-going
134 - Sublette Co. raven control 2	2011-12	Upper Green River Basin	$9,190	$9,190 requested/approved	Raven nest removal and habitat modification	Sublette Co. Conservation District	On-going
135 - Escape Ramp & spring protection fence materials (see also #47)	2011-12	Big Horn Basin, Wind River/Sweetwater	$15,000	$15,000 requested/approved	Water trough escape ramps and spring protection fencing	Niobrara Conservation District	On-going
136 - Fence collision markers	2011-12	South-central, Upper Green River Basin, Southwest	$100,000	$42,000 approved	Volunteer construction and placement of fence markers to prevent/mitigate sage-grouse fence collisions	Medicine Bow Conservation District, WGFD, private landowners, BLM	On-going
137 - Buffalo Internet lek monitoring database	2011-12	Northeast	$2,500	$2,500 requested/approved; $2,465 spent	Maintain real-time lek database for the Buffalo BLM FO to facilitate monitoring coordination between agencies and industry	BLM, WGFD, industry	Complete
138 - Audubon Community Naturalist	2011-12	Bates Hole/Shirley Basin	$178,500	$10,000 requested/approved	Sagebrush ecosystem education program for schools	various foundations and grants	On-going
139 - North Laramie Range cheatgrass control	2011-12	Bates Hole/Shirley Basin	$206,700	$26,000 requested/approved	Cheatgrass control	Wildlife and Nat. Res. Trust, WGFD, Gov's Big Game Lic. Coalition	On-going
	2011-12 Total			**~1,200,000 approved**			

Attachment D.
Wyoming Sage-Grouse Research Reports (through May 31, 2012)

The following list includes final research reports from WGF sage-grouse research or theses and dissertations from university research efforts. It does not include annual agency monitoring reports or popular press articles.

Bedrosian, B. and D Craighead. 2010. Jackson Hole sage grouse project completion report: 2007-2009. Craighead Beringia South. Kelly, Wyoming. Includes 4 appended reports:

A: Common raven activity in relation to land use in western Wyoming: Implications for greater sage grouse reproductive success.

B: Critical winter habitat characteristics of greater sage-grouse in a high altitude environment.

C: Sage grouse baseline survey and inventory at the Jackson Hole Airport.

D: Sage-grouse chick survival rates in Jackson Hole, Wyoming.

Brown, K. G. and K. M. Clayton. 2004. Ecology of the greater sage-grouse (*Centrocercus urophasianus*) in the coal mining landscape of Wyoming's Powder River Basin. Final Technical Report. Thunderbird Wildlife Consulting, Inc. Gillette, WY.

Bui, T.D. 2009. The effects of nest and brood predation by common ravens (*Corvus corax*) on greater sage-grouse (*Centrocercus urophasianus*) in relation to land use in western Wyoming. M.S. Thesis. University of Washington, Seattle.

Cagney J., E. Bainter, B. Budd, T. Christiansen, V. Herren, M. Holloran, B. Rashford, M. Smith and J. Williams. 2010. Grazing influence, objective development, and management in Wyoming's greater sage-grouse habitat. University of Wyoming College of Agriculture Extension Bulletin B-1203. Laramie. Available on-line at: http://www.wyomingextension.org/agpubs/pubs/B1203.pdf

Christiansen, T. 2006. Monitoring the impacts and extent of West Nile virus on sage-grouse in Wyoming – final report. Wyoming Game and Fish Department, Cheyenne.

Christiansen, T. 2010. Hunting and sage-grouse: a technical review of harvest management on a species of concern in Wyoming. Wyoming Game and Fish Department, Cheyenne.

Courtemanch, A., G. Chong and S. Kilpatrick. 2007. A remote sensing analysis of sage-grouse winter habitat in Grand Teton National Park and Bridger-Teton National Forest, Wyoming.

Daniel, Jonathan. 2007. Spring precipitation and sage grouse chick survival. M.S. Thesis. Department of Statistics – University of Wyoming, Laramie.

Deibert, P. A. 1995. Effects of parasites on sage-grouse mate selection. PhD Dissertation. University of Wyoming, Laramie.

Doherty, K. E. 2008. Sage-grouse and energy development: integrating science with conservation planning to reduce impacts. Dissertation. University of Montana, Missoula.

Doherty, M. K. 2007. Mosquito populations in the Powder River Basin, Wyoming: a comparison of natural, agricultural and effluent coal-bed natural gas aquatic habitats. M.S. Thesis. Montana State University, Bozeman.

Erickson, H. J. 2011. Herbaceous and avifauna responses to prescribed fire and grazing timing in a high-elevation sagebrush ecosystem. M.S. Thesis. Colorado State University, Ft. Collins.

Girard, G. L. 1937. Life history, habits, and food of the sage-grouse. University of Wyoming Publication 3. University of Wyoming, Laramie.

Heath, B. J., R. Straw, S.H. Anderson, J. Lawson. 1997. Sage-grouse productivity, survival and seasonal habitat use near Farson, Wyoming. Research Completion Report. Wyoming Game & Fish Dept., Cheyenne.

Heath, B. J., R. Straw, S. H. Anderson, J. Lawson, M. Holloran. 1998. Sage-grouse productivity, survival, and seasonal habitat use among three ranches with different livestock grazing, predator control, and harvest management practices. Research Completion Report. Wyoming Game & Fish Dept., Cheyenne.

Hess, J. E. 2010. Greater sage-grouse (*Centrocercus urophasianus*) habitat response to mowing and prescribed burning Wyoming big sagebrush and the influence of disturbance factors on lek persistence in the Bighorn Basin, Wyoming, M.S. Thesis. University of Wyoming, Laramie.

Hnilicka, P. and D. Skates. 2010. Movements and survival of sage-grouse on the Wind River Reservation, Wyoming. Completion Report. U. S. Fish and Wildlife Service Lander, Wyoming.

Holloran, M. J. 1999. Sage-grouse seasonal habitat use near Casper, WY. M.S. Thesis. University of Wyoming, Laramie.

Holloran, M. J. and S. H. Anderson. 2004. Greater Sage-grouse seasonal habitat selection and survival in Jackson Hole, Wyoming. Research Completion Report. University of Wyoming Cooperative Fish and Wildlife Research Unit, Laramie.

Holloran, M. J. 2005. Sage-grouse population response to natural gas field development in western Wyoming. PhD Dissertation. University of Wyoming, Laramie.

Holloran, M. J. and S. H. Anderson. 2005a. Spatial distribution of Greater Sage-grouse nests in relatively contiguous sagebrush habitats. Attachment A in Holloran 2005 PhD Dissertation. University of Wyoming, Laramie.

Holloran, M. J. and S. H. Anderson. 2005c. Greater Sage-grouse research in Wyoming: an overview of studies conducted by the Wyoming Cooperative Fish and Wildlife Research Unit

between 1994 and 2005. Attachment C in Holloran 2005 PhD Dissertation. University of Wyoming, Laramie.

Holloran, M.J., R.C. Kaiser, and W.A. Hubert. 2010. Yearling greater sage-grouse response to energy development in Wyoming. The Journal of Wildlife Management 74:65-72.

Honess, R. F. and G. Post. 1968. History of an epizootic in sage-grouse. Science Monograph 14. University of Wyoming Agricultural Experiment Station, Laramie.

Jensen, B. M. 2006. Migration, transition range and landscape use by greater sage-grouse (*Centrocercus urophasianus*). M.S. Thesis, University of Wyoming, Laramie.

Johnson, G. 2010. Field evaluation of larvivorous fish for mosquito management in the Powder River Basin, Wyoming. Grant summary completion report. Montana State University, Bozeman.

Johnson, G. D. 1987. Effects of rangeland grasshopper control on sage-grouse in Wyoming. M.S. Thesis, University of Wyoming, Laramie.

Kaiser, R. C. 2006. Recruitment by greater sage-grouse in association with natural gas development in Western Wyoming. M.S. Thesis, Department of Zoology and Physiology, University of Wyoming, Laramie.

King, L. and J. Petty. 2008. Investigations of a gravity-fed supplemental irrigation system to enhance sagebrush seedling establishment on reclaimed bentonite mine lands in Wyoming's Big Horn Basin. Shell Valley Consulting Associates, Inc. Shell, WY.

King, L., E. Dunklee and J. Petty. 2009. Use of supplemental watering gels to enhance Wyoming big sagebrush establishment on Big Horn Basin bentonite reclamation. Shell Valley Consulting Associates, Inc. Shell, WY.

Kirol, C. P. 2012. Quantifying habitat importance for greater sage-grouse (*Centrocercus urophasianus*) population persistence in an energy development landscape, Thesis, University of Wyoming, Laramie.

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Kuipers, J. L. 2004. Grazing system and linear corridor influences on Greater Sage-grouse habitat selection and productivity. M.S. Thesis. University of Wyoming. Laramie.

Lyon, A. G. 2000. The potential effects of natural gas development on sage grouse near Pinedale, Wyoming. M.S. Thesis, University of Wyoming, Laramie.

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Rothenmaier, D. 1979. Sage-grouse reproductive ecology: breeding season movements, strutting ground attendance and site characteristics, and nesting. M.S. Thesis. University of Wyoming, Laramie.

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Taylor, R. L., D. E. Naugle, and L. Scott Mills. 2012. Viability analyses for conservation of sage-grouse populations: Buffalo Field Office, Wyoming Final Report 27 February 2012. BLM Contract 09-3225-0012 Number G09AC00013 (8/10/10). University of Montana, Missoula**.**

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Blickley, J. L. and G. L. Patricelli. 2010. Impacts of anthropogenic noise on wildlife: research priorities for the development of standards and mitigation. Journal of International Wildlife Law & Policy, 13: 274-292.

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Harju, S. M., M. R. Dzialak, R. C. Taylor, L. D. Hayden-Wing., J. B. Winstead. 2010. Thresholds and time lags in effects of energy development on greater sage-grouse populations. Journal of Wildlife Management 74:437-448.

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Bates Hole/Shirley Basin
Local Working Group Area
Job Completion Report

Period Covered:
June 1, 2011 – May 31, 2012

Prepared by: **Justin Binfet**
Wyoming Game and Fish Department

February 21, 2013

Sage Grouse Job Completion Report

Year: 2003 - 2012, Working Group: Bates Hole

1. Lek Attendance Summary (Occupied Leks) (1)

a. Leks Counted

Year	Occupied	Counted	Percent Counted	Peak Males	Avg Males / Active Lek (2)
2003	162	49	30	1551	35.3
2004	163	52	32	1723	38.3
2005	186	59	32	3358	60.0
2006	195	63	32	3844	63.0
2007	205	56	27	2433	45.9
2008	211	62	29	2226	37.1
2009	212	60	28	1611	29.3
2010	215	109	51	2485	27.0
2011	218	103	47	1670	19.9
2012	218	77	35	1179	20.0

b. Leks Surveyed

Year	Occupied	Surveyed	Percent Surveyed	Peak Males	Avg Males / Active Lek (2)
2003	162	86	53	1514	27.0
2004	163	72	44	1465	31.2
2005	186	100	54	2396	31.5
2006	195	116	59	3421	38.4
2007	205	110	54	2913	36.9
2008	211	103	49	2031	27.4
2009	212	100	47	1693	23.5
2010	215	65	30	861	17.6
2011	218	95	44	861	14.4
2012	218	90	41	787	12.9

1) Occupied - Active during previous 10 years (see official definitions)

2) Avg Males/Active Lek - Includes only those leks where one or more strutting males were observed. Does not include "Active" leks where only sign was documented.

3) Inactive - Confirmed no birds/sign present (see official definitions)

Sage Grouse Job Completion Report

Year: 2003 - 2012, Working Group: Bates Hole

1. Lek Attendance Summary (Occupied Leks) (1) Continued

c. Leks Checked

Year	Occupied	Checked	Percent Checked	Peak Males	Avg Males / Active Lek (2)
2003	162	135	83	3065	30.7
2004	163	124	76	3188	34.7
2005	186	159	85	5754	43.6
2006	195	179	92	7265	48.4
2007	205	166	81	5346	40.5
2008	211	165	78	4257	31.8
2009	212	160	75	3304	26.0
2010	215	174	81	3346	23.7
2011	218	198	91	2531	17.6
2012	218	167	77	1966	16.4

d. Lek Status

Year	Active	Inactive (3)	Unknown	Known Status	Percent Active	Percent Inactive
2003	99	16	47	115	86.1	13.9
2004	94	28	41	122	77.0	23.0
2005	136	9	41	145	93.8	6.2
2006	152	3	40	155	98.1	1.9
2007	134	8	63	142	94.4	5.6
2008	135	35	41	170	79.4	20.6
2009	130	33	49	163	79.8	20.2
2010	143	17	55	160	89.4	10.6
2011	159	46	13	205	77.6	22.4
2012	132	30	56	162	81.5	18.5

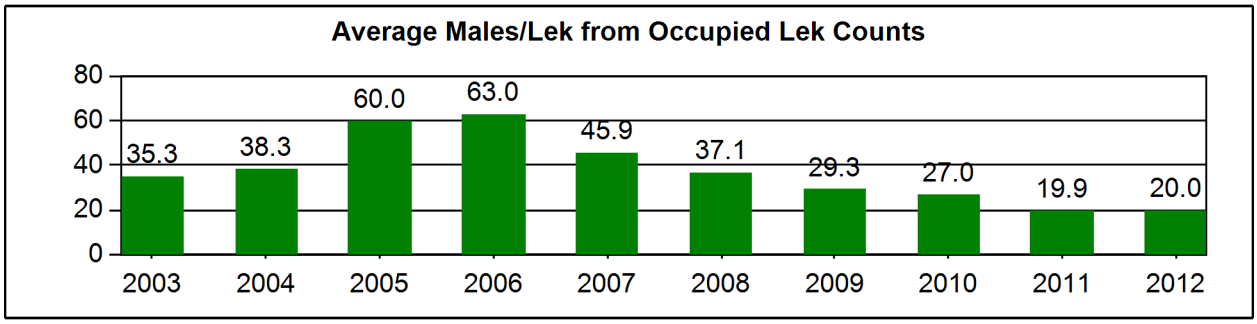
1) Occupied - Active during previous 10 years (see official definitions)

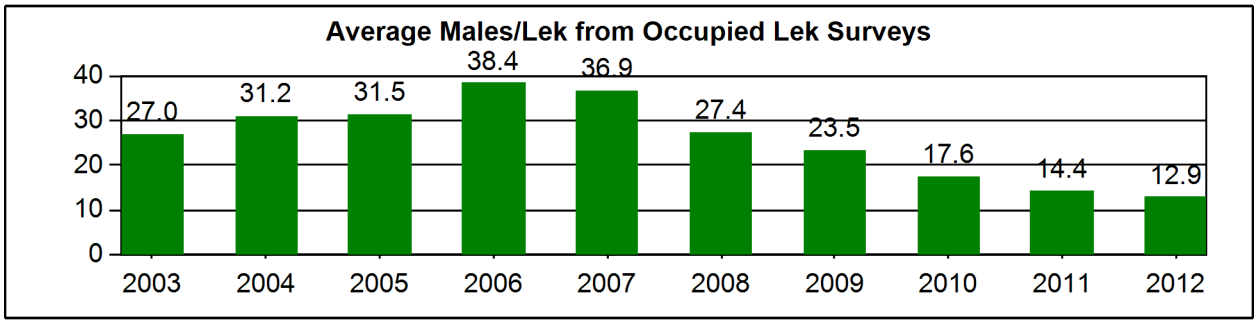
2) Avg Males/Active Lek - Includes only those leks where one or more strutting males were observed. Does not include "Active" leks where only sign was documented.

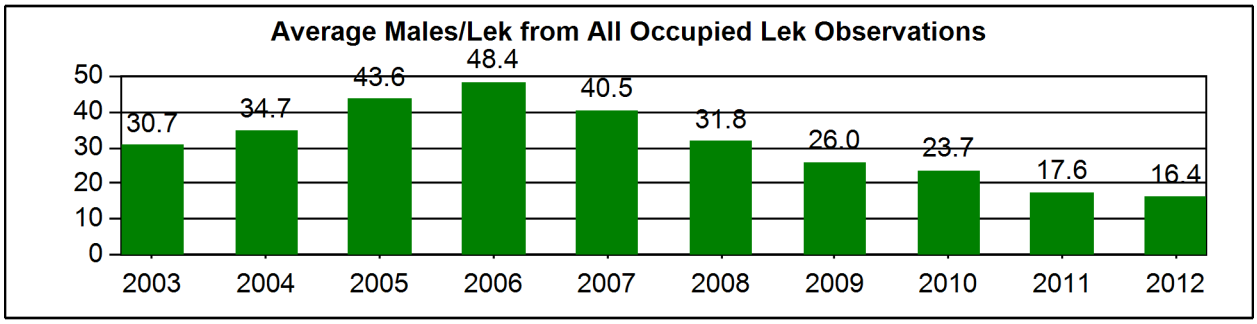
3) Inactive - Confirmed no birds/sign present (see official definitions)

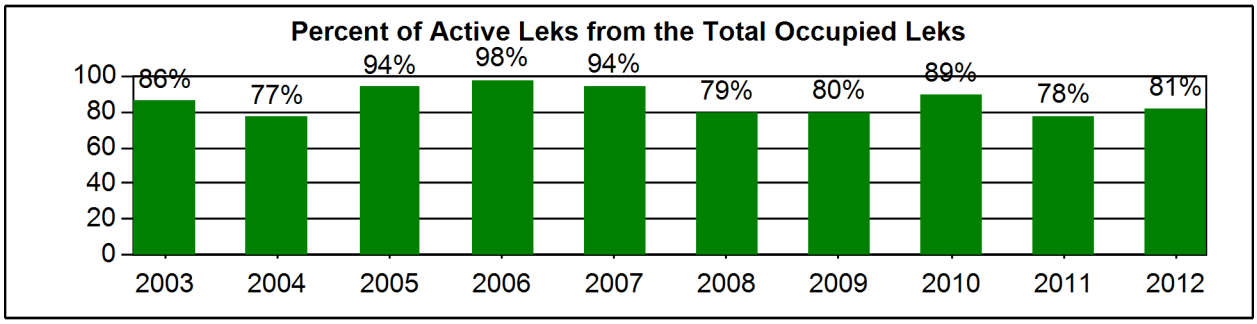
Sage Grouse Occupied Lek Attendance Summary

Year: 2003 - 2012, Working Group: Bates Hole



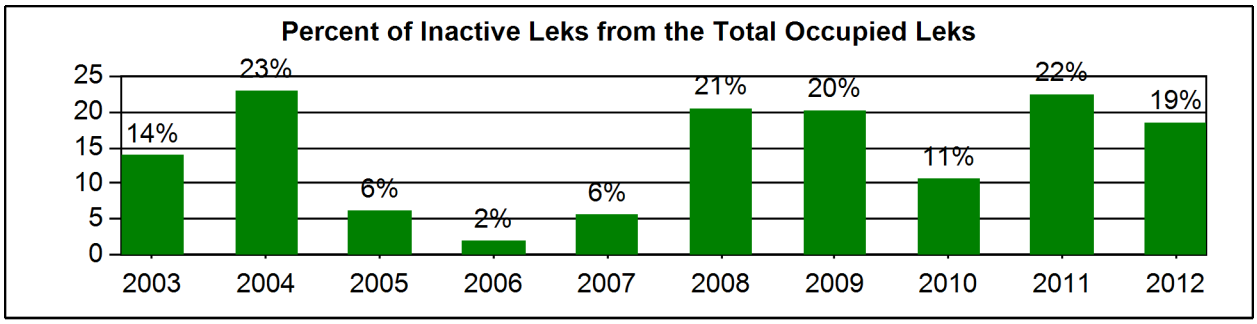






Sage Grouse Occupied Lek Attendance Summary

Year: 2003 - 2012, Working Group: Bates Hole



Sage Grouse Job Completion Report

Year: 2002 - 2011, Management Area: F

4. Sage Grouse Hunting Seasons and Harvest Data

a. Season

Year	Season Start	Season End	Length	Bag/Possesion Limit
2002	Sep-28	Oct-6	9	2/4
2003	Sep-27	Oct-5	9	2/4
2004	Sep-23	Oct-3	11	2/4
2005	Sep-23	Oct-3	11	2/4
2006	Sep-23	Oct-3	11	2/4
2007	Sep-22	Oct-2	11	2/4
2008	Sep-22	Oct-2	11	2/4
2009	Sep-19	Sep-30	12	2/4
2010	Sep-18	Sep-30	13	2/4
2011	Sep-17	Sep-30	14	2/4

b. Harvest

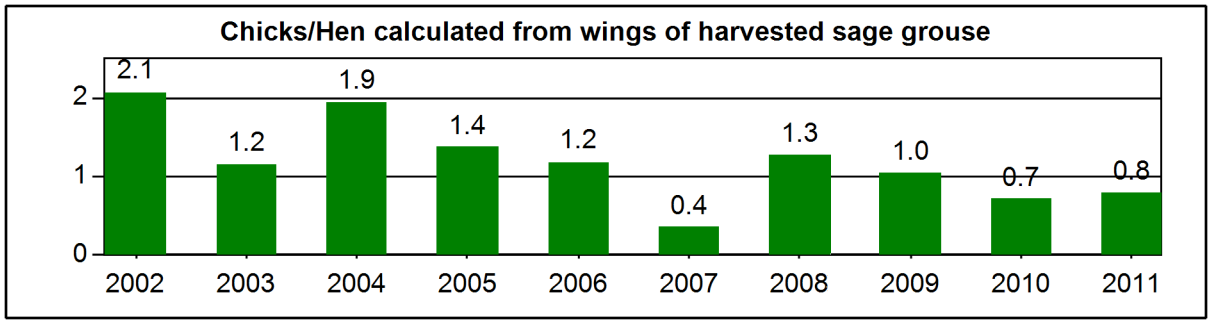
Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2002	588	377	588	1.0	1.6	1.6
2003	623	318	626	1.0	2.0	2.0
2004	1237	583	1071	1.2	2.1	1.8
2005	2304	925	1734	1.3	2.5	1.9
2006	1672	717	1169	1.4	2.3	1.6
2007	1365	655	1155	1.2	2.1	1.8
2008	1295	654	1161	1.1	2.0	1.8
2009	1026	532	956	1.1	1.9	1.8
2010	1027	480	1001	1.0	2.1	2.1
2011	1117	514	981	1.1	2.2	1.9
Avg	1,225	576	1,044	1.1	2.1	1.8

Sage Grouse Job Completion Report

Year: 2002 - 2011, Management Area: F, Working Group: Bates Hole

5. Composition of Harvest by Wing Analysis

Year	Sample Size	Percent Adult		Percent Yearling		Percent Young		Chicks/ Hens
		Male	Female	Male	Female	Male	Female	
2002	663	7.7	18.6	2.4	10.7	15.5	45.1	2.1
2003	214	20.6	24.3	2.8	11.2	19.6	21.5	1.2
2004	308	13.6	24.7	1.3	4.2	24.0	32.1	1.9
2005	372	17.5	25.8	3.0	7.8	21.5	24.5	1.4
2006	305	29.8	22.6	4.3	7.5	13.1	22.6	1.2
2007	546	19.4	53.5	4.2	2.9	8.4	11.5	0.4
2008	217	12.0	26.7	5.5	9.7	17.1	29.0	1.3
2009	314	12.7	26.1	9.2	12.1	17.8	22.0	1.0
2010	284	13.0	35.2	5.6	12.3	13.4	20.4	0.7
2011	175	14.3	35.4	4.0	10.3	16.6	19.4	0.8



Introduction

Sage-grouse are found throughout the Bates Hole/Shirley Basin Local Working Group (BHSBLWG) area in the sagebrush/grassland habitats of Bates Hole, Shirley Basin, the South Fork of the Powder River Basin, foothills of the Laramie Range and Rattlesnake Hills, and in northern Platte/southern Niobrara Counties. Occupied habitat is fairly contiguous throughout much of Bates Hole and Shirley Basin. Habitats within the South Fork of the Powder River Basin are somewhat fragmented by changes in habitat type / sagebrush cover and oil and gas development. Occupied sage-grouse habitat in the Laramie Range is primarily limited to the west slope including portions of the Laramie Plains. Large contiguous blocks of sagebrush/grassland communities east of the Laramie Range have been largely eliminated. Occupied habitat within the BHSBLWG area is nearly evenly split between private and public ownership. Approximately 51% of the known leks are found on private land with the remaining 49% found on Forest Service, Bureau of Land Management, Bureau of Reclamation, and Wyoming State Trust lands.

Sage-grouse management data collected by the WGFD focuses on lek counts and surveys, harvest statistics, brood surveys, and analysis of wings collected from harvested birds. Lek counts and surveys have been conducted within the BHSBLWG area since the 1950s. Lek counts are conducted in April and early May as per WGFD protocol (WGFD 2010). Individual leks are counted 3 or more times at 7 – 10 day intervals. Lek counts are conducted to estimate population trend based on peak male attendance. Lek surveys are also conducted in the spring, but are typically conducted only one time per lek to determine general lek activity status (e.g., active, inactive, or unknown). Limited sage-grouse brood data is also collected during July and August. Brood counts provide some indication of chick production and survival, although their use is limited in estimating recruitment due to sampling design being neither systematic nor repeatable, with sample sizes typically being small. Where available, wing data from harvested sage-grouse provide a more reliable indicator of chick production and recruitment.

Past and current management of sage-grouse within the BHSBLWG area has focused mainly on the protection and/or enhancement of sagebrush habitats and protection of leks and nesting buffers from surface disturbing activities during the breeding/nesting season. Protection efforts have primarily occurred via controlled surface use or timing stipulations attached to state and federally permitted projects and through ongoing revision of BLM Resource Management Plans. Sage-grouse habitat protection has been increasingly important given the potential listing under the Endangered Species Act. As a result, the State of Wyoming adopted a core area management strategy through Governor's Sage Grouse Executive Order 2011-5. This strategy enhances protections to sage-grouse within delineated core areas, which were further refined in 2010 (version 3). Core areas have been delineated to encapsulate important sage-grouse habitats throughout Wyoming thereby increasing protections for the majority of sage-grouse occurring in the State. Protections applied to sage-grouse habitats outside of core areas are less stringent than those within core areas in an attempt to incentivize natural resource development outside of the best remaining sage-grouse habitats.

Most sage-grouse populations in Wyoming are hunted, though some portions of the state have been closed to sage-grouse hunting to protect small, isolated populations (i.e., in the southeast, northeast, and northwest portions of the state). Based on the Bates Hole/Shirley Basin Local Working Group's (BHSBLWG) Sage-grouse Conservation Plan, hunting seasons within sage-grouse populations having less than 100 males attending leks should be closed to prevent additive mortality on small, isolated populations (BHSBLWG 2007). Hunting seasons have therefore been closed in Niobrara, Platte,

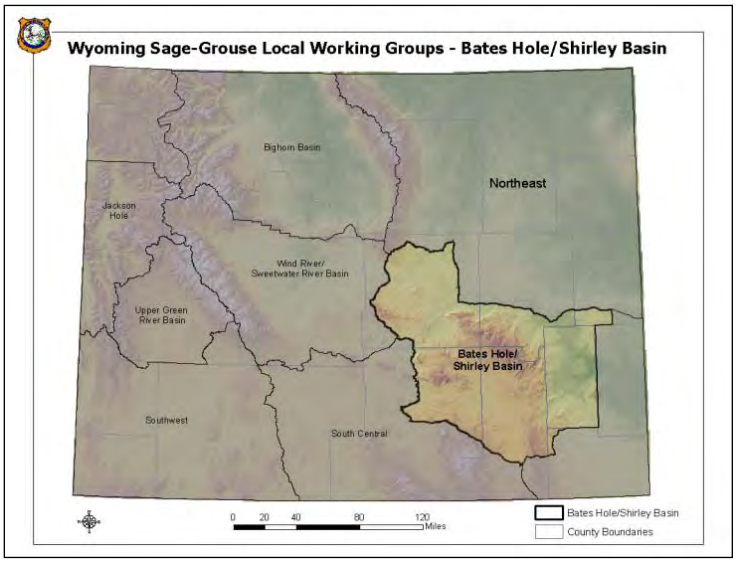
Goshen and Laramie Counties, and in the majority of Converse, Weston and Crook Counties. In addition, seasons were closed in the eastern portion of Natrona County including the Hat Six area southeast of Casper. Within these areas, sage-grouse populations occur in small, isolated patches of suitable habitat on the fringe of sage-grouse range. Within these small populations, harvest mortality is far more likely to be additive and potentially detrimental.

Historically, sage-grouse hunting seasons opened in early September. Research investigating the impacts of hunting on sage-grouse populations indicated a late September opening date had a decreased impact on hen survival, and may increase recruitment compared to an early September season (Braun and Beck 1996, Heath et al. 1997, Connelly et al. 2000). This is due to successful hens with broods being typcially more widely distributed across the landscape in later September, which decreases harvest pressure on the most successful segment of the population. In early September, hunters tend to disproportionately focus harvest pressure on successful hens with broods as they are relatively easy to locate, especially near water sources. Sage-grouse seasons within the BHSBLWG area currently span two or three weekends, opening in late September and closing in early October. From 1982 – 2001, bag and possession limits were 3 per day and 6 in possession. Since 2002, bag and possession limits have been reduced throughout the BHSBLWG area to 2 per day and 4 in possession.

Local Working Group Area

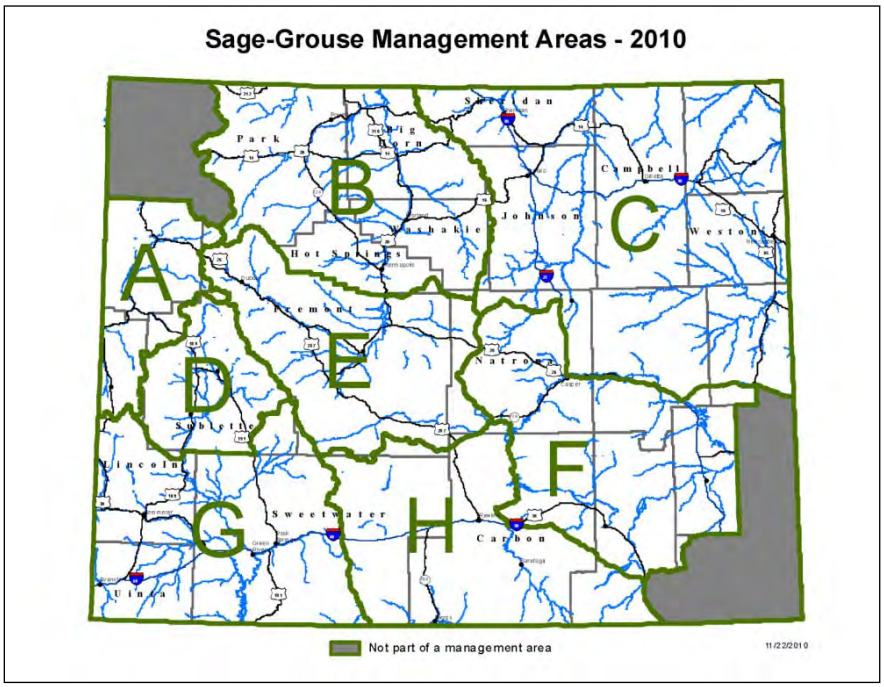
The BHSBLWG area includes Bates Hole, the Shirley Basin, the Rattlesnake Hills, the southern Bighorn Mountains, the Laramie Range, and isolated occupied habitats in southern Niobrara and Platte County (Figure 1). Political jurisdictions include Albany, Carbon, Converse, Laramie, Natrona, Niobrara, and Platte counties. This area is managed by the BLM (primarily the Casper and Rawlins Field Offices), the Bureau of Reclamation, the USDA Forest Service (Medicine Bow National Forest), the State of Wyoming, and private landowners. Major habitat types within the plan area include sagebrush/grassland, salt desert shrub, mixed mountain shrub, grasslands, mixed forests (conifers and aspen), agricultural crops, riparian corridors, and urban areas. Primary land uses within the BHSBLWG area include livestock grazing, wind energy development, oil and gas development, coal mining, and dry-land and irrigated crop production.

Figure 1. The Bates Hole/Shirley Basin Local Working Group Area.



For the reporting period, the BHSBLWG area encompasses WGFD Small/Upland Game Management Area F (Figure 2). Management areas do not correspond to sage-grouse population boundaries. Rather, management areas are used for general data collection (including harvest) and reporting for all small and upland game species. Sage-grouse are well distributed throughout most of the BHSBLWG area. Sage-grouse are largely absent from most of Platte County, some of the Laramie Plains, and higher elevation timbered areas in the Laramie Range and Shirley Mountains.

Figure 2. The Bates Hole/Shirley Basin Local Working Group area and WGFD sage-grouse management areas.



Leks and Lek Complexes

Sage-grouse, and therefore occupied leks, are well distributed throughout most of the BHSBLWG area (Figure 3). Much of the historic range in Platte County is no longer occupied due to large scale conversions of sagebrush grasslands to cultivated fields. The Wyoming Game and Fish Department summarizes lek monitoring data each year. As of spring 2012, there are 218 known occupied leks, 60 unoccupied leks, and 29 leks of an undetermined classification within the BHSBLWG area (Figure 4). Lek definitions are presented each year in the statewide Job Completion Report and as a standalone document available upon request (WGFD 2010). Fifty-six of the 60 unoccupied leks have been designated as being abandoned. Undoubtedly, there are leks within the BHSBLWG area that have not yet been identified, while other un-discovered leks have been abandoned or destroyed. The majority of leks classified as "undetermined" lack sufficient data to make a valid status determination. In these cases, historic data indicates these leks were viable at one point, with the leks subsequently being either abandoned or moved. However, location data is either generic or suspect in many of these cases, further confounding the ability to determine the status of these leks.

Figure 3. Sage-grouse lek distribution and core areas within the BHSBLWG area, 2012.

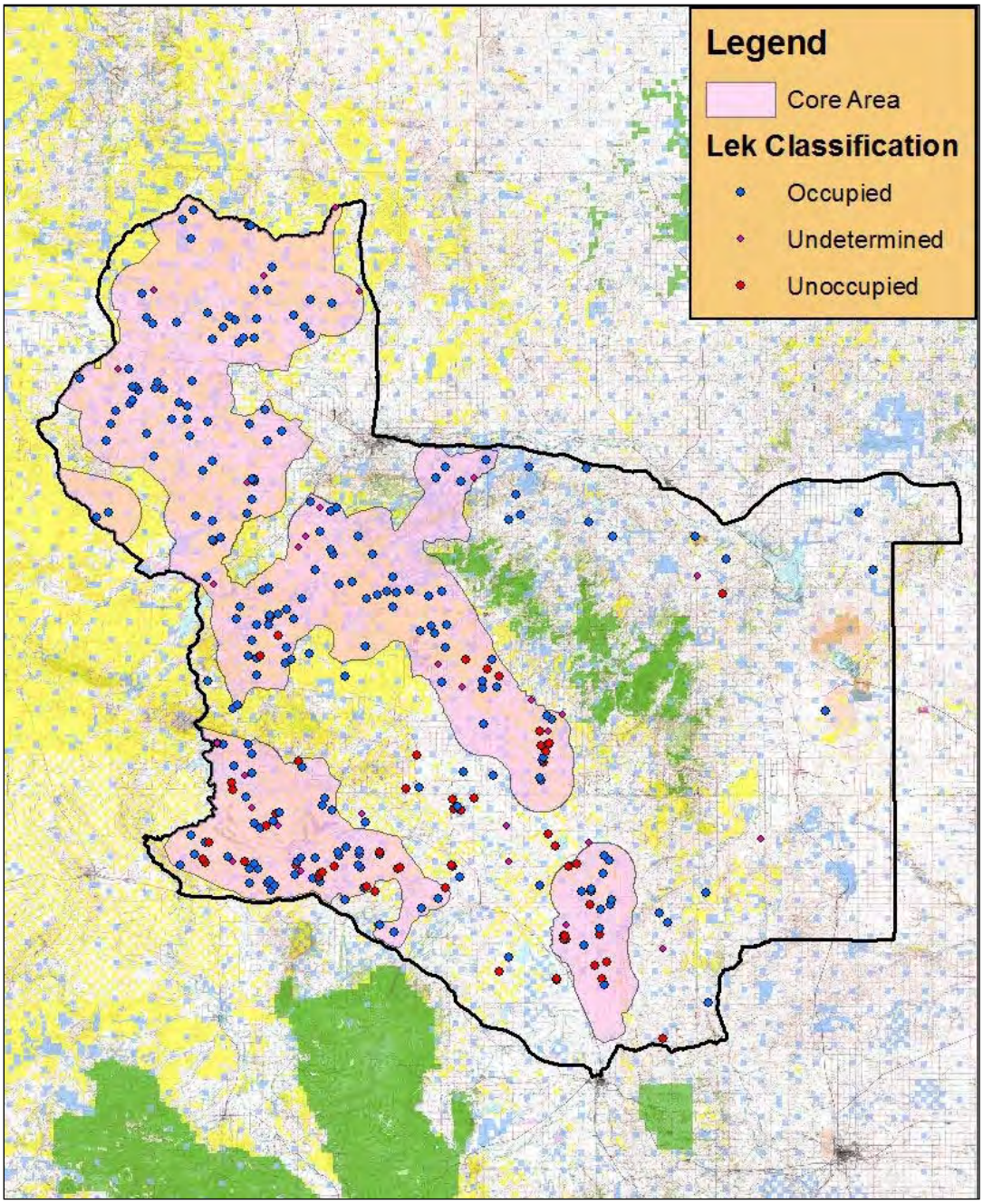


Figure 4. Sage-grouse lek demographics within the BHSBLWG area, 2012.

Sage Grouse Lek Characteristics

Working Group: Bates Hole

Region	Number	Percent
Casper	124	40.0
Lander	2	0.7
Laramie	181	59.3

Working Group	Number	Percent
Bates Hole	307	100.0

Classification	Number	Percent
Occupied	218	71.0
Undetermined	29	9.4
Unoccupied	60	19.6

BLM Office	Number	Percent
Casper	121	39.0
Lander	2	0.7
Newcastle	1	0.3
Rawlins	183	60.0

Biologist	Number	Percent
Casper	113	37.0
Douglas	9	3.0
Laramie	106	34.8
Rawlins	2	0.7
Saratoga	68	22.3
Wheatland	7	2.3

Warden	Number	Percent
	1	0.3
Cheyenne	2	0.7
Douglas	3	1.0
East Casper	36	11.8
East Rawlins	2	0.7
Elk Mountain	69	22.6
Glenrock	9	3.0
Lusk	1	0.3
Medicine Bow	67	22.0
North Laramie	38	12.5
West Casper	71	23.3
Wheatland	6	2.0

County	Number	Percent
Albany	72	23.6
Carbon	108	35.4
Converse	12	3.9
Laramie	3	1.0
Natrona	103	33.8
Niobrara	1	0.3
Platte	6	2.0

Land Status	Number	Percent
BLM	111	36.4
BLM/Private	2	0.7
BOR	1	0.3
Not Determined	2	0.7
Private	162	53.1
State	26	8.5
USF&WS	1	0.3

Management Area	Number	Percent
C	1	0.3
F	306	99.7

Lek Status	Number	Percent
Active	1	0.3
Unknown	306	99.7

Lek counts and lek surveys have been conducted within the area since the late 1950's, although historically on only a small number of leks. Since 1998, lek monitoring effort has expanded significantly, resulting in relatively consistent data sets over the last 15 years, enabling meaningful comparisons of current sage-grouse data to a running 10-year average. In 2012, personnel checked 176 known occupied and undetermined leks in the BHSBLWG area. A total of 77 leks were counted while 99 leks were surveyed. Of the leks checked where annual status was confirmed, 132 were active and 30 were inactive.

Habitat

There is little doubt sage-grouse habitat quality has declined over the past several decades throughout the BHSBLWG area. Increased human-caused disturbance (i.e., oil/gas, coal, uranium, and wind energy development), improper grazing by livestock and wildlife, sagebrush eradication programs, and long-term drought have all combined to negatively impact sage-grouse and their habitats. As the level of concern for sage-grouse and sagebrush ecosystems has risen, various habitat improvement projects have been planned and/or implemented throughout the BHSBLWG area. However, there is much debate among wildlife managers, habitat biologists, researchers, and rangeland specialists as to the efficacy of various forms of habitat treatments within sagebrush ecosystems. Given the long timeline required to reestablish sagebrush following treatment and the difficulty in measuring sage-grouse population level response to such treatments, habitat treatments designed to improve sagebrush ecosystem function should be conducted with extreme caution, especially in xeric sagebrush stands or in habitats containing isolated sage-grouse populations. Habitat treatments designed to improve sagebrush community health are detailed in Appendix I.

Population Trend

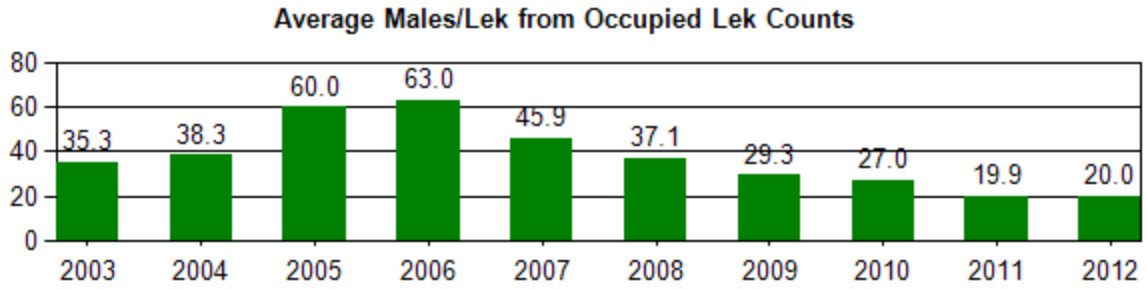
A new sage-grouse database was developed in 2012 in order to improve efficiency, reduce errors, and better facilitate data analysis. Changes were made to the manner in which lek data are calculated and reported in Table 1. The new version is based solely on "occupied" leks. The past version suggested that was the case in the title of Table 1, but when unoccupied leks were monitored those data were also included in the Table. The result of this change is that the number of "known occupied" leks is now more accurate, but reflects fewer leks than in the previous version. Similarly, the new version calculates average male lek attendance using only monitoring observations where one or more male grouse were observed strutting. The old version included a count of "0" males for leks where activity was confirmed by the presence of sign but no birds were observed. Together, these two changes result in somewhat higher, but more accurate, average male attendance for active leks than previously reported. The changes do not result in any change in population trend based on average male lek attendance. Interpreted population increases and decreases over time remain the same so no revisions to past reports are required.

Since only "occupied" leks are being reported on Table 1, it is important to consider trends in the numbers of active versus inactive leks in addition to the average size of active leks. During a period of population decline, the size of active leks typically declines and the number of inactive leks increases. The converse is typically true of an increasing population. Therefore the magnitude of both increases and decreases is usually greater than what is indicated by the average lek size alone. Average female lek attendance is not reported since our data collection technique is not designed to accurately capture these data and is therefore not useful in assessing population trend.

Monitoring male attendance on leks provides a reasonable index of sage-grouse population trend over time. Nevertheless, these data must be interpreted with caution as described in the Wyoming Greater Sage-grouse Conservation Plan (2003). Fluctuations in the number of grouse observed on leks over time are not exclusively a function of changing grouse numbers. These data also reflect changes in lek survey effort due to weather conditions dictating access to monitor leks. Over the last 10 years, the average number of males observed per ***count*** lek increased from the early 2000's to a zenith of 63 in 2006, but has since declined to 20 in 2012 (Figure 6). Male lek attendance has declined considerably from 2006 through 2012 as chick production and recruitment has been very poor over this time frame (see productivity discussion). The average number of males observed per ***count*** lek in 2012 is 47% below the previous 10-year average of 37.6, and was the lowest average recorded since intensive lek monitoring began in 1998 (along with that of 2011). Following a period of substantial growth from

2001 – 2006, sage-grouse populations have since declined by 68% from 2006 – 2012 based on the mean maximum number of males observed per counted lek.

Figure 6. Mean number of peak males per ***counted*** lek within the BHSBLWG area, 2003 – 2012.



Within the BHSBLWG area, 56 leks have been abandoned since the 1960's. The timing in which these leks were abandoned is usually difficult to determine due to gaps in data collection. Reasons for abandonment are unknown for many historic leks. It is unclear whether these leks have been abandoned due to natural sage-grouse population fluctuations over time or from anthropogenic disturbances such as natural resource development or poor grazing practices. Since 1998, many abandoned leks have been monitored, with no indication these leks have begun to be reoccupied. However, some of these leks may have never been legitimate leks, with one-time observations being recorded as leks. In addition, many of these leks have generic location-data, which further calls into question the veracity of the original lek designations. In cases where actual leks have been abandoned, such generic location-data makes (re)locating these leks much more difficult. Regardless, these leks should be maintained within the database until sufficient data has been collected to remove them as per WGFD lek monitoring protocol. Monitoring of abandoned/unoccupied leks has increased in recent years.

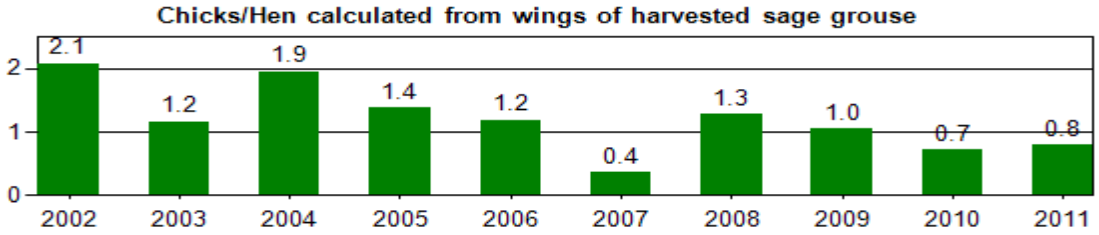
Productivity

Classifying wings based on sex and age from harvested sage-grouse provides a reasonable indicator of annual sage-grouse chick productivity. The sex and age composition of wings obtained from harvested birds is likely proportional to sex and age ratios available in the population. During fall hunting seasons, sage-grouse occur in mixed groups comprised of hens and chicks. Since hunting seasons open in late September, both barren and successful (with brood rearing) hens are typically found together. Therefore, harvest pressure is assumed to be equal across adult hens and chicks (of both sexes) as hunters do not typically differentiate between the two. Sampling bias is therefore assumed to be minimal (excluding mature males, which are typically under-harvested in proportion to the population due to some hunter selectivity) when calculating the chick:hen ratio. Summer brood surveys are also conducted, but do not provide as reliable an indicator of chick productivity given they are not conducted in a systematic and repeatable manner. In addition, many observations of sage-grouse occur along riparian areas during summer brood surveys, which may under-represent the number of barren hens occurring on uplands, thus biasing the actual chick:hen ratio. Therefore, brood survey data will not be discussed here.

Based on wing data, chick productivity was estimated to be 0.8 chicks per hen in 2011 (Figure 7). Over the last 10 years, wing-barrel estimated productivity has fluctuated between 0.4 and 2.1 chicks per hen. In general, chick/hen ratios of about 1.5:1 result in relatively stable lek counts the following

spring, while chick/hen ratios of 1.8:1 or greater result in subsequent increased lek attendance and ratios below 1.2:1 result in decline (WGFD 2007). The 2011 ratio marked the seventh consecutive year of moderate to poor chick production/survival (below 1.5 chicks/hen), resulting in population decrease. Such population decrease has been detected in the aforementioned lek attendance data. It is unknown whether the declining number of chicks observed in the harvest in recent years is due to poor nest success or chick survival, increased predation, deteriorating habitat conditions, or any combination thereof. The poor chick production/survival observed since 2007 may also be attributed to the colder and wetter springs prevailing since 2007, which may have led to increased nest abandonment/failure or poor early brood survival. Cold wet weather can be especially detrimental to sage-grouse hatchlings and juveniles during the first few weeks of life.

Figure 7. Sage-grouse productivity within the BHSBLWG area based on wing data analysis, 2002 – 2011.



Harvest

Hunter and harvest statistics provide insight into trends in wildlife populations. Typical of upland game bird populations, there is usually a direct correlation between sage-grouse population levels and hunter effort and harvest. As sage-grouse numbers decrease, hunter harvest generally declines. Conversely, when populations increase, sage-grouse hunting effort and harvest generally increases. Harvest data specific to the BHSBLWG area was obtainable starting in 1982. Prior to 1982, harvest data was recorded by county and not by the current small/upland game management areas. Since 1982, overall sage-grouse harvest has declined considerably within the BHSBLWG area (Figure 8). Harvest peaked in 1983 at 14,180 birds and subsequently declined to a low of 588 in 2002. In 2011, an estimated 1,117 sage-grouse were harvested within the BHSBLWG area. Over the last 10 years within the BHSBLWG area, trends observed in harvest data generally mirror those observed in male lek attendance from the spring (Figure 9). Over the same time frame, sage-grouse harvest declined considerably from 2000 – 2002, increased through 2005, and has generally declined over the last 6 years as sage-grouse populations have declined.

Figure 8. Total sage-grouse harvested per year within the BHSBLWG area, 1982 – 2011.

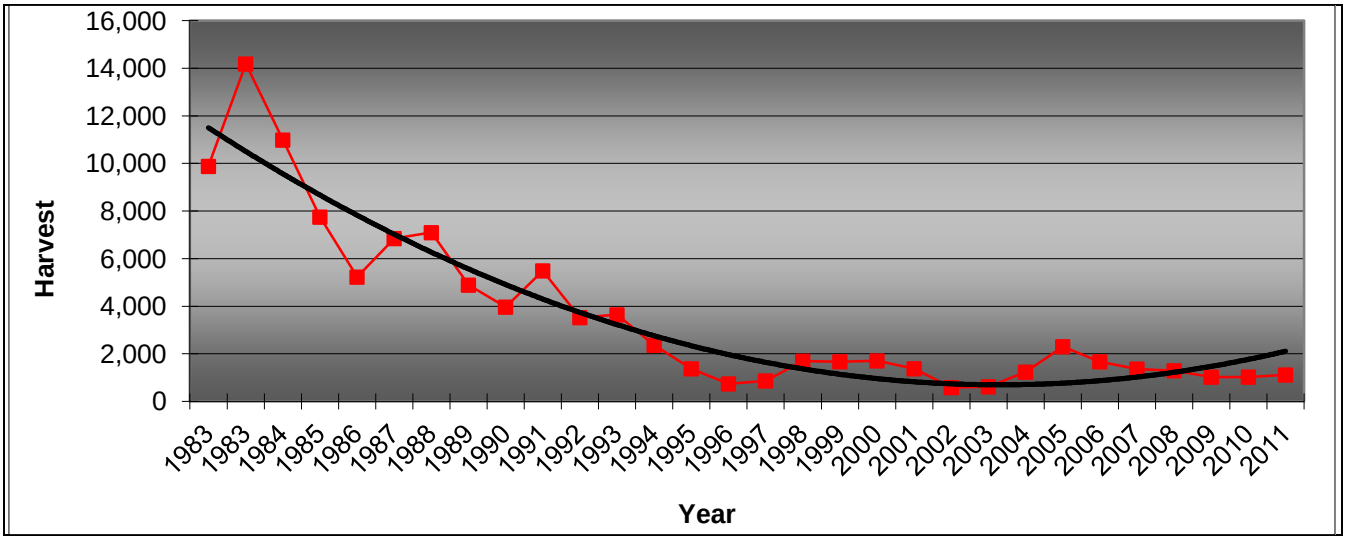
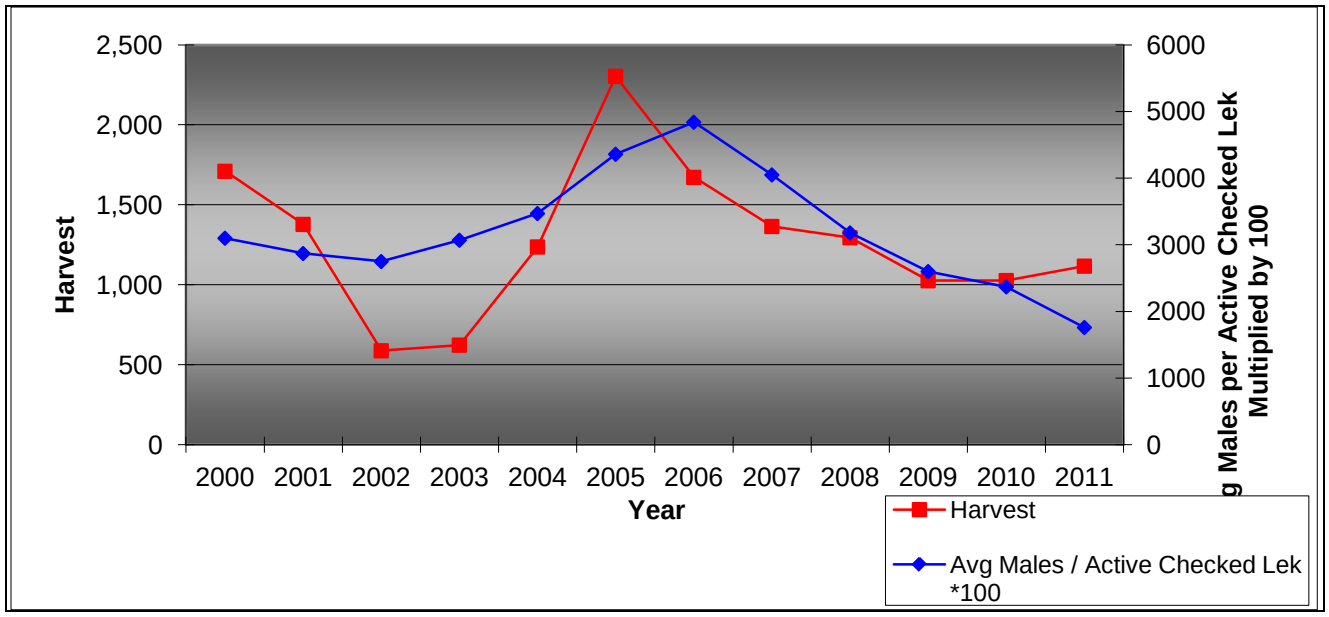


Figure 9. Total sage-grouse harvested per year and the average number of males per active lek checked within the BHSBLWG area, 2000 – 2011.

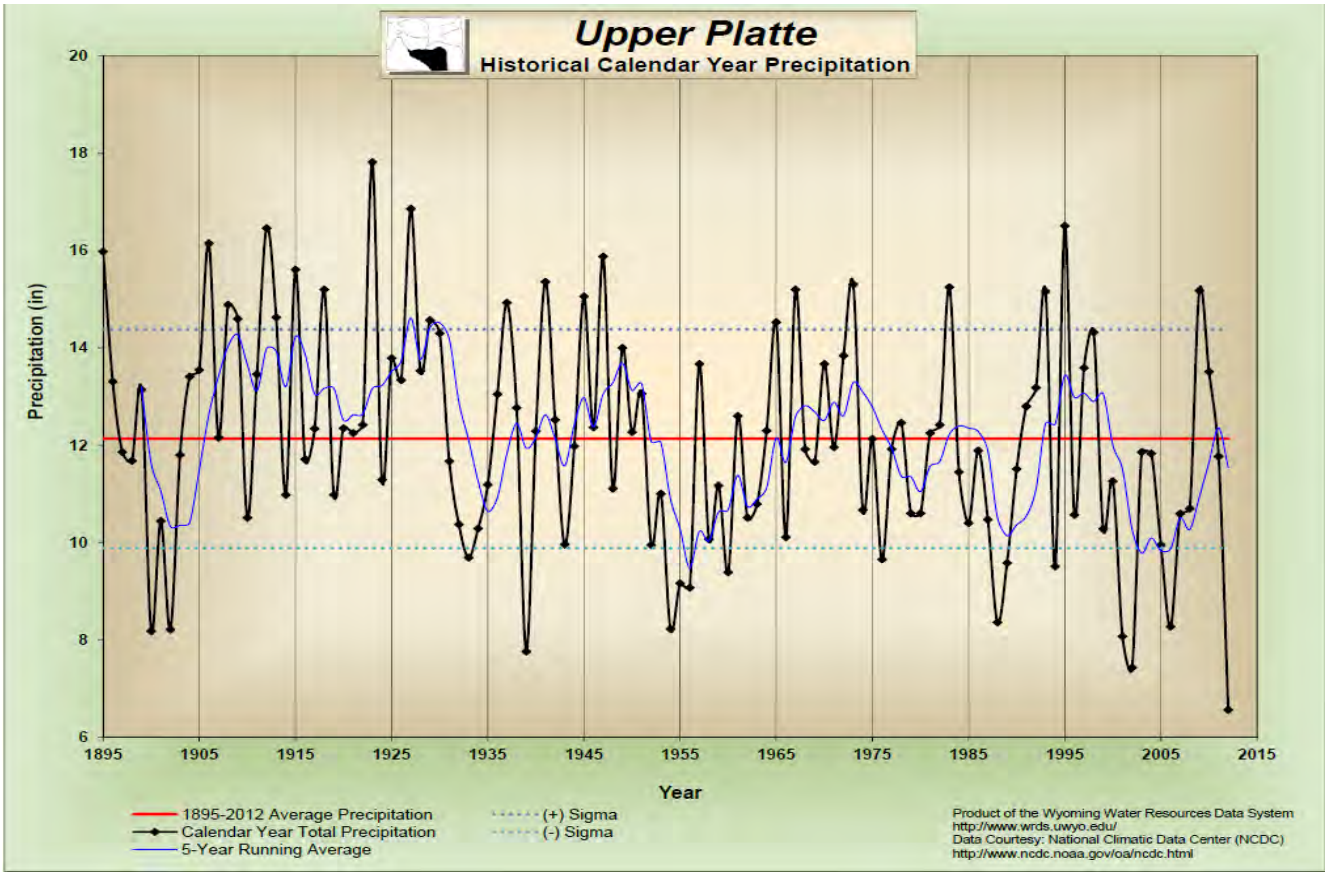


Hunter participation and harvest declined dramatically in Wyoming when the Wyoming Game and Fish Commission reduced the bag limit and shortened the hunting season in 2002 (WGFD 2008). A similar reduction occurred in 1995 when the season was moved later into September. This decline occurred in spite of a concurrent population increase (based on males/lek), demonstrating the effects increasingly conservative hunting seasons have had on hunter participation in recent years. Managers are unable to quantify population response to changes in harvest levels within the BHSBLWG area. Research suggests harvest pressure can be an additive source of mortality within small isolated sage-grouse populations, but is generally compensatory at levels under 11% of the preseason population (Braun and Beck 1985, Connelly et al. 2000, Sedinger et al. 2010).

Weather

Based on the data obtained from the Wyoming State Climate Office, the Upper North Platte climatic division experienced wetter than normal conditions during the 2011 growing season and then exceptionally dry conditions during 2012 (Figure 13). This resulted in excellent sagebrush leader growth and substantial herbaceous vegetation production in 2011. As a result, nesting cover was excellent in 2011 (as 2010 also experienced relatively good spring precipitation) with substantial residual grass cover remaining for nesting cover. In addition, forb production was relatively high in 2011, which likely benefitted sage-grouse from an herbaceous and insect foraging standpoint. However, despite the good spring moisture received in 2011, cold wet conditions prevailed during the nesting and early brood rearing periods, which may have caused elevated nest failure and abandonment and/or poor survival of newly hatched chicks during the early brood rearing phase. This may have been the primary driver behind the poor chick recruitment observed in the wing barrel data. Regardless, spring moisture is generally considered to benefit sage-grouse and sagebrush habitats in the long term far more than any deleterious effects of cold wet weather within any one singular year. It is unknown whether the population fluctuations over the last 10 years (increase through 2006 followed by subsequent decline) are a function of prevailing weather conditions or due to the cyclical nature of sage-grouse populations. The winter and early spring months of 2012 prior to the breeding season were exceptionally dry, which resulted in exceptionally poor grass and forb production and may result in decreased nesting success and/or chick survival in 2012.

Figure 13. 2012 Water Year for the Upper North Platte drainage, Wyoming Climate Division 5 (http://www.wrds.uwyo.edu/sco/data/divisional_precip/divisional_precip.html)



Special Studies

Western EcoSystems Technology, Inc. has provided progress reports to Horizon Wind Energy for The Greater Sage-Grouse Telemetry Study for the Simpson Ridge Wind Energy Project, Carbon County, Wyoming. This report was not provided within this document, but may be available upon request from the project proponent. In summary, the consulting firm was hired to conduct a long-term research project to evaluate the impacts to sage-grouse from wind energy development within a defined core area. A technical committee was assembled to define research methodology and objectives. The committee included representation from state and federal agencies as well as reputable sage-grouse researchers. This research was partially funded from local sage-grouse working group funds. Field work was initiated in 2009 and will continue through 2014 or 2015 contingent upon funding.

Diseases

West Nile Virus (WNV) was not detected in any sage-grouse within the BHSBLWG area during the reporting period. One confirmed case of WNV in sage-grouse within the BHSBLWG area was found in Carbon County from a dead radio-marked bird during the summer of 2012. The extent of WNV infection and its effects on sage-grouse populations throughout the BHSBLWG area in recent years is unknown, but potentially significant. However, no data exists to indicate recent declines in the BHSBLWG area sage-grouse population can be specifically attributed to WNV.

Recommendations

1. Revise the Bates Hole/Shirley Basin LWG Conservation Plan, which was approved by the Wyoming Game and Fish Commission in February of 2007. An addendum to the plan reflecting current state and federal regulatory policy (i.e. Governor's Executive Order (2011-5) and BLM Resource Management Plan revisions) and USFWS review will be completed in 2013.

2. Continue efforts to document seasonal habitat use throughout the BHSBLWG area, with emphasis on nesting, early-brood rearing, and winter habitats.

3. The BHSBLWG should continue to solicit conservation projects that will benefit sage-grouse. These include but are not limited to projects designed to enhance sagebrush understory herbaceous vegetation production, riparian corridor protection, wind energy related research, water development, livestock grazing management planning, etc.

4. Ensure monitoring of all count leks is conducted properly and consistently as per WGFD protocol on an annual basis (WGFD 2010). In addition, maximize overall lek monitoring efforts (including lek surveys) each year to ensure lek sample sizes are significant enough to adequately detect population change.

5. If possible, attempt to survey all leks each year while maintaining counts on all designated count leks. Encourage the public, volunteers, and especially landowners to report lek activity and assist with lek surveys and counts. Continue to monitor inactive or unoccupied leks to adjust classification status as appropriate.

6. Continue to update and refine UTM coordinates (using NAD83) of leks and map lek perimeters where needed.

7. Continue to inventory abandoned leks to see if any are appropriate for removal from the database based on appropriate criteria. Most abandoned leks within the BHSBLWG area occur within the Laramie WGFD Region.

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Appendix I. Conservation Projects within the BHSBLWG area funded through the Wyoming Governor's Sage-grouse Conservation Fund, 2011.

1) The BHSBLWG allocated $26,000 to a WGFD-led project to chemically treat 7,243 acres of cheatgrass-infested big sagebrush communities in the Bates Hole area. Much of the treated area was in sage-grouse core area.

2) The BHSBLWG allocated $50,000 to a BLM (Casper Field Office) led project to chemically treat cheatgrass infestations and allow for the recovery of sagebrush within the Henderson Draw fire area. Treatments involved chemical applications of up to 8 oz. per acre of imazapic, also known by the trade name Plateau®. All chemical applications were made in accordance to label instructions and the treatment specifications outlined in the Cheatgrass Treatments for Natrona and Converse Counties EA (2011). Additional vegetative treatments will be pursued in future years for the remainder of the cheatgrass infested burned area depending on funding availability.

   The treatment was intended to improve sagebrush grassland habitat, and therefore sage-grouse fitness, for populations occurring in the project vicinity. Reducing the threat of fire in sagebrush communities and improving the overall health of native plant communities is beneficial to sage-grouse and big-game alike. As WAFWA (2009a) concluded in a White Paper recently: "Xeric sagebrush communities, largely made up of Wyoming big sagebrush, are not adapted to fire and are characterized as having a high severity fire regime. Natural fire rotation in these settings appears to be measured in centuries not decades. Invading species such as cheatgrass have further raised the stakes for permanent vegetation type conversion from sagebrush stands to exotic annual grass/forb communities as a result of fire, particularly where understory herbs are already depressed."

3) The BHSBLWG allocated $10,000 to help fund the Audubon Wyoming Community Naturalist program was created to fulfill the educational needs of Wyoming schools and communities. Audubon Wyoming Community Naturalists' have developed the Sagebrush Traveling Trunk Program, which reaches out to youth in rural Wyoming, to educate them about science and the sagebrush habitat utilizing in-school instruction, field trips, summer camps and community presentations; and followed by continued and secondary participation with teacher training workshops, an interactive website and use of teacher "sagebrush trunks" for specific lesson plans. Aligned with the schools state standards and guidelines, The Sagebrush Traveling Trunk is a free resource for the teachers, containing lesson plans, materials, books, and props to effectively engage students while learning about the sagebrush ecosystem and why it's important to a wide variety of Wyoming wildlife.

   Included in the trunk is a unique sagebrush poster, developed by the Community Naturalists; that enable students to discover the plants and animals of the sagebrush ecosystem. These educational tools allow students to draw parallels between habitats, learn what animals need to survive, and their place in the food web. Teachers can assess the effectiveness of using the materials with pre and post program activities designed to evaluate the knowledge gained. The trunks can be "checked-out" and used by the teacher in the classroom or the Community Naturalists also can come into the schools and teach the appropriate program themselves. Audubon has successfully integrated into most of the schools in Wyoming through many years of hard work, developing programs such as the sagebrush traveling trunks that teach students and adults about the wildlife

and wildlands that surround them Due to our excellent education programs (see attachment of national education awards received in 2010 and 2011), the Community Naturalist Program has grown drastically over the past few years and demand for the programs is now stretching our ability to support such a demand.

In addition, each year, Audubon Wyoming Community Naturalists train fifty pre-service elementary teachers in science/environmental education workshops. Using Project Learning Tree (PLT) curricula, as well as our sagebrush curricula, the teachers leave the workshop with interdisciplinary lessons that help them to incorporate science/environmental education in their classroom.

Program goals included increased outreach to schools and community groups in the Natrona, Carbon, Converse, Niobrara Albany and Laramie Counties and continuing to advance outdoor science and nature education in Wyoming. Measurable goals and benefits include: Increasing outreach to schools and community groups with creation of new Sagebrush traveling trunks; and advancing environmental education in Wyoming, including development of a new Environmental Education certification program for teachers.

4) The BHSBLWG and South-Central working groups allocated $85,000 to further the research designed to assess the short-term effects of a wind energy development on greater sage-grouse seasonal habitat selection and demography. This study represents the only situation in the U.S. where preliminary reactions of sage-grouse populations to the infrastructure associated with a wind energy development can be effectively established within the next decade.

   The research project is designed as a controlled post-construction study. Data collected during the first 3 years of this study have documented seasonal use of habitats near wind turbines, thus the risk associated with this study design that displacement from infrastructure prior to the initiation of the study eliminated a distance gradient is not a concern. The researchers submitting this proposal requested partial funding from the Wyoming Sage-Grouse Conservation Fund to assist accomplishing the study.

5) The BHSBLWG, Wind River/Sweetwater, Southwest, Northeast, Upper Green River Basin, and South-Central working groups allocated $189,800 to determine sage-grouse demographic and habitat use response to a variety of sagebrush treatments including prescribed fire, mechanical treatments, and chemical treatments.

6) The BHSBLWG, Wind River/Sweetwater, Southwest, Northeast, Upper Green River Basin, and South-Central working groups allocated $49,335 to the University of California-Davis for research to develop a noise model and determine noise exposure thresholds for behavioral responses of sage-grouse on leks.

Narrative Report

Species: **Sage-grouse**
Region: **Cody**
Management area: **B**

Period covered: **6/1/2011 – 5/31/2012**
Local Working Group: **Big Horn Basin**
Prepared by: **Tom Easterly**

INTRODUCTION

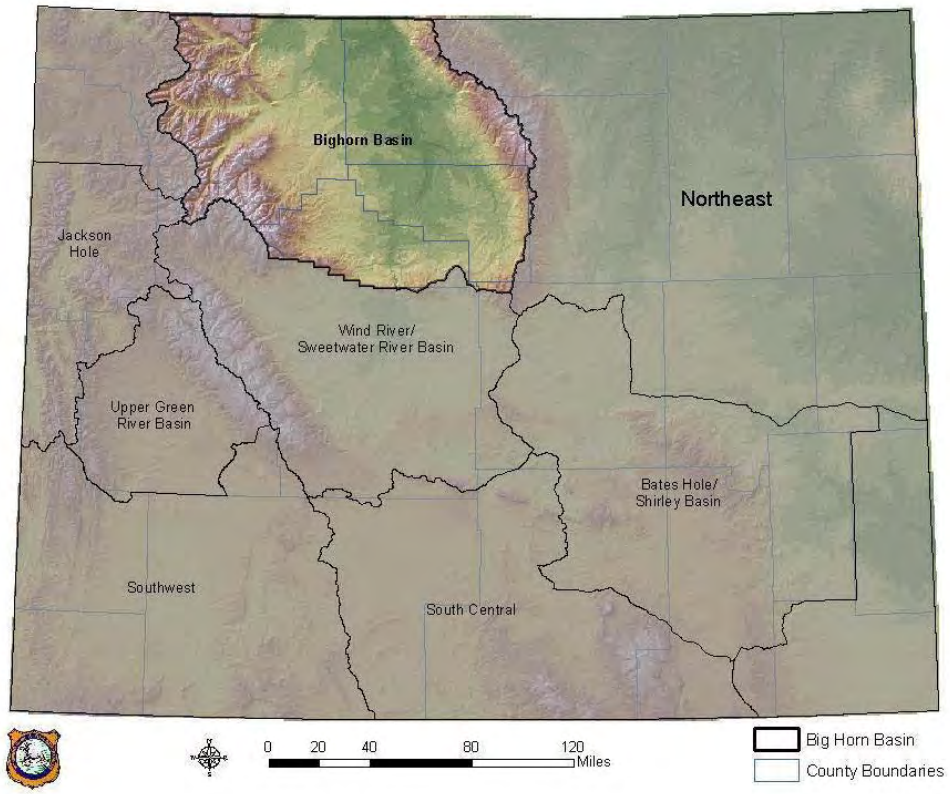
During the late 1990s, concerns increased over degradation and fragmentation of sagebrush ecosystems and declines in greater sage-grouse (*Centrocerucus urophasianus,* hereafter referred to as sage-grouse) populations. Wyoming Game & Fish Department (WGFD) increased monitoring efforts for sage-grouse across the state. An internal working group was established in 1997. A state-wide citizens working group consisting of representatives from government agencies (state and federal), agriculture, extractive industries, environmental groups, hunting groups, and Native American tribal interests was formed in 2000. This citizens' group produced the **Wyoming Greater Sage-grouse Conservation Plan,** which was approved and adopted by the WGF Commission in 2003. The Plan called for creation of local working groups (LWG) to formulate strategies on a local level to address sage-grouse conservation; eight local working groups were formed (Fig. 1).

Similar to the state-wide working group, the Big Horn Basin LWG (BHBLWG), in north-central Wyoming, consists of representatives from agriculture, mining, oil/gas production, conservation and hunting interests, a citizen at-large, local (county) government, Bureau of Land Management (BLM), Natural Resources Conservation Service (NRCS), and WGFD. A representative from local Conservation Districts was added later. BHBLWG produced the **Sage-grouse Conservation Plan for the Big Horn Basin, Wyoming** in 2007. This plan is available under "Final Local Conservation Plans" at: http://wgfd.wyo.gov/web2011/wildlife-1000817.aspx.

Between 1999 and 2003, seven petitions were filed to list the greater sage-grouse for protection under the Endangered Species Act. On March 5, 2010, after judicial and other extended reviews of its decisions, the U.S. Fish and Wildlife Service (USFWS) re-issued its decision of "warranted but precluded" for listing greater sage-grouse as threatened or endangered under the Endangered Species Act. This means sage-grouse have become a "candidate" for listing but are precluded from immediate listing due to higher priorities. This status is to be reviewed by the USFWS again in 2015.

This annual report summarizes conservation efforts and data collected on sage-grouse in the Big Horn Basin during the 2011 biological year (1 June 2011–31 May 2012), including the 2012 breeding season (lek surveys).

Figure 1. State of Wyoming sage-grouse conservation areas, highlighting the Big Horn Basin conservation area.



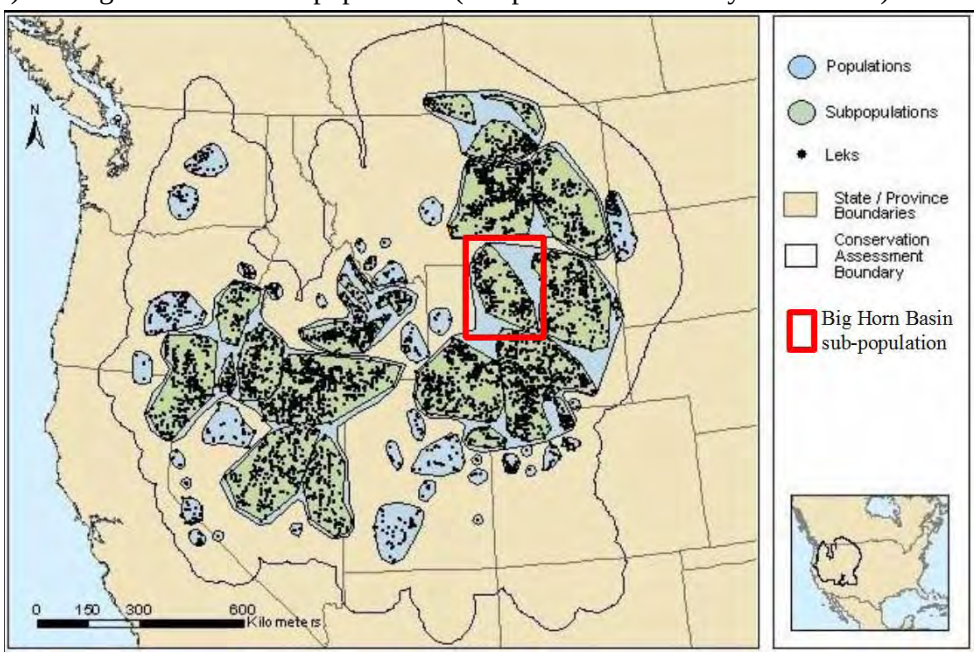
STUDY AREA

The Big Horn Basin Conservation Area (Basin) encompasses over 12,300 square miles and is subdivided into various ownership patterns and political jurisdictions. The Basin is mostly public land managed by the BLM (40%), Forest Service (25%), State "school lands" (5%), or other government agencies (>1%; Bureau of Reclamation, National Park Service, Department of Defense). Over 3,100 square miles of the Basin are private land (25%). Counties within the Basin include Big Horn, Hot Springs, Park, and Washakie. WGFD divided the state into management areas for data collection and reporting of small and upland game species. In 2010, new management areas were created for sage-grouse management that correspond with conservation areas (as mapped in Fig. 1); the Big Horn Basin is Area B. Primary land uses in the Basin include: livestock grazing, farming, oil and gas development, bentonite mining, urban and suburban developments, recreation and wildlife habitat.

Habitats within the Basin are diverse and vary depending upon such factors as soil type, annual precipitation and elevation. Major habitat types within the Basin include: sagebrush/grassland, salt desert shrub, agricultural crops and pasture lands, cottonwood-riparian corridors, mixed mountain shrub, and at higher elevations mixed conifer forests with interspersed aspen stands.

Connelly et al. (2004) recognized sage-grouse in the Big Horn Basin as a distinct sub-population (Fig 2). Mountain ranges to the east and west restrict most sage-grouse movement due to unsuitable habitat types. Grouse movements in the north and southeast portions of the Basin have not been well documented. There are several leks on both sides of the Wyoming-Montana state line, and movement between states is likely. Suitable habitat on Copper Mountain, the Owl Creek Mountains and the southern Bighorn Mountains serve as travel corridors to other areas where sage-grouse populations occur (e.g., the South Fork of the Powder River Basin).

Figure 2. Discrete populations and subpopulations of sage-grouse in western North America, highlighting (red rectangle) the Big Horn Basin sub-population. (Adapted from Connelly et. al. 2004).



As of spring 2012, there were 289 known sage-grouse leks in the conservation area; 141 of which are known to be active. Thirty-five lek sites were unoccupied (abandoned, destroyed or inactive); four of which were abandoned due to destruction of the lek site. Several leks classified as "Unknown" need additional observations before being reclassified as occupied or unoccupied. Four new strutting sites were located during the 2012 breeding season. A majority of leks (69%) occur on BLM managed land and 23% of known leks occur on private land (Table 1). There are probably other leks within the Basin that have not been discovered.

Table 1. Classification of leks in the Big Horn Basin based on activity, ownership and various geopolitical boundaries, 2012.

County	Number	Percent
Big Horn	45	15.6
Hot Springs	47	16.3
Park	98	33.9
Washakie	99	34.3

BLM Office	Number	Percent
Cody	104	36.0
Worland	185	64.0

Biologist	Number	Percent
Cody	78	27.0
Greybull	48	16.6
Worland	163	56.4

Lek Status	Number	Percent
Abandoned	26	9.0
Active	141	48.8
Destroyed	4	1.4
Inactive	5	1.7
Unknown	113	39.1

Land Status	Number	Percent
BLM	198	68.5
BOR	1	0.3
Private	67	23.2
State	22	7.6
Undetermined	1	0.3

Warden	Number	Percent
Greybull	29	10.0
Lovell	17	5.9
Meeteetse	36	12.5
North Cody	22	7.6
Powell	16	5.5
South Cody	18	6.2
Tensleep	46	15.9
Thermopolis	39	13.5
Worland	66	22.8

Classification	Number	Percent
Occupied	247	85.5
Undetermined	3	1.0
Unoccupied	39	13.5

METHODS

Since 1998, data on numbers of sage-grouse attending leks were collected in two ways: lek surveys or lek counts. Lek surveys were defined as at least one visit to a lek during the breeding season (mid March-mid May) to determine if the lek was active. Lek counts consisted of three or more visits to a lek (separated by about 7-10 days) during the peak of strutting activity (early April-early May) to document the maximum number of males in attendance. Some leks in the Basin have been surveyed since the late 1950's-early 1960s.

Brood surveys were conducted during July and August. No consistent methodology has been established for brood surveys, but usually consisted of an observer walking or driving in areas thought to be occupied by sage-grouse. Data on the number of chicks, adult hens, and adult males were collected. Locations (UTM coordinates) and habitat type were also recorded to help delineate brood rearing areas.

Harvest information was obtained through a mail questionnaire of bird hunters. Hunters were requested to provide data on number of birds harvested, days hunted, and areas hunted. Data obtained through hunter surveys had been compiled by county prior to 1982. From 1982 to 2009, data were compiled and reported by small and upland game management area. The Big Horn Basin was divided into nine management areas. Beginning in 2010, sage-grouse management areas were consolidated to correspond with conservation areas (Fig. 1). The entire Big Horn Basin is sage-grouse Management Area B.

Surveys were conducted during December through early February to delineate winter distribution and identify important habitats. Winter surveys consisted of driving or flying across areas that contain sufficient sagebrush above snow to provide cover and forage. Observers recorded location, grouse numbers, habitat type, aspect, slope, and approximate snow depth.

RESULTS AND DISCUSSION

Lek monitoring. A new sage-grouse database was developed in 2012 to improve efficiency and better facilitate data analysis. Changes were made to the manner in which lek data are calculated and reported. The revision was based definition of on "occupied" leks. The past version suggested that was also the case, but when unoccupied leks were monitored those data (zero males) were also included in the calculation of average males per lek. The result of this change is that the number of "known occupied" leks is now more accurate, but reflects fewer leks than in the previous version. Similarly, the new version calculates average male lek attendance using only monitoring observations where one or more male grouse were observed strutting. The old version also included a count of zero males for leks where activity was confirmed by the presence of sign but no birds were observed. Together, these two changes result in somewhat higher, but more accurate, average male attendance for active leks than previously reported. The changes do not result in any change in population trend based on average male lek attendance. Interpreted population increases and decreases over time remain the same so no revisions to past reports are required.

Since only "occupied" leks are being reported, it is important to consider trends in the numbers of active versus inactive leks in addition to the average size of active leks. During a period of population decline, the size of active leks typically declines and the number of inactive leks increases. The converse is typically true of an increasing population. Therefore, the magnitude

of both increases and decreases is usually greater than what is indicated by the average lek size alone.

Average female lek attendance is no longer being reported since data collection techniques are not designed to accurately capture these data; therefore, data on hens per lek is not a useful figure in assessing population trend.

The number of male sage-grouse observed at leks in the Big Horn Basin declined for the third consecutive year (Table 2, Fig. 3). Average male attendance was calculated using only active leks (those leks where one or more males were present). In spring 2012, 76% of known, occupied leks in the Big Horn Basin were visited for an average of 11.6 males per lek. Fifty-one leks were observed following count protocols (2002-11 average=72 leks) and 137 leks were surveyed (at least one visit; 2002-11 average=100). The average number of males observed at count leks (16.6 in 2012) is typically higher than survey leks (8.8 in 2012); however, long-term data sets indicate similar trends in both counts and surveys (Fedy and Aldridge 2011; Fig. 3). Count leks are typically larger and attended more consistently, while survey leks usually have fewer males. Since observers visit survey leks less frequently, it is likely that "peak" male attendance was not documented at those sites.

Declines in average male attendance at leks observed during the past few years may be natural fluctuations in sage-grouse population cycles. Sage-grouse populations, in the Basin and elsewhere, cycle on an approximate 7 to 10-year interval (Fig. 4). During the previous low in the population cycle (2002), 12 males per lek on average were observed at Big Horn Basin leks. The lowest level observed was 9.4 males/lek in 1995. Peak male attendance was 26.1 males/lek in 2006.

Over the past 50 years (1960-present), an increasing number of leks have been checked each year. Data between 1960 and 1980 are based on few leks being visited ($\leq$25 leks in 14 of 20 years; <50 leks in 19 of 20 years), so average number of males observed per lek may not be accurate. The decreasing trend in average male attendance at leks prior to 1980 may be an artifact of data collection efforts (Fig 4); however, anecdotal accounts of sage-grouse numbers do suggest dramatic declines during that period. Small sample sizes probably also account for the wide year-to-year fluctuations in average male attendance seen between 1960 and 1980.

Figure 4. Trends in average male attendance at sage-grouse leks in the Big Horn Basin, 1960-2012. Trend line (red) represents 5-year running average.

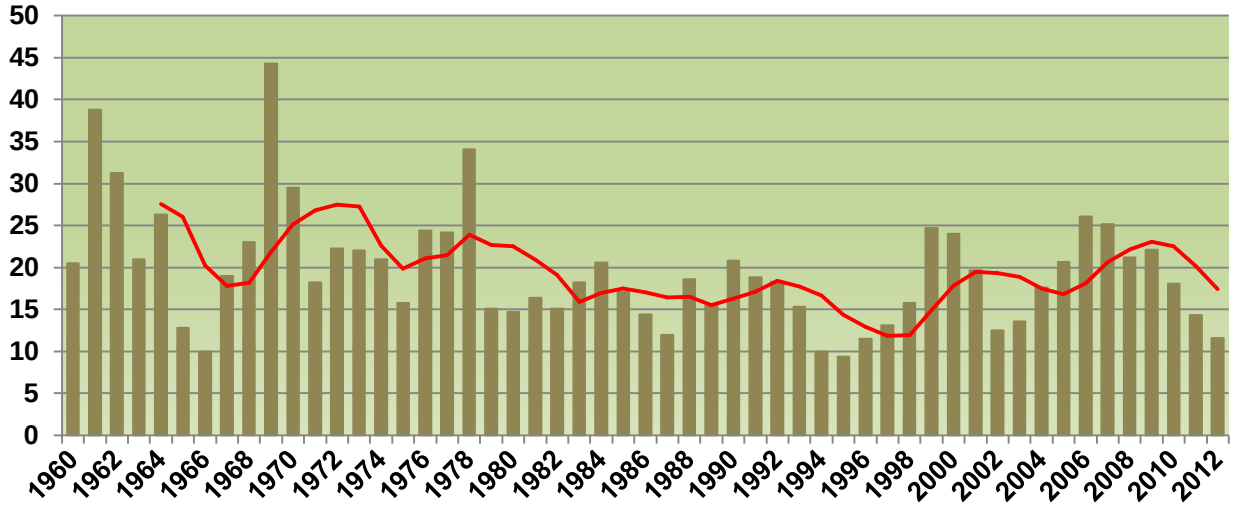


Table 2 (a-d). Lek attendance summary of occupied leks[1] in the Big Horn Basin, 2003-2012.

a. Leks Counted

Year	Occupied	Counted	Percent Counted	Peak Males	Avg Males / Active Lek[2]
2003	191	66	35	1047	16.9
2004	194	61	31	1140	21.1
2005	193	85	44	1757	23.1
2006	203	64	32	1694	28.7
2007	205	72	35	1901	28.4
2008	218	96	44	2083	24.8
2009	219	74	34	1717	25.6
2010	223	74	33	1495	21.7
2011	229	64	28	905	16.2
2012	231	51	22	798	16.6

b. Leks Surveyed

Year	Occupied	Surveyed	Percent Surveyed	Peak Males	Avg Males / Active Lek[2]
2003	191	80	42	651	10.3
2004	194	83	43	966	14.6
2005	193	79	41	1230	18.1
2006	203	97	48	1753	24.0
2007	205	82	40	1550	22.1
2008	218	79	36	1121	16.7
2009	219	95	43	1244	18.6
2010	223	108	48	1242	15.1
2011	229	118	52	972	13.0
2012	231	125	54	764	8.8

c. Leks Checked

Year	Occupied	Checked	Percent Checked	Peak Males	Avg Males / Active Lek[2]
2003	191	146	76	1698	13.6
2004	194	144	74	2106	17.6
2005	193	164	85	2987	20.7
2006	203	161	79	3447	26.1
2007	205	154	75	3451	25.2
2008	218	175	80	3204	21.2
2009	219	169	77	2961	22.1
2010	223	182	82	2737	18.1
2011	229	182	79	1877	14.3
2012	231	176	76	1562	11.6

d. Lek Status

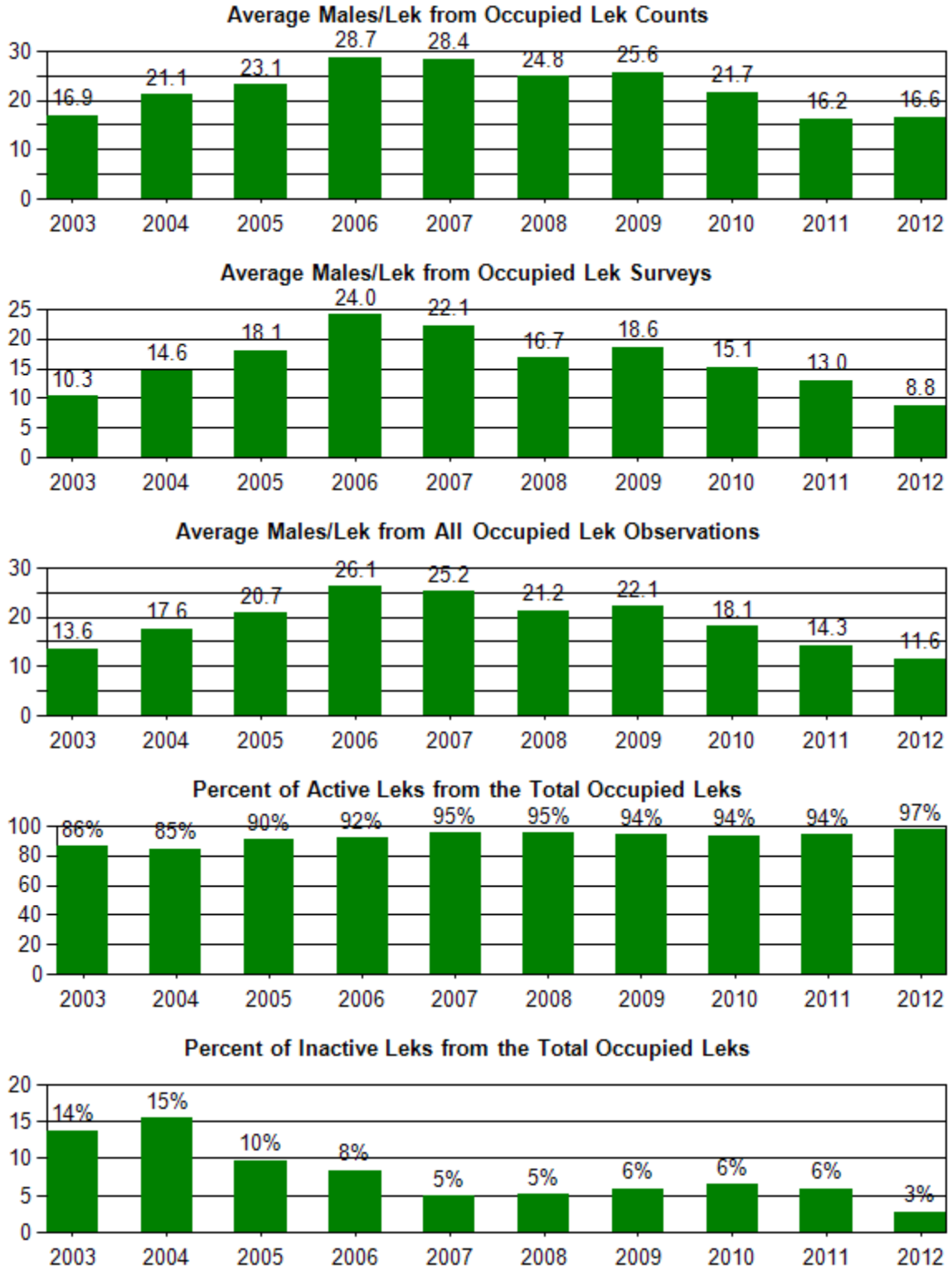
Year	Active	Inactive[3]	Unknown	Known Status	Percent Active	Percent Inactive
2003	119	19	53	138	86.2	13.8
2004	115	21	58	136	84.6	15.4
2005	140	15	38	155	90.3	9.7
2006	131	12	60	143	91.6	8.4
2007	136	7	62	143	95.1	4.9
2008	148	8	62	156	94.9	5.1
2009	128	8	83	136	94.1	5.9
2010	144	10	69	154	93.5	6.5
2011	128	8	93	136	94.1	5.9
2012	143	4	84	147	97.3	2.7

[1] Occupied - Active during previous 10 years (see official definitions).

[2] Avg Males/Active Lek – Includes ony those leks where one or more strutting males were observed. Does not include "Active" leks where only sign was documented.

[3] Inactive – Confirmed no birds or sign present (see official definitions).

Figure 3. Number of male sage-grouse observed per lek in the Big Horn Basin Conservation Area, 2002-12.



Brood surveys. Surveys for sage-grouse are conducted during July and August each year to document brood sizes and brood-rearing habitats. Most survey work is done in conjunction with other activities and no survey routes have been established. All sage-grouse observations by WGFD personnel were entered into the Department's Wildlife Observation System. WGFD personnel coded only 37 hours (including travel time to and from possible brood-rearing areas) to sage-grouse (species code CT) brood surveys (activity code 512) in 2011. Only ten observations of sage-grouse were documented during summer 2011 (Table 3). None of those observations included sightings of juvenile grouse. A direct connection between effort (time spent surveying for broods) and number of broods observed was discussed in previous annual reports.

Table 3. Brood survey data collected by Wyoming Game & Fish Department personnel in the Big Horn Basin, 2001-11.

Year	Groups observed	Broods	Chicks	Hens	Chicks/ brood	Chicks/ hen
2001	22	14	51	24	3.6	2.1
2002	12	10	35	16	3.5	2.2
2003	22	24	103	30	4.3	3.4
2004	14	17	71	73	4.2	1.0
2005	27	23	123	41	5.3	3.0
2006	23	24	99	38	4.1	2.6
2007	57	56	191	99	3.4	1.9
2008	24	18	88	29	4.6	3.0
2009	24	26	104	33	4.0	3.2
2010	23	17	64	17	3.8	3.8
2011	10	0	0	18	0	0
2001-10 average	25	23	93	40	4.0	2.3

Analysis of wings from harvested grouse was used to estimate chick production in other portions of Wyoming. An insufficient number of wings have been collected from around the Big Horn Basin in past years, thus this technique was discontinued here.

Hunting season and harvest. Beginning in 1995, the opening day of sage-grouse season was moved from 1 September to the third Saturday in September. Research suggested that hens and broods were more dispersed and less vulnerable to hunting with the later opening date. Between 1982-94, hunting seasons averaged 25 days long (range 16-31 days) and between 1995-2001 the season was open for approximately 15 days. Due to concerns over low populations, in 2002 the hunting season was again shortened and the daily bag limit decreased from three to two sage-grouse. Between 2002-11, hunting seasons for sage-grouse averaged 11 days long.

Moving and shortening the season and decreasing the bag limit decreased the number of sage-grouse harvested and the number of hunters in the Basin (Fig. 4 and Table 4). Annual average harvest (1982-1994) in the Basin was 3,756 sage-grouse taken by 1,300 hunters during 3,118 hunter days (2.8 birds/hunter, 2.4 days/hunter). Following changes to the hunting season opening date (1995-2001), an average of 549 hunters took 1,056 sage-grouse during 1,567 days of hunting (1.9 birds/hunter, 2.8 days/hunter). Since the last changes to the hunting seasons (2002-201), hunters averaged 0.7 birds/hunter and 2.3 days/hunter. In 2011, individual harvest rate decreased (0.4 birds/day and 1.2 birds/hunter) and hunter effort (2.9 days/hunter) was higher than long-term averages (Table 4).

Figure 4. Sage-grouse harvest summary for Big Horn Basin (Management Area B), 2003-12.

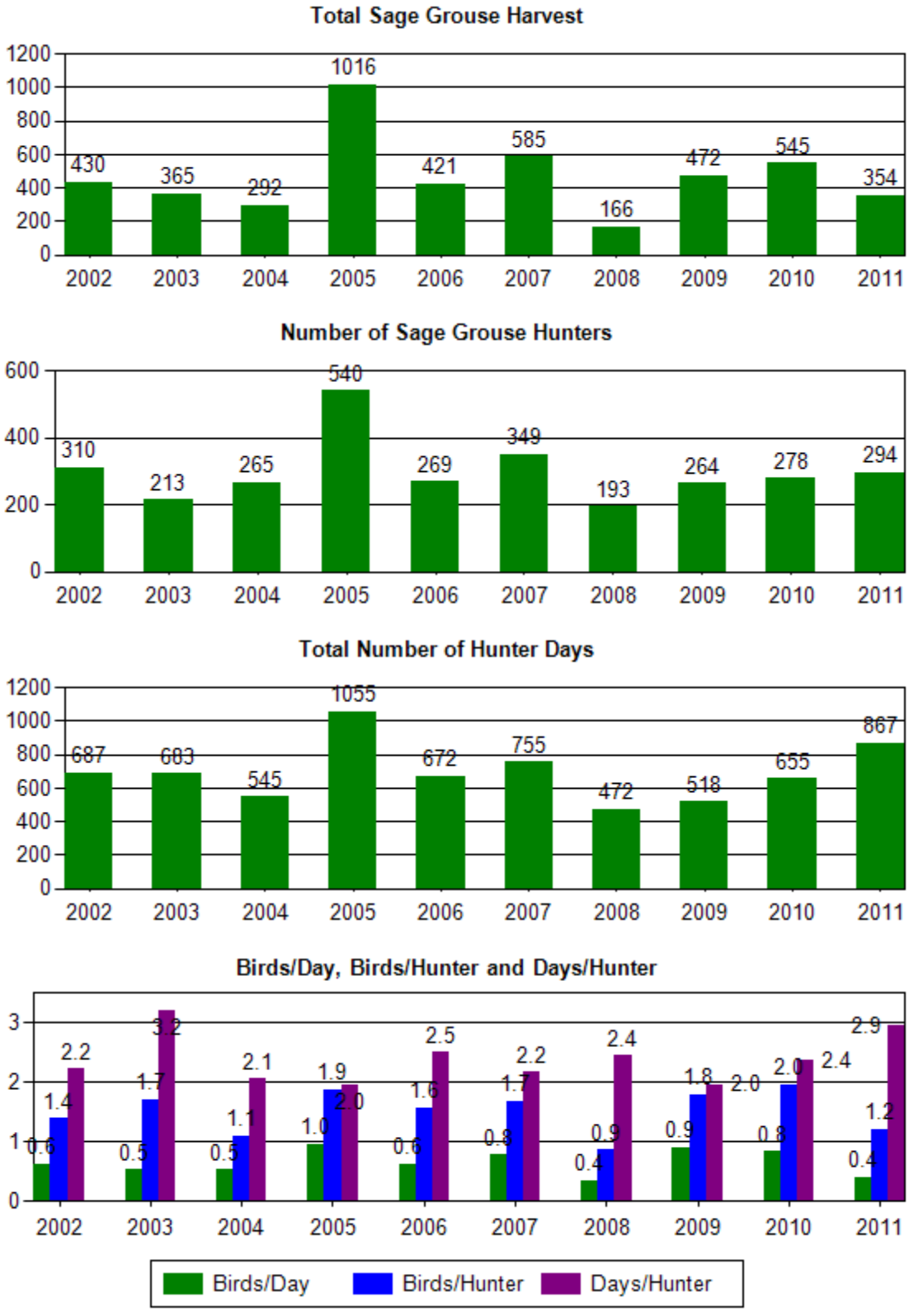


Table 4. Harvest data for sage-grouse in the Big Horn Basin, Wyoming, 2002-11.

Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2002	430	310	687	0.6	1.4	2.2
2003	365	213	683	0.5	1.7	3.2
2004	292	265	545	0.5	1.1	2.1
2005	1,016	540	1,055	1.0	1.9	2.0
2006	421	269	672	0.6	1.6	2.5
2007	585	349	755	0.8	1.7	2.2
2008	166	193	472	0.4	0.9	2.4
2009	472	264	518	0.9	1.8	2.0
2010	527	270	640	0.8	2.0	2.4
2011	354	294	867	0.4	1.2	2.9
Average	463	297	689	0.7	1.5	2.4

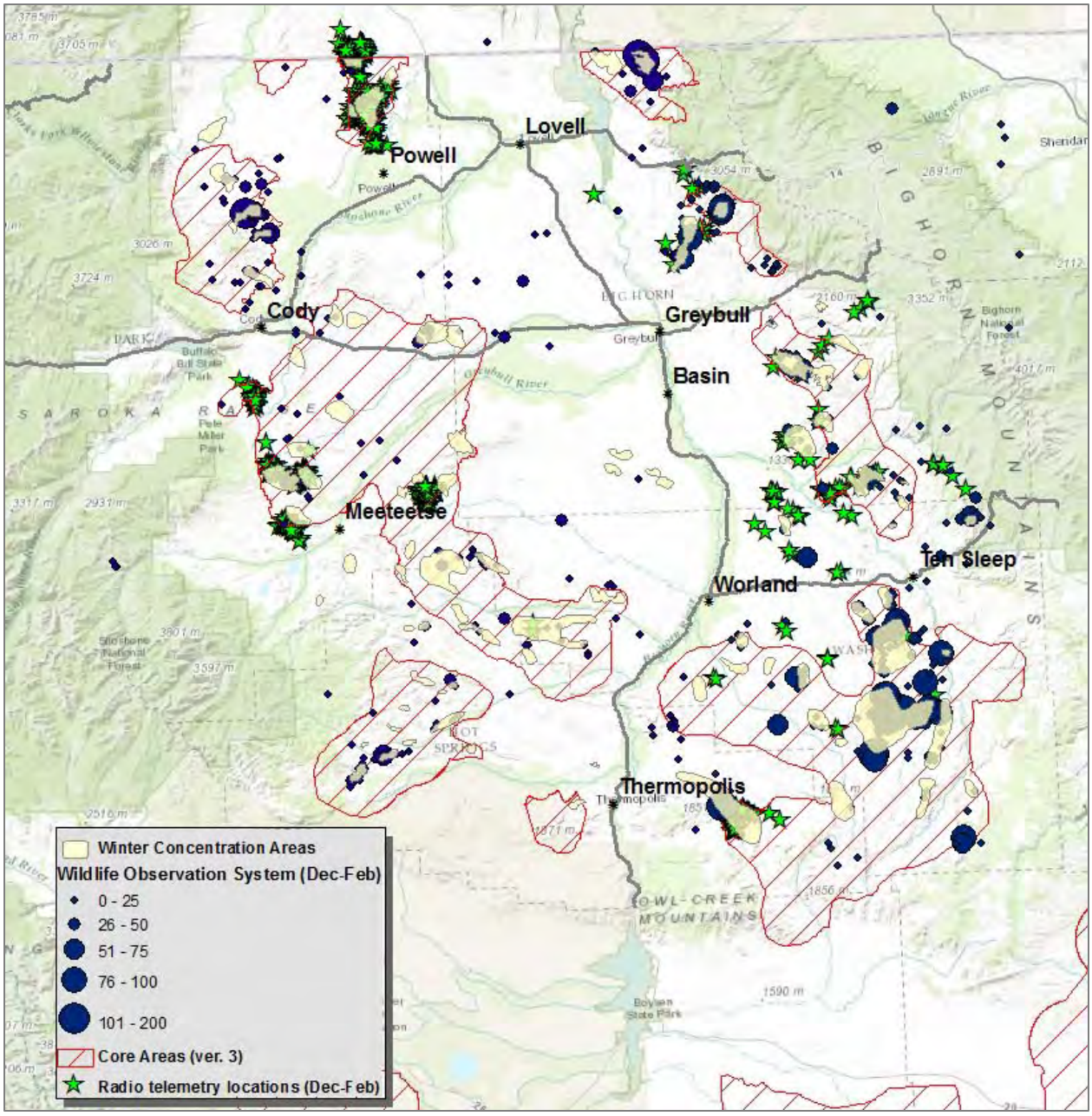
Winter concentration areas. Although winters are generally not considered a limiting season for sage-grouse populations, delineation of habitats used by large concentrations of grouse in winter has been a priority among WGFD and BLM biologists. Conservation of those winter habitat patches is important to the long-term maintenance of a sage-grouse population (Carpenter et al. 2010).

Preliminary winter concentration areas were mapped by WGFD and BLM personnel using survey flight data, Wildlife Observation System data, radio telemetry location data from two research projects currently underway, and pervious (1988) mapping done by BLM (Fig 5). Locations of grouse observed only during December, January and February were used. Survey flights were periodically conducted across potential areas in the Big Horn Basin during the past several winters and are expected to continue as budgets allow. Flights were only conducted under true winter conditions. Winter concentration areas will be further refined and delineated as more data are collected, especially using data from radio-marked birds.

Conservation planning. The BHBLWG was formed in September 2004, to develop and facilitate implementation of a local conservation plan for the benefit of sage-grouse and, whenever feasible, other species that use sagebrush habitats. The BHBLWG's mission statement is, "*Through the efforts of local concerned citizens, recommend management actions that are based on the best science to enhance sagebrush habitats and ultimately sage-grouse populations within the Big Horn Basin.*"

The Sage-grouse Conservation Plan (Plan) for the Basin identified several factors that may influence sage-grouse populations in the Basin. A brief description of each factor and potential impacts to grouse or their habitats were discussed. Impacts of each factor were addressed in the Conservation Strategy section of the Plan. Goals and objectives were formulated to address: 1) habitats, 2) populations, 3) research and 4) education. Strategies and commitments in the Plan were designed to improve sage-grouse habitats and populations in the Basin. Specific actions, recommended management practices and commitments to achieve goals and objectives were presented. The Plan can be viewed at the WGFD website: http://wgfd.wyo.gov/web2011/Departments/wildlife/pdfs/SG_BHBConservationPlan0000684 .

Figure 5. Preliminary winter concentration areas (yellow), sage-grouse observations December-February 1990-2012 (●) from WGFD's Wildlife Observation System, radio telemetry relocations (☆), and core areas (version 3; red cross hatched) in the Big Horn Basin Conservation Area.



Due to on-going conservation efforts, funding for sage-grouse conservation has increased. In 2005, the Wyoming Legislature and Governor created the Sage-grouse Conservation Fund (SgCF) to be spent by LWGs on goals established in local conservation plans. The Legislature again approved funds for SgCF in the 2006–2008, 2008-2010, and 2010-12 budget cycles. Marathon Oil Company donated a total of $70,000 between 2004 and 2010 to the Wildlife Heritage Foundation of Wyoming for sagebrush habitat work in the Basin. Those monies have funded projects designed to accomplish goals and objectives in the local conservation plan.

The LWG is currently writing a five-year update to the plan. The update will highlight activities that occurred in the Basin to conserve sage-grouse and habitats. Updates from all working groups will be submitted to USFWS prior to their review of the status of sage-grouse in 2015.

Core Areas. On 1 August 2008, Governor Freudenthal signed an Executive Order (2008-2) to focus management on the maintenance and enhancement of sage-grouse habitats and populations within core areas (i.e., Core Area Strategy). Mapping of core areas was based on density of males on leks, high number of wintering birds and intact sagebrush habitat. Core areas were revised in 2010 to exclude areas already impacted by development and to include other intact habitats (version 3; Fig 5) with the assistance of the Governor's Sage-Grouse Implementation Team and the local sage-grouse working groups. Governor Mead issued an Executive Order (2011-5) on June 2, 2011, which reiterated and clarified the intent of Wyoming's Core Area Strategy originally developed under former Governor Freudenthal's administration. Funding, reclamation efforts, habitat enhancements and other proactive efforts are focused and prioritized to occur in core areas. In its decision document, the USFWS specifically cited Wyoming's Core Area Strategy as a mechanism that, if implemented as envisioned, should ensure conservation of sage-grouse in Wyoming and therefore help preclude a future listing.

Research. One project funded by SgCF (and other sources) evaluated the relative influence of prescribed burning and mowing treatments on quality of sage-grouse nesting and early brood-rearing habitats (Hess 2010 and related publications). Hess (2010) focused on affects of treatments on vegetation parameters and insect occurrence/abundance on treated sites and nearby untreated reference sites. Sites were classified by treatment type, decade of treatment, season of treatment, and soil type. Although prescribed burning did result in greater insect (ants and beetles) abundance, higher perennial grass canopy cover (aridic soils), higher plant species richness (aridic soils), and higher soil nitrogen (burns during 2000-06), values were not significantly different from untreated sites. Grasshopper abundance was significantly higher on burned sites. Density of sagebrush was reduced post-burn. Many benefits to herbaceous vegetation may not have been observed since burns were conducted as many as 19 years prior to this research. Mowing resulted in greater insect abundance (ants) than untreated sites, but did not enhance herbaceous production (grasses or forbs). Mowing resulted in lower mortality of sagebrush and higher insect diversity than burning. Production and nutritional content of forbs was not significantly enhanced on either treatment type (over untreated sites).

In 2010, two research projects on sage-grouse were begun in the Basin. Both projects were initiated outside the purview of the WGFD and BHBLWG, and were funded from sources other than the SgCF. One is researching possible affects of bentonite mining on sage-grouse (Pratt and Beck 2011). The other project was designed to document levels of predation on adult hens, nests and broods at several sites on the west side of the Big Horn Basin (Orning and Young 2012, 2012a).

CONCLUSIONS

Despite being at a low in the population cycle, sage-grouse populations in the Basin remain stable. Sage-grouse in the Basin face threats, but are not in danger of foreseeable extinction. On-going conservation efforts are intended to mitigate some anthropogenic impacts. Research and efforts to monitor status and trends of sage-grouse populations and habitats should continue. Data should be used to direct future management efforts across the Big Horn Basin.

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Harrell, D. 2008 Peak lek attendance for greater sage-grouse within the northern Bighorn Basin, Wyoming. Technical Note 424. U.S. Department of the Interior. Bureau of Land Management, Cody Field Office, Wyoming. 12 pp.

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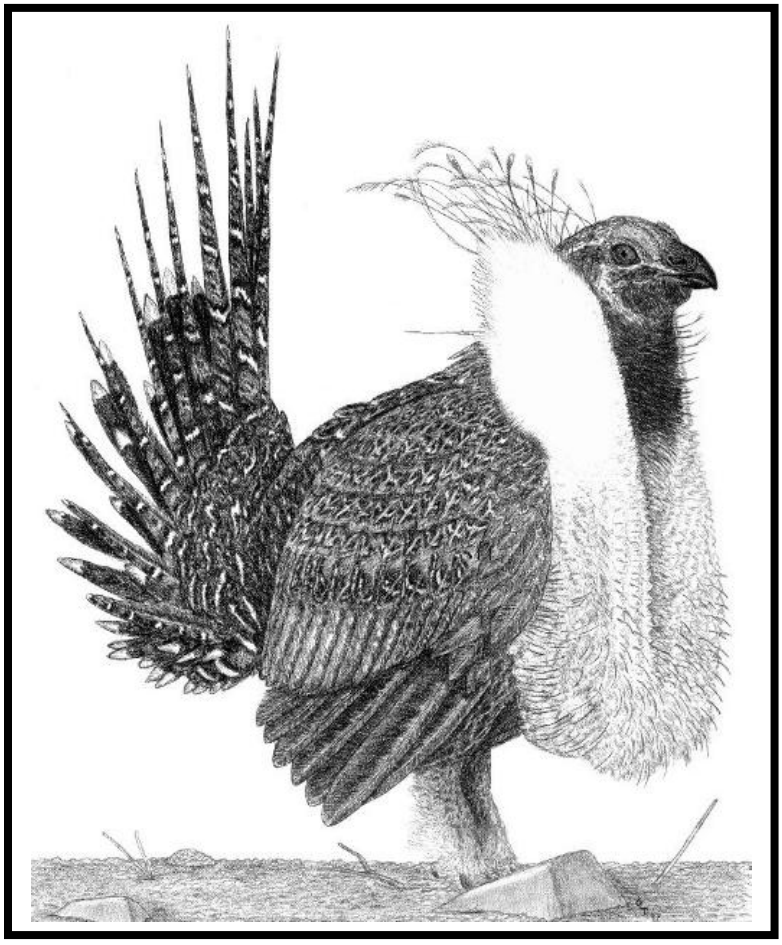
Northeast Wyoming Local Working Group

2011 ANNUAL SAGE-GROUSE COMPLETION REPORT



Prepared By:

Dan Thiele
District Wildlife Biologist, Buffalo
Wyoming Game and Fish Department

Sage Grouse Job Completion Report

Year: 2003 - 2012, Working Group: Northeast

1. Lek Attendance Summary (Occupied Leks)

a. Leks Counted

Year	Known	Counted	Percent Counted	Peak Males	Peak Females	Avg Males	Avg Females
2003	329	101	31	772	359	7.9	3.7
2004	365	141	39	990	242	7.8	1.9
2005	418	107	26	1489	487	13.9	4.6
2006	445	88	20	1793	584	20.4	6.6
2007	464	116	25	2036	358	17.6	3.1
2008	473	130	27	1894	803	14.6	6.2
2009	474	159	34	1135	531	7.1	3.3
2010	482	204	42	1561	816	7.7	4.0
2011	486	202	42	1119	478	5.6	2.4
2012	482	258	54	1776	612	6.9	2.4

b. Leks Surveyed

Year	Known	Surveyed	Percent Surveyed	Peak Males	Avg Males
2003	329	126	38	673	8.7
2004	365	200	55	908	8.2
2005	418	211	50	2112	16.0
2006	445	264	59	3304	19.3
2007	464	293	63	3440	20.4
2008	473	286	60	2327	15.8
2009	474	248	52	1346	11.8
2010	482	192	40	590	7.8
2011	486	229	47	668	7.6
2012	482	167	35	419	10.2

c. Leks Checked

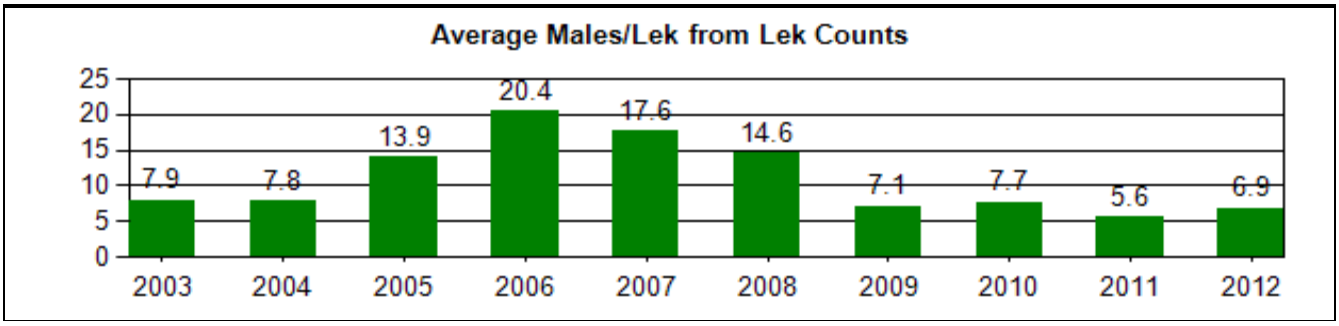
Year	Known	Checked	Percent Checked	Peak Males	Avg Males
2003	329	199	60	1347	8.9
2004	365	296	81	1763	8.5
2005	418	315	75	3588	15.2
2006	445	351	79	5089	19.7
2007	464	409	88	5476	19.2
2008	473	409	86	4112	15.2
2009	474	407	86	2481	9.1
2010	482	395	82	2151	7.7
2011	486	419	86	1756	6.3
2012	482	425	88	2195	7.3

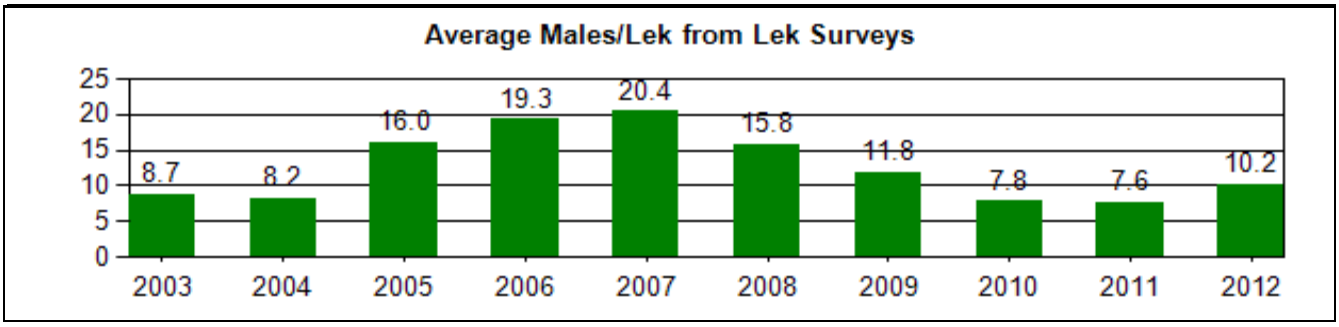
d. Lek Status

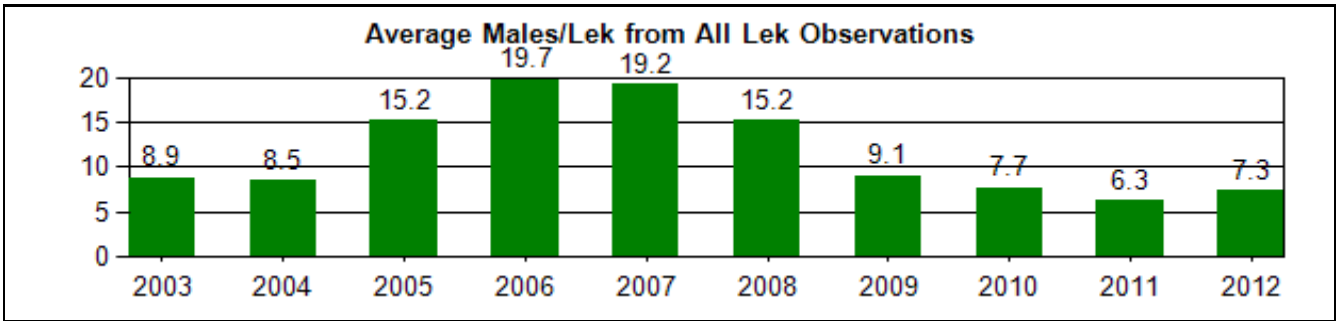
Year	Active	Inactive	Not Located	Unknown	Known Status	Percent Active	Percent Inactive
2003	121	35	1	172	156	77.6	22.4
2004	158	63	2	142	221	71.5	28.5
2005	211	35	2	170	246	85.8	14.2
2006	236	31	6	172	267	88.4	11.6
2007	249	83	3	129	332	75.0	25.0
2008	234	96	0	143	330	70.9	29.1
2009	221	98	0	155	319	69.3	30.7
2010	196	134	2	150	330	59.4	40.6
2011	182	146	0	158	328	55.5	44.5
2012	190	135	1	156	325	58.5	41.5

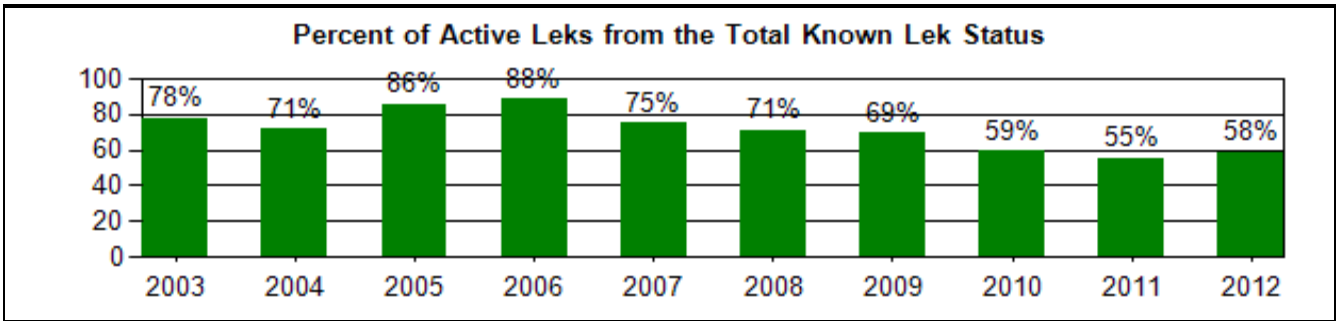
Sage Grouse Lek Attendance Summary

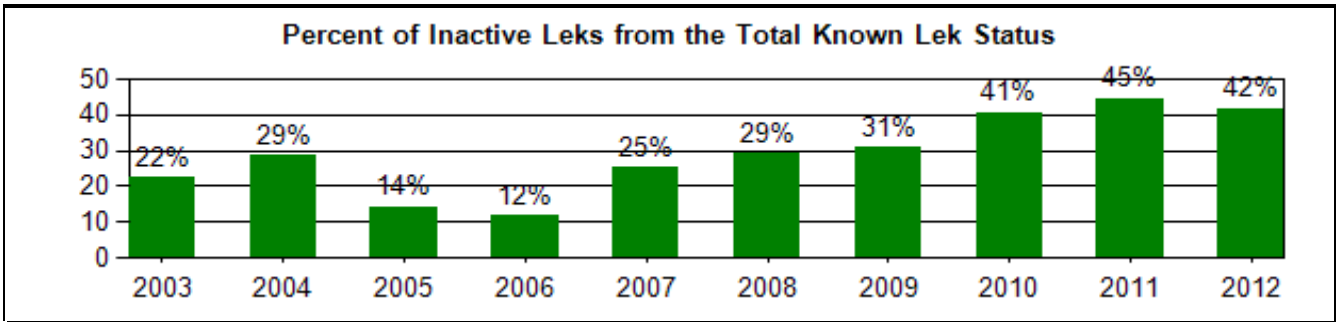
Working Group: Northeast











Sage Grouse Job Completion Report

Year: 2002 - 2011, Management Area: C, Hunt Area 4 (no harvest accounted for from Hunt Area 1)

4. Sage Grouse Hunting Seasons and Harvest Data

a. Season

Year	Season Start	Season End	Length	Bag/Possesion Limit
2002	Sep-28	Oct-6	9	2/4
2003	Sep-27	Oct-5	9	2/4
2004	Sep-23	Oct-3	11	2/4
2005	Sep-23	Oct-3	11	2/4
2006	Sep-23	Oct-3	11	2/4
2007	Sep-22	Oct-2	11	2/4
2008	Sep-22	Oct-2	11	2/4
2009	Sep-19	Sep-25	7	2/4
2010	Sep-18	Sep-20	3	2/4
2011	Sep-17	Sep-19	3	2/4

b. Harvest

Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2002	120	210	712	0.2	0.6	3.4
2003	104	80	168	0.6	1.3	2.1
2004	347	271	471	0.7	1.3	1.7
2005	422	342	1649	0.3	1.2	4.8
2006	475	283	509	0.9	1.7	1.8
2007	532	297	632	0.8	1.8	2.1
2008	101	186	295	0.3	0.5	1.6
2009	311	230	559	0.6	1.4	2.4
2010	129	117	202	0.6	1.1	1.7
2011	158	124	173	0.9	1.3	1.4
Avg	270	214	537	0.6	1.2	2.3

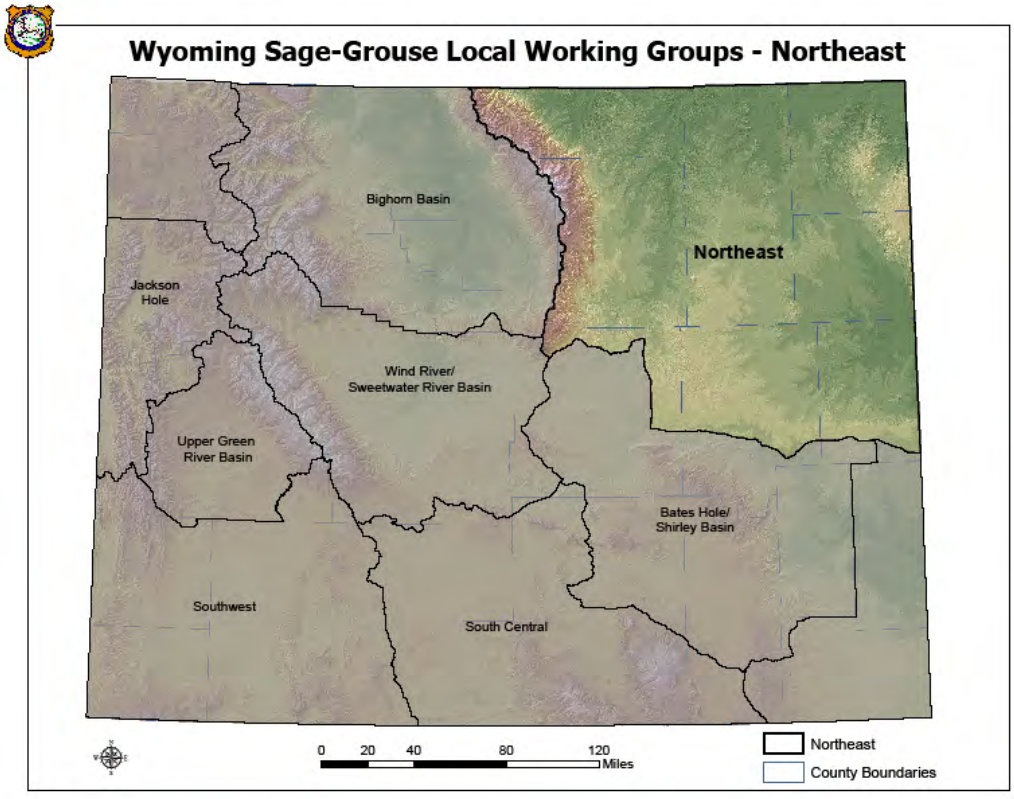
2011 JOB COMPLETION REPORT

Narrative
SPECIES: **Sage-grouse**
DAU NAME: **Northeast Wyoming Working Group**
Period Covered: **6/1/2011 – 5/31/2012**
Prepared by: **Dan Thiele, Wildlife Biologist**

INTRODUCTION

Sage-grouse data are reported for the area encompassed by the Northeast Wyoming Local Working Group Area (NEWLWGA) which was formed in 2004 to develop and facilitate implementation of a local conservation plan for the benefit of sage-grouse, their habitats, and whenever feasible, other wildlife species that use sagebrush habitats. The NEWLWGA covers Wyoming from the Bighorn Mountain divide to South Dakota and from Montana to Interstate Highway 25 and U.S. Highway 20/26 (Figure 1). The Area boundary encompasses the WGFD Sheridan Region and a portion of the Casper Region. In 2010 the Department revised sage-grouse management areas by eliminating the numbered upland and small game management areas and created management areas corresponding to working group area boundaries. The NEWLWGA is now designated as Management Area C.

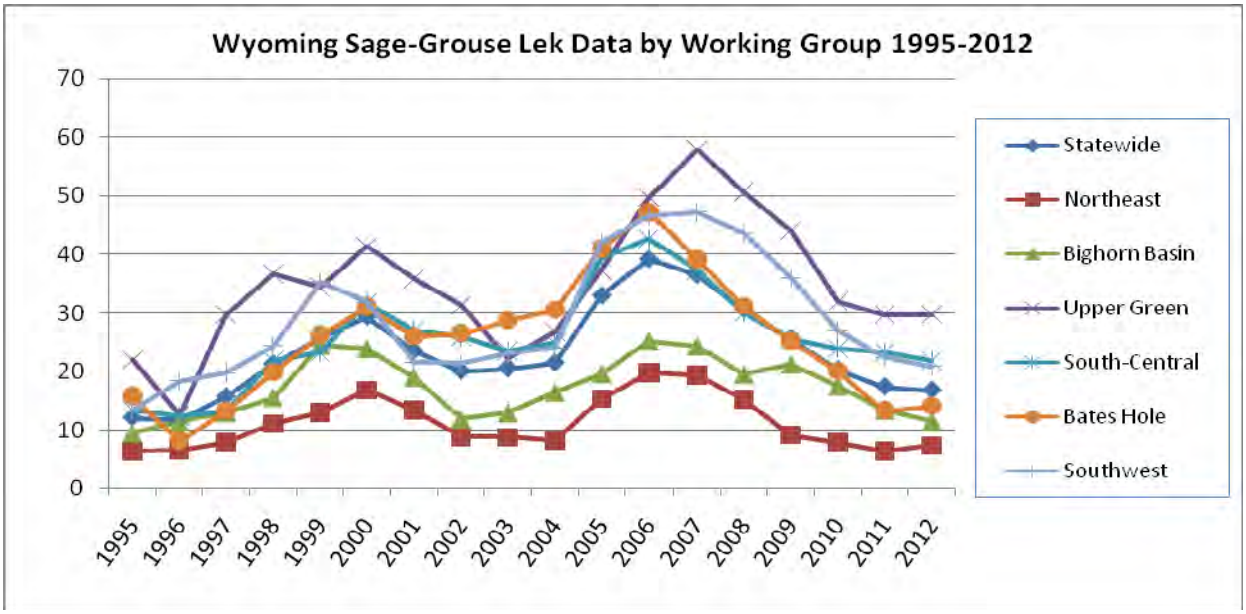
Figure 1. Northeast Wyoming Local Working Group Area.



Sage-grouse are found throughout sagebrush grassland habitats of northeast Wyoming. Occupied habitat is fairly contiguous east of the Bighorn Mountains to the Black Hills and the Wyoming-Nebraska state line with the exception of forested, grassland and highly developed agricultural habitats. Sagebrush habitats are less continuous than western Wyoming, which

contributes to lower sage-grouse densities. Northeast Wyoming has the lowest average male lek attendance in the state, averaging 7 males per active lek in 2012 compared to the statewide average of 17 males per active lek (Figure 2). Male lek attendance for the other working group areas ranged from 11 to 30 males per active lek. Most leks in northeast Wyoming are small with less than 20 males. In years when grouse are at the peak of their cycle, less than 10% of the leks have greater than 50 males at peak count.

Figure 2. Wyoming Statewide and Local Working Group Area Lek Attendance Trends.



Average male lek attendance has decreased significantly over the years. Figure 3 shows the average number of males per active lek by decade since monitoring efforts began. Average male attendance has decreased by more than one-half over the last thirty years. A slight upswing occurred from 2000-2009, however, the long-term trend remains a concern.

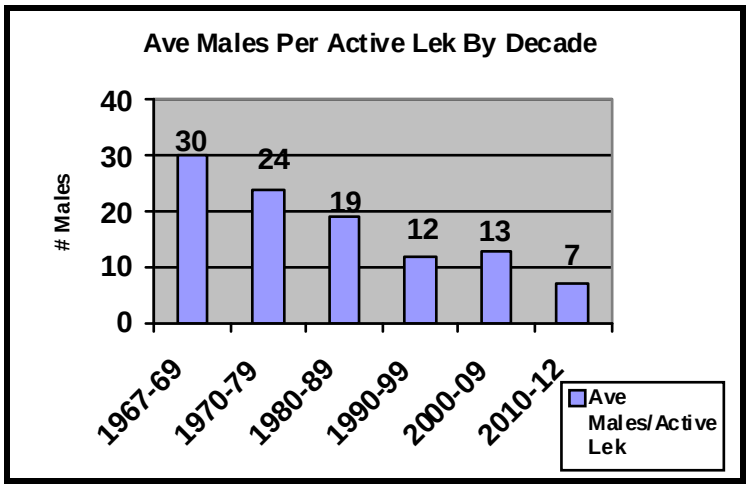
Most of the occupied habitat for sage-grouse is held in private ownership. Approximately 70 percent of the known leks are found on private land with the remaining 30 percent found on Bureau of Land Management, U.S. Forest Service, and State owned lands. Because most sage-grouse are found on private land, little direct control exists to protect important habitats, including breeding and nesting areas, brood rearing areas, and major wintering areas.

The primary economic uses of lands providing sage-grouse habitat are agriculture and energy. Livestock grazing, mainly cattle along with limited sheep production, is the primary agriculture use. Some crop production occurs as irrigated and dry land hay and some small grains. Vast coal reserves are being developed with surface pit mines in eastern Campbell County and northern Converse County. Oil and natural gas production has occurred in portions of the area since the early 20th century. An unprecedented energy boom began in the Powder River Basin in the late 1990's with the exploration and development of coalbed natural gas (CBNG) reserves. The BLM predicted 51,000 wells could be drilled in the Powder River Basin Oil and Gas Project Record of Decision (BLM 2003). In May 2012, the Wyoming Oil and Gas Conservation Commission reported that 12,116 producing wells yielded 35,258,540 Mcf of methane gas. In addition to producing wells there are over 11,980 shut in wells. Federal mineral leases provided for 69% of the production while fee leases accounted for 23% and State leases 9%. This compares to May 2011 when 14,016 producing wells yielded 40,119,217 Mcf of methane gas. At the peak of the CBNG play, more than 18,300 wells were in production (August 2008) with production peaking in January 2009 at 49,459,629 Mcf of

methane gas. Much of the development in the energy play involves federal minerals with private surface. Wells, roads, power lines, produced water, activity and dust are components of development which affect sage-grouse habitat at a broad scale.

Deep well oil and gas is increasing with new technologies enabling horizontal drilling. While CBNG activity decreases the interest in deep drilling increases. Within the BLM's Buffalo Field Office (Campbell, Sheridan & Johnson Counties) the number of pending conventional wells increased from 27 in fiscal year 2009 to 153 in fiscal year 2012. Significant development is also occurring in the Douglas area. Deep wells require large well pads and enormous amounts of truck traffic to deliver water, sand, etc for drilling and fracking.

Figure 3. Average Number of Males per Active Lek by Decade for Northeast Wyoming Leks.



Considerable debate occurred on the effects of energy development on sage-grouse. Peer reviewed research findings show significant impacts (Walker et al. 2007). These findings have yet to be embraced by some people and this has contributed to uncertainty in the public and political arenas as to the real effects of energy development. Furthermore, many continue to blame predation while some in the energy industry point to continued hunting of the species given that they are being asked for increased mitigation measures in areas of development.

A population viability analysis by Taylor et al. (2012) found that energy development had the greatest influence on male grouse lek attendance within 12.4 miles of a lek. At 8 wells per section (80 acre spacing), only 39% of males persisted while the number of large leks significantly decreased. Subjecting suppressed populations in developed areas to West Nile virus outbreaks or other stressors threatens local populations with extirpation.

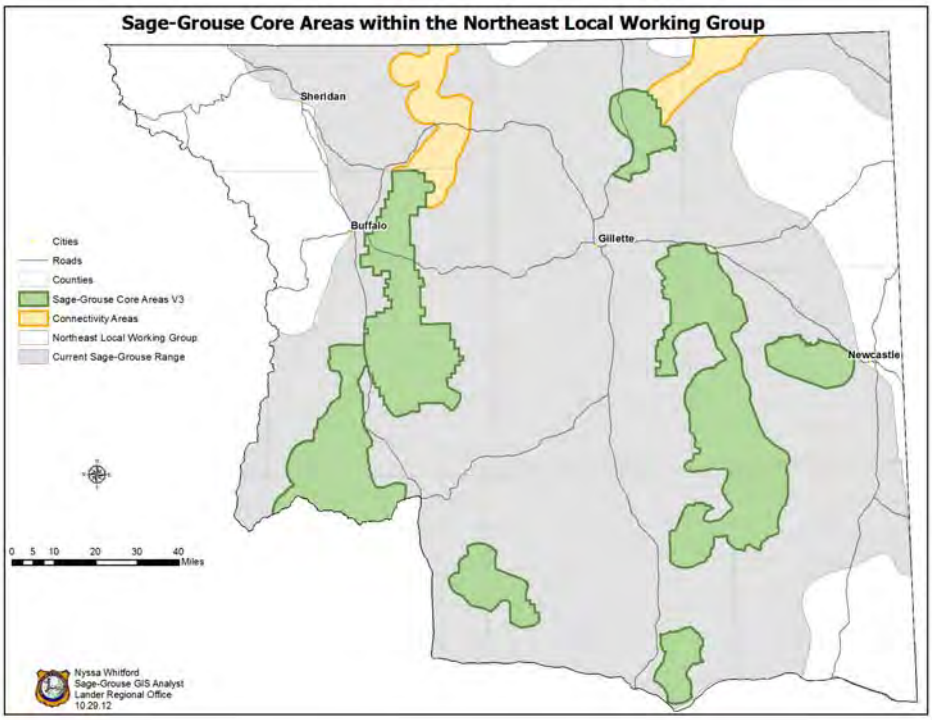
Core areas were designated in 2007 with the objective of identifying habitats that supported most of Wyoming's sage-grouse. Statewide, core areas account for approximately 34% of the current sage-grouse range while encompassing leks with 81% of the 2008 peak males. However, within a three county area of the Powder River Basin (Campbell, Johnson and Sheridan Counties), core areas were designated based on CBNG development patterns along with lek density data thereby encompassing leks supporting only 28% of the 2008 peak males.

In June 2010, the working group finalized recommendations for delineation of connectivity areas, core area boundary adjustments and sage-grouse development guidelines in and outside connectivity areas. Connectivity areas were identified using larger leks based on recommendations by Knick (2008) and habitat maps. Two connectivity areas were identified linking core habitat in Wyoming with Montana (Figure 4).

Data collection efforts on sage-grouse have focused on lek counts and surveys, which have been conducted each spring within the Area since at least 1967. Lek searches may have been conducted earlier; however, no records exist for data verification. Lek counts include those lek observations conducted three to four times each spring, about a week to 10 days apart. Lek counts are conducted to provide population trends based on the average peak male attendance. Lek surveys include lek attendance observations not following the count protocol, and are intended to determine general lek status (active, inactive or unknown).

Management of sage-grouse within the NEWLWGA has focused mainly on the protection of lek and nesting areas during the breeding season. Protection efforts have primarily occurred through the environmental commenting process and more recently the formation of core areas. Although more than 70% of the Area's leks are found on private land, the split estate nature of the surface and mineral ownership provides for greater management influence by the BLM for oil and gas resource development.

Figure 4. Wyoming Sage-grouse Core Area and Connectivity Areas (version 3).



WEATHER

Weather during the past biological year (June 2011 – May 2012) was dryer and warmer than the 30-year averages (Figures 5 and 6). Precipitation was nearly one and one-half inches below normal while the average temperature was nearly three degrees above normal. The biological year started off well due to well above normal precipitation in May 2011 (286%) after which below normal precipitation was received from June through September. Fall and winter precipitation was near normal with above normal precipitation in November, December and February. Spring precipitation was 80-90% of normal in April and May. However, the northeast area of the state fared much better than most of Wyoming. Average monthly temperatures were above normal for 10 of the 12 months with the most variation occurring in January (+7°) and March (+9°).

National Climate Data Center/National Oceanic and Atmospheric Administration (NCDC/NOAA) weather data for Wyoming Climatic Division 5 was summarized by the Biological Services Division of the Wyoming Game & Fish Department. Climatic Division 5 includes the Powder River, Little Missouri River and Tongue River drainages. Weather data from this area are provided as a general indication of weather patterns over the entire working group area.

Figure 5. 2011 Bio-Year: Monthly Precipitation Data (in), Wyoming Climate Division 5.

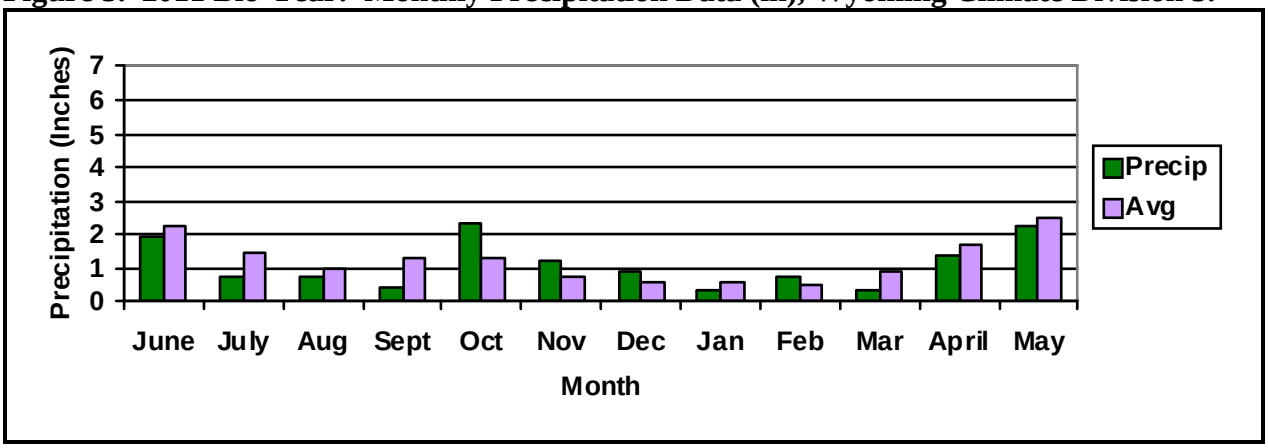
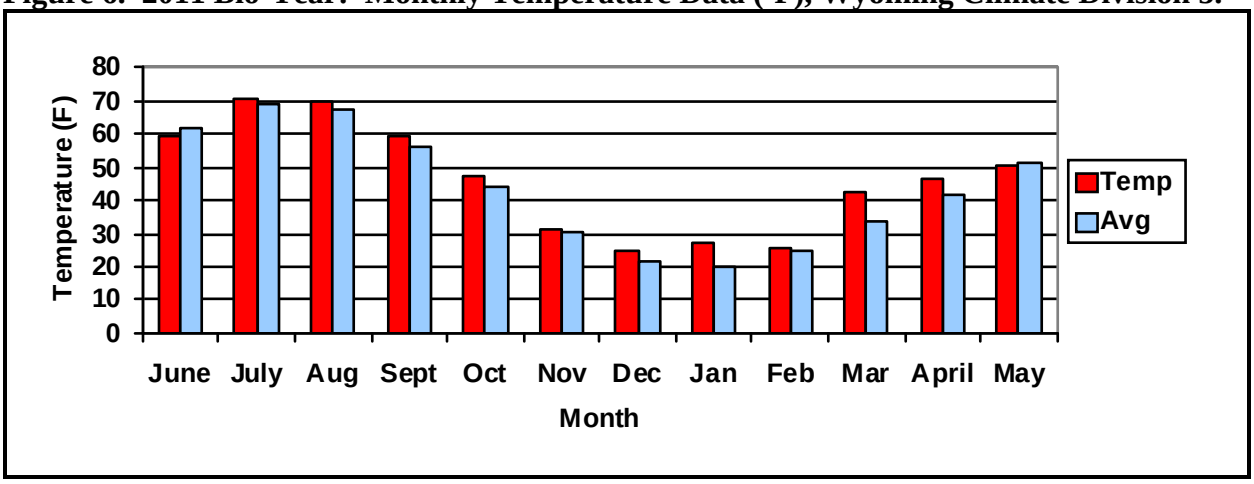


Figure 6. 2011 Bio-Year: Monthly Temperature Data (^{o}F), Wyoming Climate Division 5.



RESULTS

Variation in this report from previous year's reports is expected because of new data added to the lek database. Old records are added each year as the data become available. Additionally, new leks discovered are added to existing complexes or create new complexes. New lek count routes may also be added. Data adjustments should be taken into consideration when the current report and tables are compared to previous editions.

West Nile Virus

No West Nile virus mortalities were reported for northeast Wyoming in 2011-12. No significant mortality has been documented since 2003, however, there are fewer radio marked sage-grouse being monitored by researchers which increases the likelihood of finding mortalities. Based on human diagnosed cases of West Nile virus, outbreaks occurred in 2003 and 2007.

Taylor et al. (2012) predicted that the low elevation population of northeast Wyoming is susceptible to West Nile virus outbreaks which can decrease a population by more than 50%. Furthermore, even with no additional energy development the authors predict that some local populations may be one outbreak year away from extirpation.

Brood Surveys

Limited sage-grouse brood data have been collected in recent years due to low bird numbers and other work priorities. No brood survey data was reported in 2011. Sample sizes are generally inadequate to draw meaningful conclusions. Brood surveys the prior three years yielded chick to hen ratios of 3.4, 0.4, and 1.2 in 2010, 2009 and 2008, respectively. The 2010 ratio suggests relatively good hatch success and early brood survival, however, these results cannot be considered representative of the entire working group area.

Harvest Results

The Northeast Working Group area is comprised of Hunt Area 4 and portions of Hunt Areas 1 and 2 (Figure 7). A very small amount of Hunt Area 1 occurs in the southwestern most extent of the area while Hunt Area 2 is closed to hunting. In Hunt Area 4, a very conservative hunting season was implemented in 2009 due to continuing concerns of decreasing lek attendance trends in the working group area.

Figure 7. Northeast Wyoming Sage-grouse Hunt Areas.

Although sage-grouse numbers have decreased over time and are currently trending down, an adequate population exists to support the conservative hunting season. Nearly 2,200 males were observed during 2011 lek monitoring efforts with most of these birds in the portion of the Northeast Working Group Area included in Hunt Area 4. This number far exceeds the 100 male minimum threshold recommended to support a hunting season in the sage-grouse management guidelines (Connelly, et. al 2000). Even so, some segments of the public continue to voice concern that the WGFD continues to offer hunting seasons while working to reverse declining

population trends. In response to this concern the Department produced a white paper on the implications of harvest strategies on sage-grouse in Wyoming, *Hunting and Sage-grouse: A Technical Review of Harvest Management on a Species of Concern in Wyoming*.

The 2011 harvest survey indicated that 158 sage-grouse were harvested by 124 hunters who spent a total of 173 days hunting sage-grouse within Hunt Area 4. The average number of birds harvested per hunter day was 0.9. The average number of sage-grouse harvested per hunter was 1.3 and the average number of days hunted was 1.4.

The 2011 sage-grouse harvest increased 22% from the 129 birds harvested in 2010 but remained well below the 311 birds harvested in 2009. The low harvest is attributed to the three day season, private land access and publicity about lower bird numbers and the bird's plight which likely reduces hunter interest. The ten-year average (2002-2011) is 270 birds, with harvest ranging from a low of 101 birds in 2008 to a high of 532 birds in 2007. More than 2,000 birds were harvested as recently as 2000. Hunter numbers over the last ten years have ranged from 80 hunters in 2003 when the season was closed in Campbell, Johnson and Sheridan counties due to a West Nile virus outbreak to 342 hunters in 2005. Hunter days decreased 14% from 2010 and remained well below the 1,649 days logged in 2005.

Even though male lek attendance was higher from 2005 thru 2008, harvest was conservative compared to past levels. Beginning in 2010, the three day season appears to have dampened hunter interest to about one-half or what it was. The more conservative season length and bag limit combined with increased publicity about the sage-grouse's status likely contributes to these trends.

A limited number of sage-grouse wings are collected during the hunting season, primarily in the eastern portion of the Area. Sample sizes are small due to the low harvest and the difficulty to strategically place enough collection barrels along the many roads and highways within the Area. Composition of the harvest as determined by analysis of wings deposited by hunters in wing barrels can provide insight into current year's chick production although in most years the sample is too small to allow for reliable interpretation of the sample. The 2011 sample was only 9 wings resulting in a chick to hen ratio of 1.7. The sample is too small to draw meaningful conclusions.

Lek Monitoring Results

Lek monitoring efforts have increased substantially in recent years due to range wide declines in sage-grouse populations and the subsequent efforts of environmental groups to petition the U.S. Fish and Wildlife Service to list the species under the Endangered Species Act. Additionally, coalbed natural gas (CBNG) development in the Powder River Basin has resulted in extensive survey work to meet federal permitting requirements. The WGFD, BLM, U.S. Forest Service, private consultants and volunteers participated in ground and aerial monitoring of leks.

Sage-grouse lek monitoring efforts are accomplished through lek counts, lek surveys and searches for new leks. The Sheridan Region received additional funds from the Bureau of Land Management for sage-grouse surveys for the twelfth consecutive year. This funding was used for aerial surveys to monitor known leks and fly grid searches for new leks in those areas with seemingly adequate habitat, but no previously known leks.

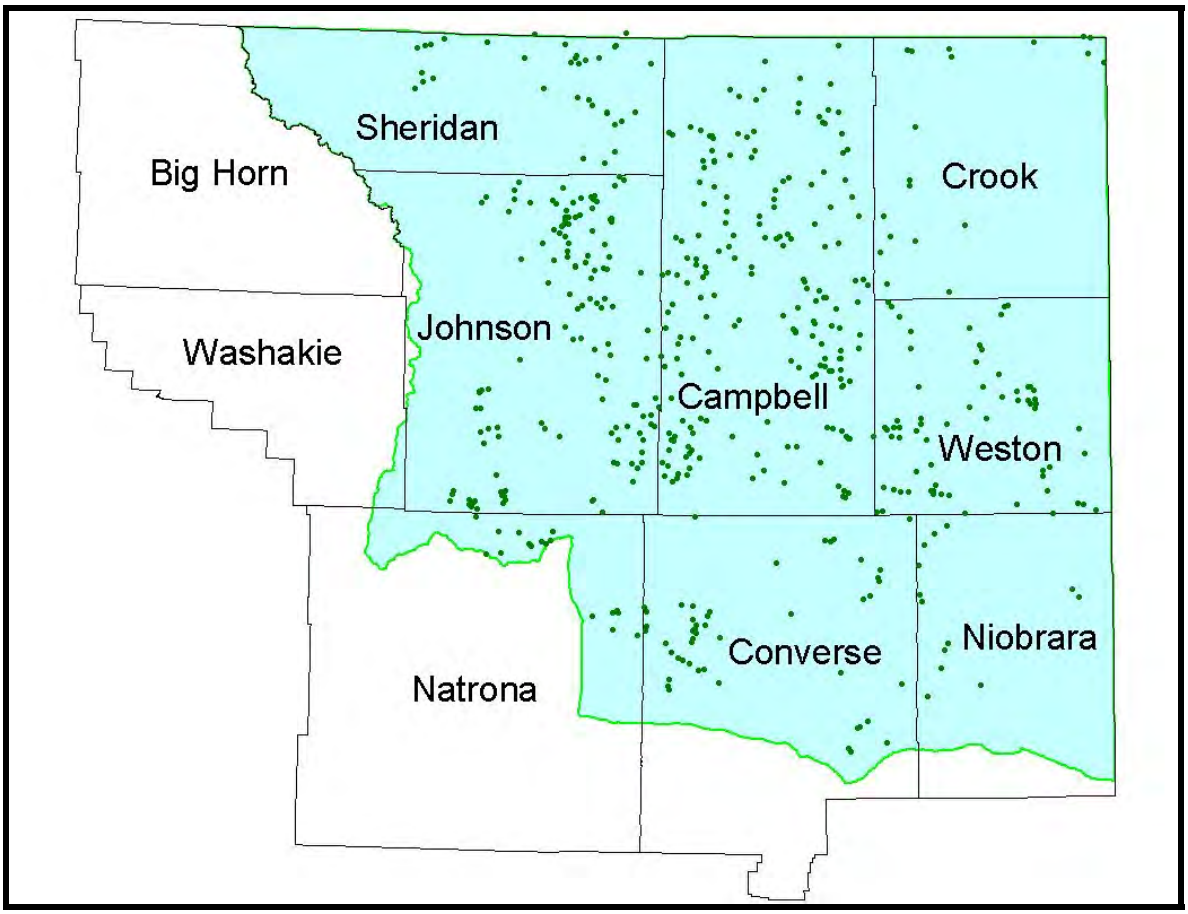
Following the 2012 lek monitoring period there are 541 documented leks in the NEWLWGA (Figure 8). Of this total, 411 are classified as occupied leks and 59 leks are classified as unoccupied leks. Unoccupied leks have either been destroyed or abandoned and are not used

by sage-grouse, however, abandoned leks should be monitored on occasion. Seventy-one leks have an undetermined status meaning they have not been documented active in the last ten years, but survey information is insufficient to designate the lek as unoccupied. The figures provided above may differ from previous years because of continued evaluation of lek data or data that arrived after the reporting period.

During the 2012 breeding season 258 leks were counted, representing 54% of known occupied leks (JCR Table 1a). The 482 known leks is less than the 541 total leks because unoccupied leks (abandoned or destroyed) are not considered potentially active. The average number of males per active lek from these lek counts was 6.9. This is up from the 5.6 males/active lek in 2011 but below the 7.7 males/active lek in 2010. The most recent cycle high of 20.4 males/active lek was in 2006.

Lek count routes were established in 2000 to document the actual number of male sage-grouse attending a lek or complex of leks. Lek counts consist of at least three ground visits to a lek following a stringent protocol to ensure accurate counts of male sage-grouse at lek sites. Designated lek count data, along with the lek counts from the private consultants and volunteers significantly improve the opportunity to better evaluate population trends. Thirty-eight official count routes covering 149 leks have been established.

Figure 8. Sage-grouse Leks in the Northeast Wyoming Working Group Area.



The number of known occupied leks checked by lek counts and lek surveys combined was 425 leks or 88% of the known occupied leks (JCR Table 1c). The average number of males/active lek was 7.3 compared to 6.3 males/active lek in 2011. The 2011 male lek attendance average

was the lowest since 1997. For the 10-year period, 2003-2012, the number of males/active lek has ranged from 6.3 in 2011 to 19.7 in 2006. These numbers and trends are comparable to the lek count data. One-hundred-ninety leks were documented as active with peak male attendance ranging from 1 to 51 males. The three leks with the highest number of males were the Jewell Draw Lek with 51 males, the Watsabaugh IV Lek with 48 males and the Wind Cave Lek with 47 males. No lek has exceeded 100 males since 2007. The median peak male attendance was 10 males, up from 7 males/active lek in 2011.

In total, there were 1,619 recorded observations of sage-grouse leks. This was over 600 fewer lek visits than recorded in 2008 due to a coordinated effort of agencies and consultants to reduce excessive visits to leks, including aerial surveys of leks also monitored from the ground. The Buffalo BLM Field Office sponsored a data sharing website on WYGIS which provided real time data sharing thereby reducing lek visits. This problem was most prevalent in the CBNG fields where monitoring buffers of Plan of Development (POD) boundaries overlap resulting in multiple visits to leks. Although some leks still experience more lek visits than necessary, the frequency has been greatly reduced.

Seven previously unknown leks were documented and added to the sage-grouse database in 2012. Peak male attendance for new leks ranged from 5 to 32 males with an average of 16 males. Several suspected leks were noted but need further documentation of activity or location before being considered confirmed leks.

Lek status as determined from lek counts and lek surveys shows 325 leks with confirmed lek status. Fifty-eight percent of the leks (n=190) with confirmed status were determined to be active (JCR Table 1d), meaning strutting males or sign of strutting (feathers/droppings) were observed at the lek site. One-hundred-thirty-five leks (42%) were determined to be inactive based on multiple ground visits and/or checks for sign (feathers/ droppings) late in the strutting season. The percentage of active leks had been decreasing for the past five years, however, in 2012 the percentage increased three percent. The percent of active leks was at 88% in 2006 which corresponded to the peak of the last population cycle but had since decreased markedly. A large number of leks (n=156) have an unknown activity status. This category includes leks that were not checked or were surveyed but had no strutting activity. For a lek to be considered inactive, two ground visits separated by 7 days and conducted under ideal conditions, or a ground check of the exact lek site late in the strutting season that fails to find sign is needed. Many leks were checked one or more times but protocol to confirm inactivity was not met.

Comparing leks in the Sheridan and Casper WGFD Regions shows differences in lek attendance and activity patterns. The Sheridan Region supports 74% of the LWG area leks. Average males per active lek for this portion of the LWG averaged 7.2 for combined surveys and counts compared to 7.7 in the Casper Region and 7.3 for the entire LWG. Furthermore, the percentage of confirmed active leks in the Sheridan Region is at its second lowest percentage (54%) in the 10-year period while the percentage of confirmed inactive leks is at 46%. These figures reflect decreasing and increasing trends, respectively, since 2006, comparable to average male lek attendance trends. Conversely, confirmed active and inactive leks in the Casper Region were 73% and 28%, respectively. These differences result from any number of factors, or combination of factors. Documented impacts from CBNG development in the Powder River Basin are no doubt influencing record low active rates the Sheridan Region data. Figures between the two regions were comparable in 2005 and 2006 and therefore suggest developing trends need close scrutiny in future years.

Some inconsistencies remain in complying with monitoring protocol and monitoring some leks on a regular basis. Some leks have not been documented as active in many years which may be due to inaccurate locations based on legal descriptions. Continued efforts at determining the

exact location and status of these leks are needed. As birds on a lek are observed, UTM coordinates are recorded using GPS. GPS locations for lek sites should make future surveys more efficient even with changes in personnel. Furthermore, with the high amount of activity around leks in areas of CBNG development, caution must be used to ensure that strutting activity represents an actual lek and not birds displaced from established leks.

Table 1. Northeast Wyoming Working Group Area Sage-grouse Lek Site Characteristics.

Region	Number	Percent
Casper	139	25.7%
Sheridan	402	74.3%

Working Group	Number	Percent
Northeast	541	100.0%

Classification	Number	Percent
Occupied	411	76.0%
Undetermined	71	13.1%
Unoccupied	59	10.9%

BLM Office	Number	Percent
Buffalo	377	69.7%
Casper	53	9.8%
Newcastle	111	20.5%

Lek Status	Number	Percent
Abandoned	37	6.3%
Active	190	35.1%
Destroyed	21	4.6%
Inactive	135	25.0%
Not Located	1	0.2%
Unknown	156	28.8%

Biologist District	Number	Percent
Buffalo	68	12.6%
Casper	30	5.5%
Douglas	40	7.4%
Gillette	242	44.7%
Newcastle	69	12.8%
Sheridan	92	17.0%

Game Warden	Number	Percent
Buffalo	75	13.9%
Dayton	18	3.3%
Douglas	19	3.5%
East Casper	5	0.9%
Glenrock	27	5.0%
Kaycee	51	9.4%
Lusk	17	3.1%
Moorcroft	52	9.6%
Newcastle	65	12.0%
North Gillette	66	12.2%
Sheridan	19	3.5%
South Gillette	121	22.4%
Sundance	5	0.9%
West Casper	1	0.2%

County	Number	Percent
Big Horn, MT	1	0.2%
Campbell	196	36.2%
Converse	47	8.7%
Crook	22	4.1%
Johnson	136	25.1%
Natrona	16	3.0%
Niobrara	19	3.5%
Powder River, MT	1	0.2%
Sheridan	36	6.7%
Weston	67	12.4%

Land Status	Number	Percent
BLM	57	10.5%
Private	395	73.0%
State	47	8.7%
USFS	42	7.8%

Management Area	Number	Percent
C	528	100.0%

Lek Characteristics

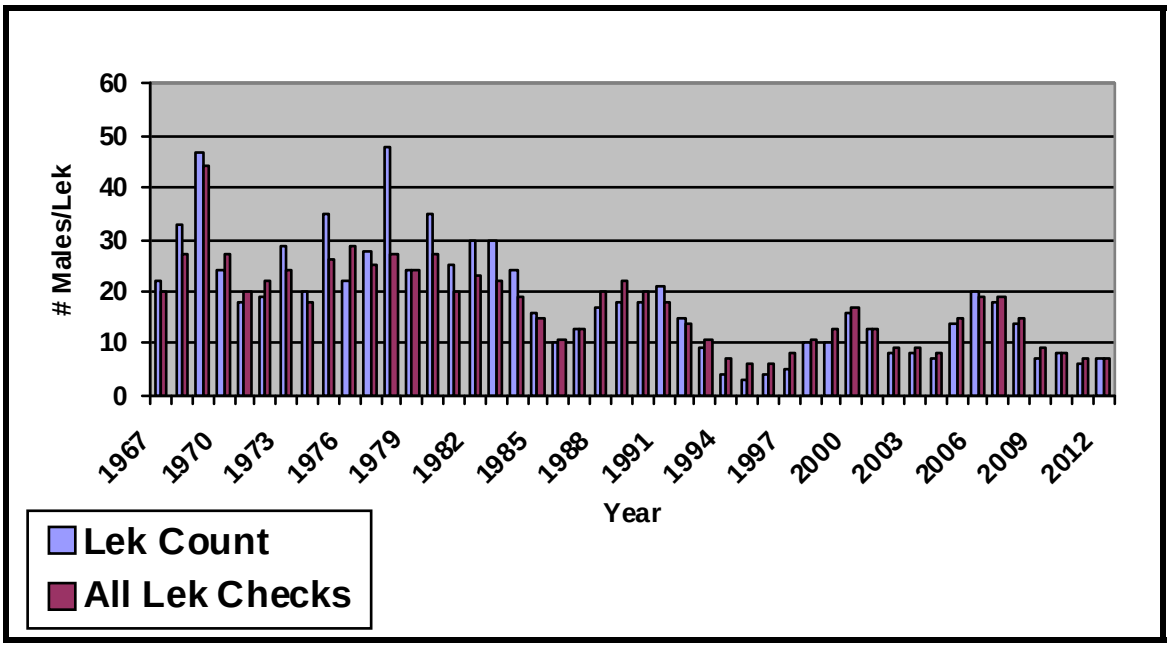
There are 541 sage-grouse leks within the NEWLWGA. Table 1 shows the demographics of leks with regard to WGFD region, BLM Office, county, biologist district, game warden district, land status, and lek status.

Population Trends

No reliable or cost effective method for estimating the sage-grouse population for the NEWLWGA exists at this time. However, the number of males/active lek provides a reasonable index of abundance of sage-grouse populations over time in response to environmental conditions and other influences. However, it must be noted that that lek data must be interpreted with caution for several reasons: 1) the survey effort and the number of leks surveyed/counted has varied over time, 2) it is assumed that not all leks in the area have been located, 3) sage-grouse populations can exhibit cyclic patterns over approximately a decade, 4) the effects of unlocated or unmonitored leks that have become inactive cannot be quantified or qualified, and 5) lek sites may change over time. Both the number of leks and the number of males attending these leks must be quantified in order to estimate population size.

Figure 9 shows the average number of males/active lek for lek counts and all lek monitoring (counts and surveys) combined from 1967 to 2012 for the NEWLWGA. If the average number of males/active lek is reflective of the sage-grouse population, the trend suggests about a 10-year cycle of periodic highs and lows. Of concern, however, is that with the exception of the most recent cycle, subsequent peaks in the average male attendance are usually lower than the previous peak. Additionally, periodic lows in the average male attendance are generally lower than the previous low. The long term trend suggests a steadily declining sage-grouse population.

Figure 9. Northeast Wyoming Working Group Male Sage-grouse Lek Attendance 1967- 2012.



It appears that sage-grouse numbers reached a new peak in 2006 and 2007, exceeding the previous peak of 2000. In fact, the trends suggest sage-grouse may have been at their highest numbers since 1991. However, the percentage of active leks was nearly ten percentage points

higher in 1991. The 2008 - 2012 data indicate that peak has passed and lek attendance is entering the declining phase of the cycle, rivaling that observed from 1994 thru 1997.

The number of total leks has increased over the last 10 years primarily due to increased survey effort associated with CBNG activities. However, the number of active leks has decreased in the last five years. It is unknown whether the actual number of leks has increased, decreased or remained the same.

HABITAT

Habitat Conditions

The general condition of native vegetation during the 2011 growing season was very good with above normal May precipitation resulting in excellent green up for warm season grasses and forbs. The improved spring precipitation for the fifth year running enabled native grasses to compete with the increased occurrence of cheatgrass resulting from the drought of 2006 combined with ample September moisture that same year. Shrub surveys showed improved sagebrush production and stand condition. Excellent residual grasses remained into the 2012 nesting season.

Habitat Impacts

Sage-grouse are influenced by many factors, both individually and cumulatively. Habitat loss and fragmentation, direct mortality and disturbance affect sage-grouse populations. The NEWLWGA identified and ranked those factors believed to be most influencing the northeast Wyoming sage-grouse population, as well as those factors that might most effectively be addressed to provide the greatest benefit for sage-grouse conservation in northeast Wyoming. Nearly all top ranking factors were directly related to, or indirectly related to, habitat. The working group felt oil, gas, and coal bed natural gas (CBNG) development, weather, vegetation management, invasive plants, and parasites and diseases were the most important influences on the northeast Wyoming sage-grouse population. In the opinion of the group, conservation efforts targeting oil, gas and CBNG development, vegetation management, invasive plants, local residential land use, and livestock grazing would be most effective in benefiting sage-grouse.

In 2011, the BLM created a position to coordinate sagebrush habitat restoration in northeast Wyoming. The biologist will look for opportunities to partner with agencies, industry, landowners and conservation organizations to restore sagebrush habitat.

SPECIAL PROJECTS

Conservation Planning

The Local Working Group held three meetings during the reporting period where the group allocated Wyoming Sage-grouse Conservation Funds, received presentations on ongoing research and habitat projects and began work on the conservation plan addendum. The Northeast Wyoming Sage-grouse Conservation Plan was finalized in August 2006. The plan and other LWG information is available on the WGFD website at http://gf.state.wy.us/wildlife/wildlifemanagement/sagegrouse/index.asp.

The LWG reviewed and allocated $156,000 from the 2011-12 Wyoming Sage-grouse Conservation Fund which totaled $1.2 million for conservation projects. The LWG prioritized the local projects for funding and supported funding a statewide project. Five local projects and one

statewide project were approved. Projects included wildfire restoration, noise research, genetic mapping to determine population connectivity, sagebrush mapping, seasonal distribution and habitat use, and maintaining a database to coordinate lek monitoring efforts.

Research

The following publications have been authored relative to research conducted in the Powder River Basin of Wyoming and Montana.

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Walker, B. L. 2008. Greater Sage-grouse Response to Coalbed-Natural Gas Development and West Nile Virus in the Powder River Basin, Montana and Wyoming, USA. Dissertation. University of Montana. Missoula, MT.

RECOMMENDATIONS

1. Participate in the Northeast Wyoming Sage-grouse Working Group. The Group has developed a conservation plan for the species and designed and implemented projects that benefit sage-grouse. The Department representative will continue to assist with implementing projects identified in the plan.
2. Assist the BLM with developing and implementing the sage-grouse monitoring program as prescribed by the Powder River Basin CBNG EIS Record of Decision (April 2003).
3. Coordinate with the BLM and industry to minimize the number of visits to leks during lek monitoring efforts.
4. Participate in WNv monitoring.
5. Assist the BLM with coordinating sage-grouse population monitoring efforts with the private consultants doing work for energy development companies.
6. Use any additional flight money from the BLM in 2013 for lek searches and surveys. All leks should be checked at least once every three years. All leks should be recorded in UTMs (NAD 83) using GPS.
7. The sage-grouse database should be maintained and used to store and report sage-grouse data. Any old records that have not been included should be added to the database. Current records should be reviewed to eliminate leks without adequate documentation to support a lek designation.
8. The Working Group should continue to solicit habitat projects on private lands that will have benefit for sage-grouse.
9. The Regions should continue to recommend protection of occupied sage-grouse leks during environmental commenting and promote their protection on private land projects.
10. Additional effort is needed to document the status of undetermined leks. Encourage reporting of lek activity from the public and in particular landowners.
11. Document wintering sage-grouse locations. Develop a seasonal range map for sage-grouse for the Working Group Area based on guidelines provided in the Wyoming Sage-grouse Conservation Plan.
12. Document lek perimeters to ensure adequate buffer distance in protecting leks.

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South Central Conservation Area
Job Completion Report

Species: **Sage-grouse** Conservation Plan Area: **South Central**
Period Covered: **June 1, 2011 – May 31, 2012** Sage-Grouse Mgmt Area: **H**
Prepared by: **Grant Frost and Will Schultz**

Introduction

The South Central Conservation Area (SCCA) generally includes The Platte Valley, Laramie Plains, Great Divide Basin, North Ferris, south Sweetwater and Little Snake River Valley in the counties of Carbon, Sweetwater, Albany, Fremont and Natrona in southern Wyoming (Figure 1). The SCCA is mostly public land and is administered by the Bureau of Land Management (BLM), the USDA Forest Service and State of Wyoming (Figure 2). A major portion of the SCCA is "checkerboard" land ownership (alternating public and private lands within 20 miles of the railroad) along the railroad corridor in the center of the western portion of the area. Major habitat types include sagebrush/grassland, salt desert shrub, short-grass prairie, mixed mountain shrub, mixed forest types, agricultural, riparian, and urban types. Transportation corridors include Interstate 80 (I-80), Union Pacific Railroad (mostly parallel to I-80), and State Highways 70, 789, 287, 230/130. Major cities and towns found in the area are Rawlins, Laramie, Saratoga, Encampment, Baggs, and Wamsutter. There are 329 occupied, 20 unknown, and 32 unoccupied leks in the SCCA. About 57% of the sage-grouse leks are on BLM administered land, 33% are on private and 6% on state owned lands.

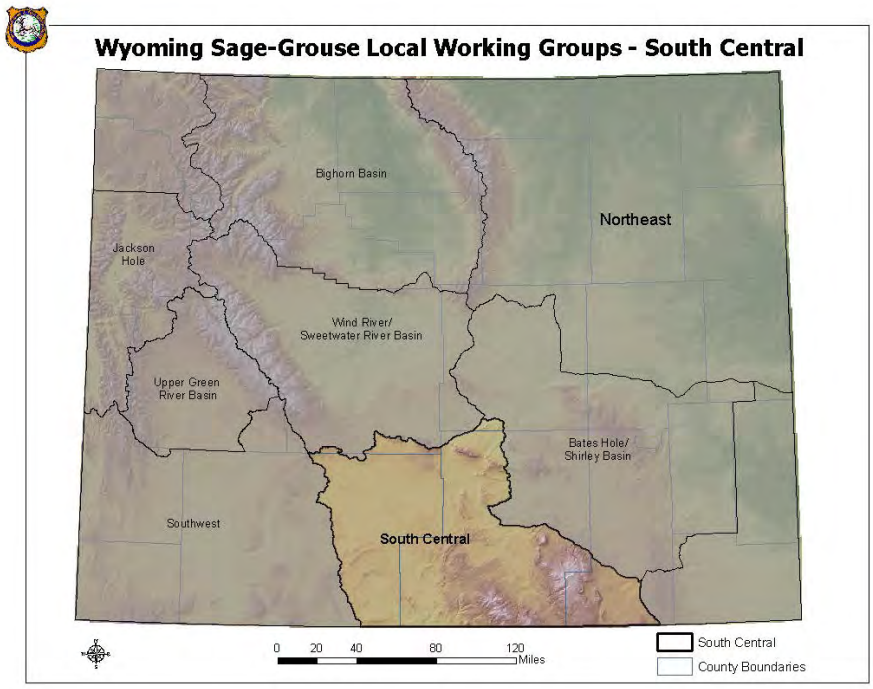

Figure 1. South Central Local Working Group area.

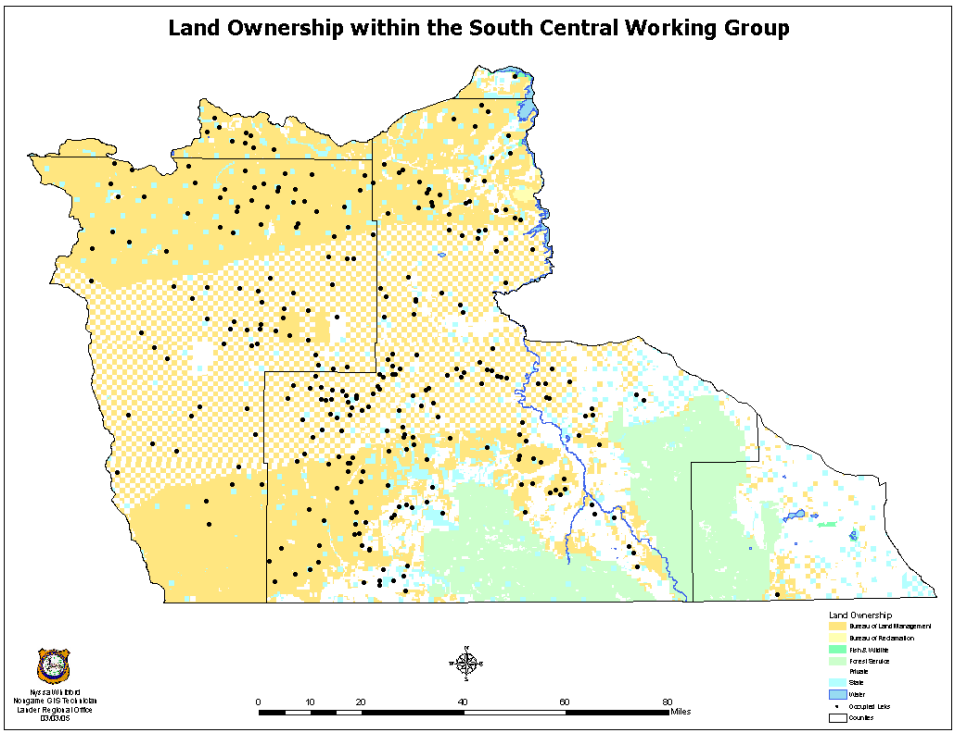

Figure 2. Landownership within the South Central Working Group Area.

The SCCA Sage-grouse Local Working Group (LWG) was initiated in September of 2004 and completed their Sage-grouse Conservation Plan (Plan) in 2007. The SCCA LWG now meets 1-2 times per year, with additional meetings if needed. Project implementation is currently underway with several projects completed, and several more planned for the next 2-3 years.

In an unprecedented move to coordinate sage grouse conservation efforts across the State of Wyoming, Gov. Dave Freudenthal released an Executive Order on Aug. 1, 2008 that established "Wyoming's Core Area Strategy." The Core Area strategy directs state agencies to work to maintain and enhance important greater sage-grouse habitat identified in Wyoming. Strategy updates were prepared during the spring and summer of 2010 by the Governor's Sage-Grouse Implementation Team, and issued in a new Executive Order by Governor Freudenthal on August 18, 2010 to replace that from 2008. Matt Mead was elected governor in November, 2010, and after evaluation issued a new Executive Order on June 2, 2011 (Executive Order 2011-5) that maintained the overall purpose and strategy but added new language meant to add flexibility and clarify agency implementation of the strategy.

In the SCCA, refinements to the Core Area map resulted in a large portion of Core Area south of Rawlins, identified under the Version 2 map, being eliminated to facilitate the proposed development of a large wind farm (Figure 3). Conversely, a large portion of sage-grouse range in the SCCA, southeast of

Encampment, was added to the Core Area map to provide for enhanced protection of habitat and possible connectivity with sage-grouse in the North Park, Colorado area.

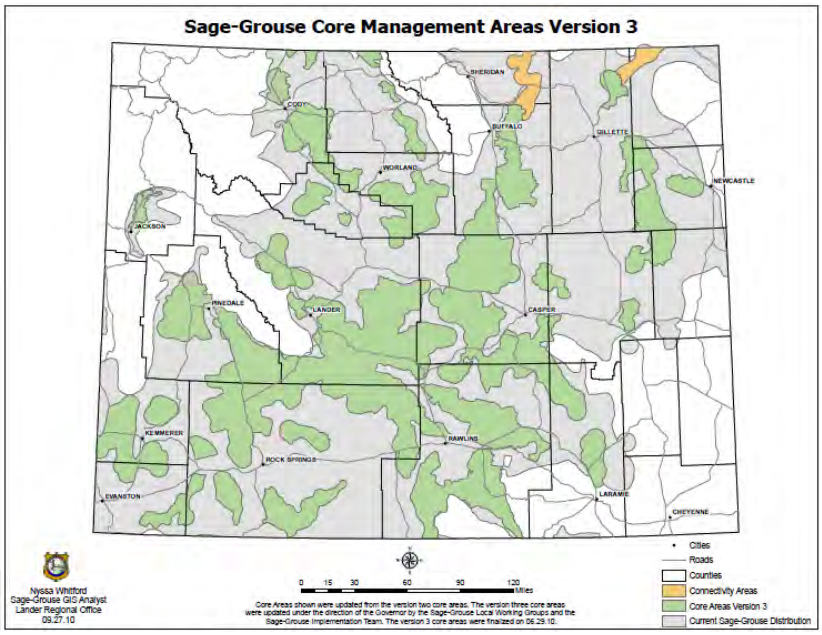

Figure 3. Wyoming sage-grouse Core Area map (V.3).

Weather

The National Climate Data Center/National Oceanic and Atmospheric Administration (NCDC/NOAA) has divided Wyoming into 10 climatic divisions for the purpose of weather data recording (Figure 4). These divisions correspond to major watersheds within the state. Wyoming's climatic division 10, the Upper Platte, covers much of the SCCA. Climatic data for all divisions can be found at the NCDC/NOAA web site: http://www.ncdc.noaa.gov/oa/ncdc.html .

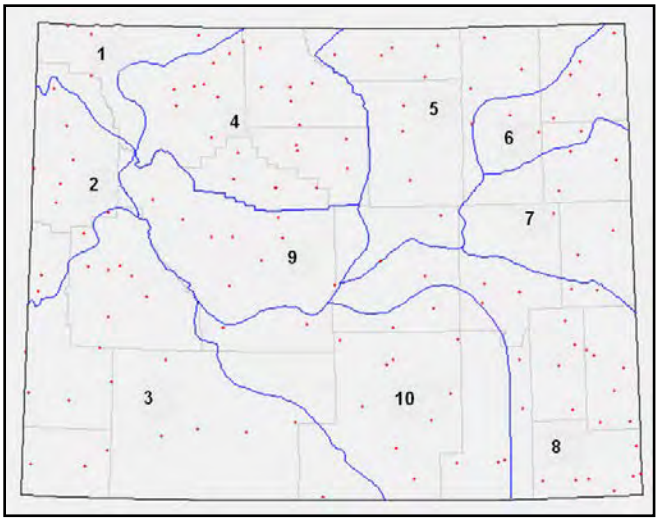

Figure 4. NCDC/NOAA, State of Wyoming Climate Division Map.

The Palmer Drought Severity Index (http://www.drought.noaa.gov/palmer.html) uses temperature and precipitation data to determine dryness. Palmer Severity Indices indicate that, over the previous 30 years there is a pattern of short periods of time where the area is wetter than normal interspersed with longer periods of moderate to severe drought (Figure 5). The years 2009-11 were a short period of wetter than average, but 2012 returned to a drought condition.

Bio-year temperatures were generally above average in the Upper Platte Climatic Division (Figure 6). The winter of 2011-12 was dryer and warmer than the winter of 2010-11. During bio-year 2011, precipitation was below average overall in the Upper Platte Climatic Division (Figure 7). Precipitation in March-June of 2012 was well below average. The warm and extremely dry conditions in May and June of 2012 likely contributed to reduced nesting success and chick survival.

Spring habitat conditions are one of the most important factors in determining nesting success and chick survival. Specifically, shrub height, live and residual grass height and cover, and forb cover have a large impact on sage-grouse nesting success. The shrub and grasses provide screening cover from predators and weather while the forbs provide forage and also provide insects that reside in the forbs. Spring precipitation is an important determinant of the quality and quantity of these vegetation characteristics. Residual grass height and cover depends on the previous year's growing conditions and grazing pressure while live grass and forb cover are largely dependent on the current year's precipitation. Increased springtime precipitation in 2009-2011 did not result in increased sage-grouse numbers, possibly due to timing, and the drought conditions in spring and early summer 2012 may have been another blow to local populations.

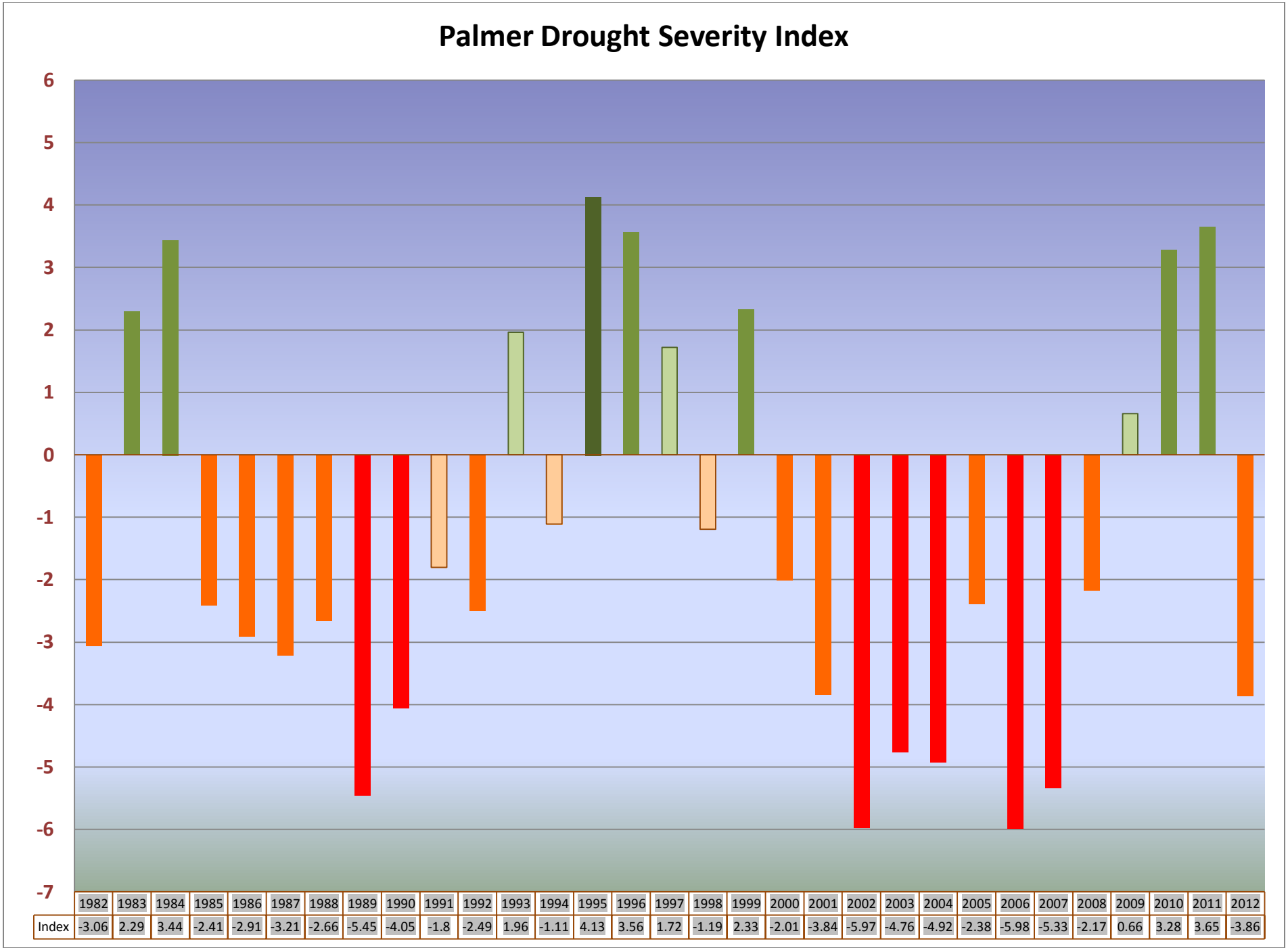

Figure 5. Drought severity trend from 1982 – 2012, Wyoming Climate Division 10

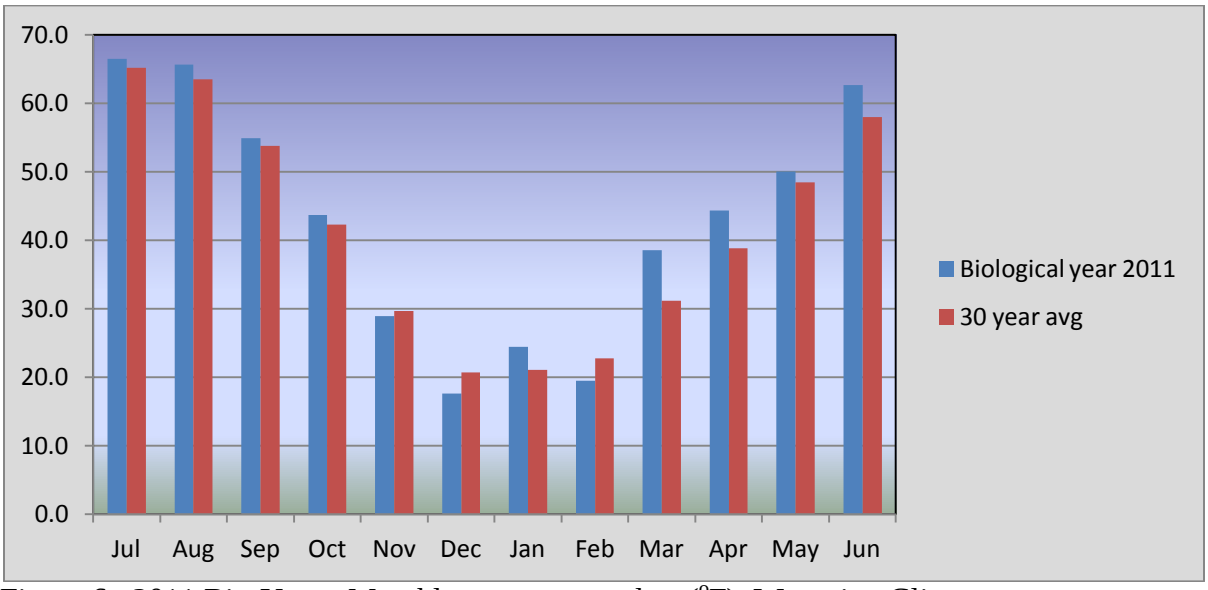

Figure 6. 2011 Bio-Year: Monthly temperature data (^{o}F), Wyoming Climate Division 10.

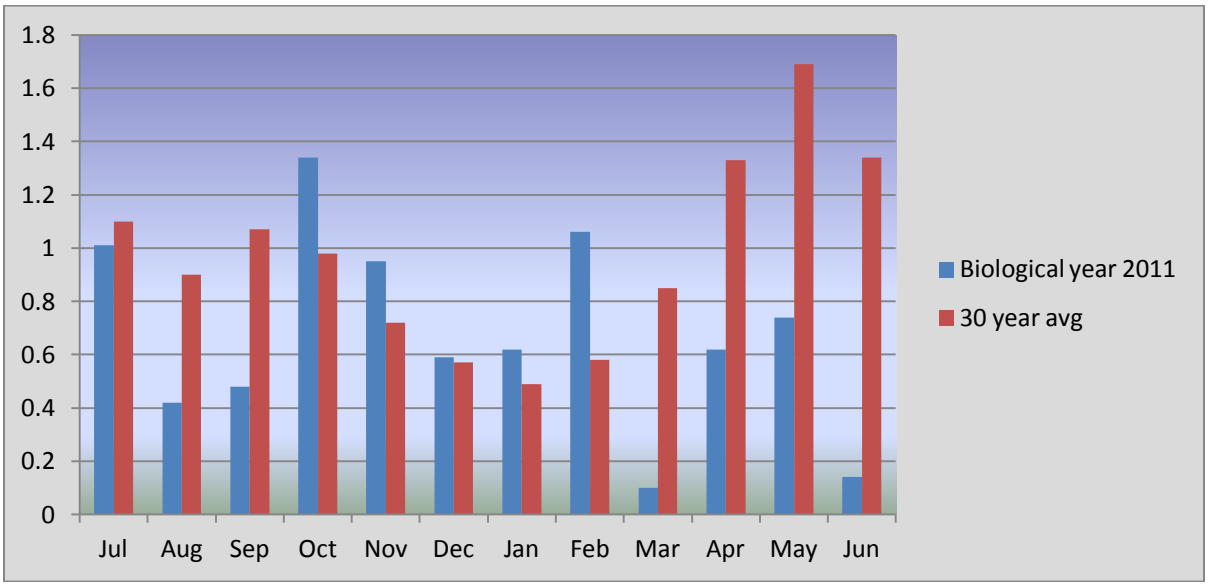

Figure 7. 2011 Bio-Year: Monthly precipitation data (in), Wyoming Climate Division 10.

Habitat

There are several energy projects within the SCCA. Most of this activity is producing natural gas from both deep gas and coal bed methane sources. In

addition to natural gas, wind energy permit proposals are being submitted to the Rawlins BLM office. A 1,000 turbine wind energy development, known as the Chokecherry/Sierra Madre wind energy project, is proposed to be located immediately south of Rawlins. While wind energy is clean and renewable, it is still an industrial development that has potential impacts to sage-grouse (and other wildlife) habitats and populations. There has been no research specific to the potential impacts of wind energy developments on sage-grouse, so it is unknown, and to what extent, if these projects will have an impact on sage-grouse. However, documented impacts from similar anthropogenic disturbances like natural gas development suggest wind power development will negatively affect sage-grouse. Moreover, documented impacts of wind turbines and associated transmission lines to other species, suggest impacts to sage-grouse are likely. Research was recently initiated to characterize and quantify these impacts (see "Special Studies" below).

The State of Wyoming released Gov. Dave Freudenthal's Executive Order on Aug. 1, 2008 that established "Wyoming's Core Area Strategy." The Core Area strategy directs state agencies to work to maintain and enhance important greater sage-grouse habitat identified in Wyoming. The strategy has been updated and replaced twice since in a new executive order by Gov. Freudenthal on August 18, 2010, and by his successor Gov. Matt Mead on June 2, 2011.

In the SCCA, refinements to the Core Area map resulted in a large portion of Core Area south of Rawlins, identified under the Version 2 map, being eliminated to facilitate the proposed development of a large wind farm (Figure 3). Conversely, a large portion of sage-grouse range in the SCCA, southeast of Encampment, was added to the Core Area map to provide for enhanced protection of habitat and possible connectivity with sage-grouse in the North Park, Colorado area.

The Wyoming Landscape Conservation Initiative (WLCI) overlaps most of the SCCA and was established in 2007 in response to landscape scale industrial growth in southwest Wyoming. WLCI is a multi-agency, long-term, science-based program designed to assess and enhance aquatic and terrestrial habitats at the landscape scale, while facilitating responsible development through local collaboration and partnerships. The priority objectives addressed are fragmented habitats, invasive species, and water quality and quantity. The WLCI works to maintain, improve or restore ecological function and health.

Finally, recent communications between the Governor's Office, WGFD and the Service have resulted in wind energy development being discouraged/prohibited from sage-grouse Core Population Areas unless and until it can be demonstrated such activity will not cause sage-grouse population declines. This has major implications for potential wind development in the SCCA.

Lek Monitoring and Population Trend

The WGFD, BLM, consultants, and volunteers monitored 206 leks in the spring of 2012. This effort represented checking approximately 75% of the occupied status leks in the SCCA. This effort was down from the 78% of leks checked in 2011. The 2003-2012 average proportion of leks checked is 82%. The proportion of leks checked in the spring of 2012 was below the 10-year average.

A new sage-grouse database was developed in 2012 in order to improve efficiency, reduce errors, and better facilitate data analysis. Changes were made to the manner in which lek data are calculated and reported in Table 1. The new version is based solely on "occupied" leks. The past version suggested that was the case in the title of Table 1, but when unoccupied leks were monitored those data were also included in the Table. The result of this change is that the number of "known occupied" leks is now more accurate, but reflects fewer leks than in the previous version. Similarly, the new version calculates average male lek attendance using only monitoring observations where one or more male grouse were observed strutting. The old version included a count of "0" males for leks where activity was confirmed by the presence of sign but no birds were observed. Together, these two changes result in somewhat higher, but more accurate, average male attendance for active leks than previously reported. The changes do not result in any change in population trend based on average male lek attendance. Interpreted population increases and decreases over time remain the same so no revisions to past reports are required.

Since only "occupied" leks are being reported on Table 1, it is important to consider trends in the numbers of active versus inactive leks in addition to the average size of active leks. During a period of population decline, the size of active leks typically declines and the number of inactive leks increases. The converse is typically true of an increasing population. Therefore the magnitude of both increases and decreases is usually greater than what is indicated by the average lek size alone.

Average female lek attendance is no longer being reported since our data collection techniques is not designed to accurately capture these data and is therefore not a useful figure in assessing population trend.

Monitoring the total number of males on a lek is used as an index of trend, but these data should be viewed with caution since survey effort has varied over time, leks have moved, birds move among leks in a complex, and other reasons that are explained on page 12 in the Wyoming Greater Sage-grouse Conservation Plan

(2003).

In 2012 (2011 biological year), observers counted a maximum of 1,521 males at count leks, averaging 28.2 males per active lek (Appendix B). This was down from averages of 33.2 and 31.0 observed in 2010 and 2011, respectively, and continues a steady decline since 2006. However, more leks are being counted, and this isn't the exact same set. Survey monitored leks, though not as accurate for trend data as count monitored leks, also exhibited a decline in average numbers of males per active lek; dropping from a combine average of about 22 males/lek for 2010-2011 to 19 males/lek in 2012. The decline is within the norms for cyclic variation and likely at least in part attributable to weather conditions in recent years. Again, there are different numbers of leks being surveyed, but the same steady decline since 2006 is seen. However, increasing levels of human development in the form of natural gas wells and infrastructure are also likely responsible based on the results of recently completed research in other parts of Wyoming (Lyon and Anderson 2003, Holloran 2005, Kaiser 2006, Walker et al. 2007, Walker 2008 and Doherty 2008).

Harvest

The 2011 upland harvest survey indicated 591 hunters spent 1,483 days to harvest 1,261 sage-grouse in the SCCA. These hunter/harvest numbers are below the 10 year average. This equals about 0.9 birds/day, 2.2 birds/hunter, and 2.3 days/hunter. Compared to 2010 when hunting regulations were similar, hunter numbers increased by 21% in 2011, while the birds/day, and birds/hunter remained similar. It appears that the higher harvest is related to a larger number of hunters that pursued sage grouse in 2011, and not an increase in the population.

Hunter-harvested wings are collected at and used for estimating productivity. Wings were collected in barrels set at major road junctions where hunters are most likely to pass, and can provide a relatively consistent source of productivity data. Wings are gathered and then aged/sexed by molt patterns, and numbers of chicks/hen are calculated and used as a measure of productivity. This technique assumes hunter harvest is unbiased between sex and age classes, especially chicks and hens. Even if this assumption is not met, trends still provide yearly comparisons of relative chick production.

During the 2011 hunting season we collected 271 wings from wing barrels within the SCCA. This was an increase of 18% when compared to the 230 collected in 2010. Age and sex composition of the wings indicated the proportion of chicks/hen increased slightly from 1.2 in 2010 to 1.3 in 2011. Statewide analyses of wing data have suggested chick/hen ratios of 1.4-1.7 typically results in relatively stable populations as determined by lek counts the following year. The chicks/hen ratio observed in the 2011 wing data appeared to correlate with the lower population size and lower production we have documented in recent lek monitoring efforts in the SCCA.

Endangered Species Act Status

In December 2007 a federal District Court judge ordered the U.S. Fish and Wildlife Service (Service) to reconsider its 2005 decision of "not warranted" for listing Greater Sage-grouse as threatened or endangered under the Endangered Species Act. On March 5, 2010 the Service issued its new decision of "warranted but precluded" which means Greater Sage-grouse have become a "candidate" for listing but are precluded from immediate listing due to higher priorities. This status is reviewed annually by the Service.

In its decision document, the Service specifically cited Wyoming's Core Area Strategy as a mechanism that, if implemented as envisioned, should ensure conservation of sage-grouse in Wyoming and therefore help preclude a future listing.

The Wyoming Game and Fish Department and Commission maintain management authority over candidate species and management emphasis will continue to focus on implementation of the Core Area Strategy.

Special Studies

In conjunction with development of the proposed Chokecherry/Sierra Madre Wind Farm, located south of Rawlins, a multi-faceted sage-grouse research project was initiated in late 2010. The principal investigators include the consulting firm SWCA, University of Missouri, and US Forest Service. A similar wind development impacts research effort was also initiated in the 7-Mile/Simpson Ridge area which is within the Bates Hole/Shirley Basin Conservation Area immediately adjacent to the SCCA. Principal investigators include W.E.S.T. Inc., Wyoming Wildlife Consultants, Inc. and the University of Wyoming.

Finally, a master's thesis was completed in the spring of 2012 by University of Wyoming student Christopher Kirol (Kirol 2012). The South-Central Local Sage-Grouse Working Group provided some of the funding for this research. The abstract of the thesis follows:

Kirol, C. P. 2012. Quantifying habitat importance for greater sage-grouse (*Centrocercus urophasianus*) population persistence in an energy development landscape. Thesis. University of Wyoming, Laramie.

Abstract

Landscapes undergoing intensive energy extraction activities present challenges to the persistence of wildlife populations. Much of the oil and gas resources in western North America, underlie

sagebrush (*Artemisia* spp.) ecosystems. The greater sage-grouse (*Centrocercus urophasianus*) is a sagebrush obligate that is dependent on this ecosystem for its entire life-cycle. Greater sage-grouse are of concern because they have shown a precipitous decline in numbers and distribution over the last half century. The decline in greater sage-grouse populations is largely attributed to extensive alteration and loss of habitat. As a consequence of this decline, the greater sage-grouse was recently listed under the Endangered Species Act of 1973 as warranted but precluded (USFWS 2010). Oil and gas development has been identified as the one of the leading threats to the species in the eastern portion of its range, which includes Wyoming. Concerns in areas that oil and gas development and greater sage-grouse overlap include direct habitat loss, habitat fragmentation, effective habitat loss due to avoidance behavior, and reduced fitness rates including lower nest success. To address these concern I developed research objectives to: 1) spatially quantify habitat quality for female greater sage-grouse during the reproductive period in the Atlantic Rim Project Area (ARPA) of south-central, Wyoming, which was being developed for coalbed natural gas (CBNG) resources, 2) utilize a non-impacted offsite reference area (Stewart Creek [SC]) to assess factors potentially contributing to changes in habitat quality resulting from energy development during the nesting period, and 3) explore microhabitat conditions that were crucial to female greater sage-grouse reproduction. To achieve my objectives I monitored radio-marked female greater sage-grouse throughout the reproductive period in 2008 and 2009.

In a geographic information system (GIS) framework, I quantified habitat quality for greater sage-grouse in the ARPA by generating a suite of habitat-specific environmental and anthropogenic variables at three landscape scales. With these variables, I modeled greater sage-grouse habitat occurrence and fitness outcomes for each female life-stage. The final occurrence models were in the form of resource selection functions (RSFs). I modeled fitness as relative survival probabilities and included them in a population growth rate function. The RSFs and population growth rate function were combined into an ecological model predicting sink and source habitats as well as a continuous habitat quality measure on the landscape. My results showed that environmental and anthropogenic variables at multiple spatial scales were predictive of female greater sage-grouse occurrence and fitness. Anthropogenic variables related to CBNG development were predictive in all of the final occurrence models, suggesting that anthropogenic features were resulting in habitat avoidance through all summer life-stages. My fitness modeling illustrated habitat-specific and scale dependent variation in survival across the ARPA landscape. When mapped, the final ecological model identified habitat patches that were contributing the most to population persistence and that source-sink dynamics within the ARPA landscape may be shifting as a result of CBNG development.

Documenting an anthropogenic impact that has already occurred yields limited inference unless a means of comparison is incorporated. I evaluated habitat and demographic responses of greater sage-grouse during nesting by comparing an energy development landscape (ARPA) to a non-impacted landscape (SC). I accomplished this by spatially shifting my nest occurrence and survival models from the ARPA to SC. In addition, I compared nest survival rates between the areas. My nest occurrence and survival models were predictive in SC without the CBNG predictor variable. Specific environmental variables that were robust predictors of nest occurrence in both areas included big sagebrush canopy cover and litter that represented dead standing woody vegetation and detached organic matter both at a 0.25-km^2 scale. Further, the variability in shrub heights at a 1.0-km^2 scale at was highly predictive of nest survival in both areas. The evidence of the predictive ability of my nest occurrence models in SC and the habitat likeness between areas allowed me to assess what greater sage-grouse nest selection in the ARPA might have looked like prior to the introduction of CBNG development by replacing time (pre-development data) with space (using SC as a spatial control). I modeled the ARPA RSF against the SC nest occurrence data (i.e., nest selection in the absence of CBNG development) and then spatially shifted the adjusted model back to the ARPA. However, the range of variability in habitat conditions between the ARPA and SC caused the spatial

shifting of the models to function poorly in practice. This elucidates an important consideration in choosing spatial control related habitat variability and the predictive errors associated with extrapolation out of the range of the data used to train the RSF. Thus for a spatial control to function well, not only do habitat conditions need to be similar to the impacted area but the range of variability in habitat conditions need to also be comparable. Nest survival was significantly higher in SC compared to the ARPA but my nest survival model did not explain this difference. In conclusion, the reference area provided additional information on possible impacts of CBNG development in the ARPA; however, inference was limited without pre-development data.

Understanding habitat selection at macrohabitat and microhabitat scales is critical to conserving and restoring greater sage-grouse habitat. Because of the similar ecological conditions, my microhabitat selection analysis for the greater sage-grouse during the nesting, early and late brood-rearing periods incorporated both the ARPA and SC. Nest microhabitat selection was positively correlated with mountain big sagebrush (*A. tridentata vaseyana*) and litter cover. I found that female greater sage-grouse preferred areas with greater sagebrush cover and greater perennial grass cover during early and late brood-rearing. However, I did not find forb cover to be predictive of early or late brood-rearing occurrence. My findings suggest that sage-grouse inhabiting xeric sagebrush habitats (≤25 cm annual precipitation) rely on sagebrush cover and grass structure for nesting as well as brood-rearing and that these structural characteristics may be more important than forb availability at the microhabitat scale.

Disease

No disease mortalities for sage-grouse were reported within the SCCA during this period.

Conservation Plan Implementation

The projects being implemented by the SCCA Local Sage-Grouse Working Group in accordance with the SCCA Conservation Plan are shown in Table 1. Additional information can be viewed at:

http://wgfd.wyo.gov/web2011/wildlife-1000817.aspx

Project Name	Biennium	Amount granted	Grantee/Project Sponsor	Project Description
Atlantic Rim SG Distribution Study	2007-2010	$30,000	BLM - Rawlins FO, WGFD	Sage-grouse habitat use telemetry study relative to Atlantic Rim Gas Field Development
Red Rim Water Development	2007-2008	$10,000	WGFD	Water development
Winter Range Survey	2007-2008	$7,000	WGFD	Sage-grouse winter distribution flights
Stratton Sagebrush Ecology Site	2007-2010	$68,300	Colorado State University	Master's research evaluating prescribed fire and grazing impacts to sage-grouse and other wildlife
Identifying habitats for Greater Sage-Grouse population persistence within the Atlantic Rim, Wyoming coalbed methane field	2009-2010	$56,590	University of Wyoming	Expansion of Atlantic Rim SG distribution study listed above
Buck Draw Solar Well	2009-2010	$3,000	BLM - Rawlins FO	Water development
Statewide Water Trough Escape Ramp, Fence Markers and Spring Fencing	2007-2008	$33,000	Niobrara Conservation District	Making escape ramps, fence markers and spring protection fence available to landowners and agencies - statewide
Statewide Seasonal Habitat Map	2009-2010	$141,000	USGS, WY Wildlife & Nat. Res. Trust	Statewide project that uses remotely sensed vegetation data and telemetry relocations to develop seasonal habitat models and maps
Impacts of Ravens on SG nests in southern WY	2011-2012	$102,892	Utah State University	Research to determine raven impacts and raven control to sage-grouse
Impacts of wind energy development in SE Wyoming	2011-2012	$85,000	National Wind Coordinating Collaborative, Western Assoc. of Fish & Wildlife Agencies	Research to establish the short-term effects of wind development to sage-grouse
Fence collision markers	2011-2012	$42,000	Medicine Bow Conservation District, WGFD, private landowners, BLM	Volunteer construction and placement of fence markers to prevent/mitigate sage-grouse fence collisions

Table 1. Projects being implemented in the SCCA with legislative funding made available to the Local Sage-Grouse Working Group.

Recommendations

1) Improve efforts to survey leks of unknown status.
2) Support LWG efforts to work on reclamation issues, especially seed mixes that benefit sage-grouse.
3) Continue to update data from SCCA in the sage-grouse database.
4) Support efforts to continue the sage-grouse research project in the Atlantic Rim project area.
5) Continue to map seasonal habitats, especially winter habitats.
6) Work with BLM (through LWG) to ensure that burns and treatments in and around sage-grouse habitat meet sage-grouse habitat treatment prescriptions.
7) Build partnerships with private landowners to maintain or improve sage-grouse habitats on private lands through mutually beneficial habitat projects.

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Sage Grouse Job Completion Report

Year: 2003 - 2012, Working Group: South Central

1. Lek Attendance Summary (Occupied Leks) (1)

a. Leks Counted

Year	Occupied	Counted	Percent Counted	Peak Males	Avg Males / Active Lek (2)
2003	258	40	16	1319	37.7
2004	256	35	14	1348	43.5
2005	253	27	11	1453	58.1
2006	250	39	16	2106	58.5
2007	250	47	19	2090	48.6
2008	258	49	19	1683	37.4
2009	262	68	26	2021	33.7
2010	267	54	20	1528	33.2
2011	265	50	19	1272	31.0
2012	276	57	21	1521	28.2

b. Leks Surveyed

Year	Occupied	Surveyed	Percent Surveyed	Peak Males	Avg Males / Active Lek (2)
2003	258	170	66	2487	20.6
2004	256	176	69	2677	21.2
2005	253	184	73	4882	36.7
2006	250	181	72	5564	40.3
2007	250	176	70	4523	35.1
2008	258	151	59	3085	28.0
2009	262	152	58	2648	24.7
2010	267	170	64	2849	21.9
2011	265	158	60	2502	22.1
2012	276	149	54	1762	18.7

1) Occupied - Active during previous 10 years (see official definitions)

2) Avg Males/Active Lek - Includes only those leks where one or more strutting males were observed. Does not include "Active" leks where only sign was documented.

3) Inactive - Confirmed no birds/sign present (see official definitions)

Sage Grouse Job Completion Report

Year: 2003 - 2012, Working Group: South Central

1. Lek Attendance Summary (Occupied Leks) (1) Continued

c. Leks Checked

Year	Occupied	Checked	Percent Checked	Peak Males	Avg Males / Active Lek (2)
2003	258	210	81	3806	24.4
2004	256	211	82	4025	25.6
2005	253	211	83	6335	40.1
2006	250	220	88	7670	44.1
2007	250	223	89	6613	38.4
2008	258	200	78	4768	30.8
2009	262	220	84	4669	28.0
2010	267	224	84	4377	24.9
2011	265	208	78	3774	24.5
2012	276	206	75	3283	22.2

d. Lek Status

Year	Active	Inactive (3)	Unknown	Known Status	Percent Active	Percent Inactive
2003	161	18	79	179	89.9	10.1
2004	161	7	88	168	95.8	4.2
2005	158	16	79	174	90.8	9.2
2006	173	24	53	197	87.8	12.2
2007	175	21	54	196	89.3	10.7
2008	163	17	78	180	90.6	9.4
2009	176	38	48	214	82.2	17.8
2010	181	29	57	210	86.2	13.8
2011	161	44	60	205	78.5	21.5
2012	157	43	76	200	78.5	21.5

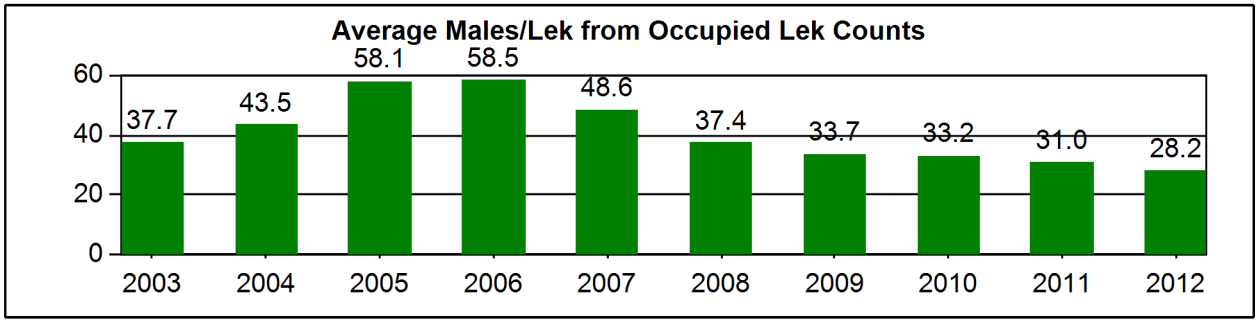
1) Occupied - Active during previous 10 years (see official definitions)

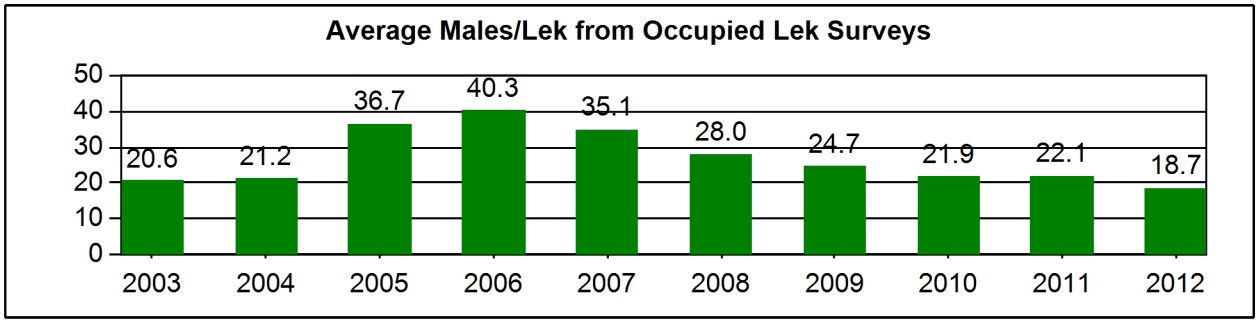
2) Avg Males/Active Lek - Includes only those leks where one or more strutting males were observed. Does not include "Active" leks where only sign was documented.

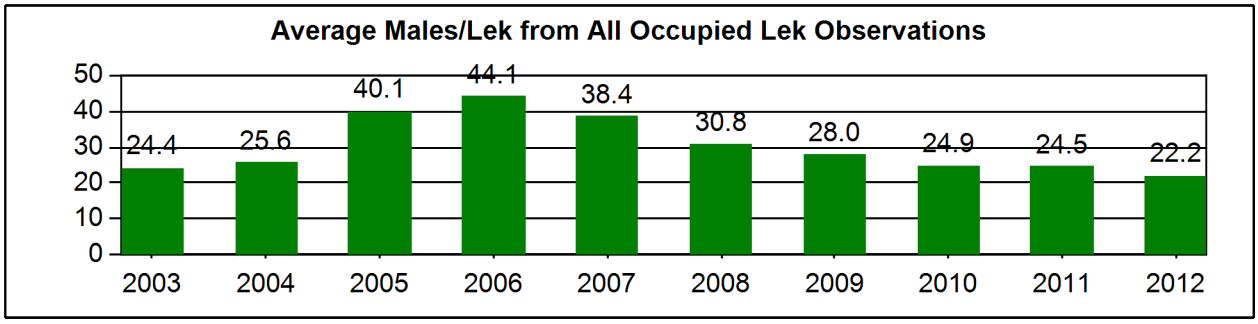
3) Inactive - Confirmed no birds/sign present (see official definitions)

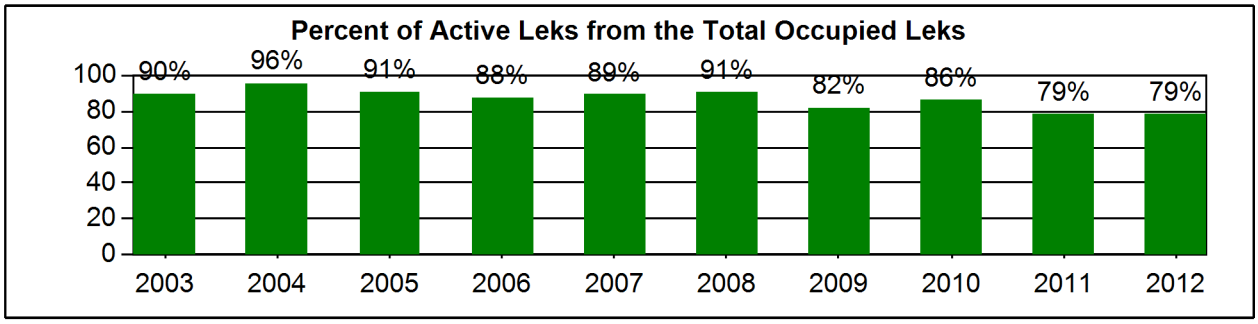
Sage Grouse Occupied Lek Attendance Summary

Year: 2003 - 2012, Working Group: South Central



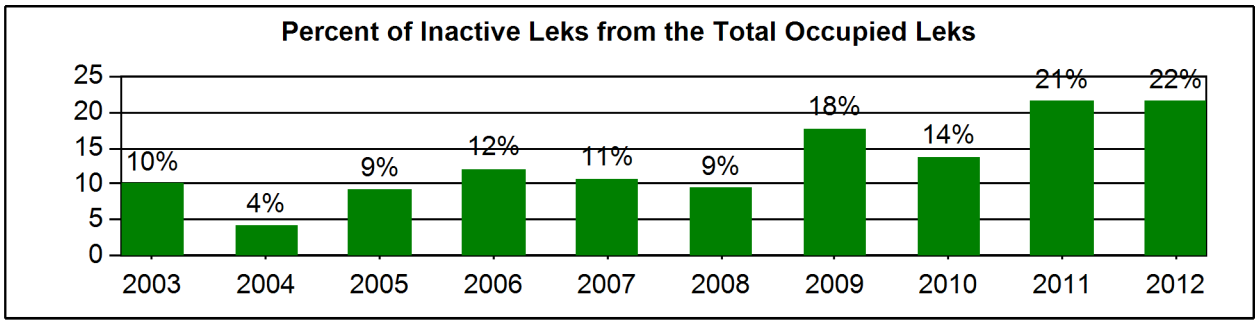






Sage Grouse Occupied Lek Attendance Summary

Year: 2003 - 2012, Working Group: South Central



Sage Grouse Lek Characteristics

Working Group: South Central

Region	Number	Percent
Green River	97	25.3
Lander	232	60.4
Laramie	55	14.3

Working Group	Number	Percent
South Central	384	100.0

Classification	Number	Percent
Occupied	329	85.7
Undetermined	20	5.2
Unoccupied	35	9.1

BLM Office	Number	Percent
Casper	2	0.5
Lander	23	6.0
Rawlins	345	89.8
Rock Springs	14	3.6

Biologist	Number	Percent
Baggs	97	25.3
Laramie	6	1.6
Rawlins	216	56.3
Saratoga	49	12.8
South Lander	16	4.2

Warden	Number	Percent
	14	3.6
Baggs	108	28.1
East Rawlins	56	14.6
Elk Mountain	6	1.6
North Laramie	1	0.3
Saratoga	43	11.2
South Laramie	5	1.3
West Rawlins	151	39.3

County	Number	Percent
Albany	6	1.6
Carbon	261	68.0
Fremont	13	3.4
Natrona	2	0.5
Sweetwater	102	26.6

Land Status	Number	Percent
BLM	220	57.3
BLM/Private	10	2.6
Not Determined	2	0.5
Private	126	32.8
Private/BLM	1	0.3
State	21	5.5
State/Private	1	0.3
USF&WS	1	0.3
WGFC	1	0.3
WGFD	1	0.3

Management Area	Number	Percent
F	1	0.3
H	383	99.7

Sage Grouse Job Completion Report

Year: 2002 - 2011, Management Area: H

4. Sage Grouse Hunting Seasons and Harvest Data

a. Season

Year	Season Start	Season End	Length	Bag/Possesion Limit
2002	Sep-28	Oct-6	9	2/4
2003	Sep-27	Oct-5	9	2/4
2004	Sep-23	Oct-3	11	2/4
2005	Sep-23	Oct-3	11	2/4
2006	Sep-23	Oct-3	11	2/4
2007	Sep-22	Oct-2	11	2/4
2008	Sep-22	Oct-2	11	2/4
2009	Sep-19	Sep-30	12	2/4
2010	Sep-18	Sep-30	13	2/4
2011	Sep-17	Sep-30	14	2/4

b. Harvest

Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2002	1140	491	1442	0.8	2.3	2.9
2003	728	294	750	1.0	2.5	2.6
2004	1626	947	1986	0.8	1.7	2.1
2005	2647	1112	2290	1.2	2.4	2.1
2006	1491	836	1738	0.9	1.8	2.1
2007	1386	739	1531	0.9	1.9	2.1
2008	1773	743	1511	1.2	2.4	2.0
2009	1619	726	1474	1.1	2.2	2.0
2010	1126	487	1165	1.0	2.3	2.4
2011	1261	591	1483	0.9	2.1	2.5
Avg	1,480	697	1,537	1.0	2.2	2.3

Sage Grouse Job Completion Report

Year: 2002 - 2011, Working Group: South Central

5. Composition of Harvest by Wing Analysis

Year	Sample Size	Percent Adult		Percent Yearling		Percent Young		Chicks/ Hens
		Male	Female	Male	Female	Male	Female	
2002	203	10.8	29.1	2.0	8.4	13.3	36.5	1.3
2003	310	13.2	28.4	0.3	4.5	24.8	28.4	1.6
2004	284	7.4	22.5	0.4	5.3	30.3	34.2	2.3
2005	345	13.6	27.8	3.8	4.6	20.0	30.1	1.5
2006	315	16.8	28.3	3.8	5.4	21.6	24.1	1.4
2007	199	20.1	35.2	7.0	12.6	10.6	14.6	0.5
2008	233	8.2	24.5	2.1	4.7	26.2	33.9	2.1
2009	282	15.2	23.8	8.5	9.9	15.6	27.0	1.3
2010	230	10.4	33.9	1.3	6.5	13.0	22.2	1.2
2011	271	11.8	29.2	3.0	7.4	20.7	27.7	1.3

Sage Grouse Wing Analysis Summary

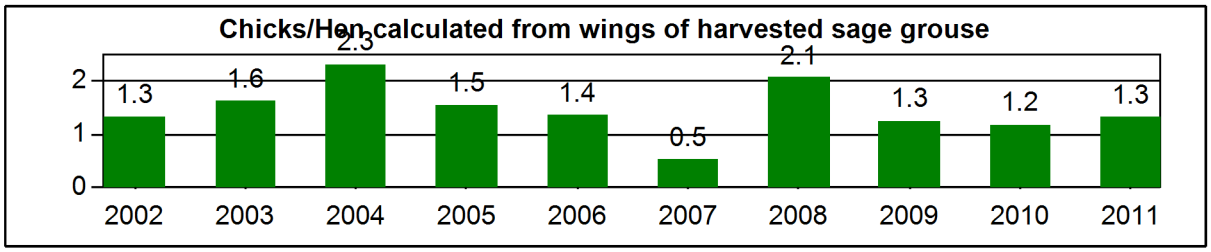
Year: 2011, Working Group: South Central

Adult Males:	32	% of All Wings:	11.8
Adult Females:	79	% of All Wings:	29.2
Adult Unknown:	1	% of All Wings:	0.4
Total Adults:	112		
Yearling Males:	8	% of All Wings:	3.0
Yearling Females:	20	% of All Wings:	7.4
Yearling Unknown:	0	% of All Wings:	0.0
Total Yearlings:	28		
Chick Males:	56	% of All Wings:	20.7
Chick Females:	75	% of All Wings:	27.7
Chick Unknown:	0	% of All Wings:	0.0
Total Chicks:	131		
Unknown Sex/Age:	1		
Total for all Sex/Age Groups:	**271**		
Chick Males:	56	% of All Chicks	42.7
Yearling Males:	8	% of Adult and Yearling Males	20.0
Adult Males:	32	% of Adult and Yearling Males	80.0
Adult and Yearling Males:	40	% of Adults and Yearlings	28.6
Total Males:	96	% of All Sex/Age Groups	35.6
Chick Females:	75	% of All Chicks	57.3
Yearling Females:	20	% of Adult and Yearling Females	20.2
Adult Females:	79	% of Adult and Yearling Females	79.8
Adult and Yearling Females:	99	% of Adults and Yearlings	70.7
Total Females:	174	% of All Sex/Age Groups	64.4
Chicks:	131	% of All Wings:	48.3
Yearlings:	28	% of All Wings:	10.3
Adults:	112	% of All Wings:	41.3

Sage Grouse Wing Analysis Summary

Year: 2011, Working Group: South Central

Chicks/Hen	1.3



Southwest
Sage-Grouse
Job Completion Report
2010

June 2010-May 2011

Patrick Burke
Wyoming Game & Fish Dept.
Green River Region

Sage Grouse Job Completion Report

Year: 2003 - 2012, Working Group: Southwest

Table 1. Lek Attendance Summary (Occupied Leks) (1)

a. Leks Counted

Year	Occupied	Counted	Percent Counted	Peak Males	Avg Males / Active Lek (2)
2003	211	59	28	1460	26.1
2004	224	50	22	1389	30.2
2005	229	59	26	2955	51.8
2006	240	67	28	4153	62.9
2007	257	68	26	3840	58.2
2008	267	69	26	4284	63.0
2009	285	70	25	2589	39.8
2010	291	77	26	2191	30.9
2011	301	74	25	1855	26.9
2012	309	81	26	1697	23.2

b. Leks Surveyed

Year	Occupied	Surveyed	Percent Surveyed	Peak Males	Avg Males / Active Lek (2)
2003	211	112	53	1705	21.9
2004	224	109	49	1642	21.3
2005	229	117	51	3424	36.8
2006	240	152	63	3973	37.5
2007	257	176	68	5791	42.9
2008	267	149	56	3951	33.2
2009	285	190	67	5485	35.2
2010	291	185	64	3714	26.2
2011	301	167	55	2900	21.2
2012	309	189	61	2889	20.8

1) Occupied - Active during previous 10 years (see official definitions)

2) Avg Males/Active Lek - Includes only those leks where one or more strutting males were observed. Does not include "Active" leks where only sign was documented.

3) Inactive - Confirmed no birds/sign present (see official definitions)

Sage Grouse Job Completion Report

Year: 2003 - 2012, Working Group: Southwest

1. Lek Attendance Summary (Occupied Leks) (1) Continued

c. Leks Checked

Year	Occupied	Checked	Percent Checked	Peak Males	Avg Males / Active Lek (2)
2003	211	171	81	3165	23.6
2004	224	159	71	3031	24.6
2005	229	176	77	6379	42.5
2006	240	219	91	8126	47.2
2007	257	244	95	9631	47.9
2008	267	218	82	8235	44.0
2009	285	260	91	8074	36.5
2010	291	262	90	5905	27.7
2011	301	241	80	4755	23.1
2012	309	270	87	4586	21.6

d. Lek Status

Year	Active	Inactive (3)	Unknown	Known Status	Percent Active	Percent Inactive
2003	134	40	37	174	77.0	23.0
2004	130	25	69	155	83.9	16.1
2005	152	19	58	171	88.9	11.1
2006	183	43	14	226	81.0	19.0
2007	214	35	8	249	85.9	14.1
2008	195	25	47	220	88.6	11.4
2009	233	33	19	266	87.6	12.4
2010	225	28	38	253	88.9	11.1
2011	220	15	66	235	93.6	6.4
2012	229	35	45	264	86.7	13.3

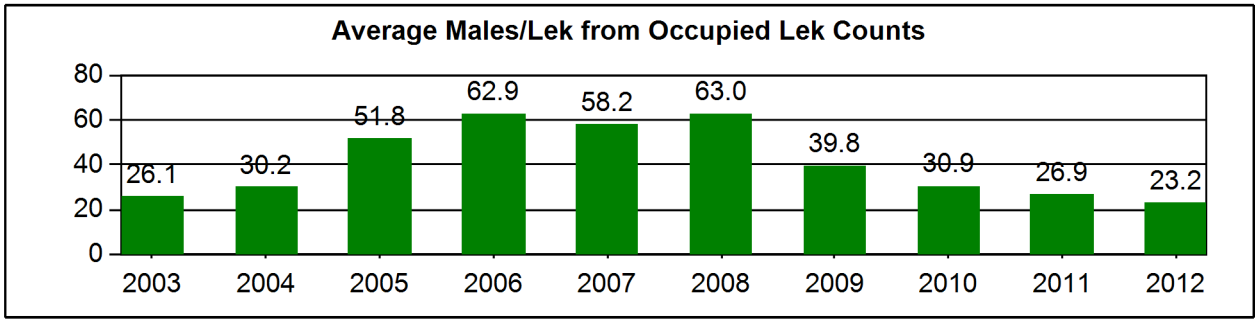
1) Occupied - Active during previous 10 years (see official definitions)

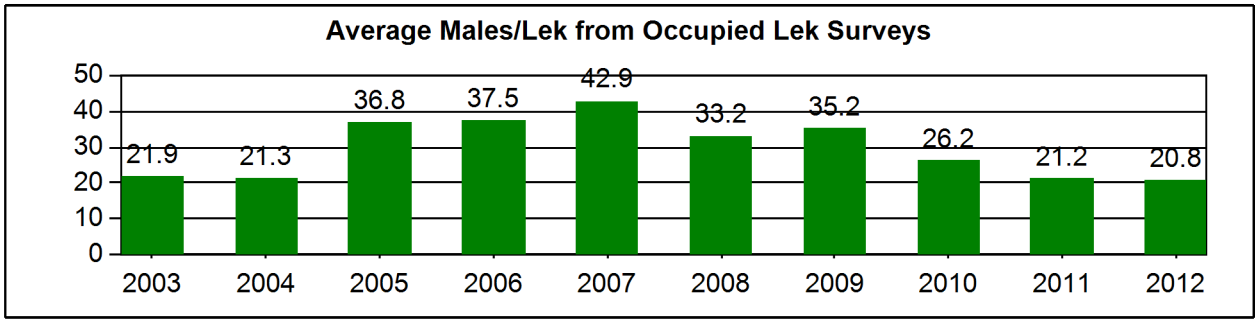
2) Avg Males/Active Lek - Includes only those leks where one or more strutting males were observed. Does not include "Active" leks where only sign was documented.

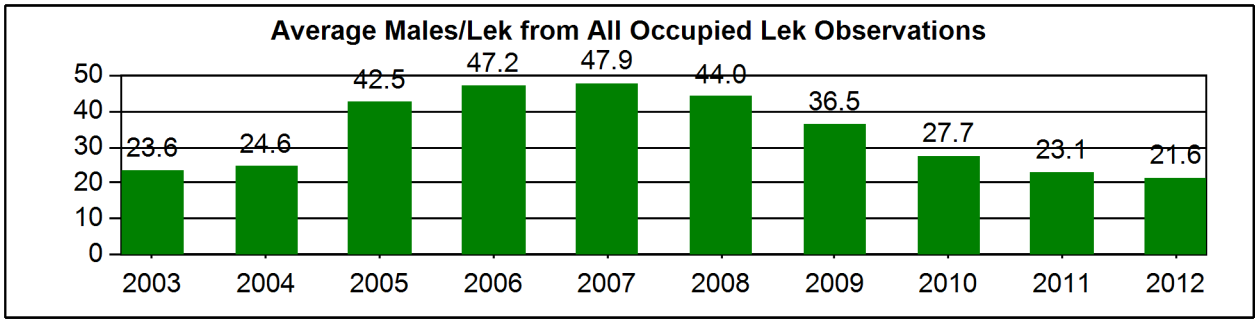
3) Inactive - Confirmed no birds/sign present (see official definitions)

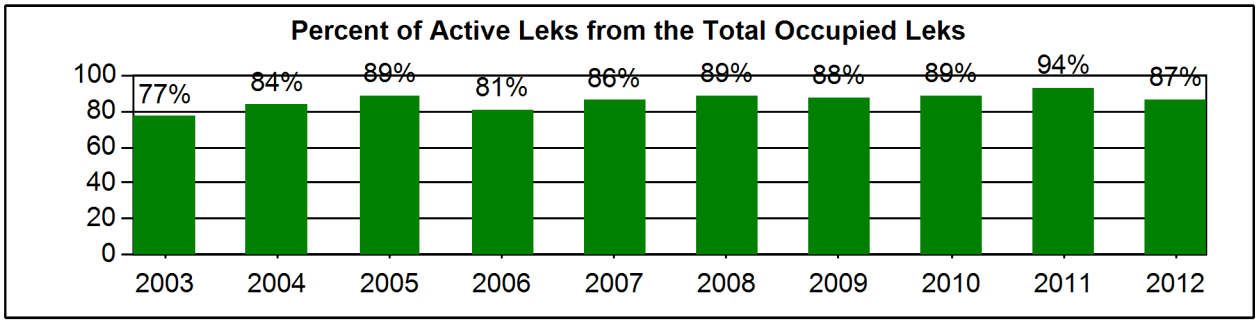
Figures 1a-e Sage Grouse Occupied Lek Attendance Summary

Year: 2003 - 2012, Working Group: Southwest



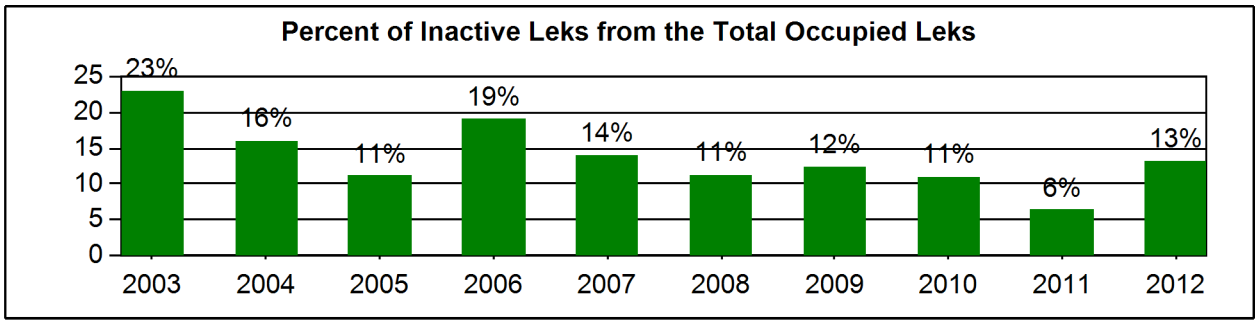






Sage Grouse Occupied Lek Attendance Summary

Year: 2003 - 2012, Working Group: Southwest



Sage Grouse Job Completion Report

Year: 2002 - 2011, Management Area: Southwest

Table 2. Sage Grouse Hunting Seasons and Harvest Data

a. Season

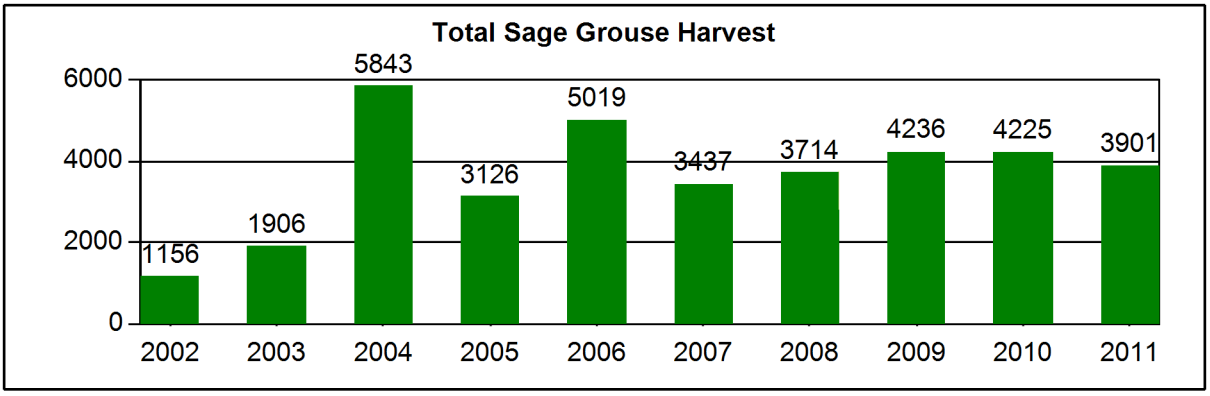
Year	Season Start	Season End	Length	Bag/Possesion Limit
2002	Sep-28	Oct-6	9	2/4
2003	Sep-27	Oct-5	9	2/4
2004	Sep-23	Oct-3	11	2/4
2005	Sep-23	Oct-3	11	2/4
2006	Sep-23	Oct-3	11	2/4
2007	Sep-22	Oct-2	11	2/4
2008	Sep-22	Oct-2	11	2/4
2009	Sep-19	Sep-30	12	2/4
2010	Sep-18	Sep-30	13	2/4
2011	Sep-17	Sep-30	14	2/4

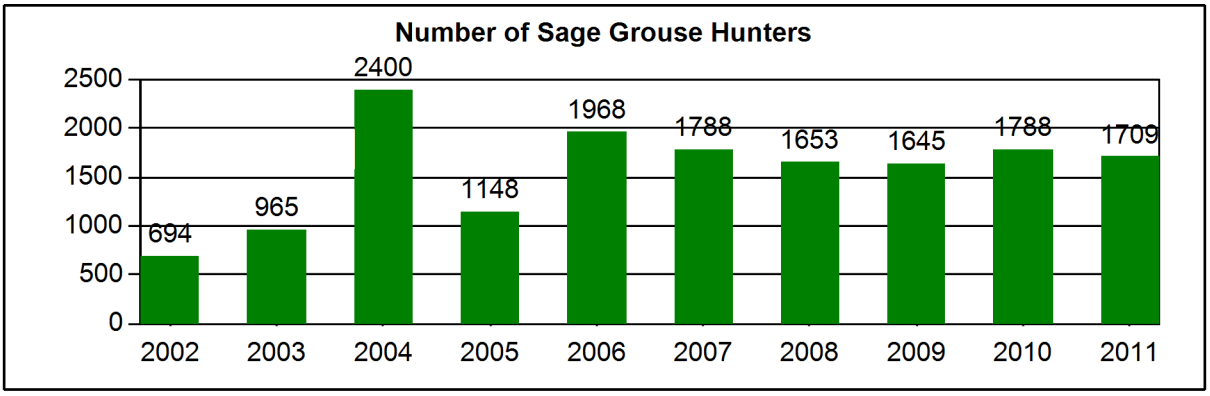
b. Harvest

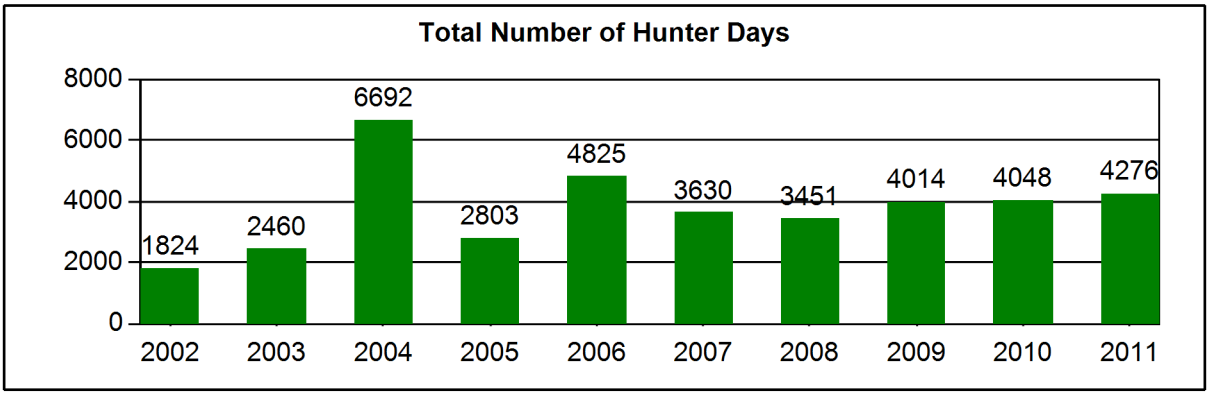
Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2002	1156	694	1824	0.6	1.7	2.6
2003	1906	965	2460	0.8	2.0	2.5
2004	5843	2400	6692	0.9	2.4	2.8
2005	3126	1148	2803	1.1	2.7	2.4
2006	5019	1968	4825	1.0	2.6	2.5
2007	3437	1788	3630	0.9	1.9	2.0
2008	3714	1653	3451	1.1	2.2	2.1
2009	4236	1645	4014	1.1	2.6	2.4
2010	4225	1788	4048	1.0	2.4	2.3
2011	3901	1709	4276	0.9	2.3	2.5
Avg	3,656	1,576	3,802	0.9	2.3	2.4

Figures 2a-d Sage Grouse Harvest Summary

Management Area: Southwest

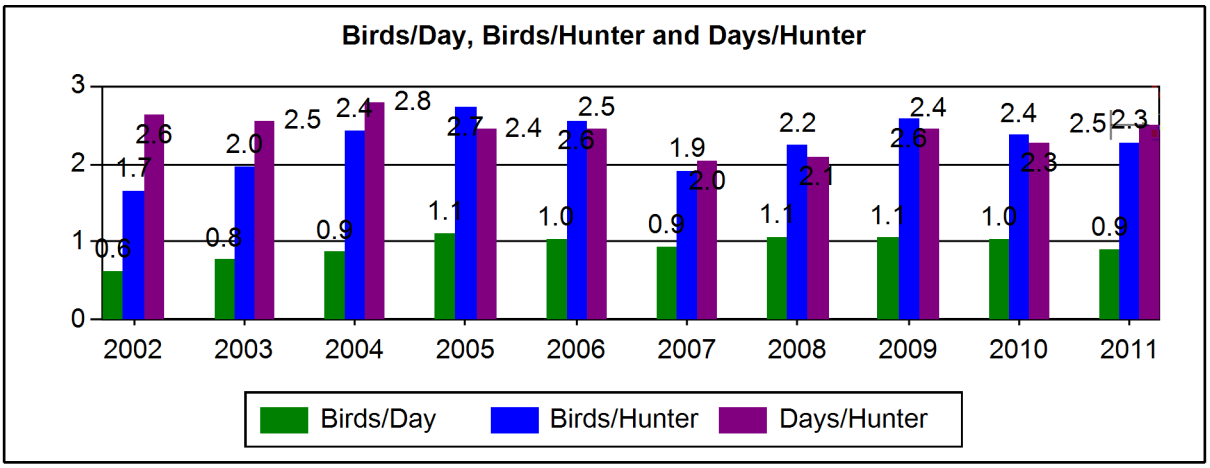






Sage Grouse Harvest Summary

Management Area: Southwest

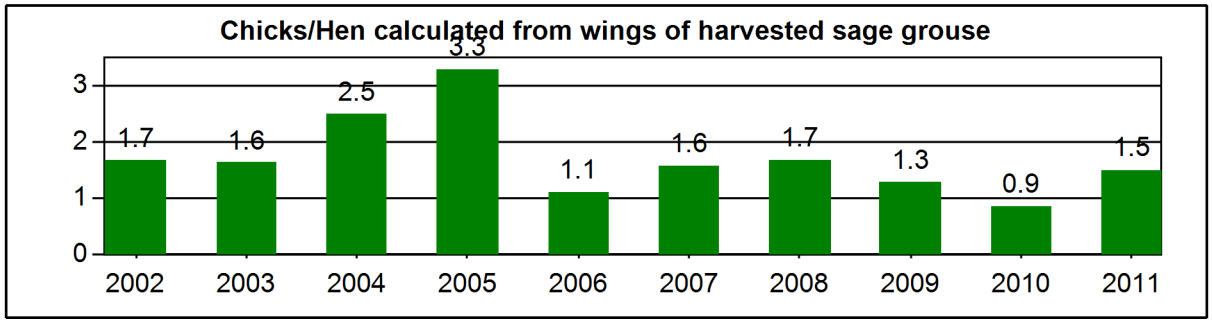


Sage Grouse Job Completion Report

Year: 2002 - 2011, Management Area: Southwest

Table 3 and Figure 3. Composition of Harvest by Wing Analysis

Year	Sample	Percent Adult		Percent Yearling		Percent Young		Chicks/
	Size	Male	Female	Male	Female	Male	Female	Hens
2002	418	9.3	28.9	3.1	3.8	25.4	29.4	1.7
2003	530	10.0	28.1	1.7	5.5	23.4	31.3	1.6
2004	841	6.7	22.7	0.7	3.8	32.1	34.0	2.5
2005	845	8.3	16.9	1.9	4.0	32.7	36.2	3.3
2006	638	16.3	32.3	2.8	6.0	17.2	25.4	1.1
2007	509	18.5	26.5	3.3	3.7	22.6	25.3	1.6
2008	666	12.9	24.6	5.0	6.0	20.1	31.4	1.7
2009	887	11.7	30.0	4.4	6.7	20.0	27.3	1.3
2010	696	2.6	51.0	0.6	0.9	2.9	3.6	0.9
2011	998	6.1	31.9	2.9	4.3	23.9	30.9	1.5



2011 Annual Sage-Grouse Job Completion Report

Conservation Plan Area: **Southwest**
Biological Year: **June 1, 2011 – May 31, 2012**

INTRODUCTION

The Southwest Wyoming Sage-Grouse Conservation Area (SWSGCA) is one of eight in Wyoming (Figure 4). The local working groups were created in 2004 and are charged with developing and implementing plans to promote sage-grouse conservation. The conservation plan for the SWSGCA was completed in July 2007. This report focuses on analysis of data for the biological year June 1, 2011 - May 31, 2012.

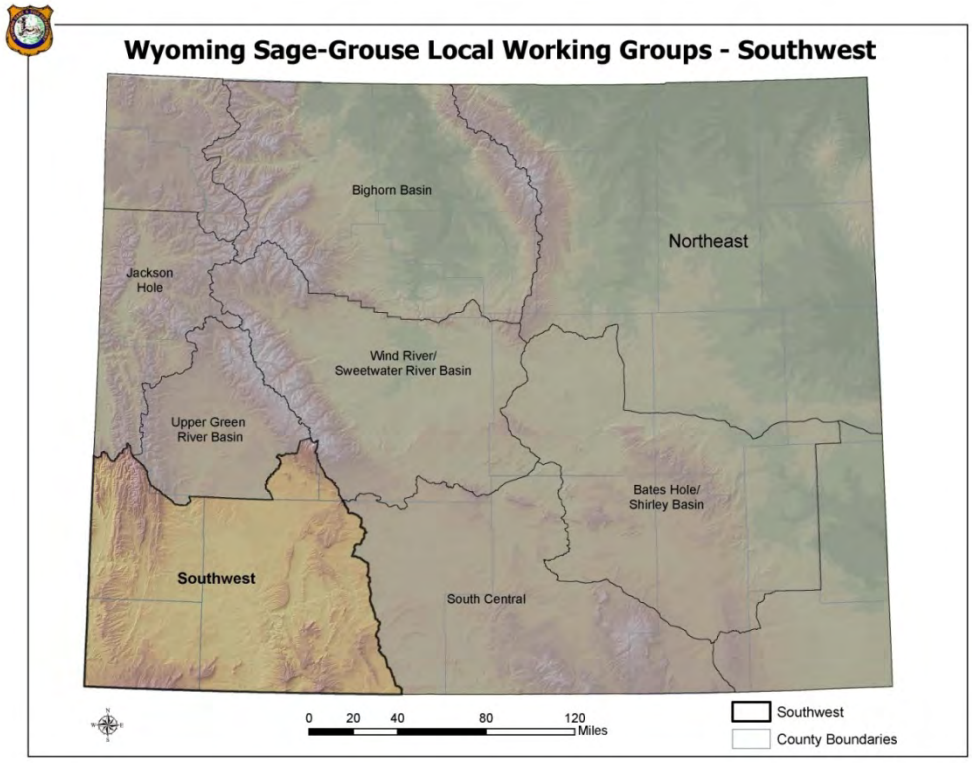


Figure 4. Wyoming Local Sage-Grouse Working Group Boundaries

In response to range-wide sage-grouse population declines and loss of sagebrush habitats, upon which sage-grouse depend, there has been an increased emphasis on sage-grouse data collection over the past two decades. Those monitoring efforts have suggested that sage-grouse populations in the SWSGCA were at their lowest levels ever recorded in the mid-1990s. Grouse numbers then responded to increased precipitation during the late 1990's with some individual leks seeing three fold increases in the number of males counted between 1997 and 1999. The return of drought conditions in the early 2000's led to decreases in chick production and survival and therefore population declines; although the populations have not fallen back to mid-1990s levels. Timely precipitation in 2004-05 increased chick survival and later lek attendance,

however drought conditions from 2006-08 appear to have caused the populations to decline. Increased springtime precipitation in 2009-2011 did not resulted in increased sage-grouse numbers. We suspect the moisture arrived with cold temperatures during the peak of hatching which may have reduced hatching success and early chick survival.

In addition to the continuing drought conditions that have been experienced off and on for the last decade, and the impacts that drought might have on sage-grouse, some of the other causes of concern for sage-grouse populations in the SWSGCA include continued pressure from natural gas development, livestock grazing practices and vegetation treatment practices. In addition to the aforementioned threats, the recent interest in wind energy development is a cause for concern and could potentially have measurable impacts on sage-grouse populations throughout Wyoming and the west. The issues of predation and the effects of hunting are concerns that are often raised by the public. Research in the Upper Green River Basin area suggests raven populations are heavily subsidized by human activities and raven predation may be impacting grouse in that area (Bui 2009). There is little documentation hunting has any population level impacts on sage-grouse in Wyoming (Christiansen 2010).

WYOMING CORE AREA STRATEGY

In an unprecedented move to coordinate sage grouse conservation efforts across the State of Wyoming, Gov. Dave Freudenthal utilized the recommendations from his Sage-Grouse Implementation Team (SGIT) and released an Executive Order on Aug. 1, 2008 that directed state agencies to work to maintain and enhance greater sage grouse habitat in Wyoming. The 2008 Executive Order is appended to the 2008 Statewide Sage-Grouse JCR. These actions constituted Wyoming's Core Area Strategy. The executive order established a "core area" strategy of management.

Following the March 2010 "warranted but precluded" listing decision by the U.S. Fish & Wildlife Service, Governor Freudenthal reconvened the SGIT and tasked them to update the core area map and strategy using the most recent data. The SGIT, with the assistance of the local working groups, prepared these updates during the spring and summer of 2010 and Governor Freudenthal issued a new Executive Order on August 18, 2010 to replace that from 2008.

Governor Freudenthal did not seek reelection and in January 2011 newly elected Governor Matt Mead was inaugurated. Governor Mead issued his own Sage-Grouse Executive Order on June 2, 2011 which reiterated and clarified the intent of Wyoming's Core Area Strategy. The new executive order is appended to the 2010-11Statewide JCR.

Most of the changes to the core areas in the SWSGCA were relatively minor with the boundaries of some of the core areas being modified to remove areas that were not occupied by sage-grouse. Some of the areas removed were juniper habitats, or areas that have already experienced substantial development and are no longer suitable sage-grouse habitat. The implementation team, at the request of wind energy development companies, modified two portions of the South Pass core area on White Mountain just north of Rock Springs. The current core areas are shown in Figure 5.

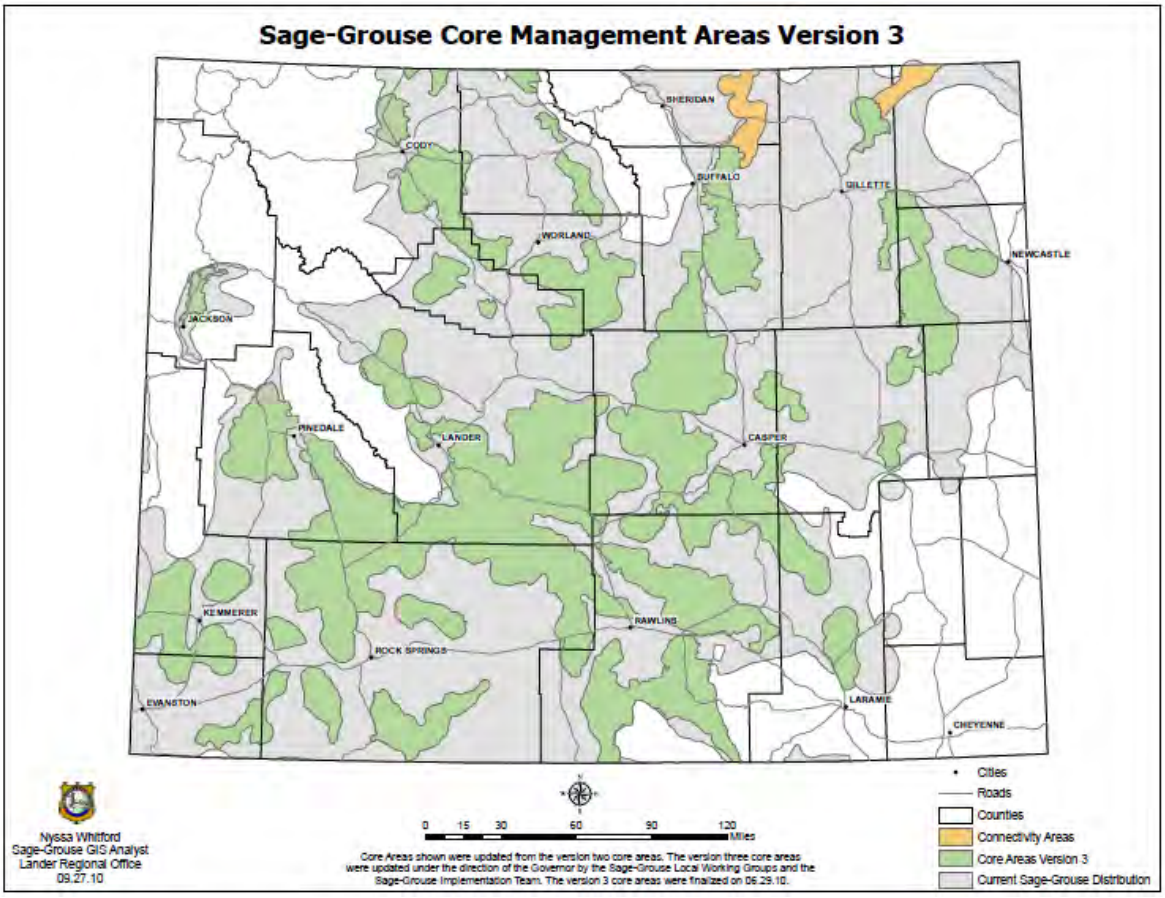


Figure 5. Wyoming sage grouse core areas Version 3.

METHODS

Data on numbers of sage-grouse males attending leks are collected in two ways: lek surveys and lek counts. Lek surveys are defined as at least one visit to a lek during the breeding season to determine if the lek was active or inactive. A lek is considered to be active if one or more males were observed strutting on the lek during one of the lek visits. Lek counts consist of three or more visits (separated by about 7-10 days) to a lek during the peak of strutting activity (late March-mid May) to better estimate the maximum number of males attending that lek. Average male attendance is calculated as the maximum number of males observed on each lek divided by the number of leks checked, using only those leks that were known to be active that year.

Harvest information is obtained through a mail/internet questionnaire of Wyoming game bird license holders. From 1982 to 2009 sage-grouse harvest data were compiled by Upland Game Management Area. Management Areas in the SWSGCA included Areas 4, 5, 6, and a portion of Area 7 (Figure 6). The remainder of Management Area 7 was included in the Upper Green River

Basin Conservation Planning Area (UGRBCA). Starting in 2010, sage-grouse harvest data are being reported by Sage-Grouse Management Area. The Sage-Grouse Management Areas were created to correspond to the local working group boundaries, which will allow for harvest data to be more accurately attributed to each conservation planning area. The Sage-Grouse Management Area for the SWSGCA is Management Area G. This change may result in a slight decrease in the harvest reported in the SWSGCA.

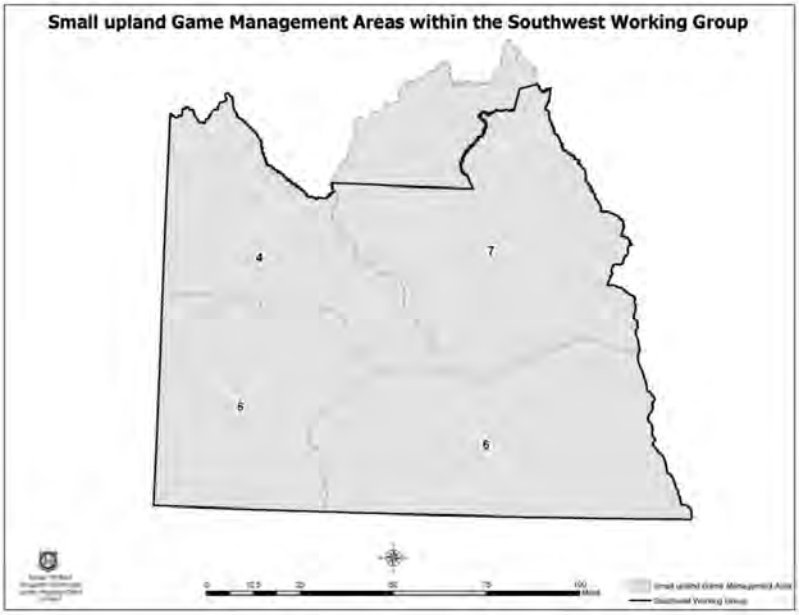


Figure 6. Small Game Management Areas within the Southwest Wyoming Sage-Grouse Conservation Planning Area. Small Game Management Areas were used to report sage-grouse harvest prior to 2010.

In addition to the mailed questionnaire, wings are collected on a voluntary basis from harvested sage-grouse in order to calculate the proportions of adults, juveniles, males, and females in the harvest. Wings were submitted by successful hunters at wing collection barrels distributed throughout the SWSGCA. Of primary interest is the chick to hen ratio, a statistic that provides an index of annual chick productivity and survival.

More specific methods for collecting sage-grouse data are described in the sage-grouse chapter of the WGFD Handbook of Biological Techniques (Christiansen 2007), which is largely based on Connelly et al (2003).

RESULTS

Lek Monitoring

A new sage-grouse database was developed in 2012 in order to improve efficiency, reduce errors, and better facilitate data analysis. Changes were made to the manner in which lek data

are calculated and reported in JCR Data Tables 1a-d. The new version is based solely on "occupied" leks. The past version suggested that was the case in the title of Table 1, but when unoccupied leks were monitored those data were also included in the Table. The result of this change is that the number of "known occupied" leks is now more accurate, but reflects fewer leks than in the previous version. Similarly, the new version calculates average male lek attendance using only monitoring observations where one or more male grouse were observed strutting. The old version included a count of "0" males for leks where activity was confirmed by the presence of sign but no birds were observed. Together, these two changes result in somewhat higher, but more accurate, average male attendance for active leks than previously reported. The changes do not result in any change in population trend based on average male lek attendance. Interpreted population increases and decreases over time remain the same so no revisions to past reports are required.

Since only "occupied" leks are being reported on JCR Data Tables 1a-d, it is important to consider trends in the numbers of active versus inactive leks in addition to the average size of active leks. During a period of population decline, the size of active leks typically declines and the number of inactive leks increases. The converse is typically true of an increasing population. Therefore the magnitude of both increases and decreases is usually greater than what is indicated by the average lek size alone.

Average female lek attendance is no longer being reported since our data collection techniques is not designed to accurately capture these data and is therefore not a useful figure in assessing population trend.

Monitoring the total number of males on a lek is used as an index of trend, but these data should be viewed with caution for several reasons: 1) the survey effort and the number of leks surveyed/counted has varied over time, 2) it is assumed that not all leks in the area have been located, 3) sage-grouse populations can exhibit cyclic patterns over approximately a decade, 4) the effects of unlocated or unmonitored leks that have become inactive cannot be quantified or qualified, and 5) lek sites may change over time. Both the number of leks and the number of males attending these leks must be quantified in order to estimate population size.

All lek monitoring data for the 2012 breeding season along with data from the past ten years for comparison are summarized in JCR Data Tables 1a-d and JCR Data Figures 2a-e. There were 309 occupied leks known to exist in the SWSGCA during the 2012 breeding season. Of the known lek sites in the SWSGCA, 270 of them were checked in 2012 resulting in 229 being documented as being active, 35 were classified as being inactive and 45 leks were of unknown or undetermined status. Because of the quantity of leks in the SWSGCA, data collection efforts were focused on lek surveys, which involved at least one visit to the lek during the breeding season over lek counts, which are more labor intensive and involve three or more visits during the breeding season. Fedy and Aldridge (2011) determined that population trends demonstrated by lek surveys are the same as those indicated by lek counts as long as the number of leks surveyed exceeds 50.

The average number of males per active lek for all leks checked (both counted and surveyed) was 21.6 males per active lek. This is a reduction from an average of 22.7 males per lek in 2010, and is the lowest average observed since 2002 when an average of 21.5 males per lek was observed. The average number of males in attendance on the 82 count leks in 2012 was 23.2 males per lek. This number is a decrease from the observed averages of recent years and is the lowest observed average since 1993 when 13.8 males per count lek were also observed. For the 189 leks that were surveyed in 2012, the average lek had 20.8 males in attendance.

It is important to note that data collection efforts have increased considerably since the early 2000's. Because of this, the observed increase in the number of grouse observed is an artifact of an increased sampling effort and does not represent an actual increase in the sage-grouse population. In 2000, only 63% of known occupied leks were checked, but since 2006, 88% of the occupied leks have been checked. In addition, efforts by WGFD personnel, volunteers, and other government and private industry biologists have led to increased numbers of known leks.

Currently, no method exists to estimate sage-grouse population size in a statistically significant way. However, the decreased male per lek averages in recent years along with lower chick per hen ratios indicates the sage-grouse population in southwest Wyoming is declining.

Harvest

The 2011 hunting season for sage-grouse in the SWSGCA ran from September 17 to September 30 and allowed for a daily take of 2 birds with a limit of 4 grouse in possession (JCR Data Table 2a). The 2011 season was consistent with how the season has been run since 2002 when the season was shortened and the daily bag limit was reduced to 2 birds. The sage-grouse season had traditionally started as early as September first and ran for 30 days; during this time the daily limit was 3 grouse with a possession limit of up to 9 birds. Over time, the season was gradually shortened and the daily bag and possession limits reduced because of concern over declining sage-grouse populations. The opening date was moved back from the first of September to the third weekend because research suggested that hens with broods were concentrated near water sources earlier in the fall and therefore more susceptible to harvest. The later opening date allowed more time for those broods to disperse and therefore reduced hunting pressure on those hens that were successful breeders and on young of the year birds.

The data for grouse harvested in the SWSGCA are reported under Sage-Grouse Management Area G for the 2010 and 2011 hunting seasons. Note that for 2001-2009 the data for all birds harvested in Management Areas 4, 5, 6, and 7 were included in the SWSGCA report even though a portion of Area 7 was located in the UGRBSGCA. Since the majority of Area 7 resided within the boundaries of the SWSGCA, the decision was made to include all of the data from Area 7 in this report.

Based on the estimates resulting from harvest surveys returned by hunters, 1,709 hunters harvested 3,901 sage-grouse during the 2011 hunting season (JCR Data Table 2b and JCR Data Figures 2a-d) which is similar to estimated hunter numbers and harvest reported in 2010, with the harvest rate being slightly lower in 2011 than the previous hunting season. The trends in

harvest statistics over the last 10 years are not well correlated with average male lek attendance due to changes in hunting season structure over that period.

Successful hunters submitted 998 grouse wings during the 2011 hunting season (JCR Data Table 3). This represents approximately one quarter of the estimated total harvest for 2011, which is higher than ten-year average submission rate of 16%.

Wings are collected to allow for the determination of the sex and age of harvested birds. Assuming that hen and chick harvest is proportional to the actual makeup of the population, chick production for that year can be estimated. Even if the rate of harvest between age/sex groups is not random, the information can be used as a tool for looking at population trends as long as any biases are relatively consistent across years. The most important ratio from the wing analysis is the chick to hen ratio; this ratio provides a general indication of chick recruitment. In general it appears that chick:hen ratios of about 1.3:1 to 1.7:1 result in relatively stable lek counts the following spring, while chick:hen ratios of 1.8:1 or greater result in increased lek counts and ratios below 1.2:1 result in subsequent declines. The chick:hen ratio as determined from hunter submitted wings for the 2011 hunting season was 1.5 chicks/hen (JCR Data Table 3 and JCR Data Figure 3). This ratio suggests a relatively stable population.

Weather

Spring habitat conditions are one of the most important factors in determining nesting success and chick survival for sage-grouse. Specifically, shrub height and cover, live and residual grass height and cover, and forb cover have a large impact on sage-grouse nesting success. The shrubs and grasses provide screening cover from predators and weather while the forbs provide forage and insects that reside in the forbs, which are an important food source for chicks. Spring precipitation is an important determinant of the quality and quantity of these vegetation characteristics. Residual grass height and cover depends on the previous year's growing conditions and grazing pressure while live grass and forb cover are largely dependent on the current year's precipitation.

The spring (March-June) precipitation and fall chick:hen ratios (as determined by hunter submitted wings) are given in Table 4 and Figure 7. Generally speaking, when spring precipitation is at or above 90% of average, chick to hen ratios are above average, but when spring precipitation is below average, chick:hen ratios are also below average.

In 2011, spring precipitation was 117% of normal however, 2011 chick production did not increase to the point that would suggest a population increase, only population maintenance. We suspect the moisture arrived with cold temperatures during the peak of hatching which may have reduced hatching success and early chick survival.

Winter weather has not been shown to be a limiting factor to sage-grouse except in areas with persistent snow cover that is deep enough to limit sagebrush availability. This condition is rarely present in the SWSGCA even during the above average winter of 2010-2011.

Table 4. Spring precipitation compared to fall chick:hen ratios in the SWSGCA 2003-2012. Precipitation data from: http://www.wrcc.dri.edu/index.html (Click on Monitoring – under Monitoring click on Drought Monitoring then click on Monthly divisional precipitation or temperature – click on the map in the relevant portion of Wyoming, in this case division #3 Green and Bear Drainage Division – set up the plot as desired including "List the data for the points plotted?" Option – add the percentages listed under March through June of the year of interest and divide by four).

Year	% of Average March-June Precipitation	Chicks:Hen
2003	93%	1.6
2004	92%	2.2
2005	134%	3.2
2006	50%	1.1
2007	57%	1.8
2008	64%	2.1
2009	141%	1.4
2010	139%	0.9
2011	117%	1.5
2012	30%	0.8

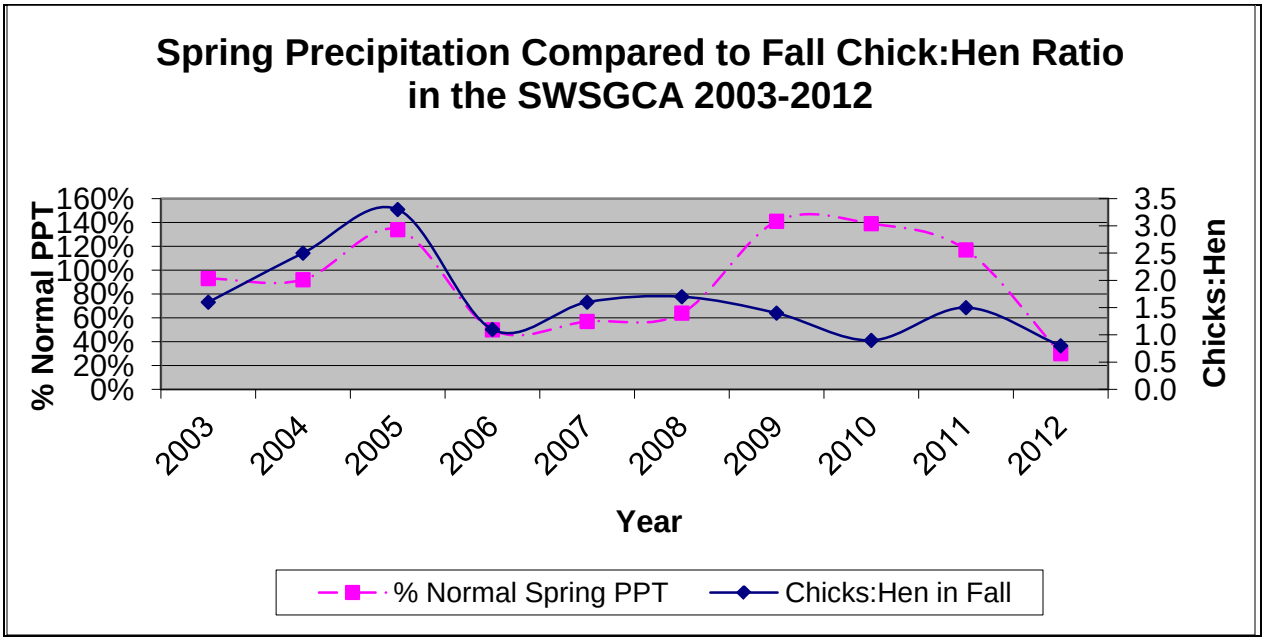


Figure 7. Percent of normal spring precipitation compared to fall chick to hen ratios in the Southwest Wyoming Sage-Grouse Conservation Planning Area

Habitat and Seasonal Range Mapping

While we believe that most of the currently occupied leks in the SWSGCA have been documented, other seasonal habitats such as nesting/early brood-rearing and winter concentration

areas have not yet been adequately identified. Efforts to map seasonal ranges for sage-grouse will continue by utilizing winter observation flights and the product of the current research effort by the USGS Science Center in Fort Collins, CO to model seasonal sage-grouse habitat in Wyoming.

CONSERVATION PLANNING/IMPLEMENTATION

Since 2005, Local Working Groups have been allocated approximately $3.7 million to support implementation of local sage-grouse conservation projects. The source of this funding is the State of Wyoming General Fund as requested by Governor Freudenthal and approved by the legislature. See Attachment A for a list of the projects either completed or being implemented in the SWSGCA during the 2009-2010 and 2011-2012 bienniums.

PAST RESEARCH/STUDIES IN THE SWSGCA

Conover, M. R., J. S. Borgo, R. E. Dritz, J. B. Dinkins and D. K. Dahlgren. 2010. Greater sage-grouse select nest sites to avoid visual predators but not olfactory predators. The Condor 112(2):331-336.

Heath, B. J., R. Straw, S. H. Anderson and J. Lawson. 1997. Sage-grouse productivity, survival, and seasonal habitat use near Farson, Wyoming. Completion Report. Wyoming Game and Fish Department. Cheyenne.

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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, Department of Zoology and Physiology. Laramie.

Slater, S. J. and J. P. Smith. 2010 Effectiveness of raptor perch deterrents on an electrical transmission line in southwestern Wyoming. Journal of Wildlife Management 74:1080-1088.

CURRENT RESEARCH IN THE SWSGCA

- Conservation planning maps and winter habitat selection of greater sage-grouse in the Hiawatha Regional Energy Development project area – Colorado Division of Wildlife.

- Impacts of raven abundance on greater sage-grouse nesting success in southwest Wyoming – Utah State University.

RECOMMENDATIONS

1) Identify important seasonal habitats, especially early brood rearing areas.

2) Implement provisions of the Governor's executive order for sage-grouse core area management.

3) Implement the SWSGCA Conservation Plan.

4) Map and integrate into the WGFD database perimeters for all known sage-grouse leks. Special emphasis should be made to map large leks and leks with impending nearby development actions first.

5) Expand lek searches to ensure that all active leks within the SWSGCA have been identified

6) Ensure that all known lek locations are accurate and recorded using UTM grid coordinates in map datum NAD83.

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Christiansen, T. 2010. Hunting and sage-grouse: a technical review of harvest management on a species of concern in Wyoming. Wyoming Game and Fish Department, Cheyenne.

Fedy, B.C. and C.L. Aldridge. 2011. The importance of within-year repeated counts and the influence of scale on long-term monitoring of sage-grouse. Journal of Wildlife Management 75(5): 1022-1033.

Attachment A: SWSGCA Sage-Grouse Projects Supported with 2009-2012 General Fund Budgets

Project Name	Budget Biennium	Local Working Group	Total Cost	SG $	Project Description	Partners	Status
94 - Petersen Ranch Project Phase II (see #52)	2009-10	Southwest	$19,500	$9,000 requested, $3,500 approved/spent	Spring protection and water development	Landowner	Complete
98 - Seasonal Habitat Mapping	2009-10	Statewide	$352,000 (multiyear)	$155,000 requested, $141,000 approved/spent	Use predictive habitat models to produce sage-grouse seasonal habitat maps	U.S. Fish & Wildlife Service, BLM, Various energy development companies	On-going
99 - Fence markers and spring protection fencing (see also #47 and 128)	2009-10	Statewide	$130,000	$64,800 requested/approved; $62,628 spent	Purchase fence markers and Steel Jack spring protection for statewide distribution	Niobrara Conservation District, numerous private landowners, BLM, The Nature Conservancy	On-going
102 - Albert Creek Grazing Mgt	2011-12	Southwest	$25,000	$12,500 requested/approved/spent	Grazing management and infrastructure	Horseshoe Spear Cattle Co., BLM, WGFD	Complete
110 - Fence marking in SW Wyoming	2011-12	Southwest	$18,091	$10,000 requested/approved	Volunteer construction and placement of fence markers to prevent/mitigate sage-grouse fence collisions	BLM, Utah's Hogle Zoo	On-going
111 - Impacts of Ravens on SG nests in southern WY	2011-12	South-Central & Southwest	not provided by applicant	$102,892 requested/approved;	Research to determine raven impacts and raven control to sage-grouse	Utah State University	On-going

Project Name	Budget Biennium	Local Working Group	Total Cost	SG $	Project Description	Partners	Status
117 - Response of SG to sagebrush treatments	2011-12	Wind River/Sweetwater, South-Central, Southwest, Bates Hole/Shirley Basin	$539,800 (multiyear)	$189,800 requested/approved	Research to determine sage-grouse demographic and habitat use response to sagebrush treatments	Univ. of Wyoming Coop Unit, WGFD	On-going
118 - Estimating noise impacts for habitat selection modeling (see also #17, 46 & 77)	2011-12	Wind River/Sweetwater, South-Central, Southwest, Bates Hole/Shirley Basin, Northeast, Upper Green River Basin	$69,415	$49,335 requested/approved	Research to develop a noise model and determine noise exposure thresholds.	Univ. California-Davis	On-going
120 - SG core areas as umbrella for non-game species	2011-12	Southwest & Wind River/Sweetwater	$249,724	$30,000 requested; $8,000 approved	Research to determine the conservation effectiveness of sage-grouse core areas for non-game species	Univ. of Wyoming Coop Unit	On-going
124 - Seven Mile Gulch Exclosure	2011-12	Southwest	$29,800	$21,600 requested/approved	Spring and associated habitat protection fencing	Unita Development Co., WGFD, volunteers	On-going
125 - Buckhorn Flowing well fencing	2011-12	Southwest	$19,000	$5,000 requested/approved	Flowing well and associated habitat protection fencing	WY Landscape Conservation Initiative, BLM	On-going
126 - Cheatgrass mapping & control - Sublette Co. Phase II (see also #100)	2011-12	Upper Green River Basin & Southwest	$92,719	$92,719 requested/approved	Cheatgrass mapping and spot control	Sublette Co. Weed & Pest/GR Basin Coordinated Weed Mgt Association	On-going
129 - Fence collision markers	2011-12	South-central, Upper Green River Basin, Southwest	$100,000	$42,000 requested/approved	Volunteer construction and placement of fence markers to prevent/mitigate sage-grouse fence collisions	Medicine Bow Conservation District, WGFD, private landowners, BLM	On-going

2011 Sage-grouse Job Completion Report
Upper Green River Basin Working Group Summary
Period Covered: 6/1/11 to 5/31/12
Prepared by: Dean Clause

Introduction

The Upper Green River Basin Working Group Area (UGRBWGA) covers Sage-grouse Management Area (SGMA) D that lies within Sublette County (prior to 2010 designated Upland Game Bird Management Area (UGBMA) 3 and the north portion of UGBMA 7). All lek data and harvest data from SGMA D is included in this 2011 JCR. Prior to 2010, only harvest data from UGBMA 3 was included in the report while that portion of UGBMA 7 that lies with UGRBWGA was reported in the Southwest WG JCR.

Sage-grouse are found in suitable sagebrush uplands throughout the Upper Green River Basin. Sage-grouse habitats within Sublette County are expansive and relatively intact outside of developing natural gas fields. Habitats for sage-grouse within Sublette County occur throughout mixed land ownership jurisdictions. Most sage-grouse leks are found on Bureau of Land Management (BLM) lands (88%), with fewer leks found on private (8%), and state (4%) ownership. Nesting and early brood rearing habitats are also found predominantly on BLM lands, while many birds move to moist meadow habitat located on private or public/private interfaces during late brood rearing and/or summer. Fall movements away from these moist areas to sagebrush-dominated uplands on BLM lands occur in late September/early October. As winter progresses, birds concentrate on sagebrush upland habitats, the location of which is determined by snow accumulations and winter severity. These winter concentration areas are also located primarily on BLM lands.

Traditionally, sage-grouse data collection within the Pinedale Region has focused on lek surveys, with a secondary emphasis on collecting information from harvested birds. Prior to 1994, relatively few leks were monitored and prior to 2000, standardized efforts were not used to collect sage-grouse lek information. Since 2000, efforts have been made to standardize lek data collection methods and increase lek monitoring efforts (i.e. collect data on more leks along with increasing the number of site visits per lek). Current lek monitoring has shifted from "lek surveys" to "lek counts" as described below.

Information presented in this report includes data and trend analysis for lek monitoring, population trends, harvest rates, productivity rates, winter distribution surveys, and weather data. Other categories covered in this report include special projects/research, management summaries, and recommendations.

Data Collection Efforts and Methods

Lek monitoring consists of inventory methods called "lek counts" or "lek surveys". A lek count consists of at least 3 site visits during the strutting season, with each visit conducted at least 7 days apart. Lek counts are used to determine annual status (active or inactive) along with determining population trends. A lek count can also be a census technique that documents the actual number of male sage-grouse observed on a lek complex. A lek complex is defined as a group of leks in close proximity between which male sage-grouse may be expected to interchange from one day to the next. In order to be classified as an accurate lek count (or census), a lek observation must include all leks within a complex on the same morning. These simultaneous observations must be performed at least 3 times during the strutting season, with at least 7 days separating each lek observation. Lek complex counts have not routinely been conducted due to manpower and logistical restraints. Lek complex counts are only practical when a few leks comprise a complex.

A lek survey consists of only 1 or 2 site visits during the strutting season. Lek surveys are primarily important to identify annual status (active or inactive) of a particular lek or lek complex and not for estimating population trends. Overall, lek counts are preferred over surveys and recent emphasis has been placed on collecting lek counts.

Based on the findings at each lek, the lek is assigned an annual status of "Active" (attended by more than one male sage-grouse), "Inactive" (it was known that there was no strutting activity during the breeding season), and "Unknown" (either active or inactive status has not been determined). Based on the past and current status, leks are assigned one of the three categories for management purposes. The category "Occupied" is a lek that has been active during at least one strutting season within the last ten years. Management protection will be afforded to occupied leks. An "Unoccupied" lek has not been active during the past 10 years, although there must be sufficient data to justify placing a lek into this category. A lek survey or count must have been conducted 4 out of 10 years during non-consecutive years (i.e. every other year) without activity to be placed in the "Unoccupied" category. Unoccupied leks are also broken down into two sub-categories ("Destroyed" – habitat no longer exists or "Abandoned" – habitat still exists). Management protection will not be afforded to unoccupied leks. The third category is

"Undetermined" which is a lek that has not documented grouse activity in the past 10 years, but doesn't have sufficient data to be classified as unoccupied (as mentioned above).

Prior to 2000, no standardized guidelines or criteria were identified to define what constitutes a lek, lek status, and lek category as identified above. Further modifications have periodically been made since then to standardize lek monitoring and definitions. This lack of consistency in the past (prior to 2003) has led to erroneous lek classification when compared to the "new" lek definitions. The review of past lek monitoring data in the Upper Green River Basin indicated that several documented leks did not meet the criteria to be identified as a lek. In addition, several leks identified in the Sage-grouse JCR database had no monitoring data at all. A common mistake was the establishment of a new lek based on one sighting of displaying males without any follow-up site visits during that same year and following annual visits to the same location revealing no grouse. It is most likely these one-time observations were birds that were displaced from a nearby lek and continued to display at a different location that particular morning. These leks not meeting the current lek definitions were deleted from the database. This database clean-up effort was initiated in 2005, resulting in numerous leks and records being deleted. Minor edits and changes will continue to be made as new information arises.

Productivity information obtained from brood surveys (# chicks/hen) has been sporadic and often yields very low sample sizes. However, one permanent brood survey route on Muddy Creek near the Bench Corral elk feedground has been monitored for over ten years. This represents the only such route within the Upper Green River Basin. Past research in the WG area has collected nest success and brood information from radio-collared birds. Data collected from radio-collared birds provides good production information.

Information on the sex/age composition of harvested birds is collected through the use of wing barrels distributed throughout Sublette County each fall. Productivity information is estimated from this data set, as the number of chicks/hen can be derived. Wing collections can also provide valuable harvest trend data. Total harvest estimates for each Upland Game Bird Management Area is obtained through a hunter harvest questionnaire that is conducted annually.

With declining long-term sage-grouse populations, both locally and range-wide, increased effort has been placed on collecting sage-grouse data. In addition, the increase in natural gas exploration and development within Sublette County has raised concerns regarding the impact of such large-scale landscape developments on sage-grouse populations. In response, several sage-grouse research projects have been initiated in this region. Local research has indicated that current habitat protection measures (stipulations) may not be restrictive enough to protect sage-grouse habitat. Current protection stipulations do not address human activities associated with maintenance and production stages of development, which also provides impacts (indirect impacts) on sage grouse. In addition, implementation of the existing habitat protection stipulations has

been variable, as several exceptions have been granted associated with gas development activities. This has resulted in scrutiny of the effectiveness of the current stipulations intended to preserve sage-grouse and sage-grouse habitats on BLM lands.

On 1 August, 2008 Governor Freudenthal signed Executive Order 2008-2 entitled, "Greater Sage-grouse Core Area Protection". The goal of the Executive Order is to maintain existing habitat conditions within core areas by permitting only development activities that will not cause declines in sage-grouse populations. *As a matter of general practice, this will be achieved by establishing a 0.6-mi. NSO around each occupied lek,* ***limiting well pad densities to an average of 1 per square mile within core area,*** *and implementing appropriate management practices. The number of well pads within a 2 mile radius of the perimeter of an occupied sage-grouse lek should not exceed 11,* ***distributed preferably in clumped pattern in one general direction from the lek***. Development scenarios in non-core areas are more flexible, but should still be designed and managed to maintain populations, habitats and essential migration routes. Non-core areas should not be construed as "sacrifice areas" since this conservation strategy requires habitat connectivity and movement between populations in core areas. The goal in non-core areas is to maintain habitat conditions that will sustain at least a 50% probability of lek persistence over the long term. In some "non-core" locations, important habitat functions of other wildlife species will guide planning and mitigation considerations. Applicable standard management practices and sage-grouse BMPs should be applied to development within both core and non-core areas to achieve the goals of the Executive Order. On June 2, 2011 a new Executive Order (2011-5) was enacted by a new governor (Matt Mead) with only a few minor changes being made to the original Executive Order from 2008.

Prior to the winter of 2003, sage-grouse winter distribution information had only been collected opportunistically during other winter surveys (deer, elk, and moose composition counts) and ground observations that were documented in the Wildlife Observation System (WOS). Some data had also been collected by private wildlife consultants conducting ground surveys directed by the BLM for clearance associated with gas development. Since 2004, certain areas within the Upper Green River Basin were surveyed to document important sage-grouse wintering areas. These surveys have been conducted aerially with a helicopter during January/February using stratified transects at approximately 1 minute (1 mile) intervals or less to document sign and live observations of grouse. These aerial surveys, along with other existing data, are very useful baseline information to identify important winter grouse habitats for future management decisions.

Weather data (particularly precipitation data) may be helpful in understanding the effects of environmental conditions on sage-grouse population dynamics. Lower than normal precipitation can affect sage-grouse by reducing the amount of herbaceous vegetation necessary for successful nesting, reduce insect and forb production for early brood success, and reduce the quantity and quality of sagebrush. Not only the amount of annual precipitation, but the timing of precipitation events can be a very significant influence on sage-grouse populations. Individual weather stations within the Upper Green River Basin include Big Piney, Cora, Daniel Fish Hatchery, and Pinedale. Some of these weather stations have incomplete and missing data, which makes monthly and annual

comparisons difficult. In addition, these local weather stations do not adequately represent large portions of the Upper Green River Basin. For these reasons, a National Climatic Data Center (NOAA Satellite and Information Service) weather site has been utilized to gather moisture and temperature data. Wyoming is split into 10 different weather reporting Divisions. Division 3 covers the entire southwestern portion of Wyoming and is used in this UGRB Sage-grouse JCR to report precipitation and temperature trends. Climatic data for Division 3 can be found at the NCDC/NOAA web site: http://www.ncdc.noaa.gov.

Results

Lek Monitoring

A total of 151 leks are currently documented in the UGRBWGA. These leks are classified as follows; 134 occupied and 17 unoccupied or undetermined. During 2012, a total of 123 occupied leks (92%) were checked (survey or count). Lek monitoring efforts in 2012 primarily focused on counts (95%) over surveys (5%). Results from the counts and surveys showed that 81% of the leks were active and 19% were inactive. The average number of males/lek for all active leks increased to 37 in 2012, compared to 35 in 2011, 38 in 2010, 52 in 2009, and 60 in 2008. Recent declining trends (2008-2012) is opposite to increasing trends from 2004-2007 (27 males/lek in 2003 to 69 in 2007).

Generally, the proportion of leks checked that are confirmed “active” has stayed relatively stable during the past 10 years, ranging from 71% to 82%. Although there has been increased lek inactivity and abandonment in areas associated with gas development activity, additional lek monitoring efforts and searches have resulted in locating new or undiscovered leks (45 new leks since 2004) negating the downward trend in the proportion of active leks in the UGRBWGA .

Previous lek analysis to assess natural gas development impacts in the Pinedale area have shown higher rates of decline on leks near or within gas field development compared to leks away from gas development. See the 2008 or 2009 Sage Grouse JCR - Upper Green River Basin Working Group Area for this complete analysis and data tables. An updated analysis on lek data trends associated with gas development will be reported in the 2012 JCR.

Population Trends and Estimates

No reliable population estimate can be made from data collected during 2012 (or any of the previous years), due to unknown male:female sex ratios and the fact that not all active leks have been located. An increasing population trend during 2004 - 2007 is indicated by an increase in the average number of males/lek since 2003. While 2008-2012 lek monitoring indicate a declining trend in the number of males/lek.

Harvest

The 2011 sage-grouse season was September 17 through September 30, which allowed a 14-day hunting season. The 2011 season was similar to the 2004 – 2010 seasons. A nine-day hunting season was initiated during both 2002 and 2003. Essentially, hunting seasons since 2002 allowed for the season to remain open through two consecutive weekends. From 1995 – 2001 hunting seasons were shortened to a 15-16 day season that typically opened during the third week of September and closed in early October. Prior to 1995, the sage-grouse seasons opened on September 1 with a 30 day season. Seasons have been shortened with later opening dates to increase survival of successful nesting hens (as they are usually more dispersed later in the fall) and to reduce overall harvest.

Bag limits from 2003 to 2011 were 2 per day and 4 in possession. 2003 was the first year that bag/possession limits had been this conservative. Bag limits traditionally (prior to 2003) were 3 birds/day with a possession limit 9 (changed to 6 birds from 1994-2002). Prior to 2010, harvest estimates in the UGRBWGA were only reported from UGBMA 3 and not in that portion of UGBMA 7 that lies within the UGRBWGA. New Sage-grouse Management Areas (SGMA) were developed in 2010, in which SGMA D covers all of the UGRBWGA and will be reported that way in future years.

The 2011 harvest survey estimated that 565 hunters bagged 1,720 sage grouse and spent 1,605 days hunting. The average number of birds per day was 1.1, the average number of birds per hunter was 3.0, and the number of days spent hunting was 2.8 during 2011. The harvest trend data indicates there has been similar hunter participation and overall harvest since 2007, although reported figures increased in 2010 and 2011 due to boundary changes associated with management areas. Prior to 2010, only a portion (UGBMA 3) of the UGRBWGA was included in the harvest statistics, and that portion of UGBMA 7 was left out of the reported harvest. Starting in 2010, all harvest within the UGRBWGA is now reported in Sage-grouse Management Area D. Harvest rates (# birds/day, # birds/hunter, and # days/hunter) have remained similar the past nine years (2003-2011). From 1995 to 2002, overall harvest and harvest rates significantly declined following altered seasons (shortened and moved to a later date). Since 2003, hunter participation has varied somewhat, but stabilized during the past 5-years.

Brood Count Surveys

Two permanent brood survey routes, one located on Muddy Creek near the Bench Corral elk feedground (Lower Muddy Creek) and one in the Upper Muddy Creek drainage (Cottonwood Ranches) are routinely conducted and results have been reported in previous JCR's. Since overall sample sizes have been poor from these brood surveys, no reliable production data exists, and therefore this data is no longer reported in JCR's. Other documented brood count data has come from random searches or opportunistic sightings.

Although sage-grouse research has been conducted in the Upper Green River Basin for over the past decade providing some nest establishment, nest success, and brood production data, no active studies have been conducted since 2009. See previous Sage-grouse JCR's (2009 or earlier) for nest success and production data summaries.

Wing Collections

A total of 18 sage-grouse wing barrels were distributed throughout Sublette County in 2011 within Sage-grouse Management Area D (old UGBMA 3 & a portion of 7). Barrels were placed prior to the sage-grouse hunting season opener and were taken down following the closing date. Wing collections were typically made following each weekend of the hunting season (collected twice). The primary feathers from these wings are used to determine age and sex based on molting patterns and feather characteristics.

A total of 547 sage-grouse wings were collected from barrels in the UGRBWGA during 2011, which is slightly higher from collections during the past 5-year period, ranging from 421 to 494. Of the 547 wings collected in 2011, 41% were adult birds, 8% were yearling birds, and 51% were juvenile birds, indicating a higher proportion of harvest on juveniles compared to 2010. The overall composition of wings in 2011 indicated a ratio of 1.4 chicks/hen (adult and yearling females), improved from 0.8 chicks/hen in 2009 and 2010, similar to the survival of 1.3 chicks/hen during 2008, and an increase from 0.6 chicks/hen in 2007. The overall past five years (2007-2011) chick survival has been poor, resulting in declining population trends. This chick/hen ratio from wing collections has provided a good indicator for future grouse population trends, as male lek attendance trends have correlated well with previous year's production (# chicks/hen) data.

Winter Distribution Surveys

Winter sage-grouse surveys were conducted in portions of the UGRBWGA during January of 2012, with funds secured through the BLM and natural gas companies. Winter surveys have been conducted annually since 2004 in portions of the Upper Green River Basin. This winter data has been used to develop winter concentrations area maps (first map developed in 2008), and continues to be updated as new data becomes available.

Weather Data

Wyoming Climatic Division 3 (Green and Bear Drainage Basin) monthly temperature and, precipitation data were obtained from: http://www.ncdc.noaa.gov/cag/time-series/us. Graphs were generated comparing 3-month (March-May) average precipitation (Figure 1) and 3-month (March-May) average temperature (Figure 2) for years 2010, 2011, and 2012. A 30-year average was also plotted on these figures to indicate a long range average for those 3-month periods.

Precipitation during March thru May was about normal in 2010, above average during 2011, and well below average during 2012 (Table 1). Temperatures had an inverse

relationship to precipitation during this same 3-month period showing near average temperatures in 2010, below average temperatures in 2011, and well above average temperatures in 2012 (Table 2). These precipitation and temperature trends adequately reflect conditions documented within the UGRBWGA.

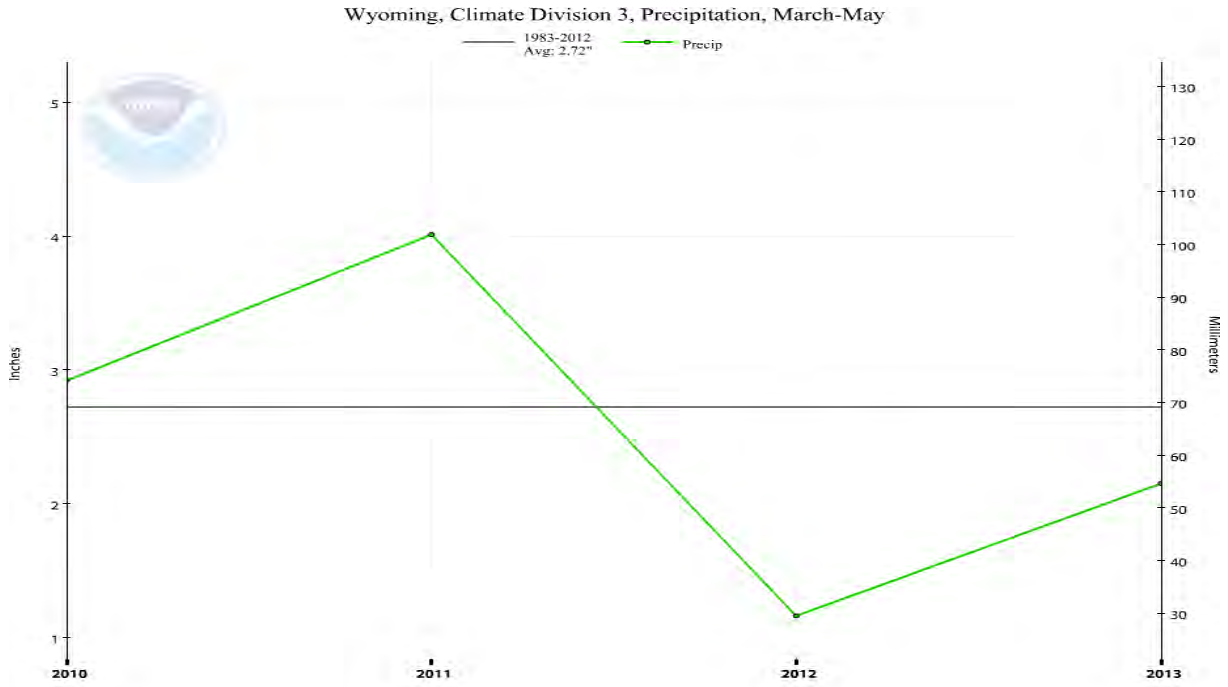


Figure 1. 3-month average (March-May) precipitation for 2010-2012.

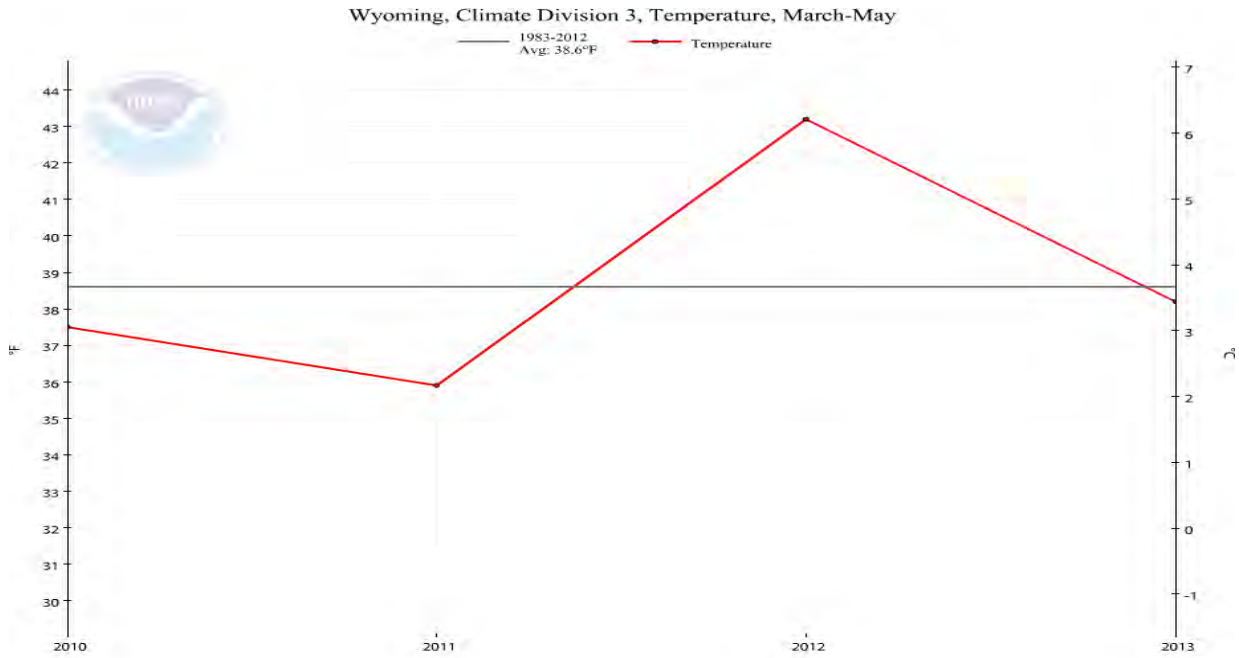


Figure 2. 3-month average (March-May) temperature for 2010-2012.

Special Projects

Sage-grouse Research Projects

From 1998-2009 there has been several research projects initiated and completed that has provided information on sage-grouse demographics and effects of natural gas development on sage-grouse populations. See UGRBWGA 2010 JCR for a summary of past sage-grouse research in the Pinedale area. Currently no sage-grouse research is being conducted in the UGRBWGA.

Sage-Grouse Working Group

The Upper Green River Basin Sage-grouse Working Group was formed in March of 2004. The group is comprised of representatives from agriculture, industry, sportsmen, public at large, conservation groups, and government agencies (federal and state). The purpose of the UGRB Working Group is to work towards maintaining or improving sage-grouse populations in the Upper Green River basin. The group is directed to formulate plans, recommend management actions, identify projects, and allocate available funding to support projects that will benefit sage-grouse. A local sage-grouse plan (Upper Green River Basin Sage-Grouse Conservation Plan) was finalized in May of 2007 and can be found on the WGFD website (gf.state.wy.us). This Plan identifies past, proposed, and ongoing projects; recommended management activities; funding sources; and other relevant sage-grouse information within the Working Group Area intended to maintain and/or increase sage-grouse populations. During 2010 a new appropriation of State monies was identified for sage grouse projects during 2010 and 2011 which has led to increased activity by the Working Group. Raven control and cheatgrass inventory projects have accounted for the majority of allocated funds granted to the UGRB Working Group in recent years.

Management Summary

Data collected and reported in this 2011 Sage-Grouse Job Completion Report (June 2011 thru May 2012) gives insight to population trends. Analysis of the past years of data indicates that the sage-grouse populations steadily increased from 2003 to 2007, dropped slightly in 2008, continued to decline through 2011, and slightly increased by May of 2012. Lek trend data indicate grouse populations were at the lowest level in 2003 during the past 10-year period.

Lek monitoring in the UGRBWGA showed a 156% increase in the peak number of males per lek from 2003 to 2007 as males increased from 27.1 males/lek to 69.3 males/lek. This trend then reversed since 2007, as the number of males/lek has declined by 47% dropping to 36.9 males/lek by spring of 2012. Sage-grouse leks within developing gas fields have continued to show declines and lek abandonment regardless of lek trends outside of gas development, indicating negative impacts to leks and populations in and near natural gas fields.

Sage-grouse hunting season dates, season length, and bag limits have remained similar since 2002, running from late September to early October for 9-14 days with a daily bag limit of 2 birds and a possession limit of 4 birds. Although season length and bag limits have remained similar since 2002, overall harvest and hunter participation has varied somewhat, while harvest rates (# birds taken/day, #birds taken/hunter, and # days/hunter) have remained similar. With grouse numbers steadily increasing from 2003-2007 and declining since 2007, the progression of hunter participation was expected to show similar trends. The fluctuation in hunter numbers is not very clear but may be attributed to hunter's assessment of grouse populations due to annual or seasonal (spring/summer) precipitation levels instead of trends in grouse populations. Variation in hunter participation can also be affected by weather conditions, especially during the current short seasons.

Wing collection from wing barrels (drop locations) continue to provide good sample sizes to determine overall chick survival trends within the UGRBWGA. During 2008, 2009, 2010, and 2011 wing collections accounted for 45%, 37%, 31%, and 32% of the reported harvest. These annual wing samples can vary significantly based on weather conditions affecting hunter participation, especially during the weekend days of hunting season. Overall, wing trends have not shown a good correlation between trends in sample sizes vs. harvest, but do provide managers the most reliable data for determining annual reproductive rates and population trends in the UGRBWGA.

Trends in chicks/hens derived from wing collections continue to show a direct correlation with following year lek trends. An increase (or decrease) in the number of chicks/hen in the harvest typically results in similar trends documented on leks the following year. In general, a chick/hen ratio below 1.1 has shown declines in overall male lek attendance the following spring, 1.1 to 1.5 chicks/ hen has shown stable attendance, and a chick/hen ratio greater than 1.5 has shown increases in lek attendance in the UGRBWGA. During the past 5 years (2007-2011) the ratio of chicks/hen average was less than 1.0 (0.98) correlating with a 47% decline in the peak number of males on leks.

Above normal precipitation during 2004 and 2005 during key periods (specifically in the spring and early summer) contributed to increased sage-grouse numbers due to enhanced production and juvenile survival in the Upper Green River Basin. Declining chick survival was documented in 2006 and 2007 caused by spring and summer drought conditions in the Upper Green River Basin. Male sage-grouse lek numbers declined by 15% during 2008, 12% in 2009, 26% in 2010, 10% in 2011, and increased by 7% in 2012. Good to above average spring precipitation during 2008-2011 has led to good herbaceous production, which should have helped turn around the recent declining trends in the UGRBWGA. Although, it appears the cold temperatures during the spring of 2009 and 2010 have impacted reproduction resulting in further declines in lek numbers in 2010. Spring moisture in 2011 resulted in some of the best habitat production documented in quite some time, most likely contributing to the slight increase in bird numbers during the spring of 2012. Sage-grouse and habitat management activities basically have remained static during the past 8+ years.

The sage-grouse population in the UGRBWGA appears to be showing some fluctuation attributed to natural influences, such as spring precipitation and temperature. On a more localized level, the current amount and rate of natural gas development in the Upper Green River Basin has and will continue to impact sage-grouse habitat and local populations. Lek monitoring data has shown lower male attendance and in several cases total bird abandonment on leks within and adjacent to developing gas fields. Sage-grouse studies and research in the UGRBWGA has also documented impacts to grouse from gas development. Direct, indirect, and cumulative impacts to sage-grouse from gas and residential development will continue to challenge managers to maintain current grouse numbers.

Recommendations

1. Continue to monitor sage-grouse leks and look for new ones.
2. Continue to monitor and provide input on natural gas development/sage-grouse projects being conducted.
3. Continue to place wing barrels in enough locations to obtain an adequate and representative sample to derive sex/age and harvest trend information.
4. Continue existing efforts and encourage new efforts to document and identify important sage-grouse areas (breeding, brood rearing, and winter).
5. Continue to work with GIS personnel and land managers to create seasonal range maps (breeding, summer/fall, and winter) to aid land managers in protecting and maintaining important sage-grouse habitats.
6. Continue to identify needed sage-grouse research, data collection efforts, project proposals, development mitigation, and funding.
7. Implement proposals and management recommendations identified in the Upper Green River Basin Sage-Grouse Working Group Conservation Plan. Update this Plan as needed.

Sage Grouse Job Completion Report

Year: 2003 - 2012, Management Area: D, Working Group: Upper Green River

1. Lek Attendance Summary (Occupied Leks) (1)

a. Leks Counted

Year	Occupied	Counted	Percent Counted	Peak Males	Avg Males / Active Lek (2)
2003	92	59	64	1462	30.5
2004	97	57	59	1531	33.3
2005	105	77	73	3003	49.2
2006	110	76	69	3953	63.8
2007	115	78	68	4329	69.8
2008	114	80	70	3721	53.9
2009	118	84	71	3850	55.0
2010	130	92	71	3099	41.9
2011	133	100	75	2692	31.7
2012	134	117	87	3514	36.6

b. Leks Surveyed

Year	Occupied	Surveyed	Percent Surveyed	Peak Males	Avg Males / Active Lek (2)
2003	92	24	26	271	16.9
2004	97	24	25	503	35.9
2005	105	20	19	657	38.6
2006	110	23	21	828	46.0
2007	115	28	24	1354	67.7
2008	114	24	21	1414	78.6
2009	118	27	23	619	38.7
2010	130	30	23	573	26.0
2011	133	25	19	943	47.2
2012	134	6	4	179	44.8

1) Occupied - Active during previous 10 years (see official definitions)

2) Avg Males/Active Lek - Includes only those leks where one or more strutting males were observed. Does not include "Active" leks where only sign was documented.

3) Inactive - Confirmed no birds/sign present (see official definitions)

Sage Grouse Job Completion Report

Year: 2003 - 2012, Management Area: D, Working Group: Upper Green River

1. Lek Attendance Summary (Occupied Leks) (1) Continued

c. Leks Checked

Year	Occupied	Checked	Percent Checked	Peak Males	Avg Males / Active Lek (2)
2003	92	83	90	1733	27.1
2004	97	81	84	2034	33.9
2005	105	97	92	3660	46.9
2006	110	99	90	4781	59.8
2007	115	106	92	5683	69.3
2008	114	104	91	5135	59.0
2009	118	111	94	4469	52.0
2010	130	122	94	3672	38.3
2011	133	125	94	3635	34.6
2012	134	123	92	3693	36.9

d. Lek Status

Year	Active	Inactive (3)	Unknown	Known Status	Percent Active	Percent Inactive
2003	59	24	9	83	71.1	28.9
2004	60	24	13	84	71.4	28.6
2005	76	24	5	100	76.0	24.0
2006	79	22	9	101	78.2	21.8
2007	82	24	9	106	77.4	22.6
2008	87	20	7	107	81.3	18.7
2009	86	26	6	112	76.8	23.2
2010	95	29	6	124	76.6	23.4
2011	104	22	7	126	82.5	17.5
2012	101	24	9	125	80.8	19.2

1) Occupied - Active during previous 10 years (see official definitions)

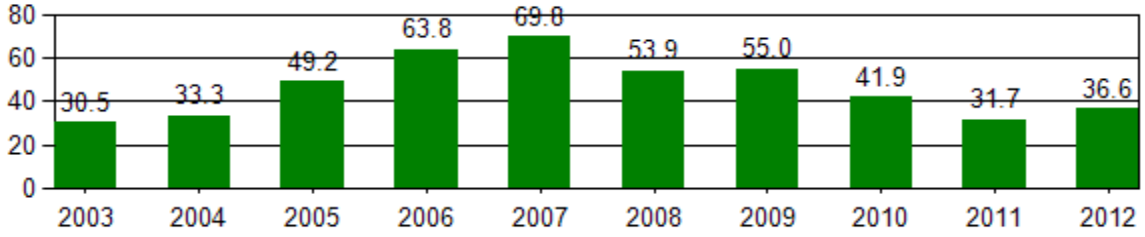
2) Avg Males/Active Lek - Includes only those leks where one or more strutting males were observed. Does not include "Active" leks where only sign was documented.

3) Inactive - Confirmed no birds/sign present (see official definitions)

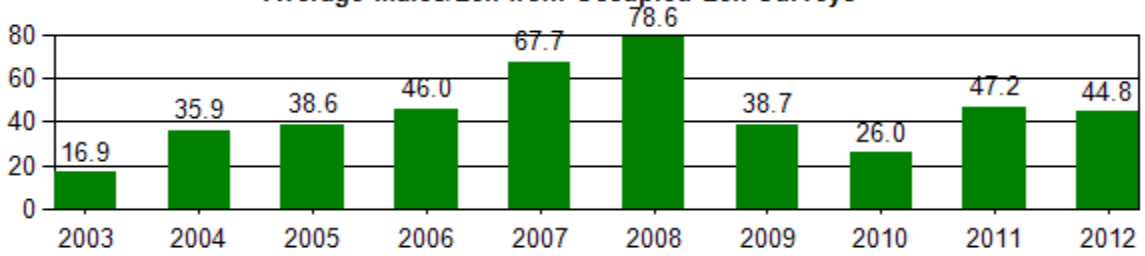
Sage Grouse Occupied Lek Attendance Summary

Year: 2003 - 2012, Management Area: D, Working Group: Upper Green River

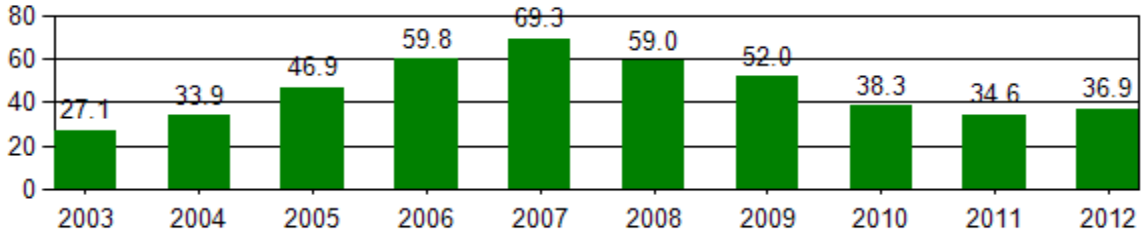
Average Males/Lek from Occupied Lek Counts



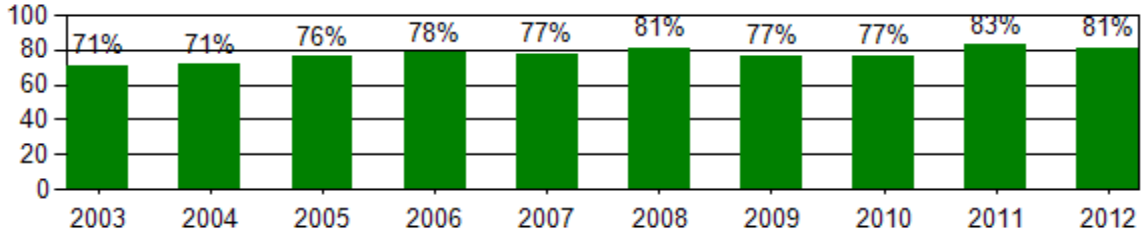
Average Males/Lek from Occupied Lek Surveys



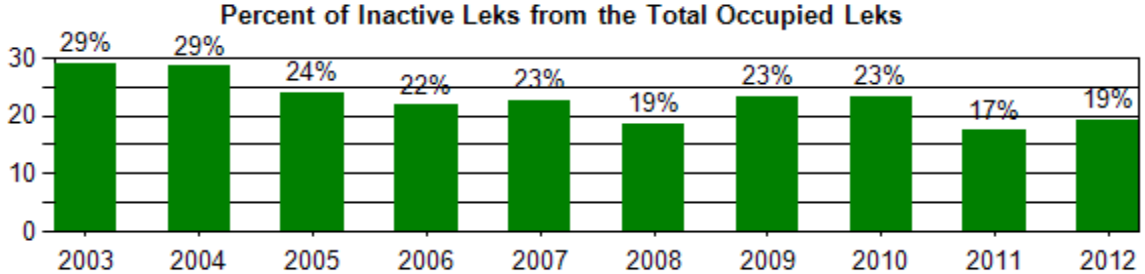
Average Males/Lek from All Occupied Lek Observations



Percent of Active Leks from the Total Occupied Leks



Percent of Inactive Leks from the Total Occupied Leks



Sage Grouse Lek Characteristics

Management Area: D, Region: Pinedale, Working Group: Upper Green River

Region	Number	Percent
Pinedale	151	100.0

Working Group	Number	Percent
Upper Green River	151	100.0

Classification	Number	Percent
Occupied	131	86.8
Undetermined	2	1.3
Unoccupied	18	11.9

BLM Office	Number	Percent
Pinedale	137	90.7
Rock Springs	14	9.3

Biologist	Number	Percent
Pinedale	80	53.0
South Jackson	71	47.0

Warden	Number	Percent
Big Piney	76	50.3
North Pinedale	14	9.3
South Pinedale	61	40.4

County	Number	Percent
Sublette	151	100.0

Land Status	Number	Percent
BLM	133	88.1
Private	12	7.9
State	6	4.0

Management Area	Number	Percent
D	151	100.0

Lek Status	Number	Percent
	8	5.3
Abandoned	6	4.0
Active	101	66.9
Destroyed	1	0.7
Inactive	25	16.6
Unknown	10	6.6

Sage Grouse Job Completion Report

Year: 2002 - 2011, Management Area: D

4. Sage Grouse Hunting Seasons and Harvest Data

a. Season

Year	Season Start	Season End	Length	Bag/Possesion Limit
2002	Sep-28	Oct-6	9	2/4
2003	Sep-27	Oct-5	9	2/4
2004	Sep-23	Oct-3	11	2/4
2005	Sep-23	Oct-3	11	2/4
2006	Sep-23	Oct-3	11	2/4
2007	Sep-22	Oct-2	11	2/4
2008	Sep-22	Oct-2	11	2/4
2009	Sep-19	Sep-30	12	2/4
2010	Sep-18	Sep-30	13	2/4
2011	Sep-17	Sep-30	14	2/4

b. Harvest

Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2002	271	231	615	0.4	1.2	2.7
2003	440	178	401	1.1	2.5	2.3
2004	1040	398	1020	1.0	2.6	2.6
2005	669	233	564	1.2	2.9	2.4
2006	2132	781	1885	1.1	2.7	2.4
2007	1297	564	1300	1.0	2.3	2.3
2008	1109	453	1116	1.0	2.4	2.5
2009	1203	460	1177	1.0	2.6	2.6
2010	1510	526	1497	1.0	2.9	2.8
2011	1720	565	1605	1.1	3.0	2.8
Avg	1,139	439	1,118	1.0	2.5	2.5

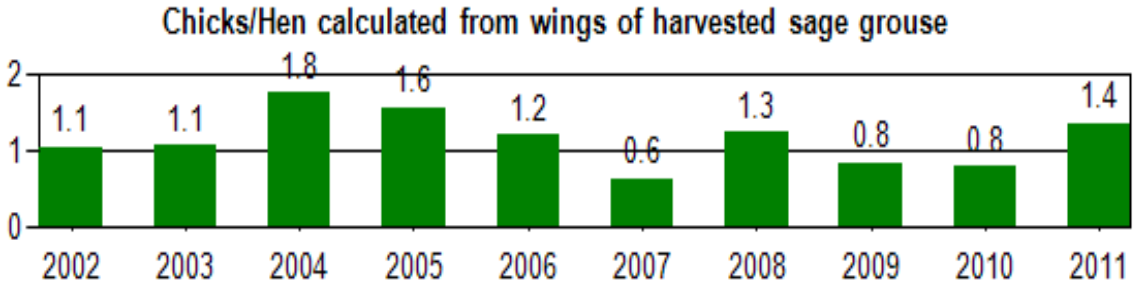
Sage Grouse Wing Analysis Summary

Year: 2011, Management Area: D, Working Group: Upper Green River

Adult Males:	47	% of All Wings:	8.6
Adult Females:	178	% of All Wings:	32.5
Adult Unknown:	0	% of All Wings:	0.0
Total Adults:	225		
Yearling Males:	22	% of All Wings:	4.0
Yearling Females:	24	% of All Wings:	4.4
Yearling Unknown:	0	% of All Wings:	0.0
Total Yearlings:	46		
Chick Males:	132	% of All Wings:	24.1
Chick Females:	144	% of All Wings:	26.3
Chick Unknown:	0	% of All Wings:	0.0
Total Chicks:	276		
Unknown Sex/Age:	0		
Total for all Sex/Age Groups:	**547**		

Chick Males:	132	% of All Chicks	47.8
Yearling Males:	22	% of Adult and Yearling Males	31.9
Adult Males:	47	% of Adult and Yearling Males	68.1
Adult and Yearling Males:	69	% of Adults and Yearlings	25.5
Total Males:	201	% of All Sex/Age Groups	36.7
Chick Females:	144	% of All Chicks	52.2
Yearling Females:	24	% of Adult and Yearling Females	11.9
Adult Females:	178	% of Adult and Yearling Females	88.1
Adult and Yearling Females:	202	% of Adults and Yearlings	74.5
Total Females:	346	% of All Sex/Age Groups	63.3

Chicks:	276	% of All Wings:	50.5
Yearlings:	46	% of All Wings:	8.4
Adults:	225	% of All Wings:	41.1
Chicks/Hen	1.4		



Species: Sage Grouse
Working Group Area: Upper Snake River Basin
Period Covered: June 1, 2011 – May 31, 2012
Prepared by: Joe Bohne

Introduction

With establishment of eight Sage Grouse Working Groups throughout the state in 2004, Sage Grouse Job Completion Reports (JCR) revised to Working Group Areas and not Game and Fish Department Regions as in the past. Until 2010 the Upper Snake River Basin Working Group included Game Bird Management Areas (GBMA) 1 (Gros Ventre and Jackson Hole) and 2 (Hoback Basin and Star Valley). However upland game management areas were revised in 2010 and the Upper Snake River Basin working group area was designated as Area A, which is covered in this report

The initial role of the Upper Snake River Basin Working Group was to develop and facilitate implementation of a local working group plan for the benefit of sage-grouse and, whenever feasible, other species that use sagebrush habitats. This conservation plan was completed in December 2007 and accepted by the Wyoming Game and Fish Commission in January 2008. The plan identifies management practices and the financial and personnel resources needed to accomplish these practices, within an explicit time frame, for the purposes of improving sage-grouse numbers and maintaining a viable population in Jackson Hole that is unique to the valley. This population is an important component of the wildlife diversity associated with Grand Teton National Park and the National Elk Refuge. As such it was designated as a sage-grouse core area in 2008. The plan also addresses the small interstate population associated with Star Valley, the small population in the Gros Ventre Valley, and the population that frequents the Hoback Basin during the spring, summer, and fall.

Information presented in this report includes only lek monitoring data. Productivity data were collected from radio marked hens as part of the sage-grouse study conducted by Craighead Beringia South (CBS) during the summers of 2007-2009 but no brood surveys were conducted. The study ended at the end of 2009 and no productivity data were collected in 2010 or 2011. No data from sex/age composition of harvested birds were collected through the use of wing barrels or field checks because the entire DAU has been closed to hunting since 2000.

Plan Area

The Upper Snake River Basin Working Group Area includes the entire Snake River drainage basin in Wyoming including the major tributaries of the Gros Ventre, Hoback and Salt River drainages. The area boundary encompasses almost all of Teton County and small portions of Sublette and Lincoln Counties (Figure 1).

The occupied sage-grouse habitat in the plan area is primarily sagebrush grassland habitat in the valley floor and foothills of Jackson Hole, Hoback Basin, Gros Ventre River Valley and in the western foothills of Star Valley. Much of the remainder of the working group area is forested habitat that is not occupied by sage-grouse. The core population in Jackson Hole is found primarily in Grand Teton National Park and on the National Elk Refuge. Sage-grouse also use some of the foothill areas on the Bridger-Teton National Forest in Jackson Hole and private land on East and West Gros Ventre Buttes. The Jackson population was designated as a core area by the Governor's Sage-grouse Implementation Team in August 2008 with the boundaries refined in 2010 (Figure 2).

Figure 1. Wyoming local sage-grouse working group boundaries.

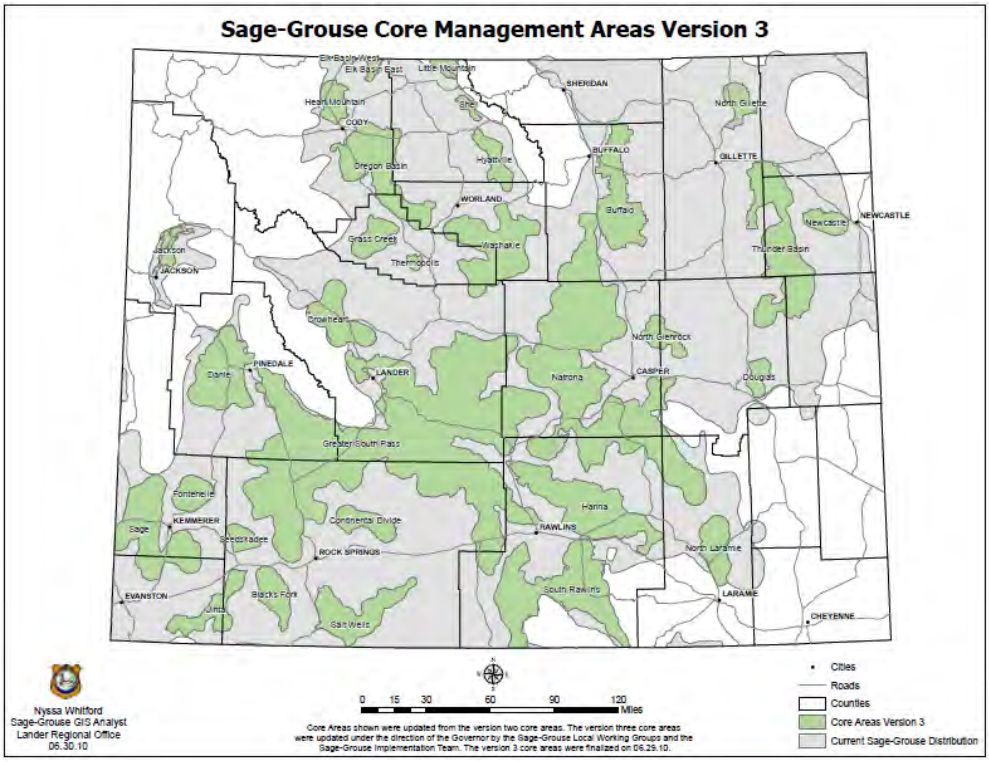


Figure 2. Wyoming Sage-Grouse Core Areas.

There are two leks and possibly a third lek in the Gros Ventre drainage on national forest land. Sage-grouse in Jackson Hole are thought to be non-migratory but some interchange with the birds using the Gros Ventre drainage is possible (Holloran and Anderson 2004).

Sage-grouse also use the sagebrush habitat in the Hoback Basin in the spring, summer and fall. A lek was discovered in the Clark Draw area in April 2010. The lek was checked 5 times and birds were present on all but the last survey. A high count of 13 males was observed on 2 occasions (Table 8). One hen was captured and fitted with a GPS radio and monitored by Bryan Bedrosian, Craighead Beringia South. This hen was bred on the Clark Draw lek and nested successfully on the nearby flank of Clark Butte. A second bird was captured and fitted with a GPS collar. The male spent most of the summer in the area between Clark Draw and Muddy Creek before he was killed by an apparent avian predator. The GPS collar was recovered on the bench west of the McNeel Elk Feedground on National Forest. Sightings of grouse in late spring by USFS personnel while conducting project planning activities associated with the natural gas lease in the area suggest there may be another lek on this bench west of the feedground. The Clark Draw lek was active in 2011 and 2012.

There is a small population of sage-grouse in Star Valley that uses habitat associated with the Gannet Hills in Wyoming and Idaho. There are three known leks located in Idaho in the Crow Creek and Stump Creek drainages near the Wyoming-Idaho state line. All three leks are small (less than 20 birds) but have been checked very infrequently. Star Valley probably provided historic habitat in the valley floor and foothills. Most of the valley no longer is considered occupied habitat primarily due to the conversion of sagebrush and mountain shrub communities to farmland. A thin strip of land about a mile wide along the Wyoming–Idaho State line, running from Big Ridge east of Spring Creek to Stump Creek, appears to provide the only suitable habitat in Star Valley in Wyoming with most of the useable habitat for this small, isolated interstate population located in Idaho (Figure 3). The habitat in Wyoming may provide much of the remaining winter habitat for this small isolated population.

Lek Monitoring

Traditionally, sage-grouse data collection within the Pinedale/Jackson Region has focused on lek surveys and the age and sex composition of harvested birds as determined from wings collected in wing barrels and from hunter field checks collections. Some effort has been made to collect brood survey data. Prior to 1994, relatively few leks were monitored and prior to 2000, standardized efforts were not used to collect sage grouse lek information. Since 2000, efforts have been made to increase data collection on sage grouse leks and standardize data collection methods. Efforts have been made to locate new leks, consistently collect data on leks by complex, and increase the number of visits to each lek. Current lek monitoring has shifted from “lek surveys” to “lek counts” as described below.

Lek monitoring consists of different inventory methods called “lek counts” or “lek surveys”. A lek count consists of at least 3 site visits during the strutting season, with each visit conducted at least 7 days apart. Lek counts are used to determine annual status (active or inactive) along with determining population trends. A lek count can also be a census technique that documents the actual number of male sage grouse observed on a lek complex. Counts are only practical where a few leks comprise a complex. Sage-grouse lek complexes include one or more leks that are located relatively close together, usually less than 1 to 2 miles apart, where males and females will frequently move between the leks during the course of the breeding season. From a

population perspective, sage-grouse lek complexes represent the basic unit for estimating and monitoring sage-grouse population trends. . In order to be classified as an accurate lek count (or census), a lek observation must include all leks within a complex on the same morning. These simultaneous observations must be performed at least 3 times during the strutting season, with at least 7 days separating each lek observation.

A lek survey consists of only 1 or 2 site visits during the strutting season. Lek surveys are primarily important to identify annual status (active or inactive) of a particular lek or lek complex and not for estimating population trends. Overall, lek counts are preferred over surveys and recent emphasis has been placed on collecting lek counts. Based on the findings at each lek, the lek will be assigned an annual status of "Active" (attended by two or more sage grouse or by the evidence of sign), "Inactive" (an absence of birds during at least two ground surveys that were at least 7 days apart or a search of the lek site produced no visible sign at the end of the breeding season), and "Unknown" (either active or inactive status has not been determined). Based on the past and current status, leks are assigned one of the three categories for management purposes. The category "Occupied" is a lek that has been active during at least one strutting season within the last ten years. Management protection will be afforded to occupied leks. An "Unoccupied" lek has not been active during the past 10 years, although there must be sufficient data to justify placing a lek into this category. A lek survey or count must have been conducted 4 out of 10 years during non-consecutive years (i.e. every other year) without activity to be placed in the "Unoccupied" category. Unoccupied leks are also broken down into two subcategories. ("Destroyed" – habitat no longer exists or "Abandoned" – habitat still exists).

Management protection is not being afforded to unoccupied leks. The third category is "Undetermined" which is a lek that has not been documented as being active in the past 10 years, but doesn't have sufficient data documentation to be considered unoccupied.

Prior to 2000, no official protocol standardized guidelines or criteria to define what constitutes a lek, lek status, and lek category as identified above. Further modifications were made in 2003 and 2006 to standardize lek monitoring and definitions. This lack of consistency in the past has led to erroneous lek classification when compared to the "new" lek definitions.

In the past, lek complex counts were not routinely conducted due to manpower and logistical constraints. Most leks were surveyed or counted periodically but no concerted effort was made to count all leks on the same day. However, starting in 2005, counts on leks in Grand Teton National Park, and to some extent on the National Elk Refuge, were coordinated to occur on the same days when it was logistically possible to observers out to the leks. We presume all the leks in Jackson Hole proper constitute a lek complex and the leks in the Gros Ventre drainage constitute a second lek complex. No marked birds from the Gros Ventre leks have appeared on the Jackson Hole leks (Holloran and Anderson 2004, Bryan Bedrosian 2010).

Lek counts and lek surveys have been conducted within the area since 1948; however, the most consistent data sets occur from 1989 to the present. Sage-grouse leks within the USRBWGA are summarized in Table 1 from 1948 through 2010. In some years it is uncertain from the data provided by Grand Teton National Park if leks that were thought to be inactive were actually checked and if they were checked and no birds were observed was the null value reported. Since the status of these leks is uncertain they are noted in the lek database report as not checked (undetermined). It is likely most of these leks are inactive in these years but occasionally some

birds do appear to use leks that have been inactive for several years. The distribution of leks in the USRB working group area is displayed in Figure 3.

Table 1 summarizes the high count on each lek over the survey period and the average number of males counted on active leks based on the high counts at each lek. There is some movement of males between leks, particularly from the North Gap lek on the National Elk Refuge (NER) to leks in Grand Teton National Park (GTNP) and between leks in the lower valley with leks in the upper valley as the spring progresses and snow melt occurs on leks at higher elevations to the north. As a result, the total of the high counts on all leks in each year may represent an inflated estimate of total males in the population. However data collected in the early years have only been reported as the high count on each lek and the summary in Table 1 is presented in this manner for comparative purposes. We presume the trends in the population based on these counts still mimic actual trends in the population. Similar trends are observed in the report using the conventional analysis provided by the WGFD sage-grouse database report.

There are 16 known or historic sage-grouse leks reported in Table 1. Thirteen leks are considered to be occupied and two appear to be unoccupied historic leks within the plan area (3 BAR H and Antelope Flats in GTNP). In recent years the Simpson lek, formerly called Poverty Flats lek in the NER was considered to be unoccupied but 3 males were sighted there in 2012 by Eric Cole, Refuge biologist. Since we had no precise location of the lek it is uncertain if the lek was missed in previous surveys or if the lek is intermittently active and possibly a satellite lek of the North Gap lek. The McBride lek is classified as occupied but has only been active on a sporadic basis in recent years (one male in 2007) and warrants additional scrutiny. It is unclear if the Airport Pit lek is really a lek, a satellite lek or a sporadic activity center for birds displaced off the airport lek by airport operations. The Bark Corral lek may have 2 activity centers (East and West)) or the West lek may be a satellite of the Bark Corral East lek. The Cottonwood lek in the Gros Ventre drainage (reported in the 2006-2007 annual report) was dropped from the database as a lek since birds were only observed there once. However, researchers suspect there may be an additional unconfirmed lek near the Fish Creek Elk Feedground but additional searches in the Gros Ventre drainage in 2012 were unsuccessful in locating the lek (Doug Brimeyer pers. com). Poor access in the spring due to seasonal road closures, muddy roads and residual snow cover makes lek surveys problematic in the Gros Ventre River Valley.

After consulting with Susan Wolff, biologist for Grand Teton National Park, we combined the Moulton East and Moulton West leks in 2007 (reported as separate leks in previous reports) to be reported as the Moulton lek (one lek with two activities centers) in Table 1 starting in the 2008 annual report. In some years it appears the total birds counted on the same day for both activity centers were reported as the high count and in other years a high count for each activity center was reported, but not necessarily on the same date (Grand Teton National Park Database). We have attempted to correct what may have been double counts by taking the highest count for a particular date on both activity centers and reporting that number for the Moulton lek. However, in 2012 both activity centers had robust breeding activity documented but the combined high for both activity centers was maintained as the total count, and birds that moved between the 2 sites were not double counted.

The Spread Creek lek was located in 2007 near the east end of Wolff Ridge in the sagebrush flat between the ridge and Spread Creek. In 2010 birds were also seen strutting on the bare ridge top of Wolff Ridge where there is considerable grouse sign. The lek was reported by other observers in the past but its location was never confirmed. The Spread Creek lek was active from 2008 -

2011 but no birds were observed there in 2012. Additional surveys of the Spread Creek/Uhl Hill/Elk Ranch Reservoir area in 2012 yielded no additional leks.

A new lek was located in 2008 as a result of the study being conducted by CBS in the Pot Holes area of Grand Teton National Park (RKO Road lek). Birds were located on the RKO Road lek on a number of occasions in 2008 and one male was trapped and fitted with radio transmitters near this new lek. The lek was active again in 2009 with a high count of 15 males and again in 2010 with a high count of 13 males, and in 2011 with 10 males. Eight males were counted on this lek in 2012 (Table 1).

A new lek was discovered in the Clark Draw area in the Hoback Basin in April 2010. The lek was checked 5 times and birds were present on all but the last survey. A high count of 13 males was observed on 2 occasions The lek was given provisionally active status in the database in spite of only be check for one year. In 2011 12 males were counted on the lek and 14 males were counted there in 2012 (Table 1).

The WGFD database reports a total of 18 leks in the USRBCA and includes the Moulton West lek and the Bark Corral West Lek as leks of record for the purposes of the 2011-2012 report (but not reported as leks in Table 1. The 3 Bar H, Antelope Flats, and the McBride leks were inactive in 2012 and all but the McBride lek are likely unoccupied. The Simpson lek was reported as inactive in 2011 but appeared to be active again as 3 males were observed strutting near the suspected site of the lek as reported in NER records. The Bark Corral West lek is not considered a separate lek in Table 1. Nine leks were considered active in 2012. It is our intent to try to resolve the status of these leks in time for in time for the 2012-2013 annual report.

Only the Moulton lek (now considered one lek with 2 activity centers) is a large lek, averaging over 40 birds. The other leks in the USRBCA are small leks (ranging from 2-30 birds). The discovery of a number of very small leks over the past 5 years (Timbered Island, Airport Pit, Dry Cottonwood, Spread Creek, RKO Road, and Clark Draw leks) has had the effect of reducing the average number of males per lek while the total number of males counted in the USRBCA increased from 1999 to 2008. However, the total number of males and average number of males per active lek has fluctuated since 2008. In 2010 the total number of males and the number of males per active lek increased. The winter of 2010-2011 was severe and deep snow persisted in the valley. Lek attendance in 2011was affected and birds either arrived late at some small leks or did not attend some leks in deep snow areas (Timbered Island and Dry Cottonwood leks). The ability to conduct lek counts was also affected and some survey dates were missed due to weather or limited access to the leks due to snow or road conditions. It is likely the counts on the Gros Ventre leks were particularly affected by survey conditions and the counts missed the peak breeding activity period for this complex. Poor production in 2011due to the cold, late spring is suspected to have contributed to the apparently suppressed population status in 2012, based on similar average male counts on active leks in 2011 and 2012.

It must be noted that that lek data in Table 1 must be interpreted with caution (as with all sage-grouse lek data)for several reasons: 1) the survey effort and the number of leks surveyed/counted has varied over time; 2) it is assumed that not all leks in the area have been located; 3) sage-grouse populations can exhibit cyclic patterns over approximately a decade; 4) the effects of unknown or unmonitored leks that have become inactive cannot be quantified; 5) lek sites may change over time; 6) not all males attend leks on any day or within a lekking season: 7) lek data collected in Grand Teton National Park from 1952 through 1985 is missing from the agency files

and no record has been found from other sources; and 8) in some years it appears that lek data were combined for some leks, which may be considered satellite leks by the observers (i.e. Beacon and Airport leks or Moulton East and Moulton West leks or Bark Corral East and West leks or North Gap and Simpson leks on NER) and it is uncertain in some years if both of these paired leks were surveyed since only a total count is presented for one of the paired leks. However, in some years prior to 2000 it appears totals may have been lumped and in other years both leks may not have been surveyed or one may have been inactive. The records are incomplete and may never be completely understood.

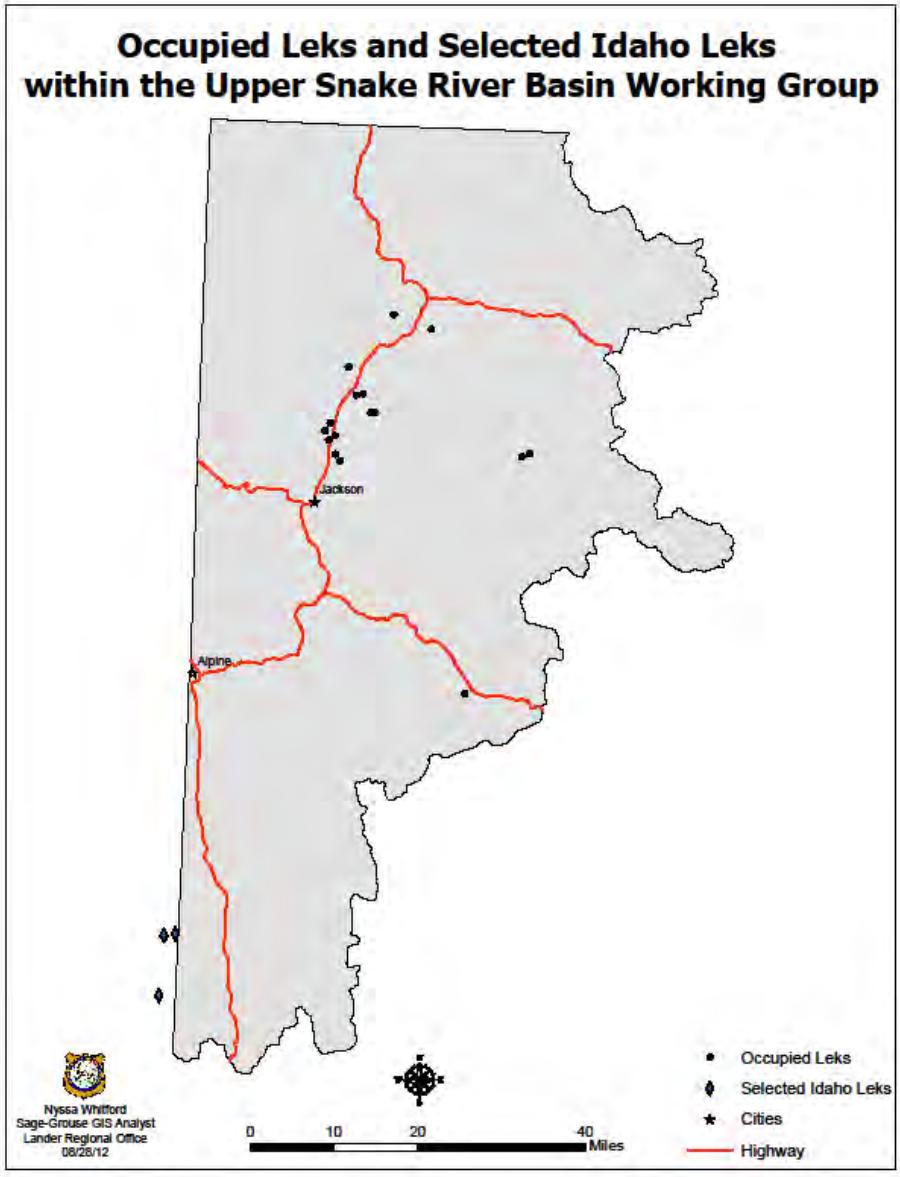


Figure 3. Occupied leks in the Upper Snake River Basin Working Group Area and adjacent selected leks in Idaho.

Table 1. Sage-grouse lek counts (maximum males) by lek for the Jackson Hole, Wyoming population , 1948-2012.
(Grand Teton National Park and Wyoming Game and Fish Dept. Unpublished data)

Year	Airport	Beacon	Airpot Pit	CircleEW/3 BarH	McBride	Antelope Flats	Moulton	Spread Creek	Bark Corral	Timbered Island	North Gap	Simpson	Breakneck Flats	Dry Cottonwood	RKO Road	Clark Draw	Total	Average # males/active lek
1948	61			13	15	59	20		36		0						204	34
1949	51			18	14	62	32		14		0						191	31.8
1950	73			9	50	55	16		20		0						223	37.2
1951	61			7	52	46	28		20		12						226	32.3
1985				NC	27	NC	51*		NC		22						NA	NA
1986	25			NC	27	11	51		NC		14	22					150	25
1987	25			NC	18	1	30		NC		NC	NC					74	18.5
1988	26			NC	23	13	85		7		23	NC					177	29.5
1989	30			NC	21	7	91		6		8	NC					163	27.2
1990	52			NC	10	10	63		8		22	NC					214	35.7
1991	63			NC	15	10	48		16		29	NC					207	34.5
1992	51			NC	12	8	37		16		21	NC					168	28
1993	37	21		NC	16	5	24		8		9	54					198	24.8
1994	NC	NC		NC	27	NC	50		NC		7	NC					84	28
1995	18	15		NC	6	4	63		10		6	NC					122	17.4
1996	18	8		NC	4	2	33		8		19	NC					92	13.1
1997	15	1		NC	6	0	48		1		10	NC					81	13.5
1998	14	0		NC	4	0	33		0		7	NC					58	14.5
1999	17	0		NC	0	0	21		0		9	NC					47	15.7
2000	18	NC		NC	0	NC	28		NC		5	NC	21				72	18
2001	15	NC		NC	NC	NC	30		NC		6	NC	19				70	17.5
2002	19	24		NC	NC	NC	28		NC		4	NC	9				84	16.8
2003	25	NC		NC	NC	NC	35		NC	8	3	NC	7				78	15.6
2004	17	NC		NC	NC	NC	54		2	15	4	NC	14				106	17.6
2005	17	NC		NC	NC	NC	49		NC	17	18	0	16	6			123	20.5
2006	26	4	6	0	0	NC	44		0	20	30	0	21	9			157	19.6
2007	23	NC	0	0	1	0	41	4	1	20	9	0	30	4			133	14.8
2008	16	0	0	0	0	0	38	5	10***	26	23	NC	22	13	12**		165	18.3
2009	10	0	2	NC	0	NC	33	4	5	22	11	0	21	1	15		124	12.4
2010	10	0	0	NC	0	NC	40	5	24	18	13	0	24	4	13	13	151	15.1
2011	11	0	0	0	0	0	27	15	10	0	21	0	5	0	10	12	111	13.9
2012	17	0	0	0	0	0	44	0	3	7	18	3	14	0	8	14	128	14.2

* includes males and females

** new lek in 2008 with multiple observations.

*** BarkCorral lek has 2 activity centers which may be separate leks. In the past birds have been observed at both sites but observations have been combined in this report.

In 2008 2 grouse seen at east lek and 8 seen at west lek.

Population Trends and Estimates

No reliable method for estimating the sage-grouse population for the USRBWGA exists at this time. Both the number of leks and the number of males attending these leks must be accurately quantified in order to accurately estimate the number of males in the population, population size and population trend. However, the number of males/lek provides a reasonable index of abundance of sage-grouse populations over time in response to environmental conditions. The average number of males per active lek takes into account the number of leks counted each year and perhaps is a more reliable measure of population trends over time.

Table 1 provides a long term perspective of the population starting with the research conducted by Patterson (1952) in 1948. Figures 4 and 5 reflect the trends since lek data was consistently collected starting in 1986 and the most recent 10 year period. The long term trend in the lek count data suggests a declining sage-grouse population reaching a low point in 1996 and again in 2009 with some recovery in the intervening years. The decline to low levels in 1996 suggests that this population could have been at risk of extirpation if the causes of the decline (which are unknown) were to persist for period of several more years. Based on the high count at each lek in 2009 a total of 124 strutting males were observed in the USRBCA with 22 males on two leks in the Gros Ventre Complex and 102 males on 8 active leks in the Jackson Hole Complex. In 2010 the maximum count was 151 males with 28 males on the 2 leks in the Gros Ventre complex, 110 in the Jackson Hole complex, and 13 on the Clark Draw lek in the Hoback. In 2012 the maximum count was 128 males with 14 males on the 2 leks in the Gros Ventre complex, 100 in the Jackson Hole complex, and 14 on the Clark Draw lek in the Hoback. The maximum total counts of males in the Jackson Hole Complex range from 214 in 1990 to 47 in 1999 to 130 in 2008 to 100 in 2012 (Table 1).

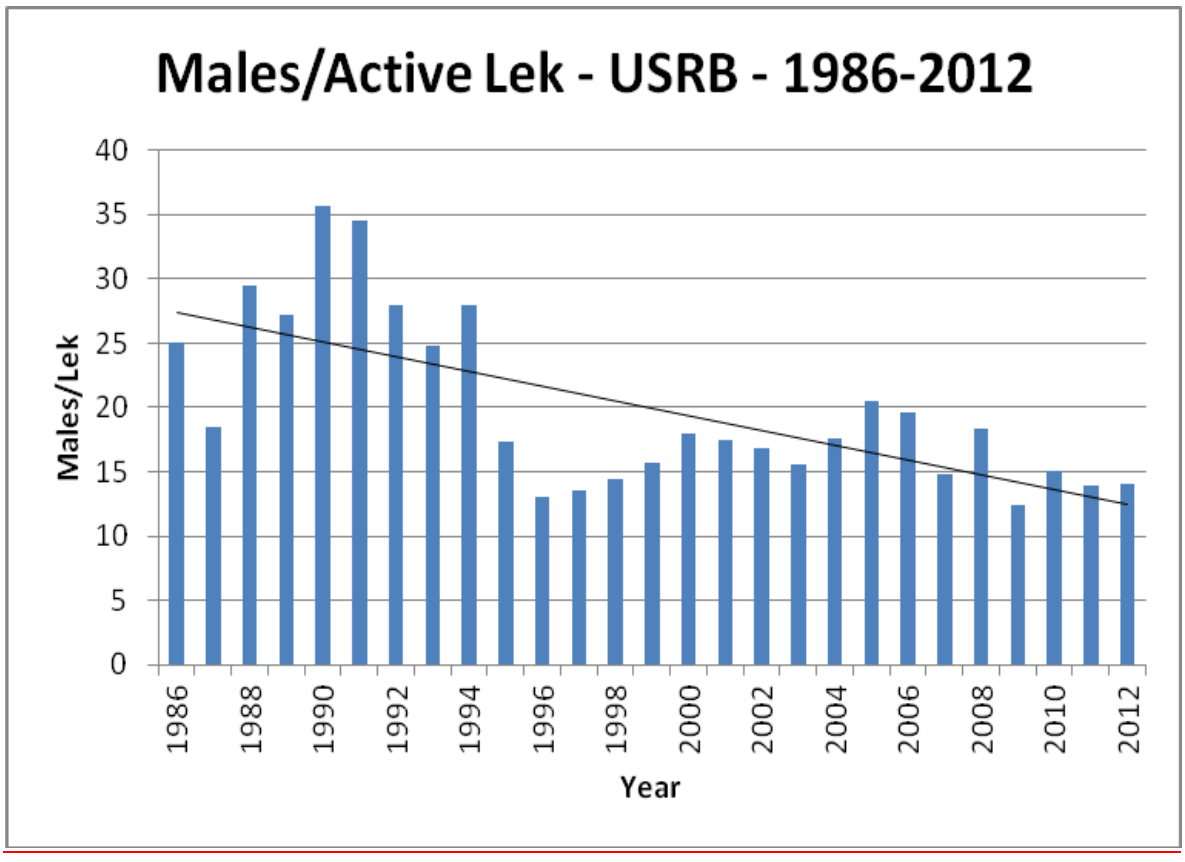
The average number of males per active lek was relatively stable from 2000 to 2008 with the exception of a dip in the average in 2007. However, the average number of male sage-grouse per lek declined from 18.3 males per lek in 2008 to 12.4 males per active lek in 2009 with a modest increase in 2010 to 15.1 males per active lek and another small dip in 2011 to 13.9 males. The average number of males per lek increased slightly to 14.1 in 2012. As with the analysis of trends reported in Table 1, the discovery of a number of very small leks in recent years (Timbered Island, Airport Pit, Dry Cottonwood, Spread Creek, RKO Road leks) has had the effect of reducing the average number of males per lek while the total number of males counted in the USRBCA generally increased from 2000 to 2008. Both the long term (1986-2011) and the short term (2002-2011) analysis indicate the population is on a decreasing trend with some annual fluctuations in total males counted (Figure 4). With small populations erratic fluctuations from year to year can be expected as the recruitment of juveniles fluctuates from year to year and there is little to buffer populations.

In an attempt to develop another index in sage-grouse population trends, researchers for Craighead Beringia South conducted a winter census of sage-grouse on known winter areas outside the National Elk Refuge (which is closed to human entry during the winter). On February 2, 2008, 14 volunteers counted 443 grouse in Jackson Hole. Snow conditions were above normal and counting conditions for the ground survey were excellent. Since the National Elk Refuge was not surveyed but provides winter habitat for sage-grouse, this count is a minimum count for this population. The Gros Ventre was not surveyed due to logistical constraints and the big game winter range closures which make a ground survey impractical. The winter census in Jackson Hole in 2009 resulted in a count of 385 birds.

The census was cancelled in February, 2010 due to lack of adequate snow in the valley floor. In February 2011 the winter census resulted in a total count of 287 grouse in the south part of the valley but no birds were observed in the north portion of the valley in the Spread Creek/Uhl Hll area In February, 2012 a similar survey was conducted and 198 sage-grouse were observed in the south portion of the valley (Bryan Bedrosian, pers.com.). Snow conditions were nominally average for the 2012 survey

Analyzing lek data from 1985-2007 Garton et al. (2011) estimated the annual rate of change for this population averaged -2.2%, which leads to the relatively high probability of populations declining below 50 effective breeders (Ne) and would place the population in a situation where it is vulnerable to the risk of extirpation. Their analysis from multi-model forecasts suggests the probability of the Jackson population declining below 50 effective breeders to be in a range of 11% and 27% in 30 and 100 years, respectively. Based on their analysis, the probability of long term persistence for populations with less than 500 effective breeding adults is 0%. Their threshold for an effective breeding population is 500 adults indexed to a minimum count of 200 males on leks (Garton et al. 2011). The Jackson population has been below 200 males counted on leks since 1992. Clearly the long term persistence of this population is of paramount concern to the local working group and resource managers.

Figure 4.



Productivity

CBS gathered data on productivity of radio marked hens from 2007-2009. In 2007 CBS researchers documented 14 of 15 (93%) instrumented hens initiated nesting. Of these nesting hens, 50 % (7/14) were success in their nesting attempts, hatching 23 chicks. An average of 3.3 chicks per successful hen or 0.67 chicks per all instrumented hens were documented in 2007. In 2008 24 of 25 (96%) instrumented hens initiated nesting. Of these nesting hens, 58.3 % (14/25) were successful in their nesting attempts, hatching 23 chicks. In 2009 15 hens with working radios initiated nesting (100%) and 10 (71%) were successful in hatching out a brood. An average of 3.3 chicks per successful hen or 0.67 chicks per all instrumented hens were documented in 2007. In 2008 the average number of chicks present in late brood counts was 2.67 (11 successful nesting hens with VHS collars) and the number of chicks in 2009 brood survey was 3.0 chicks (8 successful hens with VHF collars). Vital rates for this population are reported in the Completion Report for the Jackson Hole Sage-grouse Project (Bedrosian and Craighead 2010). No brood surveys by regional personnel were conducted in 2007 - 2011 in the USRBCA.

Harvest

Most of the plan area has been closed to hunting since the establishment of Grand Teton National Park. No hunting for sage-grouse has been allowed on lands under the jurisdiction of Grand Teton National Park or the National Elk Refuge. Prior to 1995, the traditional sage-grouse seasons opened on September 1 with a 30 day season. Seasons have gradually been shortened with later opening dates date to increase survival of successful nesting hens, as they are usually more dispersed later in the fall, and reduced overall. From 1995 through 1999 hunting seasons were shortened to a 15-16 day season that typically opened during the third week of September and closed in early October. The bag limit was 3 birds per /day, while the possession limit changed from 9 to 6 birds in 1994. In 2000 the hunting season was closed in Management Areas 1 and 2 (revised to Area A) in the Snake River Drainage. The closure was in effect for the 2000 hunting season and in subsequent years to the present.

Prior to 2000 a few hunters were known to have hunted in the Gros Ventre drainage and the Hoback Basin with some success. The annual harvest survey conducted by the Wyoming Game and Fish Department likely did not adequately sample the few hunters that hunted sage-grouse in the USRBWGA comprised of Management Areas 1 and 2. Based on the Annual Harvest Survey by the WGFD, the average harvest from 1996 through 1999 was 305 birds taken by an average of 138 hunters who spent an average of 403 days in the field. The estimated harvest ranged from 283 birds in 1996 to 407 birds in 1999 and hunters ranged from a low of 60 in 1996 to 229 reported in 1999. The average birds harvest per day ranged from 0.6 in 1999 to 1.1 in 1998 and birds per hunter ranged from 1.5 in 1997 to 4.7 in 1996. These harvest data seem inflated since a wing barrel on the Gros Ventre Road in 1998 and 1999 collected no wings. It appears the hunters who hunted in the Gros Ventre drainage or in the Hoback Basin were likely a few local hunters who traditionally hunted these areas. However, trends in the harvest data from 1996 through 1999 for the USRBWGA are similar to trends reported for the adjacent Upper Green River Basin WGA for the same time period although the values are much lower.

Based on the population viability analysis by Dr. McDonald, reported in past completion reports and Garton et al (2011), it appears that any increase in mortality of females and juveniles should be

avoided and the hunting season closure on these small isolated populations in Jackson Hole, in the Gros Ventre drainage, and in Star Valley is warranted. It is unlikely that these populations will ever be large enough to support hunting. So little is known about the small sage-grouse population in the Hoback Basin that it would be imprudent to hunt these birds until more is know about their numbers, seasonal habitat use, seasonal movements and ties to the sage-grouse population in the Upper Green River Basin.

Habitat Protection

In August 2008 Governor Freudenthal issued Executive Order 2008-2 establishing core areas and draft stipulations to protect sage-grouse habitat and populations in those core areas. The Executive Order and Core Area Policy can be found on the WGFD website. The Jackson Hole population was designated a core area while the remainder of the small sage-grouse populations in the working group conservation area fell in the non-core area designation. In response to the intense gas field development in the Upper Green River Basin, several sage grouse research projects have been initiated in this region. The results of those studies are reported or referenced in the Upper Green River Basin Working Group Conservation Plan and annual JCR. Implementation of existing stipulations intended to preserve sage grouse and sage grouse habitats on BLM and Forest Service lands have been scrutinized and exceptions granted. These stipulations are often applied to other resource development activities in an attempt to protect important sage-grouse habitats.

In 2011 Governor Mead issued his Executive order 2011-5 which provide guidance for sage-grouse conservation on state lands and set the policy for the WGFD to work with landowners and managers to implement sage-grouse conservation measures. Executive Order 2011-5 can be found on the Wyoming Game and Fish website at http://wgfd.wyo.gov/web2011/wildlife-1000817.aspx .

Based on research in the Powder River Basin and the Pinedale area, it appears that protective measures and timing stipulations in place on non-core areas on oil and gas leases and conditions of approval for individual wells on BLM lands and Federal ownership of minerals are not effective to prevent significant declines in grouse numbers within natural gas and coal bed methane gas fields Research suggests these stipulations in place on all BLM land prior to 2011 did not effectively mitigate the impacts of energy development and grouse numbers decline over time within these large natural gas fields and leks eventually disappear within the perimeter of these fields.

With long-term declines in sage grouse populations, both locally and range-wide, increased efforts have been placed on collecting sage grouse data. In addition, the increase in natural gas exploration and development within Sublette County has raised concerns regarding the impact of such large-scale landscape developments on sage grouse populations. Research has demonstrated significant adverse impacts on affected sage-grouse populations. Energy development probably will not be a major impact on sage-grouse populations in most of this working group area. However, some leasing has occurred in the Hoback Basin. The Forest Service is currently conducting a draft environmental impact analysis (DEIS Eagle Prospect and Nobel Basin Master Development Plan) with Plains Exploration and Development Company to allow the development of a deep natural gas field known as the PXP Project in the Noble Basin area north of the Hoback Rim that could result in 136 wells on 17 pads with 15 miles of new road and 14 miles of reconstructed roads and result in about 400 acres of disturbed

habitat (Bridger-Teton National Forest 2007). Most of these new roads would occur in an area that is relatively remote and accessed with low standard, two-track roads.

The Nobel Basin area provides nesting and brood rearing habitat for some sage-grouse but little is known about this small population. One hen was captured on the Clark Draw lek in 2010 and fitted with a GPS collar and we hope this bird will provide some insight into the movement patterns of birds into and out of the Hoback Basin and seasonal habitat use in the Basin, recognizing one bird may not be representative of the larger population in its movements and behavior (Bedrosian pers com.). A second sage-grouse, a male, was captured and fitted with a GPS collar in the summer of 2010. That bird was killed by an avian predator on the bench between Muddy Creek and the Hoback River in the project area in August, 2010. The hen moved from the Hoback Basin to Meadow Canyon northwest of Big Piney in the late fall of 2010 and returned to following spring, was bred on the Clark Draw lek and nest successfully near her nest site from the previous year on the west flank of Clark Butte. The hen repeated these movements in 2011 and successfully nested in the Clark Draw area again. She returned to the Meadow Canyon area where it appears she was predated during the 2011-2012 winter The Clark Draw lek is the only documented lek in the Hoback Basin but researchers suspect there may be another lek on the bench between Muddy Creek and the Hoback River in the vicinity of the site where the male with the GPS collar was killed by a predator. However, consultants collecting predevelopment data for the proposed PXP gas field found a lek in 2008 just south of the Hoback Rim in the NE ¼, NE ¼, Section 36 T36N R113W during aerial lek surveys. About 40 males were present on the snow covered lek when observed for the first time in late April. The consultants were not able to gain access to the lek, which is on private land, to get a more accurate count on the numbers of sage-grouse present or a precise location (ARCADIS 2008). It is possible this lek was incorrectly located during the consultant's survey. Additional lek survey work is needed in the Hoback Basin.

Special Projects

Bedrosian, B., R. Crandall, and D. Craighead. 2010. Jackson Hole Sage-grouse Project Completion Report: 2007-2009. Craighead Beringia South, P.O. Box 147, Kelly, WY 83011.

The USRBWG supported the sage-grouse study by Craighead Beringia South with partial funding from the Wyoming Sage-grouse Conservation Fund from 2006 through 2009. The project was initiated in the spring of 2007 with efforts to capture and attach radios to sage-grouse. The research project is supported by the National Park Service, U. S. Fish and Wildlife Service, Bridger-Teton National Forest, Wyoming Game and Fish Department, Jackson Hole Airport Board and a number of other agencies, organizations and individuals. The completion report for the project was finished in December, 2010 and was attached in Appendix 1 of the 2010-2011 Annual Report..

Airport Safety Study

The impact of the Jackson Hole Airport on the sage-grouse population is an issue which should be addressed. One active lek (Airport) and 1 inactive satellite lek (Beacon) exist within the fenced airport property. Several airplane strikes by sage-grouse have been reported but the confirmed strikes have occurred in August, not during the breeding season. Concerns about sage-grouse strikes on aircraft and the resulting safety issues has caused the Federal Aeronautics Administration to contract with Wildlife Services, USDA to study risks associated with wildlife affecting safe aircraft operations at the

Jackson Hole Airport. Efforts to reduce the risks that sage-grouse pose to airport operations could have negative impacts on this population. The study was initiated in 2006 and is pending completion and release to the public. In addition, the National Park Service has expressed interest in marking sage-grouse that frequent the airport lek with radio or satellite telemetry to more intensively study their movements and habitat selection to determine if the birds can be effectively discouraged from using the airport area for breeding and brood rearing.

In 2009 the Jackson Hole Airport Board contracted with Craighead Beringia South to provide a baseline survey and inventory of sage-grouse breeding at the Jackson Hole Airport (JHA). The study was designed to provide a base for future studies in the event changes (habitat or disturbance rates) occur within the JHA.

Objectives:

1. Obtain baseline information on current strutting behaviors and territory placement of males on the airport lek.
2. Map current, existing vegetation structure within the airport perimeter during the nesting and brood rearing phases.
3. Document potential male behavior and territory alterations due to disturbances (e.g., enplanements, predators) and lek habitat characteristics (e.g., snow placement and depths).
4. Describe current disturbances and rates of disturbance during lekking.

The report (Bedrosian and Walker 2010) was attached as Appendix 2 in the 2010-2011 Annual Report.

<u>Returning Sagebrush to the Kelly Hayfields: A 150 Acre Restoration in Grand Teton National Park</u>.

The sagebrush steppe vegetation within Grand Teton National Park (GTNP) forms the core habitat for sage grouse within the Upper Snake River Basin. While the Park contains 47,000 acres of big sagebrush, it has nearly 9,000 acres of abandoned hayfields that were once sagebrush. These hayfields are now dominated by a nearly shrubless monoculture of smooth brome (*Bromus inermis*). In the 30-50 years that these hayfields have been abandoned, sagebrush has re-established in only a limited area. However, where the sagebrush has returned, the native bunchgrass/forb understory hasn't always. Since 2006, Craighead Bergingia South has been collecting GPS points from collared sage grouse and has demonstrated that grouse do not utilize the hayfields nearly frequently as the intact sagebrush nearby. Clearly, for these hayfields to ever be prime habitat for sage grouse and other sagebrush obligates, they must be restored to their former sagebrush-steppe vegetation.

Restoring sage grouse habitat is in keeping with the goals of the Upper Snake River Basin Conservation Plan which lists grouse habitat as the #1 potential issue affecting sage grouse populations. Further, the first proposed action within the plan to address habitat is to "Manage vegetative communities to provide for nesting and early brood rearing habitats." Nesting and early brood rearing areas generally occur within 4 miles of a lek site. The Moulton lek site in GTNP has consistently been the most visited lek by sage grouse in the Upper Snake River Basin. The Moulton lek lies on the northern edge of a large area of abandoned agricultural land known as the Kelly Hayfields. Like most hayfields, the vegetation is dominated by non-native grasses, with few big sagebrush or leafy forbs. Consequently, the nesting and rearing habitat available to birds breeding at

the Moulton lek is severely diminished (Figure 5). Nearly 4,500 acres of smooth brome dominated hayfield lie within 4 miles of the Moulton lek. Removing the smooth brome and restoring the native sagebrush-steppe vegetation would add a huge amount of sage grouse habitat, and remove a large reservoir of exotic plant species. For the benefit of sage grouse and many other species, the Park has begun to restore the Kelly Hayfields to native sagebrush-steppe vegetation. Currently the Park has begun the restoration treatments in the former Hunter-Talbot homestead and has put 150 acres under treatment. This project would fund the final 150 acre piece and complete restoration treatments on this particular hayfield.

The Hunter-Talbot hayfield was chosen for the first large scale treatments for several reasons. First, it would displace the fewest number of existing sage grouse (the area isn't heavily used currently). Second, habitat modeling has shown that the area should provide good year-round habitat (Figure 6). Finally, the area is relatively small and surrounded by intact native vegetation, which should allow native plants to disperse readily into the site.

This project addresses the #1 priority of the USRBCP—Sage grouse habitat. Further, it addresses two primary objectives:

Objective 1) Manage vegetative communities to provide for nesting and early brood rearing habitats. This project will begin an alternation of the landscape from vegetation that offers no valuable nesting or brood rearing habitat, to one that will in the first years would provide brood rearing (3 to 10 years post treatment) and after some development and maturation, nesting habitat (10+ years post treatment).

Objective 6) Rehabilitation of altered habitats. This project will be one of the early phases of the long-term restoration of the Kelly Hayfields. Restoring the Kelly hayfields is action item #6 under this objective. **"**Support Kelly hayfields restoration to native sagebrush grassland plant community in Grand Teton National Park."

Project Goal: Restore sagebrush steppe vegetation to a 150 acre portion of the abandoned Hunter-Talbot hayfield. This will complement the on-going restoration of 150 adjacent acres and complete restoration treatments on this particular homestead.

GTNP recently completed a sagebrush restoration study to determine the most effective techniques to remove smooth brome and restore sagebrush steppe vegetation. We have found that one precisely timed herbicide application (3% solution of glyphosate) is very effective in killing smooth brome. Following the smooth brome die-off, opportunistic weed invasion usually occurs. These weeds can be treated with herbicide (2-4-D or glyphosate), burned, or mowed depending on the type of weed and the level of infestation. Usually 15 months after the initial smooth brome treatment the site can be prepared for drill seeding and planting. Key bunchgrass and forb species are drill seeded during a late fall application.

We have discovered that planting "islands" of dense shrubs and forbs is an effective way of insuring that vital understory and overstory species will be established on the site. These islands also increase the patchiness of a landscape in a compressed timeframe and accelerate the natural succession from hayfield to shrub steppe. These islands would be fenced with 5 feet high x 16 feet long cattle panel with grid openings large enough to allow the movement of birds and small mammals but too small for larger predators and ungulates to enter. In addition to providing protect areas of habitat, the islands

will also prevent excessive herbivory and help to build a seed source that will disperse outward into the project area.

The Park Service initiated a third sagebrush restoration project in 2011 with funding support from the USRBWG. The project goal is to restore sagebrush steppe vegetation to the abandoned Elbo Ranch hayfields (359 acres) southeast of the Hunter Talbot restoration project.

The basic timeline:

May 2011
—Pre-treatment vegetation inventory.
June 2011
—Herbicide application to remove smooth brome and other non-native species (Elbo East/West units 359 acres)
Summer 2011
—Native seed collection and cleaning.
September 2011
—Seed cover crop (Elbo East Unit 309 acres)
October 2011
—Seed native grass mix (Hunter East/West Units and Elbo West Unit 230 acres).
September 2012
— Plant shrubs and forbs throughout prior seeded units when conditions are deemed suitable, and erect fences.
June 2013
—Continued vegetation monitoring and spot spray for noxious weeds.

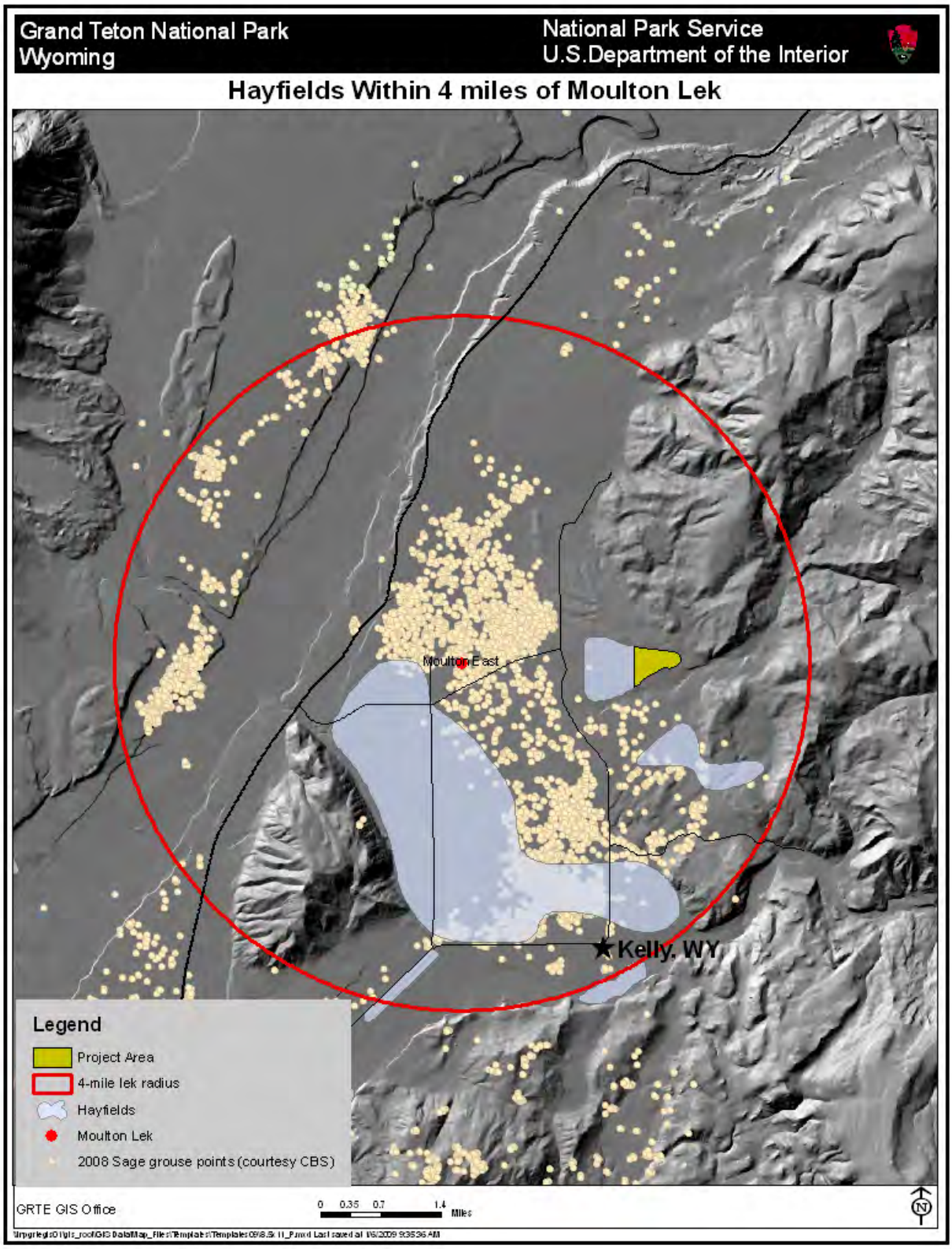

Grand Teton National Park
Wyoming
National Park Service
U.S.Department of the Interior
Hayfields Within 4 miles of Moulton Lek
Moulton East
Kelly, WY
Legend
Project Area
4-mile lek radius
Hayfields
Moulton Lek
2008 Sage grouse points (courtesy CBS)
GRTE GIS Office
0 0.35 0.7 1.4
Miles
N

Figure 5.

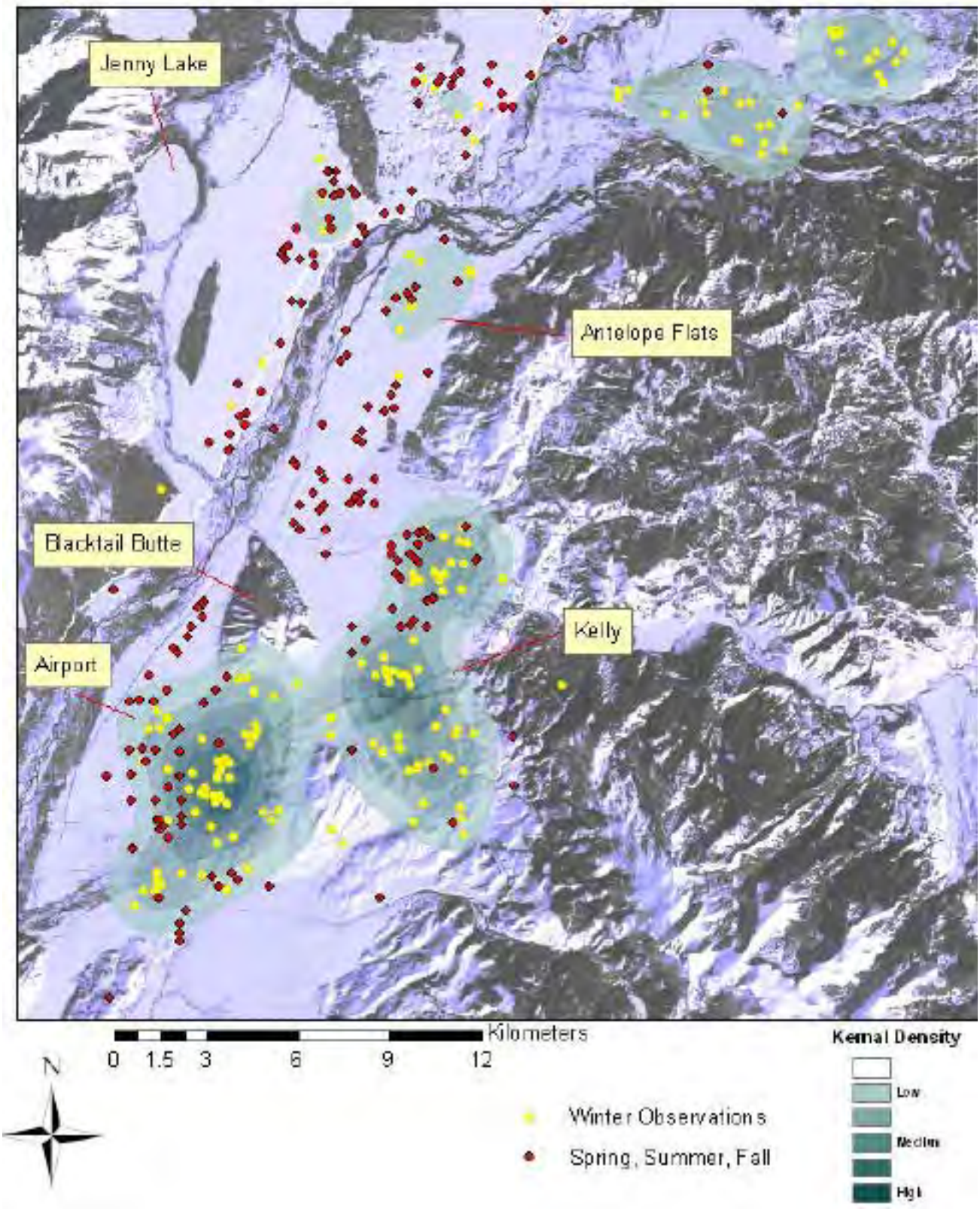


Figure 6. Grouse Density Mapping. Taken from the USBSG Conservation Plan.

Past Research Projects

Patterson, R.L. 1952. The sage grouse in Wyoming. Sage Books, Denver, Colorado, USA.

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Management Summary

If the average number of males per lek is reflective of the sage-grouse population, the trend suggests relatively high populations in the early 1990s with a sharp decline through 1999 and a modest but short lived recovery starting in 2000. The maximum total counts of males range from 214 in 1990 to 47 in 1999 to 165 in 2008 but declined to 124 males in 2009 before rebounding to 151 in 2010 but dropping by 2012 to 128 males (Table 1). Lek data must be collected consistently between jurisdictions and follow the established WGFD protocol. Searches for new leks should be conducted annually.

Lek data summarized in Figures 4 and 5 suggest the population is declining both over the long term (1986-2011) and in the short term (2002-2011). The long-term viability of this population probably can be assured only if mortality factors currently affecting this population do not increase, resulting in greater losses of adult and juvenile hens. Based on this assumption, reinstituting the hunting season in Management Area A (formerly Areas 1 and 2) is not warranted at this time.

Habitat monitoring and mapping of sagebrush habitats used by sage-grouse are a priority. Additional surveys of winter sage-grouse distribution are needed to confirm habitat selection and winter distribution. Key areas on public lands used by sage-grouse should be protected from management actions which could have adverse impacts on that habitat. Wildfire suppression should be a priority in most of the occupied sage-grouse habitat in Jackson Hole and the Gros Ventre drainage. Restoration of native sagebrush habitats on lands formerly farmed in Grand Teton National Park appear to have the greatest potential to expand and enhance habitat used by sage-grouse in the USRBCA.

The impact of the Jackson Hole Airport on the sage-grouse population is an ongoing issue. Management options that do not adversely affect the Jackson Hole sage-grouse population should be considered in any risk assessment and wildlife hazard management plan associated with safe aircraft operations at the Jackson Hole Airport. Efforts to reduce the risks that sage-grouse may pose to airport operations should be carefully evaluated to avoid negative impacts to this population which may be at some risk of extirpation.

The sage-grouse study by Craighead Beringia South provides essential information to manage the sage-grouse population and its habitat in Jackson Hole. Land management agencies and the Wyoming

Game and Fish Department should consult this report when considering habitat projects in Jackson Hole and the Gros Ventre Valley.

Recommendations

1. Coordinate lek surveys across jurisdictional boundaries using the lek survey protocols adopted by the WGFD.
2. Search for new leks annually and check historic, unoccupied or inactive leks.
3. Attempt to locate the missing historical data collected by the National Park Service.
4. Continue winter sage-grouse distribution surveys to expand winter habitat mapping capabilities and seek to map other seasonal habitats using habitat models validated with observed data.
5. Cooperate with the National Park Service, the Federal Aeronautics Administration, the Jackson Hole Airport Board, and other partners to complete the Wildlife Hazard Management Plan for the Jackson Airport and design projects to minimize risks of sage-grouse strikes on aircraft while protecting the population from further declines.
6. Consider the findings of the sage-grouse study by Craighead Beringia South to determine demographic data and vital rates for the Jackson Hole population, determine seasonal distribution and habitat use, identify critical habitat, identify limiting factors for the population, determine the influence of potential predators, develop an accurate population model, design long term monitoring protocols, propose management strategies for sagebrush habitats and fire regimes, and provide baseline data for future research.
7. Collect seasonal distribution and habitat use data for the sage-grouse populations associated with the Gros Ventre Valley, Star Valley, and the Hoback Basin. Since portions of the Hoback Basin are leased and one deep natural gas project (PXP) has been proposed, collecting data on sage-grouse using the project area should be a priority.
8. Cooperate with the Pocatello Region of the Idaho Fish and Game Department to gather more information on the interstate population in Star Valley along the Idaho-Wyoming state line
9. Support Grand Teton National Park's sagebrush habitat restoration projects in the Mormon Row and Hayfields areas which could be used as winter and nesting habitats for sage-grouse in Jackson Hole once suitable habitat has been restored.
10. Habitat losses associated with historic human footprint and more recent wildfires and prescribed burns appear to be significant. Habitat retention is the highest habitat management priority for the USRBCA. A GIS based map of vegetation treatments and wildfires in the USRBCA has been developed for the Jackson Hole and Gros Ventre Valley as part of an effort to determine the extent of habitat losses in recent years and to develop priority areas for wildfire suppression.
11. Protect important breeding, nesting, and winter habitats used by the Jackson Hole and Gros Ventre sage-grouse populations from further sagebrush loss or fragmentation until areas burned in the past 20 years in prescribed or wildfires have recovered to provide functional habitat.
12. Minimize impacts to sage-grouse breeding habitat in general sage-grouse habitat when conducting habitat enhancement projects for other wildlife species, livestock range projects, or fuels reduction projects.
12. The USRBWG Sage-grouse Conservation Plan should be revised and updated in the coming year to incorporate or adapt the core area sage-grouse policy delineated in the Wyoming Executive Order 2011-5 into the current plan. Work to implement the strategies and projects identified in the revised plan.

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Patterson, R.L. 1952. The sage grouse in Wyoming. Sage Books, Denver, Colorado, USA.

Wind River/Sweetwater River Conservation Area
Job Completion Report

Species: **Greater Sage-grouse**
Mgmt. Areas: **E & WR (1 lek from G)**
Period Covered: **June 1, 2011 – May 31, 2012**
Prepared by: **Stan Harter, South Lander Wildlife Biologist**

Introduction

The Wind River/Sweetwater River Conservation Area (WRSRCA) encompasses about 10,163 mi^2, including a diverse array of vegetation communities in central Wyoming (Figure 1). Greater sage-grouse (*Centrocercus urophasianus*) are found throughout the sagebrush/grassland habitats of Wind River and Sweetwater River drainages. Occupied habitat is fairly contiguous throughout much of the conservation area, with principal differences in sagebrush species and associated plant communities related to elevation, precipitation, and soil type diversity. Habitats within the Gas Hills and Badwater Creek areas appear to be the most fragmented by changes in habitat type and energy development. Migrant populations of sage-grouse occur within portions of the conservation area, with some overlap among more stationary resident populations. Large, contiguous blocks of sagebrush/grassland communities have been eliminated in most of the Bureau of Reclamation's (BOR) Withdrawal Area near Riverton and converted into agricultural croplands, as well as near most developed urban areas.

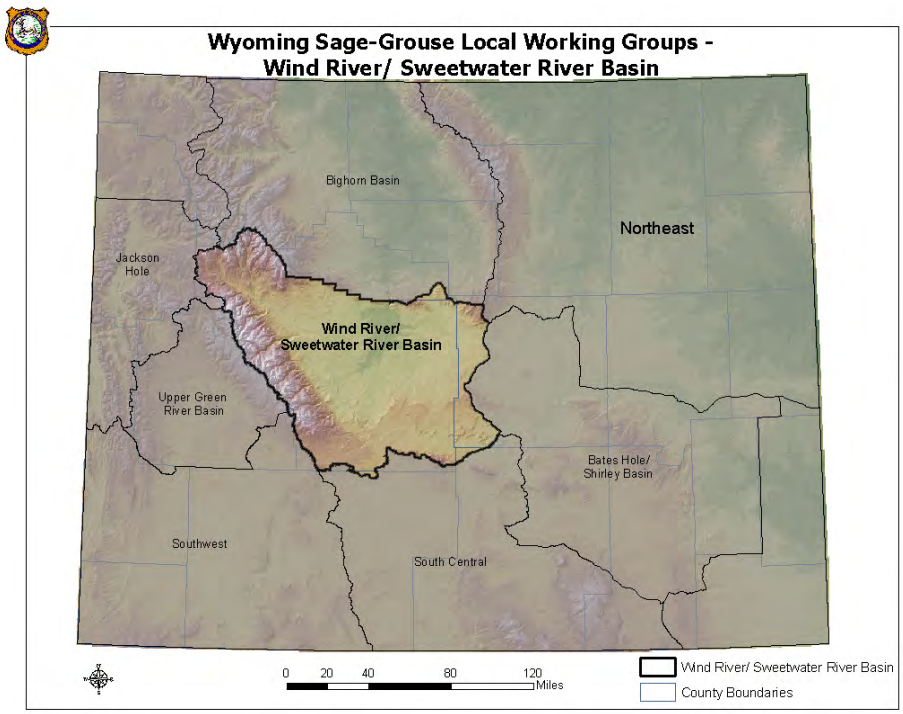

Figure 1. The Wind River/Sweetwater River Conservation Area.

Known occupied sage-grouse leks within the WRSRCA are predominantly located on public lands (59% Bureau of Land Management (BLM) and Bureau of Reclamation (BOR), or tribal lands on the Wind River Reservation (WRR – 25%). Approximately 11% of known leks are found on private land with the remaining 5% found on Wyoming State Trust lands (Appendix A).

Conservation Area

The Wind River/Sweetwater River Conservation Area features the Wind River and Sweetwater River drainages. The area extends from Dubois in the west to Muddy Gap and Waltman in the east and from South Pass and Cyclone Rim in the south to the Owl Creek Mountains and South Bighorns in the north. The WRR is also included in the local planning area. Political jurisdictions include Fremont, Hot Springs, Natrona, and very small portions of Carbon, Sublette, and Sweetwater counties. Figure 2 indicates land ownership within the WRSRCA, including areas managed by the U.S. BLM (Lander, Rock Springs, Casper and Rawlins Resource Areas), the U.S. BOR, the U.S. Forest Service (Shoshone and Bridger National Forests), the State of Wyoming, and private landowners. The Eastern Shoshone and Northern Arapaho Tribal Business Councils manage lands within WRR, in association with the U.S. Bureau of Indian Affairs and U.S. Fish and Wildlife Service (USFWS). Major habitat types within the plan area include: sagebrush/grassland, salt desert shrub, mixed mountain shrub, grasslands, mixed forests (conifers and aspen), agricultural crops, riparian corridors, and urban areas. Primary land uses within the WRSRCA include: livestock grazing, oil/gas development, mining, dryland and irrigated crop production, recreation, and urban expansion.

The Wind River/Sweetwater River Local Working Group was organized in fall 2004 to develop and implement a local conservation plan to benefit sage-grouse and other species that use sagebrush habitats. This conservation plan will identify management practices to improve sage-grouse habitat and populations. The mission statement of the Wind River/Sweetwater River Local Sage-grouse Working Group is "to identify issues and implement strategies to enhance sage-grouse and their habitats". The Wind River/Sweetwater River Local Sage-Grouse Conservation Plan was completed in August 2007. This plan and other Wyoming sage-grouse information is located on the WGFD website at http://gf.state.wy.us/wildlife/wildlife_management/sagegrouse/index.asp

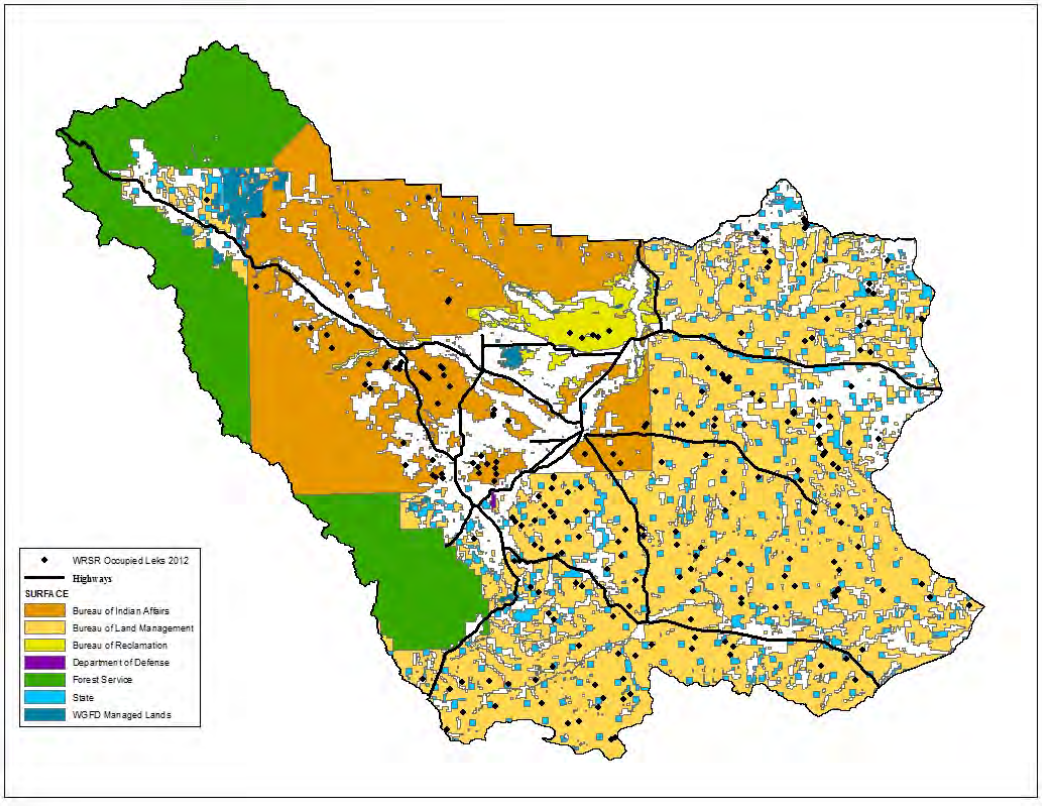

Figure 2. Land ownership within the WRSRCA (dots = 2012 occupied leks). Source: WGFD, BLM.

The WRSRCA encompasses all of the WGFD's Small/Upland Game Management Areas E and WR (Figure 4), with one lek in Management Area G. Management recommendations and conservation efforts apply to all tribal lands within the WRR in both Fremont and Hot Springs Counties. Management areas do not directly correspond to sage-grouse population boundaries, but are used for general data collection and reporting for all small and upland game species.

Endangered Species Status and Wyoming Greater Sage-Grouse Core Areas

On March 5, 2010 the U.S. Fish and Wildlife Service (Service) issued a decision of "warranted but precluded" for listing Greater Sage-grouse as threatened or endangered under the Endangered Species Act. This means Greater Sage-grouse have become a "candidate" for listing but are precluded from immediate listing due to higher priorities. This status is reviewed annually by the Service.

In its decision document, the Service specifically cited Wyoming's Core Area Strategy (described below) as a mechanism that, if implemented as envisioned, should ensure conservation of sage-grouse in Wyoming and therefore help preclude a future listing.

The Wyoming Game and Fish Department and Commission maintain management authority over candidate species and management emphasis will continue to focus on implementation of Wyoming's Core Area Strategy.

In an unprecedented move to coordinate sage grouse conservation efforts across the State of Wyoming, Governor Dave Freudenthal utilized the recommendations from his Sage-Grouse Implementation Team and released Executive Order 2008-2 on Aug. 1, 2008 establishing "Core Areas" for greater sage-grouse in Wyoming. These core areas contain the highest densities of sage-grouse in Wyoming based on peak male attendance at leks. Stipulations developed by the Governor's Sage Grouse Implementation Team provide additional conservation measures for about 83% of the state's sage-grouse on about 25% of the land area. Following the updates prepared during the spring and summer of 2010 by the Implementation Team, Governor Freudenthal issued a new Executive Order on August 18, 2010 to replace that from 2008.

Governor Matt Mead issued an Executive Order on June 2, 2011 which reiterated and clarified the intent of Wyoming's Core Area Strategy originally developed under former Governor Freudenthal's administration with the assistance of the Governor's Sage-Grouse Implementation Team and the local sage-grouse working groups. About 80% of the known leks in the WRSRCA are in core areas (Figure 3).

As a part of the updates made by the Governor's Sage Grouse Implementation Team in 2010, the WRSR LWG reviewed and revised core area boundaries to more accurately reflect actual core habitat values and sage grouse use of these habitats. Most of the changes occurred along the Lander Foothills and agricultural or residential lands near Lander, and in the Gas Hills and Green/Crooks Mountain area where past uranium mining has left the area in either non-vegetated or vegetation cover unsuitable for sage-grouse.

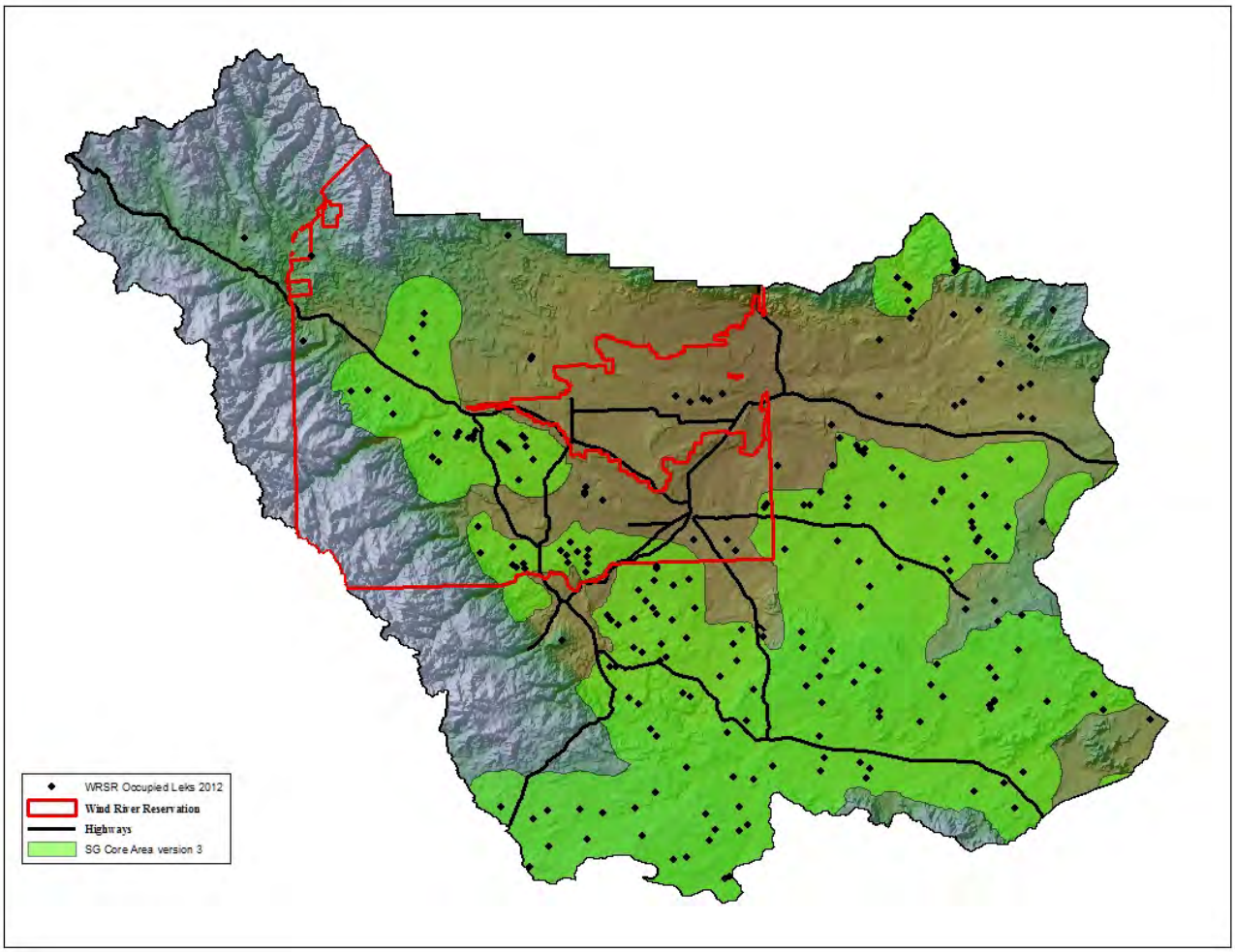

Figure 3. Wyoming Sage-Grouse Core Areas (Version 3, 2010) within the WRSRCA (dots=2012 leks). Source WGFD.

Lek Monitoring

WGFD, federal agencies, and volunteers have conducted lek counts and surveys each spring within the WRSRCA for over 40 years, providing some of the best long-term management data currently available for sage-grouse. Lek counts include those lek observations conducted 3–4 times each spring, about 7–10 days apart. Lek counts are a census technique that document the actual number of male sage-grouse observed attending a particular lek or lek complex. Lek surveys typically consist of only one spring visit and are intended to determine general lek status. Known leks indicate sage-grouse distribution within the WRSRCA as represented in Figures 2, 3, and 4.

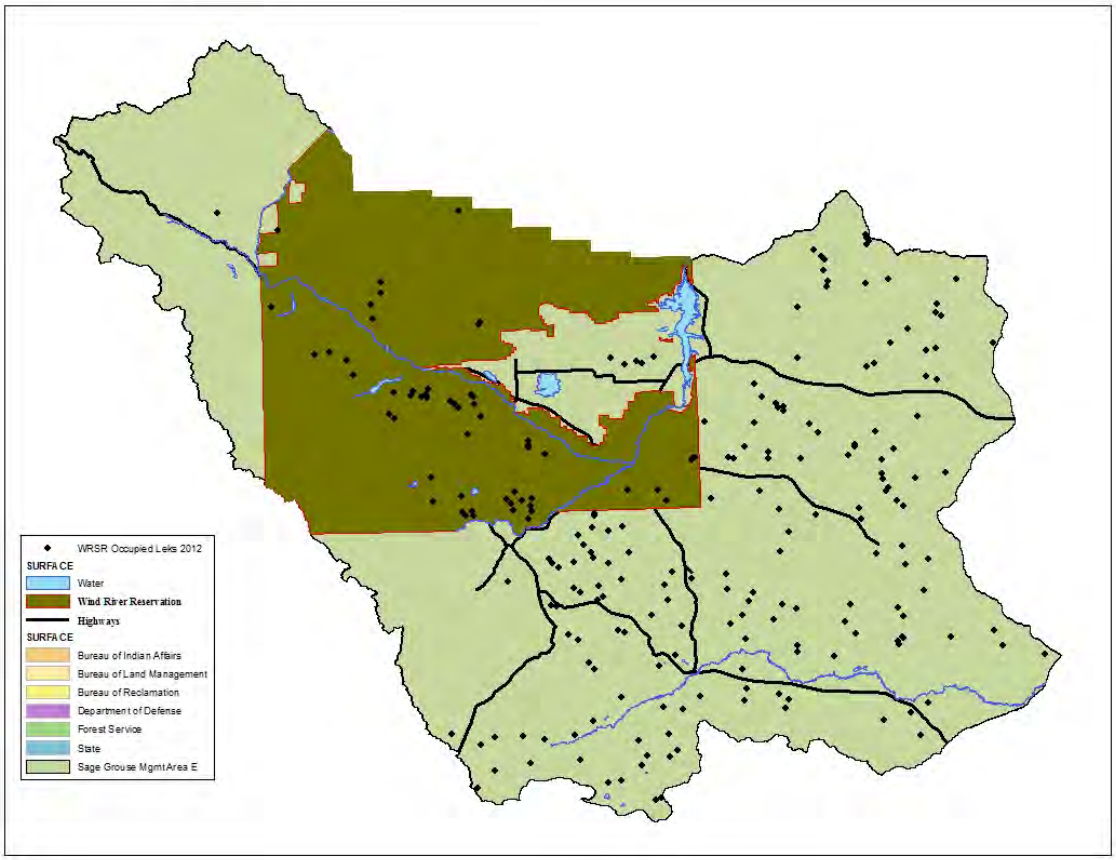

Figure 4. WGFD upland game bird management areas and known leks within the WRSRCA (dots=leks). Source WGFD.

Lek Attendance - 2012

Sage-grouse are generally found throughout the WRSRCA except in heavily forested, agriculturally developed, or urbanized areas. Sage-grouse leks in the WRSRCA are located within the Lander WGFD Region, 2 Wildlife Biologist and 6 Game Warden Districts, 4 BLM Resource Areas, 5 Wyoming counties, and WRR (Appendix A). There were 221 occupied leks within the conservation area in 2012, of which 199 were active at least once in the past 10 years. Due to changes in lek definitions, some leks have been deleted from the database, as they did not meet the definition of a lek, and should have not been included as leks in prior years. Anecdotal information indicates the possible existence of another 6 leks on WRR; however no data are available for lek attendance. In addition, there are almost certainly leks within the WRSRCA that have not yet been documented. Similarly, there are leks that have been abandoned or destroyed that are undocumented. Lek attendance increased between 1995 and 2006, but has since declined. With intensified monitoring efforts since 1995, at least 97 new or newly discovered leks have been documented in the WRSRCA.

Of the 199 known active/occupied leks in the WRSRCA, 172 were checked in 2012 by WGFD, BLM, USFWS, and SATFG, assisted by several researchers, consultants, and volunteers (Appendix A). Of those checked, 78 were counted and 94 were surveyed. Of the 149 leks where status was confirmed, 133 (89%) were active and 16 (11%) were inactive. Data for 8 new leks were added in 2012. Average peak male attendance at count leks was 28.9, which is 9% higher than in 2011 (26.9), 40% below the average since 2003 (48.8), and 61% below the peak in 2006 (76.0).

A set of 16 leks in the Government Draw/Beaver Rim area have been continuously counted since 1995, and data trends reveal little difference between these intensive lek counts and those counted intermittently or all leks checked throughout the WRSRCA during the same time period (Figure 5). Due to higher number of males in the Government Draw/Beaver Rim area, the average number of males per lek counted was higher than the remainder of the WRSRCA, but the population trends are nearly identical.

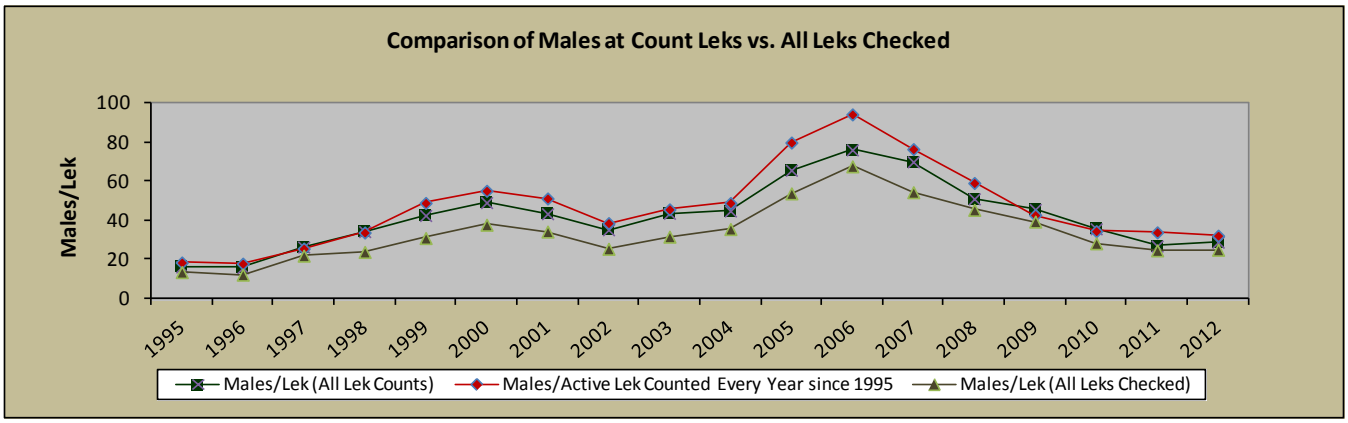

Figure 5. Male attendance trends for lek counts since 1995.

A new sage-grouse database was developed by Wyoming Game and Fish Department in 2012, to improve efficiency, reduce errors, and better facilitate data analysis. Changes were made to the manner in which lek data are calculated and reported in Table 1 (Appendix 1). The new version is based solely on active "occupied" leks. The past version suggested that was the case in the title of Table 1, but when inactive or unoccupied leks were monitored those data were also included in the table. The result of this change is that the number of "known occupied" leks is now more accurate, but reflects fewer leks than in the previous version. Similarly, the new version calculates average male lek attendance using only monitoring observations where one or more male grouse were observed strutting. The old version included a count of "0" males for leks where activity was confirmed by the presence of sign but no birds were observed. Together, these two changes result in somewhat higher, but more accurate, average male attendance for active leks than previously reported. The changes do not result in any change in population trend based on average male lek attendance. Interpreted population increases and decreases over time remain the same so no revisions to past reports are required.

Since only "occupied" leks are being reported on Table 1, it is important to consider trends in the numbers of active versus inactive leks in addition to the average size of active leks. During a period of population decline, the size of active leks typically declines and the number of inactive leks increases. The converse is typically true of an increasing population. Therefore, the magnitude of both increases and decreases is usually greater than what is indicated by the average lek size alone.

Average female lek attendance is no longer being reported since our data collection techniques is not designed to accurately capture these data and is therefore not a useful figure in assessing population trend.

Lek Perimeter Mapping

With increased interest in developing Wyoming's energy resources, emphasis has arisen to map all known sage grouse leks, complete with perimeters outlining the extent of strutting activity on each lek. As of 201**2**, almost all lek perimeters were mapped in the WRSRCA. Distance and timing stipulations for developments are applied to the perimeter of each mapped lek, rather than a centralized point. This is a significant difference for many large leks with some total lek areas reaching up to 100 acres or larger.

Population Trend

Monitoring male attendance on leks provides a reasonable index of relative change in abundance in response to prevailing environmental conditions over time. Nevertheless, these data must be viewed and interpreted with caution for several reasons described in the Wyoming Greater Sage-Grouse Conservation Plan, 2003.

Lek counts and surveys have been conducted within the WRSRCA since the early 1960s. Beginning in 1995, lek monitoring intensified, and the number of "count" leks increased markedly; with 78 leks being counted in 2012. Concurrent with increased monitoring effort, the number of sage-grouse (total males observed) also increased (Figure 6), but the increase was more dramatic beginning in 2004, peaking at 8,127 total males observed in 2006. Although the number of known leks continued to increase steadily, the number of male sage-grouse observed declined dramatically in the mid-1990s and grew rapidly in the late 1990s and early 21st century. However, since 2006, lek attendance has declined rapidly, with the average attendance in 2012 being 60% lower than in 2006. The average number of males observed/all leks checked was 25.0 in 2012, 38% below the average since 2003 (40.5). Even with sharply declining numbers since 2006, the average number of males per active lek in 2012 was about double the long-term low point (12.3) observed in 1996 (Figure 7).

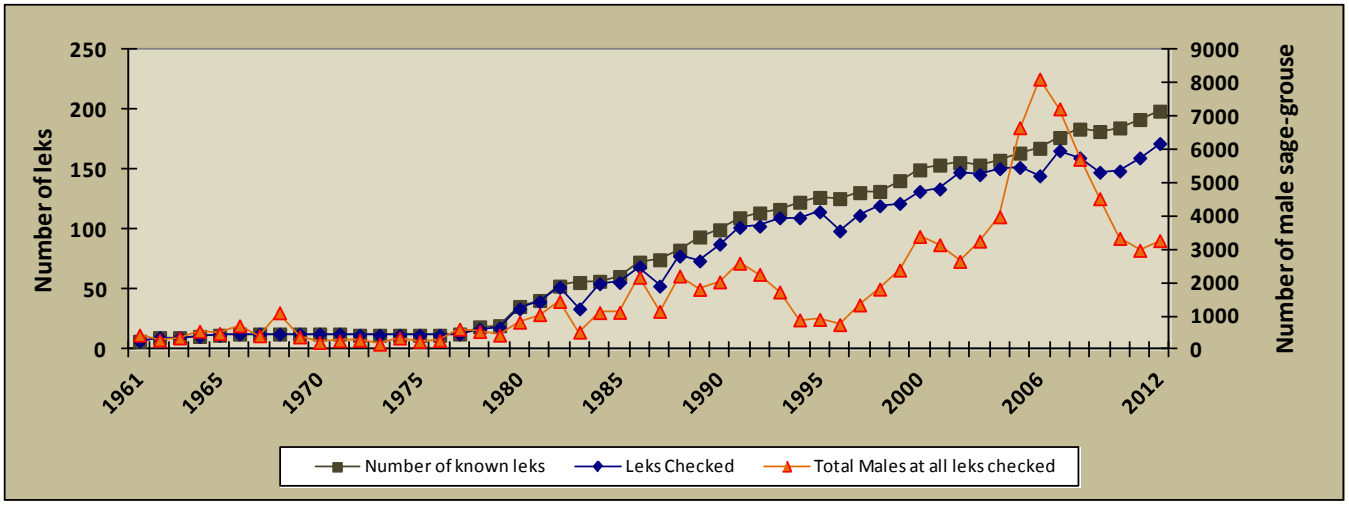

Figure 6. Lek numbers and total male attendance in WRSRCA, 1961 – 2012.

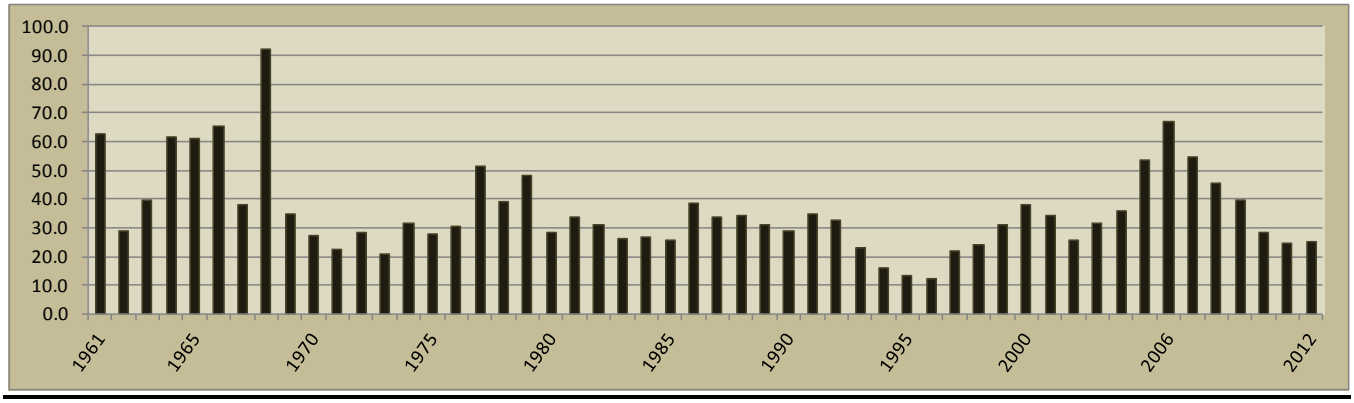

Figure 7. Average number of male sage grouse per active lek in the WRSRCA since 1961.

Productivity

Limited annual sage-grouse brood data have been collected and documented during July and early August. Brood data provide some indication of population trend based on production. In most years, brood data are limited because of low sample sizes, due to low populations or conflicting work schedule demands. No brood count protocol is established within the WRSRCA. Annual pronghorn classifications are conducted via ground observations and often allow personnel to observe numerous broods in August.

Where available, harvest wing data provide a more reliable indicator of recruitment than do brood data. Several wing barrels placed annually along major hunting area exit roads in Upland Game Bird Management Area 8 have typically provided significant wing data, due to a relatively high number of sage-grouse hunters. Table 1 in the Hunting Season and Harvest section below indicates wing data from hunter harvested birds during the 2011 hunting season yielded an average brood size of 1.4 chicks per hen, suggesting meager chick survival, (sample size shown includes chicks and hens only).

Hunting Season and Harvest

The 2011 sage grouse hunting season increased in length by 1 day (Sept. 17 – 30). Hunter numbers and sage grouse harvest decreased noticeably, reflecting lower numbers of birds were available. Hunter effort (days/bird) and birds/hunter statistics have generally followed numbers of grouse and hunters since 2002 (Appendix 1, Table 4b).

Table 1. Brood data from harvest wing barrels for Upland Bird Management Area E, 2002 - 2011.

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Chicks/Hen	1.3	1.8	5.0	1.7	1.3	1.3	1.4	1.3	1.2	1.4
Sample Size	201	208	325	515	254	298	392	457	379	316

Weather

Spring 2011 precipitation was similar to 2010, with Lander, Riverton, and Jeffrey City receiving above normal precipitation (mostly in May). However, due to the timing of this precipitation in the form of late-winter snows through May and June, this improvement in precipitation likely led to reduced chick survival, as demonstrated by the low ratio of 1.4 chicks/hen observed in the wing barrel data for fall 2011. Some hens lost nests due to the cold, wet conditions and $2^{nd}/3^{rd}$ nesting attempts were met with marginal success. Lek attendance also declined throughout most of the WRSRCA in 2012, confirming poor chick recruitment in 2011, which was most likely due to cool, wet conditions during the nesting and early brood rearing period.

Habitat (Current and Historic)

Sage-grouse habitat quality has been affected by long-term drought throughout the WRSRCA. Disturbance (i.e., localized energy development, season-long grazing by livestock and wildlife, etc.) combined with lengthy drought periods and sagebrush eradication programs in many areas have negatively impacted sage-grouse and their habitats. In an effort to improve conditions for sage-grouse, habitat improvement projects are being planned and/or implemented throughout the WRSRCA to address declining sage-grouse habitat condition. In addition, research projects in the Lander area are continuing to provide more insight to sage-grouse movements and habitat use. Habitat conditions vary greatly within the WRSRCA, due to climatic differences, soil types, land use, and elevation.

Habitat Monitoring

Sagebrush transects have been established by WGFD in the WRSRCA and are monitored for production and to estimate over-winter utilization by big game. One transect is located along Yellowstone Ridge on the west side of Beaver Creek, with a similar transect located near Moneta. Although these transects were established to monitor big game winter range conditions, they are located in habitats suitable for sage-grouse and future transects may be established to monitor conditions in other key sage-grouse habitats.

Habitat monitoring data were not collected in 2011, due to turnover in the Lander Habitat Biologist position.

The BLM has established various types of long-term upland and riparian habitat monitoring studies on public lands within the WRSRCA. Information collected is used to monitor vegetative changes in important wildlife habitats. There are over 200 Condition and Trend transects, which are typically read every 5 years, and are used to ascertain changes in plant species composition, plant diversity, ground cover and vegetative production on rangelands. Sagebrush canopy cover is monitored on 75+ permanent browse transects located in key wildlife habitats. In addition, cross-section transects, greenline, and permanent photo-points are used to monitor important riparian systems. Although the data obtained from these site-specific monitoring sites are not conducive to trend generalizations, it does indicate that drought has affected herbaceous and browse production.

Habitat Inventory

An extensive habitat mapping project was completed in southwestern portions of the WRSRCA to delineate and evaluate crucial winter and yearlong ranges associated with the South Wind River Mule Deer Herd Unit. Maps delineating specific browse communities including, sagebrush/bitterbrush (*Purshia tridentata*), silver sagebrush (*Artemisia cana*), three tip sagebrush (*Artemisia tripartita*), and mixed stands that include skunkbush sumac (*Rhus aromatica*), chokecherry (*Prunus virginiana*), snowberry (*Symphoricarpos albus*), etc. were completed by hand, and later were digitized into GIS layers. In all, nearly 170,000 acres of habitats were mapped, with more than 200 sites identified for potential habitat improvement projects. Much of the habitat contained in this project also supports sage-grouse, and projects improving sagebrush health should provide better habitat conditions for sage-grouse.

In 2007, WGFD, Rocky Mountain Elk Foundation, Mule Deer Foundation, and The Nature Conservancy completed transactions with several property owners northwest of Lander to acquire conservation easements to prevent fragmentation of wildlife habitat on approximately 3,300 acres of deeded land. In addition to these conservation easements, the landowners have a strong desire to implement habitat improvement projects for the enhancement of wildlife on these properties.

Knowledge of sage-grouse habitat use is limited throughout much of the WRSRCA outside the Lander - South Hudson focus area. As such, inventory and mapping of sagebrush and associated sage-grouse habitat should be a priority for the Wind River/Sweetwater River Local Working Group in ongoing planning efforts. Winter habitat use should also be documented when conditions and budgets allow.

Winter Habitat Survey

Limited winter observations were collected in 2011-12, mostly as opportunistic observations during deer, elk, and moose classifications flights or random ground surveys.

Government Draw Habitat Improvement Project

The Government Draw project area provides sage-grouse wintering, breeding, nesting, and early brood-rearing habitat south of Hudson, Wyoming. The area has experienced season-long cattle grazing since the early 1900s in conjunction with a long-term lack of disturbance, resulting in older age-class sagebrush stands with little regeneration and limited herbaceous understory. Recent sage-grouse studies indicate that hens with their chicks leave shortly after hatching to migrate to higher elevation habitats having greater vegetation diversity. Chick mortality can be high as these young birds must navigate across a highway and travel 20+ miles to reach preferred habitats. Increasing herbaceous plant abundance, species diversity, and the overall nutrient quality of the vegetation community may encourage birds to remain longer on their nesting and early brood-rearing habitats. Larger chicks would be better able to make the arduous trip and the end result should be increased chick survival.

Goals:

1. Improve sage-grouse nesting and early brood-rearing habitat.
2. Lengthen time spent by sage-grouse in nesting and early brood-rearing habitats.
3. Increase chick survival.
4. Utilize knowledge gained for additional treatments throughout the Lander – South Hudson focus area.

Objectives:

1. Increase forb density and diversity within treated areas.
2. Increase sage-brush recruitment and age-class diversity within treated areas.
3. Increase perennial grass plant density and diversity within treated areas.
4. Create a mosaic of vegetation communities.

The project entailed conducting different vegetation treatment methods on sagebrush/grass rangeland to determine each method's effectiveness in improving sage-grouse habitat. Prescribed fire was planned for a part of the project area having deep soils covered predominantly by Basin big sagebrush (*Artemisia tridentata tridentata*). Due to poor herbaceous cover (fine fuels) and limited time of opportunity, burning was not successful in 2006, and will be delayed until prescribed burning conditions are met and grazing deferment may be achieved. Timing of the treatment should consider grass, forb, and sagebrush recruitment goals and prevention of cheatgrass (*Bromus tectorum*) establishment and/or expansion. Initial results from the limited amount of burned areas indicate prescribed fire should not be considered as a high priority treatment in this habitat type.

The first 2 phases of mechanical sagebrush treatments have been completed. This pilot project is experimental in nature, and is designed to enhance herbaceous vegetation with the objective of increasing early brood-rearing habitat. Mechanical treatments were employed and included using a mower on 1,250 acres and Lawson pasture aerator on about 75 acres on sites with shallow soils and covered by Wyoming big sagebrush. Treated zones consisted of irregular mosaic patterns, alternating with a mosaic of untreated zones. Treatment areas were deferred from livestock grazing for the first growing season. Initial monitoring indicated an increase in hawksbeard *(Crepis spp.)*, a forb utilized by sage-grouse, in the aerated treatment zone. Grasses appear to be increasing in vigor, but it is uncertain if cover has increased as yet. Dry summers have most likely minimized seedling establishment. Sagebrush cover was reduced by 60-80% in most of the treated sites. However, stems remaining after treatment indicate a rapid response to the removal of surrounding sagebrush. Some stems produced as much as 4-6 inches of new leader growth in the first year following treatment. In 2006, several

sagebrush plants in the treatment zones produced seed stalks, which were not observed in virtually any of the untreated sites.

With measurable vegetation response observed following the first 2 phases of treatments, potential exists for expansion for several additional years. Several thousand acres of important sage-grouse habitat within the South Hudson area could benefit from these vegetation manipulation treatments. Results of this project can be used to determine additional treatment areas and treatment methods in the South Hudson area, in other sage-grouse habitat within the BLM's Lander Field Office, and elsewhere in Wyoming. The project should also improve forage conditions for pronghorn and mule deer, which utilize the area yearlong. Livestock are expected to benefit from an increase in herbaceous vegetation.

As reported above, no additional monitoring occurred in 2011.

Habitat Improvement Projects on Wind River Reservation

Three habitat treatments were implemented on the Wind River Reservation in fall 2007 and spring 2008. Table 2 provides a projects summary of these treatments.

Project area	Type of Treatment	Completed	Acres treated	Acres in project boundary	Focus Area	UTME	UTMN	Zone
Mountain Meadows	Mow	Sept 2007	301	625	Owl Creek Front	635500	4827300	12
Spring Creek	Mow	Oct 2007	124	370	Wind River Front	641300	4788900	12
Argo Butte	Prescribed burn	Spring 2008	65	300	Wind River Front	668800	4783500	12

Table 2. Habitat improvement projects conducted on Wind River Reservation in 2007 and 2008.

Special Studies

South Hudson Coal Bed Methane Study

The South Hudson Coal Bed Methane Study ended early-summer 2003. In response to a proposal to drill for coalbed natural gas (CBNG) within core sage-grouse habitat south of Hudson, WGFD and BLM embarked on a telemetry study. To gather pre-disturbance data, 6 males and 16 females were trapped from 4 leks near the proposed wells in spring 2001, and an additional 17 birds were trapped in spring 2002. These birds were equipped with radio transmitters and monitored until 2003. Although the CBNG test wells proved to be infeasible for commercial field development, the results of the telemetry study provided some valuable insight regarding sage-grouse habitat use in this area. Prior to this study, it was known that sage-grouse left the study area in June each year, but direction and distance of the emigration was unknown. Results from this study found that birds that nested in the Government Draw area south of Hudson moved south and southwest up to 65 air miles from the leks where captured. The findings of this study provided baseline data and information that was incorporated into the study design of future research conducted by Jarren Kuipers and Brian Jensen with the University of Wyoming Cooperative Fishery and Wildlife Research Unit from 2003 through 2006. Results for this project were published in the Department's 2002 Lander Region upland game completion report (Ryder, WGFD 2003).

McGraw Flats/South Pass Cattle Grazing Study by Jarren Kuipers

University of Wyoming Graduate Student Jarren Kuipers finished his Master of Science Thesis in Spring 2004 detailing results of field research conducted in the McGraw Flats/South Pass study area. The purpose of this research was to A.) Provide scientifically credible data that would assist wildlife and land management agencies and private land owners in ascertaining the impacts grazing has on sage-grouse population sustainability, and B.) Determine livestock grazing practices that will lead to overall sagebrush steppe ecosystem health and thus provide sage-grouse habitat conducive to sustainable populations. A copy of this thesis is available for review at the University of Wyoming's Science Library and in the Wyoming Game and Fish Department's Lander Regional Office (Kuipers 2004).

Migration, Transition Range And Landscape Use By Greater Sage-Grouse by Brian Jensen

University of Wyoming Graduate Student Brian Jensen began field operations for a new Master of Science study during Spring 2004 and published his thesis in May 2006. His study attempted to identify important facets of late brood-rearing habitat in western portions of Management Area 8. Data collected during Jarren Kuipers' research and the South Hudson Coal Bed Methane Study provided a starting point for habitat measurements and was supplemented by radio telemetry data collected during this new project. A copy of this thesis is available for review at the University of Wyoming's Science Library and in the Wyoming Game and Fish Department's Lander Regional Office. (Jensen 2006)

Examining the effects of noise from energy exploration and development on the breeding biology of the greater sage-grouse by University of California – Davis

A multi-year, multi-location study began in February 2006 to study the effects of noise produced by energy development on sage-grouse. The study area included the Government Draw area south of Hudson as a principal location for the research on introduced noise, combined with an area south of Pinedale where researchers are collecting measurements of noise actually produced by natural gas field energy development.

Goals:

1. To determine whether noise from energy development impacts reproduction in sage-grouse
2. Ultimately, to develop a model that managers can use to evaluate means of mitigating any impact.

Objectives:

1. Measurement of noise production and propagation in the sagebrush habitat:
2. Measurement of sounds produced by energy development
3. Long-term measurement of noise at leks
4. Measurement of sounds produced by grouse and grouse leks
5. Measurement of the propagation of sound through the environment
6. Experiment to test the effects of noise on grouse behaviors

Sage-grouse movements and survival study on the Wind River Reservation

The WRR initiated a radio telemetry study by capturing 31 grouse in April 2006 (10 adult females, 10 adult males, 4 yearling females and 7 yearling males) from 3 different leks: Mule Butte North, Sharpnose and Willow Creek. In early April 2007, 5 additional grouse (2 adult females and 3 adult males) were captured from the Sharpnose Southeast lek. The intent of the study was to provide baseline information on movements, seasonal ranges, and survival that will assist in managing the sage-grouse population at sustainable levels.

A total of 476 relocations were made between early April 2006 and the end of May 2008. Males moved further than females averaging 11.2 miles (sd = 6.4 miles) from lek of capture to the furthest location compared to 4.9 miles (sd = 2.3 miles). Greatest distance moved from lek of capture was 25.2 miles by a male grouse. Migration from winter/spring range to summer/fall range followed 2 patterns. One pattern involved movement from low elevation winter/spring range to higher elevation summer/fall range in the foothills of the Wind River Mountains. This summer/fall range consisted primarily of moister sites of mountain sagebrush with a native forb and grass understory. These sites remained greener longer than winter/spring range. One male grouse was documented at 10,060 feet utilizing alpine habitat. The second migration pattern to summer/fall range involved shorter movements to fields of irrigated alfalfa bordered or interspersed with sagebrush habitat. The second pattern did not have significant elevation change. Each pattern was comprised of nearly the same number of males and females and survival did not differ.

Average annual survival from early April 2006 to the end of May 2008 for all grouse was 38%. This is on the low end of survival as compared to other studies. Counts of males on leks from which grouse were captured declined by 64% during the 2 years of this study. Adult females had the highest survival at 52% while yearling females had the lowest survival at 16%. There were marked differences in survival when comparing by lek of capture. When considering adults survival by lek of capture, Sharpnose had 61%, Willow Creek Bench had 51%, Sharpnose Southeast had 34% and Mule Butte had 19%. The composition of adults and males to females was very similar between leks. Superficially, quality of habitat does not appear to differ between the Sharpnose leks and Mule Butte.

For mortalities, 93% (25 of 27) occurred between March 1 and September 15, with peaks in May and July. These peaks were related to predation and West Nile virus (WNv). No mortalities occurred during the fall and only 2 occurred during winter. Causes of mortality were 3 (11%) by raptor predation, 4 (15%) by mammalian predation, 3 (11%) by unknown predator, 3 (11%) by WNv and 14 (52%) that were unknown. Of the unknown, 5 (19%) were "possible" mortalities related to WNv based on evaluation of bird remains, and death in mid-summer, at lower elevation and near standing water. Of the 13 mortalities for which mortalities were determined, 77% were from predation and 23% were from WNv. Determining cause of death due to WNv is problematic and true loss is likely underestimated (Naugle *et al.* 2005). Birds that die are quickly scavenged, thus confounding one's ability to determine cause of death.

Conservation planning for greater sage-grouse at the landscape scale – Hayden-Wing Associates

Greater sage-grouse (Centrocercus urophasianus) populations have declined throughout much of their distribution. This has led to concern about the potential impacts of human activity such as energy development on long-term population persistence. Some research has been conducted on sage-grouse in central Wyoming, yet applied research is needed on specific factors driving selection/avoidance of resources, and on the location/distribution of critical habitats throughout the landscape.

ConocoPhillips, Encana, Noble Energy, and Hayden-Wing Associates (HWA) initiated research on sage-grouse in central Wyoming in 2008. Global Positioning Systems (GPS) technology was used to monitor movement and resource use among female and male sage-grouse. Data collected during the first year showed that GPS transmitters are effective in generating detailed information on movement and that sage-grouse in the study area range widely throughout the landscape. Other data on local-scale habitat characterizing brood-rearing areas are being compiled and analyzed (D. Lockman, WMSR, LLC, unpublished data).

Objectives:

- Generate science-based information on selection/avoidance of resources in all life-history phases including where and when sage-grouse use important areas.

- Generate high-resolution data-driven maps depicting critical seasonal habitat such as nesting, brood rearing, and wintering at the largest geographic extent possible.

Methods

Trapping

Sage-grouse were captured during the spring and fall of 2010 among six leks located within the drilling units of the three funding operators. The number captured at each site varied. The intent was to maintain a 3:1, female:male ratio of marked birds. Grouse were trapped at night by spotlighting from pickup trucks, using 36" diameter shallow hand nets. Grouse were weighed, banded (aluminum with WGFD contact info), measured for ageing purposes, and equipped with a Microwave 30 gram solar-powered ARGOS/GPS satellite transmitter. Transmitters were affixed using ¼ inch Teflon ribbon, fashioned into a harness that held the transmitter on the back of the bird. The Teflon harness was secured using (4) 1/4 inch copper crimps. Transmitters are programmed to record 3-15 GPS locations (accuracy ±18 m) per day per bird depending on the season.

Nest and Brood Monitoring

Nests were located by identifying clusters of GPS locations using Geographic Information Systems (GIS) software during the nesting period. In all but a few cases, ground visits of nest sites were conducted after the nest failed or hatched. Clutch sizes and brood sizes (if hatched)were determined by examining egg shells at the nest site. A nest was classified as successful if >1 egg hatched. Brood survival was determined by checking for the presence of chicks accompanying females at least once per week between hatching and >35 days post-hatch (i.e., early to mid Aug). Every effort was made to confirm the presence of chicks without flushing the hen, but when necessary the hen was flushed so the area could be searched extensively for chicks hiding in the cover. Broods were classified as successful if >1 chick survived to >35 days post-hatch.

Vegetation Sampling

All vegetation sampling was conducted by KC Harvey (formerly Wildlife Management Services of the Rockies, LLC [D. Lockman]) as a collaborative effort with this study. Habitat characteristics were recorded for: (1) all nest locations and an equal number of random locations within 200 meters of nests; (2) 1-2 randomly-selected brood locations per brood per week and an equal number of random locations based on a 24 hour step length; (3) non-brooded hen locations and random locations during spring and summer; and (4) winter locations with random locations. Step length was determined by randomly selecting a use location and determining the distance to a previous use location 24 hours prior. In some instances it was necessary to base the step length 24 hours after the use location.

Analysis

Landscape-scale resource-use metrics will be collected based on GPS location data. These data will be used to build and validate resource selection models (Manly et al. 2002). We will use locations from >20 individuals to build models, and locations from >10 individuals to validate the models. General methods will include use of logistic regression to model selected covariates against a binary dependent variable (use versus availability), and use an information theoretic approach to assess relative plausibility among candidate models. Covariates will be a function of the quality and availability of high-resolution imagery and land cover data. Aerial photography from the National Agriculture Imagery Program (NAIP), and land cover data (USDA/USDI LANDFIRE) are available for the project study area. We are also in the process of developing a landcover classification using the Feature Analyst® extension in ArcGIS® (ESRI) and 1-m NAIP imagery. Covariates could include vegetation, land use, slope,

aspect, roughness indices, soil type, and infrastructure associated with energy development such as well pads, roads, pipelines, water impoundments, and power lines (Aldridge and Boyce 2007). Residential, livestock operations, and agricultural infrastructure will also be included. Covariates associated with energy development will be modeled as time-specific variables to assure that changes in the distribution and extent of infrastructure will be taken into account.

Results

Trapping

During 2010, a total of 41 sage-grouse were transmittered; 34 females and 7 males. In addition, 35 radioed birds carried-over from 2009. One additional female was captured but banded only. We attempted to maintain 39 GPS transmitters with periodic trapping sessions to redeploy any downed or slipped transmitters. Trapping efforts were focused primarily around known leks as well as known roosting areas.

Bird Locations

Over 65,000 sage-grouse GPS locations were recorded in 2010. The maximum distance any bird moved from its capture location was 34.1 km, and the maximum distance moved between subsequent locations was 13.7 km (distance traveled in one morning). Seasonal movement patterns varied among both sexes.

Breeding

Twenty-eight of 29 (96.6%) radio-tagged females attempted nesting. Of the 21 hens that failed during the first nesting attempt, 12 (57%) initiated a second nesting attempt, and of the 8 hens that failed during the second nest attempt, 3 (37.5%) initiated a third nesting attempt, for a total of 44 nesting attempts in 2010. Ten of the 44 nests hatched in 2010. Excluding the five nests that failed during the egg-laying stage (for comparison with other years), the nest success was 25.6% in 2010. Of the 34 failed nests, 5 failed during the egg-laying stage and 29 failed during incubation. Twenty-five nest failures were attributed to nest predation, six to predation of the female, two nests were abandoned due to unknown reasons, and one nest failed to hatch even though several eggs were fertile. The average clutch size for hatched nests was 6.0/nest and the average hatching rate (% of eggs that hatch) was 85.7%. The average hatch date was June 3, but ranged from May 18 to July 14.

Six of the ten (60.0%) broods were successful in 2010. It was presumed that two young broods failed when the hens were killed, and two other broods failed from unknown causes.

Grouse Mortality

Of 76 transmittered grouse in 2010 (35 carried-over from 2009), we documented a total of 38 mortalities, three suspected mortalities (i.e., unknown), and one slipped transmitter. Three transmitters are still unrecovered and three transmitters were lost. Of the 38 mortalities, all 38 were classified as predation. Although classifying the type or species of predator is difficult and not dependable in most cases, mammalian predators were suspected for the majority of the mortalities based on sign found at the location (e.g., chewed vs. plucked feathers, scat, tooth marks, tracks, and carcass location).

Vegetation and Insect Data

Data entry and analysis is in progress (D. Lockman, KC Harvey, unpublished data).

Resource Selection Models Planned

Currently, five resource selection models are being considered for the use of these data. These include: nesting habitat, brood-rearing habitat, non-breeding summer habitat (both sexes), winter habitat, and possibly source/sink habitat models.

Vocal and anatomical evidence for two-voiced sound production in the greater sage-grouse Centrocercus urophasianus – Krakauer, et al

Greater sage-grouse, Centrocercus urophasianus, have been a model system in studies of sexual selection and lek evolution. Mate choice in this species depends on acoustic displays during courtship, yet we know little about how males produce these sounds. Here we present evidence for previously undescribed two-voiced sound production in the sage-grouse. We detected this 'double whistle' (DW) using multi-channel audio recordings combined with video recordings of male behavior. Of 28 males examined, all males produced at least one DW during observation; variation in DW production did not correlate with observed male mating success. We examined recordings from six additional populations throughout the species' range and found evidence of DW in all six populations, suggesting that the DW is widespread. To examine the possible mechanism of DW production, we dissected two male and female sage-grouse; the syrinx in both sexes differed noticeably from that of the domestic fowl, and notably had two sound sources where the bronchi join the syrinx. Additionally, we found males possess a region of pliable rings at the base of the trachea, as well as a prominent syringeal muscle that is much reduced or absent in females. Experiments with a live phonating bird will be necessary to determine how the syrinx functions to produce the whistle, and whether the DW might be the result of biphonation of a single sound source. We conclude that undiscovered morphological and behavioral complexity may exist even within well-studied species, and that integrative research approaches may aid in the understanding of this type of complexity.

Tactical allocation of effort among multiple signals in sage grouse: an experiment with a robotic female – Patricelli and Krakauer

Males in many species have complex, multicomponent sexual signals, and there may be trade-offs between different signal components. By adjusting their signaling behaviors, males may be able to produce more attractive courtship displays in the face of these trade-offs, but this possibility has rarely been tested. In this study, we examined adaptive adjustment of display behaviors during courtship in a lek-breeding bird, the greater sage grouse (Centrocercus urophasianus). We measured the potential trade-off between display quantity (display rate) and quality (a temporal feature of displays) in a wild population of sage grouse using controlled approaches of a robotic female to experimentally induce changes in male display rate. We found that males who are more successful in mating can increase quantity without a decline in quality, with only unsuccessful males expressing an apparent trade-off. Male mating success was also positively correlated with responsiveness to changes in receiver distance, suggesting that successful males may avoid a trade-off by tactically adjusting their display rate—saving energy by displaying at low levels when females are farther away and at higher levels as females approach. Alternative explanations for this differential response to female proximity are discussed. Our results suggest that to be successful, males may need both the ability to produce attractive signals and the ability to effectively allocate their display effort by responding to female behaviors.

Response of Greater Sage-grouse to Treatments in Wyoming Big Sagebrush – Smith and Beck (2011 Progress Report)

Introduction

Wyoming big sagebrush (Artemisia tridentata wyomingensis) is the most widely distributed subspecies of big sagebrush (Schuman et al. 1998, Knick et al. 2003) and provides important habitat to sagebrush occurring wildlife (Knick et al. 2003, Larrucea and Brussard 2008). Historically, Wyoming big sagebrush has been treated through chemical application, mechanical treatments, and prescribed burning to increase herbaceous forage species released from competition with sagebrush overstory. The same techniques that have been used in the

past to provide more grassy forage for livestock have been increasingly applied with the underlying idea that they will improve habitat conditions for sagebrush wildlife species such as greater sage-grouse (Centrocercus urophasianus). Objectives of many recent treatments are intended to rejuvenate sagebrush stands by killing older sagebrush plants to promote growth of younger sagebrush plants and increase herbaceous production to provide additional food sources and herbaceous structural cover (Perryman et al. 2002, Dahlgren et al. 2006, Davies et al. 2009). However, vegetation response to different treatments is variable. Wyoming big sagebrush experiences slow regeneration (25–100 + years to return to pre-treatment conditions; Baker 2006) following treatments and grass and forb cover and production typically return to pre-treatment conditions within a short time (i.e. 1-to-5 years) post treatment (Peek et al. 1979, Fischer et al. 1996).

Studies that have evaluated sage-grouse response to habitat treatments have reported varied results. For instance, Connelly et al. (2000) found a reduction in male lek attendance 1-to-5 years after prescribed burning Wyoming big sagebrush habitat in the Big Desert of southeastern Idaho. Fischer et al. (1996) found similar sage-grouse abundance on burned and unburned areas in Wyoming big sagebrush in the same study area 1-to- 3 years after treatment. Sage-grouse pellet densities did not differ between non-aerated reference sites and aerated sites in Wyoming big sagebrush 4-to-6 years following treatment in Rich County, Utah (Stringham 2010), but were higher in tebuthiuron treated sites relative to mechanical (Dixie harrow, Lawson aerator) treatments in mountain big sagebrush (A. t. vaseyana) in Parker Mountain in south-central, Utah (Dahlgren et al. 2006). With the use of GPS radio telemetry, Stringham (2010) found that female sage-grouse used treated areas about 40% of the time during the lekking period and use declined during the early brood-rearing period. Unfortunately, this study was based on 2 small study areas (265 and 270 ha) treated with aeration and also lacked replication in space or time. As such, information regarding sage-grouse use of treated areas is limited. Identification of specific habitat treatments that promote positive, negative, or neutral sage-grouse reproductive demographic response is necessary to evaluate the efficacy of sagebrush habitat treatments for sage-grouse and other wildlife species. Our first objective is to evaluate which specific habitat treatments or levels of treatment promote sage-grouse reproductive demographic response (positive, negative, or neutral). This will be done by monitoring adult survival, nest success, and brood survival, before and after treatments in both treated and offsite reference areas. Measurement of microhabitat and landscape scale features of habitat at female sage-grouse locations during pre-treatment years will help us to assess which habitats to treat, with the goal of increasing habitat quality for nesting and brood rearing.

The second and third objectives of our study are to identify the spatial and temporal scales where habitat treatments identified in research question 1 promote responses to sage-grouse population demographic rates, and identify which treatments or sizes of treatments are used proportionally more or less often by sage-grouse during the nesting and brood-rearing periods. Fine-scale habitat information coupled with demographic response rates will be imperative to answer these research questions. We will continue to monitor radio-marked females and attach GPS collars to 27 additional females at treatment and offsite reference leks to evaluate the extent that individually marked grouse use treatment locations. The demographic response of marked grouse will be correlated with their pattern of use of treatments to evaluate the relative value of habitat treatments to individual grouse. The relative use of treatment sites will provide information surrounding questions of scale and treatment type. The temporal scale necessary to identify responses to sage-grouse populations is beyond the scope of a single PhD dissertation (i.e. 3 years pre-treatment and 2 to 3 years post-treatment). Therefore, additional collaboration will be required during the post-treatment portion of this study. This progress report summarizes demographic and microhabitat characteristics from our first (2011) field season of the pre-treatment phase of the project.

STUDY AREA

Our study area lies in Fremont County, Wyoming and encompasses approximately 706 km2 (174,663 ac) in Townships 29 and 30 North and Ranges 89 through 92 West. The area includes approximately 87.5% Federal, 7.0% State, and 5.5% privately administered lands. Annual precipitation ranges from approximately 22.9 to 40.6 cm (9 to 16 in). Elevation ranges from 1626 to 2499 m. Important vegetation communities in the study area include Wyoming big sagebrush, mountain big sagebrush, basin big sagebrush (*A. t. tridentanta*), silver sagebrush (*A. cana*), black sagebrush (*A. nova*), and greasewood (*Sarcobatus vermiculatus*).

METHODS AND RESULTS

Capturing and Monitoring

We captured and radio-marked 32 female sage-grouse from 6 leks in spring 2011 by spot-lighting and hoop-netting (Giesen et al. 1982, Wakkinen et al. 1992). We used roosting locations of radio-marked adult females captured in spring to capture and radio-mark 34 additional females in August 2011. Captured females were aged (juvenile or adult) based on the shape and condition of the outermost wing primaries, and the outline of the primary tail feathers and coloration of undertail coverts (Eng 1955, Dalke et al. 1963). We attached radio transmitters (22 g, Model A4060; Advanced Telemetry Systems Incorporated, Isanti, Minnesota, USA) to females with a PVC-covered wire necklace. We collected blood samples by clipping a vestigial toenail from a metatarsus and wiping blood drops on Whatman (2008) FTA micro cards; blood samples are being collected for future genetic analyses. Prior to release we weighed captured sage-grouse to the nearest 1 g and measured the wing chord length. Mean (± SE) mass and wing chord length of 18 radio-marked adult females was 1,349 ± 28.6 g and 27.1 ± 0.2 cm, respectively. Mean (± SE) mass and chord length of 14 radio-marked juvenile females was 1,236 ± 24.9 g and 26.8 ± 0.2 cm, respectively. Fall captured female weight and chord lengths were not considered due to possible variation in body mass and morphological characteristics compared to females captured in the spring.

We began locating female sage-grouse bi-weekly on 1 May 2011 with hand-held receivers and 3-element Yagi antennas. Because we were initially unable to locate all of the females on the ground, we used a fixed-wing aircraft flight on 5 May 2011 to locate all grouse. We recorded Universal Transverse Mercator (UTM) coordinates for ground and aerial grouse locations using a hand-held 12 channel Global Positioning System (GPS) unit (Garmin Etrex; Garmin International, Olathe, Kansas, USA). During the 2011 field season we recorded approximately 450 ground points including nest, brood-rearing, and barren female locations.

Adult Female Survival, Nesting, and Brood Parameters

Twenty-five of 32 (78 ± 7.6%) radio-marked female sage-grouse survived from May through 1-August 2011. Causes of mortality included mammalian predation (3 or 43%), avian predation (3 or 43%), and unknown (1 or 14%). We located nests by circling the radio-marked females signal until the surveyor visually located the bird on a nest or isolated the nest location on the ground. To minimize human-induced nest depredation or nest abandonment, we subsequently monitored nests with triangulation from a distance of at least 50 m. We located 23 nests, which included 21 first nest attempts and 2 re-nests. Six (26.1%) nests were successful, 15 (65.2%) were depredated (including 1 hen mortality), and 2 (8.7%) were abandoned. Hatch dates for successful nests ranged from 2–24 June 2011. Of the 6 females with successful nests, 4 were alive and with broods 35 days post-hatch (66.6% brood success). Brood productivity and survival were measured at 35 and 36 days post-hatch, by back-to-back night-time spotlight counts. On average, there were 0.46 chicks per radio-marked female in our sample.

Microhabitat Sampling

We evaluated vegetation parameters, ground cover, and micro-topographic microhabitat conditions at nest, brood-rearing locations (early and late brood rearing periods), summer barren hen locations, and a dependent-random location for each use location along 2, perpendicular 30-m transect lines centered on each grouse and random location. We sampled herbaceous and ground cover using the Daubenmire (1959) technique. We recorded shrub canopy cover with the line intercept method and computed percentage cover for each shrub species as total intercept (m) divided by 60 m times 100 (Canfield 1941, Wambolt et al. 2006). We obtained shrub density through counting shrubs rooted within 1-m belt transects positioned along the right side of each 30-m transect and assessed visual obstruction using the Robel pole technique (Robel et al. 1970). We measured the height of current and residual grasses in each 20 x 50 cm Daubenmire quadrat and shrub heights for each shrub encountered along each 30-m line transect.

We examined microhabitat at random locations at a random distance and direction 100–500 m from each paired grouse location (Aldridge and Boyce 2008). We began sampling nest microhabitat plots after the first successful hatch and sampled all nest and paired random locations within 1 week of known nest fate. We used paired sample *t*-tests to compare habitat characteristics at nest and available locations (Table 1). Analysis of brood-rearing and barren hen location microhabitat plots are currently in progress. We detected no significant differences between habitat characteristics at nest and random locations at the alpha = 0.05 level. For those radio-marked females with broods, we sampled early brood locations 1 and 2 weeks post-hatch and late brood locations 4 and 5 weeks post hatch. Barren hen roosting location sampling was initiated on 1 July and ended on 30 July. For barren hens, we sampled no more than 1 location per week per individual. In total we sampled 23 nest locations, 17 brood locations, and 62 barren hen roost locations. We sampled an equal number of paired random locations to equal 204 microhabitat locations.

DISCUSSION

Our knowledge of sage-grouse demographic response to habitat treatments is limited; however, anecdotal evidence provides insights as to the set of circumstances that may elicit positive seasonal responses. For instance, nesting success is substantially increased when female sage-grouse nest under big sagebrush (Connelly et al. 1991). Similarly, big sagebrush is a primary dietary component throughout the winter (Wallestad et al. 1975). Sagebrush removal throughout sage-grouse nesting and winter habitats may not be readily apparent over the short term, however removing sagebrush in these critical areas will arguably reduce populations given their high site fidelity to seasonal habitats (Fischer et al. 1996), as well as documented reduction in male lek attendance (Connelly et al. 2000) and declines in breeding populations in treated areas (Wallestad 1975). Early brood-rearing habitats are typically found in close proximity to nests (i.e., high shrub density and cover), but also have high forb and insect availability (Drut et al. 1994, Holloran and Anderson 2005). With the intent of most sagebrush treatments to improve grass and forb production, we propose that treating brood-rearing habitats is the best option to elicit positive sage-grouse demographic response to habitat manipulations.

Development of a sage-grouse resource selection function based on use-availability data during the nesting and brood rearing period can aid in identifying suitable areas to treat, with the goal of treating habitat to increase its function for nesting and brood rearing. During 2011, nest characteristics of shrub cover, perennial grass cover, forb cover, and grass heights were similar to reported vegetation data from greater sage-grouse nesting habitats throughout their range (Hagen et al. 2007). Interestingly, we found no differences in univariate comparisons between measured vegetation characteristics at nest sites and available locations, which may be related to our small sample of nests or indicate that female sage-grouse in 2011 selected nest locations in large relatively homogenous patches of sagebrush. Analysis of multiple scales centered on these locations should aid in identifying a suite of environmental charactertistics that will describe patterns of nest and brood-site selection by sage-grouse (Doherty et al. 2010).

FUTURE DIRECTION

During 2012 we intend to increase our sample of females equipped with VHF transmitters to achieve our initial goal of 135 radio-marked grouse. We also plan to affix 27 females with Solar ARGOS / GPS PTT- 100 transmitters (Microwave Telemetry, Incorporated, Columbia, Maryland, USA) to gather fine-scale habitat selection information that cannot be quantified accurately with VHF transmitters. A relatively small sample size of radio-marked females limits our ability in identifying selection of nesting and brood rearing habitats. During 2012, we will employ the use of drop nets to bolster our capture efforts. Drop nets have been successfully used to capture male and female sage-grouse on leks in Alberta, Canada (Bush 2008). Bush's (2008) drop net design resulted in no injury to sage-grouse and did not disrupt sage-grouse lek attendance or behavior. We will implement drop nets in spring 2012 as an alternative method of capture during periods of high female lek attendance.

We will continue to sample microhabitat plots at nest, brood, and barren female locations. We will incorporate information from microhabitat sampling in 2011 and 2012 as local scale information in resource selection function modeling to identify areas for habitat treatments during fall 2013 based on probabilities of nesting and brood rearing from our location data.

We are in the process of evaluating the sample size necessary to detect change in sage-grouse demographic rates with a given degree of confidence. Power analyses can be used to identify the sample size needed to identify biologically relevant statistical significance, an important step when evaluating the effects of habitat manipulations on sage-grouse populations. If differences exist between demographic rates of grouse in the vicinity of treated areas, a power analysis will identify the number of radio-marked individuals necessary to detect a statistically significant difference. This will aid in providing a robust experimental design for our field-based analysis.

The impacts of noise on greater sage-grouse: A discussion of current management strategies in Wyoming with recommendations for further research and interim protections – Patricelli, Blickley, Hooper – University of California @ Davis (2012)

See Appendix 2 for the full report and recommendations.

Diseases

In 2011, no cases of West Nile Virus (WNV) or other avian diseases are known to have occurred in the WRSRCA.

Management Recommendations

1. Incorporate recommendations outlined in Wyoming Governor's Executive Orders and associated "Stipulations for Development in Core Sage-Grouse Population Areas".

2. Implement the Wind River/Sweetwater River Local Sage-Grouse Conservation Plan and work with land management agencies to incorporate recommended management practices.

3. Continue to collect age and sex composition of the harvest via wing collection and analyses.

4. Continue intensive lek counts in the Government Draw area south of Hudson.

5. Continue ground checks of all non-intensively monitored leks.

6. Continue to search for new or undiscovered leks in remote areas of WRSRCA.

7. Continue to cooperate with private landowners and Federal/state land managers to reduce negative impacts to crucial sage-grouse habitats.

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Appendix 1. Wind River/Sweetwater River Working Group JCR Tables and Graphs

Sage Grouse Lek Characteristics

Working Group: Wind River/Sweetwater River

Region	Number	Percent
Lander	178	75.1
WRR	59	24.9

Working Group	Number	Percent
Wind River/Sweetwater River	237	100.0

Classification	Number	Percent
Occupied	226	95.4
Unoccupied	11	4.6

BLM Office	Number	Percent
Lander - WRR	59	24.9
Casper	9	3.8
Lander	160	67.5
Rock Springs	7	3.0
Worland	2	0.8

Biologist	Number	Percent
WRR - USFWS	59	24.9
North Lander	65	27.4
South Lander	113	47.7

Warden	Number	Percent
Shoshone-Arapaho Tribal	59	24.9
Dubois	1	0.4
East Rawlins	3	1.3
Lander	65	27.4
North Riverton	30	12.7
South Riverton	67	28.3
West Rawlins	12	5.1

County	Number	Percent
Carbon	1	0.4
Fremont	210	88.6
Hot Springs	5	2.1
Natrona	20	8.4
Sweetwater	1	0.4

Land Status	Number	Percent
BLM	135	57.0
BLM/Private	1	0.4
BOR	4	1.7
Private	25	10.5
Private/BLM	1	0.4
Reservation/Tribal Lands	59	24.9
State	12	5.1

Management Area	Number	Percent
E	177	74.7
G	1	0.4
WR	59	24.9

Lek Status	Number	Percent
Active	135	57.0
Inactive	15	6.3
Unknown	87	36.7

Sage Grouse Job Completion Report

Year: 2003 - 2012, Working Group: Wind River/Sweetwater River

1. Lek Attendance Summary (Occupied Leks) (1)

a. Leks Counted

Year	Occupied	Counted	Percent Counted	Peak Males	Avg Males / Active Lek (2)
2003	154	35	23	1263	43.6
2004	158	36	23	1300	44.8
2005	164	39	24	2229	65.6
2006	168	60	36	4179	76.0
2007	177	73	41	4613	69.9
2008	184	72	39	3367	51.0
2009	182	66	36	2506	45.6
2010	185	55	30	1644	35.7
2011	192	70	36	1668	26.9
2012	199	78	39	1907	28.9

b. Leks Surveyed

Year	Occupied	Surveyed	Percent Surveyed	Peak Males	Avg Males / Active Lek (2)
2003	154	111	72	1997	27.0
2004	158	115	73	2691	32.4
2005	164	113	69	4438	49.3
2006	168	85	51	3948	59.8
2007	177	93	53	2621	39.1
2008	184	88	48	2352	39.2
2009	182	82	45	2029	33.8
2010	185	94	51	1697	23.6
2011	192	90	47	1316	22.3
2012	199	94	47	1368	21.0

1) Occupied - Active during previous 10 years (see official definitions)

2) Avg Males/Active Lek - Includes only those leks where one or more strutting males were observed. Does not include "Active" leks where only sign was documented.

3) Inactive - Confirmed no birds/sign present (see official definitions)

Sage Grouse Job Completion Report

Year: 2003 - 2012, Working Group: Wind River/Sweetwater River

1. Lek Attendance Summary (Occupied Leks) (1) Continued

c. Leks Checked

Year	Occupied	Checked	Percent Checked	Peak Males	Avg Males / Active Lek (2)
2003	154	146	95	3260	31.7
2004	158	151	96	3991	35.6
2005	164	152	93	6667	53.8
2006	168	145	86	8127	67.2
2007	177	166	94	7234	54.4
2008	184	160	87	5719	45.4
2009	182	148	81	4535	39.4
2010	185	149	81	3341	28.3
2011	192	160	83	2984	24.7
2012	199	172	86	3275	25.0

d. Lek Status

Year	Active	Inactive (3)	Unknown	Known Status	Percent Active	Percent Inactive
2003	107	8	39	115	93.0	7.0
2004	113	9	36	122	92.6	7.4
2005	125	6	33	131	95.4	4.6
2006	123	11	34	134	91.8	8.2
2007	135	11	31	146	92.5	7.5
2008	129	14	41	143	90.2	9.8
2009	115	15	52	130	88.5	11.5
2010	121	11	53	132	91.7	8.3
2011	122	12	58	134	91.0	9.0
2012	133	16	50	149	89.3	10.7

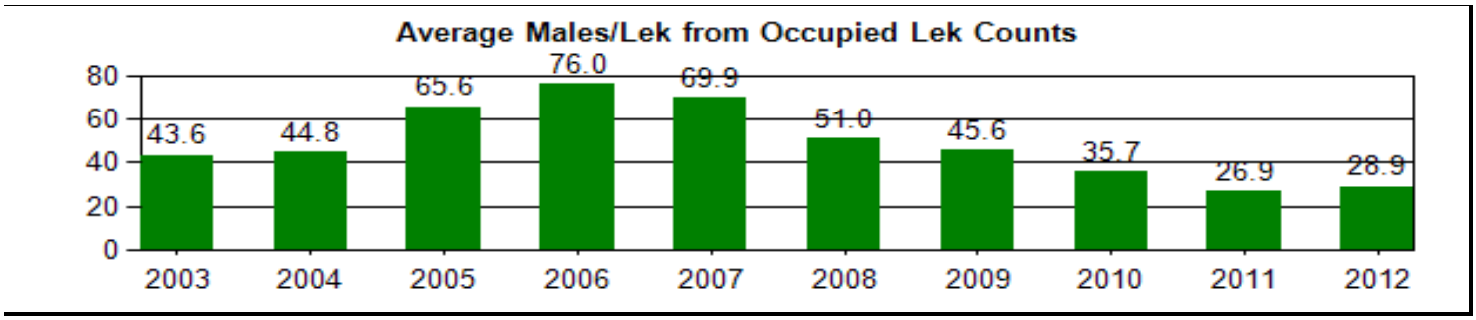
1) Occupied - Active during previous 10 years (see official definitions)

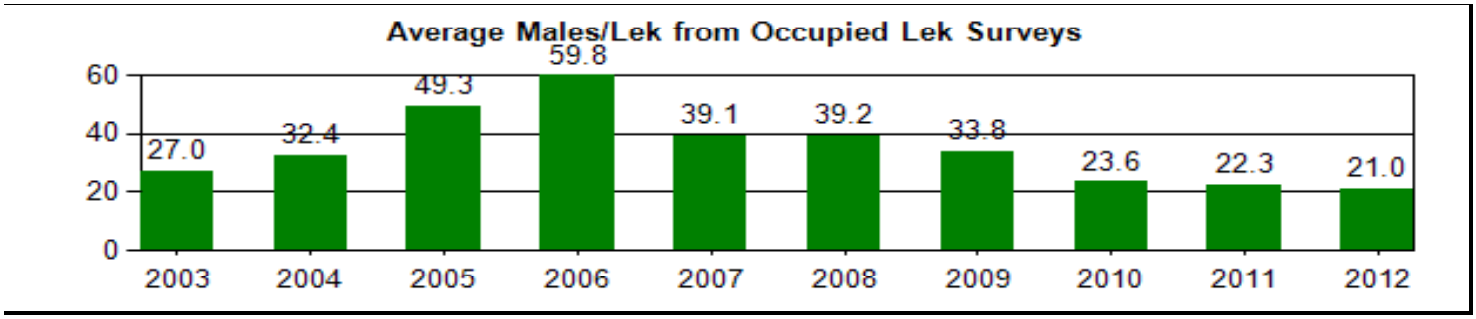
2) Avg Males/Active Lek - Includes only those leks where one or more strutting males were observed. Does not include "Active" leks where only sign was documented.

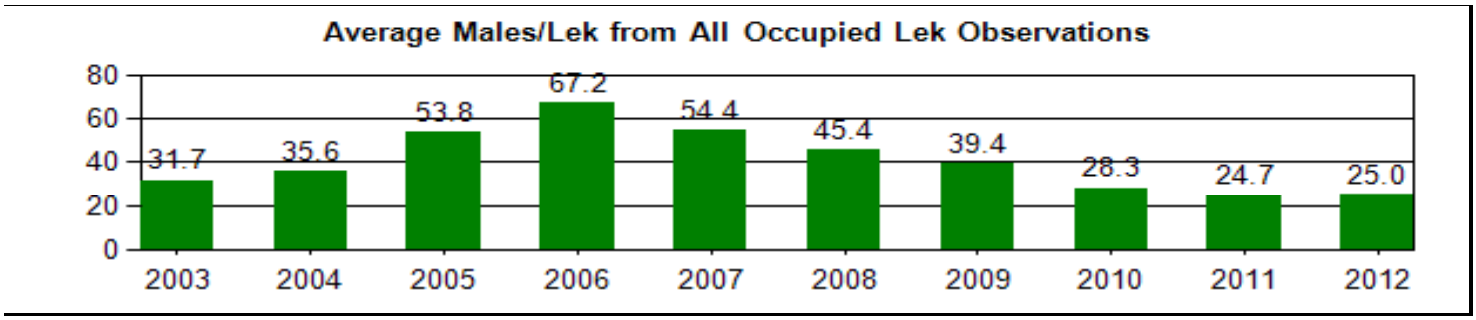
3) Inactive - Confirmed no birds/sign present (see official definitions)

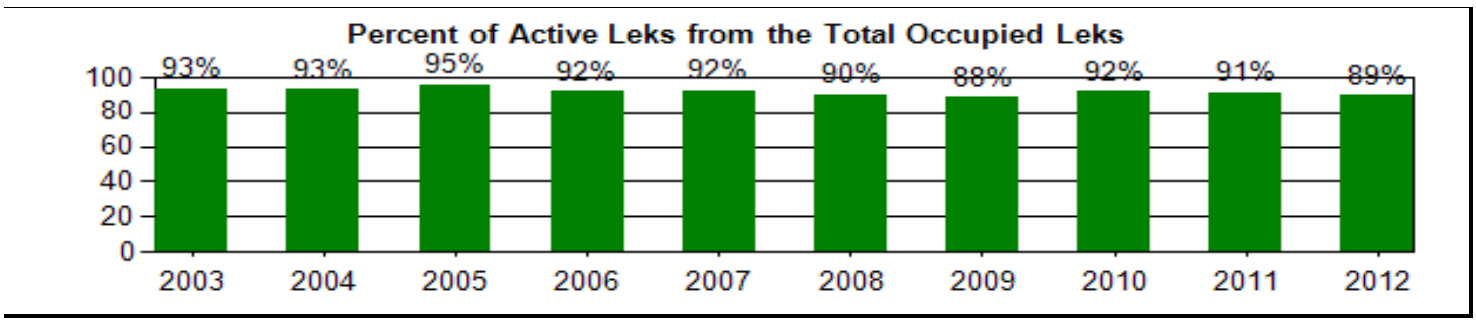
Sage Grouse Occupied Lek Attendance Summary

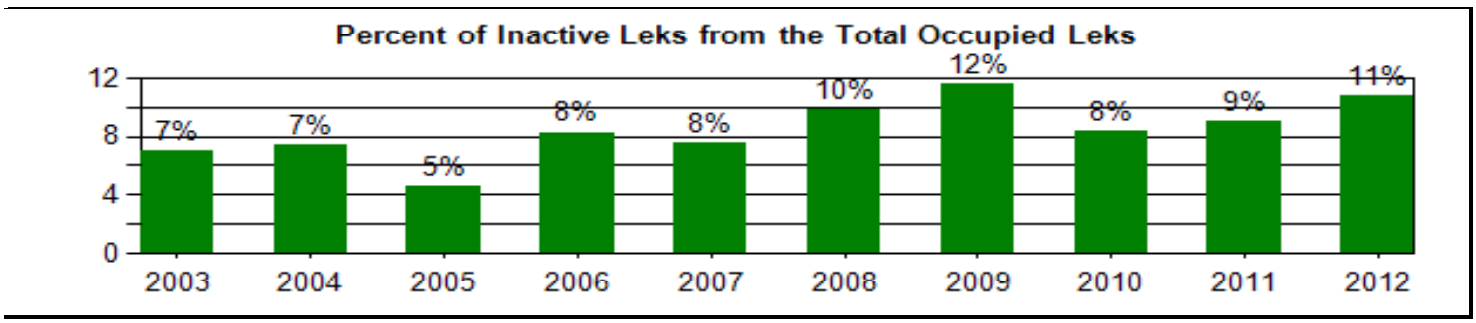
Year: 2003 - 2012, Working Group: Wind River/Sweetwater River











Sage Grouse Job Completion Report

Year: 2002 - 2011, Working Group: Wind River/Sweetwater River

4. Sage Grouse Hunting Seasons and Harvest Data

a. Season

Year	Season Start	Season End	Length	Bag/Possesion Limit
2002	Sep-28	Oct-6	9	2/4
2003	Sep-27	Oct-5	9	2/4
2004	Sep-23	Oct-3	11	2/4
2005	Sep-23	Oct-3	11	2/4
2006	Sep-23	Oct-3	11	2/4
2007	Sep-22	Oct-2	11	2/4
2008	Sep-22	Oct-2	11	2/4
2009	Sep-19	Sep-30	12	2/4
2010	Sep-18	Sep-30	13	2/4
2011	Sep-17	Sep-30	14	2/4

b. Harvest

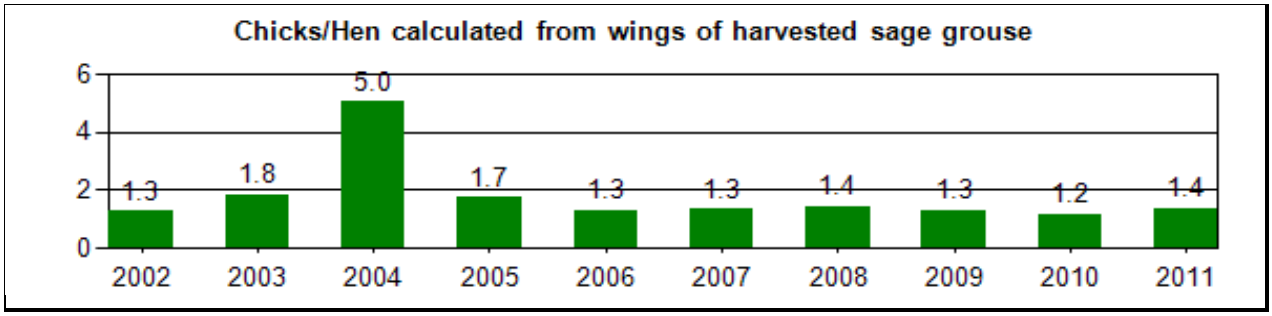
Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2002	733	377	655	1.1	1.9	1.7
2003	669	307	617	1.1	2.2	2.0
2004	1398	572	1444	1.0	2.4	2.5
2005	2994	930	2080	1.4	3.2	2.2
2006	1710	558	1183	1.4	3.1	2.1
2007	1776	788	1696	1.0	2.3	2.2
2008	2144	863	2059	1.0	2.5	2.4
2009	2295	875	2114	1.1	2.6	2.4
2010	2495	1056	2866	0.9	2.4	2.7
2011	1779	771	1801	1.0	2.3	2.3
Avg	1,799	710	1,652	1.1	2.5	2.3

Sage Grouse Job Completion Report

Year: 2002 - 2011, Working Group: Wind River/Sweetwater River

5. Composition of Harvest by Wing Analysis

Year	Sample Size	Percent Adult		Percent Yearling		Percent Young		Chicks/ Hens
		Male	Female	Male	Female	Male	Female	
2002	227	10.6	30.0	0.9	8.8	21.1	28.6	1.3
2003	236	11.9	26.3	0.0	4.7	23.7	33.5	1.8
2004	369	11.9	12.5	0.0	2.2	35.8	37.7	5.0
2005	633	13.6	22.7	5.1	7.1	21.0	30.5	1.7
2006	366	26.0	25.4	4.6	4.6	13.4	26.0	1.3
2007	397	23.9	29.2	1.0	3.0	17.1	25.7	1.3
2008	538	21.6	24.5	5.6	5.6	17.8	24.7	1.4
2009	598	16.7	24.6	6.9	8.9	14.7	28.3	1.3
2010	476	16.0	30.3	4.4	6.7	15.1	27.5	1.2
2011	376	9.0	27.1	6.9	8.5	14.4	34.0	1.4



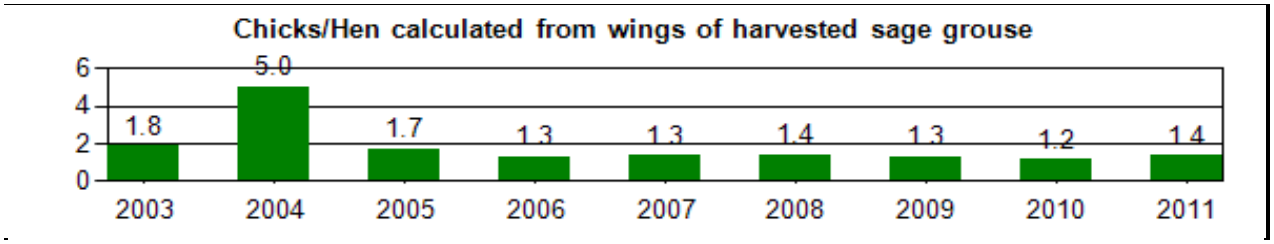
Sage Grouse Wing Analysis Summary

Year: 2011, Management Area: E, Working Group: Wind River/Sweetwater River

Adult Males:	34	% of All Wings:	9.0
Adult Females:	102	% of All Wings:	27.1
Adult Unknown:	0	% of All Wings:	0.0
Total Adults:	136		
Yearling Males:	26	% of All Wings:	6.9
Yearling Females:	32	% of All Wings:	8.5
Yearling Unknown:	0	% of All Wings:	0.0
Total Yearlings:	58		
Chick Males:	54	% of All Wings:	14.4
Chick Females:	128	% of All Wings:	34.0
Chick Unknown:	0	% of All Wings:	0.0
Total Chicks:	182		
Unknown Sex/Age:	0		
Total for all Sex/Age Groups:	**376**		

Chick Males:	54	% of All Chicks	29.7
Yearling Males:	26	% of Adult and Yearling Males	43.3
Adult Males:	34	% of Adult and Yearling Males	56.7
Adult and Yearling Males:	60	% of Adults and Yearlings	30.9
Total Males:	114	% of All Sex/Age Groups	30.3
Chick Females:	128	% of All Chicks	70.3
Yearling Females:	32	% of Adult and Yearling Females	23.9
Adult Females:	102	% of Adult and Yearling Females	76.1
Adult and Yearling Females:	134	% of Adults and Yearlings	69.1
Total Females:	262	% of All Sex/Age Groups	69.7

Chicks:	182	% of All Wings:	48.4
Yearlings:	58	% of All Wings:	15.4
Adults:	136	% of All Wings:	36.2
Chicks/Hen	1.4		



Appendix 2. Noise Management Recommendations from UC-Davis

The impacts of noise on greater sage-grouse: A discussion of current management strategies in Wyoming with recommendations for further research and interim protections

Prepared for:
The Bureau of Land Management, Lander Field Office and Wyoming State Office, Cheyenne and Wyoming Game and Fish Department

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EXECUTIVE SUMMARY

Recent research has demonstrated that noise from natural gas development negatively impacts sage-grouse abundance, stress levels and behaviors (Blickley et al. 2012; Blickley & Patricelli 2012; Blickley et al. In review). Other types of anthropogenic noise sources (e.g. infrastructure from oil, geothermal, mining and wind development, off-road vehicles, highways and urbanization) are similar to gas-development noise and thus the response by sage-grouse is likely to be similar. These results suggest that effective management of the natural soundscape is critical to the conservation and protection of sage-grouse. The goals of this report are to (I) discuss current approaches in the management of new and existing noise sources within and outside sage-grouse core areas of Wyoming, (II) recommend research priorities for establishing effective noise management strategies, and (III) provide managers and policy makers with recommendations for the interim protection of sage-grouse from known or expected impacts of increased noise levels using the best available science to date.

I. Current Management Strategies in Wyoming

In this report, we detail some concerns with current management strategies for noise. Management objectives for noise are typically established relative to ambient noise levels, stating that noise levels measured at lek edge should not exceed 10 dB over ambient. The choice of ambient value thus has large consequences, setting the upper limit of allowable noise. Outside core areas, 39 dB is typically used as a default measure of ambient; however, this value is much higher than ambient measures from undisturbed habitats. Inside core areas, Wyoming Executive Order 2011-5 stipulates measurement of ambient values at the perimeter of each lek to establish a baseline. While this will typically lead to more realistic ambient values than 39 dB, the complexity of measurement protocols and variable weather conditions make it impractical to accurately measure ambient levels at each lek. Even accurate ambient measures will include noise from existing sources, which may allow more than 10 dB of noise above an undisturbed ambient. In addition, there is little scientific basis for the "10 dB over ambient" threshold. Further research may find this threshold insufficient to protect sage-grouse—or too stringent. Further, these stipulations apply only within the lek perimeter, potentially allowing disturbance to foraging, nesting and brood-rearing habitat. Finally, this stipulation alone allows a great deal of traffic noise, which has a much more detrimental impact on sage-grouse than more continuous noise (Blickley et al. 2012). In response to these concerns, we offer the following recommendations for consideration during revision and implementation of Resource Management Plans.

II. Recommendations for research priorities

We recommend the following research priorities to inform the development of effective management strategies for noise in sage-grouse habitats. (1) We recommend an effort to map baseline pre-development ambient noise levels across the state by combining measurement of existing noise levels by trained personnel with predictive modeling. (2) Once ambient noise values are established, we recommend evaluating whether the current threshold of 10 dB above ambient is appropriate to protect sage-grouse. We recommend that the most feasible way to do so is by using habitat-selection models to analyze changes in sage-grouse population measures relative to variation in noise levels in disturbed areas. This method would also allow assessment of noise impacts outside of the breeding season. (3) Similarly, to establish more effective strategies for managing traffic noise, we recommend that researchers include noise from traffic in habitat-selection models. Doing so would help to establish whether the impacts from traffic noise are better mitigated by setting objectives for noise exposure levels or by restricting the siting and traffic volume of roads directly.

III. Recommendations for interim protections

Since the needed research will take time to complete, we provide managers and policy makers with the following recommendations for interim management strategies using the best available science to date. We emphasize that protections based on these interim recommendations may need to be revised upon completion of ongoing and future research.

1. Experimental evidence indicates that sage-grouse do not habituate to the impacts of noise over time (Blickley et al. 2012), therefore the combined impact of all anthropogenic noise sources should be considered when assessing disturbance to sage-grouse habitat. Therefore, we recommend that interim noise-management objectives should be set relative to typical ambient noise levels in sage-grouse habitat pre-development. Based on the best available measurements in undisturbed areas (discussed in detail in parts I.1. and III.1. of this report), we recommend an ambient value 20-22 dBA. This new default ambient would replace the previous default of 39 dBA or replace empirical measurements of ambient noise at lek edge.

2. We recommend continuing to allow an increase in noise levels of 10 dB above ambient. As discussed above, we do not yet know whether this level is appropriate to protect sage-grouse. However, this threshold is based on the best available science to date and is therefore reasonable when combined with realistic measures of ambient (i.e. 20-22 dBA).

   Establishing a protocol for the measurement of noise levels would facilitate accurate and repeatable assessment of compliance with noise-exposure objectives. We recommend using an A-weighted L_{50} as a measure of median noise exposure. The most relevant measurements would be those collected during times when noise exposure is most likely to affect greater sage-grouse—nights and mornings (i.e. 6 pm – 9 am). Accuracy would be improved by collection of measurements at multiple (3-4) locations between each noise source and the edge of the protected area. Measurements should be taken with a Type-1 sound level meter (ANSI S1.4-1983; or a method with similar accuracy) for ≥1 hour at each site, ideally over multiple days with suitable climactic conditions.

3. Current stipulations for sage-grouse core areas (WY Executive Order 2011-5) limit noise within the perimeter of the lek. However, in this report we review the evidence that noise will also disturb sage-grouse during off-lek activities critical to reproduction. Therefore we recommend that management strategies aim to protect the soundscape in areas critical for mating, foraging, nesting and brood-rearing activities, rather than protecting the lek alone. Thus we recommend that noise exceeding 10 dB over ambient be managed as a "disruptive activity" throughout sage-grouse nesting and brood-rearing habitat (e.g. BLM Instruction Memorandum WY-2012-019).

4. Given the difficulty of measuring intermittent traffic noise, we recommend that interim management strategies focus not on limiting traffic noise levels, but rather on the siting of roads or the limitation of traffic volumes during crucial times of the day (6 pm to 9 am) and/or season (i.e. breeding season). We estimate that noise levels will typically drop to 30 dBA at 1.3 km (0.8 mi) and to 32 dBA at 1.1 km (0.7 mi) from the road (these levels represent 10 dB over ambient using 20 or 22 dBA ambient respectively). Therefore to avoid disruptive activity in areas crucial to mating, nesting and brood-rearing activities, we recommend that roads should be sited (or traffic should be seasonally limited) within 0.7-0.8 miles from the edge of these areas. We emphasize that we are not recommending the siting of roads 0.7-0.8 miles from the edge of the lek perimeter, but rather 0.7-0.8 miles from the edge of crucial lekking, nesting and early brood-rearing areas.

BACKGROUND

Greater sage-grouse (*Centrocercus urophasianus*) populations have declined throughout their range, leading to their designation as a candidate for listing under the Endangered Species Act. Among the factors identified as a threat to sage-grouse is the expansion of energy development across much of the remaining sage-grouse habitat (e.g. Aldridge & Boyce 2007; Doherty et al. 2010; Doherty et al. 2008; Holloran et al. 2010; Holloran 2005; Kaiser 2006; Naugle et al. 2011; Walker et al. 2007). One potential means by which energy development and other human activities might impact sage-grouse populations is through the production of noise (Blickley & Patricelli 2010; Braun 1986; Braun 1998; Connelly et al. 2004; Holloran 2005; Rogers 1964).

Acoustic communication is very important in the reproductive behaviors of sage-grouse, and energy exploration and development activities generate substantial noise; it is therefore important to determine whether noise produced from energy development affects sage-grouse breeding biology. Female sage-grouse use male vocalizations to find leks within the habitat (Gibson 1989), and after their arrival at a lek, females assess male vocalizations (and other aspects of male display) when choosing a mate (Dantzker et al. 1999; Gibson 1996; Gibson & Bradbury 1985; Patricelli & Krakauer 2010; Wiley 1973). Noise from natural gas development is primarily produced by drilling rigs, compressors, generators and traffic on access roads. All of these noise sources are loudest below 2 kHz (Blickley & Patricelli 2012). Male sage-grouse produce acoustic signals between 0.2-2 kHz, so the potential exists for industrial noise to mask sage-grouse communication and thus interfere with the ability of females to find and choose mates (Blickley & Patricelli 2012). For a prey species such as sage-grouse, noise may also increase predation risk by masking the sounds of approaching predators, and/or increase stress levels by increasing the perception of predation risk (Quinn et al. 2006; Rabin et al. 2006). In other vertebrate species, noise has been found to impact individuals directly, for example, by causing startling behaviors, increased heart rate or increased annoyance; all of these factors may interfere with normal foraging, resting and breeding behaviors and contribute to higher stress levels and/or reduced fitness (reviewed in Barber et al. 2009; Kight & Swaddle 2011).

Holloran (2005) found observational evidence suggesting that noise may be at least partly responsible for impacts of natural gas development on sage-grouse populations in the Pinedale Anticline Project Area (PAPA), Wyoming. He found that juvenile males avoid recruitment to leks located near natural-gas drilling sites, even if these leks previously had high male attendance; these effects are more pronounced downwind of the drilling sites where noise levels are higher, indicating that noise may contribute substantially to these declines (Holloran 2005).

To investigate potential impacts from noise on greater sage-grouse lekking activity, we experimentally introduced noise from natural gas drilling rigs and access traffic on roads at eight leks and compared lek attendance to eight paired control leks near Hudson, Wyoming between 2006 and 2008[1]. We found immediate and sustained declines in male attendance on noise leks (29% declines on

[1] We began playback of drilling noise at two leks and traffic noise at two leks in 2006 and began monitoring their paired controls. In 2007 and 2008, we expanded the sample size to include four drilling-noise leks and four traffic-noise leks and their paired controls. Noise was played 24-hours a day beginning in mid-February to early March and continuing through the end of April of each year. Noise was recorded from drilling sites and main haul roads on the PAPA and played back using rock-shaped outdoor speakers placed in a line along one edge of the lek; this created a gradient in noise levels, decreasing with distance from the speakers. On leks with traffic noise playback, recordings of big rig trucks and pickup trucks were combined with 30- and 60-second files of silence at a ratio reflecting the average number of trucks expected to drive on a main energy field access road; these files were then played using the "random shuffle" feature on an MP3 player. On leks with drilling noise, a 14-minute recording of a drilling rig was played on continuous loop. Drilling noise recordings were broadcast on experimental leks at an L_{eq} of 71.4 ± 1.7 dBF (56.1 ± 0.5 dBA) as measured at 16 meters; on traffic noise leks, where the amplitude of the noise varied with the simulated passing of vehicles, noise was broadcast at an L_{max} (maximum RMS amplitude) of 67.6 ± 2.0 dBF (51.7 ± 0.8 dBA). These playback levels approximate the noise level at 0.25 mile (402 m) from a

drilling noise leks and 73% declines on traffic noise leks relative to paired control leks) and evidence of similar declines in female attendance; these results suggest strong noise avoidance in male and possibly female sage-grouse (Blickley et al. 2012). In addition, we found elevated stress hormone levels in fecal samples collected from noise leks compared to control leks, suggesting that even males who do not abandon noisy leks suffer a physiological impact (Blickley et al. In review). Further, our analyses of behaviors on leks with traffic noise playback suggest that males alter the timing of their vocalizations in response to noise—most males wait out noisy periods without strutting (during the sounds of trucks passing), but males who do not wait out the noise, strut at a higher rate (Blickley et al. in prep). These results are consistent with males avoiding the impacts of masking noise on their ability to attract females; other types of disturbance, such as startling or learned aversion to vehicular noise may also contribute to this response. Other types of anthropogenic noise sources (e.g. infrastructure from oil, geothermal, mining and wind development, off-road vehicles, highways and urbanization) are similar to the noise used in this experiment, and thus response by sage-grouse to other noise sources is likely to be similar. These results suggest that effective management of the natural soundscape is critical to the conservation and protection of sage-grouse.

The goals of this report are to (I) discuss current approaches in the management of new and existing noise sources within and outside sage-grouse core areas of Wyoming, (II) recommend research priorities for establishing effective noise management strategies, and (III) provide managers and policy makers with recommendations for the interim protection of sage-grouse from known or expected impacts of increased noise levels using the best available science to date.

I. CURRENT NOISE MANAGEMENT STRATEGIES IN WYOMING

Noise management strategies in greater sage-grouse habitat typically share three common components: (1) the management objective for noise is established relative to ambient levels, (2) noise is limited to 10 dB over these ambient levels, and (3), compliance with this objective is measured at lek edge. In light of the research reviewed above, here we discuss potential issues with these three components of noise management strategies, both in terms of whether they are practical to implement and in terms of their likely efficacy in reducing disturbance to sage-grouse populations. In addition, we discuss special issues related to management of noise from traffic.

1. Ambient noise levels

Management strategies on Wyoming public lands outside of the core areas (and before the core area strategy was implemented) typically allow for noise exposure on leks up to 10 dB over the ambient level; the ambient level is typically defined as 39 dBA[2], which thus sets the limit of exposure at 49 dBA (e.g. BLM 1999; BLM 2003; BLM 2008). However, there is evidence that 39 dBA is not an appropriate estimate of ambient levels in sagebrush habitat. This value originated in a 1971 EPA report; it is a measurement from a single farm in Camarillo, CA, on an afternoon. The farm is described in the report as follows:

> Rural agricultural near tomato field; 50 yards to the trees around the yard and dwelling area; 160 yds to Walnut Ave., a lightly travelled surface road; 0.6 mi to State Hwy 118, a 2-lane moderately travelled highway; 0.6 mi to LeLeror Ave. and 0.75 mi to La Vista Ave, both lightly travelled surface roads; 3.5 mi to Santa Paula Freeway; 3.6 mi to the Ventura Freeway; 4.5 mi to Camarillo. The major intruding

typical drilling site. To control for visual disturbance of the speaker system and researcher presence, control leks had dummy speakers placed in the same arrangement and were also visited to simulate the periodic battery changes on noise leks.

[2] All dB values presented here are measures of Sound Pressure Level (SPL) and thus relative to the threshold of human hearing (20µPa).

> events were created by jet propeller aircraft flyovers and dogs barking. Other intruding events were background traffic noise. Trucks on distant freeways could be heard distinctly but did not raise the noise level above its residual value. The residual noise level during the evening hours was dominated by crickets. During the day an orchard pruner in the distance controlled the minimum noise level. (EPA 1971)(available here)

Based on this description, it is clear that this farm is very different from undisturbed sage-grouse habitat. This EPA report presented this value as an example of an afternoon noise level in an active rural area; the value was not recommended as a default level for undisturbed landscapes. Further this value is median noise level (L_{50})[3], which in a busy area such as this, will include some noise from the anthropogenic sources listed in the description above, as well as birds, insects, wind gusts, etc. A more appropriate measure is the L_{90}—the level exceeded 90% of the time. The L_{90} is accepted by the American National Standards Institute (ANSI S12.9Part1) as a measure of background or "residual noise level"[4]. Indeed, the same EPA report found residual noise levels of 30-34 dBA on rural farms and 16-22 dBA in wilderness areas—whereas 39 dBA residual values were more typical of residential areas in Los Angeles, Detroit and Boston. Further, this 39 dBA measurement was collected during an afternoon, when noise levels are typically higher[5]. Since calm nights and morning are when sound is most critical for communication in sage-grouse, as well as detection of the sounds of approaching predators, this is the most important window of time for noise measurement. Afternoons in much of the habitat of the sage-grouse are windy, making noise measurements difficult and impeding communication and predator detection by sage-grouse and other wildlife[6].

Reports and noise levels measured in disturbed and undisturbed areas in Wyoming further suggest that 39 dB is inappropriate as an ambient value for most sage-grouse habitat. KC Harvey (2009) recently measured noise exposure on leks on the PAPA and found that most leks—even those with multiple active drilling rigs nearby—had residual (L_{90}) and median (L_{50}) levels much less than the "ambient" of 39 dBA (**Table 1**), demonstrating that this value is unrealistically high. Our measurements of leks in the PAPA and Powder River Basin lead to the same conclusion[7].

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[3] The L_{50} is the median noise level—the level that was exceeded 50% of the time (see **Figure 1**). This measure is collected over some time period (e.g. 1 hour, or from 6 pm to 9 am) with this period being broken down into much smaller intervals (typically 1 second); an L_{50} of 30 dBA would mean that half of the intervals measured were less than 30 dBA and half of them were greater than 30 dBA. This metric is preferable to using a measure of average noise over a longer interval, like L_{eq} or L_{avg}, since these average metrics are more heavily influenced by occasional loud events, such as those caused by a songbirds, insects, aircraft, wind gusts, etc. These intruding sounds will have no impact on the L_{50}, unless they are present more than 50% of the time.

[4] The L_{90} is the residual or background noise level. As with the L_{50}, the L_{90} is collected over some time period (e.g. 1 hour, or from 6 pm to 9 am) with this period being broken down into much smaller intervals (typically 1 second); an L_{90} of 20 dBA would mean that 10% of the intervals measured were less than 20 dBA and 90% of them were greater than 20 dBA (see **Figure 1**). Residual noise levels reflect background noise level at a site, since they exclude most intruding noise from birds, insects, wind gusts and sporadic anthropogenic noises (passing vehicles or aircraft) that raise the average (e.g. L_{eq} or L_{avg}) and peak values (e.g. L_{peak}, L_{max}, L_{10}) over a measurement period. This metric is the most suited for estimating ambient values to set the baseline for management objectives. Note that in an area with anthropogenic noise sources producing continuous noise (like most energy development infrastructure), the L_{90} measurement will not represent pre-development ambient values since the continuous noise source will contribute to the residual levels. To estimate predevelopment ambient for a disturbed site, measurements must be collected in a similar but undisturbed area, or estimated through modeling.

[5] L_{50} measurements at the same Camarillo farm were 32-34 dBA at night and in the early morning; the L_{90} levels at this time were < 30 dBA (US EPA 1971).

[6] This is not to say that daytime noise levels are irrelevant, rather that noise disturbance during this time is less likely to have an impact on breeding, since anthropogenic noise will often be masked by wind noise. Further, since measurements in the afternoon are more difficult and results are more variable, it is less practical to use afternoon measures for ambient or exceedance values. Ideally, however, anthropogenic contributions to noise levels throughout the day would be kept as close to nighttime/morning target levels as possible.

[7] In the Powder River Basin 2007, we measured three leks finding an average L_{eq} of 34.6 dBA, a minimum of 33.4 dBA and a maximum of 36.3 dBA. In the Pinedale Anticline between 2007 and 2009, we measured 14 leks finding an average of 39.1 dBA, a minimum of 31.4 dBA and a maximum of 47.4 dBA. Unfortunately, L_{90} and L_{50} values in dBA were not collected.

Which ambient value would be more appropriate? Based on our review of reports and empirical measurements collected in Wyoming, we estimate that true ambient values pre-development in nights and calm morning in sagebrush habitat are closer to 20-22 dBA (justification for these values is presented in part **III.1.**). If 22 dBA is the true ambient value, then a 49 dBA noise source would exceed ambient by 27 dB—this is a 22-fold increase in the noise level, which would be perceived by humans as at least 6 and a half times louder than ambient; such a sound would dominate the soundscape and cause significant disruption[8].

Indeed, results from our experiments indicate that 49 dBA is too loud to avoid significant impacts on sage-grouse. Our noise-playback leks (described above, Blickley et al. 2012) experienced levels that were in compliance these recommendations, i.e. less than 49 dBA across most of the lek area, except the area within ~20 meters of the speakers. Yet we found large declines in attendance, increases in stress levels and altered display behaviors across the lek (Blickley et al. in review, in prep). Therefore, the available scientific evidence shows that 39 dBA is inappropriate for use as a default ambient value for sage-grouse habitat, and suggests that allowing 49 dBA of noise exposure on leks and other sensitive areas will cause significant disturbance to greater sage-grouse populations.

In 2010, stipulations for sage-grouse core areas in Wyoming were created by Executive Order 2010-4. These stipulations used measured ambient values, rather than using 39 dBA as a default ambient value. A more recent executive order affirms this approach, stating:

> New noise levels, at the perimeter of a lek, should not exceed 10 dBA above ambient noise (existing activity included) from 6:00 p.m. to 8:00 am during the initiation of breeding (March 1 May 15). Ambient noise levels should be determined by measurements taken at the perimeter of a lek at sunrise. (Wyoming Executive Order 2011-5).

Since measured ambient noise levels are likely to be less than 39 dBA in most places, the core area stipulations will typically limit noise to levels lower than 49 dBA and thus offer greater protection for sage-grouse. But since existing activity is explicitly included in measurements of ambient noise, there may be some areas where the core stipulations allow more than 49 dBA, when existing sources lead to ambient measures greater than 39 dBA. Further, each new development may add 10 dB to existing noise levels, potentially causing an incremental increase in noise over time. Such increasing noise would likely cause increasing impacts, since sage-grouse do not appear to habituate to anthropogenic noise over time. The declines we observed on our noise playback leks were immediate and sustained throughout the three-year experiment (Blickley et al. 2012) and elevated stress hormones were observed through the second and third years of the experiment (Blickley et al. In review), indicating that sage-grouse do not adapt to increased noise levels over time. Therefore, the combined impact of all anthropogenic noise sources should be considered when assessing disturbance to sage-grouse habitat. To do so, management objectives would be set relative to the undisturbed soundscape, capping the total noise exposure at or near 10 dB above a "pre-development" ambient value[9].

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[8] For reference, it is helpful to remember a rule of thumb from physics: every 6 dB increase in noise levels is a doubling in amplitude (measured as changes in air pressure). One often hears the rule of thumb that a 10 dB increase in noise is subjectively *perceived* by humans as a doubling in loudness. However, this perception depends on the frequencies (i.e. pitch) of the sounds and can vary with amplitude. Indeed, in humans a 6 dBA increase in noise level leads to an approximate doubling in the number of noise complaints (ANSI S12.9/Part 4 Table F.1), suggesting that humans are more sensitive than this 10 dB rule of thumb implies. Since we do not know if sage-grouse or other non-human animals perceive sounds similarly to humans, the non-subjective "6 dB doubling" rule of thumb is preferable. An online calculator to determine how decibel values relate to loudness ratios can be found here. OSHA examples of noise levels of common sources can be found here.

[9] Such a cap would not preclude further development at sites which already have sources that exceed ambient by nearly 10 dB. This is due to the complex way that multiple sound sources combine to determine overall noise levels (see formulas and explanation here). A new source would need to be 9 dB less than the existing source at the measurement site (edge of the protected area) to add only 0.5 dB to the total noise exposure. A new source 6 dB quieter than the existing source would lead to a 1 dB increase in total noise level.

In addition, collecting measurements of ambient noise levels in quiet areas is extremely challenging and requires expensive, specialized equipment; this makes the requirement to collect ambient values at each lek difficult to implement. Unfortunately, non-ideal weather (especially wind, even at low levels) and almost all errors by the person deploying the noise meter (e.g. poor placement of the meter for long-term deployment, rustling from clothing, crunching leaves underfoot and even breathing close to the meter when handheld) will inflate ambient measures. Even professional measurements on Type-1 sound level meters will typically overestimate ambient levels in quiet areas (<27 dBA). This is because A-weighting[10] boosts the amplitudes of the mid-frequencies, which in very quiet areas includes noise from the pre-amplifier on the sound-level meter[11]. All of these sources of measurement inaccuracy will inflate ambient values and therefore allow more noise exposure at leks.

In summary, establishing an appropriate ambient value for sage-grouse habitat is a complex task. Further research is needed to establish pre-development ambient noise values, and in the interim, using a realistic estimate of pre-development ambient would offer more protection to sage-grouse than either an unrealistic default value (39 dBA) or ambient values measured at lek edge.

2. The 10 dB threshold

Once an ambient noise value (or values) is established, most current noise management strategies limit new noise levels to 10 dB above this ambient value. This 10 dB threshold is used commonly inside and outside of Wyoming core areas and in other states; however, we do not yet know whether this threshold is sufficient to protect greater sage-grouse. This threshold is based on only a handful of studies on songbirds (Wyoming Bird Conservation Plan, 2003; Dooling & Popper 2007), and there is no scientific basis for assuming that sage-grouse will respond to noise in a manner similar to songbirds. In fact, their low-frequency vocalizations might make them more vulnerable to masking by anthropogenic noise than many songbirds (Blickley & Patricelli 2012). Recent studies of songbirds have found that species with larger body size and lower-frequency vocalizations are more prone to population declines in response to noise (Francis et al. 2009; Hu & Cardoso 2009).

Furthermore, 10 dB is a significant increase in the amount of noise. For an animal vocalizing to communicate with potential mates or offspring, a 10 dB increase in noise levels corresponds to up to a tenfold decrease in the active space of the vocalization—the "listening area" over which it can be detected by receivers (Barber et al. 2009; Brenowitz 1982)[12]. This same increase in noise will lead to

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[10] A-weighting (ANS S1.42-2001) is used to account for changes in level sensitivity as a function of frequency. In an effort to simulate the relative response of the human ear, A-weighting de-emphasizes the high (>6.3 kHz) and low (<1 kHz) frequencies, and emphasizes the frequencies in between. Unfortunately, there is no weighting specific to sage-grouse or other wildlife. Most birds, besides owls, have hearing capabilities similar or slightly worse than humans; therefore, some experts recommend that A-weighting may be a suitable if not ideal metric for studies of birds (Dooling and Popper 2007).

[11] Most Type-1 (ANSI S1.4-1983) precision sound level meters (SLM) have a "noise floor" of ~17 dB, meaning that they cannot measure quieter sounds, since these sounds will be masked by the noise from the SLM itself. Some SLM noise is typically detected up to 10 dB above the noise floor (i.e. 27 dB), especially when using A-weighting, as discussed in the text. This is not a problem when measuring louder sounds (i.e. many noise sources associated with development) which overwhelm any contribution of the noise from the SLM (as well as noise from a slight breeze or other incidental sounds). Measurements of quiet sounds are thus particularly challenging. Type-2 SLMs are more affordable (often ~$400 rather than ~$9,000 for Type-1) but can have noise floors of ~35 dB and should therefore never be used to measure ambient noise or quiet sound sources (expected to be <35-40 dBA); some more expensive Type-2 meters have noise floors approaching 22 dBA and would therefore be more useful for measuring quiet sounds, but not ambient levels. Within a few decibels above the noise floor, the accuracy of Type-2 meters is typically only slightly lower than Type-1 meters. Type-3 SLMs have higher noise floors and lower accuracy and should not be used for measuring ambient or assessing compliance.

[12] Barber et al. (2009) offered simple formulas for estimating the reduction in detection distance and listening area resulting from an increase in background noise. The formula for calculating how the detection distance changes with an increase in noise is: detection distance=$10^{(-\text{(dB change in noise)}/20)}$. This shows a halving of detection distance for each 6 dB increase in noise, therefore a more than three-fold decrease (69% decrease) in detection distance with a 10 dB increase in noise and a tenfold reduction in detection distance (90% decrease) with a 20 dB increase in noise. When one is concerned with the total area over which a sound can be detected, rather than the distance between the sound source and receiver, then the appropriate measure is listening area. The area of a circle (i.e. listening area

up to a three-fold decrease in the detection distance between two receivers (Barber et al. 2009)[12]—meaning that receiver must be three times closer to hear a vocalization in noise than in quiet conditions, and perhaps more critically, a predator would be able to approach three times closer in noise before it was detected by a sage-grouse. Indeed, the night-time capture of sage-grouse by spotlighting is greatly improved by a noise source to mask the sound of footsteps from approaching biologists (Connelly et al. 2003); predators likely gain a similar advantage in noise. Masking of vocalizations and the sounds of predator approach is only one source of impacts from noise—animals may also suffer from behavioral disruptions, elevated hearth rate, interrupted rest and increased stress levels (reviewed in Barber et al. 2009; Kight & Swaddle 2011). These impacts may have significant consequences; a recent study in humans found a 12% increase in the risk of a heart attack with every 10 dB increase in exposure to chronic traffic noise (Sørensen et al. 2012). Many of these behavioral and physiological impacts may occur at or below the 10 dB threshold. Alternatively, further study may reveal that the 10 dB threshold is sufficient or even too conservative. Therefore, research is needed to determine whether the 10 dB threshold is appropriate for sage-grouse.

3. Where measurements are collected

Inside and outside of the core areas, current management strategies that limit noise to 10 dB over ambient levels typically specify that measurements should be collected at lek edge to assess compliance (e.g. WY Executive Order 2011-5; BLM 1999, 2003, 2008). This introduces two potential problems, which are discussed in turn below.

First, the presence of sage-grouse on the lek will influence sound level measurements. On the edge of a lek with many birds vocalizing, one could find "ambient" noise measures of 50-60 dBA L_{eq}[13], which would thus allow up to 60-70 dBA of anthropogenic noise. Even after an ambient value is established, determining whether a development complies with stipulated noise levels would require measuring noise exposure again at lek edge. One can imagine a scenario where increasing development noise causes declines in lek attendance, which causes noise level readings to decrease over time as fewer birds contribute to the sounds of the lek. Clearly, these data would tell us little about the actual noise levels of anthropogenic sources and could be very misleading. There are methods available to reduce this problem, such as using appropriate noise metrics (such as L_{50} and L_{90}; see part **I.1.**) and collecting measurements before birds arrive on the lek or after birds are flushed. But this issue makes the current stipulations more difficult, disruptive and ambiguous to implement.

Second, and much more importantly, if noise levels drop down to stipulated levels at the edge of the lek, then much of the area surrounding the lek will be exposed to higher noise levels (see **Figures 3** & **4**). This management strategy therefore protects only a fraction of sage-grouse activities during the breeding season—mate assessment and copulation on the lek—leaving unprotected other critical activities in areas around the lek, such as foraging, roosting, nesting and brood rearing. Our experimental design allowed us to examine only impacts of noise on the lek, since creating noise over a larger area would require noise sources much larger than battery-powered speakers (i.e. actual industrial infrastructure). Thus we cannot provide direct evidence that off-lek noise will impact sage-grouse populations. However, there is indirect evidence of such impacts.

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around the vocalizing animal) decreases with the square of the radius (i.e. detection distance between the vocalizing animal and the receiver), so here the formula is: listening area = $10^{(-(\text{dB change in noise})/10)}$. This leads to a halving of listening area with every 3 dB increase in noise and tenfold reduction with every 10 dB. These decreases in active space and detection distance are less extreme when environmental attenuation of noise is considered, but are nonetheless very large (Blickley and Patricelli 2012).

[13] L_{eq} (also called L_{avg}) is the equivalent noise level (see Figure 1). This can be thought of as the average noise level across the sample period; more precisely, it is the level of a constant sound over a specific time period that has the same sound energy as the actual (variable) sound.

Evidence suggests that male display and copulation activities on the lek may be affected by noise occurring around the lek area, even if the lek area itself meets management objectives for noise. In order to sustain their costly display behaviors, males must forage off lek, potentially exposing them to higher noise disturbance levels (**Figures 3** & **4**). Vehrencamp et al. (1989) found that males on the lek who are in good condition and are successful in mating forage further from the lek during the day, compared to unsuccessful, poor-condition males (range 200-750 meters, or 0.12-0.46 miles, off lek). Other studies have found males travelling an average of 0.6 miles (max 1.5 miles) to forage off lek (e.g. Schoenberg 1982; Wallestad & Schladweiler 1974). If foraging in noisy areas increases male stress levels or predation risk, or decreases foraging efficiency (as has been found in other vertebrate species; Quinn et al. 2006; Rabin et al. 2006), then these noise impacts may affect subsequent male display behaviors on the lek. More importantly, there is evidence that females and juvenile males use the sounds created by males on the lek to locate leks in the landscape (Gibson 1989). Blickley and Patricelli (2012) found that industrial noise masks these sounds, which will make it more difficult for females and juvenile males in noisy areas surrounding a lek to find the lek itself. Reduced female visitation would decrease copulation activities on the lek, and reduced juvenile male recruitment would lead to male attendance declines over time. For these reasons, the protection of lekking activities may require protection of more than just the lek surface alone.

Additionally, other critical components of successful breeding occur off lek, potentially in areas with higher noise levels **(Figures 3** & **4**). Since 64% of females nest within a 5 km (3.1 mile) radius of the lek and 74-80% of females nest within a 6.4 km (4 mile) radius of the lek (Holloran & Anderson 2005; Moynahan 2004), many of these nesting females will experience noise levels exceeding management objectives for the lek. Most vocalizations used between hens and chicks are much quieter than sounds produced by males on leks (Schroeder et al. 1999), and therefore much more prone to masking (Blickley & Patricelli 2012). Additionally, predation rates can be high for chicks and females on nests in disturbed habitats (Hagen 2011), and females likely rely mainly on acoustic rather than visual cues to predator approach at night. Thus when noise masks the sounds of predator approach, females and chicks may be more at risk in noisy areas than males on the lek. Further, breeding females may suffer detrimental health impacts from elevated stress, at a time when stress levels are already elevated (Jankowski 2007). While we do not have direct evidence for an impact of noise on these off-lek activities, there is evidence that proximity to roads and infrastructure (which raises noise levels) affects nest placement, nest initiation rates, chick survival and brood-rearing activities (Aldridge & Boyce 2007; Holloran et al. 2010; Holloran & Anderson 2005; Lyon & Anderson 2003).

Other types of disruptive activities in sage-grouse habitat are managed throughout areas critical for lekking, nesting and early brood rearing (e.g. BLM Instruction Memorandum WY-2012-019; Wyoming Executive Order 2011-5); there is no scientific basis for focusing the monitoring and management of noise on the lek area alone, without including these other critical areas.

4. Traffic Noise

There is evidence that noise from traffic is has a significant impact on sage-grouse. Blickley et al. (2012) found 73% decline in male attendance on traffic-noise leks compared to their paired controls, more than twice the decline observed on drilling-noise leks (29%). Traffic noise was also found to cause an increase in stress hormone levels (Blickley et al. In review) and a disruption of strutting patterns on the lek (Blickley et al. in prep). Further evidence comes from other studies not focused on noise alone. Lyon and Anderson (2003) found that even light vehicular traffic (1–12 vehicles per day) substantially reduced nest initiation rates and increased the distance of nests from lek sites. Holloran (2005) found that traffic on roads within 0.8 miles of the lek during the early morning while males are

strutting is related to declines in male attendance. These results suggest that effective management strategies should include efforts to minimize traffic near areas critical for sage-grouse reproduction.

However, management strategies that allow up to 10 dB of noise above ambient are not sufficient to protect sage-grouse from the impacts of traffic noise. Since traffic noise in sage-grouse habitat is typically intermittent and interspersed with periods of quiet, a great deal of traffic would be needed to raise overall noise levels by 10 dBA. In general, a tenfold increase in traffic is associated with a 10 dB increase in average noise levels, so an increase from 2 to 20 vehicles or from 200 to 2,000 vehicles over a given time interval. A tenfold increase in traffic would likely have a major impact on sage-grouse, yet may not exceed current noise management objectives inside and outside of core areas. This suggests that approaches for the management of more continuous noise sources, such as noise from compressors stations, drilling rigs and other permanent or temporary infrastructure, may not be suitable for the management of traffic noise.

II. RECOMMENDATIONS FOR RESEARCH PRIORITIES

While our understanding of noise impacts on sage-grouse has improved over the last few years, there is still much to learn. Below, we outline recommendations for research that would help to develop more effective management strategies for anthropogenic noise.

1. Establishing ambient values

As discussed in part **I.1.**, management objectives for noise are typically established relative to ambient noise levels, stating that noise measured at lek edge should not exceed 10 dB over ambient. The choice of ambient value thus has large consequences, setting the upper limit of allowable noise. In order for such management strategies to protect vulnerable species, it is therefore critical to establish accurate ambient values.

Due to the previously discussed difficulty of measuring ambient values at quiet locations, we suggest that it is not feasible or practical to establish baseline noise levels by having agency personnel or consultants with little specialized training measure ambient at each lek prior to development. Further, experimental evidence indicates that ambient values should represent the pre-development ambient levels, such that new developments do not further impact already impacted soundscapes (see part **I.1.**). One approach to establish ambient noise levels is to commission the measurement of ambient levels by professionals with experience in environmental acoustics. Such professionals would need to measure ambient values for each site prior to development (or if there are already noise sources in an area, they could choose a similar but undisturbed area to estimate natural ambient levels). Alternatively these professionals could sample noise levels at representative undisturbed areas across the state, using such measurements to establish ambient values by region or habitat type. Measurements should be collected using a Type-1 precision sound level meter (ANSI S1.4-1983)[11] enclosed in environmental housing for long-term deployment at each site[14]. Alternative methods, such as carefully calibrated audio recording units that can be used to calculate appropriate metrics[14] would also be appropriate (Lynch et al. 2011; Patricelli et al. 2007).

[14] The meter should log A-weighted 1/3-octave spectra of noise at 1-sec intervals. The following metrics (at a minimum) should be collected: Leq, Lmax, Lpeak, L_{10}, L_{50}, L_{90} (see Figure 1). Each metric should be collected as A-weighted values, and if possible, as dBF (i.e. dB-flat or unweighted) and C-weighted. With a logging SLM, one can save the time history, showing how noise levels change over time in the sampling period. This can be very useful in isolating the causes of change in noise levels. One can also calculate each metric hourly or over the entire sampling period. Hourly metrics are useful when focusing on a critical time window (e.g. 6pm to 9 am). The meter (or a nearby station) should also log wind speed, so that measurements can be excluded when wind likely to contributed to noise levels.

We recommend that a better approach would be to combine such empirical sampling of noise levels with modeling, to create a map of natural ambient noise across the state. This would lead to broader coverage of the state, since collecting empirical measurements at each key site would be time consuming and interpolating levels between these sites would be inaccurate without a model. The National Parks Service (NPS) Natural Sounds and Night Skies Division is currently developing a model to predict ambient noise levels with and without existing developments. The model uses a machine-learning algorithm to improve predictions using publically-available input variables related to location, climate, land cover, hydrology, and degree of human development. The algorithm improves its accuracy (i.e. learns to improve its estimates) with each new empirical measurement. Output from such a model would be available to any parties interested in evaluating the natural noise levels at a current or proposed development site in the state. These measurements are not grouse specific, thus this data would be useful for multiple public and private agencies interested in tracking noise exposure.

2. Determining an appropriate threshold

Once an ambient value is determined, we must then determine whether the current threshold of 10 dB above ambient is sufficient to protect sage grouse. The ideal method to determine the appropriate threshold would be a dose-response experiment, where noise is played back at different levels to different leks, to determine the maximum noise level before an impact occurs. However, such an experiment is logistically infeasible for multiple reasons, including the necessity to impact a very large sample of leks (multiple leks at each playback level, with many playback levels) and large expense. A more feasible way to determine the threshold level at which sage-grouse are impacted by noise is by analyzing nesting success, lek attendance and other population variables relative to existing variation in noise levels in a spatially-explicit manner using habitat-selection modeling. This method examines the impact of "natural" variation in noise exposure across a disturbed landscape, while statistically controlling for other possible contributors, and allows estimation of the slope of the relationship between noise and measures of population change. This relationship can then be used to determine the threshold level at which a minimal (or acceptable) level of impact on sage-grouse occurs. We are currently collaborating with Dr. Matt Holloran to develop noise layers for use in habitat-selection models of the Pinedale Anticline during development (beginning in 1998). We encourage researchers to consider including noise layers in habitat-selection models for other regions. Such an approach would also be useful for examining noise impacts outside of the breeding season, especially in winter, where changes in habitat quality and availability can lead to significant impacts on population health (Beck 1977; Doherty et al. 2008; Swenson et al. 1987).

3. Measuring traffic noise

Evidence shows that traffic noise causes impacts on sage-grouse, as discussed in part **I.4.**; however, limiting traffic noise by setting noise-exposure objectives will be difficult. This is because intermittent traffic, such as the traffic in most sage-grouse habitat, causes short periods of loud noise interspersed with longer periods of quiet. With a variable noise source such as this, is it difficult to choose which metric to use in setting management objectives. This is especially true since we do not know whether it is the total noise exposure through the day (or in a critical time period, such as nights and/or mornings) or the maximum noise level as a vehicle passes that best predicts impacts on grouse. Given that Lyon and Anderson (2003) found that nesting activities can be disturbed by only 1-12 vehicles per day, the chosen metric would need to be sensitive to infrequent sounds. A measure of "average" amplitude (e.g. L_{eq}) would be problematic, since the occasional noise events would be averaged with much longer quiet periods, having little effect on measured values (see part **I.4.**). Similarly, the sounds of vehicles passing would have little to no influence on median noise level (L_{50}), unless traffic noise is detectable

50% of the time or more. Even measures of maximum noise levels (such as the L_{max}, a measure of the maximum RMS amplitude during the sample period; see **Figure 1**) can be problematic, since other sound sources besides vehicles can affect these measures. This is especially problematic during long-term deployment of meters for monitoring, since a single meadowlark perched near (or on) the meter could lead to extremely high L_{max} measurements. Excluding these events would require that they be identified in synchronized audio recordings; alternatively, the 1/3-octave band frequency profile of the noise may be useful for these exclusions. A protocol could be developed to do this, but different methods would need to be tested. Even with such a protocol in place, L_{max} values may be more informative when combined with a measure of exposure, such as L_{eq} or axle counts.

To establish more effective management strategies for traffic noise, more information is needed about which noise metrics best predict traffic impacts on sage-grouse. Such information could be gathered by including traffic noise in habitat-selection models. This approach will allow estimation of the relationships between demographic variables (e.g. lek attendance, nest location, nest success) and traffic variables (distance, traffic level and noise level). This would help to establish whether the impacts from traffic noise are better mitigated through setting noise objectives or by managing the siting and traffic levels of roads directly. If informative metrics are identified for measurement of traffic noise, then protocols should be established for accurate and repeatable measurements in the field, given the challenges discussed. The noise layers we are currently developing for the Pinedale Anticline area will include traffic noise and allow us to begin addressing this issue. We encourage researchers to consider including traffic-noise layers in habitat-selection models for other regions.

III. RECOMMENDATIONS FOR INTERIM PROTECTIONS

The research described above, however, will take time. Below, we provide managers and policy makers with recommendations for the interim protection of sage-grouse from known or expected impacts of increased noise levels using the best available science to date. We emphasize that protections based on these interim recommendations may need to be revised upon completion of ongoing and future research.

1. Setting an ambient value

Based on our review of reports and empirical measurements collected in Wyoming, we have concluded that true ambient values pre-development in nights and calm morning in sagebrush habitat are likely to be 16-22 dBA. The first source for this conclusion is the 1971 EPA report from which the original 39 dBA ambient value was drawn (US EPA 1971). This report finds residual noise levels (L_{90})[4] in wilderness areas of 16-22 dBA[15], measured during day and nighttime at a campsite on the north rim of the Grand Canyon National Park; the report concludes that "these increases in (residual) noise level, from wilderness to farm and to city, are the result of man's activities and his use of machines". Lynch et al. (2011) more recently measured noise exposure at 189 sites in 43 U.S. National Parks, finding an average 24-hour residual noise level of 21.6 dBA[16].

[15] 16 dBA was the daytime residual level (7am to 7pm) and ~22 dBA was the night time residual level (10pm-7am). In most places, nighttime residual levels will be lower than daytime due to environmental conditions (temperature, humidity, breeze, etc.) However, these values are reversed due to crickets which were active early in the night. Evening readings of ~28 dBA (7pm to 10 pm) were dominated by crickets and are not included here since insect noise is minimal during the sage-grouse breeding season due to low temperatures.

[16] These measures include only the 1/3 octave bands from 12.5 Hz to 800 Hz, so they are not directly comparable to the full-spectrum measures from other sources given in the text (these narrower-spectrum measures will be lower than the full-spectrum measures). However, these frequencies span most anthropogenic noise and residual noise in undisturbed areas, so this measure provides an appropriate estimate of ambient noise levels at these sites (Lynch et al. 2011).

In addition, we have analyzed the detailed data from long-term deployment of a sound level meter by KC Harvey consulting on the Pinedale Anticline Project Area (KC Harvey 2009)[17]. The median L_{90} among these 12 leks was 27.2 dBA and the minimum lek was 22.2 dBA (**Table 1**, **Figure 2**). Given that all of these leks experienced some noise from natural gas infrastructure and highways (and that this Type-2 sound level meter[11] had a noise floor of 20-22 dBA), these are conservative (i.e. slightly high) estimates of pre-development ambient. Other recent measurements in areas with low levels of disturbance have found similar residual levels[18].

Since 16 dBA is at or below the limit of measurement on most Type-1 sound level meters[11], it would be a difficult to implement protections based on this ambient value without an immediate shift in methods for measurement and/or data-processing. Further, it is clear that residual ambient values even in undisturbed areas are sometimes higher. Therefore, we recommend that an ambient value of 20-22 dBA should be used for interim protections in sage-grouse habitat. In revised management strategies, this new default ambient would replace the previous default of 39 dBA or replace empirical measurements of ambient at lek edge.

2. Setting a threshold above ambient

As discussed in part **I.2.**, we do not yet know whether limiting noise to 10 dB above ambient is appropriate for protecting sage-grouse. However, we recommend continuing to use the 10 dB threshold as an interim measure, combined with appropriate measures of ambient (i.e. 20-22 dBA). This threshold value is based on the best available science to date, but should be revised as needed when better information becomes available. Using 20 dBA as the ambient value, this would allow up to 30 dBA of noise exposure; using 22 dBA as ambient, this would allow up to 32 dBA of noise exposure.

How should compliance with this management objective be measured? Noise can be variable over time, space and frequency spectrum, so no single metric can capture this complexity. However, using multiple metrics to assess compliance may be complicated to implement, at least in the interim. Therefore, we recommend using the A-weighted L_{50} as a measure of median noise exposure[3]. This metric is useful because it is less influenced by the brief intruding sounds (e.g. birds, insects and airplanes) that can dominate other metrics. This metric may also exclude some types of noise produced by the development being monitored, including vehicles (unless traffic is very heavy). For that reason, it will typically not be effective at reflecting impact caused by traffic noise. Despite this concern, the L_{50} is recommended because otherwise birds, insects and other indicators of a healthy habitat may be counted against compliance (unless audio recordings are produced, allowing monitors to exclude time periods with such activity; this may be a preferable solution in the long run, but it will require time to develop such a protocol).

We recommend that measurements are made during times when noise exposure is most likely to affect greater sage-grouse: nights and mornings (i.e. 6 pm – 9 am). Further, we recommend using the average of L_{50} values at multiple (3-4) locations between each noise source and the edge of the protected area. Since noise values can change with topography and local ground cover, this will reduce the impact of aberrant measurements (high or low) at particular locations. Measurements should be

[17] Available here.

[18] A recent EIS (DOE EA-1849) for a geothermal development in sage-grouse habitat near Elko, NV, found an ambient noise level of 25 dBA (measured from 12-5am on 6/17/11). This area is described as follows: "Existing noise at the power plant site is dominated by ambient sources including wind, ranch vehicles, livestock, irregular mineral exploration, and recreational uses such as all-terrain vehicles, on BLM land to the west of the site". We also collected brief ambient noise values with a handheld Type-1 noise meter on Preacher Lek near Hudson, WY. This lek is on relatively-undisturbed federal land, but noise from nearby Highway 789 was clearly audible when readings were being collected. Six males were present on the lek, but ambient measures were collected when birds were not vocalizing. The L_{90} for these measurements was 25.4 dBA. These two measures are slightly higher than the 22 dB given as the upper end of the range of pre-development ambient values, which is appropriate since both sites have anthropogenic noise sources nearby.

taken with a Type-1 sound level meter[11] (or a method with similar accuracy and a noise floor <25 dBA). We recommend making measurements of at least 1 hour at each site, ideally over multiple days and climactic conditions, since weather (temperature [especially temperature inversions], humidity and wind) can affect noise levels. We recommend collecting additional metrics whenever possible, for research and long-term monitoring[14].

It should be noted that based on the measurements presented in **Table 1**, four of the 12 monitored leks on the Pinedale Anticline are in compliance with the noise management objectives recommended here based on a 20 dBA ambient value (i.e. they do not exceed an L_{50} of 30 dBA). Two of the other leks are within 0.5 dB of compliance with recommended objectives based on an ambient of 22 dBA. Given that these leks are in a heavily developed area, which has experienced declines in sage-grouse populations (Holloran et al. 2010; Holloran 2005), this suggests (1) that these recommended protections are not as onerous as they may initially seem, even using an ambient value of 20 dBA, and (2) that even these stricter recommendations may not suffice to avoid population declines if noise levels are measured at lek edge (as in Table 1), rather than across nesting and brood-rearing habitats, as discussed below.

3. Redefining the protected area

Current noise management strategies typically recommend noise measurements at the edge of the lek to assess compliance (e.g. WY Executive Order 2011-5; BLM 1999, 2003, 2008). This approach manages noise levels the lek area itself, and not the surrounding habitat critical to support lekking activities and successful reproduction. In part **I.3.**, we review the evidence that this off-lek noise will affect on-lek activities and successful reproduction. Therefore we recommend that interim and longer-term management strategies aim to protect the soundscape in areas critical for mating, foraging, nesting and brood-rearing activities. Thus we recommend that noise exceeding 10 dB over ambient be managed as a "disruptive activity" throughout sage-grouse nesting and brood-rearing habitat (e.g. BLM Instruction Memorandum WY-2012-019). To accomplish this, we recommend measuring compliance with noise objectives at the edge of nesting/brood-rearing habitats, rather than at the edge of the lek.

4. Limiting traffic noise

Given the difficulty of measuring intermittent traffic noise and the uncertainty about which metrics are informative (see part **II.3.**), we recommend that interim protections focus not on setting objectives for traffic noise levels, but rather on the siting of roads or the limitation of traffic during critical times of the day (6pm to 9 am) and/or year (breeding season).

To develop interim recommendations for the siting of roads, we estimated the distance from a road at which noise levels (L_{max} as a single vehicle passes) will drop down to 10 dB over ambient. Using an ambient of 20 dBA, we calculate that vehicle noise will diminish to 30 dB at ~1.3 km (0.8 miles) from the road. Using an ambient of 22 dB, we calculate that vehicle noise will diminish to 32 dBA at ~1.1 km (0.7 miles) from the road[19]. Therefore to avoid disruptive activity in areas crucial to

[19] To calculate this estimate of impact distances from roads, we used 2006 measurements of noise levels from 17 vehicles (flatbed trucks and big rigs) on the Luman Road and 8 vehicles on the North Jonah Road on the Jonah Field in Sublette County, WY. All measurements were made at ¼ mile from the road. A-weighted L_{max} values were averaged for each road and the average of the two roads was 45.47 dBA (S.E. = 1.3 dBA; range 37 - 58.7 dBA); we similarly calculated average A-weighted levels for each octave from 16-16,000 Hz. In each octave band, we calculated propagation using the assumption of spherical spreading (see formula here) and octave-specific excess attenuation values from the Pinedale Anticline Noise Analysis report prepared by the BLM with assistance from the Army Corps of Engineers and US Forest Service (BLM, 1999). Using these methods, we extrapolated noise propagation beyond our ¼-mile levels until levels reached 32, 30, 22 and 20 dBA; the distances at which those levels were reached are presented above. These estimates are based on the maximum noise levels as a single vehicle passes, however, on roads with sufficient traffic to create a steady stream of vehicles, noise

mating, nesting and brood-rearing activities, we recommend that managers consider siting roads (or seasonally limiting traffic) within 0.7-0.8 miles from the edge of these areas. We emphasize that we are recommending restrictions within 0.7-0.8 miles of the edge of sage-grouse nesting and brood-rearing habitat (e.g. BLM Instruction Memorandum WY-2012-019), not the lek edge. Further, note that noise from traffic will be audible at least until levels drop down to ambient values, which will occur 1.5-1.7 miles from the road[19]. These distances may be much farther during temperature inversions, which are common during the lekking hours in sage-grouse habitat (for an ambient of 20 dB and 22 dB respectively, traffic noise in a temperature inversion would reach 10 dB over ambient at 1.1 and 1.4 miles from the road, and this noise would reach ambient at 2.8 and 3.3 miles from the road). Therefore, adopting these recommendations will not eliminate traffic noise in critical areas, but should reduce its impact.

Given that traffic noise was found to have more than twice the impact of continuous noise on lek attendance (Blickley et al. 2012), minimizing traffic noise as a disruptive activity in all areas critical for successful reproduction should be a priority in any revised noise management strategy. In areas where implementing recommended limits on siting or traffic is not possible, other measures may reduce traffic noise impacts. One possibility would be to adjust timing of the shift change in development areas to avoid causing an increase in traffic during critical times. Avoiding shift changes between 6 pm and 9 am would be ideal, but if this is not possible, then avoiding 12 am to 9 am would likely be a significant improvement.

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drops off more slowly and these distances would be up to *twice as far* (levels would follow predictions of cylindrical spreading, dropping only 3 dB with every doubling of distance, rather than 6 dB, as assumed here). Similarly, noise levels drop off according to predictions of cylindrical spreading during temperature inversions, which are common in sage-grouse habitat during the early morning. For these reasons, the distances presented above may be conservative estimates (i.e. underestimates) of the distance that sound will propagate from a road. The same calculations were used to estimate propagation distances around a hypothetical noise source in Figure 3 and a drilling rig in Figure 4. For Fig 4, we used an example drilling rig measured in the PAPA in 2006 at an L_{eq} of 66.7 dBA at 216 feet. This drilling rig measurement is from a single example rig and is not meant to be representative of all drilling rigs. The hypothetical source in Fig 3 uses the same octave spectrum as the drilling rig, which is typical of industrial noise sources, but is scaled to an overall dBA level of 65 dBA at 1000 feet.

AUTHORS

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Figure 1. Some common metrics used to measure noise levels. The gray line represents the noise level (RMS amplitude over a short sample period, typically one second) as it changes over time through the sampling period (the time history).

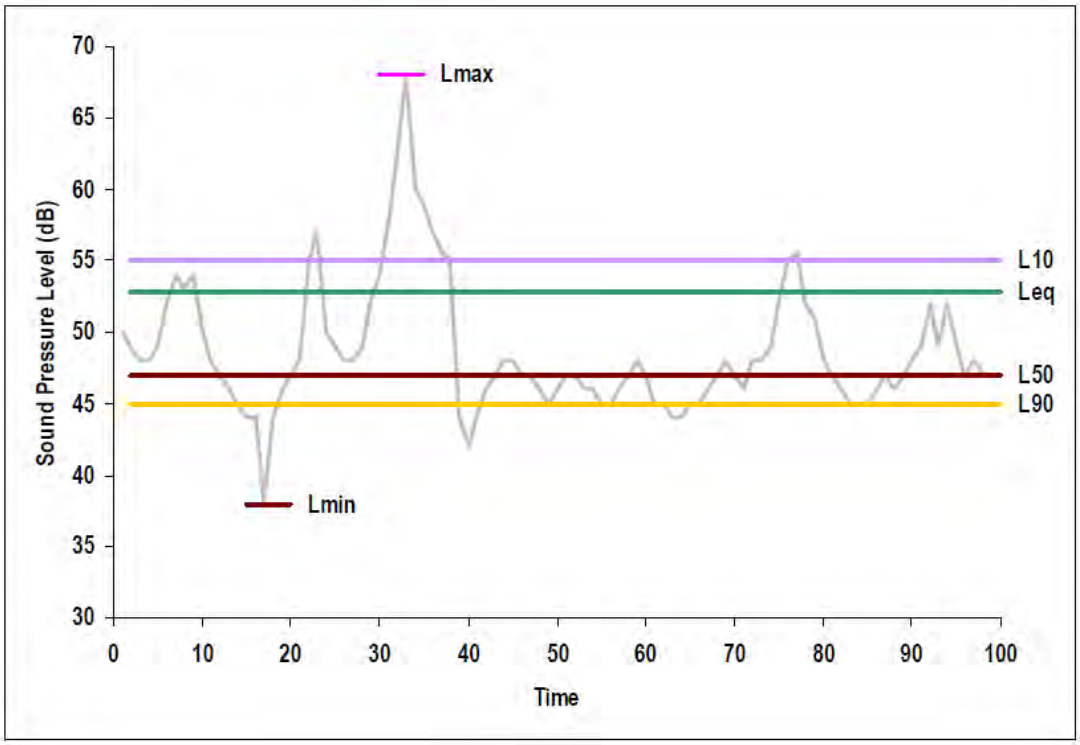


Table 1. S**pring 2009 noise levels on leks in the Pinedale Anticline Project Area.** Data were collected by KC Harvey Consultants (KC Harvey 2009) from multi-day deployments of four Type-2 sound level meters (Quest - SoundPRO-DL-2-1/3-10; noise floor 20-22 dB). All measures are presented in dBA. Weather data are not available and windy periods were not excluded, so these values likely include substantial energy from wind. All leks are close enough to development sites, access roads and/or highways to experience anthropogenic noise (see Figure 2); it is not clear from the report whether noise levels may also reflect sounds from males displaying on the leks (displaying males on these relatively-small leks are unlikely to significantly impact L_{50} or L_{90} measures, but may affect other metrics). Measurements are from the full 24 hrs/day, so they are not focused on the night and morning periods likely critical to greater sage-grouse (6 pm to 9 am).

Lek Name	Dates	Duration (hrs)	L_{90}	L_{50}	L_{10}	L_{avg} (L_{eq})	L_{max}	L_{min}	L_{peak}
Alkali Draw	April 2 & 6	121	23.6	28.8	41.2	44.1	92.6	19.6	114.0
Big Fred	April 12, 16 & May 12	123	27.6	33.9	44.0	42.4	80.2	22.0	100.5
Bloom Reservoir	April 22 & 27	120	22.2	29.2	44.7	41.9	83.9	19.4	103.4
Cat	May 2 & 7	120.3	22.8	28.1	44.1	44.3	86.9	19.6	106.0
Little Fred	April 12, 16 & May 7	85.5	32.7	36.7	45.5	44.2	80.8	31.8	101.9
Lovatt West	April 22, 23 & May 12	127	30.4	33.7	48.3	47.4	84.5	28.2	106.8
Lower Sand Springs Draw	May 7	111.3	25.9	29.8	41.5	39.7	73.4	23.6	88.6
Mesa Road 3	May 12	141.3	31.9	32.1	33.1	32.5	53.4	31.7	88.5
Oil Fork Road	April 17, 22 & 27	120.4	24.5	33.0	46.7	42.8	78.0	22.8	88.6
The Rocks	April 6	147.5	32.1	33.1	46.8	44.4	95.3	31.7	107.7
Shelter Cabin Reservoir	April 6, 12 & May 27	99.1	27.1	32.4	41.9	40.5	78.0	23.3	88.6
South Rocks	May 2	121	27.4	33.3	46.2	42.7	73.7	23.8	88.6
MEAN		119.8	27.4	32.0	43.7	42.2	80.1	24.8	98.6
MEDIAN		120.7	27.2	32.7	44.4	42.8	80.5	23.4	101.2
S.D.		16.4	3.7	2.5	4.0	3.7	10.8	4.8	9.4
S.E.		3.3	0.7	0.5	0.8	0.7	2.2	1.0	1.9
MAX		147.5	32.7	36.7	48.3	47.4	95.3	31.8	114.0
MIN		85.5	22.2	28.1	33.1	32.5	53.4	19.4	88.5

Figure 2. Locations of leks presented in Table 1. This is figure 1 from the report by KC Harvey showing locations where noise measurements were collected (KC Harvey 2009).

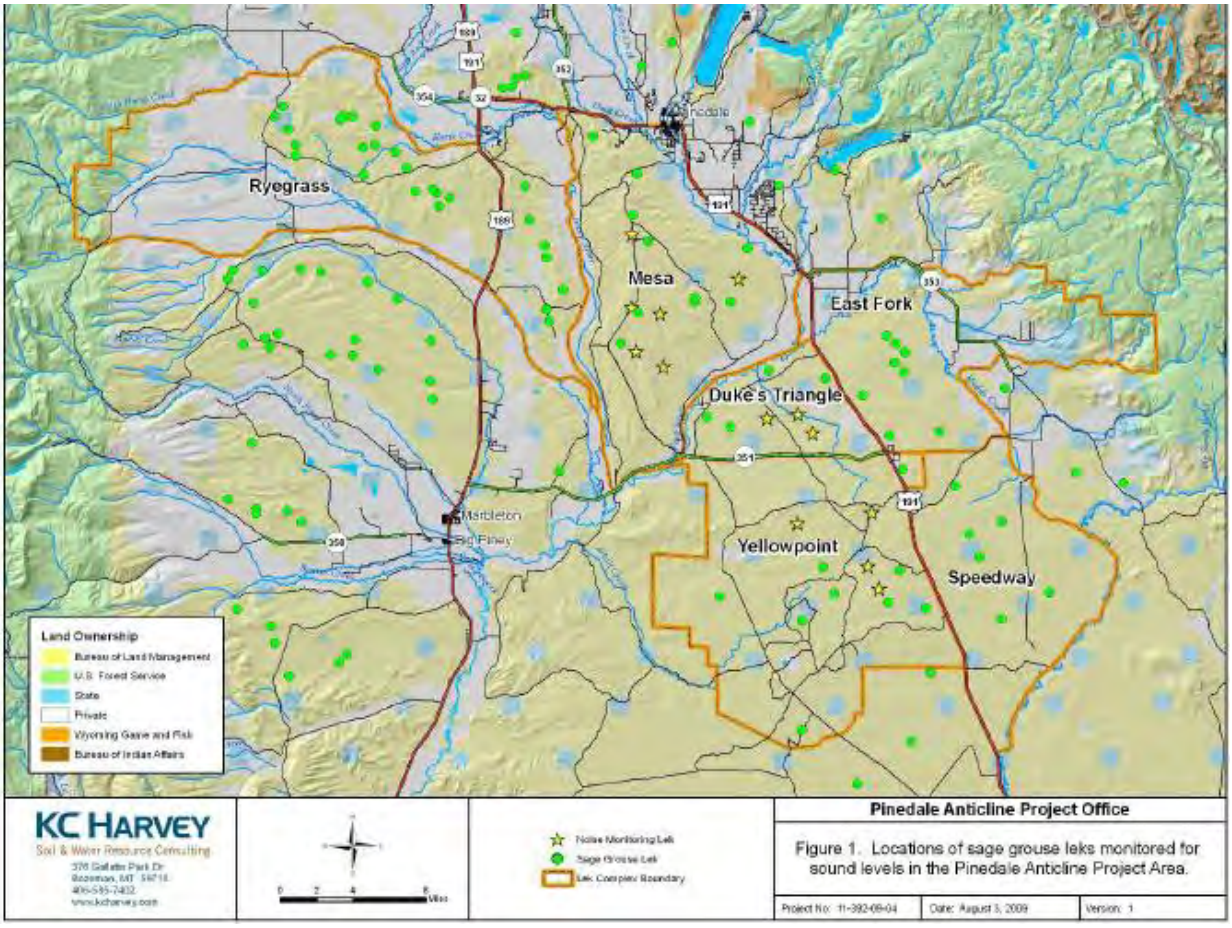


Figure 3. An illustration of noise levels surrounding a lek. This illustration shows a lek in the center, surrounded by a 0.6 mile buffer, a 1.9 mile buffer encompassing ~45% of nests, and a 4-mile buffer encompassing 74-80% of nests (Holloran & Anderson 2005; Moynahan 2004). Noise propagation is shown from a hypothetical loud noise source or combination of sources measuring 65 dBA at 1000 feet (with the same frequency spectrum as drilling noise[19]) located at the edge of the 1.9 mile buffer. Noise is predicted to exceed 10 dBA over ambient (20 dBA) for a radius of approximately 1.9 miles (darker blue), and to be audible above ambient for at least 3.4 miles (lighter blue)[19]. This figure demonstrates that even when the lek area is within recommended noise levels, much of the surrounding area critical for foraging, nesting and brood-rearing may be exposed to higher levels of noise. Distances are approximately to scale and calculations assume no temperature inversions, which nearly double sound propagation distances, and no topographical or ground effects[19].

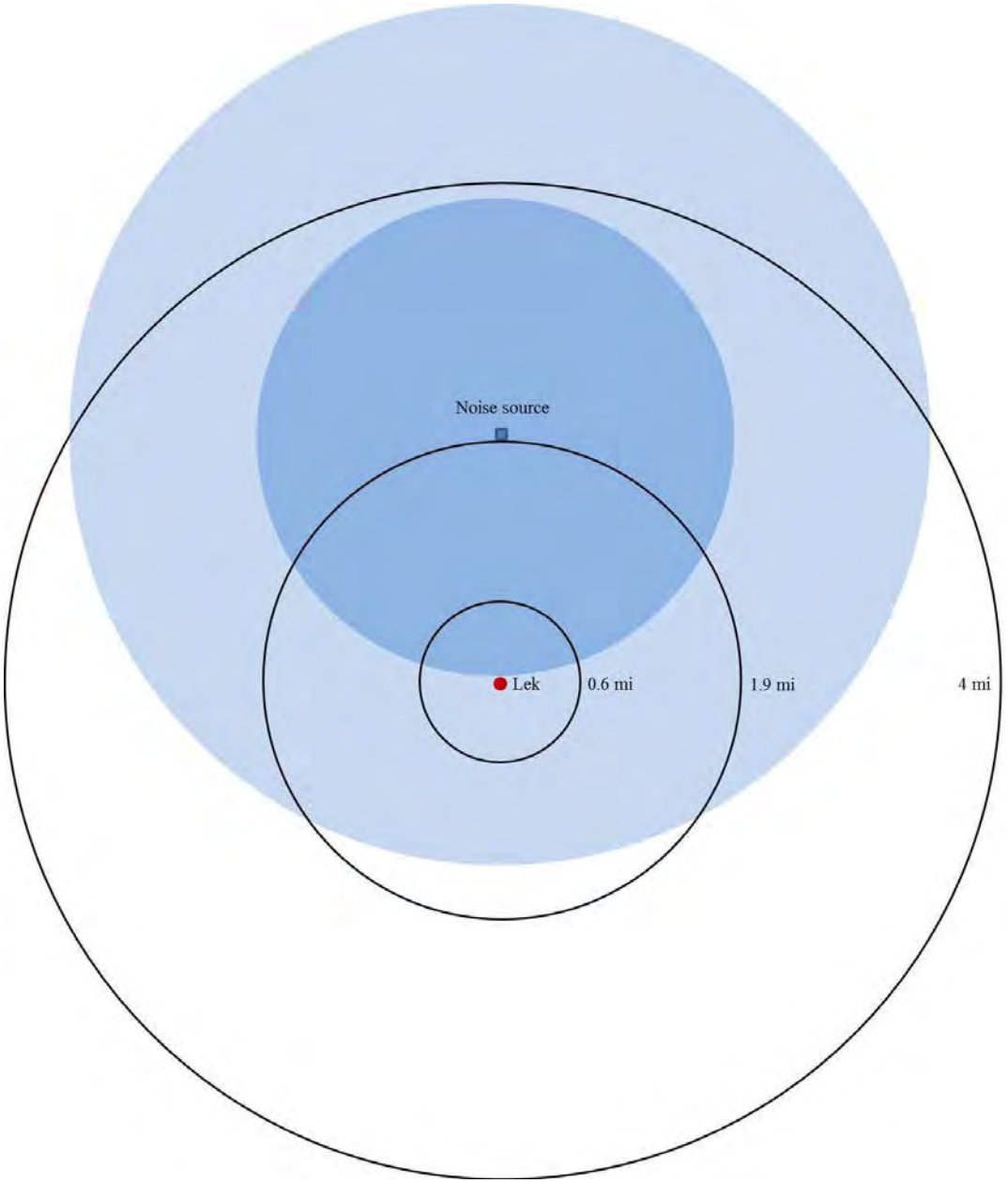
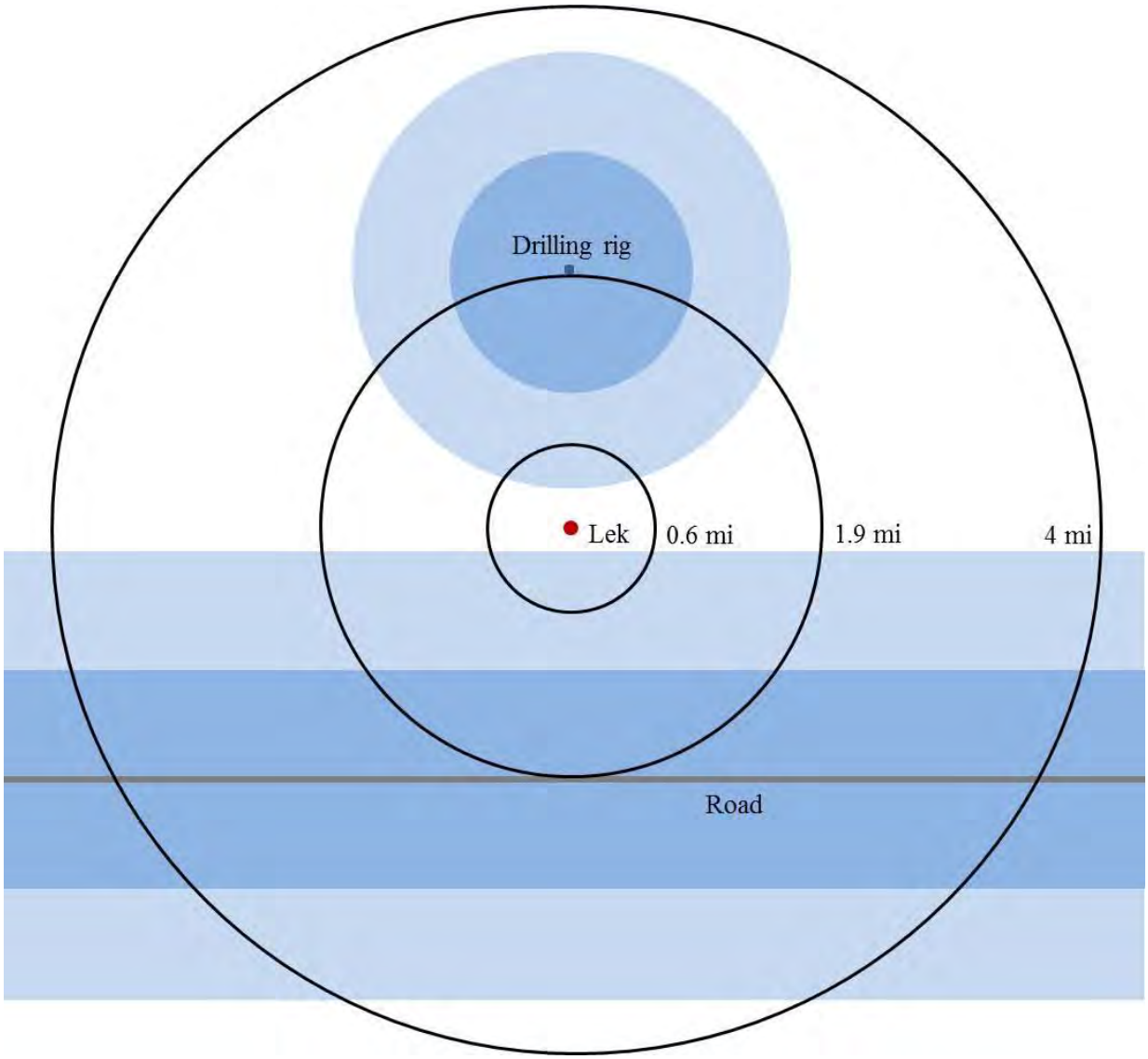


Figure 4. Traffic and drilling noise surrounding a lek. This illustration shows a lek in the center, surrounded by a 0.6 mile buffer, a 1.9 mile buffer encompassing ~45% of nests, and a 4-mile buffer encompassing 74-80% of nests (Holloran & Anderson 2005; Moynahan 2004). Noise from an example natural gas drilling rig at the edge of the 1.9 mile buffer exceeds 10 dBA over ambient (20 dBA) for a radius of approximately 0.9 miles (darker blue), and is audible above ambient for at least 1.65 miles (lighter blue)[19]. An average road at the lower edge of the 1.9 mile buffer will have noise levels (L_{max}) exceeding ambient by 10 dBA for a distance of 0.8 miles and will be audible above ambient for at least 1.7 miles with each passing vehicle[19]. With both sound sources, the lek area is within recommended noise levels, but much of the surrounding area critical for foraging, nesting and brood-rearing is exposed to higher levels of noise. Distances are approximately to scale and calculations assume no temperature inversions, which nearly double sound propagation distances, and no topographical or ground effects[19].



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