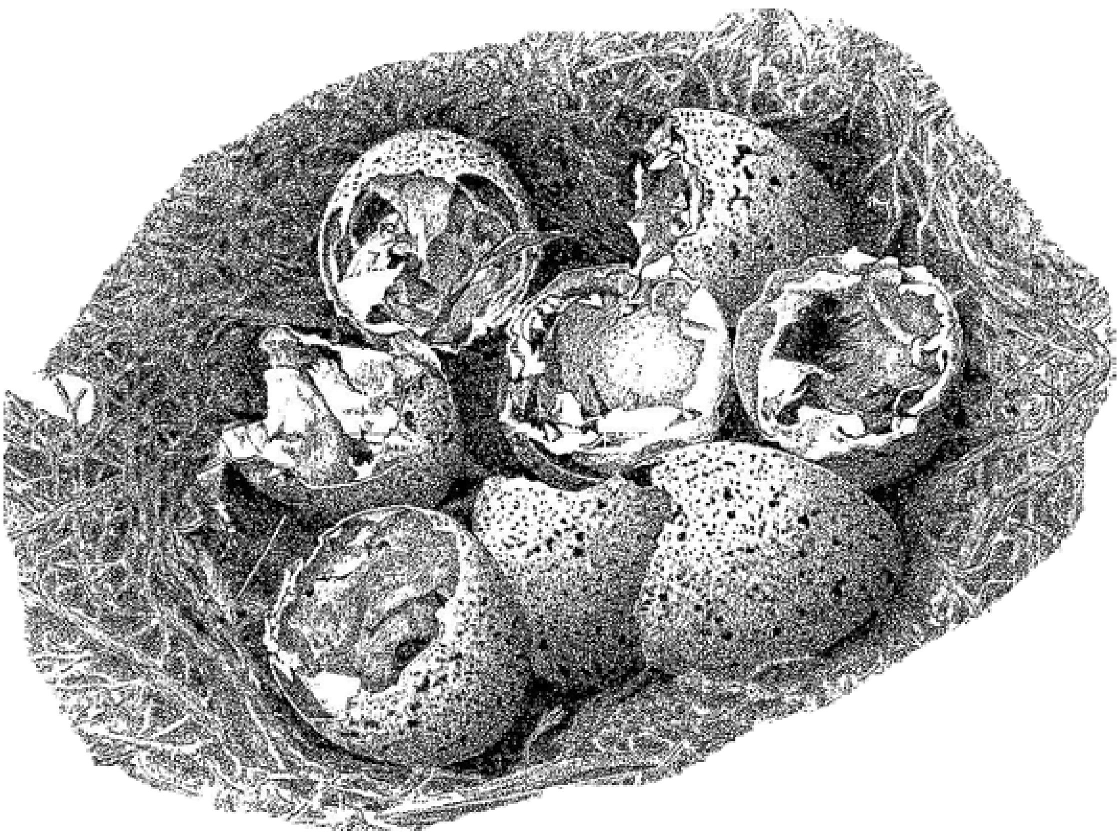
2010
GREATER SAGE-GROUSE JOB COMPLETION REPORT



Edson Fichter

June 1, 2010 – May 31, 2011

Wyoming Game and Fish Department
Cheyenne, WY

Table of Contents

Page

Sage-Grouse Job Completion Report

PERIOD COVERED: 6/1/2010 - 5/31/2011
WORKING GROUP: Statewide Summary **PREPARED BY: Tom Christiansen**

1. LEK ATTENDANCE SUMMARY (OCCUPIED LEKS)

a. Leks Counted

			Percent	Max Totals		Avg./Active Lek	
Year	Known	Counted	Counted	Males	Females	Males	Females
2002	1593	341	21.4	6995	2721	20.5	8.0
2003	1624	419	25.8	8935	3492	21.3	8.3
2004	1690	449	26.6	9537	2319	21.2	5.2
2005	1776	466	26.2	16319	3928	35.0	8.4
2006	1836	477	26.0	21811	5394	45.7	11.3
2007	1908	521	27.3	21277	3677	40.8	7.1
2008	1942	575	29.6	19347	5226	33.6	9.1
2009	1977	607	30.7	15545	5521	25.6	9.1
2010	2022	692	34.2	14094	6436	20.4	9.3
2011	2025	646	31.9	10931	4432	16.9	6.9

b. Leks Surveyed

Year	Known	Surveyed	Percent Surveyed	Max Total	Avg Males/ Active Lek
2002	1593	775	48.7	8792	19.7
2003	1624	846	52.1	9540	19.6
2004	1690	887	52.5	10964	21.0
2005	1776	939	52.9	19423	31.4
2006	1836	1043	56.8	23062	34.3
2007	1908	1080	56.6	22332	32.7
2008	1942	972	50.1	16548	27.3
2009	1977	1004	50.8	15123	25.5
2010	2022	961	47.5	11748	20.4
2011	2025	967	47.8	10097	18.7

c. Leks Checked

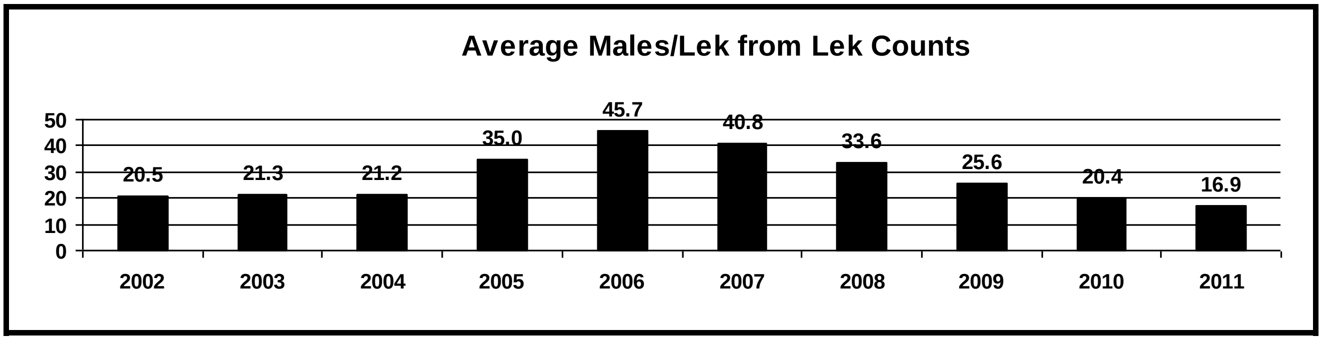
Year	Known	Checked	Percent Checked	Max Total	Avg Males/ Active Lek
2002	1593	1091	68.5	15502	20.1
2003	1624	1224	75.4	18154	20.6
2004	1690	1287	76.2	20262	21.6
2005	1776	1387	78.1	35497	33.0
2006	1836	1507	82.1	44670	39.2
2007	1908	1588	83.2	43501	36.5
2008	1942	1528	78.7	35537	30.6
2009	1977	1604	81.1	30565	25.6
2010	2022	1643	81.3	25626	20.3
2011	2025	1603	79.2	20971	17.7

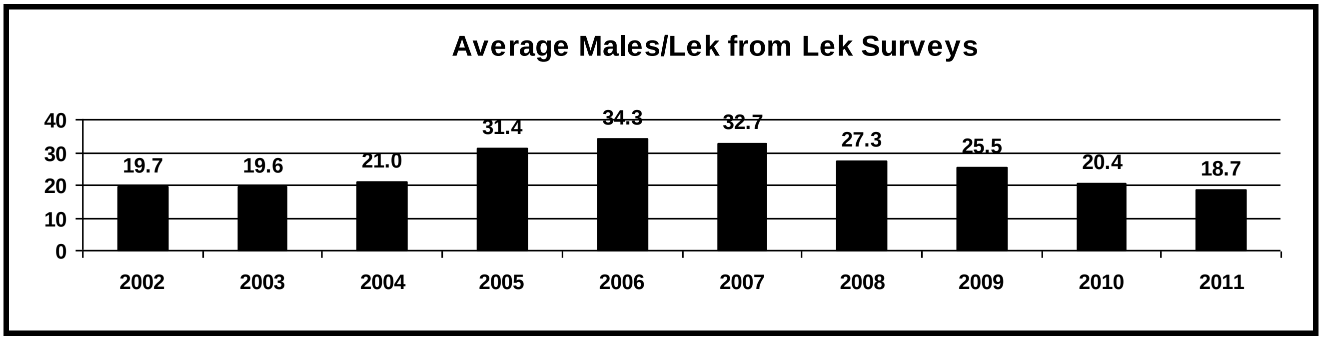
d. Lek Status

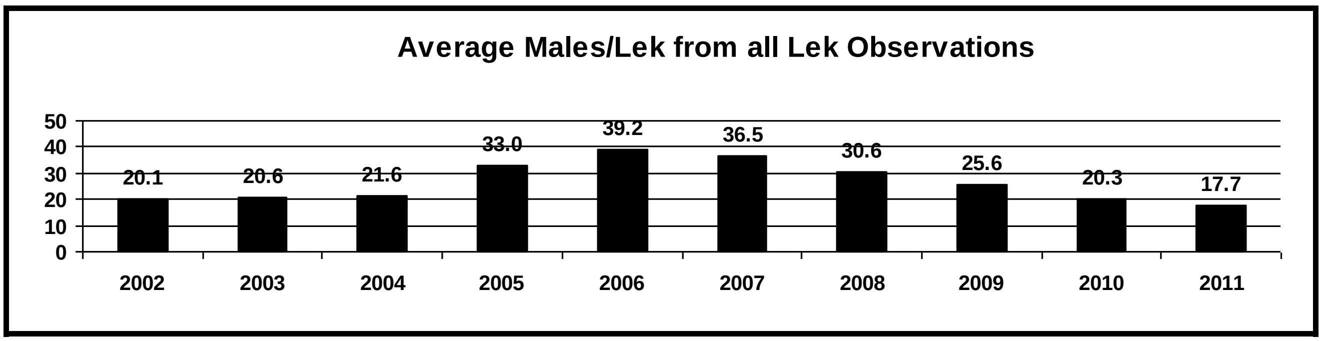
					Confirmed Status		
Year	Active	Inactive	Not Located	Unknown	Total	Active	Inactive
2002	726	116	16	735	842	86.2%	13.8%
2003	807	160	16	641	967	83.5%	16.5%
2004	840	180	7	663	1020	82.4%	17.6%
2005	1001	127	6	642	1128	88.7%	11.3%
2006	1083	149	8	596	1232	87.9%	12.1%
2007	1135	191	6	576	1326	85.6%	14.4%
2008	1102	216	3	621	1318	83.6%	16.4%
2009	1098	252	0	627	1350	81.3%	18.7%
2010	1115	260	3	644	1375	81.1%	18.9%
2011	1049	278	0	698	1327	79.1%	20.9%

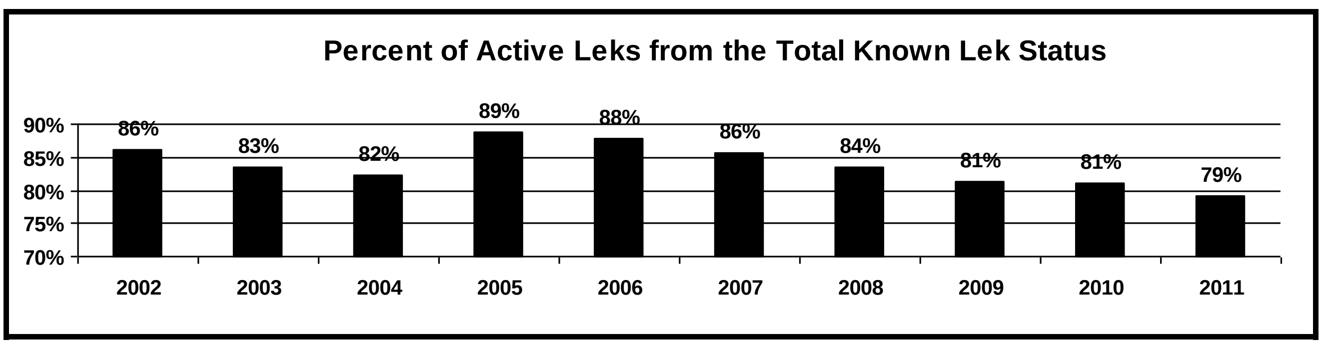
SAGE-GROUSE LEK ATTENDANCE SUMMARY

WORKING GROUP: Statewide Summary **Area(s): All**









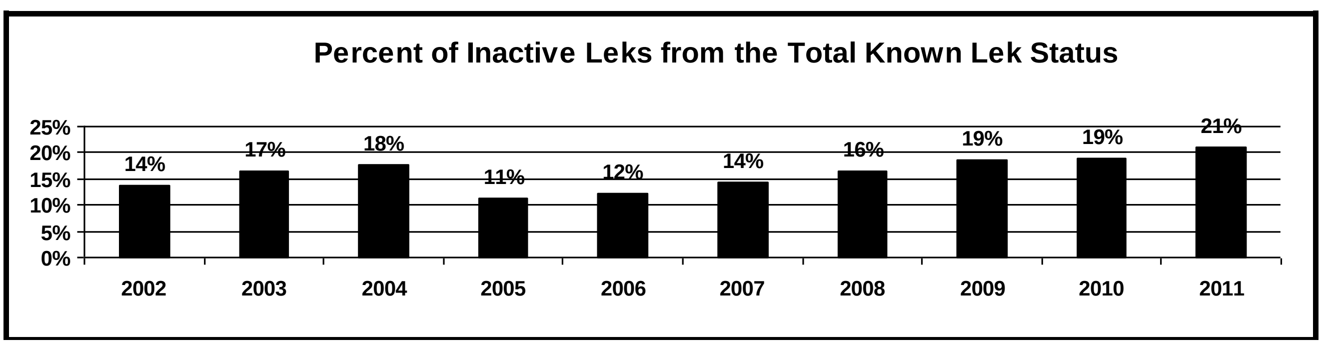


Table3. Summary of unoccupied (historic) leks and lek complexes.

a. Unoccupied Leks

Year	Total Number of Leks: Abandoned	Destroyed	Number of abandoned leks checked
2002	182	31	70
2003	194	31	129
2004	190	34	63
2005	196	32	68
2006	207	32	110
2007	216	35	75
2008	207	39	86
2009	216	39	73
2010	213	41	82
2011	234	42	89

Sage Grouse Lek Characteristics

Region	Number	Percent
Casper	258	11.2%
Cody	283	12.2%
Green River	464	20.1%
Jackson	18	0.8%
Lander	464	20.1%
Laramie	236	10.2%
Pinedale	199	8.6%
Sheridan	391	16.9%

Working Group Area	Number	Percent
Bates Hole	305	13.2%
Big Horn Basin	283	12.2%
Northeast	528	22.8%
South Central	378	16.3%
Southwest	417	18.0%
Upper Green River	149	6.4%
Upper Snake River	18	0.8%
Wind	235	10.2%

Classification	Number	Percent
Occupied	1,854	80.2%
Undetermined	152	6.6%
Unoccupied	307	13.3%

BLM Office	Number	Percent
Buffalo	366	15.8%
Casper	183	7.9%
Cody	101	4.4%
Kemmerer	184	8.0%
Lander	240	10.4%
Newcastle	110	4.8%
Pinedale	165	7.1%
Rawlins	524	22.7%
Rock Springs	255	11.0%
Worland	185	8.0%

Unoccupied Leks	Number
Abandoned	243
Destroyed	43
N/A	3
Unk	1

County	Number	Percent
Albany	78	3.4%
Big Horn	44	1.9%
Big Horn, MT	1	0.0%
Campbell	188	8.1%
Carbon	369	16.0%
Converse	58	2.5%
Crook	22	1.0%
Fremont	227	9.8%
Hot Springs	51	2.2%
Johnson	133	5.8%
Laramie	3	0.1%
Lincoln	133	5.8%
Natrona	137	5.9%
Niobrara	19	0.8%
Park	96	4.2%
Platte	6	0.3%
Powder River, MT	1	0.0%
Sheridan	36	1.6%
Sublette	172	7.4%
Sweetwater	288	12.5%
Teton	17	0.7%
Uinta	70	3.0%
Washakie	98	4.2%
Weston	66	2.9%

Land Status	Number	Percent
BLM	1156	50.0%
BLM/Private	13	0.6%
BOR	7	0.3%
National Park	15	0.6%
Not Determined	4	0.2%
Private	866	37.4%
Reservation	56	2.4%
State	143	6.2%
State/Private	1	0.0%
USF&WS	2	0.1%
USFS	48	2.1%
WGFD	2	0.1%

Table 4. Sage-grouse hunting seasons and harvest data.

a. Season

Year	Season Dates	Length	Bag/Possession Limit
2001	Sept 22-Oct 7	16	2/4
2002	Sept 28-Oct 6	9	2/4
2003	Sep 27-Oct 5	9	2/4
2004	Sept 23-Oct 3	11	2/4
2005	Sept 23-Oct 3	11	2/4
2006	Sept 23-Oct 3	11	2/4
2007	Sept 22-Oct 2	11	2/4
2008 Area 1	Sept 20-Sept 30	11	2/4
2008 Area 4	Sept 20-Sept 26	7	2/4
2009 Area 1	Sept 19-Sept 30	12	2/4
2009 Area 4	Sept 19-Sept 25	7	2/4
2010 Area 1	Sept 18-Sept 30	13	2/4
2010 Area 4	Sept 18-Sept 20	3	2/4

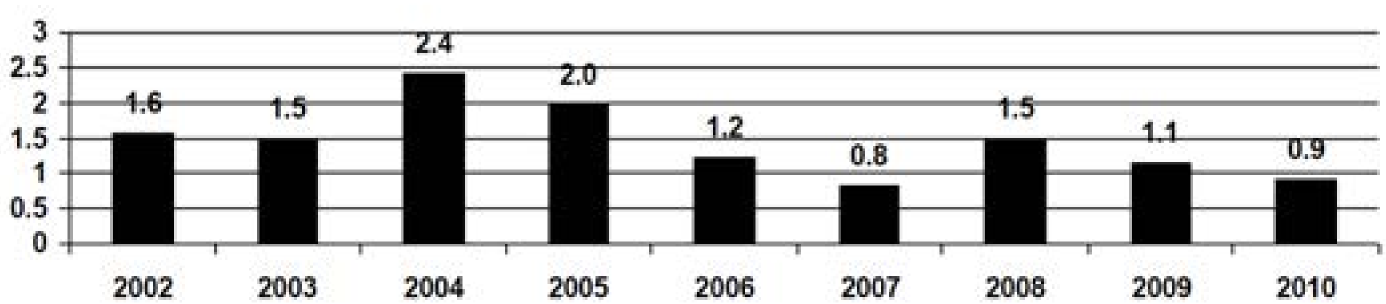
b. Harvest

Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2001	12,586	5,471	14,267	0.9	2.3	2.6
2002	4,557	2,730	6,642	0.7	1.7	2.4
2003	4,835	2,355	5,705	0.8	2.1	2.4
2004	11,783	5,436	13,229	0.9	2.2	2.4
2005	13,178	5,230	12,175	1.1	2.5	2.3
2006	12,920	5,412	11,981	1.1	2.4	2.2
2007	10,378	5,180	10,699	1.0	2.0	2.1
2008	10,302	4,745	10,065	1.0	2.2	2.1
2009	11,162	4,732	10,812	1.0	2.4	2.3
2010	11,057	4,732	11,434	1.0	2.3	2.4
Avg.	10,276	4,602	10,701	0.9	2.2	2.3

Table 5. Composition of harvest by wing analysis.

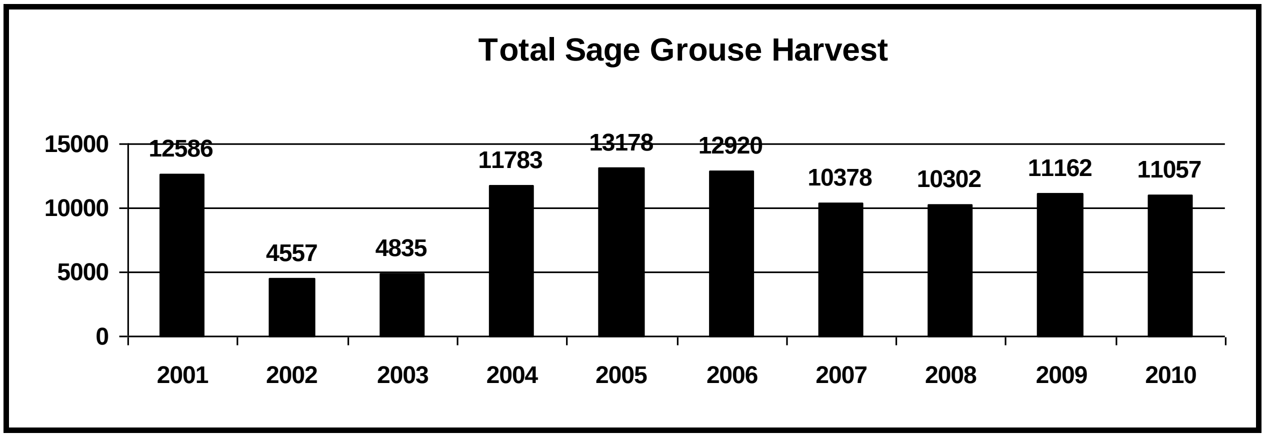
Year	Sample Size	Percent Adult Male	Percent Adult Female	Percent Ylg Male	Percent Ylg Female	Percent Young Male	Percent Young Female	Chicks /Hen
2002	1808	9.9	27.2	2.4	7.1	18.6	34.8	1.6
2003	1606	13.0	27.6	1.7	6.5	21.9	29.2	1.5
2004	2268	9.6	22.0	1.3	4.0	30.6	32.5	2.4
2005	2841	13.0	21.8	3.4	6.4	24.3	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	2155	10.2	40.0	2.5	5.8	11.2	16.6	0.9

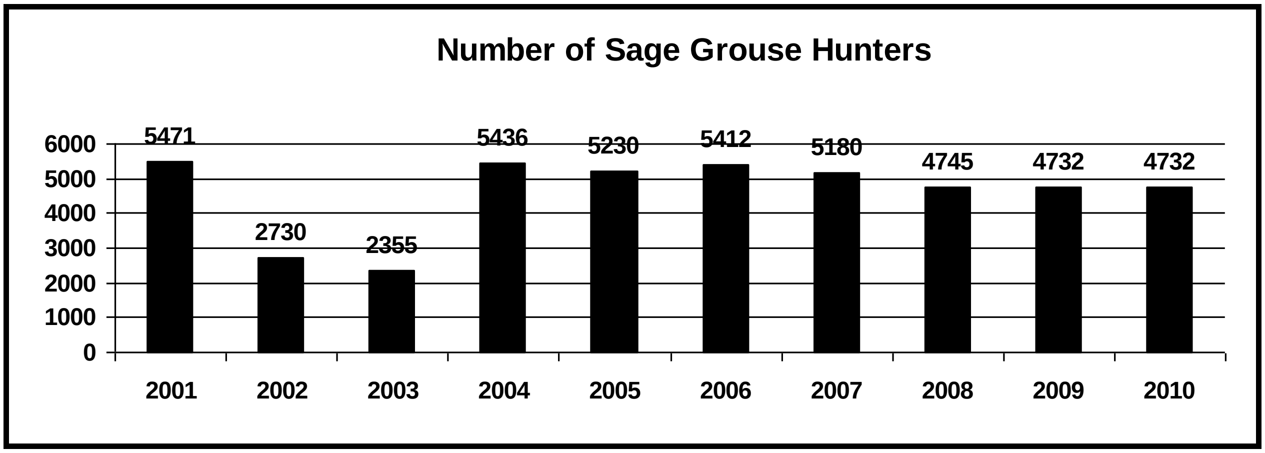
Chicks/hen calculated from wings of harvested sage-grouse.

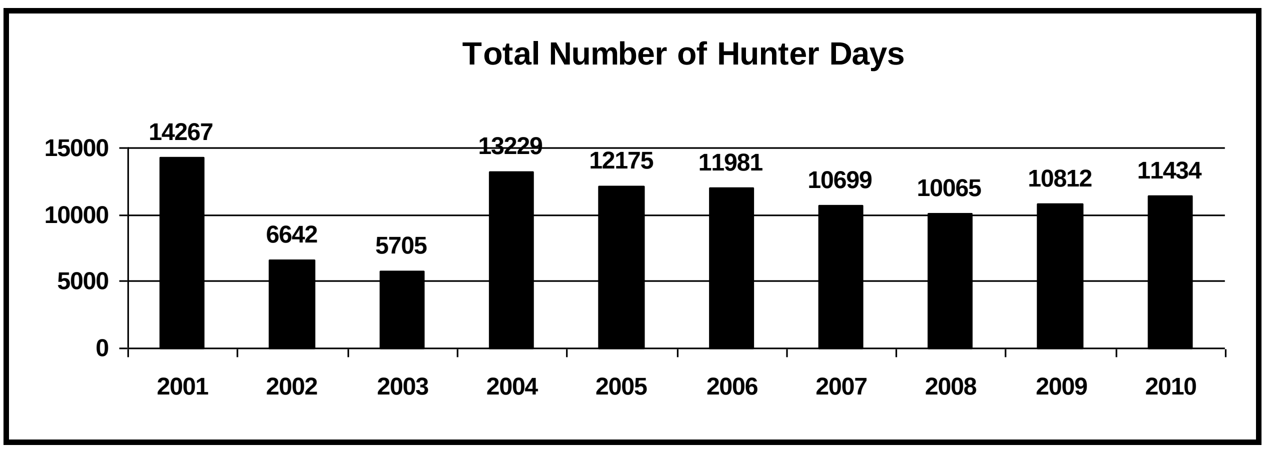


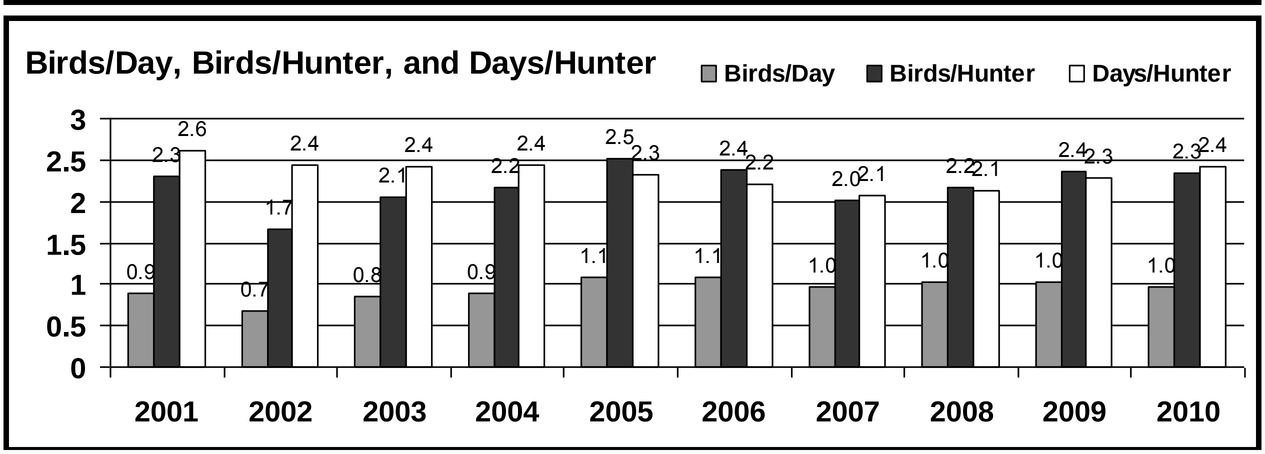
SAGE-GROUSE HARVEST SUMMARY

WORKING GROUP: Statewide Summary **Area(s): All**









Sage-Grouse Job Completion Report

Conservation Plan Area: **Statewide Summary**
Period Covered: **6/1/2010 – 5/31/2011**
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. Grouse numbers then increased during the late 1990's with some individual leks seeing three-fold increases in the number of males counted between 1997 and 1999. This increase was synchronous with increased spring precipitation over the period. The return of drought conditions in the early 2000's appeared to have led to decreases in chick production and survival and therefore population declines, although the population did not decline to mid-1990s levels. Improved habitat conditions due to timely precipitation in 2004 are believed to have led to high chick production and survival. This resulted in 2006's counts and surveys having the highest recorded average males per lek since 1978. A return to dry spring and summer conditions reduced recruitment and the average males per lek declined from 2007 through 2010. Additionally, untimely late snow storms in May and early June of both 2009 and 2010 likely contributed to reduced nesting success and chick survival.

Primary issues of concern for sage-grouse in Wyoming include: energy development impacts, drought, livestock grazing practices, vegetation treatment practices and West Nile virus. Public concerns that are often expressed include effects of predation and hunting.

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 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 on Aug. 1, 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 (Attachment A) on August 18, 2010 to replace that from 2008. Then, newly elected Governor Matt Mead issued an Executive Order (Attachment B) on June 2, 2011 which reiterated and further clarified the intent of the CAS. While this action came two days after this reporting period ended, its importance makes it appropriate for inclusion in this report.

The 2010 Legislature approved the 2011-2012 biennium General Fund budget which again includes funding for the sage-grouse program. Allocation of over $1 million of these funds to local projects began in mid-2010 and will continue through mid-2012.

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.

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 five decades.

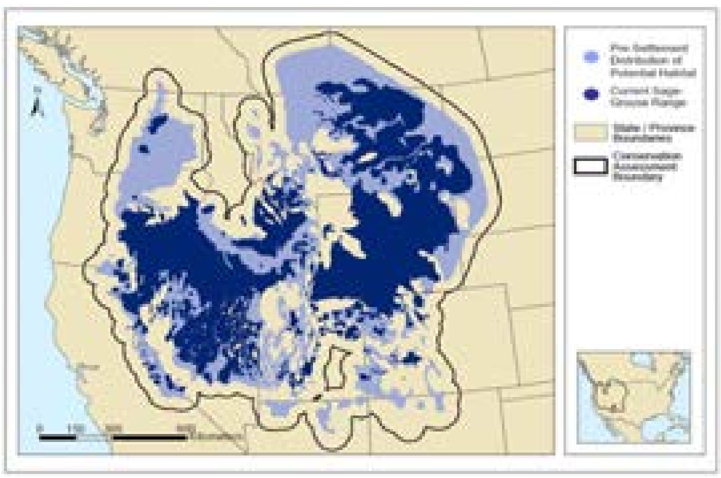


Figure 2. Current distribution of sage-grouse and pre-settlement distribution of potential habitat in North America (Schroeder 2004). For reference, Gunnison sage-grouse in SE Utah and SW Colorado are shown.

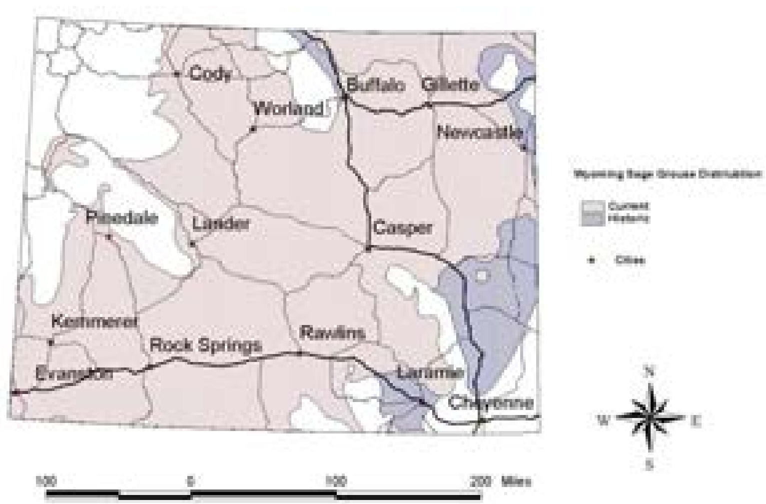


Figure 3. Sage-grouse distribution in Wyoming.

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 Attachments A and B) 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 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 (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 individual leks are missing making comparisons to current information difficult. Concurrent with increased monitoring effort over time, the number of grouse (males) has also increased (Figure 4). The increased number of grouse counted is not necessarily a reflection of a population increase; rather it is resultant of increased monitoring efforts.

More recently, 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 (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 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 illustrate sage-grouse densities based on 2008-2010 peak male lek counts and surveys.

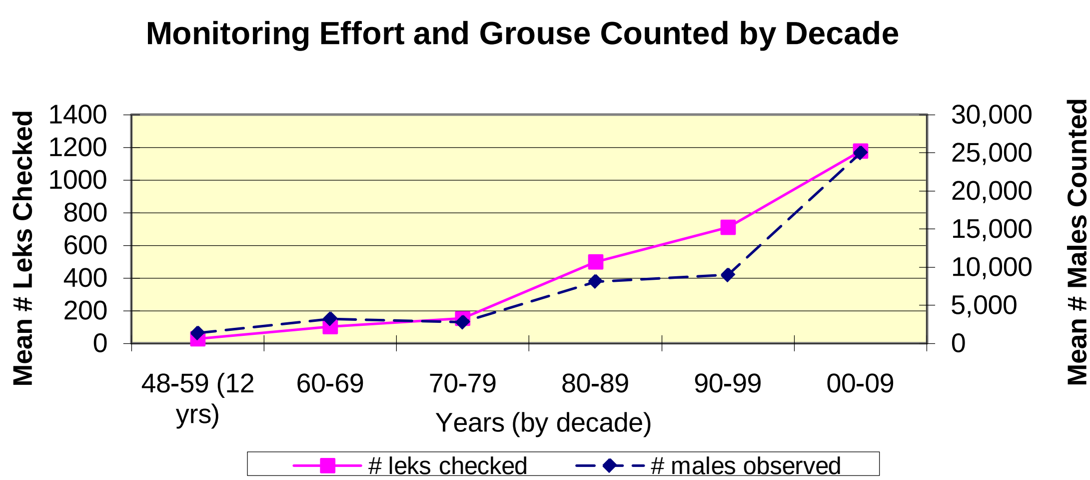


Figure 4. Mean annual numbers of leks checked (monitoring effort) and male grouse counted in Wyoming 1948-2009 by decade.

Lek monitoring data for the 2011 breeding season are summarized in JCR Data Tables 1 a-d. Male attendance at all leks visited (counts and surveys) averaged 17.7 males per lek during spring 2011, a 13% decrease below the 20.2 males/lek observed in 2010 and 55% decline from the 39.2 males/lek observed in 2006. For the 10-year period (2001-2010), average male lek attendance ranged from 17.7 males/lek in 2011, the lowest average males per lek since 1997, to 39.2 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 in Tables 1a-d 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.

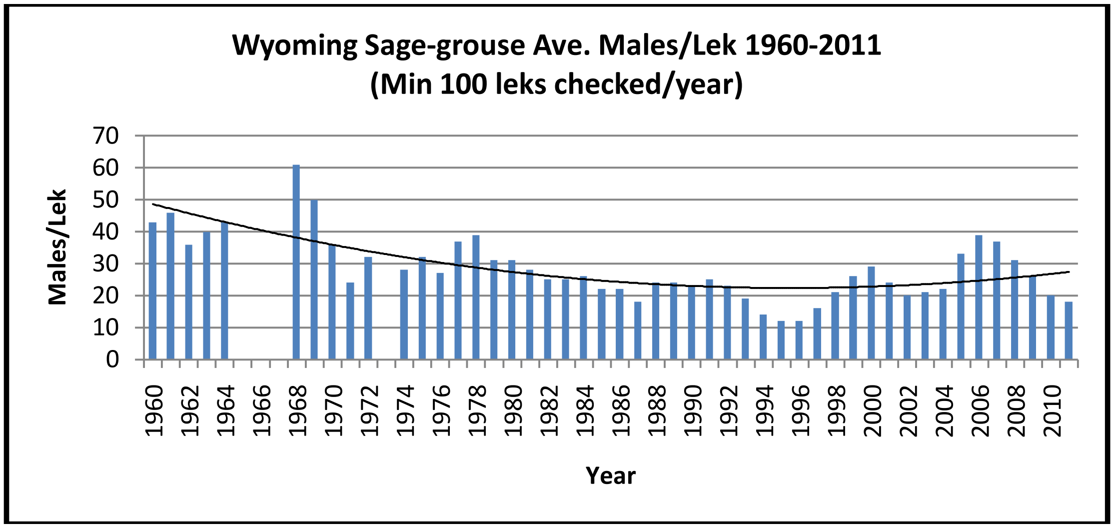


Figure 5. Average number of males per lek counted in Wyoming from 1960-2010 with a minimum of 100 leks checked each year.

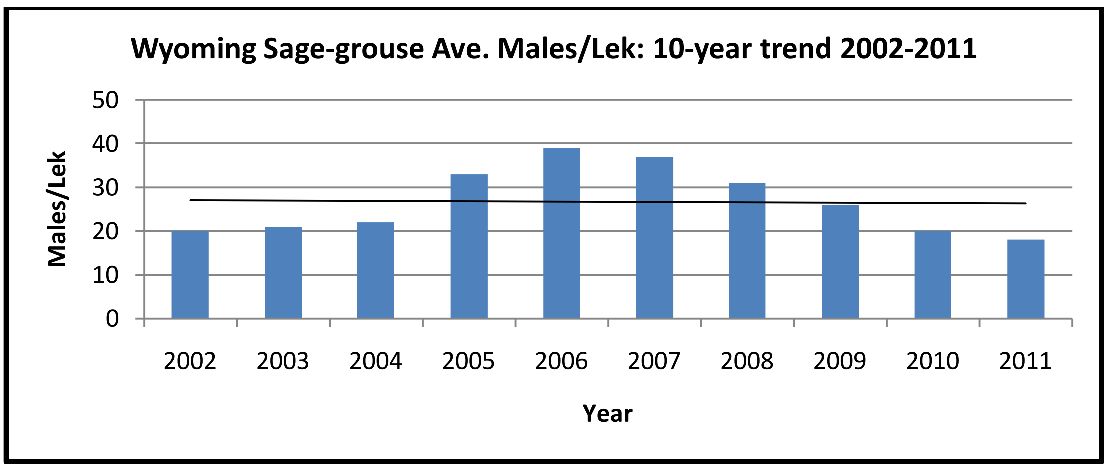


Figure 6. Average number of males per lek observed on leks in Wyoming from 2001-2010 with trend line.

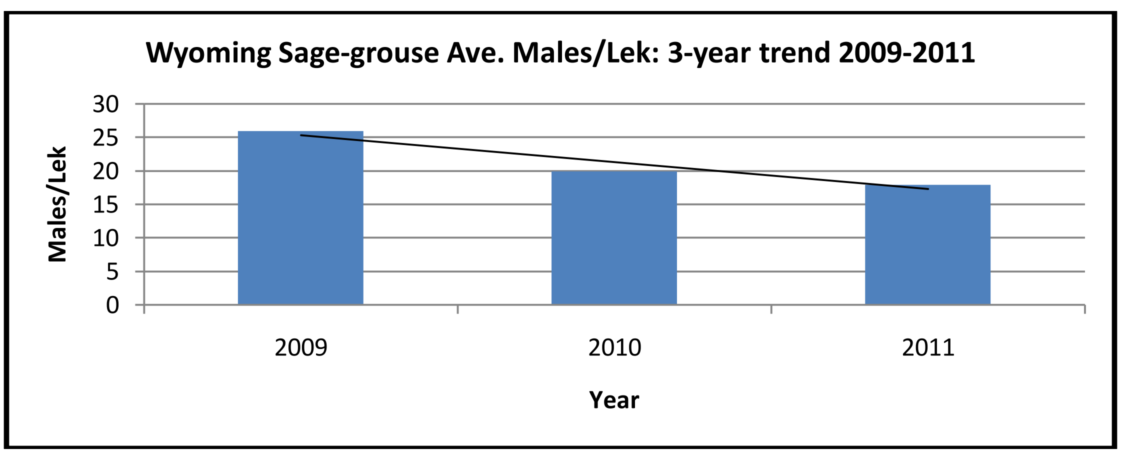
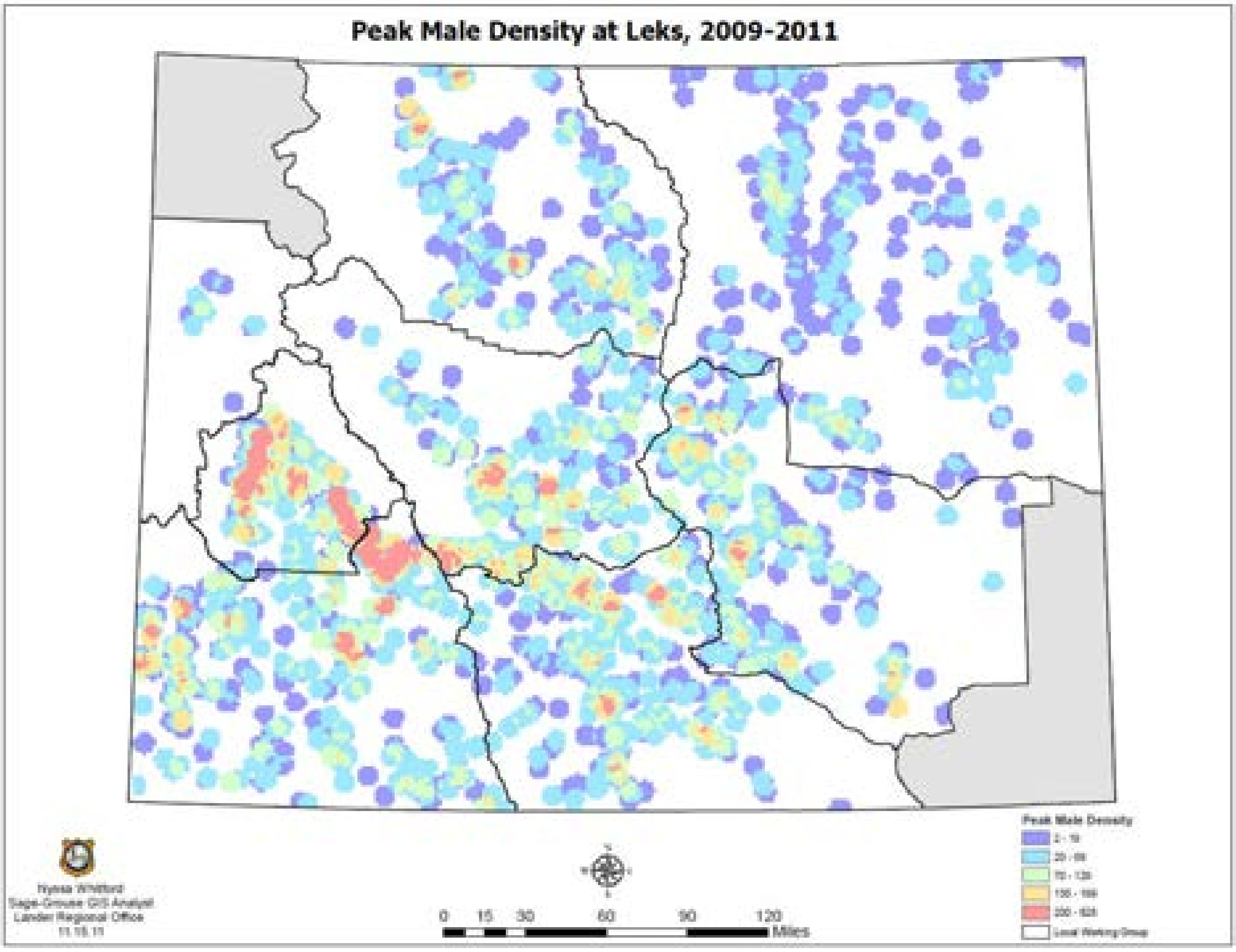


Figure 7. Average number of males per lek observed on leks in Wyoming from 2008-2010 with trend line.



Figures 8. Relative sage-grouse density based on peak male lek counts and surveys 2009-2011.

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 executive summary of that document is appended as Attachment C. 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).

The major change made to the 2010 hunting season was to reduce the season length from six days to three in Area 4 (Figure 9, Table 1).

2010 SAGE GROUSE HUNT AREAS

Area	Season Dates	Daily/Poss. Limits	Falconry
1	Sept. 18-Sept. 30	2/4	Sept. 1-Mar. 1
2, 3	Closed	Closed	Closed
4	Sept. 18-Sept. 20	2/4	Sept. 1-Mar. 1

Figure 9 and Table 1. 2010 sage-grouse hunting season map and regulations.

Hunting seasons in Wyoming are shown in JCR Data Table 4a. 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 9).

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 (JCR Data Table 4a and b). 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. Low reproduction in 2006 and 2007 resulted in a 22% decline in reported harvest between 2005 and 2007. Hunter numbers also declined during this period but by only 10%. Hunter numbers and harvest were stable between 2009 (4,732 hunters/11,162 birds) and 2010 (4,732 hunters/11,057 birds) in spite of what lek counts suggest is a declining population. The 2010 harvest data are near the 10-year averages.

The number of sage-grouse wings collected from hunters decreased by 18% in 2010, which is contrary to the stable harvest figures reported above. In 2010, 2,155 wings were recorded (JCR Table 5), which is about 19% of the estimated harvest. This is very near the 10-year average of 20%. Although not significant in its impact, note that original data sheets from the Southwest Area were lost before data entry. Fortunately, the number of chicks and hens from this area were recorded prior to this loss. Thus the sample size does not include adult and yearling males from the Southwest Area. Past samples suggest the number of these males would have been approximately 100, which would have brought the proportion of estimated harvest represented in the wing collection to 20%.

The 2010 chick:hen ratio (based on harvested wing analysis) was 0.9 chicks per hen (JCR Table 5). This level of productivity is typically associated with a declining population. This is consistent with the 2011 lek data (all lek checks), which indicated a 13% decrease in the average numbers of males on leks (Table 2). 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.

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%

Table 2. Potential influence of chick production, based on wings from harvested birds, on population trend as measured by male lek attendance.

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 (1,800+) 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 on Aug. 1, 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 (Attachment A) on August 18, 2010 to replace that from 2008. Then, newly elected Governor Matt Mead issued an Executive Order (Attachment B) on June 2, 2011 which reiterated and further clarified the intent of the CAS. While this action came two days after this reporting period ended, its importance makes it appropriate for inclusion in this report.

One of the key updates to the CAS was a revision of the sage-grouse core area map incorporating winter and late-brood rearing habitat in addition to the breeding habitat used in the initial versions of the core area maps. New core habitat was added where new large leks had been discovered since the previous version of the map was developed. Local working groups also used high resolution aerial photography (NAIP). For example, forested habitats were removed from the edge of core. Finally, areas of existing or authorized human development shown to be incompatible with sage-grouse were excised from core. The mapping efforts resulted in a sage-grouse density (Figure 10) and a sage-grouse core management area map (Figure 11) upon which the state's core area strategy is based.

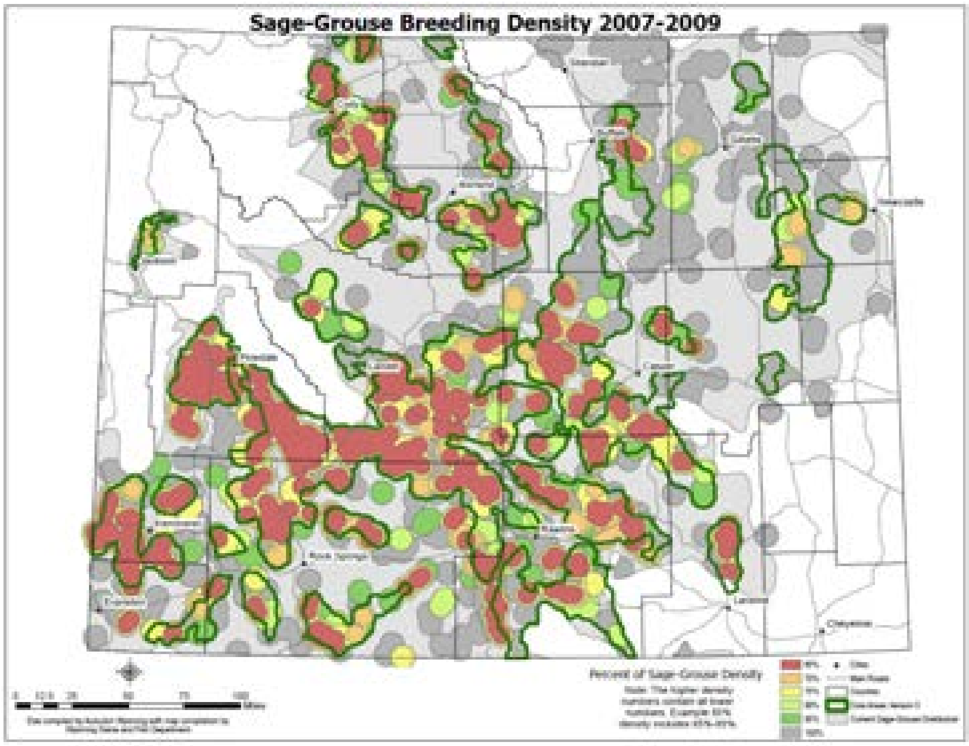


Figure 10. Sage-grouse Implementation Team Core Area map (Version 3) based on 2007-2009 lek counts, and a 5.3-mile nesting habitat buffer, known late brood-rearing and winter concentration areas outside these lek buffers and known management activities such as natural gas developments.

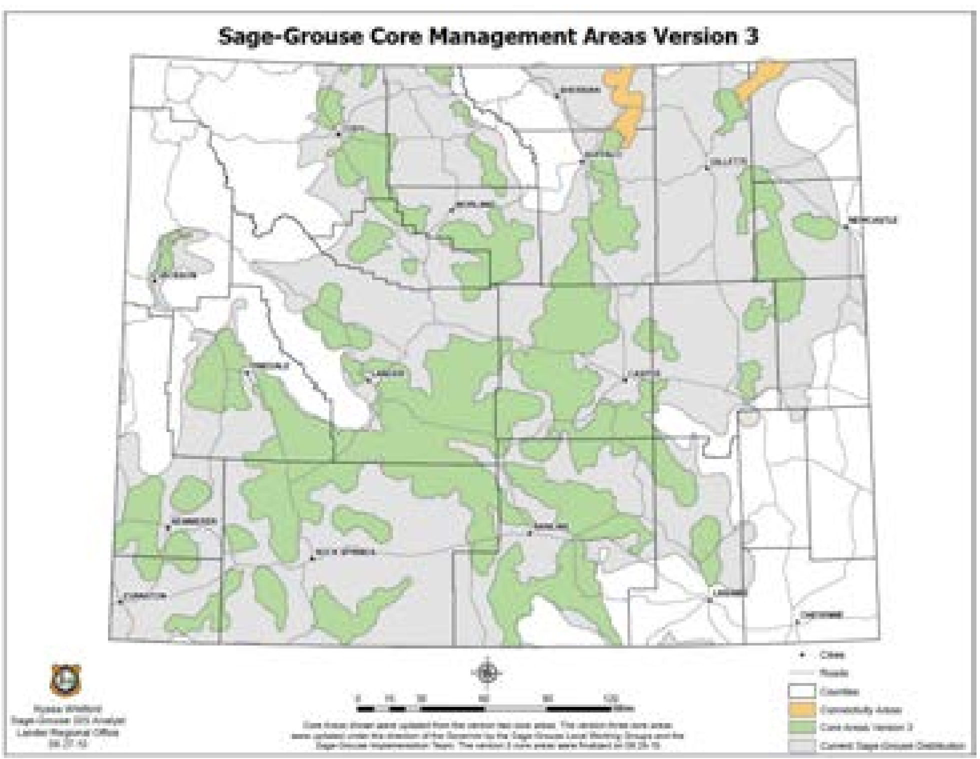


Figure 11. Wyoming sage-grouse core areas Version 3, with connectivity areas (yellow).

Conservation Planning

In 2000, the Wyoming Sage-Grouse Working Group was formed to develop a statewide strategy for conservation of sage-grouse in Wyoming. The working group consisted of 18 Wyoming citizens from diverse backgrounds including agricultural, industrial, governmental, environmental, hunting and tribal interests. This group met for three years resulting in The Wyoming Greater Sage-Grouse Conservation Plan (State Plan) being approved by the Wyoming Game and Fish Commission in June 2003 (WGFD 2003). The State Plan is largely reliant on implementation by local working groups. The state's eight LWGs all submitted final conservation plans between 2006 and 2008. All of the plans went through a public review process prior to being finalized.

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 includes another $1.2 million for local projects. Allocation of these funds began in mid-2010 and the 19 individual projects approved so far are listed in Attachment E.

The State Plan had several goals and Recommended Management Practices (RMPs) that require WGF implementation. Aside from establishing and administering the LWGs, those goals and RMPs that the WGF has direct responsibility over and addressed in 2010-2011 are shown in Attachment F.

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.

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 (Doherty 2007, Naugle et al. 2004, Naugle et al. 2005, Walker et al. 2004, Walker et al. 2007, Zou et al. 2006, Christiansen and Tate 2011, Walker and Naugle 2011).

Monitoring efforts in 2010 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 2010 suggest WNv activity and mortality were not significant in Wyoming as no WNv mortality was documented.

A correction to the 2008-09 Statewide Sage-Grouse Job Completion Report - one case of West Nile virus mortality was documented in Natrona County that was not reported. See the 2008-09 Bates Hole-Shirley Basin JCR for additional details. This correction means a total of two cases of the disease were documented in Wyoming in 2008. Also in 2008-09, a consulting firm experimentally applied and evaluated the use of larvicides to control Culex tarsalis mosquitoes to minimize transmission of WNv in northeast Wyoming (Big Horn Environmental Consultants 2009).

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 seven peer-reviewed manuscripts based on Wyoming research were published (Blickley and Patricelli 2010, Doherty et al. 2010, Doherty et al. 2011, Kiesecker et al. 2011, Naugle et al. 2011a, Naugle et al. 2011b and Slater and Smith 2010).

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. The University of California-Davis is also continuing their research specifically designed to assess the effects of noise generated by natural gas development on sage-grouse. Various industry consultants are conducting similar efforts.

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 2009). The Wyoming Core Area Strategy (Attachment B) is reliant on research efforts.

Grazing Management

A group of range and wildlife scientists and managers has prepared a document titled, *"Greater Sage-Grouse Habitat and Livestock Grazing Management with Emphasis on Nesting and Early Brood-Rearing"* (Cagney et al. 2010). This peer-reviewed document is now being distributed as a University of Wyoming Extension Bulletin.

Habitat Treatment

Some natural resource professionals promote using different types of treatments to reduce sagebrush cover in order to increase resiliency of sagebrush-grassland habitats to wildfire, improve forage for livestock grazing, diversify age-structure of sagebrush, reduce “decadent” stands of big sagebrush, and enhance sage-grouse habitat. These treatments include prescribed fire, mechanical alterations, herbicide applications and intensive, short-duration livestock grazing. 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. Thus the topic is controversial within the profession and is a research and policy focus (WAFWA 2009 and references therein). As part of the current sage-grouse core area strategy revision process, new policy was developed in 2010 to address this issue (Attachment G).

PAST RESEARCH/STUDIES

See Attachment H.

MANAGEMENT RECOMMENDATIONS

1) Implement Governor Freudenthal’s Sage-Grouse Executive Order and Core Area Strategy.

2) Continue to implement actions that meet the goals of the Wyoming Greater Sage-grouse Conservation Plan (2003).

3) Continue to implement local conservation plans in all 8 planning areas. Revisions/updates to these plans are required to make them consistent with the Wyoming Core Area Strategy.

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

5) 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.

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

7) 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: Wyoming Governor's Executive Order 2010-4

DAVE FREUDENTHAL
GOVERNOR

THE STATE OF WYOMING

STATE CAPITOL
CHEYENNE, WY 82002

Office of the Governor

STATE OF WYOMING
EXECUTIVE DEPARTMENT
EXECUTIVE ORDER

2010- 4
(Replaces 2008-2)

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 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 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, I, Dave Freudenthal, Governor of the State of Wyoming, do hereby issue this Executive Order providing as follows:

1. Management by state agencies should, to the greatest extent possible, 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 existing activities in Core Population Areas 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. Provided these activities are within a defined project boundary (such as a recognized oil and gas 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).
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 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 115 kV or larger transmission lines. New

transmission 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). New transmission lines sited outside this corridor 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.

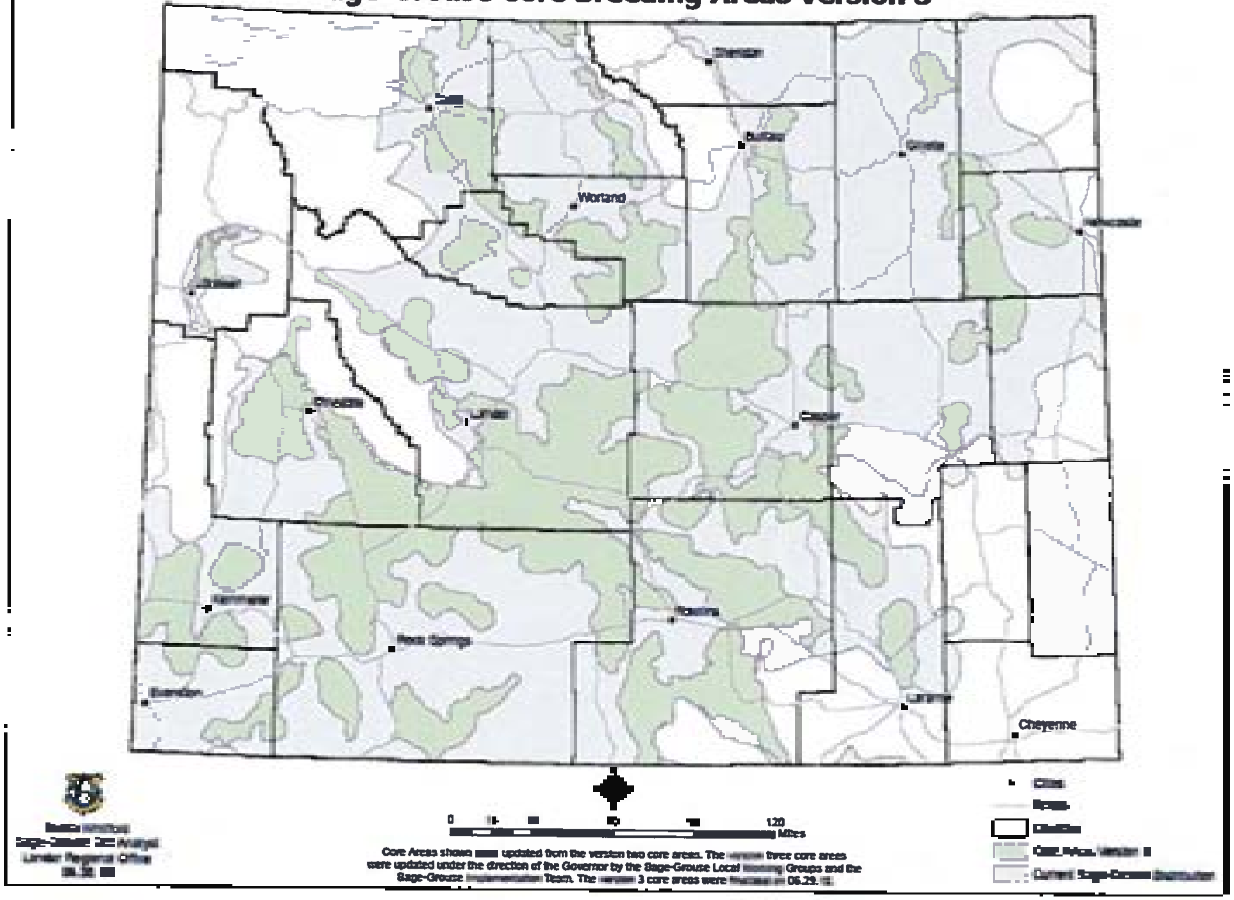
17. State agencies shall report to the Office of the Governor within ninety (90) days detailing their actions to implement this Executive Order.

Given under my hand and the Executive Seal of the State of Wyoming this 18th day of August, 2010.

Dave Freudenthal
Governor

ATTACHMENT A

Sage-Grouse Core Breeding Areas Version 3



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 in any 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 A 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 Project Impact Analysis Area (PIAA) 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. Project impact analysis area (PIAA) delineation:
   Determine all leks that may be affected by the project by placing a four-mile boundary around the project boundary (as defined by the proposed area of disturbance related to the project). All occupied leks located within the four-mile boundary will be considered affected by the project.

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

2. Disturbance analysis: Total disturbance acres within the PIAA will be determined through an evaluation (Appendix A) 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 habitat assessment will be conducted to create a baseline survey identifying:
    a. Suitable and unsuitable habitat within the PIAA
    b. Sage-grouse use of suitable habitat (seasonal, densities, etc)
    c. Priority restoration areas (which could reduce 5% cap)
        i. Areas where plug and abandon activities will eliminate disturbance
        ii. Areas where old reclamation has not produced suitable habitat
    d. Areas of invasive species
    e. 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 PIAA times 100 equals the percent of disturbed suitable habitat within the PIAA. 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 PIAA.

Permitting: The complete analysis package developed by consultation and review outlined herein will be forwarded to the appropriate permitting agency. Wyoming Game and Fish Department recommendations will be included, as will other recommendations from project proponents and other appropriate agencies.

Excepted Activities: A list of "deminimus" activities, including standard uses of the landscape, is being developed and will be completed by 01 July 2010 as further guidance for these recommendations.

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 de minimus actions defined herein 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 PIAA 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 A 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-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.

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**: Limit new noise levels to 10 dBA above ambient noise (existing activity included) measured at the perimeter of a lek from 6 PM to 8 AM during initiation of breeding (March 1 to May 15). Actual thresholds may be adjusted upon completion of current research being conducted in core habitat.

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 4.0 miles of an occupied lek. Initial disturbance in unsuitable habitat between March 15 and June 30 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. 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 if all such treated areas make up less than 20% of the suitable sagebrush habitat within the PIAA, 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**: For all activities allowed in Core Areas, sage-grouse monitoring will be conducted to evaluate the response of the affected populations (PIAA identified leks) to the permitted activity. Monitoring plans will be coordinated and modified by the permitting agency with input from WGFD. Monitoring will include the evaluation of affected leks and at least three reference leks (one control area) outside the PIAA. 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.

11. **Existing Activities**: Areas already disturbed or approved for development within Core Areas prior to Executive Order 2008-02 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 PIAA. 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 PIAA.

    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 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 more than 5% (up to 32 acres) per 640 acres of suitable sage-grouse habitat within connectivity corridors.

b. For protection of connectivity corridors, a controlled surface use (CSU) buffer of 0.6 miles around leks or their documented perimeters is required. In addition, a March 15 – 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 Development:** Wind development is not recommended in sage-grouse core areas.

Appendix 1
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. The references provided below will assist where more detailed site evaluations are required.

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 PIAA, Larger riparian/wet meadow, and grass/forb producing areas may be considered suitable habitat as determined on a case by case basis; or
3) is a burned or treated sagebrush site being managed to return to its ecological site potential via succession that will allow it to meet a minimum 5% sagebrush canopy cover within 10 to 15 years.

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

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. Suitable habitat rendered unusable due to numerous anthropogenic disturbances less than 1.2 miles apart that preclude use by sage-grouse.

ATTACHMENT C

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. 2010-4

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 capable of storing less than 20 acre-feet and drilling of agricultural and residential water wells (including installation of tanks, water windmills and solar water pumps) 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 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 15 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 0.60 miles from leks and maintenance on existing fence. For new fencing within 0.60 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).

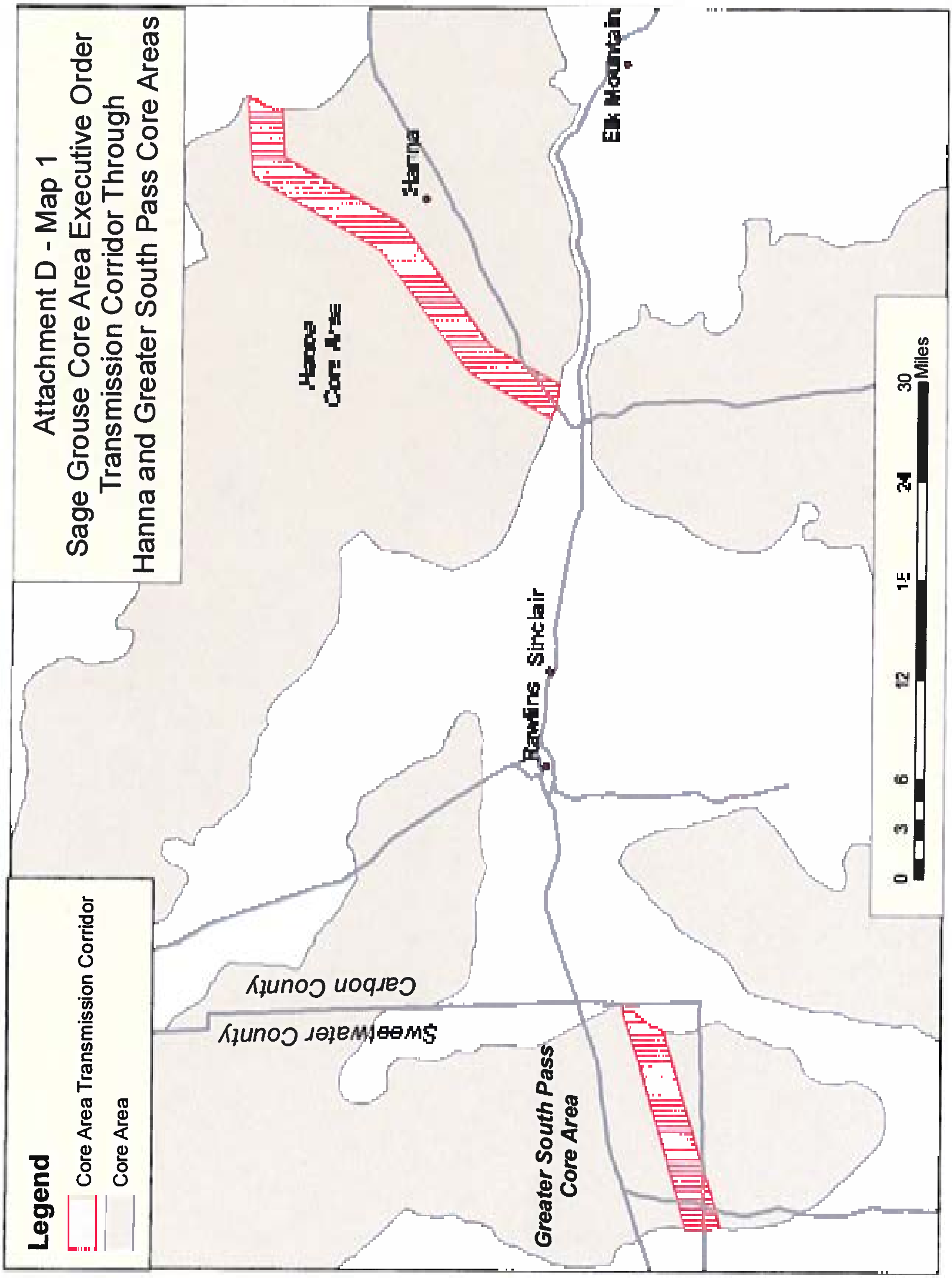
9. Spring development if the spring is protected with fencing and enough water remains at the site to provide mesic (wet) vegetation.

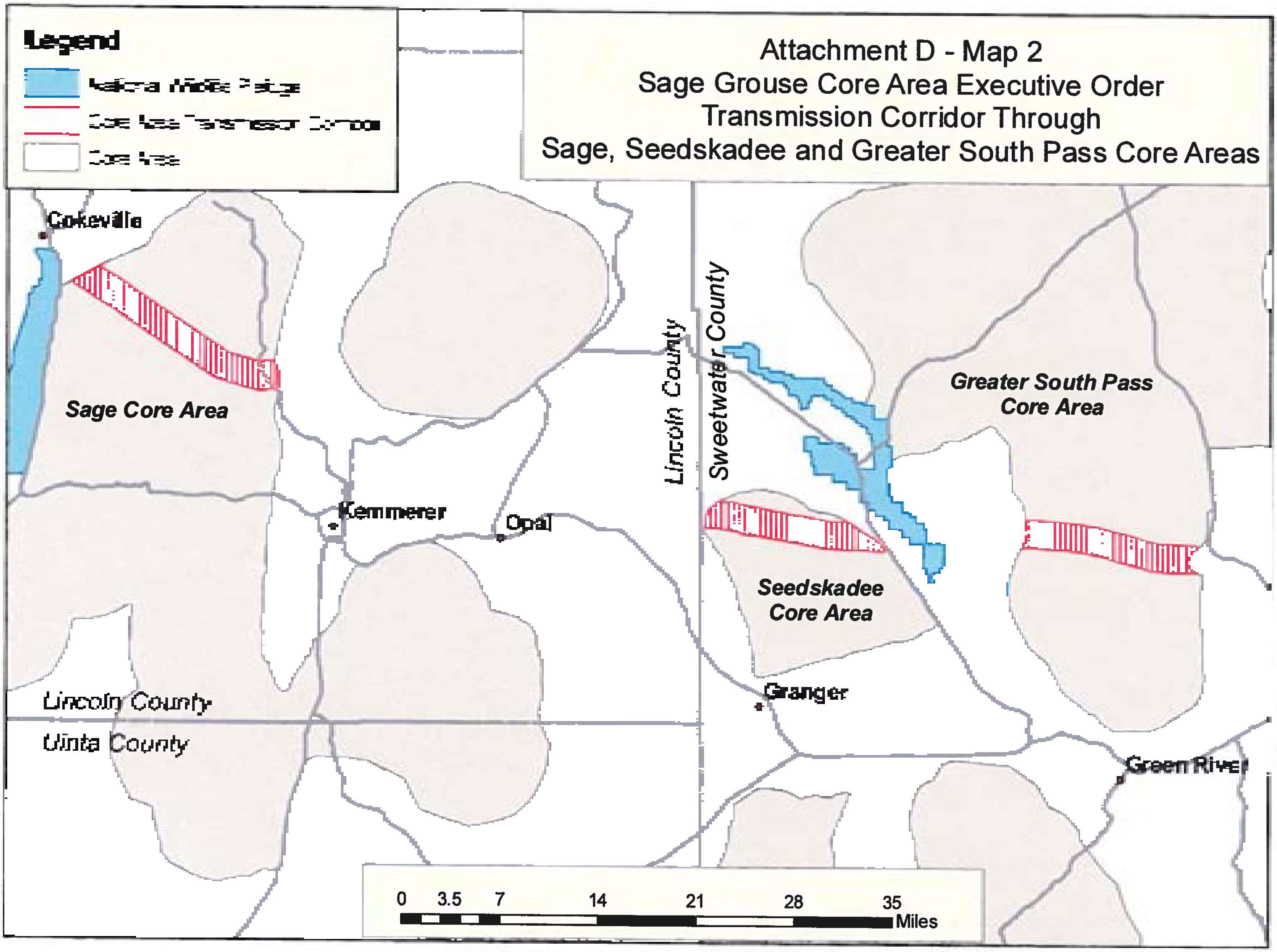
10. Herbicide use within existing road, pipeline and power line rights-of-way. Herbicides application using spot treatment. Grasshopper/Mormon cricket control following Reduced Agent-Area Treatments (RAATS) protocol.

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
Elk Mountain
Rawlins
Sinclair
Carbon County
Sweetwater County
Greater South Pass
Core Area
0
3
6
12
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
Cokeville
Sage Core Area
Kemmerer
Opal
Lincoln County
Uinta County
Lincoln County
Sweetwater County
Greater South Pass
Core Area
Seedskadee
Core Area
Granger
Green River
0
3.5
7
14
21
28
35
Miles

Attachment B: Wyoming Governor's Executive Order 2011-5.

MATTHEW H. MEAD
GOVERNOR

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

PHONE: (307) 777-7434

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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.

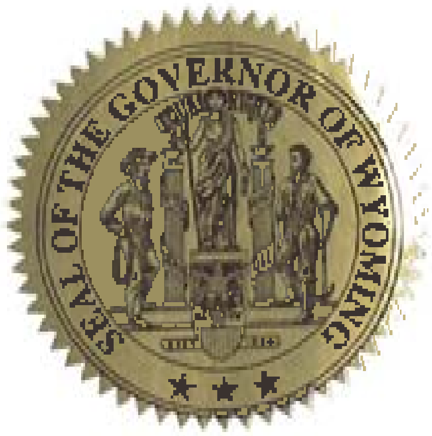
18 State agencies shall strive to maintain consistency with the items outlined in this Executive Order, but it should be recognized that adjustments to the stipulations may be necessary based upon local conditions and limitations. The goal is to minimize future disturbance by co-locating proposed disturbances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

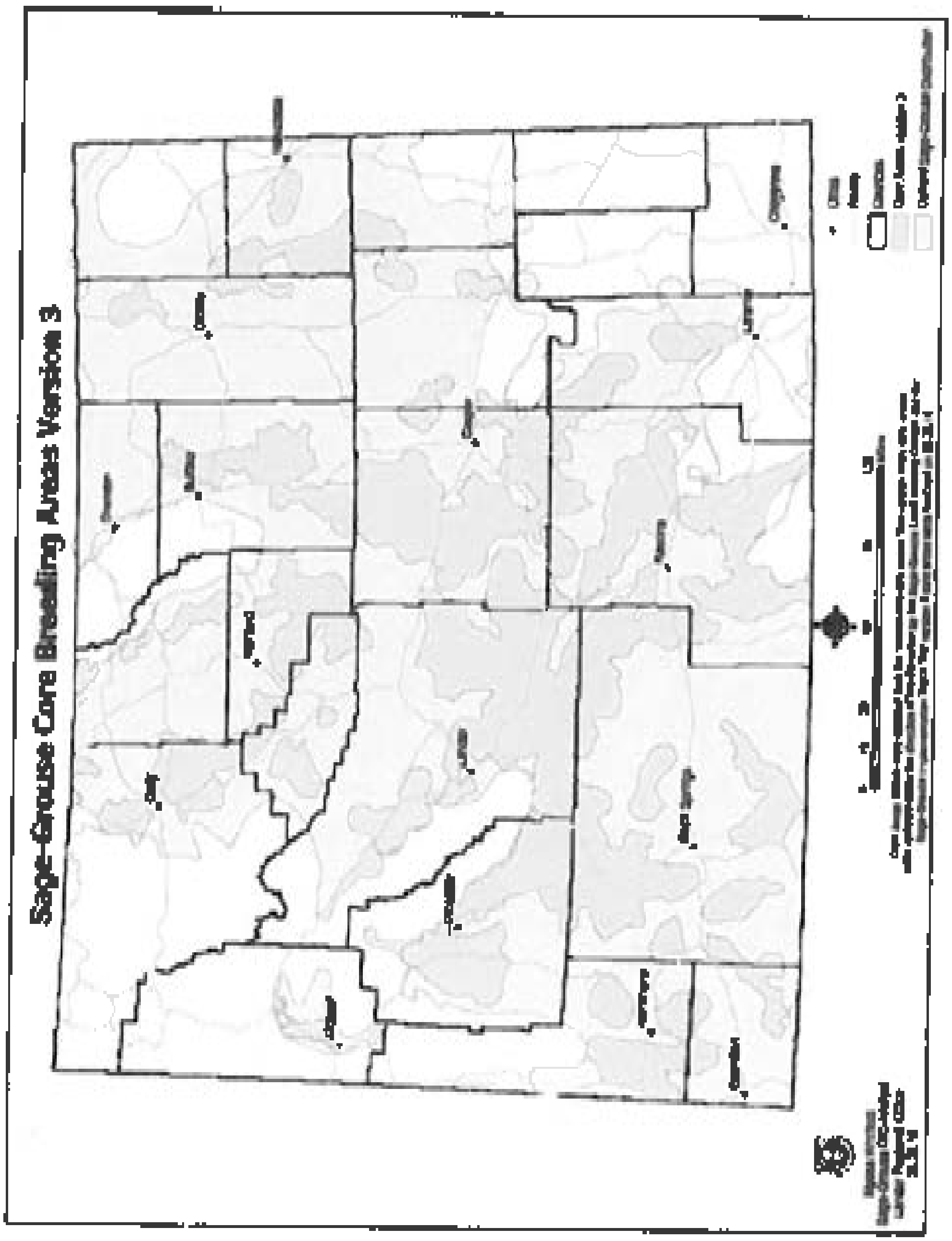
This Executive Order shall remain in effect until August 18, 2015, at which time all provisions of this Executive Order shall be reevaluated.

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.

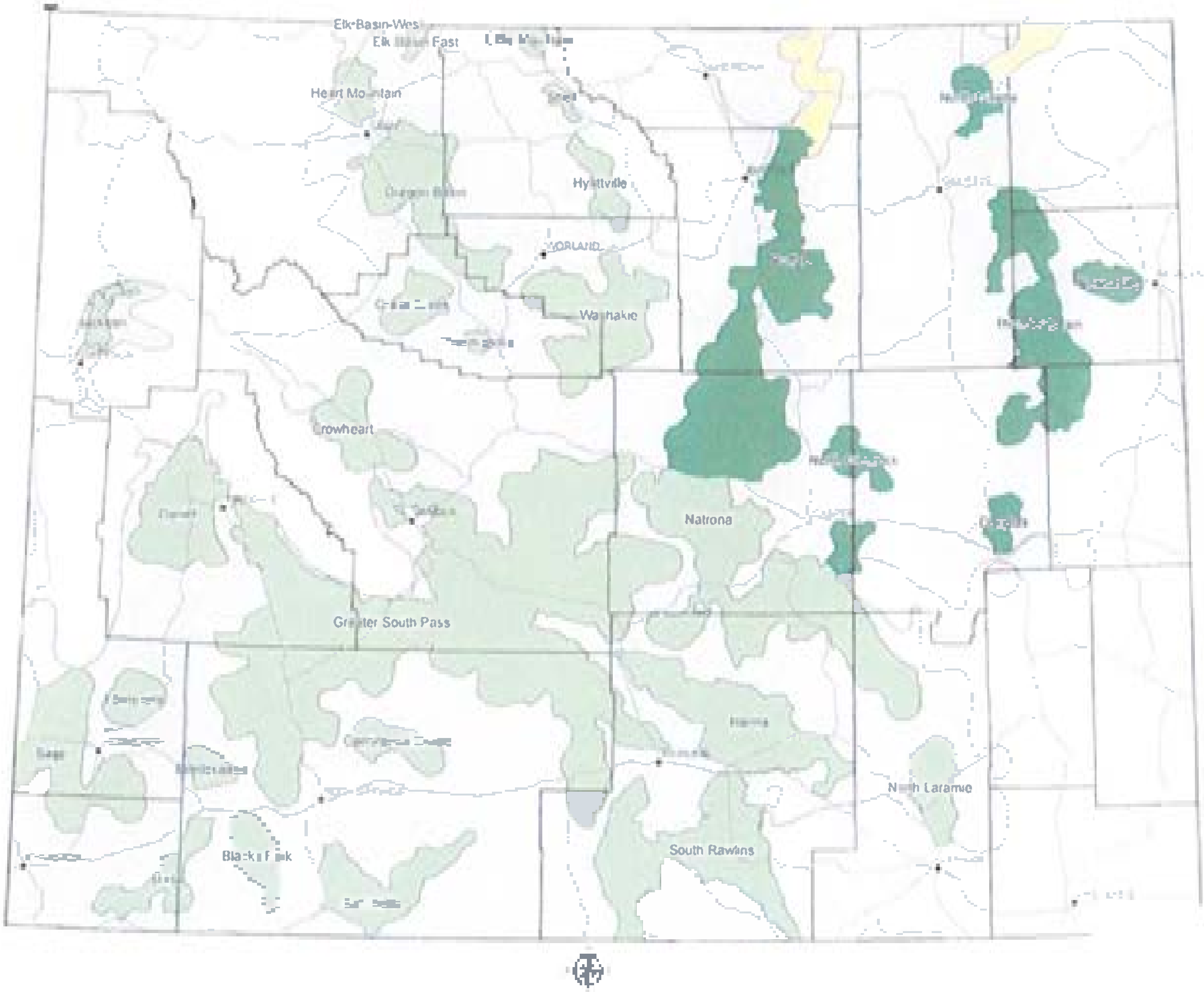
8. **Sagebrush Treatment:** Sagebrush eradication is considered disturbance and will contribute to the 5% disturbance factor. Northeast Wyoming, as depicted in Figure 1, is of particular concern because sagebrush habitats rarely exceed 15% canopy cover and large acreages have already been converted from 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 15 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).

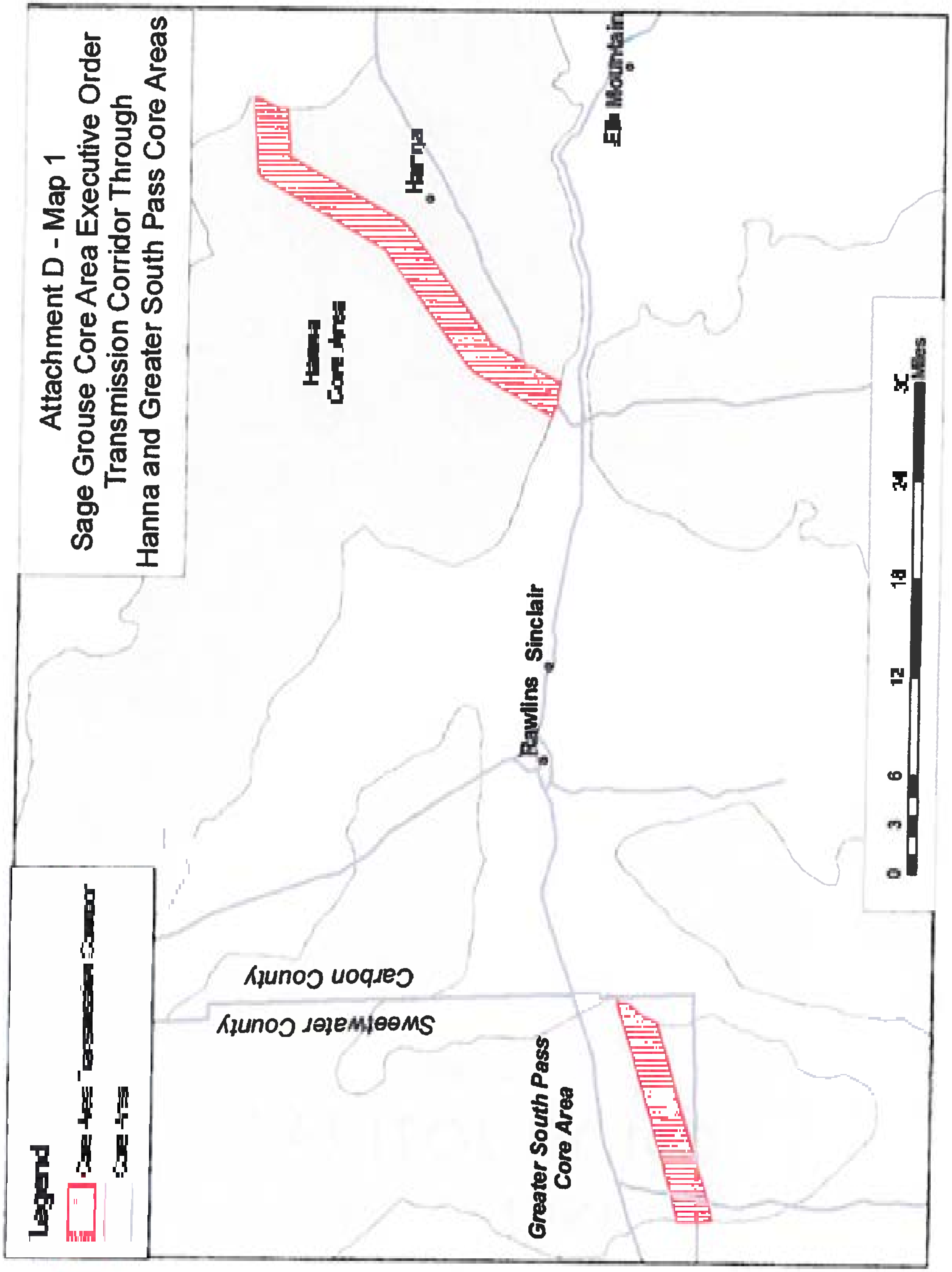
9. Spring development if the spring is protected with fencing and enough water remains at the site to provide mesic (wet) vegetation.

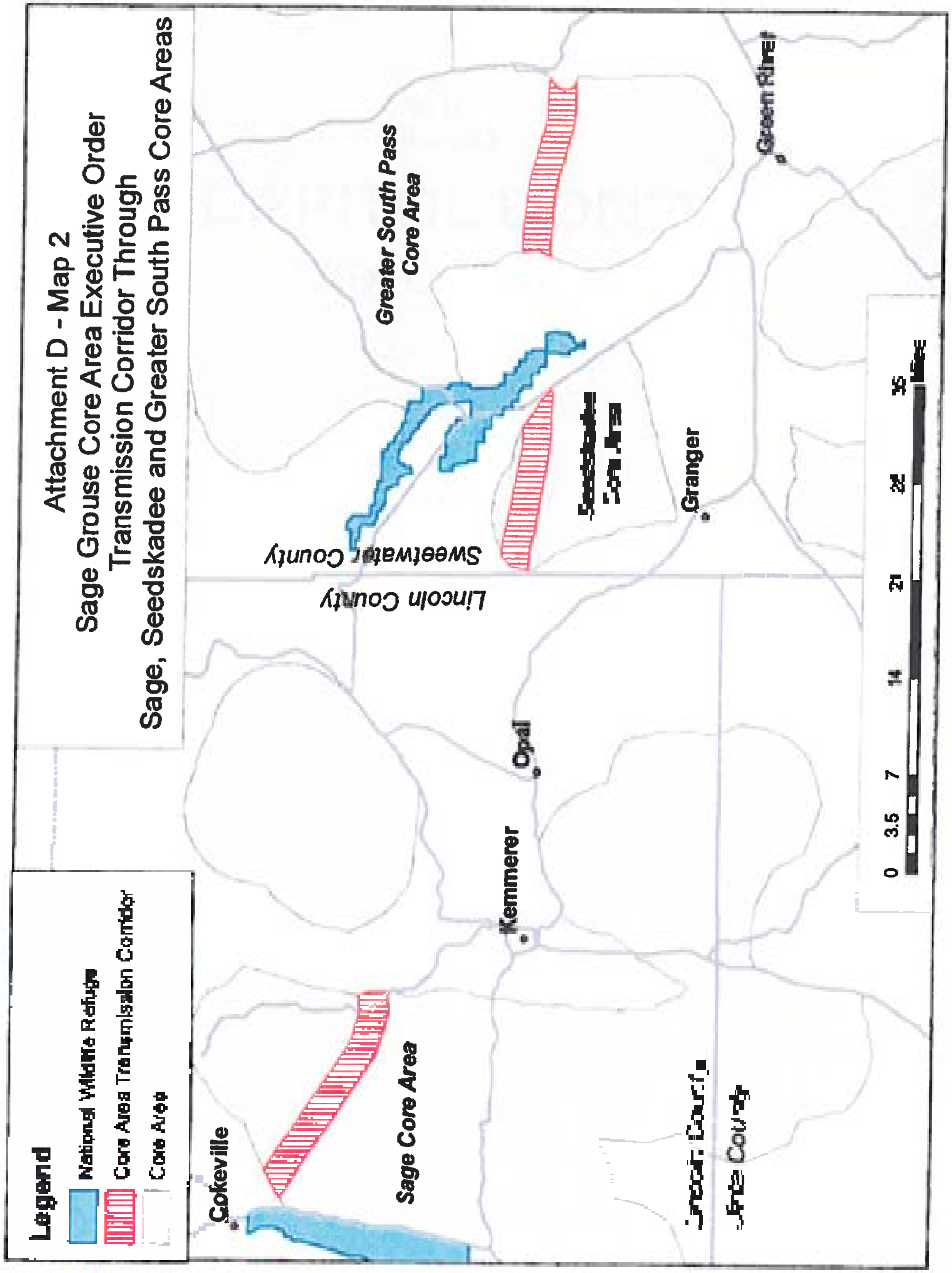
10. Herbicide use within existing road, pipeline and power line rights-of-way. Herbicides application using spot treatment. Grasshopper/Mormon cricket control following Reduced Agent-Area Treatments (RAATS) protocol.

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
Hanna
Elk Mountain
Rawlins
Sinclair
Carbon County
Sweetwater County
Greater South Pass
Core Area
0 3 6 12 18 24
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
Cokeville
Sage Core Area
Kemmerer
Opal
Lincoln County
Sweetwater County
Granger
Greater South Pass
Core Area
Green River
0 3.5 7 14 21 28 35

Attachment C:

Executive Summary

Hunting and Sage-Grouse:

A Technical Review of Harvest Management on a Species of Concern in Wyoming

Revised - September 2010

Tom Christiansen, Sage-Grouse Program Coordinator, Wyoming Game and Fish Dept.

(note: complete 19 page document is posted on the WGF web page)
http://gf.state.wy.us/wildlife/wildlife_management/sagegrouse/index.asp

On March 5, 2010 the U.S. Fish and Wildlife Service (USFWS) announced its determination that a range-wide listing of the greater sage-grouse (*Centrocercus urophasianus*) as threatened or endangered under the Endangered Species Act of 1973 was warranted, but precluded by higher priority listing actions. Therefore, sage-grouse are a "candidate" species under the Endangered Species Act, but remain a state-managed species. In light of this decision, concerns have been expressed about the potential impacts that hunting greater sage-grouse may have on their long-term conservation and annual status reviews conducted by the USFWS.

Harvest of greater sage-grouse currently occurs in 9 of the 11 states in which they reside. Wyoming boasts the largest and most widespread populations of grouse of any of the states. Sage-grouse hunting has generally become more conservative in Wyoming and across the West in recent decades in response to declining sage-grouse populations over the last half-century. Over the last 15 years however, the average number of males at leks has increased in Wyoming indicating an increasing statewide population. Local 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.

No studies have demonstrated hunting as the primary cause of reduced numbers of greater sage-grouse. However, sage-grouse are a relatively long-lived species whose existence is more dependent on survival rates than reproductive output. This strategy is different than many upland and small game species where long life and survival are sacrificed for high reproductive output. Sage-grouse demonstrate high over-winter survival, which limits the applicability of the concept of compensatory mortality with regard to hunter harvest. Therefore, the biology of sage-grouse suggests more conservative harvest management practices should be implemented compared to harvest strategies for species such as pheasants or partridges.

Changes made to hunting seasons in 1995 substantially reduced hunter participation and sage-grouse harvest rates in Wyoming. The fact that Wyoming, as a normal part of routine wildlife management, changed its hunting season strategy with the intent of better protecting hens with broods is not well understood by many in Wyoming. This action occurred prior to the species being petitioned for listing under the Endangered Species Act. The fact that the changes were made pro-actively prior to the widespread concern for sage-grouse has led to a perception that WGFD has not responded to the concerns by closing hunting seasons or otherwise minimizing harvest effects. In addition to the changes made in 1995, more recent examples of increasingly restrictive hunting seasons include: 1) hunting season closures established in 2000 for northwest and southeast Wyoming, 2) shortened seasons with reduced bag limits in 2002, 3) emergency closure of three counties in 2003 due to a West Nile virus outbreak, 4) expansion of the southeast Wyoming closure in 2007 and 2008 into northeast Wyoming, and 5) increasingly conservative seasons for areas in northeast Wyoming still open for hunting. These actions were recommended by local WGF managers in response to local conditions and data.

In their March 2010 listing decision, the USFWS concluded that the key threats to the continued survival of sage-grouse are 1) habitat loss, fragmentation, and modification and 2) inadequacy of existing regulatory mechanisms, particularly in relation to energy and other development. The USFWS also evaluated the "utilization" (e.g. hunting) of sage-grouse and concluded that “the greater sage-grouse is not threatened by overutilization for commercial, recreational, scientific, or educational purposes now or in the foreseeable future".

This is similar to its January 2005 finding whereby the USFWS determined that hunting, as currently regulated by state wildlife agencies, was not a significant threat to the conservation of sage-grouse. The expert panel used by the USFWS to make this determination ranked hunting 17th out of 19 potential threats considered.

Regulated hunting is the cornerstone of the North American Model of Wildlife Conservation, a system that keeps wildlife a public and sustainable resource, scientifically managed by professionals. Many greater sage-grouse populations can, and do, support hunting under this model.

Harvest of greater sage-grouse provides population data not easily obtained except through costly radio-telemetry studies of specific populations. Wings from hunter-harvested birds are used to determine the ratio of hens to chicks, which provides an index to annual chick production. In conjunction with population trend counts, these data contribute to understanding the dynamics of sage-grouse populations.

Hunting creates a constituency of sage-grouse advocates who are interested in seeing the needs of grouse populations are met and license fees provide revenue for management. Wyomingites are generally supportive of a multiple-use management philosophy on public lands. Regulated hunting, as recommended by state and local conservation plans, is a sustainable multiple-use activity similar to well-managed grazing and energy development. Eliminating hunting would also eliminate an ally, the hunter-conservationist, in the on-going efforts to prevent the need for listing sage-grouse under the Endangered Species Act.

Sage-grouse hunting regulations take into account biology, formal public involvement via state and local planning efforts, and informal public perceptions. Consequences of varying greatly from established guidelines and conservation plans could undermine local sage-grouse conservation efforts in Wyoming. Closing hunting seasons where biological data do not justify such a management decision would create a public perception that sage-grouse populations in Wyoming may indeed require protection under the Endangered Species Act. Conversely, not recognizing real, but biologically unfounded, concerns about hunting impacts could threaten voluntary industry-led conservation initiatives and/or generate resistance to comply with state and federal land use stipulations/regulations. Efforts to inform all stakeholders of the issues associated with sage-grouse hunting should be increased in addition to continuing generally conservative sage-grouse hunting seasons.

Attachment D:

Western Agencies Sage and Columbian Sharp-tailed Grouse Technical Committee

Alberta British Columbia California Colorado Idaho
Montana Nevada North Dakota Oregon
Saskatchewan South Dakota Utah
Washington Wyoming

Recommendation 1 – Hunting Greater Sage-grouse

Background

Regulated hunting is the cornerstone of the North American Model of Wildlife Conservation, a system that keeps wildlife a public and sustainable resource, scientifically managed by professionals. Many greater sage-grouse (*Centrocercus urophasianus*) populations can, and do, support hunting under this model. On March 5, 2010, the U.S. Fish and Wildlife Service (USFWS) announced its determination that listing the greater sage-grouse range-wide was warranted, but precluded by higher-priority listing actions. Therefore, sage-grouse are a "candidate" species under the Endangered Species Act, but remain a state-managed species. In light of this decision, concerns have been expressed about the potential impacts of hunting greater sage-grouse.

Recommendation

The WAFWA Sage and Columbian Sharp-tailed Grouse Technical Committee recommends states continue to adjust hunting seasons adaptively at the population level, using the best available science and guidelines, current sage-grouse population data (e.g., lek counts, productivity estimates from wing data or brood counts, survival estimates from local radio-telemetry studies), and local circumstances that can change annually (e.g., West Nile virus, drought, or habitat loss due to wildfire). The social aspects, as well as biological implications of changes to harvest seasons, should be thoughtfully considered as hunting regulations are developed. States should critically evaluate harvest survey techniques and adjust accordingly to ensure results are sufficiently accurate and precise. ~~Additional research is warranted to better determine the effects of harvest on sage-grouse numbers.~~ (Deleted by Bird Conservation Committee)

Justification

In their listing decision, the USFWS concluded that the key threats to the continued survival of sage-grouse are 1) habitat loss, fragmentation, and modification and 2) inadequacy of existing regulatory mechanisms, particularly in relation to energy and other development. The USFWS also evaluated the "utilization" (e.g., hunting) of sage-grouse and concluded that "the greater sage-grouse is not threatened by overutilization for commercial, recreational, scientific, or educational purposes now or in the foreseeable future" (USFWS 2010 p. 77). The "Summary of Factor B" section of this document is appended below (Appendix A).

Reese and Connelly (*in press*) authored the sage-grouse hunting chapter in the recent Studies in Avian Biology sage-grouse monograph which provides a detailed review of the science and social aspects of this issue. The abstract of this manuscript is appended below (Appendix B).

Since the Reese and Connelly review, 2 additional studies evaluated the potential impacts of hunting to sage-grouse. Sedinger et al. (2010) reported that harvest of less than 11% of the fall population is unlikely to have an important influence on local population dynamics of sage-grouse. Meanwhile Gibson et al. (*in press*) studied the potential effects of hunting on an intermittently-hunted, isolated sage-grouse population and determined the numbers of males on leks in spring decreased significantly as the previous autumn harvest increased; suggesting that hunting had an additive, not compensatory, effect on this population. The abstracts from both of these manuscripts are appended (Appendices C and D).

Hunting opportunity for greater sage-grouse has been reduced in response to general population declines of known (e.g., disease and habitat loss) and unknown origin. While hunting has not been demonstrated as the primary cause of decline in greater sage-grouse populations, the cautionary recommendations outlined in the sage-grouse management guidelines (Connelly et al. 2000) remain appropriate.

Finally, sage-grouse management and conservation projects in some states are funded largely with earmarked revenue generated from the sales of upland game bird licenses or stamps. It would be difficult to justify the use of such hunter dollars for managing an unhunted species, especially if the sage-grouse populations can support harvest.

Appendix A: USFWS (2010 p. 77) *Summary of Factor B (overutilization for commercial, recreational, scientific, or educational purposes):*
Greater sage-grouse are not used for any commercial purpose. In Canada, hunting of sage-grouse is prohibited in Alberta and Saskatchewan. In the United States, sage-grouse hunting is regulated by State wildlife agencies and hunting regulations are reevaluated yearly. We have no information that suggests any change will occur in the current situation, in which hunting greater sage-grouse is prohibited in Washington and allowed elsewhere in the range of the species in the U.S. under State regulations, which provide a basis for adjustments in annual harvest and emergency closures of hunting seasons. We have no evidence suggesting that gun and bow sport hunting has been a primary cause of range-wide declines of the greater sage-grouse in the past, or that it currently is at a level that poses a significant threat to the species. However, although harvest as a singular factor does not appear to threaten the species throughout its range, negative impacts on local populations have been demonstrated and there remains a large amount of uncertainty regarding harvest impacts because of a lack of experimental evidence and conflicting studies. Significant habitat loss and fragmentation have occurred during the past several decades, and there is evidence that the sustainability of harvest levels depends to a large extent upon the quality of habitat and the health of the population. However, recognition that habitat loss is a limiting factor is not conclusive evidence that hunting has played no role in population declines or that reducing or eliminating harvest will not have an effect on population stability or recovery.

Take from poaching (illegal hunting) appears to occur at low levels in localized areas, and there is no evidence that it contributes to population declines. The information on non-consumptive recreational activities is limited to lek viewing, the extent of such activity is small, and there is no indication that it has a negative impact that contributes to population declines. Harvest by Native American tribes, and mortality that results from handling greater sage-grouse for scientific purposes appears to occur at low levels in localized areas and thus we do not consider these to be a significant threat at either the range-wide or local population levels. We know of no utilization for educational purposes. We have no reason to believe any of the above activities will increase in the future.

We do not believe data support overuse of sage-grouse as a singular factor in range-wide population declines. We note, however, that in light of present and threatened habitat loss (Factor A) and other considerations (e.g., West Nile virus outbreaks in local populations), continued close attention will be needed by States and tribes to carefully manage hunting mortality, including adjusting seasons and allowable harvest levels, and imposing emergency closures if needed.

In sum, we find that this threat is not significant to the species such that it causes the species to warrant listing under the Act.

Appendix B: Reese and Connelly (*in* press). *Abstract:*
Harvest of greater sage-grouse (*Centrocercus urophasianus*) has occurred throughout recorded history, but relatively few studies addressed the impact of harvest on sage-grouse numbers. Harvest of greater sage-grouse occurs in 10 of 11 western states in which they reside. Hunting seasons, and bag and possession limits have often become more conservative over the species' range during the past decade as states responded to changing population numbers and perceived threats to the birds, and then acted to reduce harvest opportunities. By 2007, hunting season lengths ranged from 2–62 days with a mean length of 10 days. Annual harvest estimates range from 10 birds in South Dakota to 10,378 in Wyoming. Total estimated annual harvest of greater sage-grouse in the 10 states in 2007 was 28,180 birds.

The effects of hunting on sage-grouse populations remains equivocal based on published literature, but the paradigm of harvest as compensatory may be shifting as evidence accumulates that populations of greater sage-grouse require more conservative hunting regulations to reduce the potential for excessive harvest. Recent research suggests that because greater sage-grouse normally experience low mortality over winter, mortality from hunter harvest in September and October may not be compensatory. Harvest mortality on most populations of greater sage-grouse appears to be low, but both harvest levels and population abundance must be closely monitored in every population to improve management regulations for the harvest of the species. Biological data obtained from harvested birds is vital for continued management of sage-grouse populations. No studies have demonstrated that hunting is a primary cause of reduced numbers of greater sage-grouse, and cessation of harvest in Washington 20 years ago has not resulted in increasing population levels. Continued concern over general population declines in greater sage-grouse populations from known (disease, habitat loss, and habitat fragmentation) and unknown origins, requires new research and continued routine collection of biological data for each population to optimize future harvest strategies.

Appendix C: Sedinger et al. 2010. *Abstract:*
We used band-recovery data from 2 populations of greater sage-grouse (*Centrocercus urophasianus*), one in Colorado, USA, and another in Nevada, USA, to examine the relationship between harvest rates and annual survival. We used a Seber parameterization to estimate parameters for both populations. We estimated the process correlation between reporting rate and annual survival using Markov chain Monte Carlo methods implemented in Program MARK. If hunting mortality is additive to other mortality factors, then the process correlation between reporting and survival rates will be negative. Annual survival estimates for adult and juvenile greater sage-grouse in Nevada were 0.42 $\pm$0.07 ($x \pm$ SE) for both age classes, whereas estimates of reporting rates were 0.14 $\pm$ 0.016, 0.14 $\pm$ 0.010, 0.19 $\pm$ 0.014, and 0.18 $\pm$ 0.014 for adult females, adult males, juvenile females, and juvenile males, respectively. Corresponding mean annual survival estimates were 0.59 $\pm$ 0.01, 0.37 $\pm$ 0.03, 0.78 $\pm$ 0.01, and 0.64 $\pm$ 0.03. Estimated process correlation between logit-transformed reporting and survival rates for greater sage-grouse in Colorado was $p = 0.68 \pm 0.26$, whereas that for Nevada was $p = 0.04 \pm 0.58$. We found no support for an additive effect of harvest on survival in either population, although the Nevada study likely had low power. This finding will assist managers in establishing harvest regulations and otherwise managing greater sage-grouse populations.

Appendix D: Gibson et al. (*in* press) *Abstract:*
How hunting mortality affects population size is an important, but understudied problem in the applied ecology of grouse and other upland gamebirds. At issue is whether mortality from recreational hunting is additive and therefore depresses population size, or is compensatory and does not. Empirical analyses of this issue may be inconclusive if harvest levels increase with population size or if statistical analysis fails to control for serial dependence in estimates of population size. We examined the effect of hunting on population size in greater sage-grouse *Centrocercus urophasianus*

using a lek count time series from an intermittently hunted and relatively isolated population in eastern California. Over a 39-year study period (1960-1998), annual variation in harvest recorded in the field was uncorrelated with the previous spring's lek count. After controlling for a positive correlation between lek counts in successive years, numbers of males on leks in spring decreased significantly as harvest during the previous autumn increased. This pattern is expected if hunting mortality is additive and lowers population size. In light of this and similar results from an independent study in Idaho, we suggest that additive, rather than compensatory, hunting mortality should become the default assumption for wildlife managers when setting hunting regulations for greater sage-grouse.

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Contact: Tom Christiansen, Wyoming Game and Fish Department

Adoption: Unanimously approved on July 1, 2010

Tom Hemker, Chair
WAFWA Sage and Columbian Sharp-tailed Grouse Technical Committee

WAFWA Director Business Meeting Action:

Approved July 21, 2010 including the edit made by the Western Bird Conservation Committee.

Attachment E. Wyoming Sage-Grouse Projects Supported with 2011-12 General Fund Biennium Budget

Project Name	Local Working Group	Total Cost	SG $	Project Description	Partners	Status (as of 6/1/2011)
Cheatgrass mapping - Upper Green River Basin Phase I	Upper Green River Basin	$71,390	$55,000 requested/approved/spent	Cheatgrass mapping and spot control	Sublette Co. Weed & Pest/ GR Basin Coord Weed Mgt Assoc	Underway
West Slope Bighorn Mtns Cheatgrass Control	Big Horn Basin	$20,000	$10,000 requested/approved/spent	Cheatgrass control	BLM - Cody FO	Underway
Albert Creek Grazing Mgt	Southwest	$25,000	$12,500 requested/approved/spent	Grazing management and infrastructure	Horseshoe Spear Cattle Co., BLM, WGFD	LWG approved
ACC Cheatgrass Control	Big Horn Basin	$150,000 (multiyear)	$20,000 requested/approved, $17,100 spent	Cheatgrass control and effectiveness monitoring	Big Horn Co. Weed & Pest, Am. Colloid Co.	Underway
Emergency Wildfire Restoration	Northeast	$53,774	$33,250 requested/approved, $30,257 spent	Restoration of wildfire area in the Buffalo sage-grouse core area	Lake DeSmet Cons. District, private landowner, WGFD	Underway
Jackson Hole SG Habitat and Movement Modeling	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	Underway
Black Mountain Cheatgrass Control and Sagebrush Restoration	Big Horn Basin	$260,000	$105,000 requested, $96,000 approved	Cheatgrass control and sagebrush seedling establishment and planting in wildfire area.	WGFD, BLM, Wildlife and Nat. Res. Trust	LWG approved
Crooked Crk and Rome Hill Juniper Treatment	Big Horn Basin	$90,000	$22,500 requested/approved	Mechanical juniper removal from sage-grouse habitat	BLM - Worland FO	Underway
Grand Teton NP lek monitoring	Upper Snake River Basin	$11,369	$4,032 requested/approved/spent	Hire technicians to conduct lek monitoring in Grand Teton NP	Grand Teton National Park, WGFD	Underway

Attachment E. Wyoming Sage-Grouse Projects Supported with 2011-12 General Fund Biennium Budget

Project Name	Local Working Group	Total Cost	SG $	Project Description	Partners	Status (as of 6/1/2011)
Invasive Species Mapping and Control in BTNF & GTNP	Upper Snake River Basin	$53,000	$12,000 requested, $6,500 approved	Invasive/noxious weed mapping and control.	Teton Co. Weed & Pest, Grand Teton NP, Nat'l Elk Refuge, Bridger-Teton NF, Jackson Hole Airport	Underway
Restoration of SG habitat on mined sites	Big Horn Basin	$36,026	$21,053 requested/approved	Research to test methods to improve sagebrush seedling vigor and survival for mine reclamation	Michigan Technical University, MI SWACO, American Colloid, BLM	Underway
Fence marking in SW Wyoming	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	Underway
Impacts of Ravens on SG nests in southern WY	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	Underway
Noxious weed control in Spring Crk/Big Ridge BTNF	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	LWG approved

Attachment E. Wyoming Sage-Grouse Projects Supported with 2011-12 General Fund Biennium Budget

Project Name	Local Working Group	Total Cost	SG $	Project Description	Partners	Status (as of 6/1/2011)
Improving SG habitat in the Cottonwood Crk drainage	Big Horn Basin	$630,000 (multiyear)	$99,809 requested, $30,195 approved	LWG $ to provide spring protection aspect of larger habitat restoration project	TNC, WYDEQ, Wildlife & Nat. Res. Trust, LU Ranch, Hot Springs Weed & Pest, Exxon Mobil, Marathon Oil, WGFD, Spring Gulch Cattle Co.	Underway
Kelly Hayfields restoration Phase II	Upper Snake River Basin	$140,181	$52,647 requested; $31,585 approved	Restore native vegetation to abandoned smooth brome hayfields.	Grand Teton National Park, NRCS	LWG approved
Impacts of wind energy development in SE Wyo	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	Underway
Sharpnose sagebrush treatment Unit 2	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	Underway
Estimating noise impacts for habitat selection modeling	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	LWG approved

Attachment F.

Goals from the WY Greater Sage-grouse Conservation Plan (2003) addressed by WGFD in 2009-10.

Population and Population Monitoring Goal #1) Maintain or increase cyclical peak sage-grouse numbers as measured by a consistently applied monitoring protocol using data from the year 2000 as a baseline (28 males/count lek).

Action: 684 leks were monitored at the intensity required to be "count" leks.
Status: Spring 2010 males/count lek = 20

Population and Population Monitoring Goal #2) Do not allow the average number of males/count lek to decline below 10 during cyclical lows.

Action: 684 leks were monitored at the intensity required to be "count" leks.
Status: Spring 2010 males/count lek = 20 (most recent "low")

Population and Population Monitoring Goal #3) Maintain or increase active sage-grouse leks at or above the number of known leks in 2002 (1,650-1,700).

Action: Leks continue to be documented and monitored regularly.
Status: Spring 2010 occupied leks = 1,899

Population and Population Monitoring Goal #5) Reflect as accurately as possible the historic distribution and status of sage-grouse.

Action: Preparation of local and statewide JCRs.
Status: On-going annually.

Action: Participation in the update of Connelly et al. 2004 into a peer-reviewed publication as a Studies in Avian Biology monograph. Participation included providing data and lead in authoring the disease chapter.
Status: Pre-publication draft provided to the Service for use in the listing decision. Final publication is in press.

Population and Population Monitoring Goal #6) Continue to implement established protocols for future population monitoring and record keeping, including mechanisms to insure consistent implementation.

Action: Member of Western Association of Fish & Wildlife Agencies Sage-Grouse Technical Team which coordinates this task across the range.
Status: On-going, continuous.

Action: Implement consistent lek monitoring, data storage and reporting across the state via written protocol, a statewide database and annual job completion reports.
Status: On-going, continuous.

Conflicting Wildlife and Wild Horse Management Goal #1) Minimize negative impacts to sage-grouse caused by management practices and habitat improvement projects intended for other species.

Action: Since release of the State Plan, the Sage-Grouse Management Guidelines and other documents demonstrating concern for sage-grouse increased attention has been given to the potential effects of wildlife population and habitat management practices to sage-grouse. The patch sizes of some habitat treatments have been modified to better accommodate sage-grouse needs.
Status: On-going; need to quantify/qualify the results.

Hunting Goal #1) Conduct hunting of sage-grouse in a manner that is compatible with maintaining robust populations and allows depressed population to increase.

Action: Hunting seasons have been set in accordance with, or more conservative than, the RMPs designed to achieve this goal.
Status: On-going, continuous.

Parasites and Disease Goal #1) Minimize impacts of parasites or disease on sage-grouse in Wyoming.

Action: Continued to monitor sage-grouse for West Nile virus impacts.
Status: On-going, no significant outbreaks were documented in 2009.

Action: Authored the disease chapter of the peer-reviewed update of Connelly et al. 2004 which will be published as a Studies in Avian Biology Monograph.

Vegetation Management Goal #1) Restore, maintain and/or enhance sagebrush ecosystem health and ecological processes and functions including associated riparian systems.

Vegetation Management Goal #2) Maintain or enhance natural patterns (e.g. seasonal migrations), functions (e.g. cover/food), and processes (e.g. fire).

Vegetation Management Goal #3) Maintain sagebrush habitats with a healthy understory of native grasses and forbs, diversity of species, diversity of age classes, and patches of varying size and density.

Action: These goals are long-standing ones of the WGF when conducting habitat treatments. Since release of the State Plan, the Sage-Grouse Management Guidelines and other documents demonstrating concern for sage-grouse increased attention has been given to the potential effects of wildlife habitat management practices to sage-grouse. The patch sizes of some habitat treatments have been modified to better accommodate sage-grouse needs.
Status: On-going

Weather Goal #1) Better define weather and climate related effects on sage-grouse populations and their interactions with other limiting factors in order to correctly understand and assess fluctuations in sage-grouse populations.

Weather Goal #2) Determine cause and effect relationships between forage drought, multiple uses, and sage-grouse recruitment.

Action: The JCRs have weather sections that, in part, address these goals.
Status: On-going.

Action: A USGS scientist attempted to address this question with an in-depth analysis of Wyoming climate and grouse data. The scientist was unable to detect cause and affect relationships. This does not mean such relationships don't exist. Rather the relationships may be more complex than existing data can demonstrate.
Status: No additional action planned in the immediate future.

Implementation of Recommended Mgt Practices (RPMs) From the WY Greater Sage-grouse Conservation Plan (2003)

Population RMP #1) Prepare local and statewide annual summaries of sage-grouse data utilizing the primary database that includes information on the location and status of all known leks, hunter harvest and wing data.

Action: Preparation of local and statewide JCRs.
Status: On-going annually (although new duties associated with implementing the state's core area strategy have delayed preparation and distribution of recent statewide reports).

Population RMP #2) Develop a monitoring protocol that would more accurately document long-term population trends.

Action: See Population Goals #5-6 above.
Status: See Population Goals #5-6 above.

Population RMP #3) Develop and refine techniques to measure productivity where wing data are unavailable.

Action: Brood surveys are conducted in Northeast Wyoming and the Big Horn Basin where sample sizes of wing data are low.
Status: On-going

Population RMP #4) Review population data annually to determine three and ten year trends.

Action: See Figures 6 and 7.
Status: On-going; complete to date

Winter Habitat RMP #1) Use aerial photos, surveys, other remote sensing techniques, local knowledge and anecdotal information to identify winter habitat.

Action: All of the above techniques are being implemented around the state to accomplish this goal.

Status: On-going, not complete.

Breeding Habitat RMP #1) Limit distribution of lek site information to avoid stressing birds. Avoid disturbance on lek sites while birds on the lek, generally from March through May.

Action: Lek sites are not made available for easy public access, but rather the info is available as needed to assist project planners and others avoid impacts. A lek viewing guide was developed and distributed (hard copies and electronic download) prior to the 2007 lek viewing season.

Status: On-going

Breeding Habitat RMP #2) Identify and map lek and lek-associated habitats.

Action: Lek sites are mapped. Mapping of lek perimeters is on-going.

Status: Point data are mapped but perimeter mapping is not complete and will likely take several years to complete.

Landscape Habitat RMP #4) Within three years, identify and map seasonal sage-grouse habitats statewide.

Action: Some seasonal habitats, especially lek and winter habitats have been or are being mapped.

Status: On-going. Because of limitations of current remote sensing technology, this task will take longer than three years to complete.

Conflicting Wildlife and Wild Horse Management RMP #1) Evaluate effects to sage-grouse caused when managing for other wildlife species.

Conflicting Wildlife and Wild Horse Management RMP #4) Document areas where conflicting species management goals may negatively impact sage-grouse.

Conflicting Wildlife and Wild Horse Management RMP #6) When planning mitigation projects, avoid negative impacts to sage-grouse.

Conflicting Wildlife and Wild Horse Management RMP #7) Review big game herd goals and modify and implement special big game seasons to meet harvest objectives as necessary to improve habitat conditions for sage-grouse.

Conflicting Wildlife and Wild Horse Management RMP #8) Incorporate sage-grouse needs into management plans for wildlife, especially big game.

Action: All these RMPs are being considered or implemented as recommended on an as needed basis.
Status: On-going.

Hunting RMP #1) In stable to increasing populations (based on lek count information) maintain a 2 to 4 week hunting season with a 3 bird daily bag limit beginning no earlier than September 15.

Hunting RMP #2) If populations are declining (for 3 or more consecutive years based on lek count information) implement more conservative regulations that might include: reduced bag limits, adjusted season dates, limited quota seasons or closed seasons.

Hunting RMP #3) Populations should not be hunted where less that 300 birds comprise the breeding populations (i.e. less than 100 males are counted on the leks).

Hunting RMP #4) Collect hunter harvest data via hunter surveys and wing barrels.

Action: All the hunting RMPs are being conservatively implemented. A white paper on the issue was prepared and distributed in early 2008 (Christiansen 2008).
Status: On-going and continuous.

Action: Harvest surveys and wing barrels are used to collect harvest data.
Status: On-going; annual.

Parasites and Diseases RMP #1) Investigate and record deaths that could be attributed to parasites or disease.

Action: WGF field personnel are encouraged to submit carcasses of dead sage-grouse (other than roadkills or harvested birds) to the Wyoming State Vet Lab for necropsy to determine cause of death. This practice was emphasized with the Northeast Wyoming outbreak of West Nile virus in 2003.
Status: On-going, continuous. No significant outbreaks were documented in 2009.

Parasites and Diseases RMP #2) Develop and implement strategies to deal with disease outbreaks where appropriate.

Action: WGF closed the sage-grouse hunting season in northeast Wyoming in 2003 as a precautionary measure when significant numbers of sage-grouse mortalities were documented
Status: Complete, continued monitoring will determine future needs.

Recreation RMP #7) Agencies should generally not provide all lek locations to individuals simply interested in viewing birds.

Action: Lek sites are not made available for easy public access. Sites of well-known individual lek sites are provided to those that request information on where to view leks. A lek viewing guide was developed and distributed (hard copies and electronic download) prior to the 2007 lek viewing season.
Status: On-going, viewing guide complete and available.

Vegetation Management RMPs #1-22) see State Plan

Action: Virtually all these RMPs are considered/implemented when WGF personnel conduct vegetation treatments.
Status: On-going.

Weather RMP #1) Correlate, on a local level, historical and present weather data with historical and present sage-grouse population data to determine weather impacts to sage-grouse populations and habitat.

Action: The local JCRs incorporate these analyses.
Status: On-going. Additional efforts needed.

Attachment G.

WYOMING GAME AND FISH DEPARTMENT PROTOCOLS FOR TREATING SAGEBRUSH TO BENEFIT SAGE GROUSE (11/29/2010)

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 2010-4, to conserve sage-grouse and prevent population declines in core habitat areas.

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 determine the Project Impact Analysis Area (PIAA) outlined in Executive Order 2010-4 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 and will include 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 PIAA, 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 PIAA 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).

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.

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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 p

Attachment H.
Wyoming Sage-Grouse Research Reports

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.

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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

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Sage-Grouse Job Completion Report

PERIOD COVERED: 6/1/2010 - 5/31/2011
WORKING GROUP: Bates Hole **PREPARED BY: Justin Binfet**

1. LEK ATTENDANCE SUMMARY (OCCUPIED LEKS)

a. Leks Counted

			Percent	Max Totals		Avg./Active Lek	
Year	Known	Counted	Counted	Males	Females	Males	Females
2002	216	44	20.4	1245	348	28.3	7.9
2003	221	49	22.2	1522	527	31.1	10.8
2004	223	53	23.8	1723	476	32.5	9.0
2005	230	63	27.4	3358	628	53.3	10.0
2006	231	64	27.7	3844	790	60.1	12.3
2007	248	56	22.6	2407	472	43.0	8.4
2008	248	62	25.0	2215	946	35.7	15.3
2009	252	61	24.2	1611	603	26.4	9.9
2010	248	114	46.0	2485	1170	21.8	10.3
2011	248	105	42.3	1658	619	15.8	5.9

b. Leks Surveyed

Year	Known	Surveyed	Percent Surveyed	Max Total	Avg Males/ Active Lek
2002	216	94	43.5	1024	24.4
2003	221	121	54.8	1599	26.7
2004	223	97	43.5	1472	29.4
2005	230	125	54.3	2397	31.1
2006	231	139	60.2	3513	38.2
2007	248	125	50.4	2913	36.9
2008	248	123	49.6	2050	27.3
2009	252	121	48.0	1693	23.5
2010	248	74	29.8	861	17.6
2011	248	107	43.1	831	14.6

c. Leks Checked

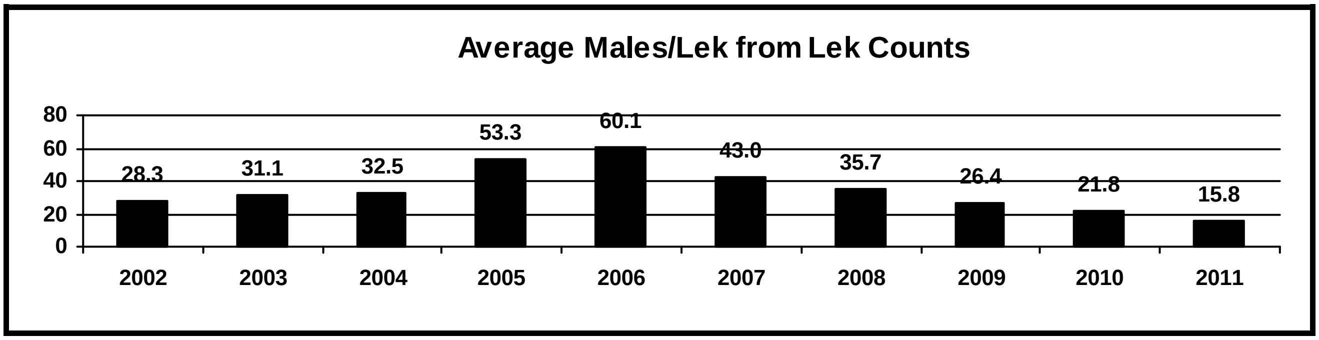
Year	Known	Checked	Percent Checked	Max Total	Avg Males/ Active Lek
2002	216	133	61.6	2252	26.5
2003	221	167	75.6	3076	29.0
2004	223	149	66.8	3195	31.0
2005	230	182	79.1	5755	41.1
2006	231	201	87.0	7268	47.2
2007	248	180	72.6	5320	39.4
2008	248	184	74.2	4246	31.2
2009	253	180	71.4	3271	25.0
2010	248	186	75.0	3346	20.5
2011	248	210	84.7	2489	15.4

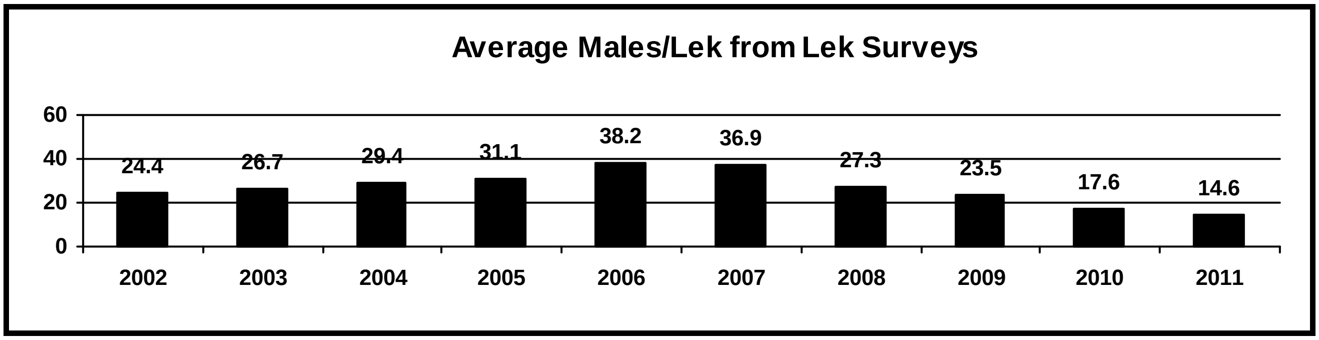
d. Lek Status

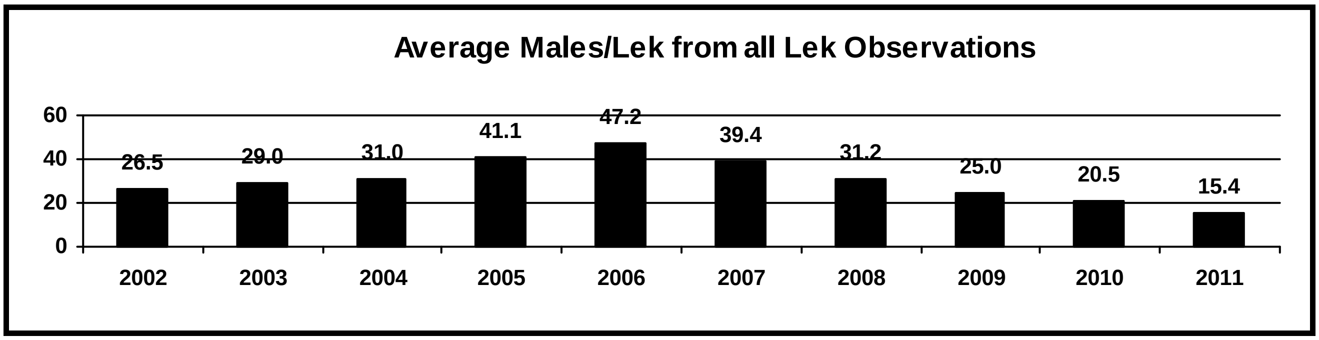
						Confirmed Status	
Year	Active	Inactive	Not Located	Unknown	Total	Active	Inactive
2002	87	12	7	110	99	87.9%	12.1%
2003	99	16	10	96	115	86.1%	13.9%
2004	94	28	0	101	122	77.0%	23.0%
2005	136	9	2	83	145	93.8%	6.2%
2006	152	3	0	76	155	98.1%	1.9%
2007	134	8	0	106	142	94.4%	5.6%
2008	136	36	2	74	172	79.1%	20.9%
2009	130	33	0	89	163	79.8%	20.2%
2010	146	15	1	86	161	90.7%	9.3%
2011	156	46	0	46	202	77.2%	22.8%

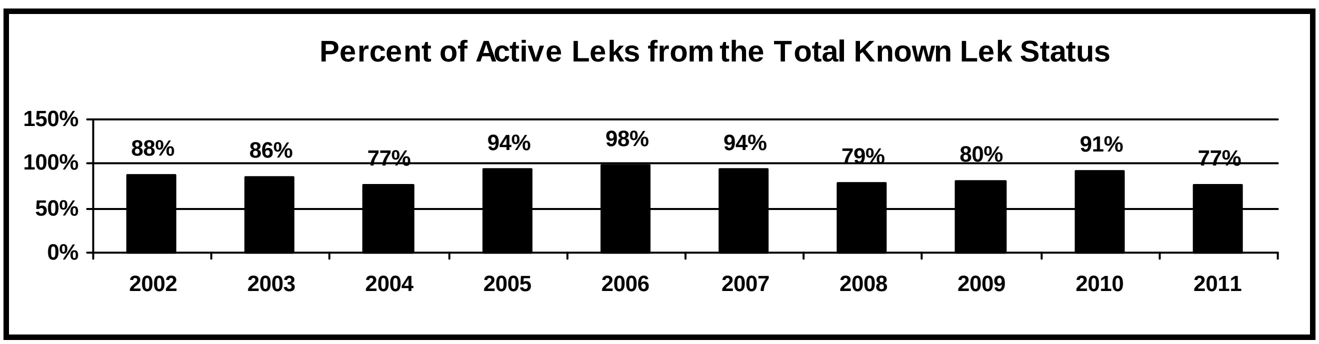
SAGE-GROUSE LEK ATTENDANCE SUMMARY

WORKING GROUP: Statewide Summary **Area(s): All**









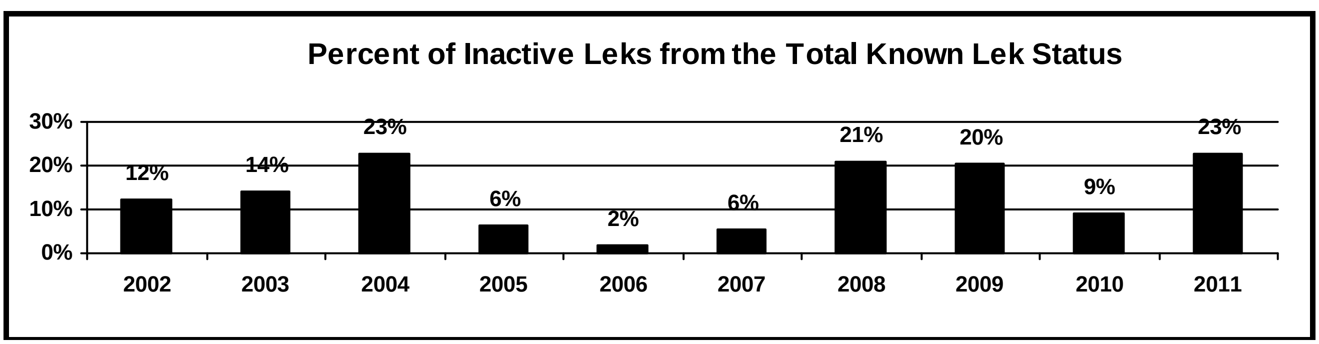


Table 4. Sage-grouse hunting seasons and harvest data.

a. Season

Year	Season Dates	Length	Bag/Possession Limit
2001	Sept 22-Oct 6	16	3/6
2002	Sept 28-Oct 6	9	2/4
2003	Sept 27-Oct 5	9	2/4
2004	Sept 23-Oct 3	11	2/4
2005	Sept 23-Oct 3	11	2/4
2006	Sept 23-Oct 3	11	2/4
2007	Sept 22-Oct 2	11	2/4
2008	Sept 22-Oct 2	11	2/4
2009	Sept 19- Sept 30	12	2/4
2010	Sept 18- Sept 30	13	2/4

b. Harvest

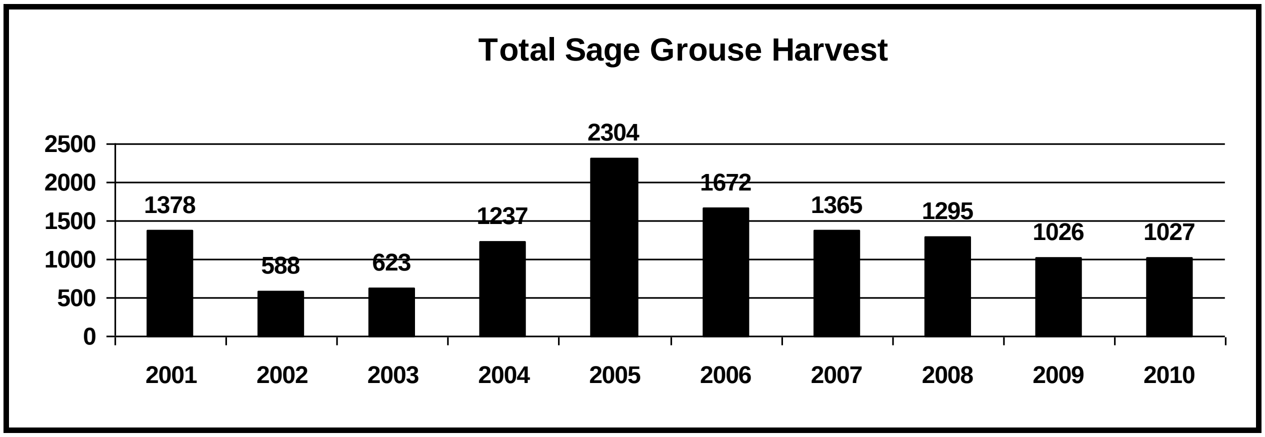
Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2000	1,698	753	1,364	1.2	2.3	1.8
2001	1,378	725	1,396	1.0	1.9	1.9
2002	588	377	588	1.0	1.6	1.6
2003	623	318	626	1.0	2.0	2.0
2004	1,237	583	1,071	1.2	2.1	1.8
2005	2,304	925	1,734	1.3	2.5	1.9
2006	1,672	717	1,169	1.4	2.3	1.6
2007	1,365	655	1,155	1.2	2.1	1.8
2008	1,295	654	1,161	1.1	2.0	1.8
2009	1,026	532	956	1.1	1.9	1.8
2010	1,027	480	1,001	1.0	2.1	2.1
Avg.	1,252	597	1,086	1.1	2.1	1.8

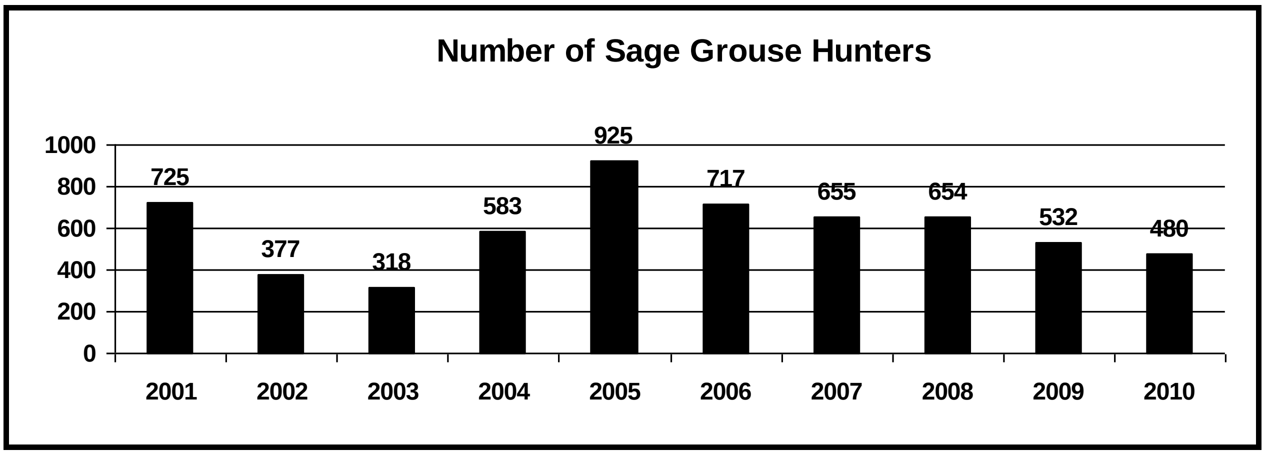
Table 5. Composition of harvest by wing analysis.

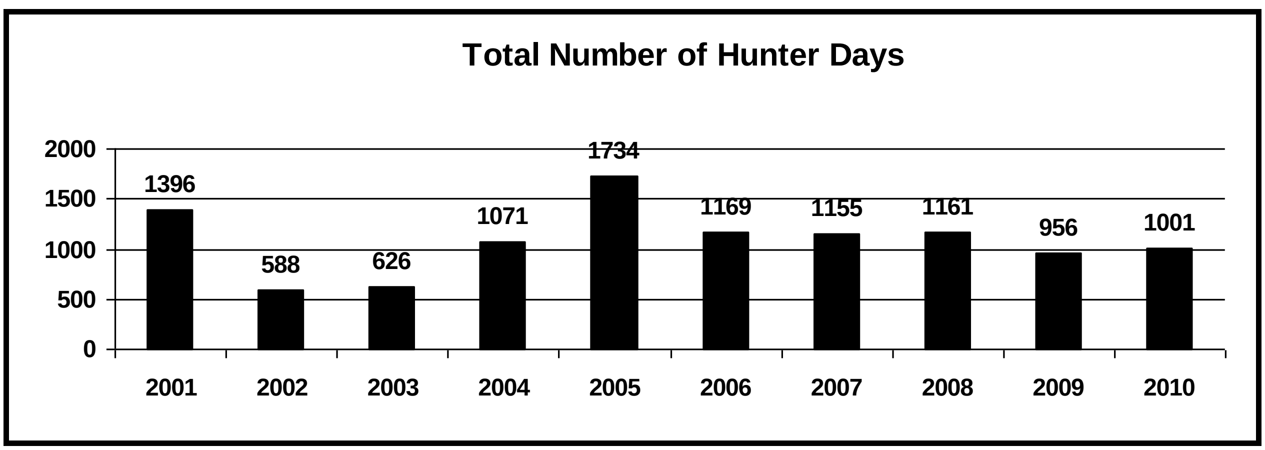
	Sample	Percent Adult		Percent Ylg		Percent Young		
Year	Size	Male	Female	Male	Female	Male	Female	Chicks /Hen
2001	560	9.3	19.8	0.4	8.9	21.6	40.0	2.1
2002	663	7.7	18.6	2.4	10.7	15.5	45.1	2.1
2003	214	20.6	24.3	2.8	11.2	19.6	21.5	1.2
2004	308	13.6	24.7	1.3	4.2	24.0	32.1	1.9
2005	372	17.5	25.8	3.0	7.8	21.5	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	160	12.5	26.3	6.9	10.0	15.6	28.8	1.2
2009	314	12.7	26.1	9.2	12.1	17.8	22.0	1.0
2010	268	11.6	35.8	6.0	13.1	13.4	20.1	0.7

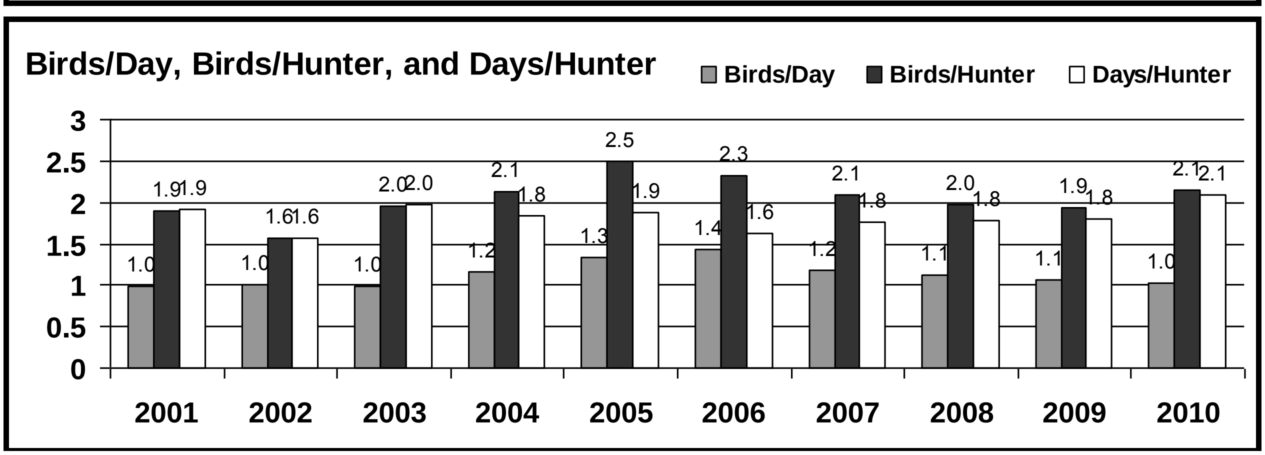
SAGE-GROUSE HARVEST SUMMARY

WORKING GROUP: Bates Hole **Area(s):** All









Sage-grouse Wing Analysis Summary 2010

Region: **Area :**

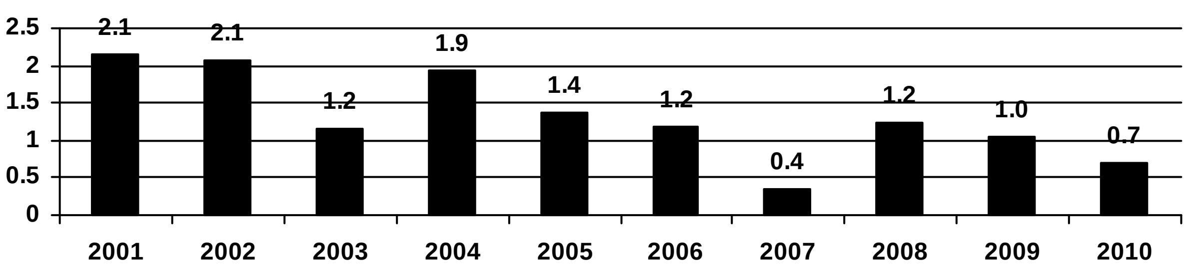
Working Group:

Adult Males:	31	**Percent of All Wings:**	11.6%
Adult Females:	96	**Percent of All Wings:**	35.8%
Adult Unknown:	0	**Percent of All Wings:**	0.0%
Total Adults:	127		
Yearling Males:	16	**Percent of All Wings:**	6.0%
Yearling Females:	35	**Percent of All Wings:**	13.1%
Yearling Unknown:	0	**Percent of All Wings:**	0.0%
Total Yearlings:	51		
Chick Males:	36	**Percent of All Wings:**	13.4%
Chick Females:	54	**Percent of All Wings:**	20.1%
Chick Unknown:	0	**Percent of All Wings:**	0.0%
Total Chicks:	90		
Unknown Sex/Age:	0	**Percent of All Wings:**	0.0%
Total for all Sex/Age Groups:	268		

Chick Males:	36	**Percent of All Chicks:**	40.0%
Yearling Males:	16	**Percent of Adult and Yearling Males:**	34.0%
Adult Males:	31	**Percent of Adult and Yearling Males:**	66.0%
Adult and Yearling Males:	47	**Percent of Adults and Yearlings:**	26.4%
Total Males:	83	**Percent of All Sex/Age Groups:**	31.0%
Chick Females:	54	**Percent of All Chicks:**	60.0%
Yearling Females:	35	**Percent of Adult and Yearling Females:**	26.7%
Adult Females:	96	**Percent of Adult and Yearling Females:**	73.3%
Adult and Yearling Females:	131	**Percent of Adults and Yearlings:**	73.6%
Total Females:	185	**Percent of All Sex/Age Groups:**	69.0%

Chicks:	90	**Percent of All Wings:**	33.6%
Yearlings:	51	**Percent of All Wings:**	19.0%
Adults:	127	**Percent of All Wings:**	47.4%
Chicks/Hen:	**0.7**		

Chicks/hen calculated from wings of harvested sage-grouse.



Bates Hole/Shirley Basin Conservation Area (BHSBCA)
Job Completion Report

Species: **Sage-grouse**
Period Covered: **June 1, 2010 – May 31, 2011**
Mgmt. Areas: **22, 24, 27, 28, 30, 32, and 33**
Prepared by: **Justin Binfet**

Introduction

Sage-grouse are found throughout the Bates Hole/Shirley Basin Conservation Area (BHSBCA) 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 and oil and gas development. Sage-grouse habitat in the Laramie Range is primarily limited to the west slope, and includes portions of the Laramie Plains. Large contiguous blocks of sagebrush/grassland communities east of the Laramie Range have been largely eliminated.

Occupied habitat for sage-grouse within the BHSBCA 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 focus 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 BHSBCA since the 1950s. Lek counts are conducted in April and early May. 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 provide a more reliable indicator of chick production and recruitment.

Past and current management of sage-grouse within the BHSBCA 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 federally permitted projects and through recent revision of the Resource Management Plans in the Casper and Rawlins BLM Field Offices. 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 a Governor's Executive Order. 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 and increase protections for ~83% of the sage-grouse occurring in Wyoming. Protections applied to sage-grouse habitats outside of core areas are less stringent than those within core areas. This discrepancy was designed to focus natural resource development outside of the best remaining sage-grouse habitats.

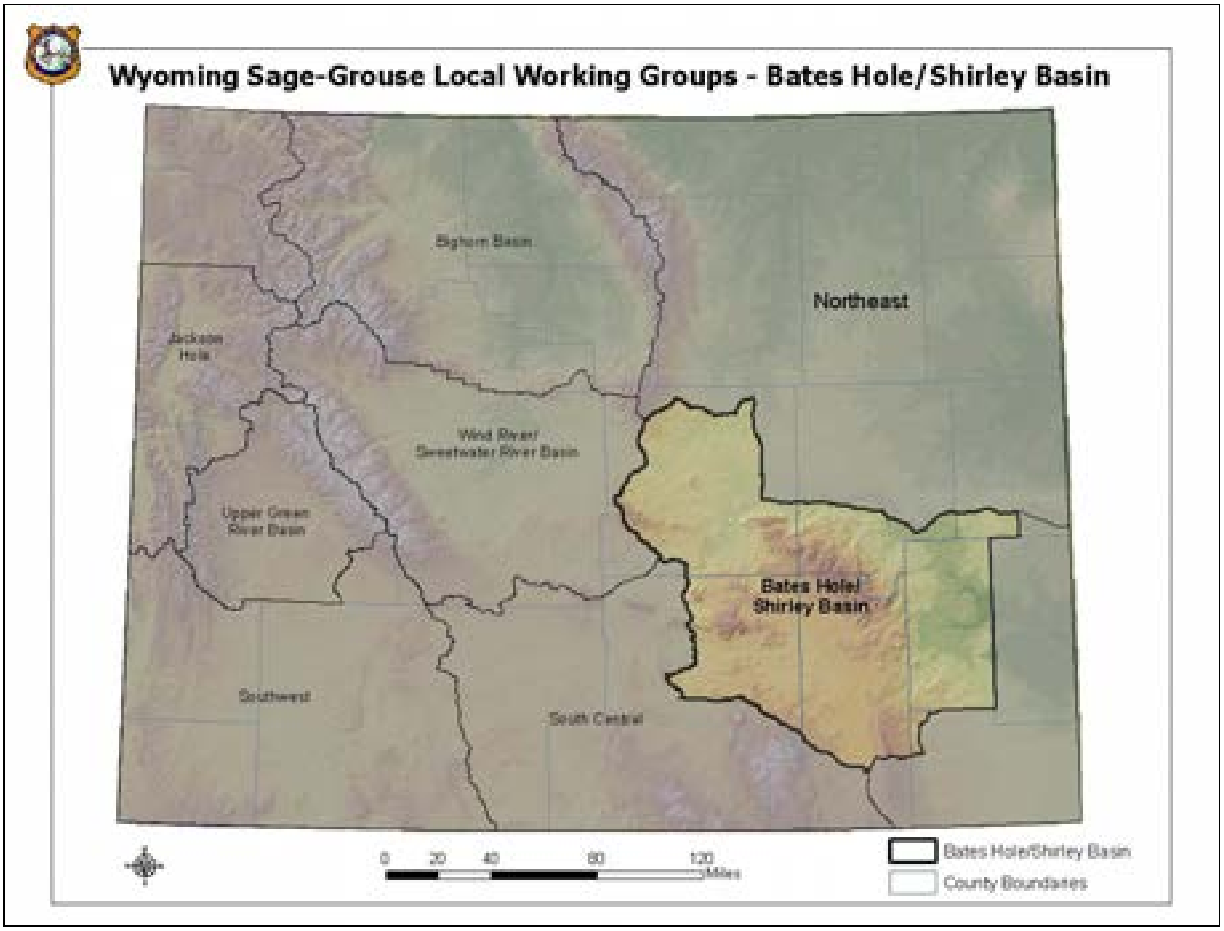
Most sage-grouse populations in Wyoming are hunted, though some portions of the state have been closed to sage-grouse hunting to protect small, isolated populations (i.e., in the southeast, northeast, and northwest portions of the state). Based on the Bates Hole/Shirley Basin Local Working Group's (BHSBLWG) 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 the Hat Six area southeast of Casper and in Converse, Niobrara, Platte, and Laramie Counties. 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 pressure 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 BHSBCA currently span two weekends, opening in late September and closing in early October, with the exception of the Hat Six area, Converse, and Platte Counties where seasons have been closed entirely. 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 BHSBCA to 2 per day and 4 in possession.

Conservation Area

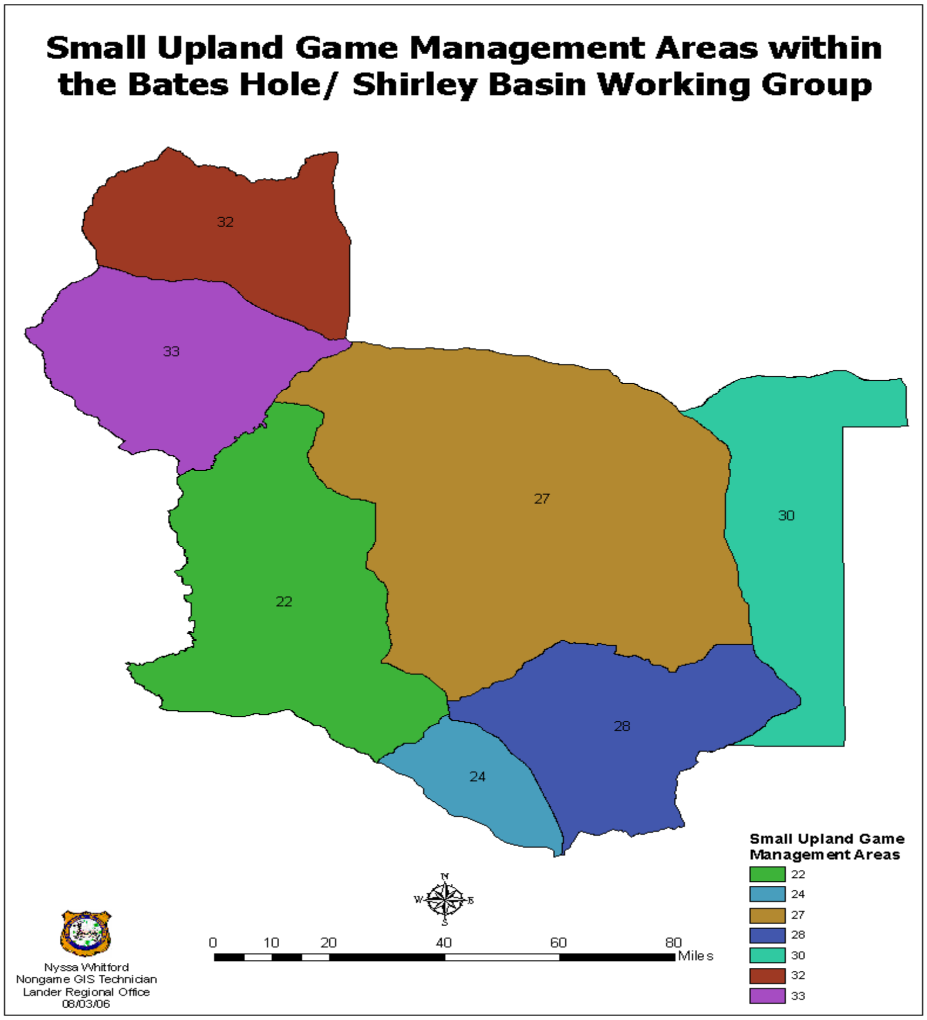
The BHSBCA includes Bates Hole, the Shirley Basin, the Rattlesnake Hills, the southern Bighorn Mountains, the Laramie Range, and isolated occupied habitats in southern Niobrara and Platte County (Figure 1). Political jurisdictions include Albany, Carbon, Converse, Laramie, Natrona, Niobrara, and Platte 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 BHSBCA 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 Conservation Area.



For the reporting period, the BHSBCA encompasses all or a portion of WGFD Small/Upland Game Management Areas 22, 24, 27, 28, 30, 32, and 33 (Figure 2). The management areas do not correspond to sage-grouse population boundaries. Rather, management areas are used for general data collection and reporting for all small and upland game species. Further, the BHSBCA area is not aligned on the boundary for Area 24. Because harvest data is recorded by these management areas and not by the outlined plan area, analyses/statistics reported include some information outside of the BHSBCA. Sage-grouse are well distributed throughout most of the BHSBCA. Beginning in biological year 2011, sage-grouse management areas will be redrawn based on local working group boundaries.

Figure 2. The Bates Hole/Shirley Basin Conservation Area and WGFD upland game management areas.



Leks and Lek Complexes

Sage-grouse, and therefore occupied leks, are well distributed throughout the BHSBCA (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 2011, there are 214 known occupied leks, 59 unoccupied leks, and 31 leks of an undetermined status within the BHSBCA (Figure 4). Lek definitions are presented in Appendix I. Fifty-four of the 59 unoccupied leks have been abandoned, while 2 have been destroyed. Undoubtedly, there are leks within the BHSBCA that have not yet been identified, while other un-discovered leks have been abandoned or destroyed. The majority of leks defined 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 BHSBCA, 2011.

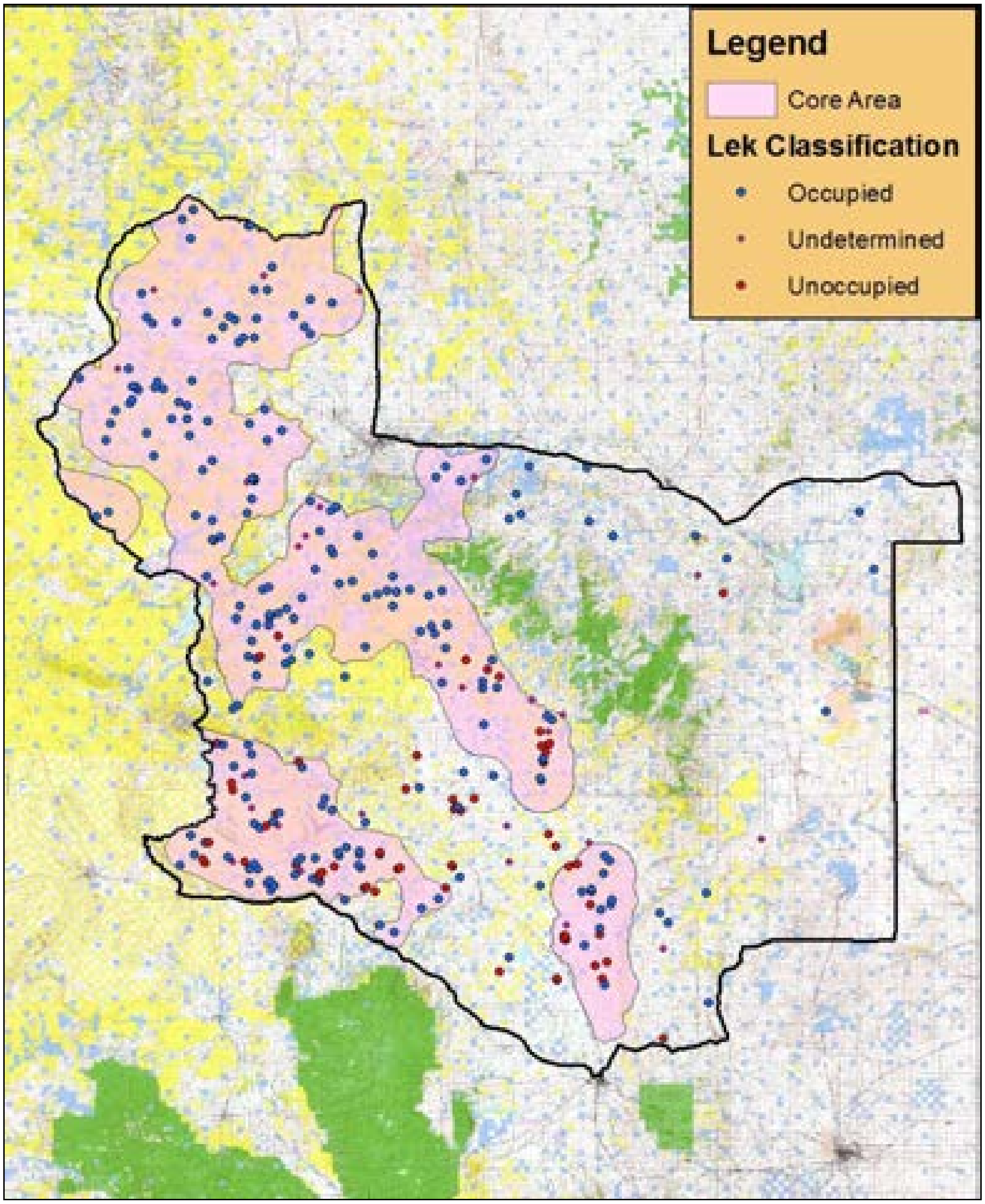


Figure 4. Sage-grouse lek demographics within the BHSBCA, 2011.

Sage Grouse Lek Characteristics

Region	Number	Percent
Casper	121	39.8%
Lander	2	0.7%
Laramie	181	59.5%

Working Group Area	Number	Percent
Bates Hole	304	######

Classification	Number	Percent
Occupied	214	70.4%
Undetermined	31	10.2%
Unoccupied	59	19.4%

BLM Office	Number	Percent
Casper	118	38.8%
Lander	2	0.7%
Newcastle	1	0.3%
Rawlins	183	60.2%

Unoccupied Leks	Number
Abandoned	54
Destroyed	2

Biologist District	Number	Percent
Casper	112	36.8%
Douglas	9	3.0%
Laramie	106	34.9%
Rawlins	2	0.7%
Saratoga	68	22.4%
Wheatland	7	2.3%

Game Warden District	Number	Percent
Cheyenne	2	0.7%
Douglas	3	1.0%
East Casper	36	11.8%
East Rawlins	2	0.7%
Elk Mountain	69	22.7%
Glenrock	8	2.6%
Laramie	1	0.3%
Lusk	1	0.3%
Medicine Bow	67	22.0%
North Laramie	38	12.5%
West Casper	71	23.4%
Wheatland	6	2.0%

County	Number	Percent
Albany	72	23.7%
Carbon	108	35.5%
Converse	11	3.6%
Laramie	3	1.0%
Natrona	103	33.9%
Niobrara	1	0.3%
Platte	6	2.0%

Land Status	Number	Percent
BLM	111	36.5%
BLM/Private	2	0.7%
BOR	1	0.3%
Not Determined	2	0.7%
Private	161	53.0%
State	26	8.6%
USF&WS	1	0.3%

Management Area	Number	Percent
22	114	37.5%
24	4	1.3%
27	75	24.7%
28	35	11.5%
30	3	1.0%
32	29	9.5%
33	44	14.5%

Lek counts and lek surveys have been conducted within the area since the late 1950's, although only on a small number of leks. Since 1998, lek monitoring effort has expanded significantly, resulting in relatively consistent data sets over the last 14 years, enabling meaningful comparisons of current sage-grouse data to a running 10-year average. In 2011, personnel checked 212 of the 245 (87%) known occupied and undetermined leks in the BHSBCA. A total of 105 leks were counted while 107 leks were surveyed. This marks a dramatic increase in the number of leks counted compared to the previous 5-year average of 71. Of the leks checked where annual status was confirmed, 156 were active and 46 were inactive.

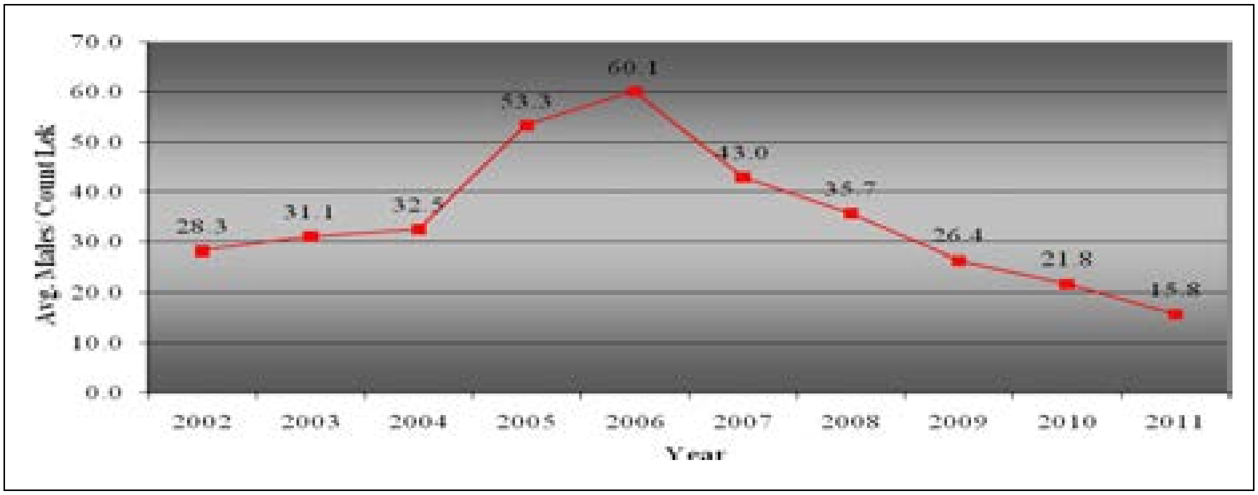
Habitat

There is little doubt sage-grouse habitat quality has declined over the past several decades throughout the BHSBCA. 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 impacted 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 BHSBCA. 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 II.

Population Trend

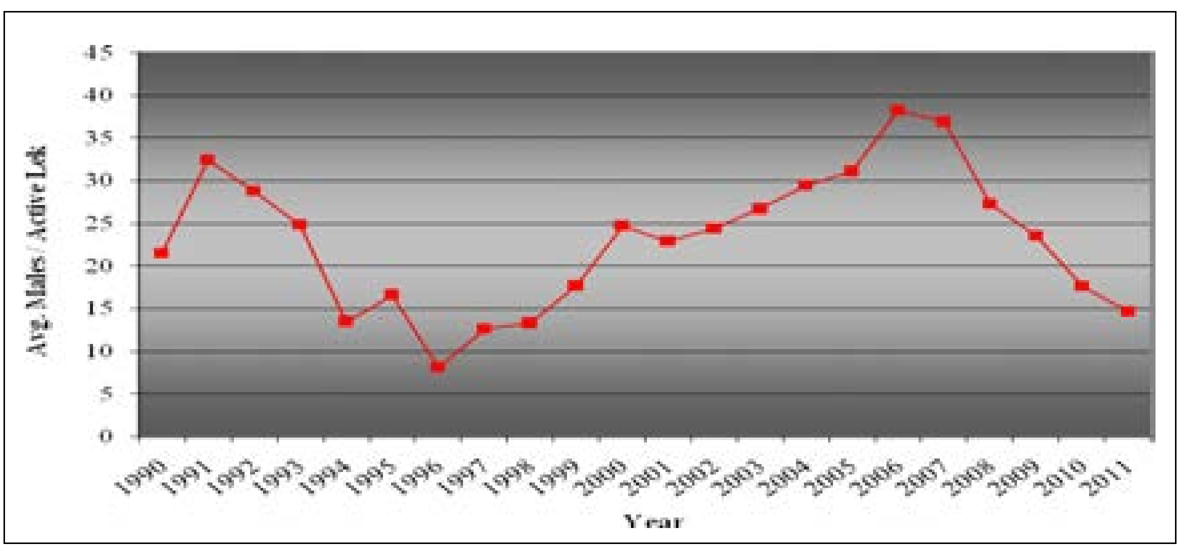
Monitoring male attendance on leks provides a reasonable index of sage-grouse population trend over time. Nevertheless, these data must be interpreted with caution as described in the Wyoming Greater Sage-grouse Conservation Plan (2003). Fluctuations in the number of grouse observed on leks over time 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 28.3 in 2002 to 60.1 in 2006, but has since declined to 15.8 in 2011 (Figure 6). Male lek attendance has declined considerably from 2006 through 2011 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 2011 is 56% below the previous 10-year average of 36.0, and was the lowest average recorded since intensive lek monitoring began in 1998.

Figure 6. Mean number of peak males per ***counted*** lek within the BHSBCA, 2002 – 2011.



Following a period of substantial growth from 2001 – 2006, sage-grouse populations have since declined by 74% from 2006 – 2011 based on the mean maximum number of males observed per counted lek. The 2011 average male lek attendance (obtained from lek counts) was the lowest average recorded within the BHSBCA since intensive lek monitoring began in 1998. Average male lek attendance was lower from 1994 – 1997, but no more than 5 leks were counted in any one year. Because relatively few lek counts were conducted prior to 1998, the average number of males per active lek obtained from lek surveys must be used when comparing current population trend to data obtained prior to 1998. Both lek count and lek survey data produce similar lek attendance trends, and are therefore both reliable indicators of population trend. Based on lek *survey* data, the low average number of males per active lek in 2011 was still higher than averages from 1994 – 1998 (Figure 7). In 2011, a maximum total of 2,489 male sage-grouse were observed during lek surveys and counts within the BHSBCA.

Figure 7. Mean number of peak males per ***surveyed*** lek within the BHSBCA, 1990 – 2011.



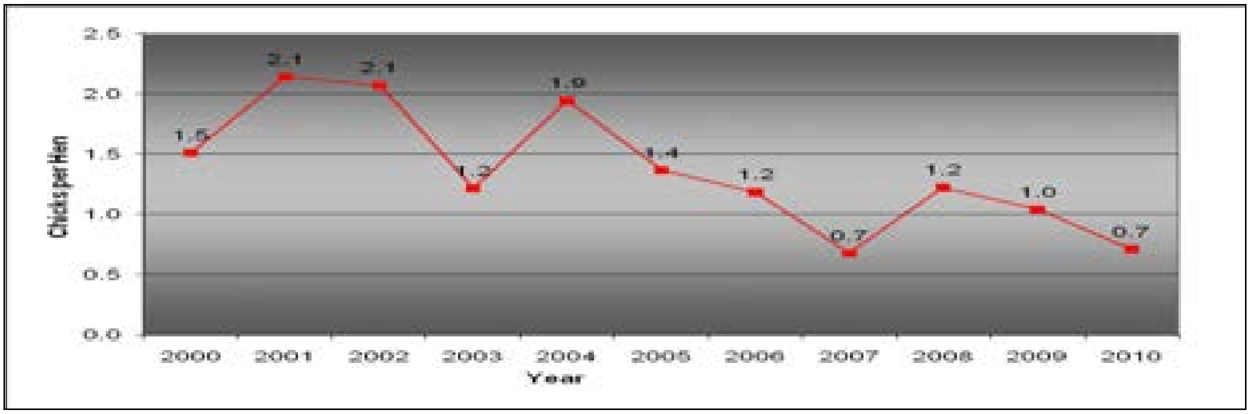
Within the BHSBCA, 54 leks have been abandoned since the 1960's. The timing in which these leks were abandoned is usually difficult to determine due to gaps in data collection. Reasons for abandonment are unknown for many historic leks. It is unclear whether these leks have been abandoned due to natural sage-grouse population fluctuations over time or from anthropogenic disturbances such as natural resource development, poor grazing practices, or hunting/recreation. 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) 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 0.7 chicks per hen in 2010, which was 53% below the previous 10-year average of 1.5 (Figure 8). Over the last 10 years, wing-barrel estimated productivity has fluctuated between 0.7 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 2010 ratio marked the sixth consecutive year of moderate to poor chick production/survival (below 1.5 chicks/hen), resulting in population decrease. Such population decrease has been observed 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 8. Sage-grouse productivity within the BHSBCA based on wing data analysis, 2000 – 2010.



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 BHSBCA 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 BHSBCA (Figure 9). Harvest peaked in 1983 at 14,180 birds and subsequently declined to a low of 588 in 2002. In 2010, an estimated 1,027 sage-grouse were harvested within the BHSBCA. Over the last 10 years within the BHSBCA, trends observed in harvest data generally mirror those observed in male lek attendance from the spring (Figure 10). Over the same time frame, sage-grouse harvest declined considerably from 2000 – 2002, increased through 2005, and has subsequently declined over the last 5 years as sage-grouse populations have declined.

Figure 9. Total sage-grouse harvested per year within the BHSBCA, 1982 – 2010.

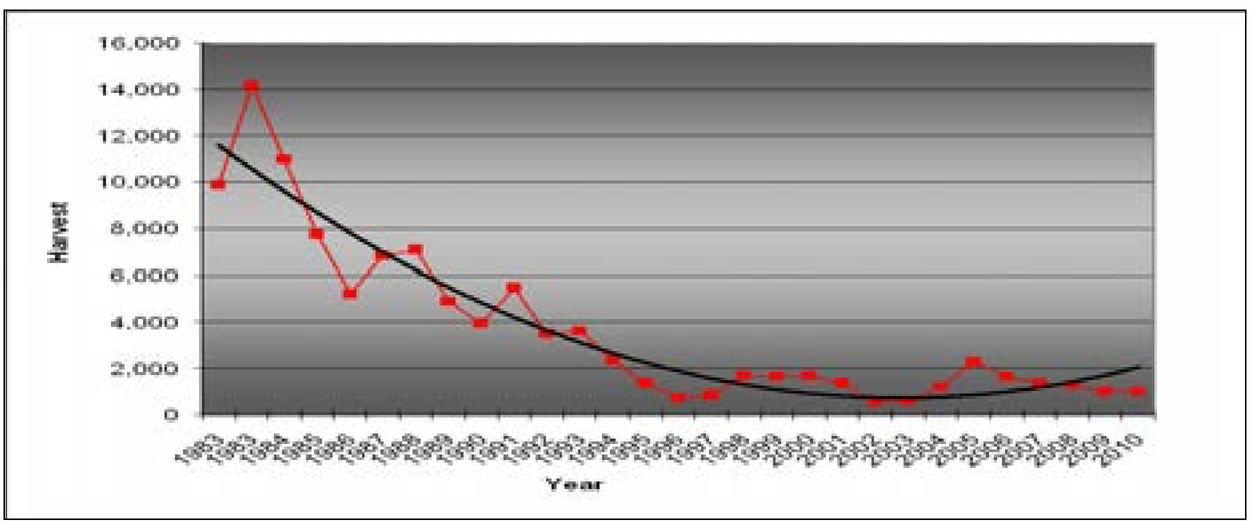
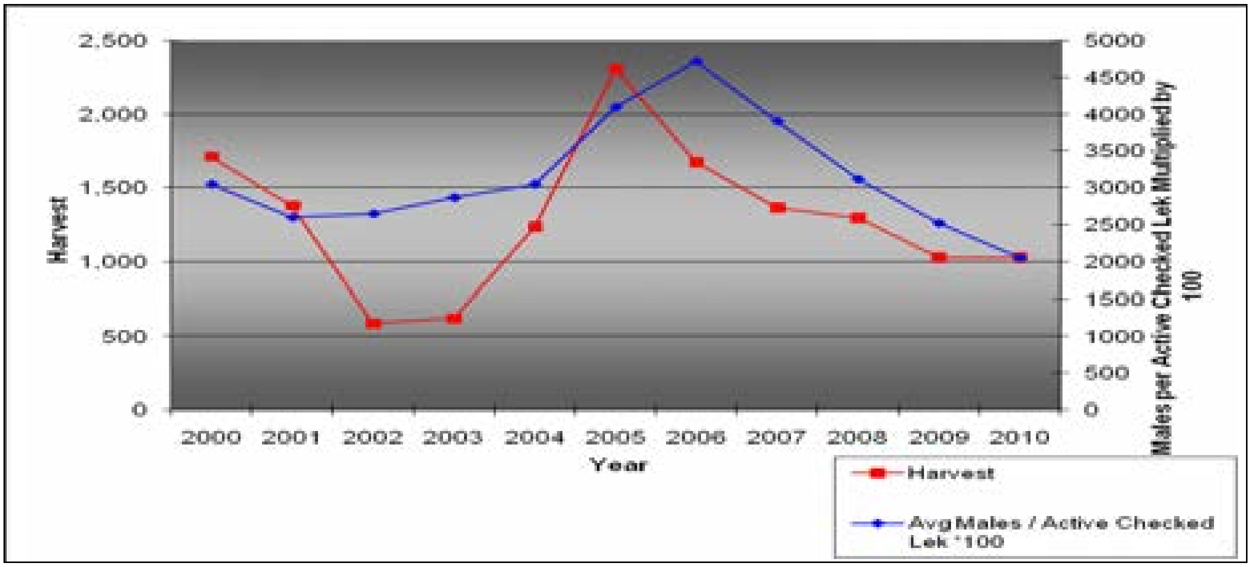


Figure 10. Total sage-grouse harvested per year and the average number of males per active lek checked within the BHSBCA, 1999 – 2010.



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 2008a). 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 BHSBCA. 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 Palmer Drought Severity Index, the climatic regime in the BHSBCA can largely be characterized by long-term drought from the late 1990's through 2007. Since 2007, precipitation has improved dramatically. The following explanation of the Palmer Drought Severity Index was copied from the 2010 WGFD Big Game JCR – Appendix A (WGFD 2011). The Palmer Drought Severity Index was developed in the 1960s, using temperature and precipitation data to determine dryness. The index is most effective in determining long-term drought. Another index, the Crop Moisture Index (CMI) is more sensitive to short-term conditions. On the Palmer scale, zero is normal, -2 is moderate drought, -3 is severe drought, and -4 is extreme drought. Positive numbers indicate wetter than normal time periods. Since this index does not reflect snow moisture, it typically works best for areas east of the Continental Divide. Palmer Severity Indices indicate that, from 1995-1999, the Lower Platte climatic division experienced wetter than normal conditions (Figures 11 & 12). The division entered drought conditions in 2000, with conditions becoming extreme in 2002, 2004 and 2006. However, conditions in recent years have returned to wetter than normal. Temperatures were generally cooler than normal during the spring and winter and warmer than normal in the summer in bio-year 2010 (Figures

13 & 14). During bio-year 2010, precipitation was generally well above normal, especially during the spring growing season (Figures 15 & 16).

Figure 11. Drought severity trend for Wyoming Climate Division 8 (Lower North Platte Drainage), 1982 – 2010 (http://www.drought.noaa.gov/palmer.html).

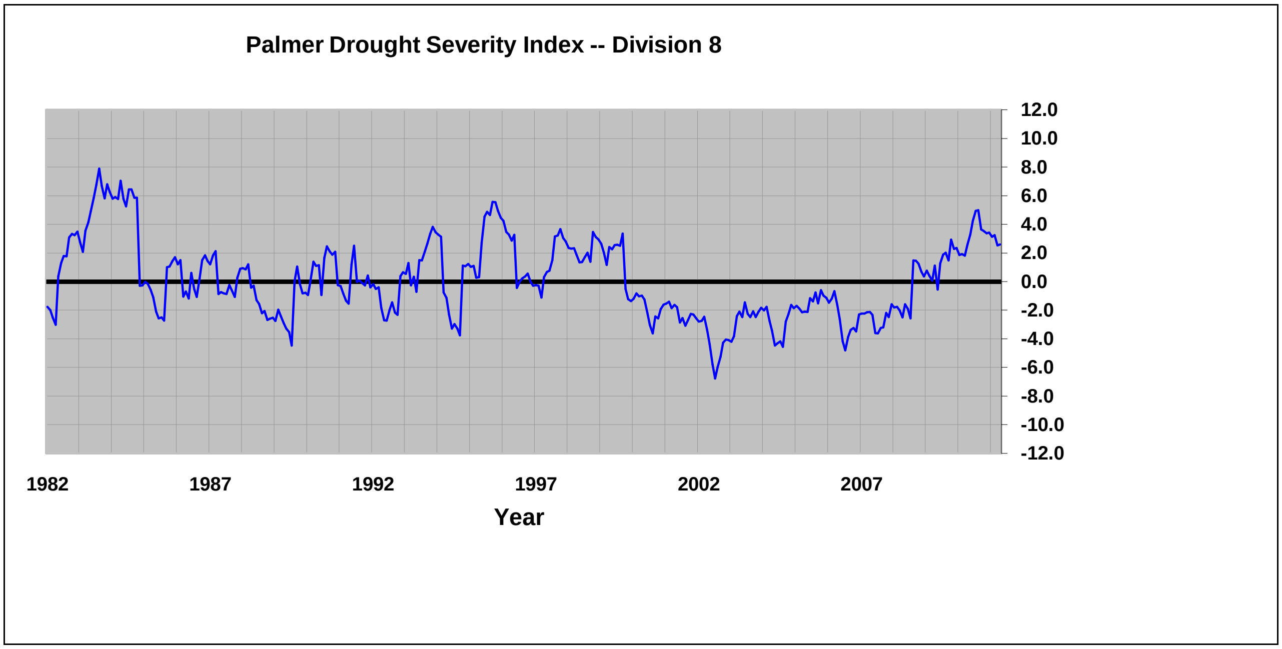


Figure 12. Drought severity trend for Wyoming Climate Division 10 (Upper North Platte Drainage), 1982 – 2010 (http://www.drought.noaa.gov/palmer.html).

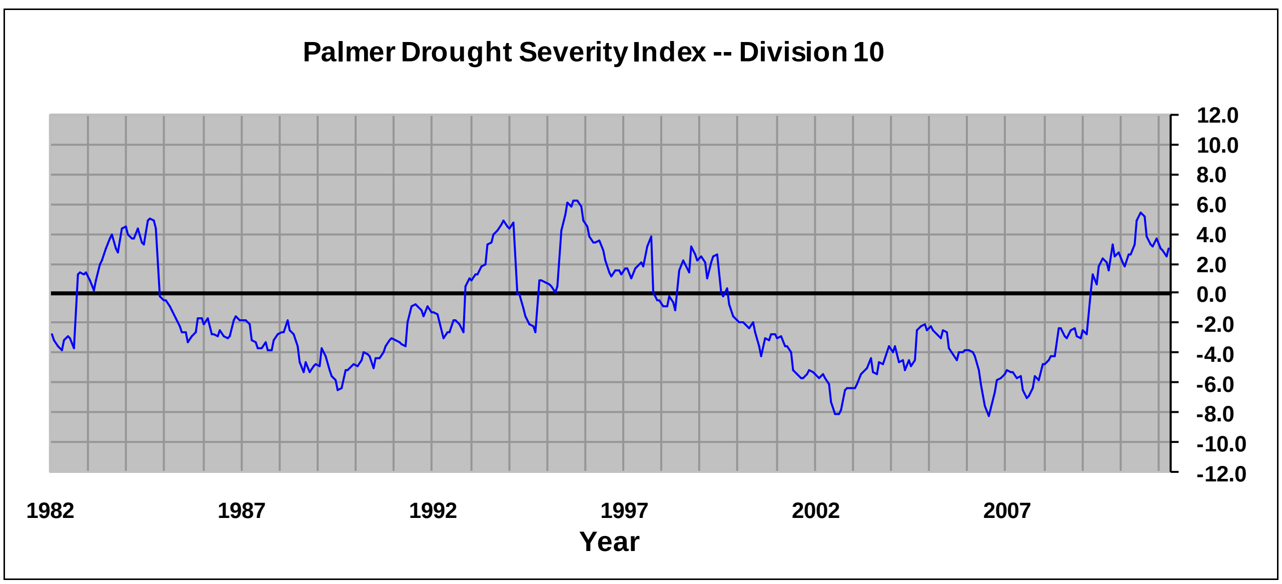


Figure 13. 2010 Bio-Year monthly temperature data (^{o}F), Wyoming Climate Division 8 (Lower North Platte Drainage).

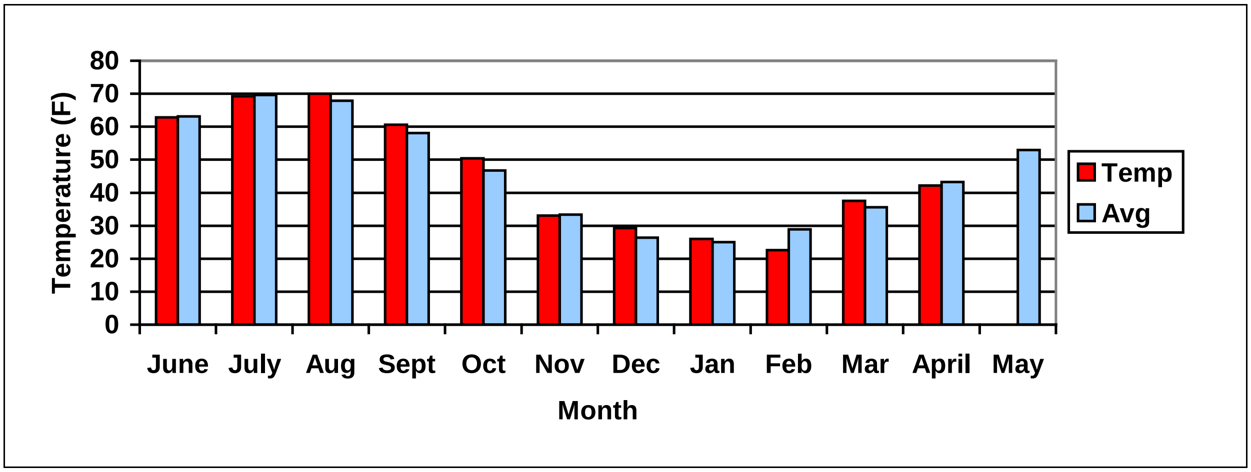


Figure 14. 2010 Bio-Year monthly temperature data (^{o}F), Wyoming Climate Division 10 (Upper North Platte Drainage).

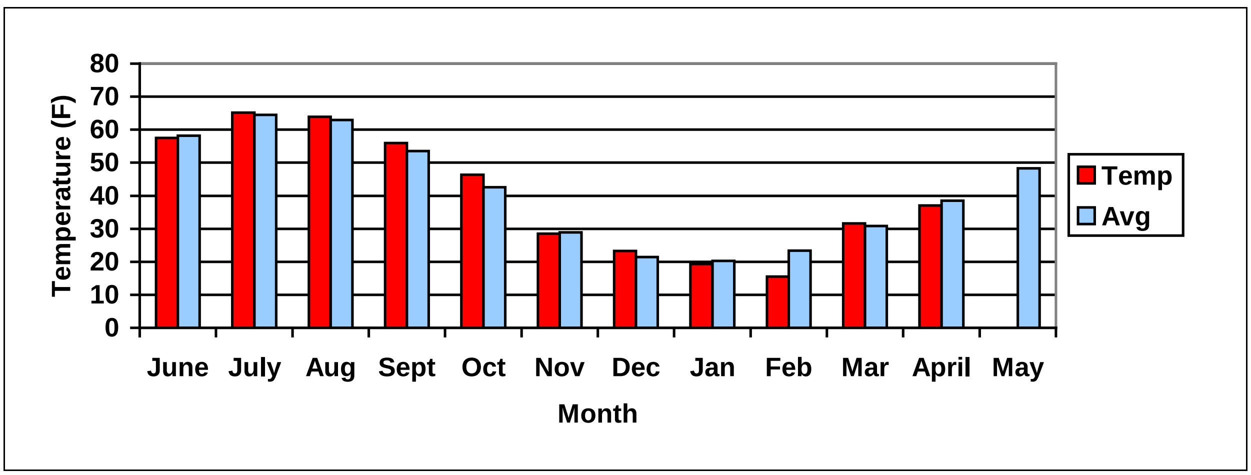


Figure 15. 2010 Bio-Year monthly precipitation data (in), Wyoming Climate Division 8 (Lower North Platte Drainage).

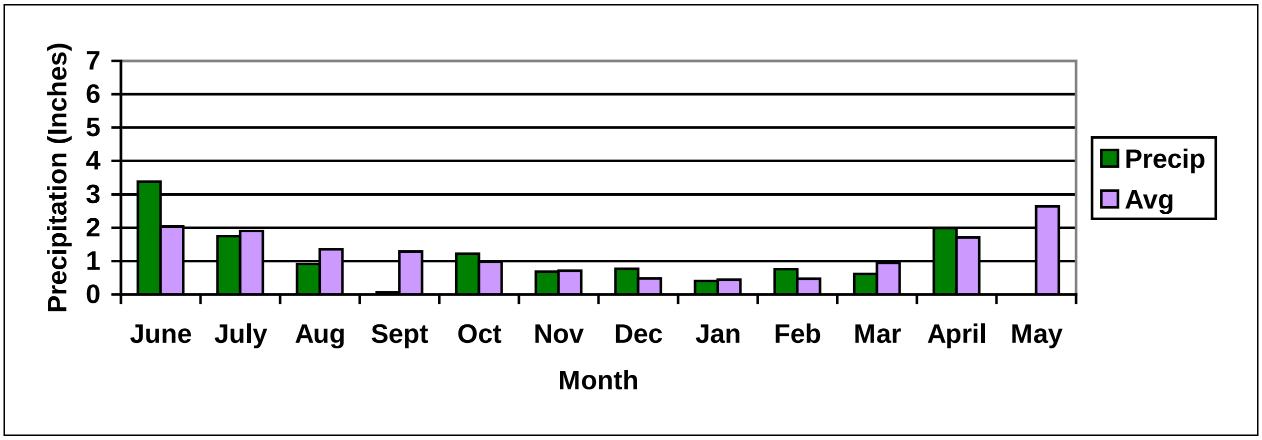
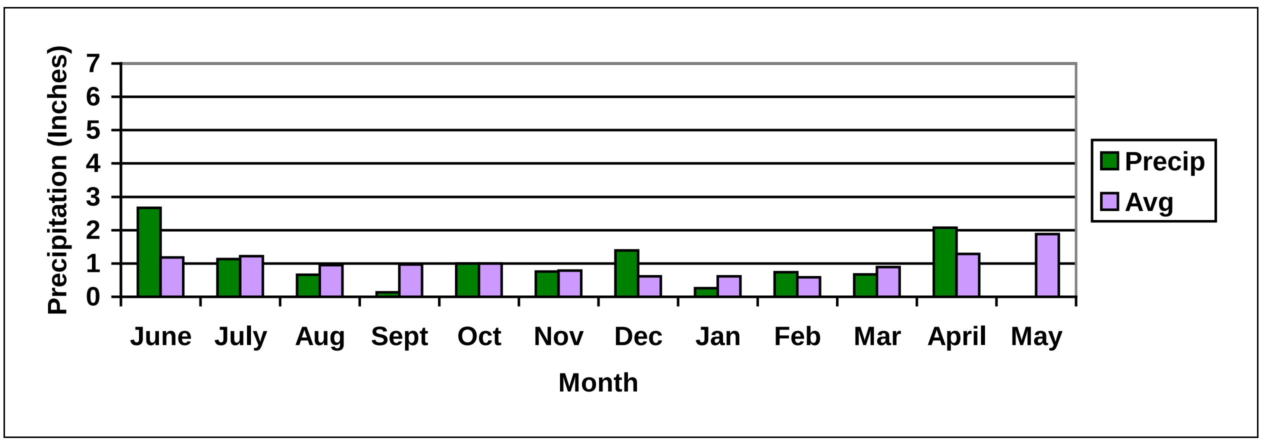


Figure 16. 2010 Bio-Year monthly precipitation data (in), Wyoming Climate Division 10 (Upper North Platte Drainage).



Despite drought conditions prevailing throughout the BHSBCA from 2001 – 2006, sage-grouse populations increased within this area. During the springs of 2007 – 2010, the region received substantial spring precipitation resulting in vastly improved herbaceous plant and sagebrush leader growth production over the last 4 growing seasons. However, such cool wet springs may have caused elevated nest failure and abandonment and/or poor survival of newly hatched chicks during the early brood rearing phase. This has been evidenced by the poor chick:hen ratios observed in the 2007 – 2010 wing 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. Meaningful correlations between annual variations in precipitation (and resulting vegetative production) and population trend have not been made.

Special Studies

The Western Natrona County Sage-grouse Distribution Study was commissioned during the spring of 2008. This study, which is a joint venture with the BLM, WGFD, and the University of Wyoming, was initiated to map seasonal habitat selection and document parasite loading within a high-density sage-grouse population in western Natrona County. This research was primarily funded by the BLM and partially funded from local sage-grouse working group funds. Field data collection concluded in the fall of 2010. The final report has been compiled in the form of a Masters Thesis (Mandich 2011).

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, and 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.

Diseases

West Nile Virus (WNV) was first detected in western Natrona County from a dead radio-marked bird during the summer of 2008. During the summer of 2009, a second sage-grouse was confirmed to have died from WNV. These radio-marked grouse were research birds from the aforementioned Western Natrona County Sage-grouse Distribution Study. Within this study, most cases of summer marked bird mortality could not be definitively attributed to WNV as most carcasses were too decomposed at time of discovery to permit diagnosis. The impact on populations exposed to WNV was analyzed by looking at survival of radio-collared adult female sage grouse from 12 studies across their range (Naugle et al. 2005). Late summer survival (July 1 – September 30) for birds from populations with West Nile Virus was 10% lower (86% survival) than for birds from populations with no WNV (96%). The extent of WNV infection and its effects on sage-grouse populations throughout the BHSBCA over the last two years is unknown, but potentially significant. However, no data exists to indicate recent declines in the BHSBCA sage-grouse population can be specifically attributed to WNV.

Recommendations

1. Continue to implement the Bates Hole/Shirley Basin LWG Conservation Plan, which was approved by the Wyoming Game and Fish Commission in February of 2007.

2. Begin revision of the Bates Hole/Shirley Basin LWG Conservation Plan to conform to the Wyoming Governor's Executive Order (2011-5) and the Bureau of Land Management's Instructional Memorandum outlining sage-grouse protections within Wyoming.

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

4. Continue, and perhaps expand, sagebrush monitoring throughout the BHSBCA to ensure adequate data is collected to document use and productivity. Where appropriate, wildlife managers should use this data to ensure proper utilization by big-game (primarily pronghorn).

5. The BHSBLWG should continue to solicit conservation projects that will benefit sage-grouse. These might include riparian corridor protection, wind energy related research, water development, and different livestock grazing regimes.

6. Ensure monitoring of all count leks/complexes is conducted properly and consistently on an annual basis. Continuity is very important to detect population change.

7. Attempt to check leks that have not been monitored for many years to determine their status. If possible, attempt to at least survey all leks each year. 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.

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

9. 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 BHSBCA occur within the Laramie WGFD Region.

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Appendix I. Wyoming Game and Fish Department Sage-grouse Lek Definitions (revised 2/09/2010)

Wyoming Sage-Grouse Definitions:
The following definitions have been adopted for the purposes of collecting and reporting sage-grouse data. See the sage-grouse chapter of the Wyoming Game and Fish Department's Handbook of Biological Techniques for additional technical details and methods.

Lek - A traditional courtship display area attended by male sage-grouse in or adjacent to sagebrush dominated habitat. A lek is designated based on observations of two or more male sage-grouse engaged in courtship displays. Before adding the suspected lek to the database, it must be confirmed by an additional observation made during the appropriate time of day, during the strutting season. Sign of strutting activity (tracks, droppings, feathers) can also be used to confirm a suspected lek. Sub-dominant males may display on itinerant (temporary) strutting areas during population peaks. Such areas usually fail to become established leks. Therefore, a site where small numbers of males (<5) are observed strutting should be confirmed active for two years before adding the site to the lek database.

Satellite Lek – A relatively small lek (usually less than 15 males) that develops within about 500 meters of a large lek during years of relatively high grouse numbers. Locations of satellite leks should be encompassed within lek perimeter boundaries. Birds counted on satellite leks should be added to those counted on the primary lek for reporting purposes.

Lek Perimeter – The outer perimeter of a lek and any associated satellites. Perimeters should be mapped by experienced observers using established protocols for all leks with larger leks receiving higher priority. Perimeters may vary over time as population levels or habitat and weather conditions change. However, changes to mapped perimeters should occur infrequently and only if grouse use consistently (2+ years) demonstrates the existing perimeter to be inaccurate. A point **within** the lek perimeter must be recorded or calculated as the identifying location for the lek. The point may be the geographic center of the perimeter polygon as calculated though a GIS exercise or a GPS point reflecting the center of breeding activity as typically witnessed on the lek.

Lek Complex - A lek or group of leks within 2.5 km (1.5 mi) of each other between which male sage-grouse may interchange from one day to the next.

Lek Count - A census technique that documents the actual number of male sage-grouse observed attending a lek complex. The following criteria are designed to assure counts are done consistently and accurately, enabling valid comparisons to be made among data sets. Additional technical criteria are available from the WGFD.

- Conduct lek counts at 7-10 day intervals over a 3-4 week period after the peak of mating activity. Although mating typically peaks in early April in Wyoming, the number of males counted on a lek is usually greatest in late April or early May when attendance by yearling males increases.
- Conduct lek counts only from the ground. Aerial counts are not accurate and are not comparable to ground counts.
  - Conduct counts from ½ hour before sunrise to 1 hour after.
  - Count attendance at each lek a minimum of three times annually during the breeding season.

- Conduct counts only when wind speeds are less than 15 kph (~10 mph) and no precipitation is falling.
- All leks within a complex should be counted on the same morning.

Lek Count Route – A lek route is a census of a group of leks that are relatively close and represent part or all of a single breeding population/sub-population. Leks should be counted on routes to facilitate repetition by other observers, increase the likelihood of recording satellite leks, and account for shifts in breeding birds if they occur. Lek routes should be established so that all leks along the route can be counted within 1.5 hours following the criteria listed under "Lek Count".

Lek Survey - Ideally, all sage-grouse leks would be counted annually. However, some breeding habitat is inaccessible during spring because of mud and snow, or the location of a lek is so remote it cannot be routinely counted. In other situations, topography or vegetation may prevent an accurate count from any vantage point. In addition, time and budget constraints often limit the number of leks that can be visited. Where lek counts are not feasible for any of these reasons, surveys are the only reliable means to monitor population trends. Lek surveys are designed principally to determine whether leks are active or inactive, requiring as few as one visit to a lek. Obtaining accurate counts of the numbers of males attending is not essential. Lek surveys involve substantially less effort and time than lek counts. They can also be done from a fixed-wing aircraft or helicopter. Lek surveys can be conducted from the initiation of strutting in early March until early-mid May, depending on the site and spring weather.

Annual status – Lek status is assessed annually based on the following definitions:

- **active** – Any lek that has been attended by male sage-grouse during the strutting season. Acceptable documentation of grouse presence includes observation of birds using the site or signs of strutting activity.

- **inactive** – Any lek where sufficient data suggests that there was no strutting activity throughout a strutting season. Absence of strutting grouse during a single visit is insufficient documentation to establish that a lek is inactive. This designation requires documentation of either: 1) an absence of birds on the lek during at least 2 ground surveys separated by at least 7 days. These surveys must be conducted under ideal conditions (4/1-5/7, no precipitation, light or no wind, ½ hour before to 1 hour after sunrise) or, 2) a ground check of the exact known lek site late in the strutting season (after 4/15) that fails to find any sign (droppings/feathers) of strutting activity. Data collected by aerial surveys may not be used to designate inactive status.

- **unknown** – Leks for which status as active or inactive has not been documented during the course of a strutting season. Except for those leks not scheduled for checks in a particular year, use of this status should be rare. Leks should be checked with enough visits to determine whether it is active or not. It is better to have two good checks every other year and confirm it "inactive" than to check it once every year, not see birds, but remain in “unknown” status.

Management status - Based on its annual status, a lek is assigned to one of the following categories for management purposes:

- **occupied lek –** A lek that has been active during at least one strutting season within the prior ten years. Occupied leks are protected through prescribed management actions during surface disturbing activities.

- **unoccupied lek –** (Formerly “historical lek”.) There are two types of unoccupied leks, “destroyed” and “abandoned.” Unoccupied leks are not protected during surface disturbing activities.

- **destroyed lek –** A formerly active lek site and surrounding sagebrush habitat that has been destroyed and is no longer suitable for sage-grouse breeding. A lek site that has been strip-mined, paved, converted to cropland or undergone other long-term habitat type conversion is considered destroyed. Destroyed leks are not monitored unless the site has been reclaimed to suitable sage-grouse habitat.

- **abandoned lek –** A lek in otherwise suitable habitat that has not been active during a period of 10 consecutive years. To be designated abandoned, a lek must be “inactive” (see above criteria) in at least four non-consecutive strutting seasons spanning the ten years. The site of an “abandoned” lek should be surveyed at least once every ten years to determine whether it has been reoccupied by sage-grouse.

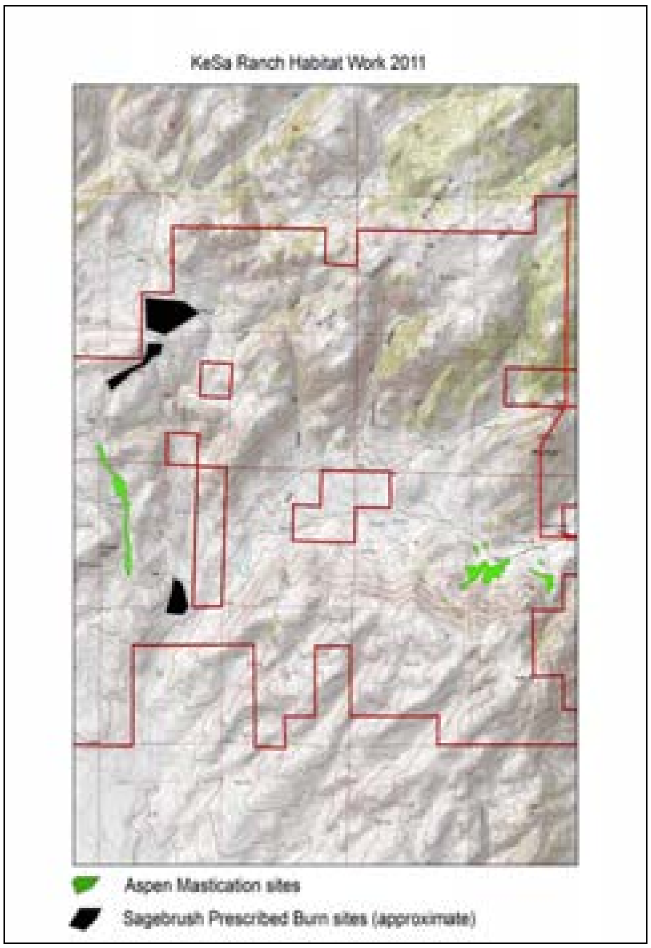
- **undetermined lek –** Any lek that has not been documented active in the last ten years, but survey information is insufficient to designate the lek as unoccupied. Undetermined leks will be protected through prescribed management actions during surface disturbing activities until sufficient documentation is obtained to confirm the lek is unoccupied. Use of this status should be rare (see “unknown” above).

Winter Concentration Area - During winter, sage-grouse feed almost exclusively on sagebrush leaves and buds. Suitable winter habitat requires sagebrush above snow. Sage-grouse tend to select wintering sites where sagebrush is 10-14 inches above the snow. Sagebrush canopy cover utilized by sage-grouse above the snow may range from 10 to 30 percent. Foraging areas tend to be on flat to generally southwest facing slopes or on ridges where sagebrush height may be less than 10 inches but the snow is routinely blown clear by wind. When these conditions are met, sage-grouse typically gain weight over winter. In most cases winter is not considered limiting to sage-grouse. Under severe winter conditions grouse will often be restricted to tall stands of sagebrush often located on deeper soils in or near drainage basins. Under these conditions winter habitat may be limiting. On a landscape scale, winter habitats should allow sage-grouse access to sagebrush under all snow conditions.

Large numbers of sage-grouse have been documented to persistently use some specific areas which are characterized by the habitat features outlined above. These areas should be delineated as “winter concentration areas”. Winter concentration areas do not include all winter habitats used by sage-grouse, nor are they limited to narrowly defined “severe winter relief” habitats. Delineation of these concentration areas is based on determination of the presence of winter habitat characteristics confirmed by repeated observations and sign of large numbers of sage-grouse. The definition of "large" is dependent on whether the overall population is large or small. In core population areas frequent observations of groups of 50+ sage-grouse meet the definition while in marginal populations group size may be 25+. Consultation and coordination with the WGFD is required when delineating winter concentration areas.

Appendix II. Descriptions of conservation projects within the BHSBCA funded through the Wyoming Governor's Sage-grouse Conservation Fund (via the BHSBLWG), 2010.

1) On the KeSa Ranch in northeastern Albany County, approximately 60 acres of mountain big sagebrush (*Artemisia tridentata vaseyana*) was burned to provide sagebrush age class diversity and enhance grass and forb production to benefit sage-grouse brood rearing habitats (and other wildlife habitats). Post-treatment monitoring updates were not available at the time of this report.



2) During September 2011, WGFD burned 499 acres of mountain big sagebrush communities to reduce big sagebrush canopy and density. This reduction will increase plant diversity by allowing more resources (moisture, sunshine, etc.) to be utilized by grasses and forbs. Furthermore, the implementation of this project will release more water into the watershed by removing big sagebrush. This project was not implemented to remove all big sagebrush, but to remove big sagebrush in specific areas that would provide the most diversity by creating a mosaic of burned and unburned areas across the landscape. Moreover, the project implemented on Indian Creek was to remove big sagebrush that had encroached wet meadows and spring source areas, which if not treated, would further dry these areas over time. This burn also was designed to enhance grass and forb production to benefit sage-grouse brood rearing habitats (and other wildlife habitats). Post-treatment monitoring updates were not available at the time of this report. Seasonal sage-grouse use of this project area will be monitored in 2012 and 2013.

Big Horn Basin Sage-Grouse JCR Narrative Report

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

Period covered: **6/1/2010 – 5/31/2011**
Local Working Group: **Big Horn Basin**
Prepared by: **Tom Easterly**

INTRODUCTION

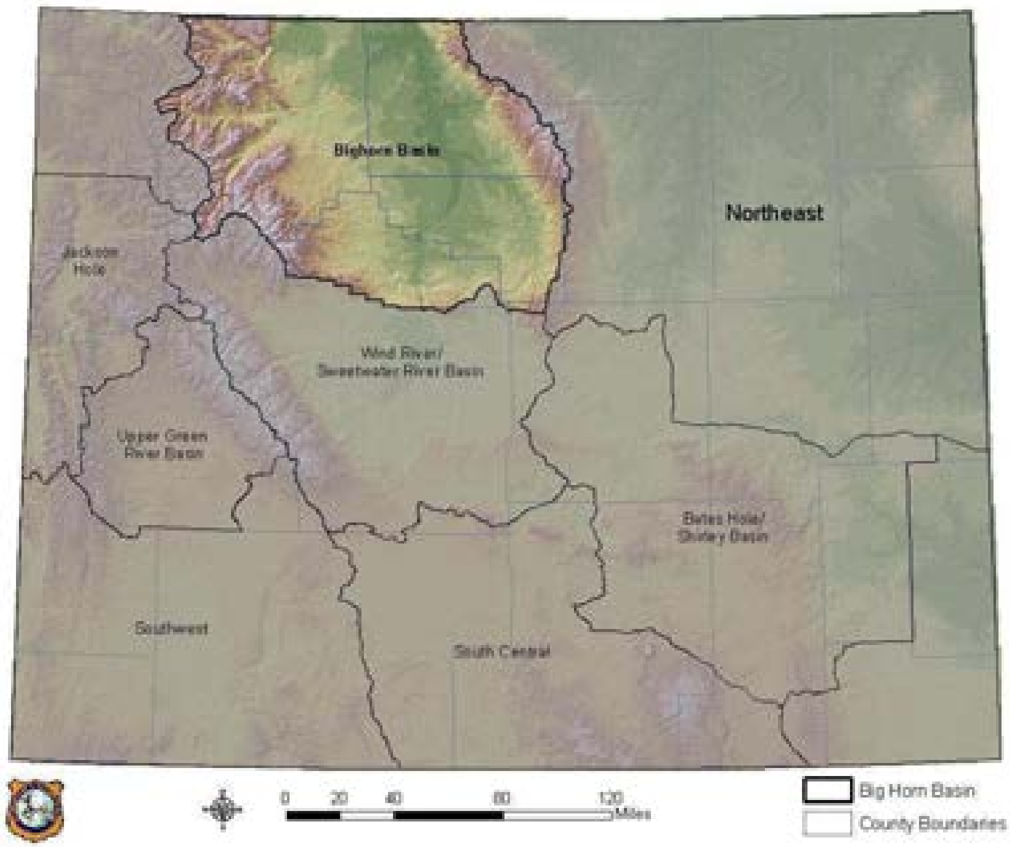
During the late 1990s, concerns increased over degradation and fragmentation of sagebrush ecosystems and declines in greater sage-grouse (*Centrocerucus urophasianus*, hereafter referred to as sage-grouse) populations. Wyoming Game & Fish Department (WGFD) increased monitoring efforts for sage-grouse 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 industry, 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 local working group (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://gf.state.wy.us/wildlife/wildlife_management/sagegrouse/index.asp.

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 annually by the USFWS.

This annual report summarizes conservation efforts and data collected on sage-grouse in the Big Horn Basin during the 2010 biological year (1 June 2010–31 May 2011), including the 2011 breeding season.

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



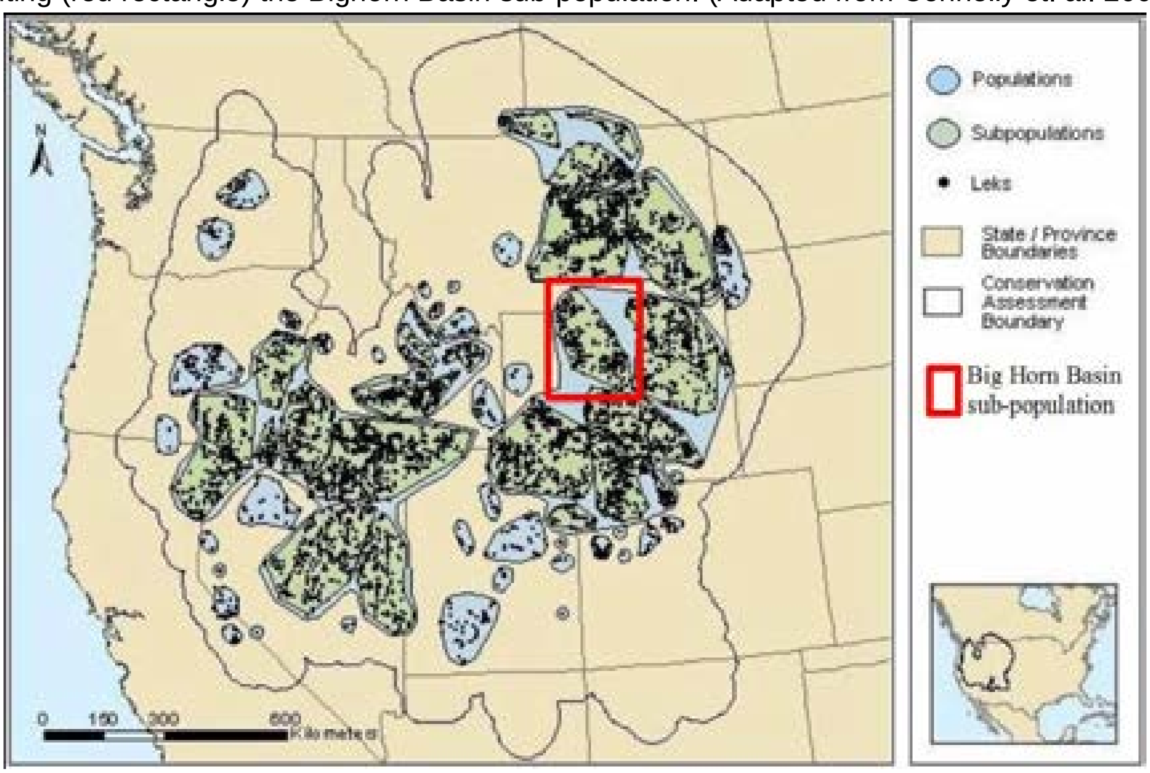
STUDY AREA

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 Bureau of Land Management (BLM; 40%), Forest Service (25%), State "school lands" (5%), or other government agencies (>1%; Bureau of Reclamation, National Park Service, Department of Defense). Over 3100 square miles of the Basin (25%) are private land. Counties within the Basin include Big Horn, Hot Springs, Park, and Washakie. WGFD has the state divided into management areas for data collection and reporting of small and upland game species. Beginning last year, 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, dry-land and irrigated 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 plan area 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 Bighorn Basin sub-population. (Adapted from Connelly et. al. 2004).



As of spring 2011, there were 242 known, occupied sage-grouse leks in the conservation area. Two new strutting sites were located during the 2011 breeding season. There are probably leks within the Basin that have not been discovered. A majority of leks (69%) occur on BLM managed land and 23% of known leks occur on private land (Table 1). Thirty-seven additional lek sites were unoccupied (“abandoned” or "historical"); four of which were abandoned due to destruction of the lek site. Several leks previously classified as "Undetermined" or unknown have been reclassified as unoccupied as more data was collected.

Table 1. Distribution of the 283 sage-grouse leks within the Big Horn Basin Conservation Area based on status and various geopolitical subdivisions, 2010.

Classification	**Number**	**Percent**
Occupied	242	85.5%
Undetermined	4	1.4%
Unoccupied	37	13.1%

Unoccupied Leks	**Number**
Abandoned	24
Destroyed	4
Unknown	9

Land Status	**Number**	**Percent**
BLM	194	68.6%
Private	65	23.0%
State	22	7.8%
BOR	1	0.4%

County	**Number**	**Percent**
Big Horn	44	15.5%
Hot Springs	45	15.9%
Park	96	33.9%
Washakie	98	34.6%

WGFD Biologist District	**Number**	**Percent**
Cody	76	26.9%
Greybull	47	16.6%
Worland	160	56.5%

BLM Office	**Number**	**Percent**
Cody	101	35.7%
Worland	182	64.3%

WGFD Game Warden District	**Number**	**Percent**
Greybull	28	9.9%
Lovell	17	6.0%
Meeteetse	36	12.7%
North Cody	22	7.8%
Powell	14	4.9%
South Cody	18	6.4%
Ten Sleep	43	15.2%
Thermopolis	38	13.4%
Worland	67	23.7%

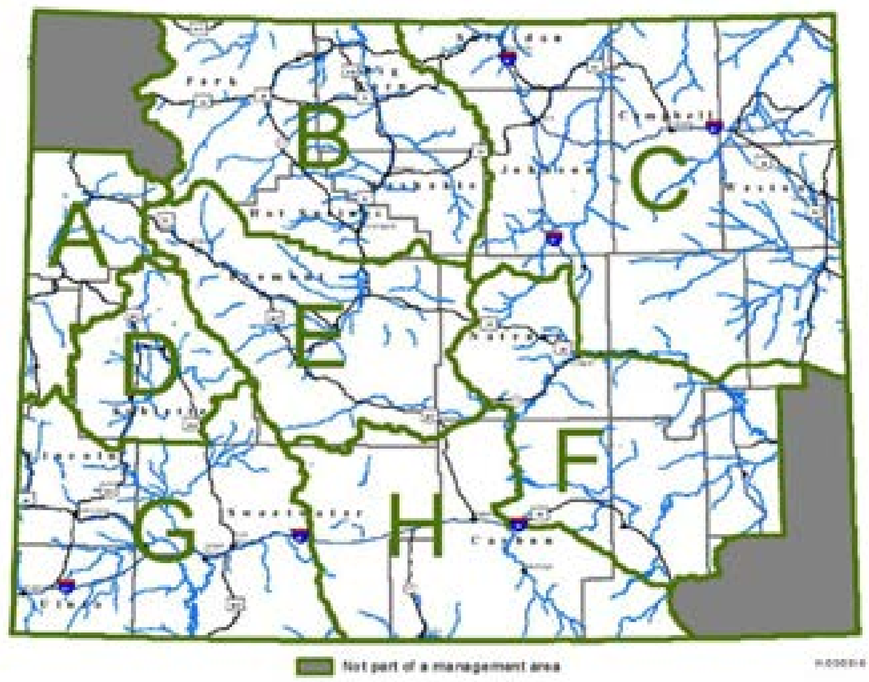
METHODS

Since 1998, data on numbers of sage-grouse attending leks were collected in two ways: lek surveys and 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-rearing 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 and 3). The entire Big Horn Basin is sage-grouse Management Area B.

Figure 3. Sage-grouse management areas in Wyoming, 2010.



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

Lek monitoring. The number of male sage-grouse observed at leks in the Big Horn Basin conservation area during the 2011 breeding season declined from 2010 lek observations (Table 2, Fig. 4). For 2011, there was an average of 13.0 males observed at all active leks (counted and surveyed). Average male attendance was calculated using only active leks (those leks where one or more males were present). In spring 2011, 64 leks were observed following count protocols (2000-10 average=72) and 131 leks were surveyed (at least one visit; 2000-10 average=95). The average number of males observed at count leks (13.6) is typically higher than survey leks (12.3); however, long-term data sets indicate similar trends in both counts and surveys (Fedy and Aldridge 2011). Count leks are typically larger and attended more consistently, while

Table 2 (a-d). Lek attendance summary (occupied leks) in the Big Horn Basin, 2000-2011.

a. Leks Counted

Year	Known	Counted	Percent Counted	Max Totals Males	Max Totals Females	Avg. /Active Lek Males	Avg. /Active Lek Females
2000	223	46	20.6	1141	418	24.8	9.1
2001	223	43	19.3	791	300	18.4	7.0
2002	224	57	25.4	773	395	13.6	6.9
2003	226	66	29.2	1051	438	15.9	6.6
2004	233	61	26.2	1140	242	18.7	4.0
2005	235	84	35.7	1753	596	20.9	7.1
2006	239	64	26.8	1714	546	26.8	8.5
2007	241	71	29.5	1876	525	26.4	7.4
2008	242	96	39.7	2054	739	21.4	7.7
2009	245	75	30.6	1717	658	22.9	8.8
2010	250	75	30.0	1492	649	19.9	8.7
2011	246	64	26.0	871	431	13.6	6.7

b. Leks Surveyed

Year	Known	Surveyed	Percent Surveyed	Max Total	Avg Males/ Active Lek
2000	223	60	26.9	1126	23.5
2001	223	80	35.9	1316	19.6
2002	224	72	32.1	572	10.2
2003	226	91	40.3	651	10.3
2004	233	91	39.1	967	14.4
2005	235	92	39.1	1251	17.9
2006	239	104	43.5	1727	24.0
2007	241	89	36.9	1546	22.4
2008	242	84	34.7	1114	16.9
2009	245	111	45.3	1245	18.3
2010	250	125	50.0	1204	14.9
2011	246	131	53.3	959	12.3

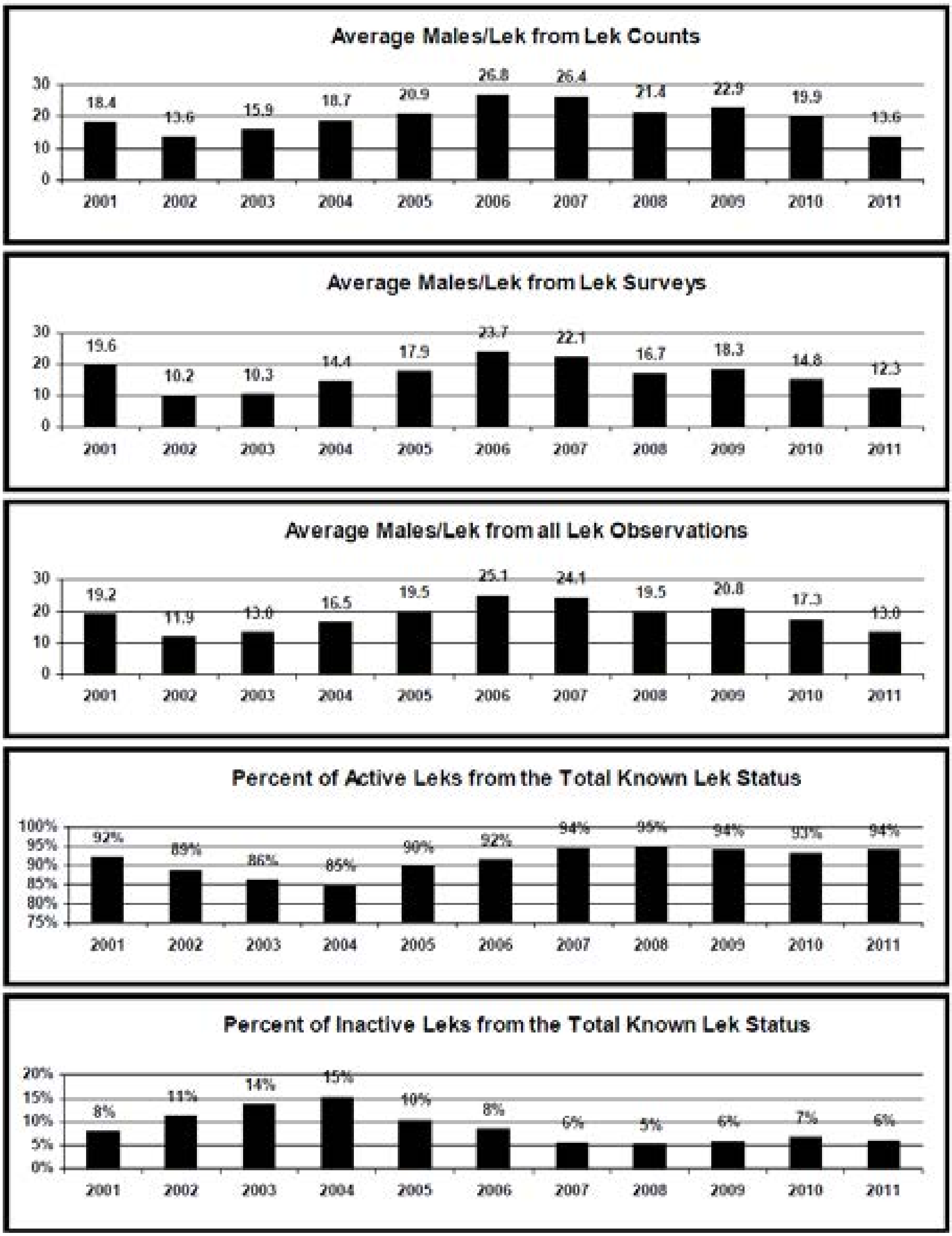
c. Leks Checked

Year	Known	Checked	Percent Checked	Max Total	Avg Males/ Active Lek
2000	223	106	47.5	2267	24.1
2001	223	123	55.2	2107	19.2
2002	224	129	57.6	1345	11.9
2003	226	157	69.5	1680	13.0
2004	233	154	66.1	2107	16.5
2005	235	178	75.7	3004	19.5
2006	239	168	70.3	3441	25.3
2007	241	161	66.8	3422	24.3
2008	242	180	74.4	3168	19.6
2009	245	185	75.5	2952	20.8
2010	250	199	79.6	2696	17.4
2011	246	191	77.6	1807	13.0

d. Lek Status

Year	Active	Inactive	Not Located	Unknown	-----Confirmed Status----- Total	Active	Inactive
2000	93	4	2	124	97	95.9%	4.1%
2001	107	9	1	106	116	92.2%	7.8%
2002	102	13	4	105	115	88.7%	11.3%
2003	120	19	3	84	139	86.3%	13.7%
2004	117	21	4	91	138	84.8%	15.2%
2005	139	16	1	79	155	89.7%	10.3%
2006	129	12	1	97	141	91.5%	8.5%
2007	136	8	1	96	144	94.4%	5.6%
2008	147	8	0	87	155	94.8%	5.2%
2009	128	8	0	109	136	94.1%	5.9%
2010	142	10	0	98	152	93.4%	6.6%
2011	126	8	0	112	134	94.0%	6.0%

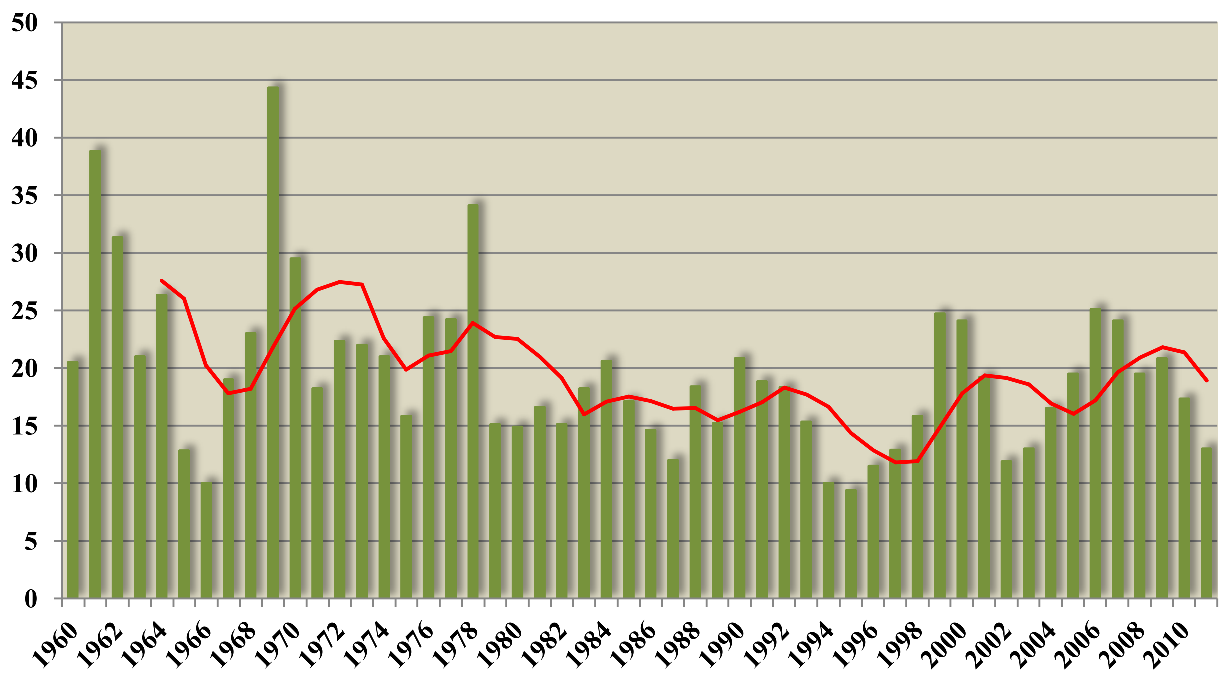
Figure 4. Sage-grouse lek attendance for the Big Horn Basin, Wyoming, 2001-11.



survey leks are usually smaller. It is less likely that “peak” male attendance is documented at survey leks since they area visited by observers less frequently.

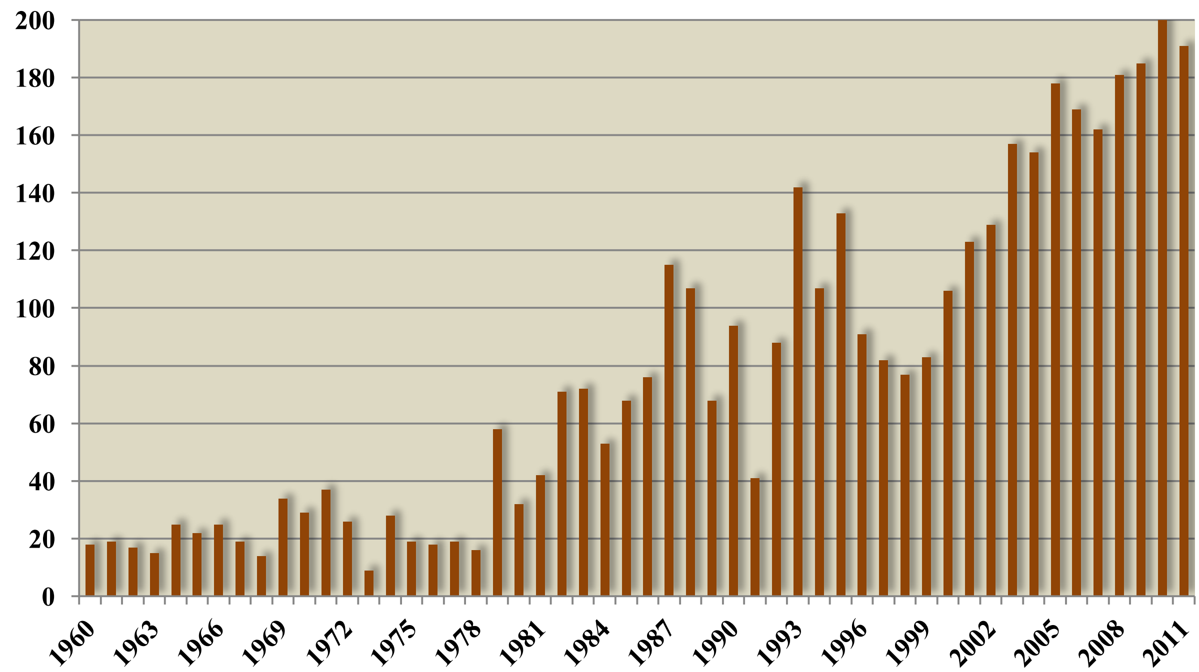
Declines in average male attendance at leks observed during the past three years may be natural fluctuations in sage-grouse population cycles and not a declining trend in the Big Horn Basin subpopulation (Fig. 5). Sage-grouse populations, in the Basin and elsewhere, cycle on an approximate 7 to 10-year interval. 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 25 males/lek in 2006.

Figure 5. Trends in average male attendance at sage-grouse leks in the Bighorn Basin, 1960-2011. Trend line (red) represents 5-year running average.



Over the past 30-years (1981-2011), an increasing number of leks have been checked (counted and surveyed) each year (Fig. 6). In most years (all but 3), over 50 leks were included in calculations of average males per lek. Averages based on a small number of leks may not represent actual conditions. The decreasing trend in average male attendance at leks prior to 1980 may be an artifact of data collection efforts (Fig 6); however, anecdotal accounts of sage-grouse numbers in the Basin do suggest declines during that period. Small sample sizes probably also account for the wide fluctuation in average male attendance seen between 1960 and 1980.

Figure 6. Number of sage-grouse leks checked (counted and surveyed) in the Bighorn Basin, 1960-2011.



Brood surveys. Surveys for sage-grouse are conducted during July and August each year to document nest success and brood-rearing habitats. Most survey work is done in conjunction with other activities and no survey routes were established. All sage-grouse observations by WGFD personnel were entered into the Department's Wildlife Observation System. WGFD personnel coded 104 hours to sage-grouse (species code CT) brood surveys (activity code 512) in 2010; including travel time to and from possible brood-rearing areas. Twenty-three groups of female sage-grouse were observed (Table 3). Groups of grouse recorded as only males, only unknown adults, or unknown sex/age were not included in Table 3. It is unlikely that nest success and brood survival was 100% as suggested in Table 3 (no barren hens classified). Observers may need additional training on classification of grouse to sex since adults were only classified as hens when broods were evident.

Broods were observed mostly in agricultural fields and sagebrush-grassland habitats. Locating broods and counting chicks in dense vegetation (e.g., alfalfa, tall sagebrush) is difficult, so total chick production may be underestimated. For those groups of grouse where birds were classified to sex and age, there were 3.8 chicks per brood and 3.8 chicks per hen. Between 1999 and 2008, grouse production averaged 4.1 chicks/brood and 2.5 chicks/hen (Table 4). Most annual production data was based on small sample sizes (less than 25 groups of grouse), so results may not reflect true conditions. The chicks/hen value in 2010 was higher than expected since no barren hens were classified.

Table 3. Number of sage-grouse hens with or without broods observed by WGFD personnel in the Big Horn Basin during summer 2010.

Observ. date	Adult female	Adult unknown	Juvenile	Unknown sex/age	Habitat	General location
7/8	1		5		sagebrush	Porcupine drainage
7/19	1		3		sagebrush	Tatman Mtn
7/19	1		6		ag. land	Roach Gulch
7/19	1		2		sagebrush	East Ridge
7/19	1		4		sagebrush	East Ridge
7/21	1		5			Wood River
7/21	1		2		sagebrush	Nowater drainage
7/22	1		5		ag. land	Wood River
7/23	1		1		ag. land	Whistle Creek
7/27	1		3		ag. land	Gooseberry drainage
7/29	1		6		sagebrush	Wild Horse Butte
7/31	1		3		sagebrush	Cottonwood Ck-Rattlesnake
7/31	1		4		sagebrush	Cottonwood Ck-Rattlesnake
7/31	1		4		ag. land	Cottonwood Ck-Rattlesnake
8/3	1		3		sagebrush	Middle Fk Otter Ck
8/16	1		4		sagebrush	Heart Mtn canal
8/18	1		4		sagebrush	McCullough Peaks
Total	17		64			

Other observations with insufficient data for inclusion in brood calculations:

Observ. date	Adult female	Adult unknown	Juvenile	Unknown sex/age	Habitat	General location
7/29		9	3		ag. land	Cottonwood Ck-Blue Mesa
7/29		13	6		ag. land	Cottonwood Ck-Blue Mesa
7/29		25	11		ag. land	Cottonwood Ck-Blue Mesa
7/29		6	1	12	ag. land	Cottonwood Ck-Blue Mesa
8/16		4	7		sagebrush	Heart Mtn canal

Table 4. Brood survey data collected by Wyoming Game & Fish Department personnel in the Bighorn Basin, 1999-2009.

Year	Groups observed	Broods	Chicks	Hens	Chicks/ brood	Chicks/ hen
2000	24	25	85	32	4.3	2.7
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
2000-09 Average	25	24	95	42	4.1	2.5

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

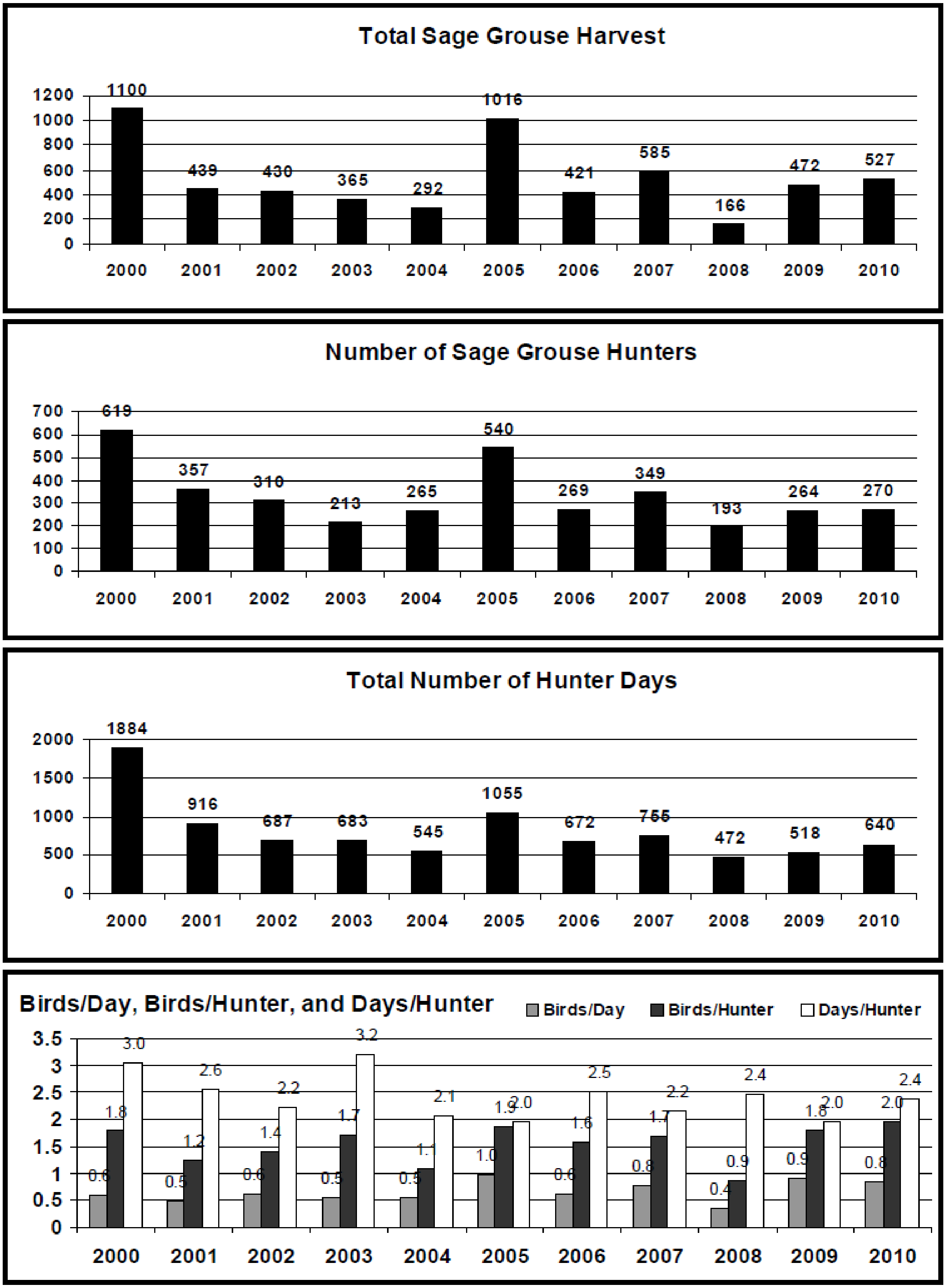
Hunting season and harvest. Beginning in 1995, the opening day of sage-grouse season was moved from 1 September to the third Saturday in September. Research suggested that hens and broods were more dispersed and less vulnerable to hunting with the later opening date. Between 1982-94, hunting seasons 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 2002-10, hunting seasons for sage-grouse averaged 11 days long. Grouse hunting season in 2010 was 13 days.

Moving and shortening the season and decreasing the bag limit decreased the number of sage-grouse harvested and the number of hunters in the Big Horn Basin (Table 5 and Fig. 7). 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 (2002-2009), hunters averaged 1.5 birds/hunter and 2.3 days/hunter. Hunter numbers and birds harvested in 2005 were similar to values prior to changes in regulations (pre-2002). More hunters may have gone afield in 2005 to take advantage of higher grouse populations and/or several hunters did report wanting the opportunity to harvest grouse before they were placed on the endangered species list. In 2010, individual harvest rate increased (2.0 birds/hunter) but effort was similar to long-term averages (2.4 days/hunter).

Table 5. Harvest data for sage-grouse in the Big Horn Basin, 2000-10.

Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2000	1,100	619	1,884	0.6	1.8	3.0
2001	439	357	916	0.5	1.2	2.6
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
2000-09 Avg.	529	338	819	0.6	1.6	2.4

Figure 7. Sage-grouse harvest summary for the Big Horn Basin, Wyoming, 2001-11.



Winter concentration areas. Although winters are generally not considered a limiting season for sage-grouse populations, delineation of habitats used in winter by large concentrations of grouse has been a priority. Conservation of those winter habitat patches is important to the long-term maintenance of a sage-grouse population. Survey flights were periodically conducted across potential areas in the Bighorn Basin during the past several winters and are expected to continue as budgets allow. Flights should only be conducted under true winter conditions. Winter concentration areas will be further delineated as more data are collected. No composite map of winter areas has been developed for the Basin.

Conservation planning. The Big Horn Basin LWG 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 Big Horn Basin LWG'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*."

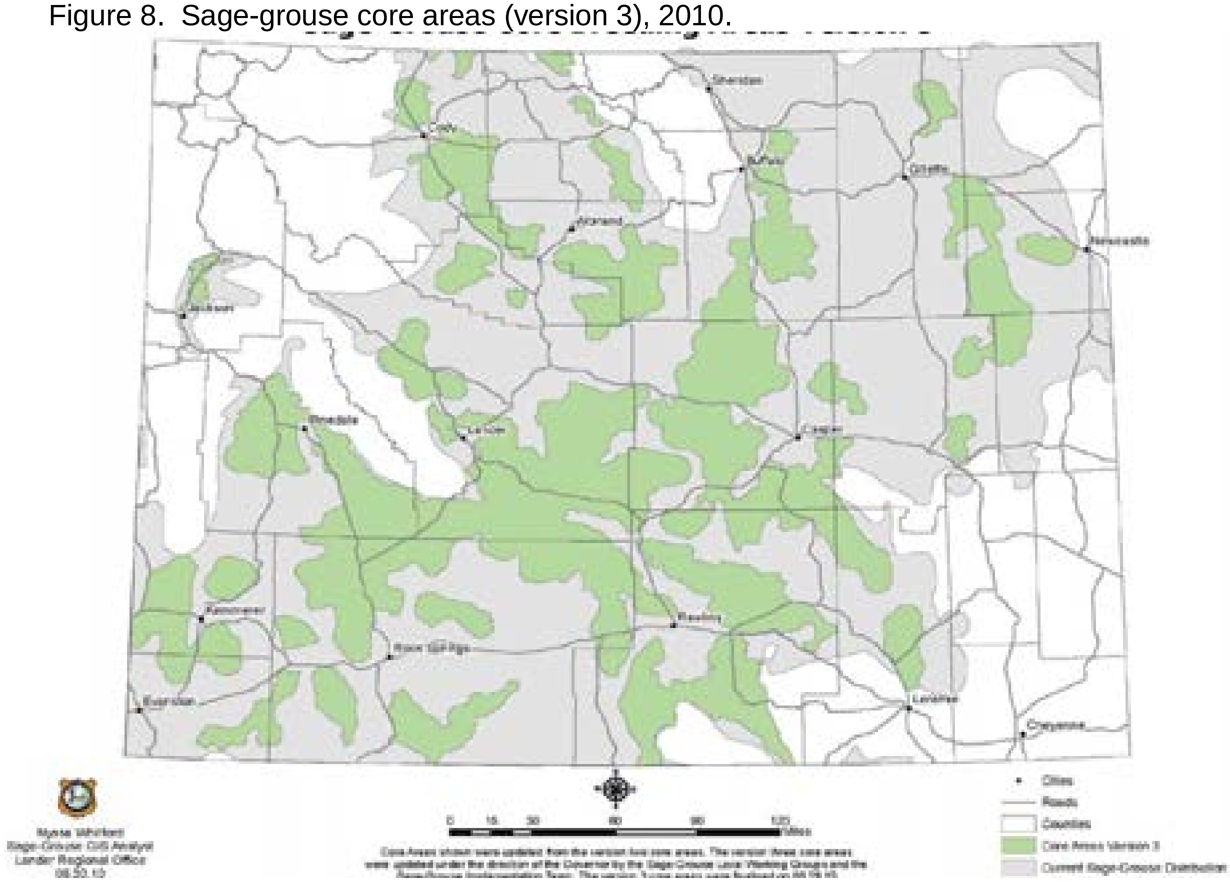
The Sage-grouse Conservation Plan for the Big Horn Basin identified several factors that may influence sage-grouse populations in the Big Horn Basin. A brief description of each factor and potential impacts to grouse or their habitats were discussed. Impacts of each factor were addressed in the Conservation 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 Big Horn 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://gf.state.wy.us/wildlife/wildlife_management/sage-grouse/BigHornBasin.

Due to on-going conservation efforts, funding for sage-grouse conservation has increased. In 2005, the state 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 of our local conservation plan.

In 2010, the BHBLWG allocated funding to several new projects designed to address undesirable vegetation that had invaded sagebrush-grassland habitats. The BLM began mowing juniper from sagebrush at two projects sites: Rome Hill and Crooked Creek (Washakie County). Several project sites (Black Mountain [Hot Springs Co], American Colloid property near Hyattville, and sites within Shell and Little Mountain Core Areas) were treated for cheatgrass invasions with an chemical herbicide (Plateau©). Funding was also allocated to other projects designed to improve sage-grouse habitat including: restoring sagebrush to sites on Black Mountain (Hot Springs Co.) that had been burned by wildfire; field testing the efficacy of sagebrush grown in copper-lined tubes to restore sage-grouse habitat on mined (bentonite) lands; and the development and fencing of three springs in the Prospect, Wagonhound and Twenty-one Creek drainages to provide reliable water and patches of riparian/wet meadow habitat for grouse, other wildlife and livestock.

Core Areas. On 1 August 2008, Governor Freudenthal signed an Executive Order (2008-2) to focus management on the maintenance and enhancement of habitats and populations within "core areas". 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 (Fig. 8). 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 with the assistance of the Governor's Sage-Grouse Implementation Team and the local sage-grouse working groups. Funding, reclamation efforts, habitat enhancements and other proactive efforts are to be 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.

Figure 8. Sage-grouse core areas (version 3), 2010.



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 and Beck 2010 and related publications). They focused on affects of burning and mowing 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). Several habitat managers in the Basin have questioned the validity of these results, noting irregularities in the statistical analysis and presentation of results of this research.

In 2010, two research projects on sage-grouse were begun in the Big Horn Basin. Both projects were initiated outside the purview of the BHBLWG and are funded from sources other than the Sage-grouse Conservation Fund. One was the expansion of the bentonite-grouse pilot project conducted last year. 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.

American Colloid Inc., a bentonite mining company, completely funded a doctoral graduate research project supervised by Dr. Jeff Beck, Department of Ecosystem Science and Management, College of Agriculture and Natural Resources, University of Wyoming. They will be investigating habitat use by sage-grouse and demographics (adult survival, nest success, brood survival and migration) in an area near many bentonite mines (Shell Core Area) and an area with little to no mining activity (Hyattville Core Area).

During the 2010 field season, they captured and radio-marked sage-grouse at the two study sites (Shell and Hyattville core areas). They monitored 55 nests and 19 broods. They completed microhabitat vegetation sampling plots at all nests, 37 brood locations, and random location associated with every nest and brood location (184 total plots). Results following only one year are preliminary and will be summarized in subsequent reports when more data are available.

The predation project is overseen and funded by a steering committee consisting of many public (Conservation Districts, local Predator Boards, USDA Wildlife Services, WGFD) and private (oil/gas companies, individual ranches) entities. Refer to progress reports for a listing of cooperating partners. Local Wildlife Service personnel and a graduate student working with Dr. Julie Young, USDA Wildlife Services, National Wildlife Research Center, Utah State University, are conducting this research.

Twenty-five hens were captured during spring 2011 and fitted with radio transmitters. Once hens initiated nests, trail cameras were installed to monitor fate of nests and predator species that visit nest sites. Preliminary data indicated that a variety of predators (e.g., coyote, raven, golden eagle, and badger) visited sage-grouse nests and had varying affects on hen, nest, and/or brood survival. Results following only one year are preliminary and will be summarized in subsequent reports when more data are available. The up-coming field season will involve experimental removal of predators (coyotes and/or ravens) in some study areas to monitor survival and population level affects compared to control sites (no predator removal).

CONCLUSIONS

Sage-grouse populations in the Big Horn Basin remain stable, despite being at a low in the population cycle. 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.

Literature Cited.

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.

Hess, J.E. and J.L. Beck. 2010. Greater sage-grouse (*Centrocercus urophasianus*) nesting and early brood-rearing habitat response to mowing and prescribed burning Wyoming big sagebrush and influence of disturbance factors on lek persistence in the Bighorn Basin, Wyoming. Final Research Report, Department of Renewable Resources, University of Wyoming. December 29, 2010. 152pp.

Northeast Wyoming Local Working Group

2010 ANNUAL SAGE-GROUSE COMPLETION REPORT

Prepared By:

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

Sage-Grouse Job Completion Report

YEAR: 2010 | **PERIOD COVERED: 6/1/2010 - 5/31/2011**
WORKING GROUP: Northeast | **PREPARED BY: Dan Thiele**

1. LEK ATTENDANCE SUMMARY (OCCUPIED LEKS)

a. Leks Counted

			Percent	Max Totals		Avg./Active Lek	
Year	Known	Counted	Counted	Males	Females	Males	Females
2002	305	100	32.8	776	456	7.8	4.6
2003	329	101	30.7	772	359	7.6	3.6
2004	365	142	38.9	990	242	7.0	1.7
2005	417	106	25.4	1489	487	14.0	4.6
2006	445	88	19.8	1793	584	20.4	6.6
2007	464	116	25.0	2036	358	17.6	3.1
2008	472	130	27.5	1894	803	14.6	6.2
2009	474	159	33.5	1135	531	7.1	3.3
2010	481	203	42.2	1561	816	7.7	4.0
2011	481	174	36.2	986	433	5.7	2.5

b. Leks Surveyed

Year	Known	Surveyed	Percent Surveyed	Max Total	Avg Males/ Active Lek
2002	305	109	35.7	515	9.7
2003	329	126	38.3	673	9.9
2004	365	199	54.5	908	9.2
2005	417	208	49.9	2112	16.1
2006	445	263	59.1	3294	19.4
2007	464	292	62.9	3440	20.4
2008	472	286	60.6	2351	16.0
2009	474	247	52.1	1346	11.8
2010	481	191	39.7	580	7.8
2011	481	225	46.8	653	8.2

c. Leks Checked

Year	Known	Checked	Percent Checked	Max Total	Avg Males/ Active Lek
2002	305	196	64.3	1237	8.7
2003	329	199	60.5	1347	8.7
2004	365	296	81.1	1763	8.2
2005	417	311	74.6	3588	15.3
2006	445	350	78.7	5079	19.8
2007	464	408	87.9	5476	19.2
2008	472	408	86.4	4112	15.2
2009	474	406	85.7	2481	9.1
2010	481	393	81.7	2141	7.8
2011	481	398	82.7	1639	6.5

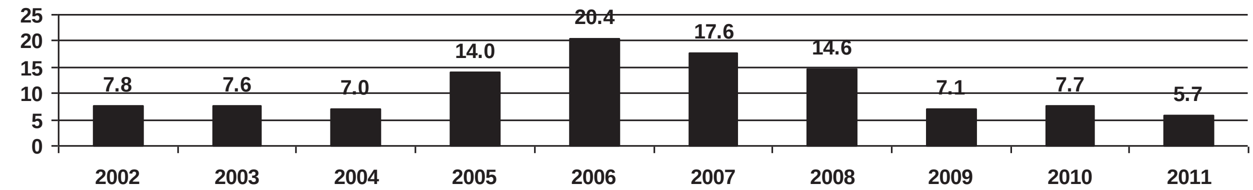
d. Lek Status

						Confirmed Status	
Year	Active	Inactive	Not Located	Unknown	Total	Active	Inactive
2002	116	35	2	152	151	76.8%	23.2%
2003	121	35	1	172	156	77.6%	22.4%
2004	158	64	2	141	222	71.2%	28.8%
2005	210	34	2	171	244	86.1%	13.9%
2006	235	31	6	173	266	88.3%	11.7%
2007	249	82	3	130	331	75.2%	24.8%
2008	234	95	0	143	329	71.1%	28.9%
2009	221	97	0	156	318	69.5%	30.5%
2010	195	133	2	151	328	59.5%	40.5%
2011	169	126	0	186	295	57.3%	42.7%

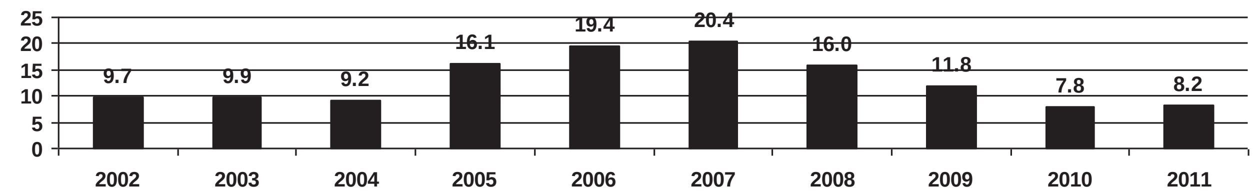
SAGE-GROUSE LEK ATTENDANCE SUMMARY

WORKING GROUP: Northeast **Area(s): All**

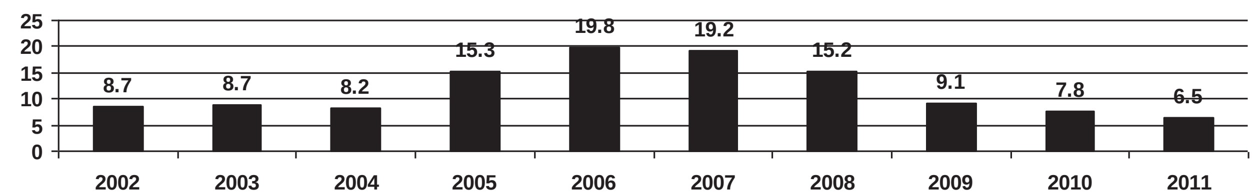
Average Males/Lek from Lek Counts



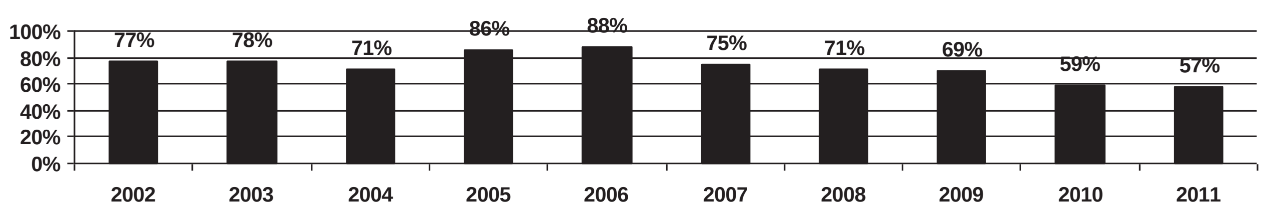
Average Males/Lek from Lek Surveys



Average Males/Lek from all Lek Observations



Percent of Active Leks from the Total Known Lek Status



Percent of Inactive Leks from the Total Known Lek Status

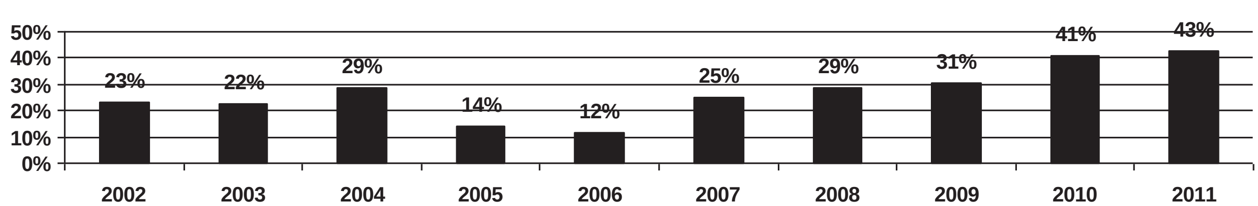


Table3. Summary of unoccupied (historic) leks and lek complexes.

a. Unoccupied Leks

Year	Total Number of Leks: Abandoned	Destroyed	Number of abandoned leks checked
2002	20	13	12
2003	20	13	9
2004	19	13	9
2005	19	12	10
2006	23	13	11
2007	23	15	11
2008	23	18	22
2009	24	19	15
2010	24	21	20
2011	29	20	15

Table 4. Sage-grouse hunting seasons and harvest data.

a. Season

Year	Season Dates	Length	Bag/Possession Limit
2002	Sept 28-Oct 6	9	2/4
2003	Sept 27-Oct 5	9	2/4
2004	Sept 23-Oct 3	11	2/4
2005	Sept 23-Oct 3	11	2/4
2006	Sept 23-Oct 3	11	2/4
2007	Sept 22-Oct 2	11	2/4
2008	Sept 22-Oct 2	11	2/4
2009	Sept 19- Sept 25	7	2/4
2010	Sept 18- Sept 20	3	2/4

b. Harvest

Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2001	956	518	1,414	0.7	1.8	2.7
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	1,649	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
Avg.	350	253	661	0.6	1.3	2.4

Table 5. Composition of harvest by wing analysis.

Year	Sample Size	Percent Adult		Percent Ylg		Percent Young		Chicks /Hen
		Male	Female	Male	Female	Male	Female	
2002	35	5.7	51.4	0.0	11.4	0.0	31.4	0.5
2003	22	9.1	9.1	9.1	9.1	27.3	36.4	3.5
2004	64	12.5	12.5	25.0	15.6	26.6	7.8	1.2
2005	109	6.4	14.7	5.5	16.5	26.6	30.3	1.8
2006	56	3.6	14.3	17.9	21.4	28.6	14.3	1.2
2007	96	10.4	25.0	8.3	6.3	33.3	16.7	1.6
2008	6	0.0	0.0	50.0	50.0	0.0	0.0	0.0
2009	24	25.0	33.3	8.3	29.2	4.2	0.0	0.1

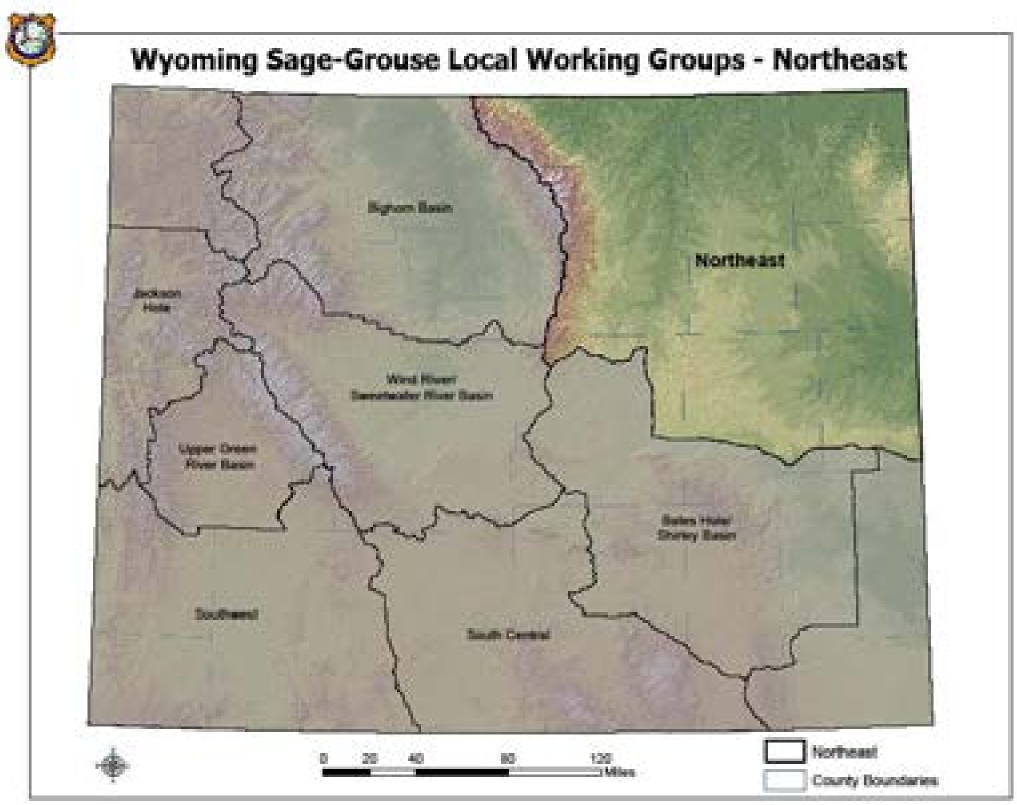
2010 JOB COMPLETION REPORT

Narrative
SPECIES: **Sage-grouse**
DAU NAME: **Northeast Wyoming Working Group**
MGMT AREA: **C**
Period Covered: **6/1/2009 – 5/31/2010**
Prepared by: **Dan Thiele, Wildlife Biologist**

INTRODUCTION

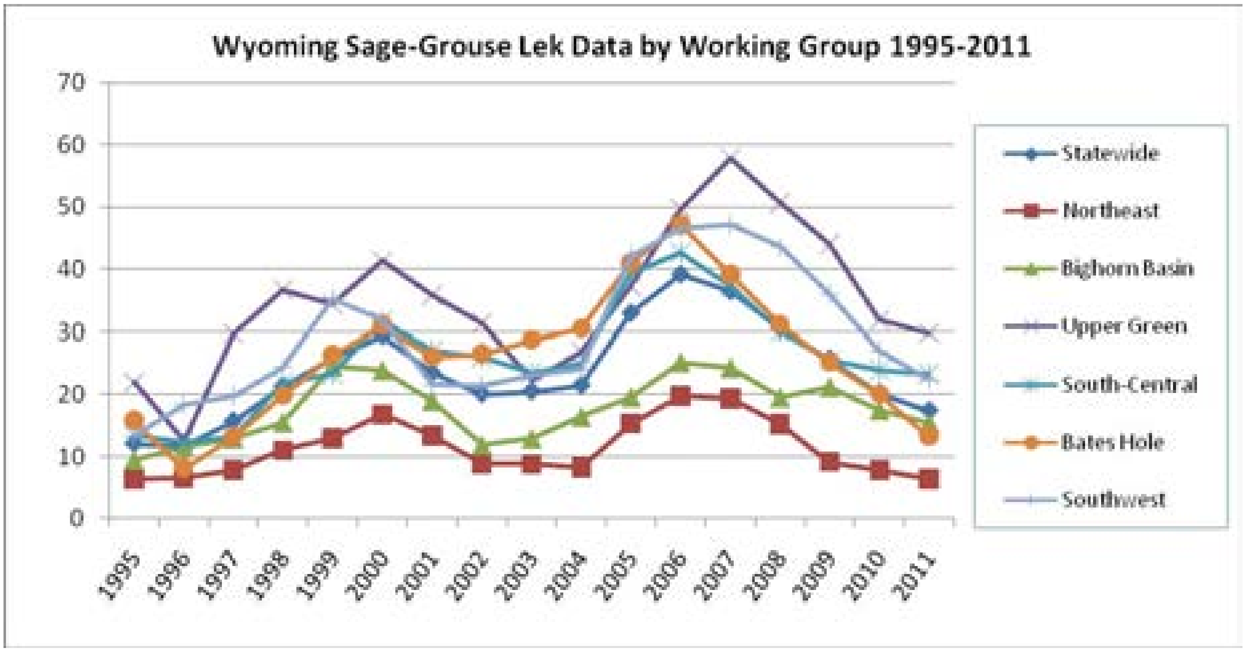
Sage-grouse data are reported for the area encompassed by the Northeast Wyoming Local Working Group Area (NEWLWGA) which was formed in 2004 to develop and facilitate implementation of a local conservation plan for the benefit of sage-grouse, their habitats, and whenever feasible, other wildlife species that use sagebrush habitats. Prior to 2005, sage-grouse management was reported by Wyoming Game and Fish Department (WGFD) Region. 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 6 males per active lek in 2011 compared to the statewide average of 17 males per active lek (Figure 2). Male lek attendance for the other working group areas ranged from 13 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 Local Working Group Area Lek Attendance Trends.



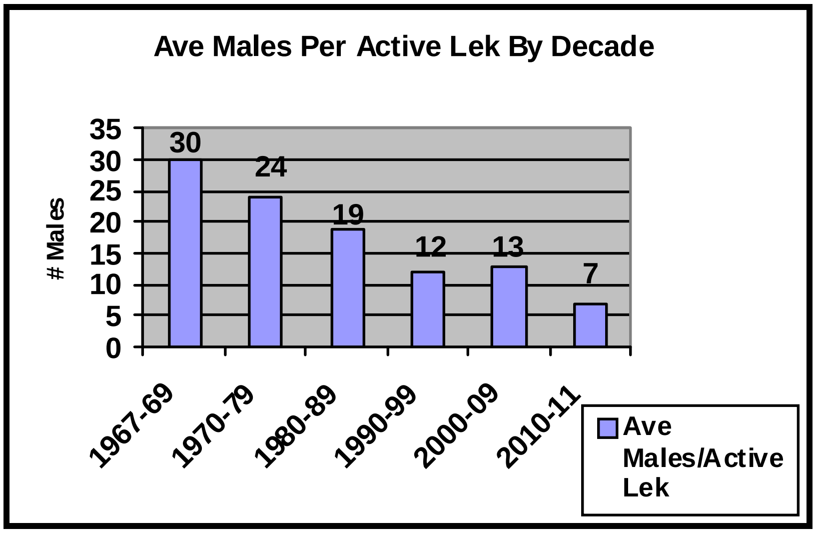
Average male lek attendance has decreased significantly over the years. Figure 3 shows the average number of males per active lek by decade since monitoring efforts began. Average male attendance has decreased by more than one-half over the last thirty years. A slight upswing occurred from 2000-2009, 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 2011, the Wyoming Oil and Gas

Conservation Commission reported that 14,016 producing wells yielded 40,119,217 Mcf of methane gas. In addition to producing wells there are over 11,450 shut in wells. Federal mineral leases provided for 67% of the production while fee leases accounted for 25% and State leases 8%. 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.

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



Considerable debate is occurring on the effects of energy development on sage-grouse. Peer reviewed research findings show significant impacts (Walker et al. 2007). These finding have yet to be embraced by the general public 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.

Several petitions to list the species under the federal Endangered Species Act have been filed within the Rocky Mountain west. In January 2004, the U.S. Fish and Wildlife Service issued a ruling that the Service would conduct a detailed review of the status of sage-grouse to determine if listing under the Endangered Species Act was warranted. In January 2005, the Service issued a finding that listing was not warranted. However, conservation efforts continued with the formation of local working groups across the west to address long term declines in sage-grouse populations and sagebrush habitats. Following a legal challenge by Western Watersheds Project on the Service's decision, the United States District Court for the District of Idaho reversed the U.S. Fish and Wildlife Service's decision and remanded the case back to the Service for further consideration (December 2007). Meanwhile, an increasing number of research projects provided new information on sage-grouse and sage-grouse habitat. A peer reviewed scientific monograph incorporated the latest scientific information and analysis on the sage-grouse in 2009, providing a principle source of the latest information of sage-grouse and their habitats from which the U.S. Fish and Wildlife Service would base their listing determination. The monograph was published in 2011 in *Studies of Avian Biology*, managed by the Cooper Ornithological Society (Knick and Connelly, 2011). The U.S. Fish and Wildlife Service released their 12-month finding on petitions to list the greater sage-grouse on 5 March 2010, finding that the listing of the greater sage-grouse (range-wide) was warranted but precluded by higher priority species. Therefore, the sage-grouse is designated as a candidate for Endangered Species Act protection. Candidate species do not receive regulatory protection under the Endangered Species Act but the U.S. Fish and Wildlife Service encourages voluntary conservation of the species.

At the state level, Govenor Freudenthal convened a sage-grouse summit in 2007 and created an implementation team to develop a conservation strategy to manage the species to prevent listing under the Endangered Species Act and retain State authority in management decisions. The Governor issued an Executive Order in August 2008 outlining the core area strategy with 23 recommendations that conserve Wyoming's most important sage-grouse habitats while allowing for natural resources development outside core areas. 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.

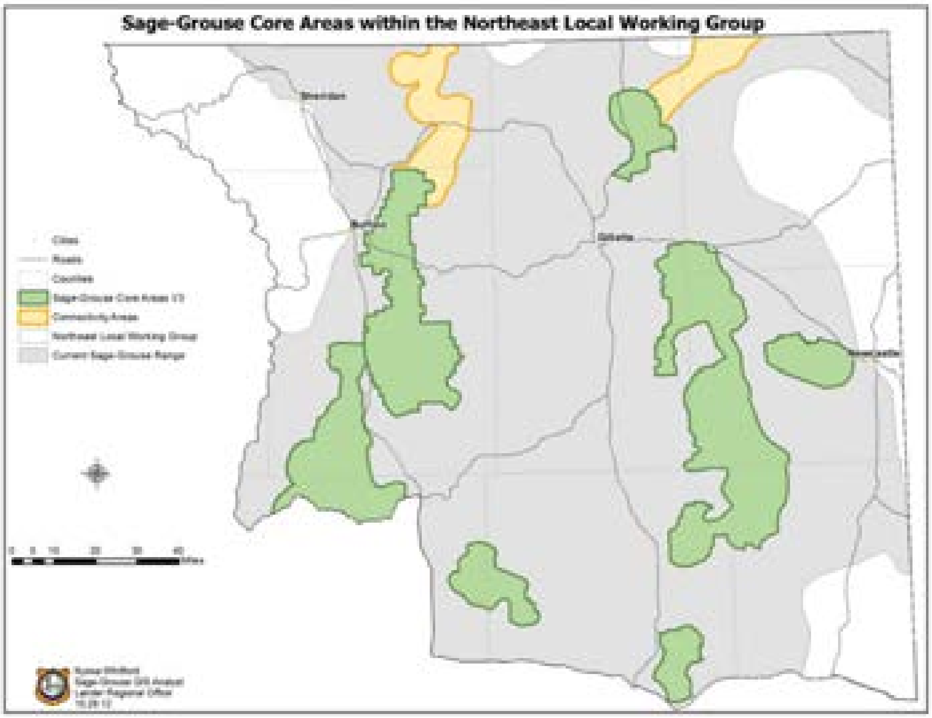
After the U.S. Fish and Wildlife Service decision, Governor Freudenthal asked the sage-grouse implementation team to revisit Wyoming's sage-grouse management strategy. The group's three tasks were to review core area boundaries, review development guidelines inside and outside core habitats, and identify connectivity areas to ensure movement corridors between populations to preserve genetic integrity. The NEWLWG held a series of meetings to identify recommended adjustments to core area boundaries and identify connectivity areas between Wyoming core areas to Montana populations. Core areas were adjusted using habitat maps, development maps and public input. Connectivity areas were identified using larger leks based on recommendations by Knick (2008) and habitat maps. The group forwarded revision recommendations to the sage-grouse implementation team for final approval in September 2010 (Figure 4). In addition, the working group developed a list of recommendations for development within connectivity areas.

Following Governor Matt Mead's election in 2010 he issued executive order 2011-5 (replaces 2010-4), Greater Sage-grouse Core Area Protection, which reiterated and clarified the intent of Wyoming's Core Area Strategy originally developed under former Governor Freudenthal's administration with assistance with the Governor's Sage-grouse Implementation Team and the local sage-grouse working groups. The revision incorporated connectivity areas and select recommendations for connectivity management.

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.

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

Beginning in 2005, a wetter weather pattern developed for northeast Wyoming ending the period of drought which began in 2000. This pattern continued into the current biological year (June 2010 – May 2011) with nearly 19 inches of precipitation, 27% above normal (Figure 5). May 2010 rainfall was nearly double the normal with 4.8 inches followed by a normal amount in June. This contributed to excellent spring greenup but may have negatively impacted nesting and early brood survival. Summer and fall precipitation was below normal while winter and spring 2011 precipitation was above normal. May 2011 rainfall totaled 7.1 inches, nearly 5 inches above normal which again likely impacted nest success and early brood survival. Average monthly temperatures were near normal with the exception of a warmer average temperature in October (Figure 6). Cooler temperatures prevailed in June, February, April and May. The April and May temperatures corresponded to cooler and wetter weather

Figure 5. 2010 Bio-Year: Monthly Precipitation Data (in), Wyoming Climate Division 5.

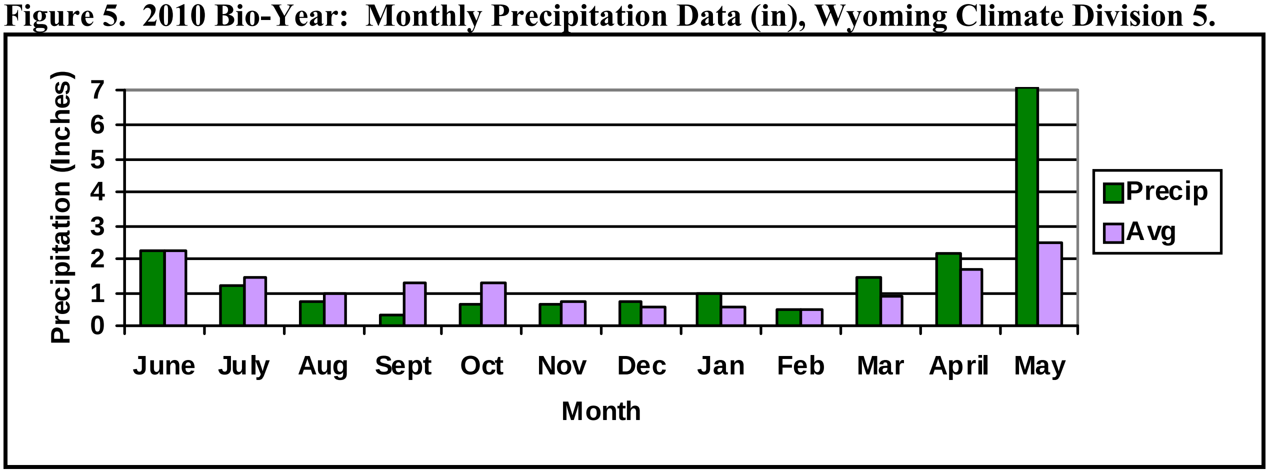
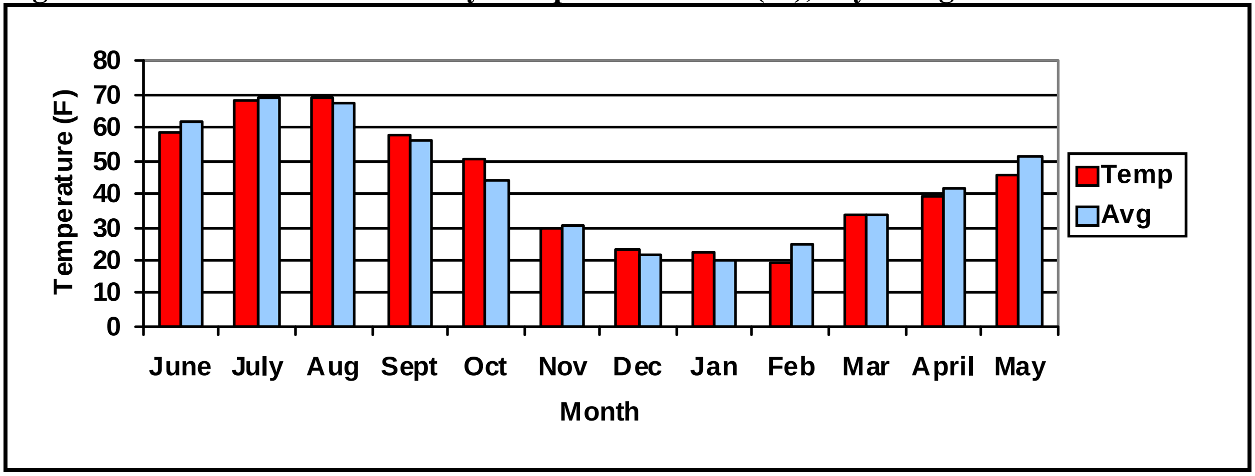


Figure 6. 2010 Bio-Year: Monthly Temperature Data (°F), Wyoming Climate Division 5.



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.

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 2010-11. No significant mortality has been documented since 2003, however, there are fewer radio marked sage-grouse being monitored by researchers which increase the likelihood of finding mortalities.

Brood Surveys

Limited sage-grouse brood data have been collected in recent years due to low bird numbers and other work priorities. In 2010, seven broods in Newcastle Biologist District were classified totaling 35 birds resulting in a chick to hen ratio of 3.4 chicks per hen. This sample size is inadequate to draw any firm conclusions. Brood surveys the past three years yielded chick to hen ratios of 0.4, 1.2 and 3.2 in 2009, 2008 and 2007, respectively. The 2007 ratios suggests relatively good hatch success and early brood survival, however, these results cannot be considered representative of the entire working group area.

Harvest Results

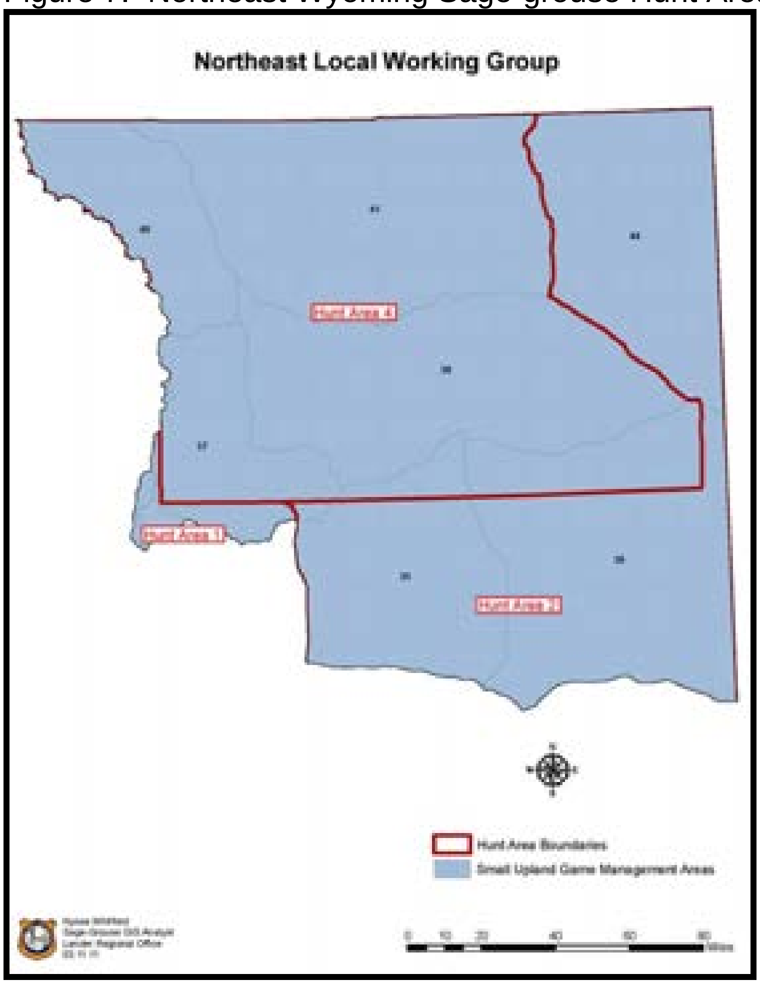
A more conservative hunting season was implemented in northeast Wyoming due to continuing concerns with decreasing lek attendance trends in the working group area. The Sheridan and

Casper Regions considered maintaining the seven day season while reducing the bag and possession limit to 1 and 2, respectively, but decided to reduce the season length to three days and keep the bag and possession limits at two and four, respectively. The falconry season did not change.

Although sage-grouse numbers have decreased over time and are currently trending down, an adequate population exists to support the conservative hunting season. More than 2,100 males were observed during 2010 lek monitoring efforts with most of these birds in the portion of the Northeast Working Group Area included in Hunt Area 4 (Figure 7). This number far exceeds the 100 male minimum threshold recommended to support a hunting season in the sage-grouse management guidelines. 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 2010 harvest survey indicated that 129 sage-grouse were harvested by 117 hunters who spent a total of 202 days hunting sage-grouse within Hunt Area 34. The average number of birds harvested per hunter day was 0.6. The average number of sage-grouse harvested per hunter was 1.1 and the average number of days hunted was 1.7.

Figure 7. Northeast Wyoming Sage-grouse Hunt Areas.



The 2010 sage-grouse harvest decreased nearly 60% from the 311 birds harvested in 2009 and slightly higher than the 101 birds harvested in 2008. The lower harvest is likely due to the reduced number of days in the hunting season combined with publicity about lower bird numbers and the bird's plight which likely reduces hunter interest. The ten-year average (2001-2010) is 350 birds, with harvest ranging from a low of 101 birds in 2008 to a high of 956 birds in 2001. 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 to 518 hunters in 2001. Hunter days decreased 64% from 2009 but remained well below the 3,414 days logged in 2001.

Harvest had developed an increasing trend from 2003 through 2007. Harvest decreased the past two years likely due to the more conservative hunting season structure and lower bird numbers. Even though male lek attendance was higher from 2005 thru 2008, hunter interest remains well below past levels. The more conservative season length and bag limit combined with increased publicity about the sage-grouse's plight 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 provides 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 2010 sample was only 11 wings resulting in a chick to hen ratio of 0.6 to 1.0. The sample is too small to warrant confidence and likely explains the difference from the 3.4 chicks per hen found during brood counts.

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.

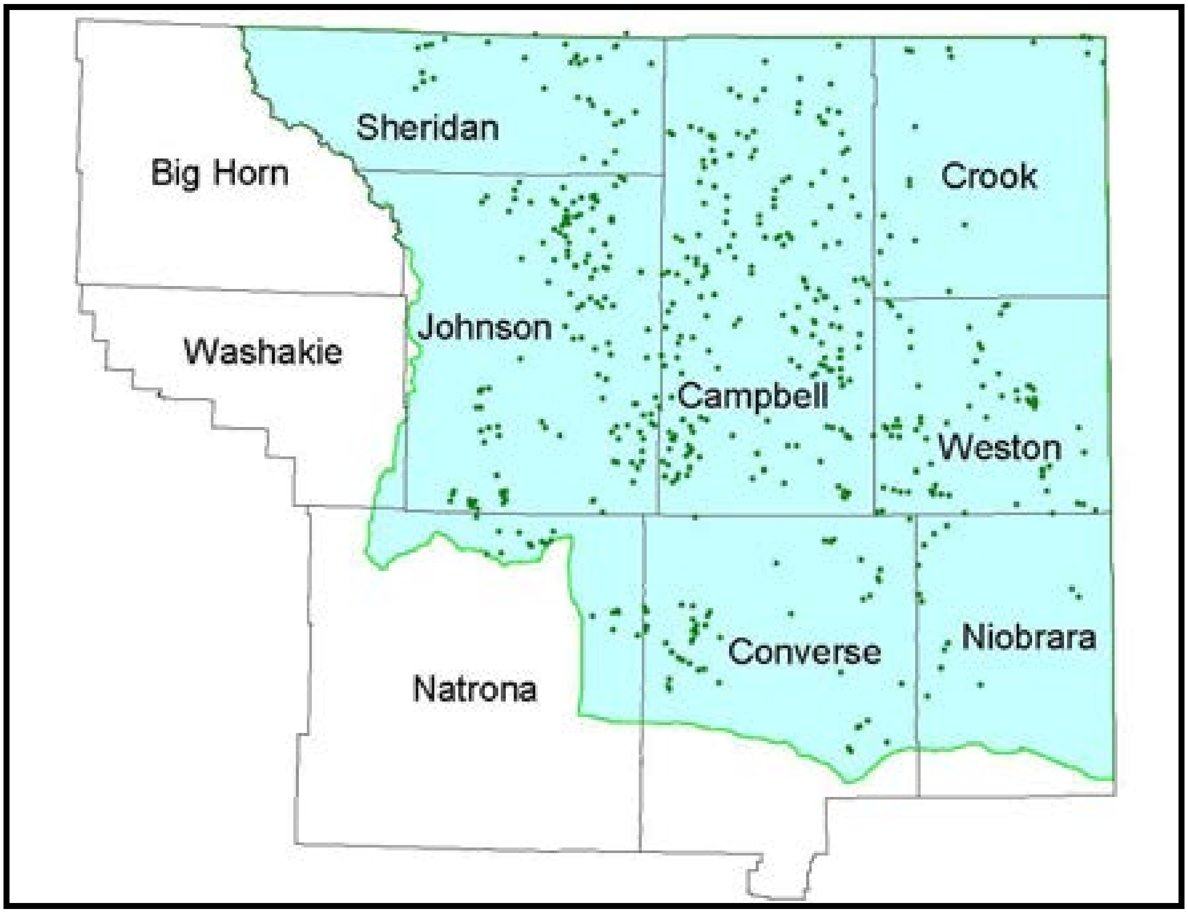
Sage-grouse lek monitoring efforts are accomplished through lek counts, lek surveys and searches for new leks. The Sheridan Region received additional funds from the Bureau of Land Management for sage-grouse surveys for the eleventh consecutive year. This funding was used for aerial surveys to monitor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

Following the 2011 lek monitoring period there are 528 documented leks in the NEWLWGA (Figure 8). Of this total, 401 are classified as occupied leks and 57 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 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 (see Appendix 1 for lek definitions). 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 2011 breeding season 174 leks were counted, representing about 36% of known occupied leks (JCR Table 1a). The 481 known leks is less than the 528 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 5.7. This is 26% below the 7.7 males/active lek in 2010 and more than 70% below the most recent cycle high of 20.4 males/active lek found 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 in the Working Group Area.

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 398 leks or 83% of the known occupied leks (JCR Table 1c). The average number of males/active lek was 6.5 compared to 7.8 males/active lek in 2010. This was the lowest number of males/active lek since 1997. For the 10-year period, 2002-2011, the number of males/active lek has ranged from 6.5 in 2011 to 19.8 in 2006. These numbers and trends are comparable to the lek count data. One-hundred-sixty-nine leks were documented as active with peak male attendance ranging from 1 to 45 males. The three leks with the highest number of males were the Flying E Lek with 45 males, the Keyton 6 Lek with 36 males and the Stranahan I Lek with 32 males. No lek has exceeded 100 males since 2007. The median peak male attendance was 7 males, down from 8 males/active lek in 2008 and 2009.

In total, there were 1,451 recorded observations of sage-grouse leks. This was over 800 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 monitored from the ground. 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 2007. Peak male attendance for new leks ranged from 6 to 25 males with an average of 11 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 295 leks with confirmed lek status. Fifty-seven percent of the leks (n=169) with confirmed status were determined to be active (JCR Table 1d), meaning strutting males or signs of strutting (feathers/droppings) were observed at the lek site. One-hundred-twenty-six leks (43%) were determined to be inactive based on multiple ground visits and/or checks for sign (feathers/ droppings) late in the strutting season. For the 10-year period, the percentage of leks with confirmed status as active was the lowest while the percentage of leks confirmed inactive was the highest. A large number of leks (n=186) 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 5.7 for combined surveys and counts compared to 11.9 in the Casper Region and 6.5 for the entire LWG. Furthermore, the percentage of confirmed active leks in the Sheridan Region is at its lowest percentage (52.5%) in the 10-year period while the percentage of confirmed inactive leks is at 47.5%, the highest in the 10-year period. 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 74.4% and 25.6%, 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. The Sheridan Region typically has a lower percentage of confirmed active leks and a higher percentage of confirmed inactive leks than the Casper Region. However, figures 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 equipment. 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	137	25.9%
Sheridan	391	74.1%

Working Group	Number	Percent
Northeast	528	100.0%

Classification	Number	Percent
Occupied	401	75.9%
Undetermined	70	13.3%
Unoccupied	57	10.8%

BLM Office	Number	Percent
Buffalo	366	69.3%
Casper	53	10.0%
Newcastle	109	20.6%

Unoccupied Leks	Number
Abandoned	37
Destroyed	21
N/A	2

Biologist District	Number	Percent
Buffalo	66	12.5%
Casper	30	5.7%
Douglas	39	7.4%
Gillette	234	44.3%
Newcastle	68	12.9%
Sheridan	91	17.2%

Game Warden	Number	Percent
Buffalo	72	13.6%
Dayton	18	3.4%
Douglas	18	3.4%
East Casper	5	0.9%
Glenrock	27	5.1%
Kaycee	51	9.7%
Lusk	19	3.6%
Moorcroft	50	9.5%
Newcastle	62	11.7%
North Gillette	66	12.5%
Sheridan	19	3.6%
South Gillette	115	21.8%
Sundance	5	0.9%
West Casper	1	0.2%

County	Number	Percent
Big Horn, MT	1	0.2%
Campbell	188	35.6%
Converse	47	8.9%
Crook	22	4.2%
Johnson	133	25.2%
Natrona	16	3.0%
Niobrara	18	3.4%
Powder River, MT	1	0.2%
Sheridan	36	6.8%
Weston	66	12.5%

Land Status	Number	Percent
BLM	56	10.6%
Private	384	72.7%
State	46	8.7%
USFS	42	8.0%

Management Area	Number	Percent
C	528	100.0%

Lek Characteristics

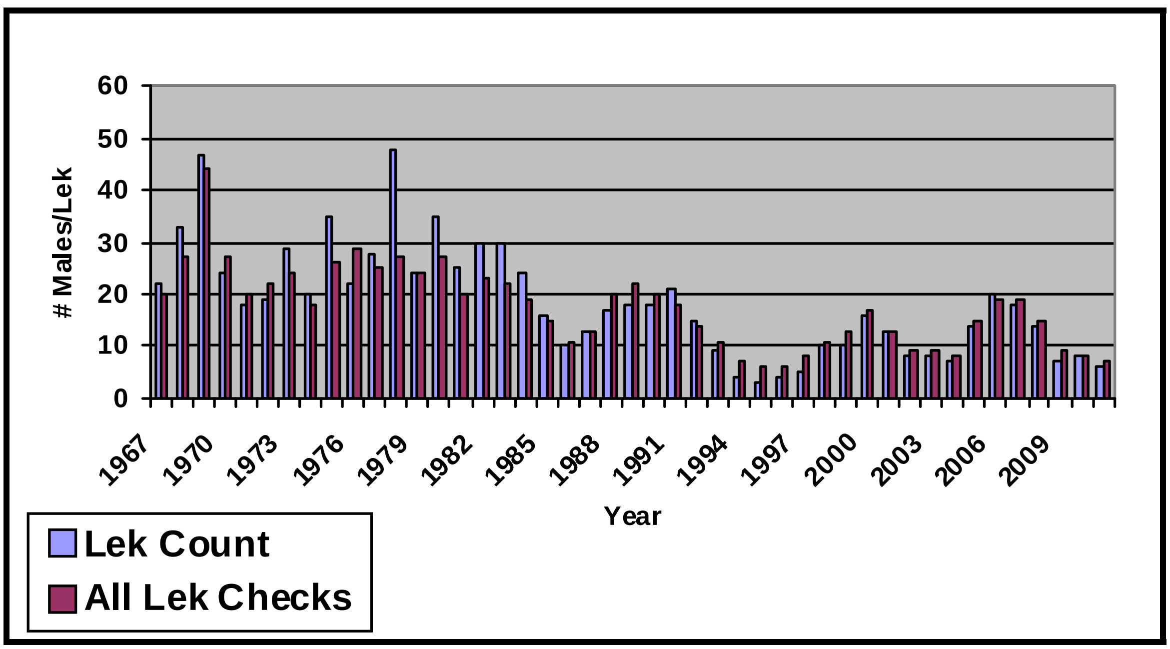
There are 528 sage-grouse leks within the NEWLWGA. Table 1 shows the demographics of leks with regard to WGFD region, county, biologist district, game warden district, land status, and historical status.

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 2011 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- 2011.



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. The 2008 - 2011 data indicate that peak has passed and lek attendance is entering the declining phase of the cycle, rivaling that observed from 1994 thru 1997.

Although the number of total leks, as well as active leks, has increased significantly over the last 10 years, this is primarily due to increased survey effort associated with CBNG activities. 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 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 fourth 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.

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 Northeast Wyoming Working Group 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.

SPECIAL PROJECTS

Conservation Planning

The conservation planning process for Wyoming sage-grouse populations was initiated in 2000 with the state plan completed in mid-2003. The state plan is the umbrella document for local conservation planning efforts.

The Northeast Wyoming Sage-grouse Conservation Plan was finalized in August 2006 and submitted it to the Wyoming Game and Fish Commission in September. The plan and other LWG information is available on the WGFD website at http://gf.state.wy.us/wildlife/wildlifemanagement/sagegrouse/index.asp. With the completion of the conservation plan working group meetings were scaled back.

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 the statewide projects. 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.

In June 2011, Wyoming Governor Meade issued Executive Order 2011-5, Greater Sage-grouse Core Area Protection, an updated executive order that calls for the continuation of habitat conservation and limited development on 15 million acres of Wyoming's most important sage-grouse habitat. Wyoming's core areas were originally established in 2008 by Governor Freudenthal.

Research

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

Doherty, K. E. 2008. Sage-grouse and Energy Development: Integrating Science With Conservation Planning to Reduce Impacts. Dissertation. University of Montana. Missoula, MT.

Doherty, K. E., D. E. Naugle, B. L. Walker, and J. M. Graham. 2008. Greater sage-grouse winter habitat selection and energy development. Journal of Wildlife Management 72:187–195.

Foster, M. A.. W. N. Davis, and A. C. Beyer. 2011. Monitoring Greater Sage-Grouse Populations and Habitat Use in the Southeast Montana Sage-grouse Core Area. Project Update January 2011. Montana Fish Wildlife and Parks *in cooperation* with the Bureau of Land Management. Miles City, MT. 41 pp.

Harju, S.M., M.R. Dzialak, R.C. Taylor, L.D. Hayden-Wing, and 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.

Knick, Steven, and Steven Hanser. 2008. Connecting Pattern and Process in Greater Sage-grouse Populations and Sagebrush Landscapes *in* Carl D. Marti, ed. Ecology and Conservation of Greater Sage-Grouse: A Landscape Species and Its Habitats. Studies in Avian Biology No 38. UC Press, Berkley.

Kucker Doherty, M. 2007. Comparison of Natural, Agricultural and Effluent Coal Bed Natural Gas Aquatic Habitats. Master of Science. Montana State University. Boseman, MT.

Naugle, D. E., C. L. Aldridge, B. L. Walker, T. E. Cornish, B. J. Moynahan, M. J. Holloran, K. Brown, G. D. Johnson, E. T. Schmidtmann, R. T. Mayer, C. Y. Kato, M. R. Matchett, T. J. Christiansen, W. E. Cook, T. Creekmore, R. D. Falise, E. T. Rinkes, M. S. Boyce. 2004. West Nile virus: pending crisis for Greater Sage-grouse. Ecology Letters. Volume 7, Issue 8, p. 704-713.

Naugle, D. E., C. L. Aldridge, B. L. Walker, K. E. Doherty, M. R. Matchett, J. McIntosh, T. E. Cornish, and M. S. Boyce. 2005. West Nile virus and sage-grouse: What more have we learned? Wildlife Society Bulletin, 33(2):616-623.

Taylor, R. L., D. E. Naugle, and L. S. Mills. 2010. Viability analyses for conservation of sage-grouse populations. Completion report, Miles City Field Office, Montana, USA.

Walker, B. L., D. E. Naugle, K. E. Doherty, and T. E. Cornish. 2004. Outbreak of West Nile Virus in Greater Sage-grouse and Guidelines for Monitoring, Handling, and Submitting Dead Birds. Wildlife Society Bulletin 32(3): 1000–1006.

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.

Continuing research is occurring in the Powder River Basin including studies sponsored by Fidelity Exploration and Development Company and Anadarko Petroleum Corporation and the BLM.

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 2012 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. Wing barrels should again be used in 2009 for recruitment analysis. Because of low return in many areas, wing barrels should only be used in areas where a substantial number of wings will be collected.
8. 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.
9. The Working Group should continue to solicit habitat projects on private lands that will have benefit for sage-grouse.
10. The Regions should continue to recommend protection of occupied sage-grouse leks during environmental commenting and promote their protection on private land projects.
11. Additional effort is needed to document the status of undetermined leks. Encourage reporting of lek activity from the public and in particular landowners.
12. 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.
13. Document lek perimeters to ensure adequate buffer distance in protecting leks.

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Wyoming Sage-Grouse Definitions:

(Revised 09/15/2011)

The following definitions have been adopted for the purposes of collecting and reporting sage-grouse data. See the sage-grouse chapter of the Wyoming Game and Fish Department's Handbook of Biological Techniques for additional technical details and methods.

Lek - A traditional courtship display area attended by male sage-grouse in or adjacent to sagebrush dominated habitat. A lek is designated based on observations of two or more male sage-grouse engaged in courtship displays. Before adding the suspected lek to the database, it must be confirmed by an additional observation made during the appropriate time of day, during the strutting season. Sign of strutting activity (tracks, droppings, feathers) can also be used to confirm a suspected lek. Sub-dominant males may display on itinerant (temporary) strutting areas during population peaks. Such areas usually fail to become established leks. Therefore, a site where small numbers of males (<5) are observed strutting should be confirmed active for two years before adding the site to the lek database.

Satellite Lek – A relatively small lek (usually less than 15 males) that develops within about 500 meters of a large lek during years of relatively high grouse numbers. Locations of satellite leks should be encompassed within lek perimeter boundaries. Birds counted on satellite leks should be added to those counted on the primary lek for reporting purposes.

Lek Perimeter – The outer perimeter of a lek and any associated satellites. Perimeters should be mapped by experienced observers using established protocols for all leks with larger leks receiving higher priority. Perimeters may vary over time as population levels or habitat and weather conditions change. However, changes to mapped perimeters should occur infrequently and only if grouse use consistently (2+ years) demonstrates the existing perimeter to be inaccurate. A point **within** the lek perimeter must be recorded or calculated as the identifying location for the lek. The point may be the geographic center of the perimeter polygon as calculated though a GIS exercise or a GPS point reflecting the center of breeding activity as typically witnessed on the lek.

Lek Complex - A lek or group of leks within 2.5 km (1.5 mi) of each other between which male sage-grouse may interchange from one day to the next.

Lek Count - A census technique that documents the actual number of male sage-grouse observed attending a lek complex. The following criteria are designed to assure counts are done consistently and accurately, enabling valid comparisons to be made among data sets. Additional technical criteria are available from the WGFD.

- Conduct lek counts at 7-10 day intervals over a 3-4 week period after the peak of mating activity. Although mating typically peaks in early April in Wyoming, the number of males counted on a lek is usually greatest in late April or early May when attendance by yearling males increases.
- Conduct lek counts only from the ground. Aerial counts are not accurate and are not comparable to ground counts.

- Conduct counts from ½ hour before sunrise to 1 hour after.
- Count attendance at each lek a minimum of three times annually during the breeding season.
- Conduct counts only when wind speeds are less than 15 kph (~10 mph) and no precipitation is falling.
- All leks within a complex should be counted on the same morning.

Lek Count Route – A lek route is a census of a group of leks that are relatively close and represent part or all of a single breeding population/sub-population. Leks should be counted on routes to facilitate repetition by other observers, increase the likelihood of recording satellite leks, and account for shifts in breeding birds if they occur. Lek routes should be established so that all leks along the route can be counted within 1.5 hours following the criteria listed under "Lek Count".

Lek Survey - Ideally, all sage-grouse leks would be counted annually. However, some breeding habitat is inaccessible during spring because of mud and snow, or the location of a lek is so remote it cannot be routinely counted. In other situations, topography or vegetation may prevent an accurate count from any vantage point. In addition, time and budget constraints often limit the number of leks that can be visited. Where lek counts are not feasible for any of these reasons, surveys are the only reliable means to monitor population trends. Lek surveys are designed principally to determine whether leks are active or inactive, requiring as few as one visit to a lek. Obtaining accurate counts of the numbers of males attending is not essential. Lek surveys involve substantially less effort and time than lek counts. They can also be done from a fixed-wing aircraft or helicopter. Lek surveys can be conducted from the initiation of strutting in early March until early-mid May, depending on the site and spring weather.

Annual status – Lek status is assessed annually based on the following definitions:

- **active** – Any lek that has been attended by male sage-grouse during the strutting season. Acceptable documentation of grouse presence includes observation of birds using the site or signs of strutting activity.

- **inactive** – Any lek where sufficient data suggests that there was no strutting activity throughout a strutting season. Absence of strutting grouse during a single visit is insufficient documentation to establish that a lek is inactive. This designation requires documentation of either: 1) an absence of birds on the lek during at least 2 ground surveys separated by at least 7 days. These surveys must be conducted under ideal conditions (4/1-5/7, no precipitation, light or no wind, ½ hour before to 1 hour after sunrise) or, 2) a ground check of the exact known lek site late in the strutting season (after 4/15) that fails to find any sign (droppings/feathers) of strutting activity. Data collected by aerial surveys may not be used to designate inactive status.

- **unknown** – Leks for which status as active or inactive has not been documented during the course of a strutting season. Except for those leks not scheduled for checks in a particular year, use of this status should be rare. Leks should be checked with enough visits to determine whether it is active or not. It is better to have two good checks every other year and confirm it "inactive" than to check it once every year, not see birds, but remain in "unknown" status.

Management status - Based on its annual status, a lek is assigned to one of the following categories for management purposes:

- **occupied lek** – A lek that has been active during at least one strutting season within the prior ten years. Occupied leks are protected through prescribed management actions during surface disturbing activities.

- **unoccupied lek** –There are two types of unoccupied leks, "destroyed" and "abandoned." Unoccupied leks are not protected during surface disturbing activities.

    - **destroyed lek** – A formerly active lek site and surrounding sagebrush habitat that has been destroyed and is no longer suitable for sage-grouse breeding. A lek site that has been strip-mined, paved, converted to cropland or undergone other long-term habitat type conversion is considered destroyed. Destroyed leks are not monitored unless the site has been reclaimed to suitable sage-grouse habitat.

    - **abandoned lek** – A lek in otherwise suitable habitat that has not been active during a period of 10 consecutive years. To be designated abandoned, a lek must be "inactive" (see above criteria) in at least four non-consecutive strutting seasons spanning the ten years. The site of an "abandoned" lek should be surveyed at least once every ten years to determine whether it has been reoccupied by sage-grouse.

- **undetermined lek** – Any lek that has not been documented active in the last ten years, but survey information is insufficient to designate the lek as unoccupied. Undetermined leks are not protected through prescribed management actions during surface disturbing activities until sufficient documentation is obtained to confirm the lek is occupied. Use of this status should be rare (see "unknown" above).

Winter Concentration Area - During winter, sage-grouse feed almost exclusively on sagebrush leaves and buds. Suitable winter habitat requires sagebrush above snow. Sage-grouse tend to select wintering sites where sagebrush is 10-14 inches above the snow. Sagebrush canopy cover utilized by sage-grouse above the snow may range from 10 to 30 percent. Foraging areas tend to be on flat to generally southwest facing slopes or on ridges where sagebrush height may be less than 10 inches but the snow is routinely blown clear by wind. When these conditions are met, sage-grouse typically gain weight over winter. In most cases winter is not considered limiting to sage-grouse. Under severe winter conditions grouse will often be restricted to tall stands of sagebrush often located on deeper soils in or near drainage basins. Under these conditions winter habitat may be limiting. On a landscape scale, winter habitats should allow sage-grouse access to sagebrush under all snow conditions.

Large numbers of sage-grouse have been documented to persistently use some specific areas which are characterized by the habitat features outlined above. These areas should be delineated as “winter concentration areas”. Winter concentration areas do not include all winter habitats used by sage-grouse, nor are they limited to narrowly defined “severe winter relief” habitats. Delineation of these concentration areas is based on determination of the presence of winter habitat characteristics confirmed by repeated observations and sign of large numbers of sage-grouse. The definition of “large” is dependent on whether the overall population is large or small. In core population areas frequent observations of groups of 50+ sage-grouse meet the definition while in marginal populations group size may be 25+. Consultation and coordination with the WGFD is required when delineating winter concentration areas.

Sage-Grouse Job Completion Report

YEAR: 2010 **PERIOD COVERED: 6/1/2010 - 5/31/2011**
WORKING GROUP: South Central **PREPARED BY: Will Schultz**

1. LEK ATTENDANCE SUMMARY (OCCUPIED LEKS)

a. Leks Counted

Year	Known	Counted	Percent Counted	Max Totals Males	Max Totals Females	Avg./Active Lek Males	Avg./Active Lek Females
2002	320	26	8.1	1153	418	44.3	16.1
2003	317	41	12.9	1319	660	32.2	16.1
2004	313	36	11.5	1348	314	37.4	8.7
2005	322	27	8.4	1415	459	52.4	17.0
2006	325	42	12.9	2106	782	50.1	18.6
2007	332	48	14.5	2087	319	43.5	6.6
2008	336	49	14.6	1648	479	33.6	9.8
2009	343	77	22.4	2021	1139	26.2	14.8
2010	348	57	16.4	1501	908	26.3	15.9
2011	349	50	14.3	1237	493	24.7	9.9

b. Leks Surveyed

Year	Known	Surveyed	Percent Surveyed	Max Total	Avg Males/ Active Lek
2002	320	205	64.1	2801	22.1
2003	317	210	66.2	2623	20.8
2004	313	215	68.7	2781	21.2
2005	322	227	70.5	5147	36.8
2006	325	233	71.7	5659	39.3
2007	332	232	69.9	4583	33.5
2008	336	181	53.9	3181	27.9
2009	343	189	55.1	2662	24.6
2010	348	220	63.2	2978	22.4
2011	349	189	54.2	2453	22.5

c. Leks Checked

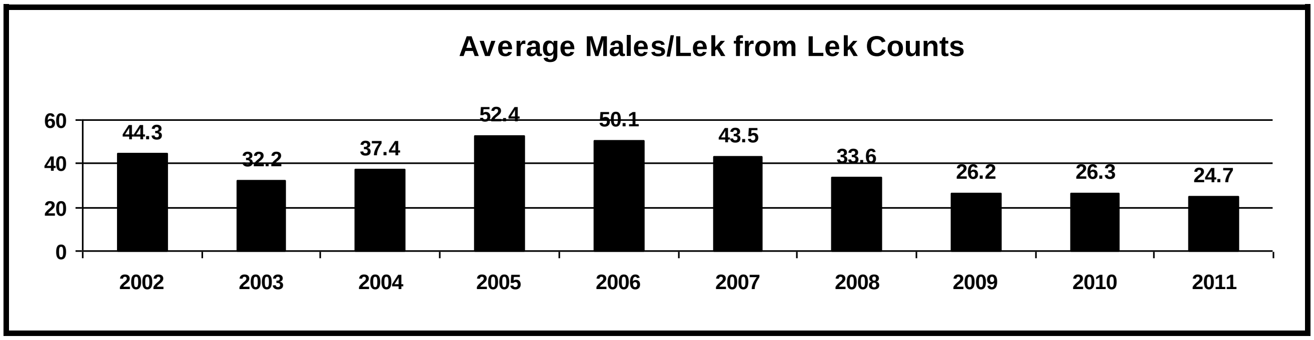
Year	Known	Checked	Percent Checked	Max Total	Avg Males/ Active Lek
2002	320	226	70.6	3828	25.9
2003	317	243	76.7	3806	23.5
2004	313	246	78.6	4025	24.8
2005	322	245	76.1	6336	39.4
2006	325	266	81.8	7670	42.6
2007	332	271	81.6	6617	37.2
2008	336	226	67.3	4768	30.0
2009	343	263	76.7	4669	25.4
2010	348	274	78.7	4377	23.4
2011	349	239	68.5	3690	23.2

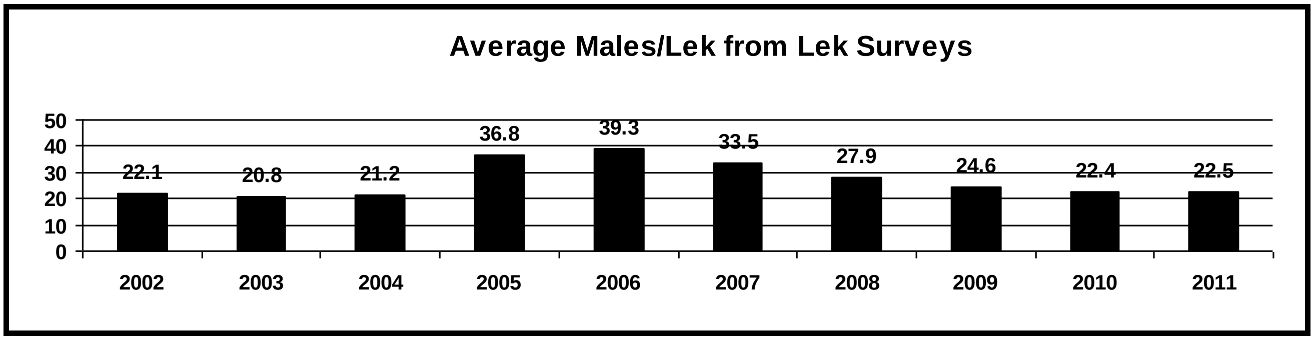
d. Lek Status

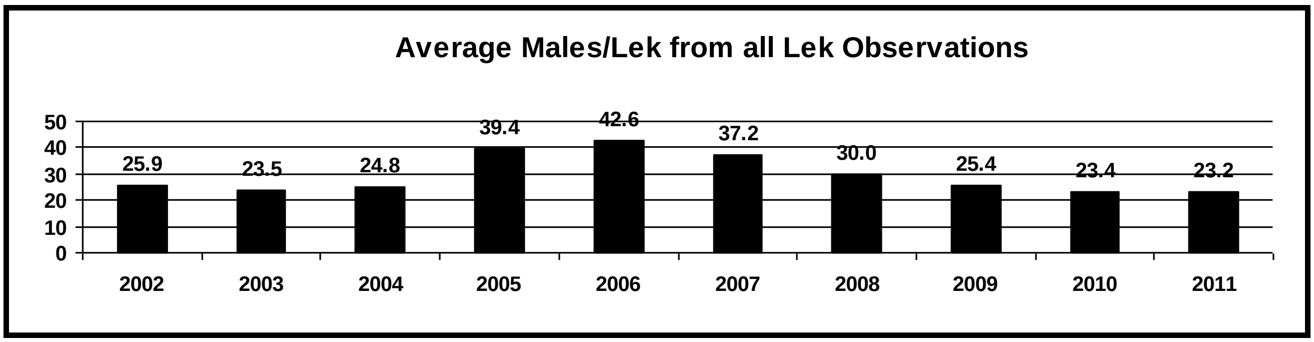
Year	Active	Inactive	Not Located	Unknown	Total	Confirmed Status Active	Confirmed Status Inactive
2002	151	5	0	164	156	96.8%	3.2%
2003	161	18	0	138	179	89.9%	10.1%
2004	161	7	0	145	168	95.8%	4.2%
2005	158	16	0	148	174	90.8%	9.2%
2006	173	24	0	128	197	87.8%	12.2%
2007	175	21	0	136	196	89.3%	10.7%
2008	163	17	0	156	180	90.6%	9.4%
2009	177	38	0	128	215	82.3%	17.7%
2010	182	29	0	137	211	86.3%	13.7%
2011	156	41	0	152	197	79.2%	20.8%

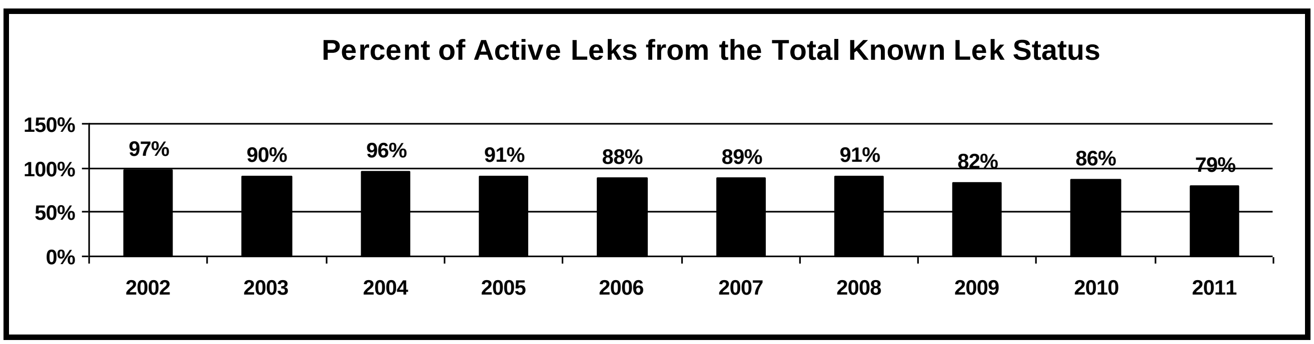
SAGE-GROUSE LEK ATTENDANCE SUMMARY

WORKING GROUP: South Central **Area(s):** All









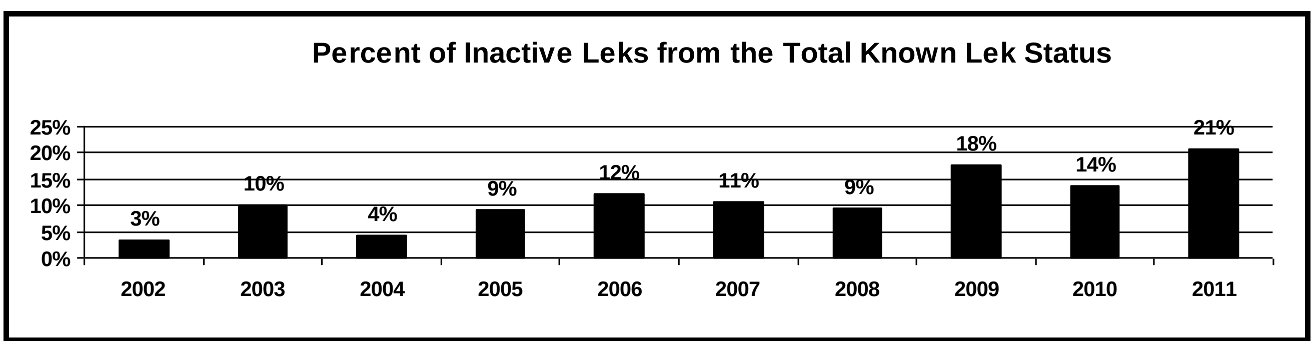


Table3. Summary of unoccupied (historic) leks and lek complexes.

a. Unoccupied Leks

Year	Total Number of Leks: Abandoned	Total Number of Leks: Destroyed	Number of abandoned leks checked
2002	21	1	2
2003	25	1	9
2004	27	1	8
2005	27	1	10
2006	27	1	15
2007	28	1	15
2008	29	1	9
2009	27	1	5
2010	28	1	9
2011	31	1	12

Sage Grouse Lek Characteristics – South-Central

Region	Number	Percent
Green River	97	25.7%
Lander	227	60.1%
Laramie	54	14.3%

Working Group Area	Number	Percent
South Central	378	100.0

Classification	Number	Percent
Occupied	323	85.4%
Undetermined	23	6.1%
Unoccupied	32	8.5%

BLM Office	Number	Percent
Casper	2	0.5%
Lander	23	6.1%
Rawlins	339	89.7%
Rock Springs	14	3.7%

Unoccupied Leks	Number
Abandoned	30
Destroyed	1

Biologist District	Number	Percent
Baggs	97	25.7%
Baggs	97	25.7%
Laramie	5	1.3%
Rawlins	211	55.8%
Saratoga	49	13.0%
South Lander	16	4.2%

Game Warden District	Number	Percent
Baggs	108	28.6%
East Rawlins	56	14.8%
Elk Mountain	6	1.6%
Rock Springs	14	3.7%
Saratoga	43	11.4%
South Laramie	5	1.3%
West Rawlins	146	38.6%

County	Number	Percent
Albany	5	1.3%
Carbon	260	68.8%
Fremont	13	3.4%
Natrona	2	0.5%
Sweetwater	98	25.9%

Land Status	Number	Percent
BLM	217	57.4%
BLM/Private	11	2.9%
Not Determined	2	0.5%
Private	123	32.5%
State	21	5.6%
State/Private	1	0.3%
USF&WS	1	0.3%
WGFD	2	0.5%

Management Area	Number	Percent
H	378	100.0

Table 4. Sage-grouse hunting seasons and harvest data.

a. Season

Year	Season Dates	Length	Bag/Possession Limit
2001	Sep 22-Oct 7	16	3/6
2002	Sep 28-Oct 6	9	2/4
2003	Sep 27-Oct 5	9	2/4
2004	Sept 23-Oct 3	11	2/4
2005	Sept 23-Oct 3	11	2/4
2006	Sept 23-Oct 3	11	2/4
2007	Sept 22-Oct 2	11	2/4
2008	Sept 22-Oct 2	11	2/4
2009	Sept 19- Sept 30	12	2/4
2010	Sept 18- Sept 30	13	2/4

b. Harvest

Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2000	3,460	1,097	2,738	1.3	3.2	2.5
2001	1,777	761	2,062	0.9	2.3	2.7
2002	1,140	491	1,442	0.8	2.3	2.9
2003	728	294	750	1.0	2.5	2.6
2004	1,626	947	1,986	0.8	1.7	2.1
2005	2,647	1,112	2,290	1.2	2.4	2.1
2006	1,491	836	1,738	0.9	1.8	2.1
2007	1,386	739	1,531	0.9	1.9	2.1
2008	1,773	743	1,511	1.2	2.4	2.0
2009	1,619	726	1,474	1.1	2.2	2.0
2010	1,126	487	1,165	1.0	2.3	2.4
Avg.	1,707	748	1,699	1.0	2.3	2.3

Table 5. Composition of harvest by wing analysis.

Year	Sample Size	Percent Adult		Percent Ylg		Percent Young		Chicks /Hen
		Male	Female	Male	Female	Male	Female	
2001	693	6.3	25.1	1.2	6.1	23.1	38.1	2.0
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

Sage-grouse Wing Analysis Summary 2010

Region: **Area :**

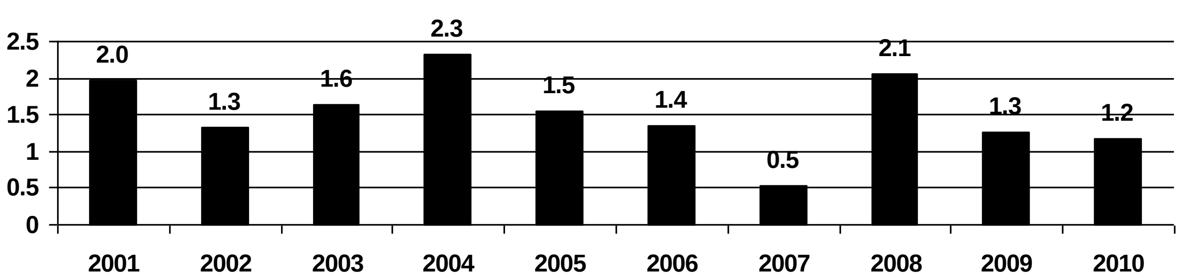
Working Group: South Central

Adult Males:	24	**Percent of All Wings:**	10.4%
Adult Females:	78	**Percent of All Wings:**	33.9%
Adult Unknown:	0	**Percent of All Wings:**	0.0%
Total Adults:	102		
Yearling Males:	3	**Percent of All Wings:**	1.3%
Yearling Females:	15	**Percent of All Wings:**	6.5%
Yearling Unknown:	0	**Percent of All Wings:**	0.0%
Total Yearlings:	18		
Chick Males:	30	**Percent of All Wings:**	13.0%
Chick Females:	51	**Percent of All Wings:**	22.2%
Chick Unknown:	29	**Percent of All Wings:**	12.6%
Total Chicks:	110		
Unknown Sex/Age:	1	**Percent of All Wings:**	0.4%
Total for all Sex/Age Groups:	230		

Chick Males:	30	**Percent of All Chicks:**	37.0%
Yearling Males:	3	**Percent of Adult and Yearling Males:**	11.1%
Adult Males:	24	**Percent of Adult and Yearling Males:**	88.9%
Adult and Yearling Males:	27	**Percent of Adults and Yearlings:**	22.5%
Total Males:	57	**Percent of All Sex/Age Groups:**	28.4%
Chick Females:	51	**Percent of All Chicks:**	63.0%
Yearling Females:	15	**Percent of Adult and Yearling Females:**	16.1%
Adult Females:	78	**Percent of Adult and Yearling Females:**	83.9%
Adult and Yearling Females:	93	**Percent of Adults and Yearlings:**	77.5%
Total Females:	144	**Percent of All Sex/Age Groups:**	71.6%

Chicks:	110	**Percent of All Wings:**	47.8%
Yearlings:	18	**Percent of All Wings:**	7.8%
Adults:	102	**Percent of All Wings:**	44.3%
Chicks/Hen:	**1.2**		

Chicks/hen calculated from wings of harvested sage-grouse.



South Central Conservation Area
Job Completion Report

Species: **Sage-grouse** Conservation Plan Area: **South Central**
Period Covered: **June 1, 2010 – May 31, 2011** Sage-Grouse Mgmt Area: **H**
Prepared by: **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 along 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 323 occupied, 23 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 5% on state owned lands.

Figure 1. South Central Local Working Group area.

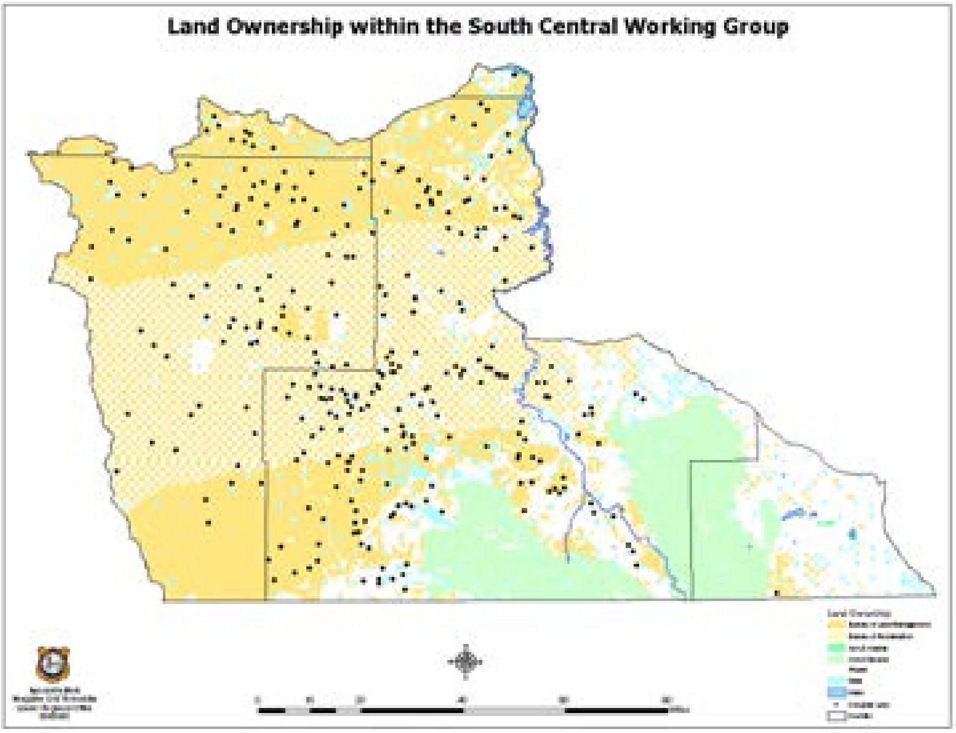


Figure 2. Landownership within the South Central Working Group Area.

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.

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.

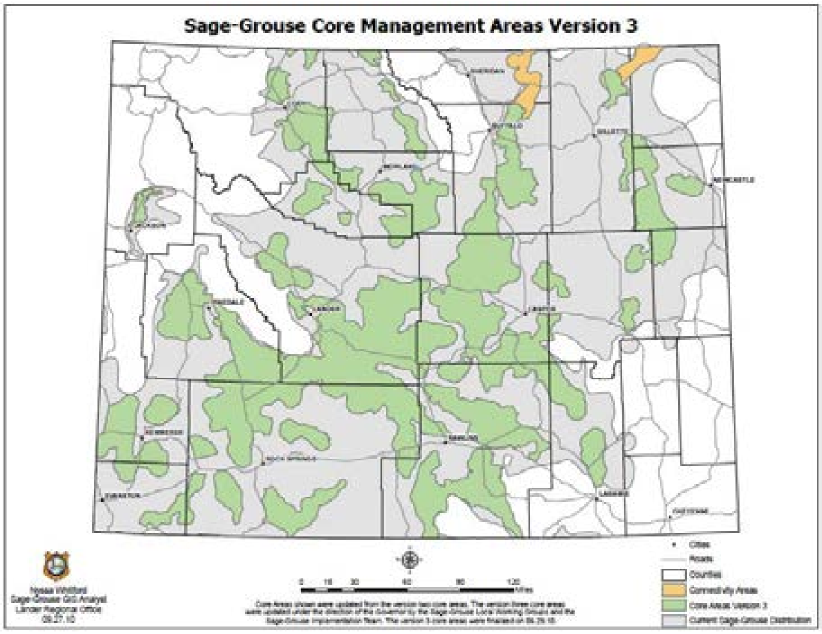


Figure 3. Wyoming sage-grouse Core Area map (V.3).

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 . The 2010 bio-year weather data reported here was compiled from the 2010 Big Game Job Completion Report. (WGFD 2011).

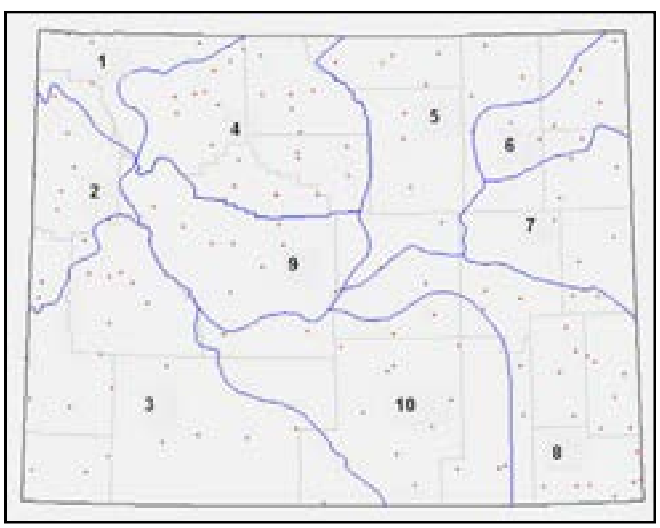


Figure 4. NCDC/NOAA, State of Wyoming Climate Division Map.

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, from 1995-1999, the Upper Platte climatic division generally experienced wetter than normal conditions (Figure 5). The division entered extreme drought conditions in 2000 and remains there through 2008. Conditions returned to wetter than normal in 2009.

Bio-year temperatures were generally average or below average in the Upper Platte Climatic Division (Figure 6). The winter of 2010-11 was dryer and colder than the winter of 2009-10. During bio-year 2010, precipitation was slightly wetter than average overall in the Upper Platte Climatic Division (Figure 7). Precipitation in May and June of 2009 was higher than average. Untimely late winter storms in May and early June of 2010 may have 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 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.

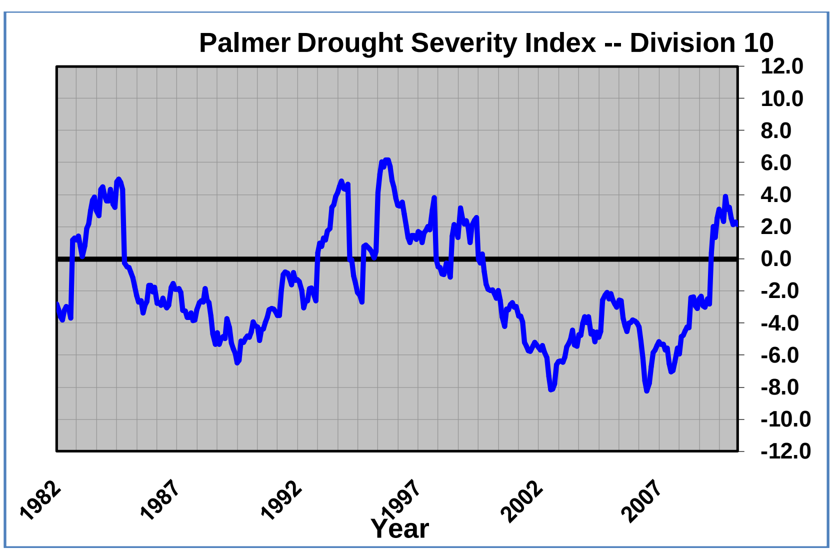


Figure 5. Drought severity trend from 1982 – 2011, Wyoming Climate Division 10.

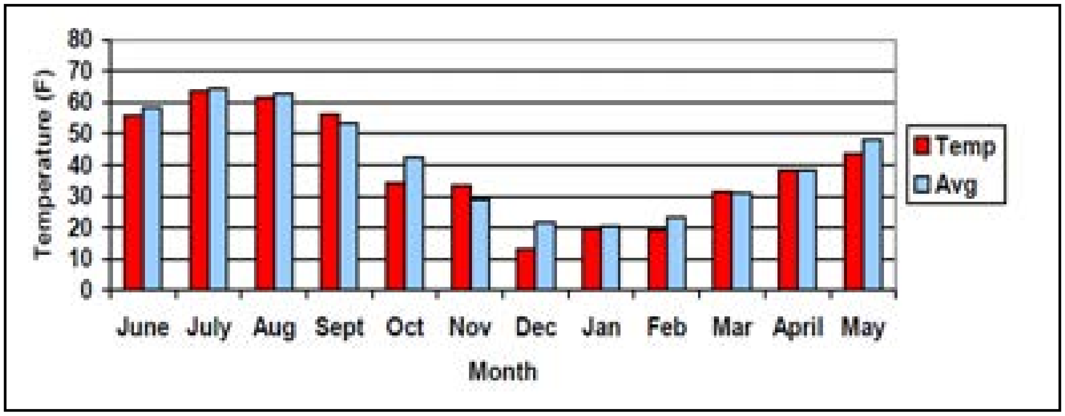


Figure 6. 2010 Bio-Year: Monthly temperature data (^{o}F), Wyoming Climate Division 10.

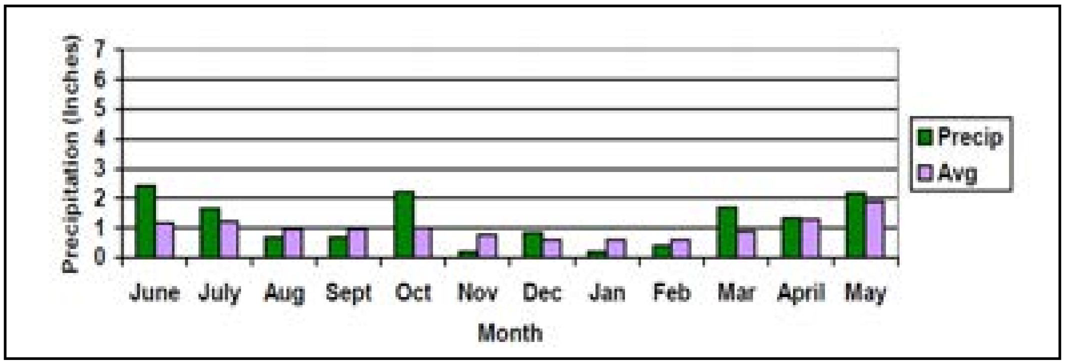


Figure 7. 2010 Bio-Year: Monthly precipitation data (in), Wyoming Climate Division 10.

Habitat

There are several energy projects within the SCCA, most are natural gas, both deep gas and coalbed methane. In addition to natural gas, wind energy permit proposals are being submitted to the Rawlins BLM office, with a major project being planned, the Chokecherry/Sierra Madre project south of Rawlins. While wind energy is a 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. 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.

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 Imitative (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 the 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 239 leks in the spring of 2011. This effort represented checking approximately 69% of the occupied status, plus unknown status, leks in the SCCA. This effort was up from the 65% of leks checked in 2010. The 2002-2011 average proportion of leks checked is 68%. The proportion of leks checked in the spring of 2011 was similar to the 10-year average. Although monitoring efforts were hampered somewhat by late winter storms, it appeared observers were able to take advantage of favorable weather when possible.

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 2011 (2010 biological year), observers counted found a maximum of 1,237 males attended count leks, averaging 24.7 males per active lek (Appendix B). This was slightly down from averages of 26.2 and 26.32 observed in 2009 and 2010, respectively. Survey monitored leks, though not as accurate for trend data as count monitored leks, also exhibited a slight decline in average numbers of males per active lek; dropping from a combine average of about 24 males/lek for 2009-2010 to 23 males/lek in 2011. The slight decline is within the norms for cyclic variation and likely at least in part attributable to weather conditions in recent years. 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 2010 upland harvest survey indicated 487 hunters spent 1,165 days to harvest 1,126 sage-grouse in the SCCA. This equals about 1.0 birds/day, 2.3 birds/hunter, and 2.4 days/hunter. Compared to 2009 when hunting regulations were similar, hunter numbers decreased by 33% in 2010, while the birds/day, and birds/hunter remained similar. The lower population size suggested lek monitoring is in agreement with the harvest data observed in the upland harvest survey information.

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 2010 hunting season we collected 230 wings from wing barrels within the SCCA. This was a decrease of 18% when compared to the 282 collected in 2009. Age and sex composition of the wings indicated the proportion of chicks/hen decreased slightly from 1.3 in 2009 to 1.2 in 2010. 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 2010 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

The Atlantic Rim sage-grouse research project continued during this period. This cooperative effort among the BLM, WGFD, and Anadarko Petroleum Corp is being conducted by Beck and Kirol of the University of Wyoming. The project objectives are; 1) to generate seasonal probability-of-occurrence maps across the Atlantic Rim project area where greater sage-grouse will occur seasonally based of habitat selection of radio-marked birds; 20 identify source habitats through seasonal risk-assessment modeling; 3) generate areas-of-critical-conservation-concern maps across the Atlantic Rim based on limiting seasonal habitats, risk assessment, multi-seasonal occurrence, and seasonal juxtaposition. An interim progress report was released in January of 2011 (Kirol and Beck 2011).

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 2011 by Colorado State University student Heidi Erickson (Erickson 2011). The South-Central Local Sage-Grouse Working Group provided some of the funding for this research. The abstract of the thesis follows:

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.

Abstract

Changes in land use over the last two centuries have been linked to reduced geographic distributions of sagebrush (*Artemisia spp*.) habitats and sagebrush associated avifauna. Livestock grazing is one of the principle land uses of publicly administered sagebrush ecosystems. Prescribed fire and other sagebrush control methods are often implemented in an attempt to increase the quantity or quality of available livestock forage. These treatments have also been recommended by some as a tool for enhancing habitat to meet seasonal forage requirements for greater sage-grouse (*Centrocercus urophasianus*) or other wildlife species. In this thesis, I examine differences in: 1) herbaceous productivity (peak standing crop biomass), 2) relative habitat use by sage-grouse, and 3) habitat suitability for migratory songbirds related to prescribed fire and summer grazing timing treatments in a high-elevation sagebrush community. Increased livestock forage availability in burns occurred only during one of three post-burn years investigated and was further limited to only one of three grazing treatment pastures (early summer). Graminoid peak standing crop in burn treatments with later summer grazing never surpassed unburned big sagebrush plots subjected to the same grazing treatment.

Habitat suitability and use by avian species appeared to be largely unaffected by post-fire grazing timing. Although sage-grouse use of burn treatments was greater when burn configuration was more heterogeneous, use was minimal across all burn treatments the first four years after burning. Sagebrush obligate songbirds, such as Brewer's sparrow (*Spizella breweri*) and sage thrasher (*Oreoscoptes montanus*), also strongly avoided burn treatments, particularly with increasing distance to intact big sagebrush (*A. tridentata*) nesting substrate. Although ground nesting species, such as vesper sparrow (*Pooecetes gramineus*), preferred reduced shrub cover associated with burn treatments, this species also responded negatively to more uniform patterns of big sagebrush removal. These results suggest that avian species are minimally impacted by summer livestock grazing at the light to moderate intensity levels resulting from my grazing treatments, regardless of timing. However, sage-grouse and migratory songbirds displayed clear seasonal avoidance of burn treatments. These results demonstrate that negative avifauna responses to sagebrush removal may strongly outweigh limited short-term gains in livestock forage production resulting from prescribed fire in some high-elevation big sagebrush systems.

<u>Disease</u>

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://gf.state.wy.us/wildlife/wildlife_management/sagegrouse/index.asp .

Project Name	Biennium	Amount granted	Grantee/Project Sponsor	Project Description
Atlantic Rim SG Distribution Study	2007-2008 2009-2010	10,000 20,000	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: Assessing the effects of grazing treatments on sagebrush vegetation and wildlife communities across prescribed burns and habitat controls	2007-2008 2009-2010	10,000 58,300	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
SC Red Mountain Seeding	2009-2010	5,000	Laramie Rivers Cons. District	Forb seed purchase for use in CRM level habitat plan – This project failed to materialize.
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

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.

Literature Cited and/or Studies in Area

Beck, J. L. and K. Kirol. 2008. Identifying habitats for greater sage-grouse population persistence within the Atlantic Rim, Wyoming coalbed methane field. Study Overview. Univ. of Wyoming. 6pp.

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Lyon, A. G., and S. H. Anderson. 2003. Potential gas development impacts on sage grouse nest initiation and movement. Wildlife Society Bulletin 31:486-491.

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_______. 2011. Appendix A. Wyoming Statewide Weather Data: Biological Years 2008 – 2010 *in* Laramie Region Big Game Job Completion Report. Laramie, WY. 34pp.

Sage-Grouse Job Completion Report

PERIOD COVERED: 6/1/2010 - 5/31/2011
WORKING GROUP: Southwest **PREPARED BY: Patrick Burke**

1. LEK ATTENDANCE SUMMARY (OCCUPIED LEKS)

a. Leks Counted

			Percent	Max Totals		Avg./Active Lek	
Year	Known	Counted	Counted	Males	Females	Males	Females
2002	238	35	14.7	841	304	24.0	8.7
2003	238	59	24.8	1460	434	24.7	7.4
2004	253	49	19.4	1389	242	28.3	4.9
2005	258	59	22.9	2955	449	50.1	7.6
2006	267	67	25.1	4153	526	62.0	7.9
2007	283	68	24.0	3840	605	56.5	8.9
2008	292	69	23.6	4284	646	62.1	9.4
2009	312	71	22.8	2581	829	36.4	11.7
2010	323	82	25.4	2190	1125	26.7	13.7
2011	321	75	23.4	1855	993	24.7	13.2

b. Leks Surveyed

Year	Known	Surveyed	Percent Surveyed	Max Total	Avg Males/ Active Lek
2002	238	132	55.5	1533	20.4
2003	238	133	55.9	1725	21.8
2004	253	121	47.8	1642	21.3
2005	258	126	48.8	3415	36.7
2006	267	172	64.4	3990	36.9
2007	283	196	69.3	5810	42.7
2008	292	162	55.5	4000	33.3
2009	312	208	66.7	5529	35.4
2010	323	202	62.5	3808	26.8
2011	321	172	53.6	2832	21.6

c. Leks Checked

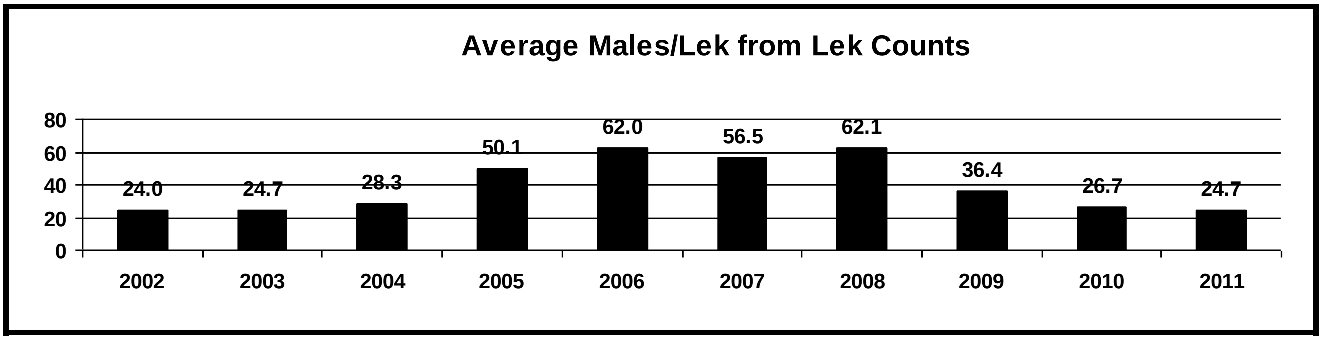
Year	Known	Checked	Percent Checked	Max Total	Avg Males/ Active Lek
2002	238	166	69.7	2343	21.5
2003	238	190	79.8	3165	23.1
2004	253	170	67.2	3031	24.1
2005	258	184	71.3	6364	42.1
2006	267	239	89.5	8143	46.5
2007	283	263	92.9	9612	47.3
2008	292	230	78.8	8217	43.7
2009	312	278	89.1	8064	35.7
2010	323	281	87.0	5884	26.5
2011	321	245	76.3	4654	22.7

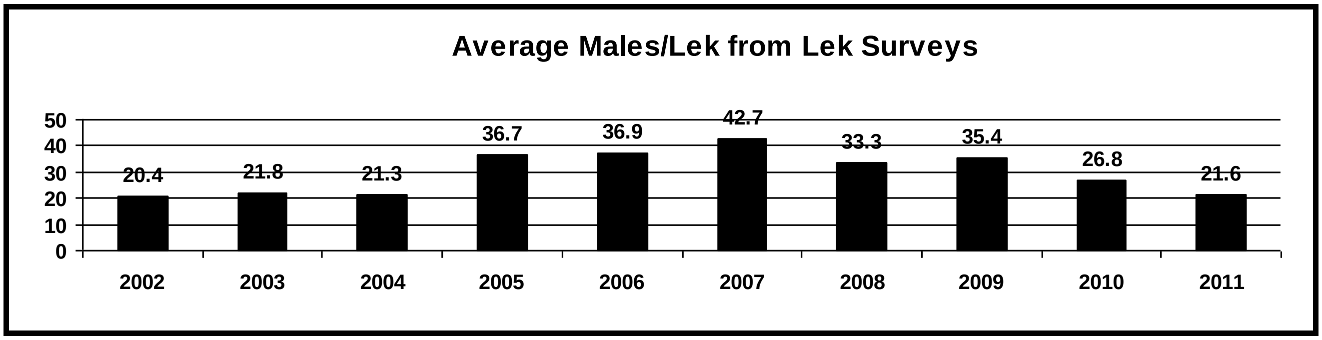
d. Lek Status

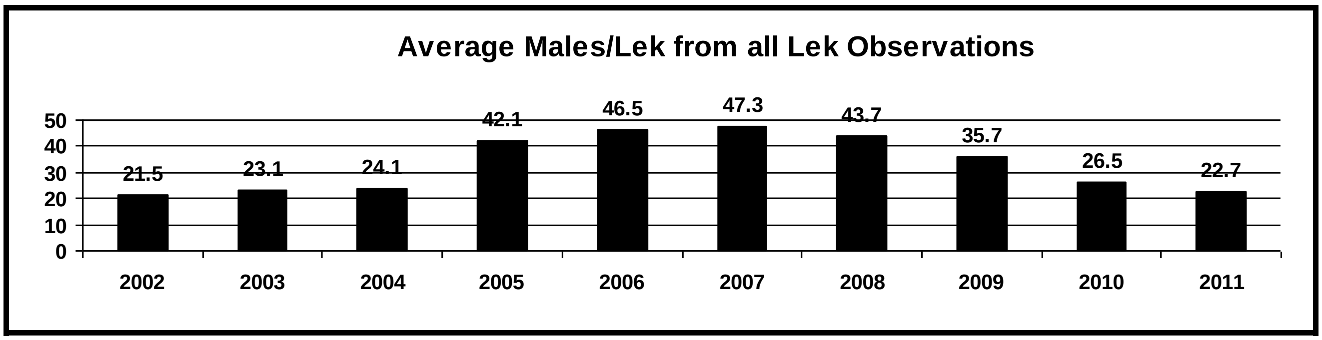
					Confirmed Status		
Year	Active	Inactive	Not Located	Unknown	Total	Active	Inactive
2002	112	26	2	98	138	81.2%	18.8%
2003	134	39	0	65	173	77.5%	22.5%
2004	130	25	0	98	155	83.9%	16.1%
2005	151	19	0	88	170	88.8%	11.2%
2006	183	41	0	43	224	81.7%	18.3%
2007	213	34	0	36	247	86.2%	13.8%
2008	194	25	0	73	219	88.6%	11.4%
2009	231	32	0	49	263	87.8%	12.2%
2010	223	28	0	72	251	88.8%	11.2%
2011	212	15	0	94	227	93.4%	6.6%

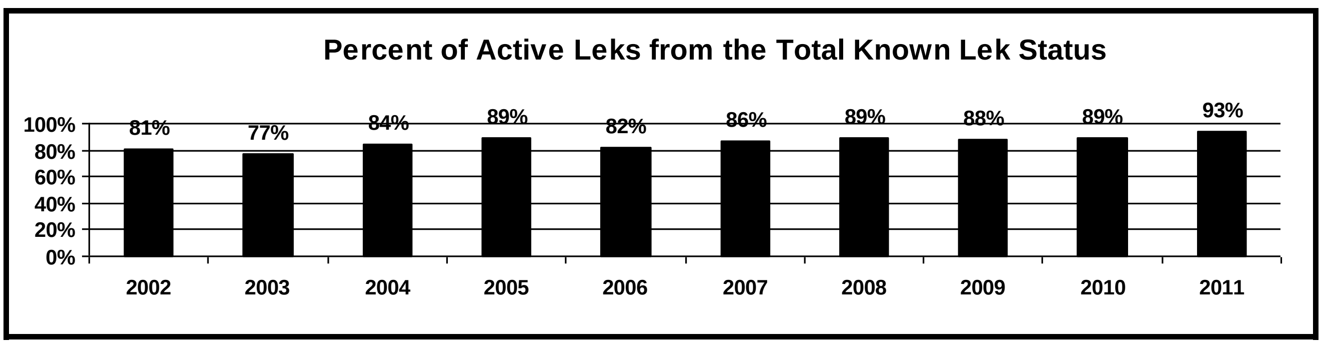
SAGE-GROUSE LEK ATTENDANCE SUMMARY

WORKING GROUP: Southwest **Area(s): All**









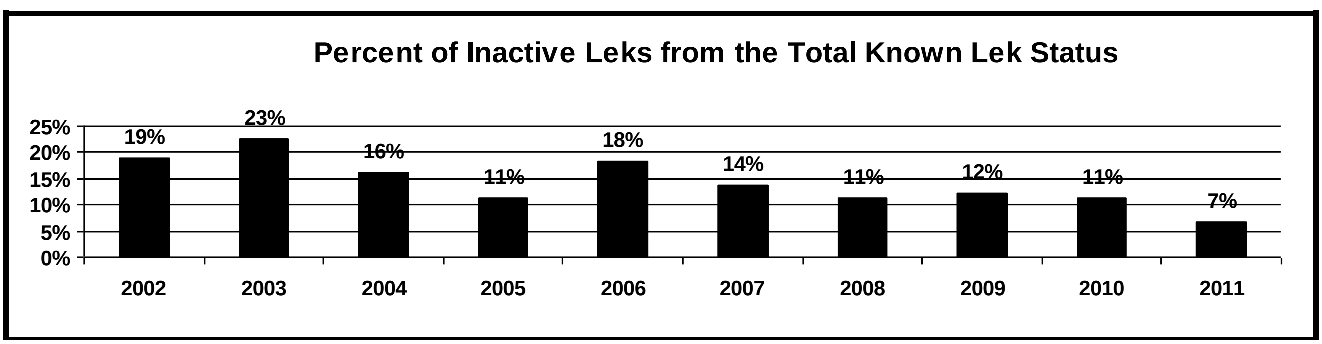


Table3. Summary of unoccupied (historic) leks.

a. Unoccupied Leks

Year	Total Number of Leks: Abandoned	Destroye	Number of abandoned leks checked
2002	74	14	18
2003	79	14	63
2004	79	14	3
2005	80	14	1
2006	81	14	25
2007	81	14	13
2008	81	14	14
2009	79	14	24
2010	78	14	20
2011	83	14	14

Sage Grouse Lek Characteristics

Region	Number	Percent
Green River	367	88.0%
Pinedale	50	12.0%

Working Group Area	Number	Percent
Southwest	417	100.0

Classification	Number	Percent
Occupied	299	71.7%
Undetermined	19	4.6%
Unoccupied	99	23.7%

BLM Office	Number	Percent
Kemmerer	184	44.1%
Pinedale	12	2.9%
Rawlins	1	0.2%
Rock Springs	220	52.8%

Unoccupied Leks	Number
Abandoned	85
Destroyed	14
N/A	1

Biologist District	Number	Percent
Baggs	4	1.0%
Green River	148	35.5%
Kemmerer	215	51.6%
Pinedale	50	12.0%

Game Warden District	Number	Percent
Baggs	2	0.5%
Cokeville	59	14.1%
Evanston	29	7.0%
Green River	68	16.3%
Kemmerer	68	16.3%
Mountain View	47	11.3%
Rock Springs	94	22.5%
South Pinedale	50	12.0%

County	Number	Percent
Fremont	3	0.7%
Lincoln	133	31.9%
Sublette	22	5.3%
Sweetwater	189	45.3%
Uinta	70	16.8%

Land Status	Number	Percent
BLM	311	74.6%
National Park	2	0.5%
Private	93	22.3%
State	10	2.4%
USFS	1	0.2%

Management Area	Number	Percent
G	417	100.0

Table 4. Sage-grouse hunting seasons and harvest data.

a. Season

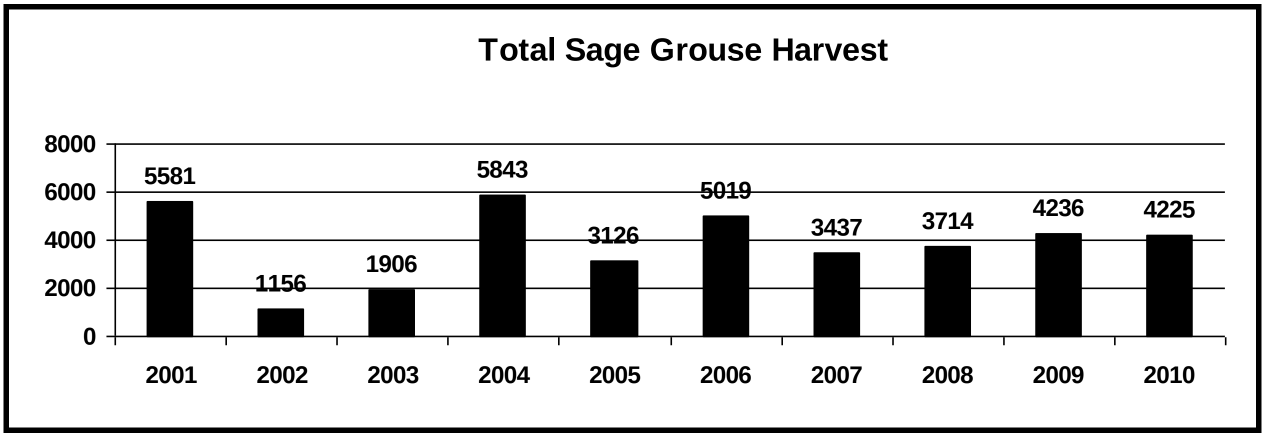
Year	Season Dates	Length	Bag/Possession Limit
2001	Sept 22-Oct 7	16	3/6
2002	Sept 28-Oct 6	9	2/4
2003	Sept 27-Oct 5	9	2/4
2004	Sept 23-Oct 3	11	2/4
2005	Sept 23-Oct 3	11	2/4
2006	Sept 23-Oct 3	11	2/4
2007	Sept 22-Oct 2	11	2/4
2008	Sept 22-Oct 2	11	2/4
2009	Sept 19- Sept 30	12	2/4
2010	Sept 18- Sept 30	13	2/4

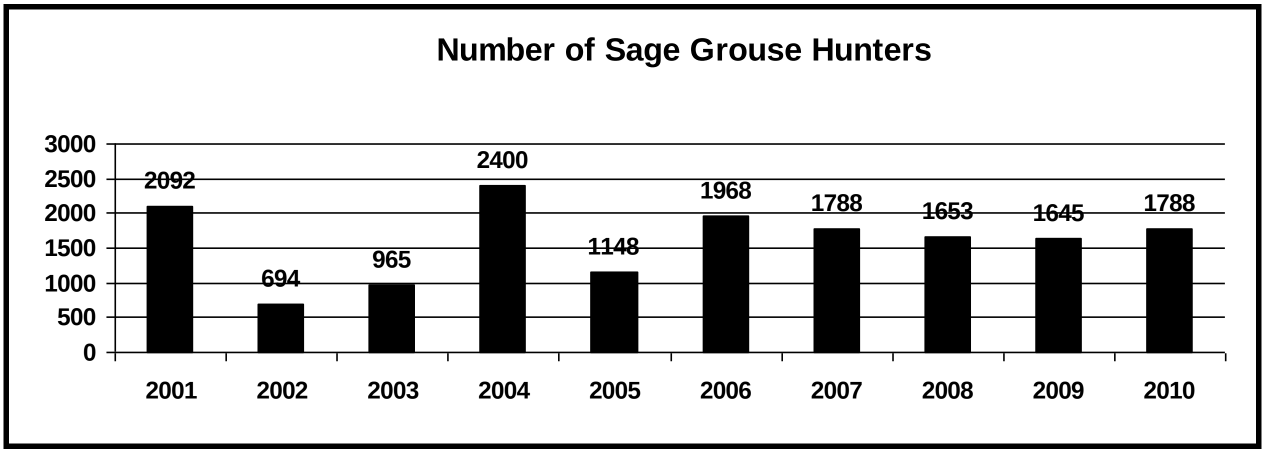
b. Harvest

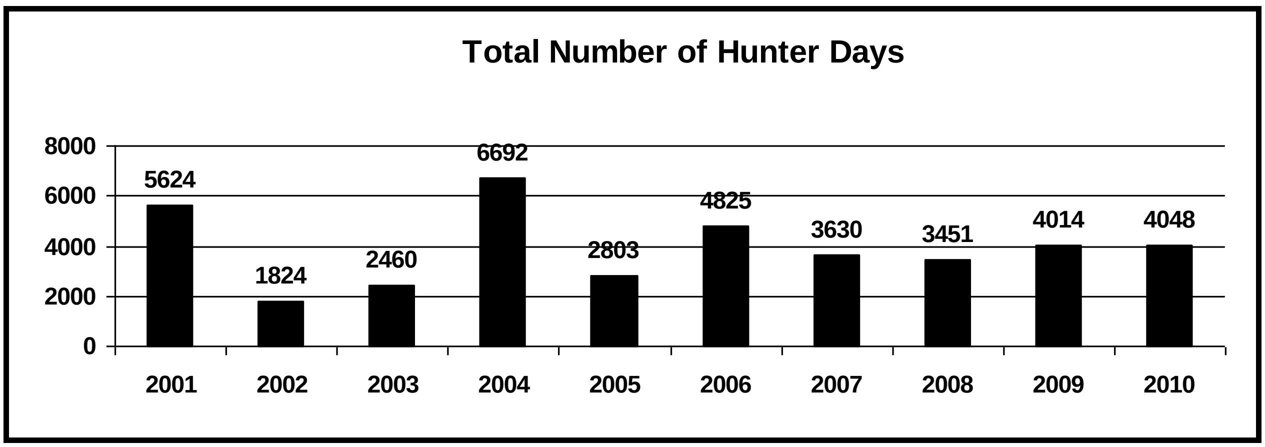
Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2001	5,581	2,092	5,624	1.0	2.7	2.7
2002	1,156	694	1,824	0.6	1.7	2.6
2003	1,906	965	2,460	0.8	2.0	2.5
2004	5,843	2,400	6,692	0.9	2.4	2.8
2005	3,126	1,148	2,803	1.1	2.7	2.4
2006	5,019	1,968	4,825	1.0	2.6	2.5
2007	3,437	1,788	3,630	0.9	1.9	2.0
2008	3,714	1,653	3,451	1.1	2.2	2.1
2009	4,236	1,645	4,014	1.1	2.6	2.4
2010	4,225	1,788	4,048	1.0	2.4	2.3
Avg.	3,824	1,614	3,937	1.0	2.3	2.4

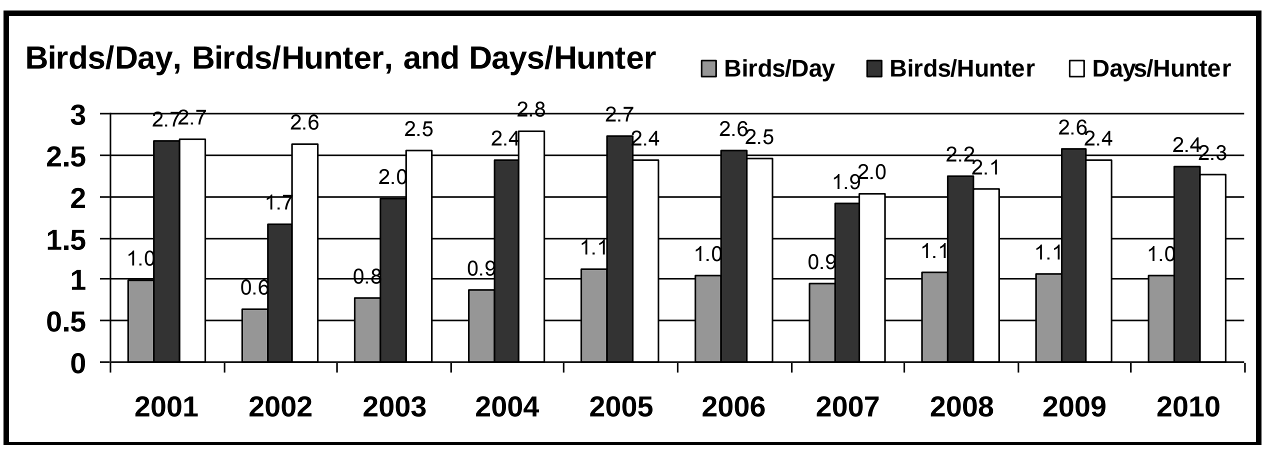
SAGE-GROUSE HARVEST SUMMARY

WORKING GROUP: Southwest **Area(s): All**









Chicks/hen calculated from wings of harvested sage-grouse.

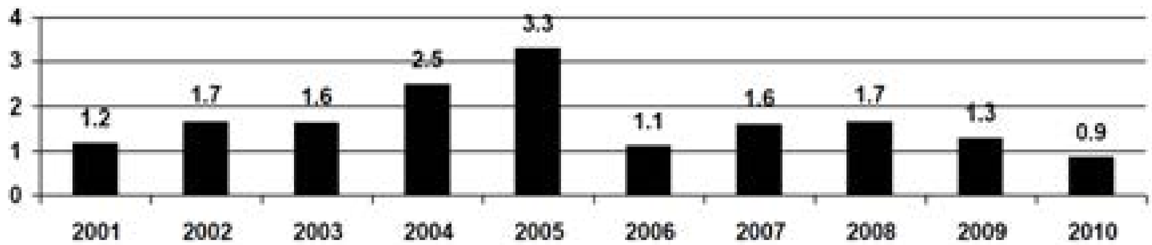


Table 5. Composition of harvest by wing analysis.

Year	Sample Size	Percent Adult Male	Percent Adult Female	Percent Ylg Male	Percent Ylg Female	Percent Young Male	Percent Young Female	Chicks /Hen
2001	842	11.3	35.0	2.7	4.9	25.1	24.6	1.2
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[1]	696[2]							0.9

1) Original data sheets from 2010 were lost before data entry. The number of chicks and hens were recorded prior to this loss.

2) The sample size does not include adult and yearling males due to lost data sheets.

2010 Annual Sage-Grouse Job Completion Report

Conservation Plan Area: **Southwest**
Biological Year: **June 1, 2010 – May 31, 2011**

INTRODUCTION

The Southwest Wyoming Local Sage-Grouse Working Group (SWLWG) is one of eight local sage-grouse working groups in Wyoming (Figure 1). The local working groups were created in 2004 and are charged with developing and implementing plans to promote sage-grouse conservation and, whenever possible, conservation of other species that use sagebrush dominated habitats. The goal of these conservation plans is to identify strategies to improve sage-grouse numbers and prevent the need for the listing of the species under the Endangered Species Act. The conservation plan for the SWLWG was completed in July 2007. This report focuses on analysis of data for the biological year June 1, 2010 - May 31, 2011.

Figure 1. 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 decade (Connelly et al. 2004). Those monitoring efforts have suggested that sage-grouse populations in the Southwest Sage-Grouse Conservation Planning Area (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 Southwest Planning Area 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. Newly completed 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 2.

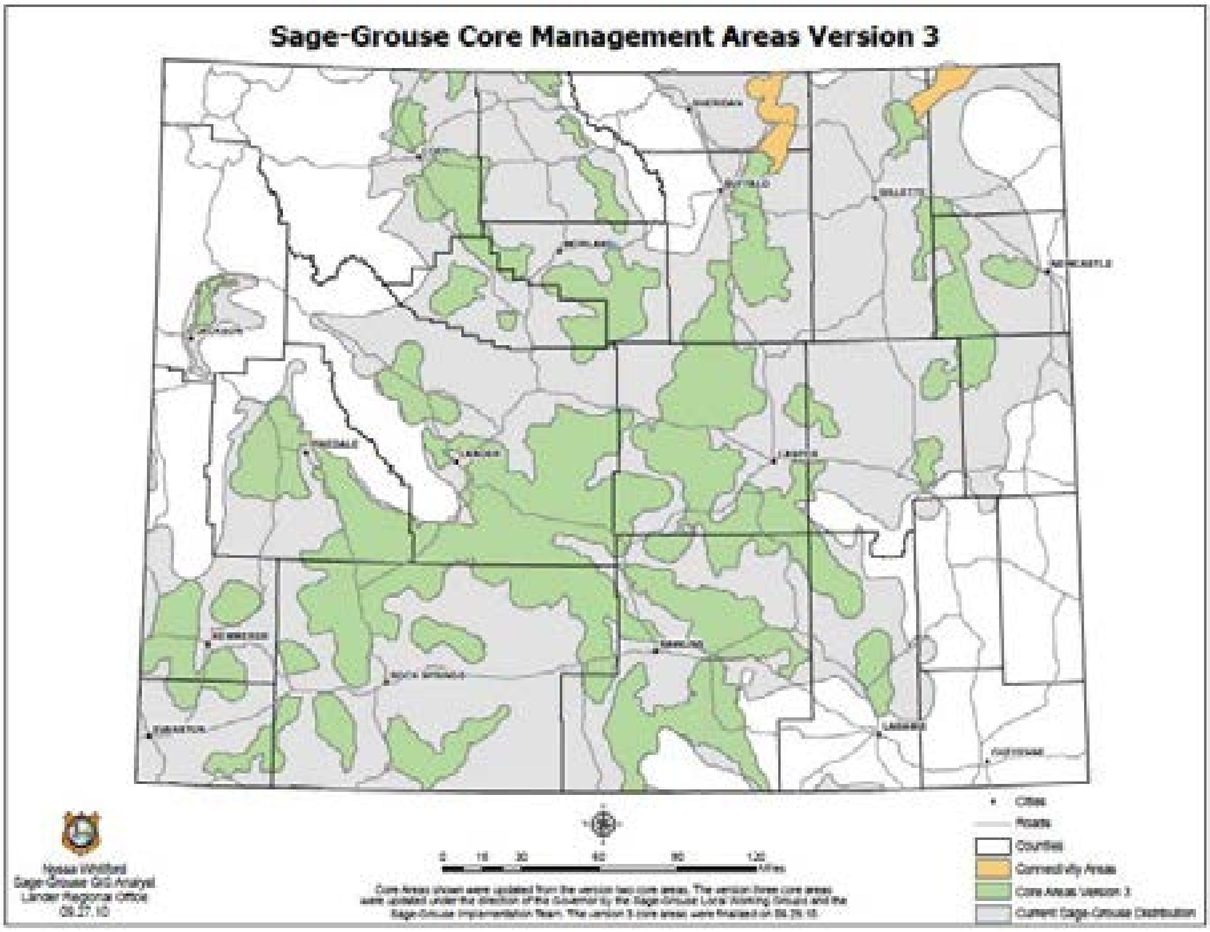


Figure 2. Wyoming sage grouse core areas Version 3.

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 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 5). 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 new 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.

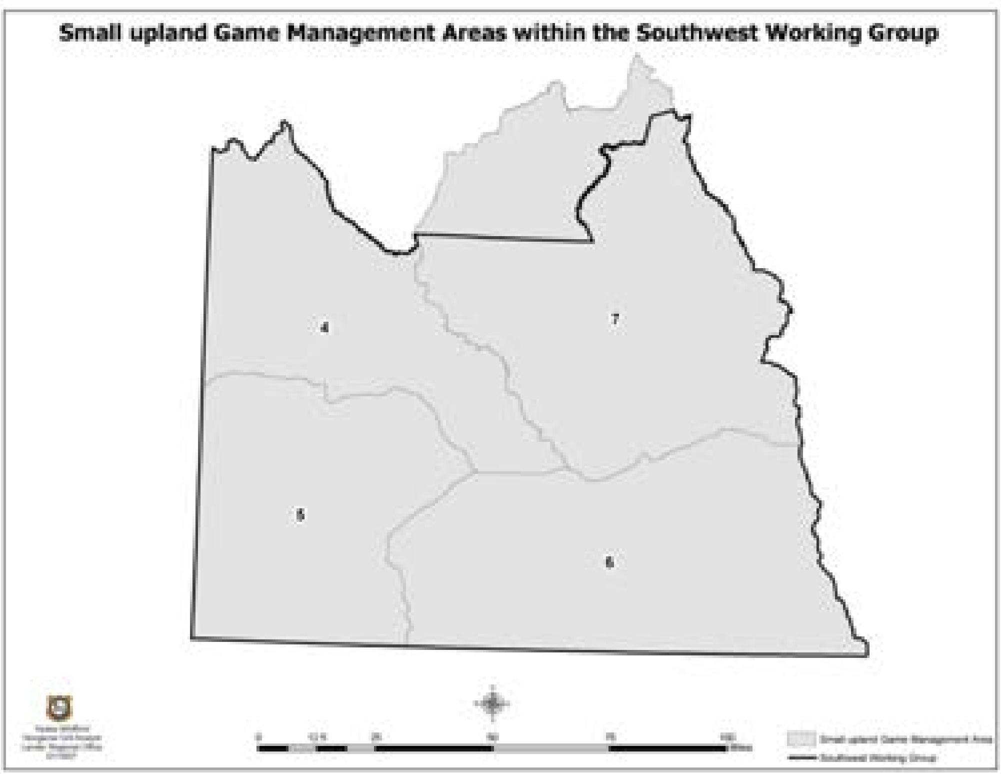


Figure 5. Small Game Management Areas within the Southwest Wyoming Sage-Grouse Conservation Planning Area. Small Game Management Areas were used to report sage-grouse harvest prior to 2010.

In addition to the mail questionnaire, wings are collected from harvested sage-grouse in order to calculate the proportions of adults, juveniles, males, and females in the harvest. Wings were submitted voluntarily 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

All lek monitoring data for the 2011 breeding season along with data from the past ten years for comparison are summarized in the JCR Data Tables 1 (a-d). There were 299 occupied leks known to exist in the SWSGCA during the 2011 breeding season. There are also 99 unoccupied leks and 19 leks of undetermined classification. Of these 417 total sites, 245 were checked in 2011 resulting in 212 being documented active, 15 inactive and 94 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.

The average number of males per active lek for all leks checked (both counted and surveyed) was 22.7 males per active lek. This is a reduction from an average of 32.5 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 75 count leks in 2011 was 24.7 males per lek. This number is a decrease from the observed averages of recent years and is the lowest observed average since 2003 when 24.7 males per count lek were also observed. For the 172 leks that were surveyed in 2011, the average lek had 21.6 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 59.6% of known occupied leks were checked, but since 2006, around 80% 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.

Note that the number of "known" leks on JCR table1 (a-d) include all "occupied" leks plus the number of unoccupied and unknown status leks checked during that year, and therefore reports a different number than the number of confirmed occupied 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 2010 hunting season for sage-grouse in the SWSGCA ran from September 18 to September 30 and allowed for a daily take of 2 birds with a limit of 4 grouse in possession (Table 4 a). The

2010 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 hunting season. 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 UGRBCA. 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 the SWLWG report.

Based on the harvest surveys returned by hunters, it was estimated that 1,788 hunters harvested 4,225 sage-grouse during the 2010 hunting season (Table 4 b) which is essentially identical to data reported in 2009. 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 696 grouse wings in 2010. This represents approximately 16% of the estimated total harvest for 2010, which is in line with the 16% ten-year average.

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 2010 hunting season was 0.9 chicks/hen. This ratio suggests a declining population. This ratio is the lowest ratio observed in the SWSGCA in the last decade.

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 9 and Figure 6. 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 2010, spring precipitation was 139% of normal however, 2010 chick production did not increase correspondently. 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 9. Spring precipitation compared to fall chick:hen ratios in the SWSGCA 2001-2010. 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**
2001	44%	1.2
2002	50%	1.7
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%	N/A

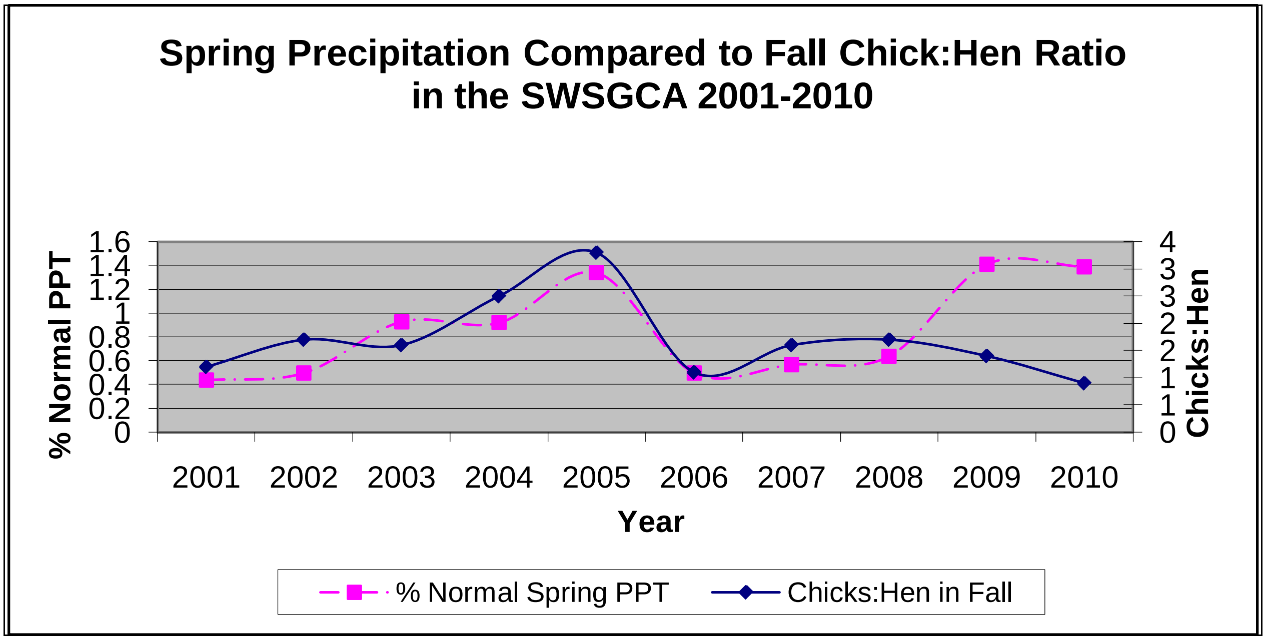


Figure 6. Percent of normal spring precipitation compared to fall chick to hen ratios in the Southwest Wyoming Sage-Grouse Conservation Planning Area

Habitat and Seasonal Range Mapping

While we believe that most of the currently occupied leks in Southwest Wyoming 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.

Patterson, R. L. 1952. The sage-grouse in Wyoming. Wyoming Game and Fish Department. Sage Books.

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) Map important seasonal habitats, especially early brood rearing habitats

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.

LITERATURE CITED

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.

Christiansen, T. 2007. Chapter 12: Sage Grouse (*Centrocercus urophasianus*). Pages 12-1 to 12-51 in S.A. Tessmann (ed). Handbook of Biological Techniques: third edition. Wyoming Game and Fish Department. Cheyenne, WY.

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

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

Sage-Grouse Job Completion Report

PERIOD COVERED: 6/1/2010 - 5/31/2011
WORKING GROUP: Upper Green River **PREPARED BY: Dean Clause**

1. LEK ATTENDANCE SUMMARY (OCCUPIED LEKS)

a. Leks Counted

			Percent	Max Totals		Avg./Active Lek	
Year	Known	Counted	Counted	Males	Females	Males	Females
2002	98	42	42.9	1213	456	28.9	10.9
2003	98	61	62.2	1462	577	24.0	9.5
2004	103	62	60.2	1541	212	24.9	3.4
2005	107	81	75.7	3003	650	37.1	8.0
2006	113	78	69.0	3869	689	49.6	8.8
2007	119	78	65.5	4290	313	55.0	4.0
2008	121	83	68.6	3721	609	44.8	7.3
2009	119	85	71.4	3850	1142	45.3	13.4
2010	133	93	69.9	3099	1176	33.3	12.6
2011	133	102	76.7	2692	842	26.4	8.3

b. Leks Surveyed

Year	Known	Surveyed	Percent Surveyed	Max Total	Avg Males/ Active Lek
2002	98	23	23.5	605	40.3
2003	98	26	26.5	272	16.0
2004	103	24	23.3	503	35.9
2005	107	20	18.7	657	38.6
2006	113	25	22.1	923	48.6
2007	119	31	26.1	1393	66.3
2008	121	24	19.8	1414	78.6
2009	119	28	23.5	619	38.7
2010	133	32	24.1	573	26.0
2011	133	26	19.5	954	45.4

c. Leks Checked

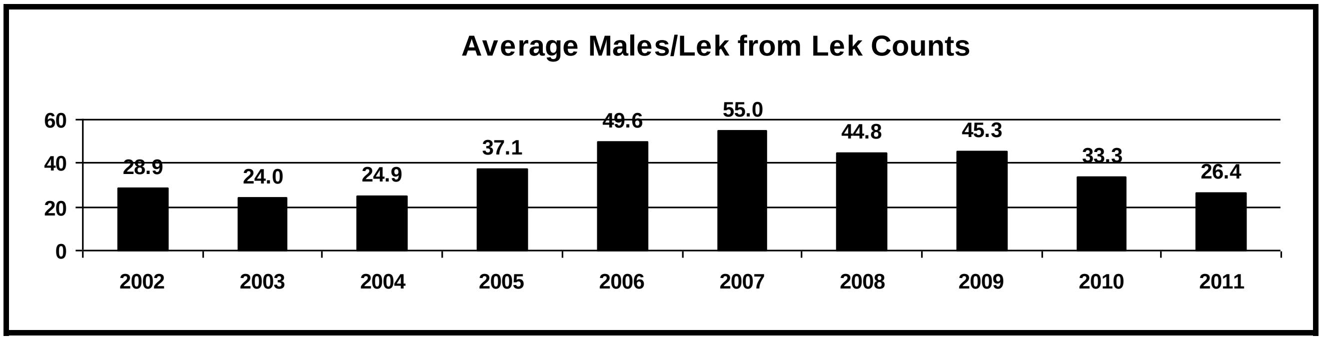
Year	Known	Checked	Percent Checked	Max Total	Avg Males/ Active Lek
2002	98	64	65.3	1761	31.4
2003	98	87	88.8	1734	22.2
2004	103	86	83.5	2044	26.9
2005	107	101	94.4	3660	37.3
2006	113	102	90.3	4781	49.8
2007	119	108	90.8	5683	58.0
2008	121	107	88.4	5135	50.8
2009	119	113	95.0	4469	44.2
2010	133	125	94.0	3672	31.9
2011	133	127	95.5	3635	29.8

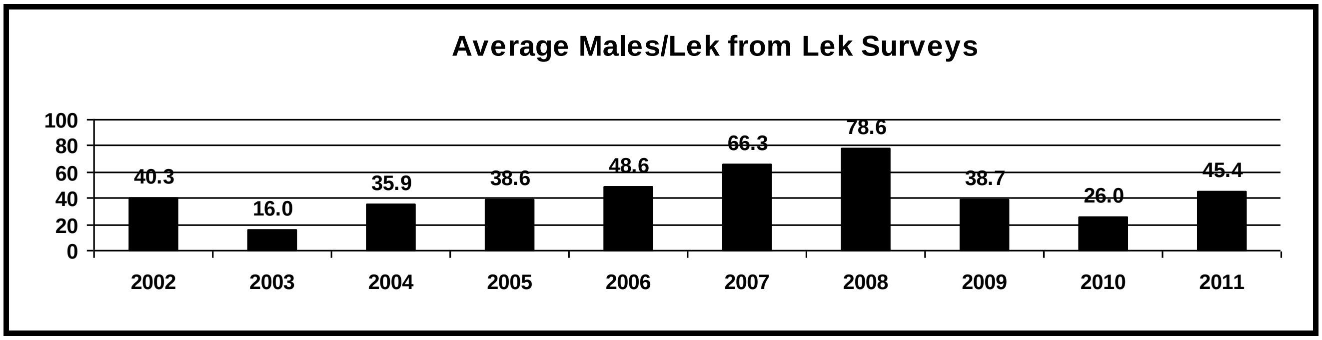
d. Lek Status

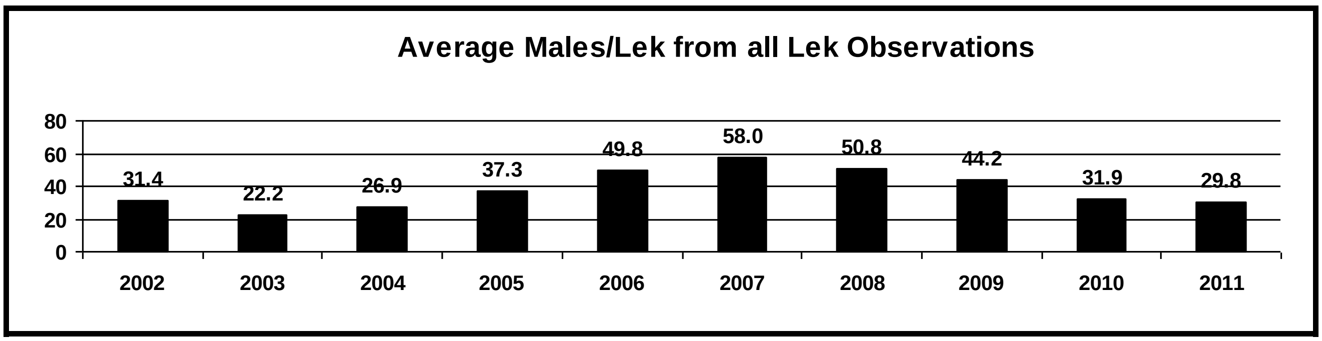
						Confirmed Status	
Year	Active	Inactive	Not Located	Unknown	Total	Active	Inactive
2002	47	15	0	36	62	75.8%	24.2%
2003	59	24	1	14	83	71.1%	28.9%
2004	61	24	0	18	85	71.8%	28.2%
2005	76	25	0	6	101	75.2%	24.8%
2006	79	23	0	11	102	77.5%	22.5%
2007	82	25	1	11	107	76.6%	23.4%
2008	87	20	0	14	107	81.3%	18.7%
2009	86	27	0	6	113	76.1%	23.9%
2010	95	30	0	8	125	76.0%	24.0%
2011	104	23	0	6	127	81.9%	18.1%

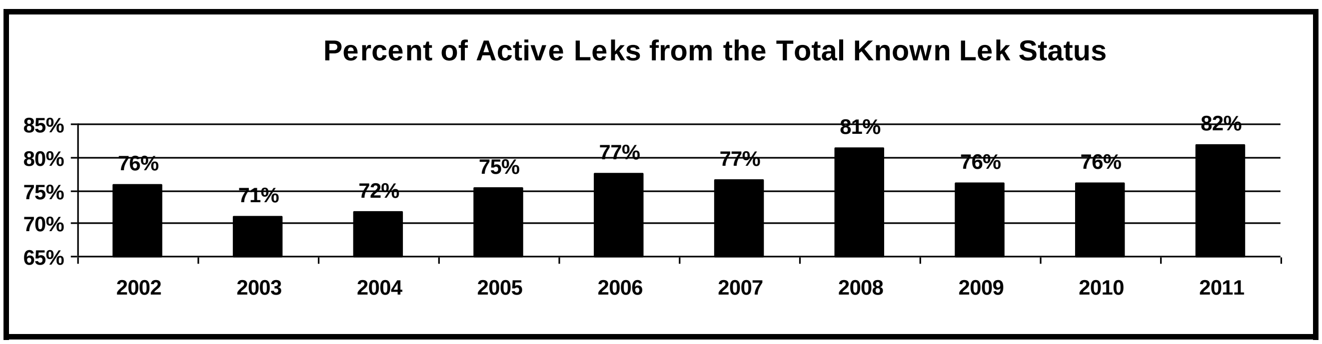
SAGE-GROUSE LEK ATTENDANCE SUMMARY

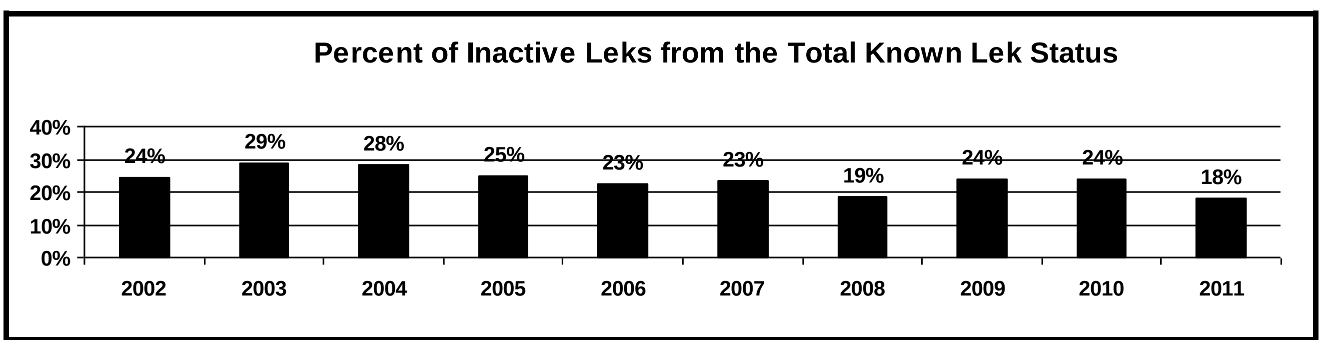
WORKING GROUP: Upper Green River **Area(s): All**











2. LEK COMPLEX ATTENDANCE SUMMARY (OCCUPIED COMPLEXES)

a. Lek Complexes Counted

Year	Number of Complexes	Maximum Totals Males	Maximum Totals Females	Avg./Active Complex Males	Avg./Active Complex Females	Number of Leks
2002	15	1183	454	78.9	30.3	82
2003	16	1090	345	68.1	21.6	85
2004	16	1514	208	94.6	13.0	90
2005	18	2574	492	143.0	27.3	96
2006	21	3108	564	148.0	26.9	112
2007	22	3508	253	159.5	11.5	113
2008	18	2742	505	152.3	28.1	110
2009	22	3147	898	143.0	40.8	119
2010	26	2618	1015	100.7	39.0	144
2011	25	2500	841	100.0	33.6	140

b. Lek Complexes Surveyed

Year	Number Complexes	Max. Total Males	Avg. Males/ Active Complex	Number of Leks
2002	1	82	82.0	4
2003	7	146	24.3	16
2004	2	148	148.0	5
2005	4	281	93.7	11
2006	3	288	144.0	6
2007	2	466	233.0	12
2008	6	635	158.8	15
2009	6	234	39.0	13
2010	2	12	6.0	3
2011	5	194	48.5	39

c. Lek Complexes Checked

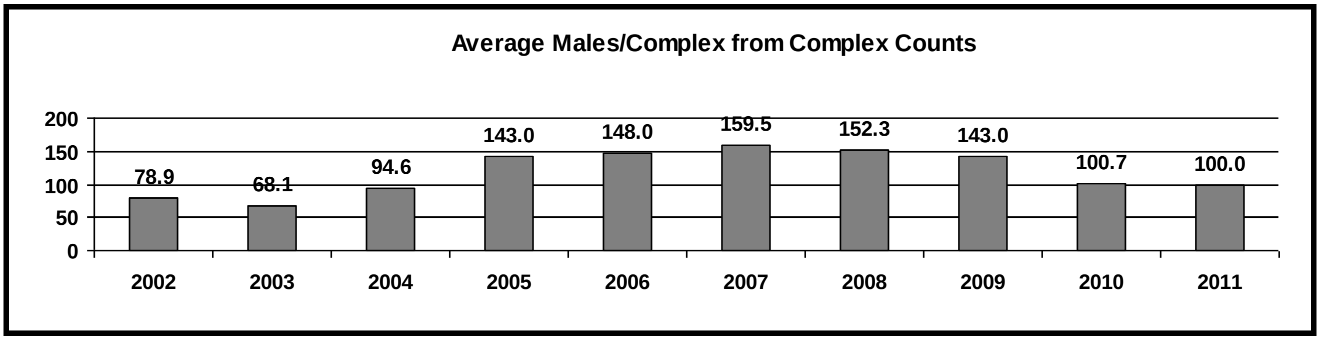
Year	Number Complexes	Max. Total Males	Avg. Males/ Active Complex	Number of Leks
2002	16	1265	79.1	86
2003	23	1236	56.2	101
2004	18	1662	97.8	95
2005	22	2855	136.0	107
2006	24	3396	147.7	118
2007	24	3974	165.6	125
2008	24	3377	153.5	125
2009	28	3381	120.8	132
2010	28	2630	93.9	147
2011	30	2694	92.9	179

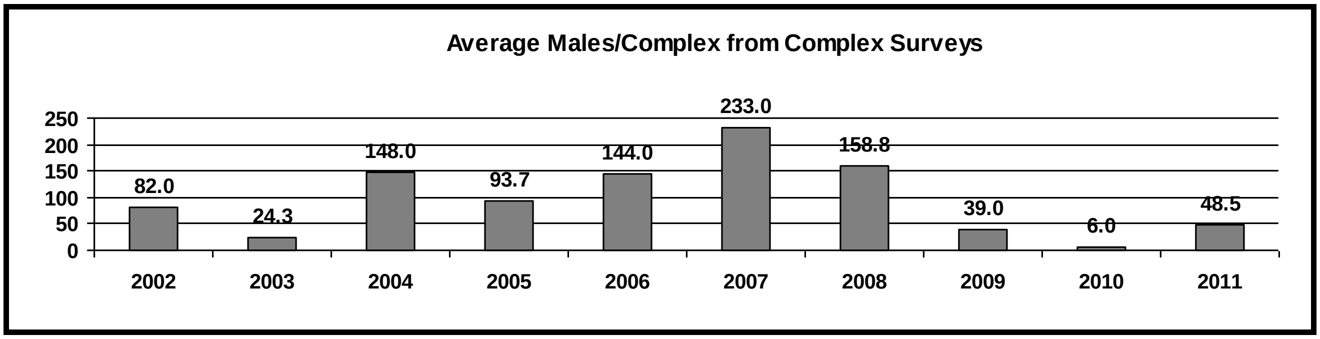
d. Lek Complex Status

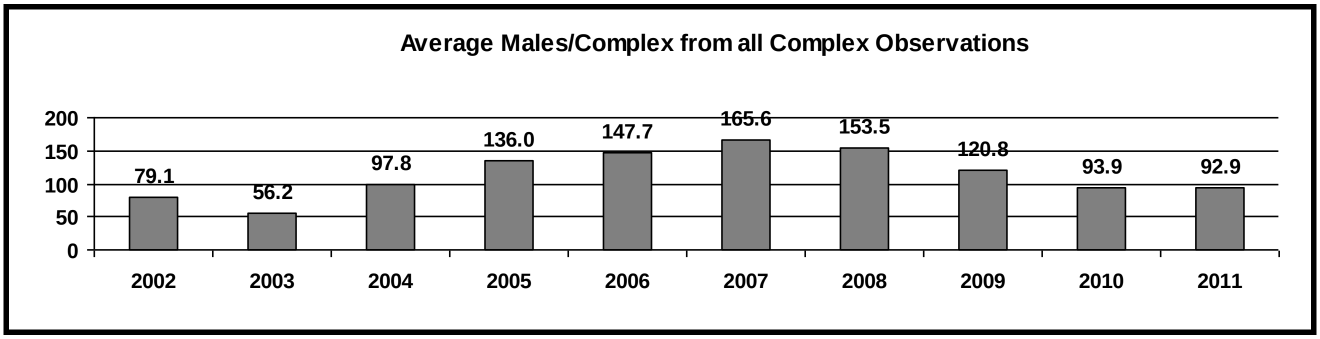
Year	Number of Occupied Complexes Active	Inactive	Unknown	Total	Known Status Total	Active	Inactive
2002	16	0	7	23	16	######	0.0%
2003	20	2	1	23	22	90.9%	9.1%
2004	17	1	5	23	18	94.4%	5.6%
2005	21	1	1	23	22	95.5%	4.5%
2006	20	4	0	24	24	83.3%	16.7%
2007	22	2	0	24	24	91.7%	8.3%
2008	21	3	0	24	24	87.5%	12.5%
2009	27	1	0	28	28	96.4%	3.6%
2010	27	1	0	28	28	96.4%	3.6%
2011	28	2	0	30	30	93.3%	6.7%

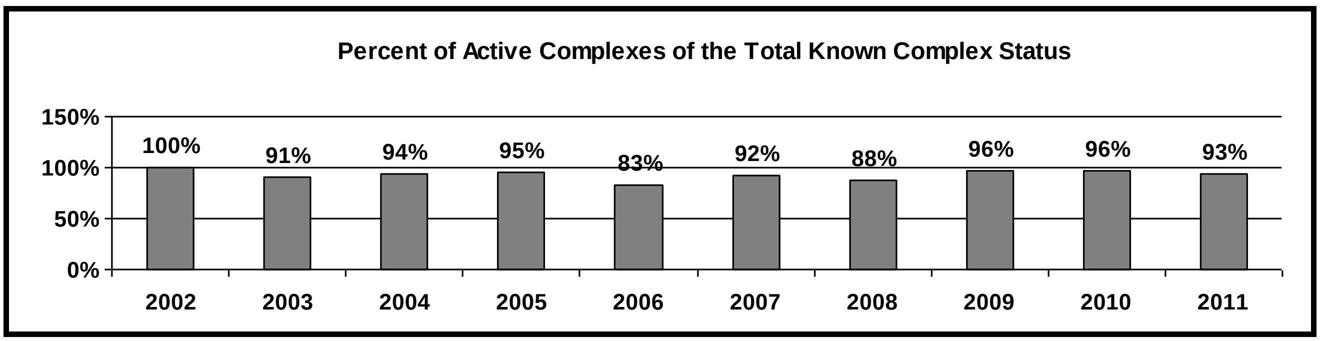
SAGE-GROUSE LEK COMPLEX ATTENDANCE SUMMARY

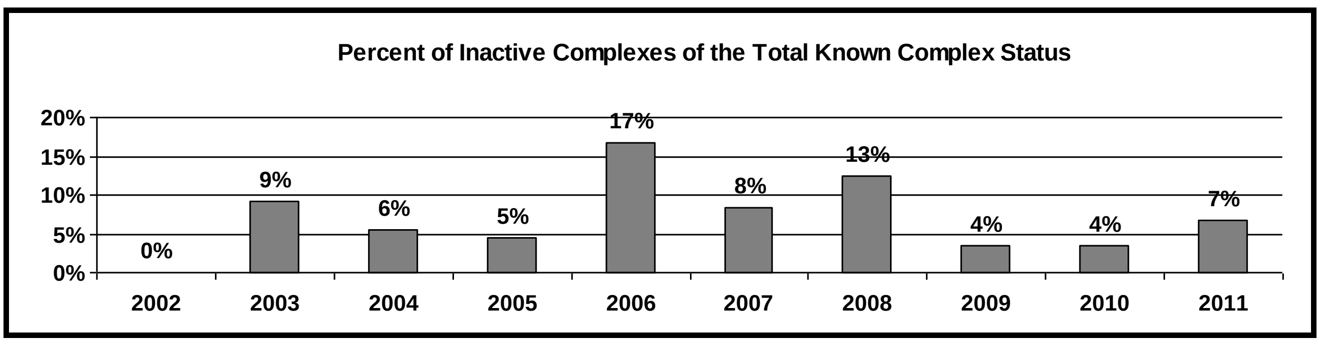
WORKING GROUP: Upper Green River **Area(s): All**











Sage Grouse Lek Characteristics – Upper Green River Basin

Region	Number	Percent
Pinedale	149	100.0

Working Group Area	Number	Percent
Upper Green River	149	100.0

Classification	Number	Percent
Occupied	129	86.6%
Undetermined	4	2.7%
Unoccupied	16	10.7%

BLM Office	Number	Percent
Pinedale	135	90.6%
Rock Springs	14	9.4%

Unoccupied Leks	Number
Abandoned	7
Destroyed	1

Biologist District	Number	Percent
Pinedale	79	53.0%
South Jackson	70	47.0%

Game Warden District	Number	Percent
Big Piney	75	50.3%
North Pinedale	13	8.7%
South Pinedale	61	40.9%

County	Number	Percent
Sublette	149	100.0

Land Status	Number	Percent
BLM	132	88.6%
Private	11	7.4%
State	6	4.0%

Management Area	Number	Percent
D	149	100.0

Table 4. Sage-grouse hunting seasons and harvest data.

a. Season

Year	Season Dates	Length	Bag/Possession Limit
2002	Sept 28-Oct 6	9	2/4
2003	Sept 27-Oct 5	9	2/4
2004	Sept 23-Oct 3	11	2/4
2005	Sept 23-Oct 3	11	2/4
2006	Sept 23-Oct 3	11	2/4
2007	Sept 22-Oct 2	11	2/4
2008	Sept 22-Oct 2	11	2/4
2009	Sept 19- Sept 30	12	2/4
2010	Sept 18- Sept 30	13	2/4

b. Harvest

Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2001	681	324	933	0.7	2.1	2.9
2002	271	231	615	0.4	1.2	2.7
2003	440	178	401	1.1	2.5	2.3
2004	1,040	398	1,020	1.0	2.6	2.6
2005	669	233	564	1.2	2.9	2.4
2006	2,132	781	1,885	1.1	2.7	2.4
2007	1,297	564	1,300	1.0	2.3	2.3
2008	1,109	453	1,116	1.0	2.4	2.5
2009	1,203	460	1,177	1.0	2.6	2.6
2010	1,510	526	1,497	1.0	2.9	2.8
Avg.	1,035	415	1,051	1.0	2.4	2.5

Table 5. Composition of harvest by wing analysis.

Year	Sample Size	Percent Adult Male	Percent Adult Female	Percent Ylg Male	Percent Ylg Female	Percent Young Male	Percent Young Female	Chicks /Hen
2002	250	15.2	40.0	2.8	0.0	20.0	22.0	1.1
2003	265	12.5	32.1	3.4	8.7	16.6	26.8	1.1
2004	402	11.7	28.6	0.5	3.2	28.6	27.4	1.8
2005	537	17.7	23.3	3.4	7.4	19.0	29.2	1.6
2006	421	15.4	28.7	3.6	7.8	20.9	23.5	1.2
2007	485	20.0	39.2	2.3	8.5	13.6	16.5	0.6
2008	494	12.8	29.4	3.4	7.9	22.3	24.3	1.3
2009	445	14.8	38.7	3.4	5.8	15.7	21.6	0.8
2010	469	13.6	39.2	2.1	7.9	17.3	19.8	0.8

Sage-grouse Wing Analysis Summary 2010

Region: **Area :**

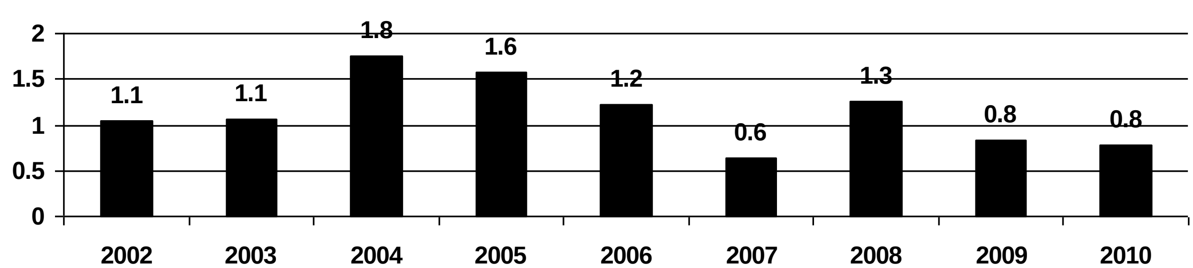
Working Group: Upper Green River

Adult Males:	64	**Percent of All Wings:**	13.6%
Adult Females:	184	**Percent of All Wings:**	39.2%
Adult Unknown:	0	**Percent of All Wings:**	0.0%
Total Adults:	248		
Yearling Males:	10	**Percent of All Wings:**	2.1%
Yearling Females:	37	**Percent of All Wings:**	7.9%
Yearling Unknown:	0	**Percent of All Wings:**	0.0%
Total Yearlings:	47		
Chick Males:	81	**Percent of All Wings:**	17.3%
Chick Females:	93	**Percent of All Wings:**	19.8%
Chick Unknown:	0	**Percent of All Wings:**	0.0%
Total Chicks:	174		
Unknown Sex/Age:	0	**Percent of All Wings:**	0.0%
Total for all Sex/Age Groups:	469		

Chick Males:	81	**Percent of All Chicks:**	46.6%
Yearling Males:	10	**Percent of Adult and Yearling Males:**	13.5%
Adult Males:	64	**Percent of Adult and Yearling Males:**	86.5%
Adult and Yearling Males:	74	**Percent of Adults and Yearlings:**	25.1%
Total Males:	155	**Percent of All Sex/Age Groups:**	33.0%
Chick Females:	93	**Percent of All Chicks:**	53.4%
Yearling Females:	37	**Percent of Adult and Yearling Females:**	16.7%
Adult Females:	184	**Percent of Adult and Yearling Females:**	83.3%
Adult and Yearling Females:	221	**Percent of Adults and Yearlings:**	74.9%
Total Females:	314	**Percent of All Sex/Age Groups:**	67.0%

Chicks:	174	**Percent of All Wings:**	37.1%
Yearlings:	47	**Percent of All Wings:**	10.0%
Adults:	248	**Percent of All Wings:**	52.9%
Chicks/Hen:	**0.8**		

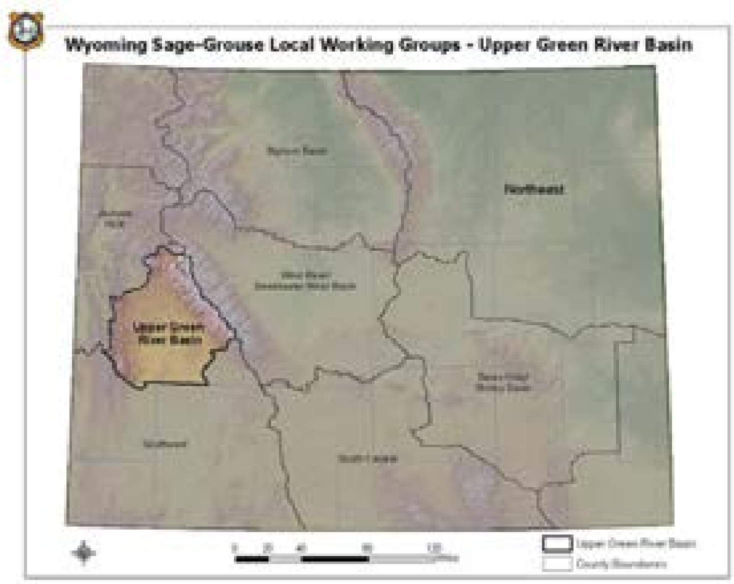
Chicks/hen calculated from wings of harvested sage-grouse.



Narrative
Conservation Plan Area: **Upper Green River Basin**
Period Covered: **6/1/2010 – 5/31/2011**
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. Ongoing research in the WG area has annually 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. 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 has 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/oa/ncdc.html.

Results

Lek Monitoring

A total of 149 leks are currently documented in the UGRBWGA. These leks are classified as follows; 129 occupied, 4 undetermined, and 16 unoccupied. During 2011, a total of 127 (95%) of the occupied and undetermined leks were checked (survey or count). Lek monitoring efforts in 2011 primarily focused on counts (80%) over surveys (20%). Results from the counts and surveys showed that 82% of the leks were active and 18% were inactive. The average number of males/lek for all active leks declined to 30 in 2011, compared to 32 in 2010, 44 in 2009, and 50 in 2008. This declining trend is a change compared to increasing trends from 2004-2007 (27 males/lek in 2004, 37 in 2005, 49 in 2006, and 57 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 (43 new leks since 2004) negating the downward trend in the proportion of active leks in the UGRBWGA .

An analysis was completed in 2008 to assess natural gas development impacts in the Pinedale area. This analysis compared leks within a 1-mile radius of any gas field activity (primarily based on well pads) to leks outside 1 mile of gas activity but within the same lek complex. Leks within the Pinedale Anticline Project Area (PAPA) that are located within gas development areas showed a 37% decline, compared to a 37% increase documented on leks away from gas development activities. Leks within the Jonah Project Area that are located within gas development areas showed a 47% decline, compared to a 193% increase (n=1) documented from one lek away from gas development activities. See the 2008 or 2009 Sage Grouse JCR - Upper Green River Basin Working Group Area for this complete analysis and data tables.

In September of 2008 the Record of Decision for the Supplemental EIS on the PAPA included a “wildlife monitoring matrix” component that identifies sage-grouse thresholds and triggers for management intervention. Efforts were taken during 2010 to recommend modifications (for BLM consideration) to the “matrix” sage grouse monitoring components to better clarify data collection efforts, data analysis, and mitigation thresholds. Results from this matrix monitoring effort will be reported in future years once monitoring criteria modifications and data analysis are made.

There are currently 26 occupied lek complexes in the UGRBWGA containing 151 total leks (includes unknown and unoccupied leks). This equates to an average of 5.8 leks per complex, with a range of 1 to 22 leks per complex. Lek complex designations are somewhat arbitrary and can show great variation due to number and location of leks within each complex.

During 2011, 24 of 26 lek complexes (92%) were documented as “active”. If one lek is active within a complex, the entire complex is classified “Occupied”. Similar to the trend with lek data, the average number of males per lek complex has recently declined compared to 2007.

Population Trends and Estimates

No reliable population estimate can be made from data collected during 2011 (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 and males/complex since 2003. While 2008-2011 lek monitoring indicate a declining trend in the number of males/lek, compared to 2007.

Harvest

The 2010 sage-grouse season was September 18 through September 30, which allowed a 13-day hunting season. This 2010 season was similar to the 2004 – 2009 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 gradually 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 2010 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 2010 harvest survey estimated that 526 hunters bagged 1,510 sage grouse and spent 1,497 days hunting. The average number of birds per day was 1.0, the average number of birds per hunter was 2.5, and the number of days spent hunting was 2.5 during 2010. The harvest trend data indicates there has been similar hunter participation and overall harvest since 2007, although reported figures increased in 2010 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, now identified as Sage-grouse Management Area D. Harvest rates (# birds/day, # birds/hunter, and # days/hunter) have remained similar the past eight years (2003-2010). 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, although the past 4-year period (2006-2009) has shown higher hunter participation than the previous 3-year period (2003-2005). Hunter participation in Management Area 3 has reflected similar trends to the sage-grouse population in the UGRBWGA.

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 are shown in Table 1. Overall sample sizes have been relatively poor from these permanent brood surveys and fail to provide reliable production data. Most other documented brood count data has come from random searches or opportunistic sightings.

Table 1. Sage Grouse Brood Survey Routes Data, 2007-2011.

Location	Year	Chicks	Hens	Chick/Hen Ratio	Males	Unclass.	Totals
Lower Muddy Creek	2007	21	26	0.8	9	10	66
	2008	6	14	0.8	9	0	29
	2009	0	2	0	0	0	2
	2010	0	2	0	0	0	2
	2011	0	0	0	0	0	0
Cottonwood Ranches	2007			1.1			110
	2008			0.5			150
	2009	18	53	0.3	10	3	84
	2010	NA	NA	NA	NA	NA	NA
	2011	6	8	0.8	1	0	15

Although sage-grouse research has been ongoing in the Upper Green River Basin for over the past decade providing some nest establishment, nest success, and brood production data, no active studies were ongoing during 2010. 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 2010 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). Primary feathers from these wings are used to determine age and sex based on molting patterns.

A total of 469 sage-grouse wings were collected from barrels in the UGRBWGA during 2010, which is relatively similar to the collections during the past 5-year period, ranging from 421 to

494. Of the 469 wings collected in 2010, 53% were adult birds, 10% were yearling birds, and 37% were juvenile birds, very similar harvest composition to 2009. The overall composition of wings in 2010 indicated a ratio of 0.8 chicks/hen (adult and yearling females) the same as in 2009, a decline from the survival of 1.3 chicks/hen during 2008, and a slight increase from 0.6 chicks/hen in 2007. The past five years (2006-2010) chick survival has been poor, ranging from 0.6 to 1.2 chicks/hen. 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 years production (# chicks/hen) data.

Winter Distribution Surveys

Winter sage-grouse surveys were conducted throughout the majority of the UGRBWGA during January of 2011, due to funds secured through the BLM. Winter surveys have been conducted periodically 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 will continue to be updated as new data becomes available.

Weather Data

The Palmer Drought Severity Index was developed in the 1960s (http://www.drought.noaa.gov/palmer.html). The index uses temperature and precipitation data to determine dryness. It is most effective in determining long-term (several months) drought. Another index, the Crop Moisture Index (CMI) is more sensitive to short-term conditions. On the Palmer scale, zero is normal, -2 is moderate drought, -3 is severe drought, and -4 is extreme drought. Positive numbers indicate wetter than normal time periods. The Palmer Index is standardized to local conditions. Since this index does not reflect snow moisture, it typically works best for areas east of the Continental Divide.

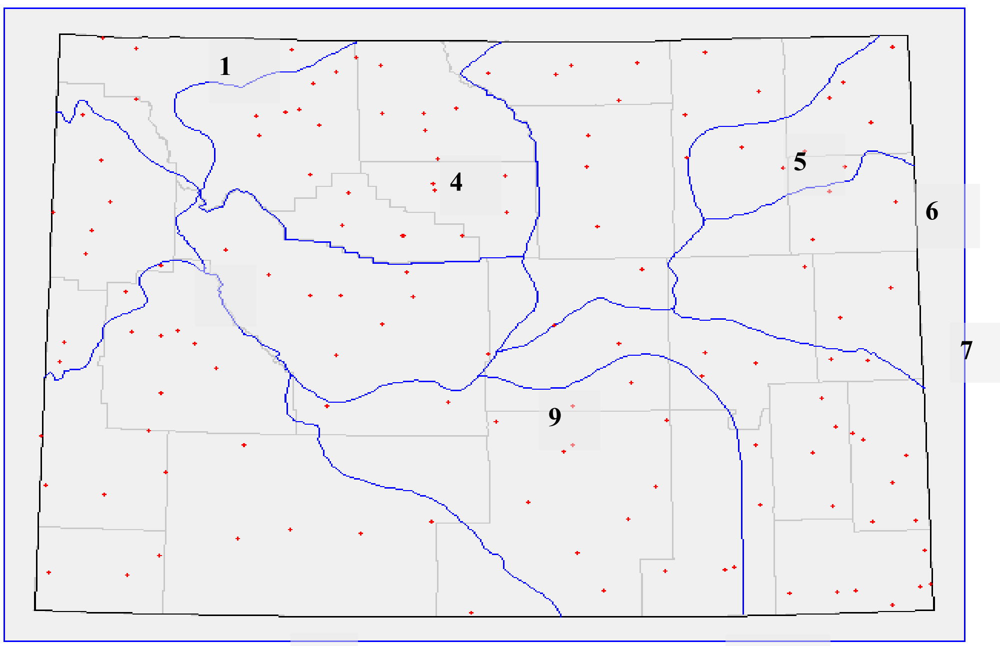
Additional contact information for NCDC can be found at the following web address: http://lwf.ncdc.noaa.gov/oa/about/ncdccontacts.html.

Wyoming Division 3 monthly temperature, precipitation, and Palmer drought severity data were obtained from: http://lwf.ncdc.noaa.gov/oa/climate/onlineprod/drought/ftppage.html (Figure 1). Graphs portraying Palmer Drought Severity Index data over time were created for Division 3 (Figure 2). Graphs were generated comparing monthly and 30-year normal temperature (Figures 3-5) and precipitation data (Figures 6-8) for bio-years 2008, 2009, and 20010. A bio-year (or biological year) is defined as June – May. A climatic normal is the arithmetic average of a meteorological element over a 30-year period (generally, three consecutive decades). The normal monthly temperature and precipitation are calculated by adding the yearly values for a given month and then dividing by the number of years in the period.

Climatic Division 3 – Green and Bear Drainage Basin

Palmer Severity Indices indicate that, from 1995-1999, the Green and Bear Drainage Basin climatic division generally experienced wetter than normal conditions (Figure 2). However, the division entered drought conditions in 2000, with conditions becoming extreme until 2004, then again from 2006-2010. Temperatures were generally normal during bio-years 2008, 2009 and 2010 (Figures 3, 4 & 5). Bio-years 2008, 2009, and 2010 saw below normal precipitation, although June of 2009 received nearly three times the normal amount and the winter/spring of 2010-2011 had above average precipitation during most months (Figures 6, 7 & 8).

Figure 1. NCDC/NOAA, State of Wyoming Climate Division Map.
http://www.wrds.uwyo.edu/wrds/wsc/normals/normalmap.html



Climatic Division 3 – Green and Bear Drainage Basin

Figure 2. Drought severity trend from 1982 – 2011, Wyoming Climate Division 3.

8

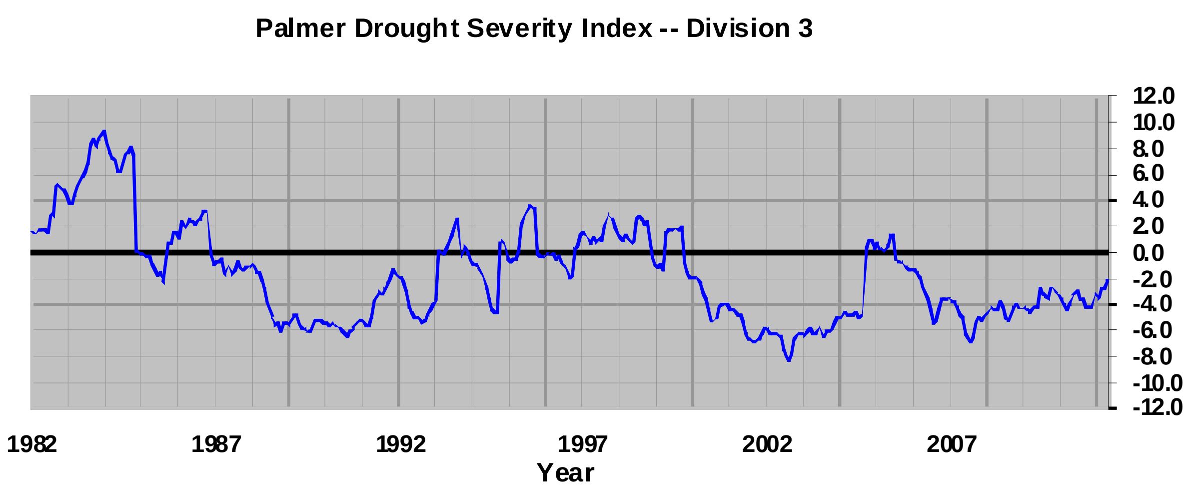


Figure 3. 2008 Bio-Year: Monthly temperature data (^{o}F), Wyoming Climate Division 3.

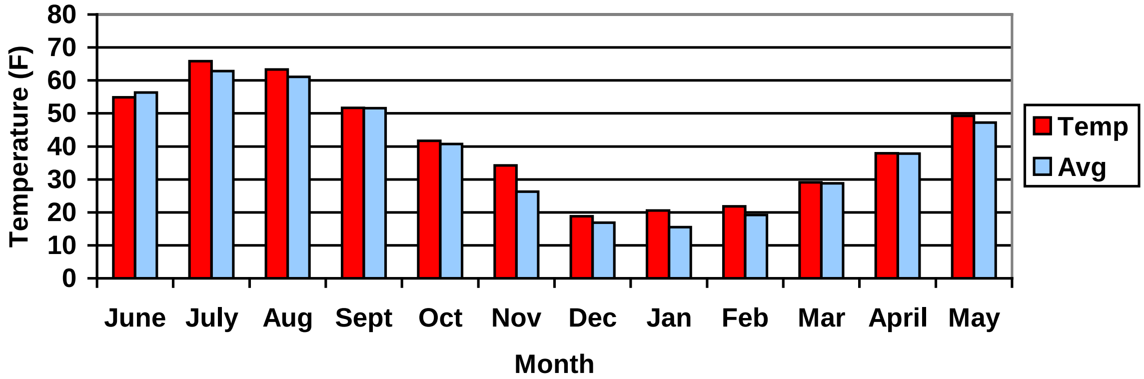


Figure 4. 2009 Bio-Year: Monthly temperature data (^{o}F), Wyoming Climate Division 3.

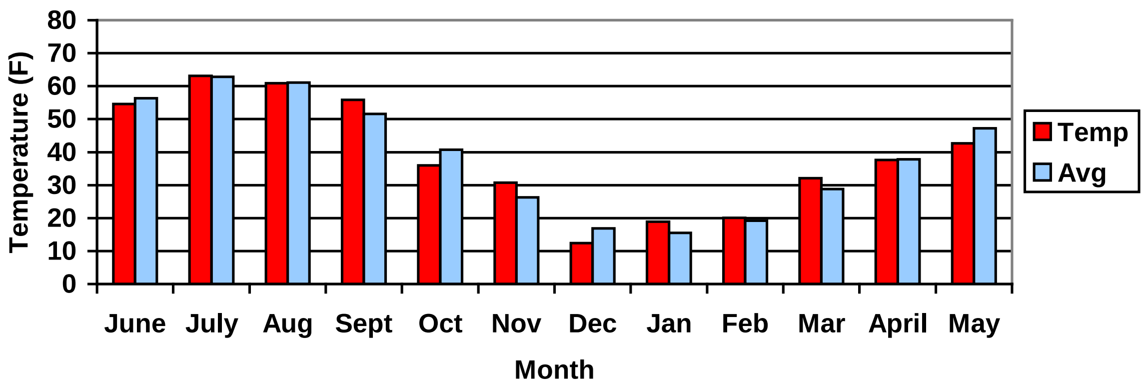


Figure 5. 2010 Bio-Year: Monthly temperature data (^{o}F), Wyoming Climate Division 3.

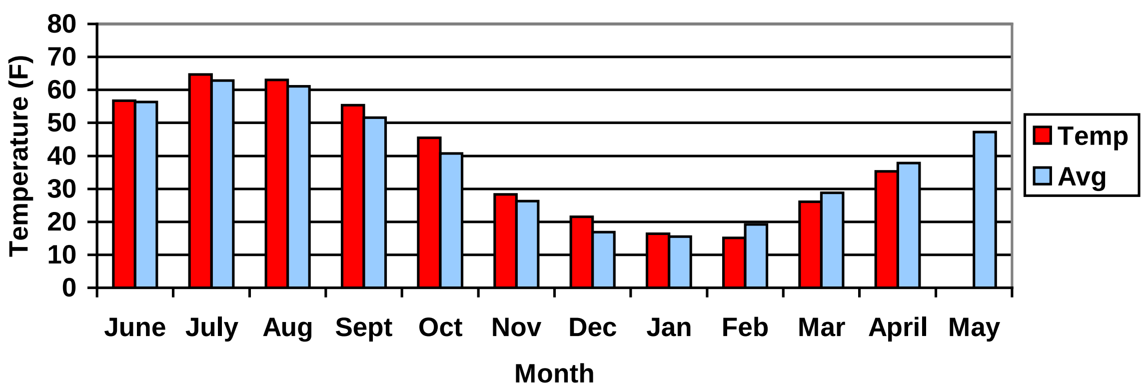


Figure 6. 2008 Bio-Year: Monthly precipitation data (in), Wyoming Climate Division 3.

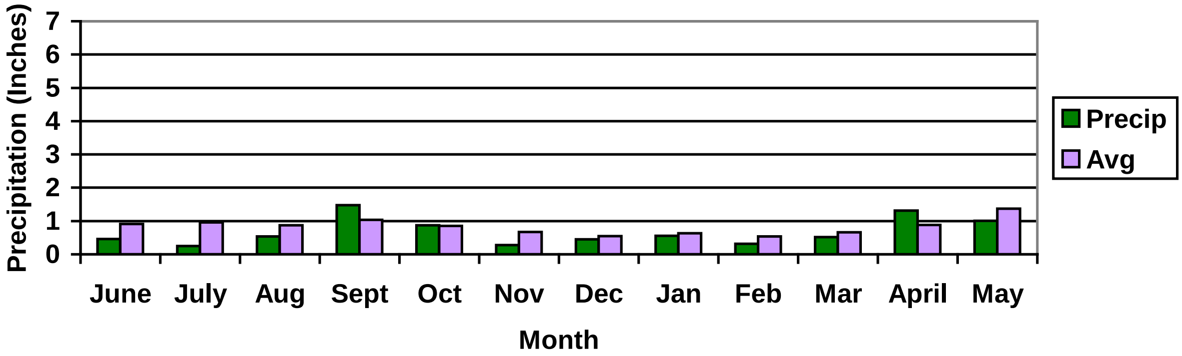


Figure 7. 2009 Bio-Year: Monthly precipitation data (in), Wyoming Climate Division 3.

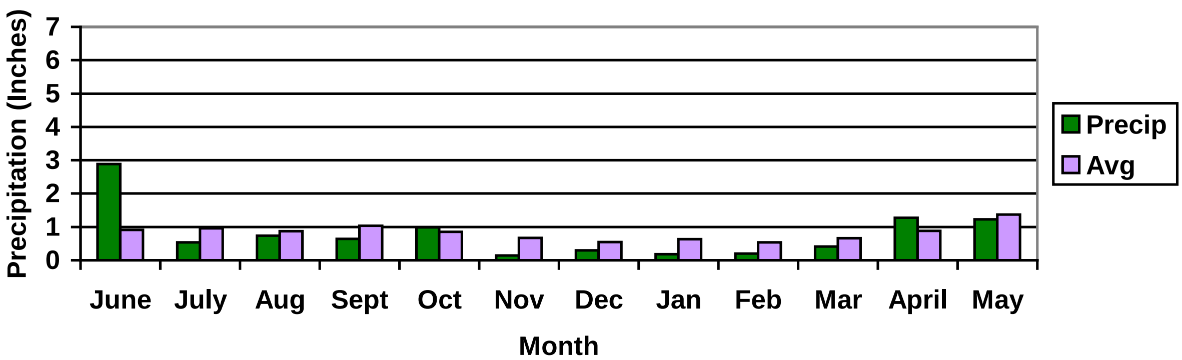
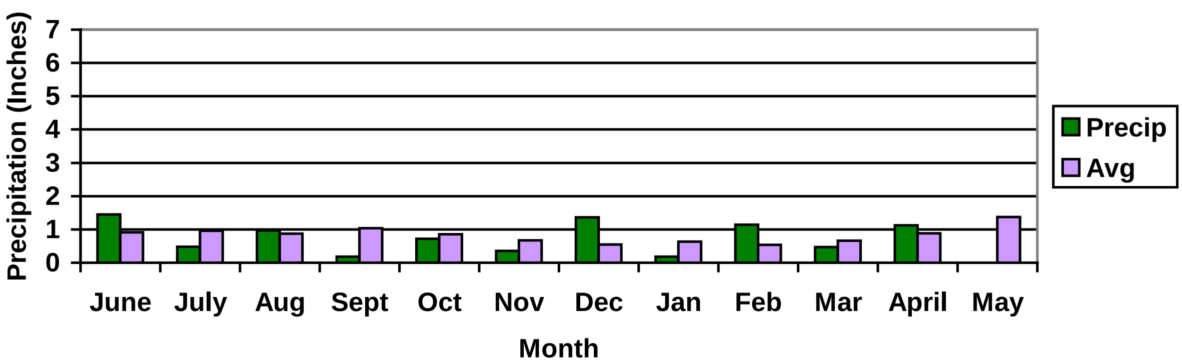


Figure 8. 2010 Bio-Year: Monthly precipitation data (in), Wyoming Climate Division 3.



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 Appendix 1 for a summary of past and ongoing sage-grouse research in the Pinedale area.

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 which led to increased activity by the Working Group. There has been three new members added and one existing member voluntarily retired from the Working Group in 2010.

Management Summary

Data collected and reported in this 2011 Sage-Grouse Job Completion Report gives insight to population trends. Analysis of the past years of data indicates that the sage-grouse populations have steadily increased from 2003 to 2007, dropped slightly in 2008, and have continued to decline through May, 2011. Grouse populations were at the lowest level in 2003 during the past 10-year period.

Lek monitoring in the UGRBWGA showed a 161% increase in the peak number of males per lek from 2003 to 2007 as males increased from 22.2 males/lek to 58.0 males/lek. This trend then reversed since 2007, as the number of males/lek has declined by 48% dropping to 29.8 males/lek by 2010. Sage-grouse leks within developing gas fields have continued to show declines 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 9-13 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, 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 with grouse number trends. The fluctuation in hunter numbers is not very clear but may be attributed to hunters assessment of grouse populations due to annual or seasonal (spring/summer) precipitation levels instead of documented bird population trends. Variation in hunter participation can also be affected by weather conditions, especially during the current short seasons. Hunter participation declined in 2002 and 2003 as a result of shortened seasons starting in 2001 combined with lower grouse numbers and drought conditions. Hunter participation increased in 2004 with increasing grouse numbers and very wet spring/summer conditions; dropped in 2005 with increasing grouse numbers and average annual precipitation (but spring and summer drought conditions); drastically increased in 2006 with increasing grouse number and very wet conditions in June and August; dropped in 2007 with increasing grouse number and drought conditions; and dropped in 2008 & 2009 with declining grouse number and good spring moisture. In 2010, the reported number of hunters increased most likely due to changes in sage-grouse management area boundaries and not a reflection of higher hunter participation.

Wing collection samples sizes from wing barrels (drop locations) showed similar increasing trends to the harvest survey trends during 2003 and 2004, but showed conflicting trends in 2005 - 2007 (wing collections increased as reported harvest declined in 2005 and 2007, and wing collections declined as reported harvest increased in 2006). It may be possible that reported harvest estimates were low in 2005, as wing collections accounted for an unusually high proportion of the reported harvest at 80%. During 2008 2009, and 2010 wing collections accounted for 45%, 37%, and 31% 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 trends in the UGRBWGA.

Nest success, brood counts, chick/hen ratios, and wing collections all indicate improved sage-grouse production during 2004 and 2005, with production dropping off in 2006 and 2007, improving in 2008, and dropping in 2009. Research data from collared birds (sample size varied from 46 to 113) show nest success at 45% in 2003, increasing to 62-63% in 2004 and 2005, declining to 51% in 2006, increasing to 63% during 2007, no data available in 2008, nest success at 47% in 2009, and no data in 2010. The number of chicks per total hens (successful and unsuccessful hens) improved from 0.55 chicks/hen in 2002 to 0.85 chicks/hen in 2005, dropped to 0.77 chicks/hen in 2006, and improved to 1.02 chicks/hen in 2007, no data available in 2008, 0.63 chicks/hen in 2009, no data in 2010. The 2002 and 2003 chicks/hen ratio determined from wing collections was 1.1 for both years and increased to 1.8 and 1.6 chicks/hen in 2004 and 2005, dropped to 1.2 during 2006, dropped significantly to 0.6 chicks/hen in 2007, increased to 1.3 chicks/hen in 2008, and dropped to 0.8 chicks/hen in 2009 and 2010. Chick/hen ratios derived from harvest (wings) has shown a direct correlation with populations trends and still provides the most useful and widespread data set for detecting reproductive rate trends. 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.

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 during 2006 and 2007. Male sage-grouse lek numbers declined by 12% during 2008, 13% in 2009, 27% in 2010, and 6% in 2011. 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 lek numbers declining by 27% in 2010. Sage-grouse and habitat management activities basically have remained static during the past 7+ 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 fields. 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 the Muddy Creek and Cottonwood Ranches sage-grouse brood survey route in the South Jackson Biologist District and establish new routes.
4. Continue to place wing barrels in enough locations to obtain an adequate and representative sample to derive sex/age and harvest trend information.
5. Continue existing efforts and encourage new efforts to document and identify important sage-grouse areas (breeding, brood rearing, and winter).
6. 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.
7. Continue to identify needed sage-grouse research, data collection efforts, project proposals, development mitigation, and funding.
8. Implement proposals and management recommendations identified in the Upper Green River Basin Sage-Grouse Working Group Conservation Plan. Update this Plan as needed.

Appendix 1 - Sage-grouse Research Applicable to the UGRBWGA

Completed Studies

Girard, George L. 1937. Life History, Habits and Food of the Sage Grouse. University of Wyoming Publications in Science Vol. III, No. 1. 56pp. University of Wyoming Press, Laramie.

This was the first study of sage-grouse in Wyoming and it was undertaken in Sublette County in 1934. The author noted that much of the information concerning sage-grouse at the time was based on casual observation, and popular articles were written "with little regard for established facts". The purpose of the study was to investigate the life history, habits, and food of the sage grouse, and "to secure information that may be of use to the governments of western states in formulating measures designed to increase or maintain the species in its present habitat". The report details the bird's physical description, distribution, life history, behavioral habits and factors impacting sage-grouse at the time. Suggested management actions included hunting restrictions, establishment of refuges, livestock grazing management, habitat management, and a public education campaign.

Lyon, Alison. G., Potential effects of natural gas development on sage grouse near Pinedale, Wyoming. M.S., Department of Zoology and Physiology, May, 2000.

Sage grouse (Centrocercus urophasianus) populations have been declining over the last half of the century due to such factors as habitat degradation and loss. As natural gas development has increased in Wyoming, so has the concern over how this type of development might effect sage-grouse populations. Therefore a study was initiated on the Pinedale Mesa to examine the effects of natural gas and oil development on use, productivity, general movements and habitat use of sage grouse. A total of 80 grouse (60 adults and 20 chicks) were captured and radio-collared on six leks on the Pinedale Mesa between March-August 1998. Lek classification was determined by the presence of natural development within a 3km buffer and topographic features surrounding the leks. The grouse were monitored and located (using radio telemetry techniques) on a weekly basis to determine lek use, nest site, early brood rearing, late brood rearing, summer and winter habitat selection. Vegetation data collected at use and random sites included: sagebrush density, canopy cover and height, grass and residual grass height and cover and forb cover. Results from the study indicated that hens captured on the disturbed leks demonstrated lower nest initiation rates, traveled twice as far to nest sites, and selected higher total shrub canopy cover and live sagebrush canopy cover than hens captured off of undisturbed leks. Also, most grouse chicks were lost during extreme early brood rearing from hens that mated on all leks. Therefore extreme early brood survival appears to be the limiting factor in sage-grouse population stability on the Pinedale Mesa. Finally, four roosters, and five hens moved up to 60 miles to breed and nest after capture on the Mesa. Consequently we hypothesize that the Mesa is critical winter range for multiple populations of sage-grouse spanning a large demographic area.

Holloran, Matthew J., Greater Sage-Grouse (*Centrocercus urophasianus*) Population Response to Natural Gas Field Development in Western Wyoming. PhD, Department of Zoology and Physiology, December, 2005.

Sage-grouse (*Centrocercus* spp.) populations have declined dramatically throughout the western United States since the 1960s. Increased gas and oil development during this time has potentially contributed to the declines. This study investigated impacts of development of natural gas fields on greater sage-grouse (*C. urophasianus*) breeding behavior, seasonal habitat selection, and population growth in the upper Green River Basin of western Wyoming. Greater sage-grouse in western Wyoming appeared to be excluded from attending leks situated within or near the development boundaries of natural gas fields. Declines in the number of displaying males were positively correlated with decreased distance from leks to gas-field-related sources of disturbance, increased levels of development surrounding leks, increased traffic volumes within 3 km of leks, and increased potential for greater noise intensity at leks. Displacement of adult males and low recruitment of juvenile males contributed to declines in the number of breeding males on impacted leks. Additionally, responses of predatory species to development of gas fields could be responsible for decreased male survival on leks situated near the edges of developing fields and could extend the range-of-influence of gas fields. Generally, nesting females avoided areas with high densities of producing wells, and brooding females avoided producing wells. However, the relationship between selected nesting sites and proximity to gas field infrastructure shifted between 2000 – 2003 and 2004, with females selecting nesting habitat farther from active drilling rigs and producing wells in 2004. This suggests that the long-term response of nesting populations is avoidance of natural gas development. Most of the variability in population growth between populations that were impacted and non-impacted by natural gas development was explained by lower annual survival buffered to some extent by higher productivity in impacted populations. Seasonal survival differences between impacted and non-impacted individuals indicates that a lag period occurs between when an individual is impacted by an anthropogenic disturbance and when survival probabilities are influenced, suggesting negative fitness consequences for females subjected to natural gas development during the breeding or nesting periods. I suggest that currently imposed development stipulations are inadequate to protect greater sage-grouse, and that stipulations need to be modified to maintain populations within natural gas fields.

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

Abstract: The area near Pinedale, Wyoming, in the upper Green River Basin has some of the highest densities of greater sage-grouse in the world. Decreasing counts of males attending leks and evidence of overall population reductions, coupled with increasing natural gas development, have raised concern for conservation of greater sage-grouse in the area. Low yearling recruitment could be causing a decline in the numbers of birds using leks near natural gas development. This study investigated recruitment of males and females to determine if they continued to breed in areas with natural gas development, were displaced to other areas to breed, or did not breed at all. Results indicated that yearling males tended to avoid leks highly immersed into developing gas fields. Females that bred or nested in the gas fields had later nest hatching dates and fewer and smaller broods than birds outside the fields. Both males and females showed low fidelity to natal leks and nest sites. This study suggests that assessing the potential influence of a natural gas field on greater sage-grouse should involve multiple variables to describe the developing field and incorporate the cumulative effects they may have on lek use as the spatial orientation of the leks relative to the developing field changes over time.

<u>Ongoing Studies</u> - Compilation of Greater Sage-Grouse Research Conducted in Wyoming in 2011

GREATER SAGE GROUSE POPULATION GENETIC STRUCTURE PROJECT: FALL 2011

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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)

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][1] The Nature Conservancy, 258 Main Street, Lander, Wyoming 82520; [2] Wyoming Natural Diversity Database, University of Wyoming, 1000 E. University Ave. Dept 3381, 315 Berry Center, Laramie, Wyoming 82071; [3]University of Montana, Missoula, Montana 59812; [4]The Nature Conservancy, 708 S. 5th St Laramie, Wyoming 82070; [5] The Nature Conservancy, 1101West River Parkway, Suite 200, Minneapolis, Minnesota 55415-1291; National Resources Conservation Service, 10 East Babcock, Room 443, Bozeman, Montana 59715

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.

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

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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.

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

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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.

LINKING SAGE-GROUSE NEST VEGETATION STRUCTURE DATASETS TO ECOLOGICAL SITES

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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*)

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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

Species: Sage Grouse
Period Covered: June 1, 2010 – May 31, 2011
Management Areas: A
Working Group Area: Upper Snake River Basin
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. 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 (Figure 2).

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

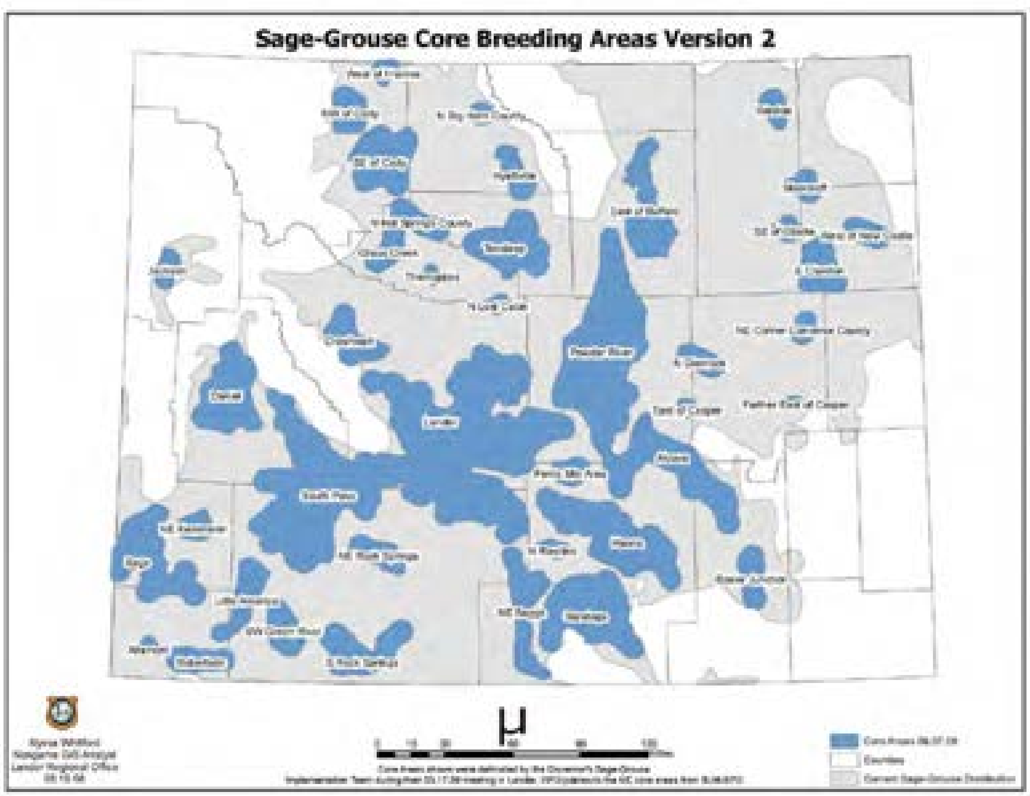


Figure 2. Wyoming Sage-Grouse Core Areas.

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.

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 standardized guidelines or criteria were identified 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 pers. com.).

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 2011. 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 to leks in Grand Teton National Park 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 15 known or historic sage-grouse leks reported in Table 1. Twelve leks are considered to be occupied and three appear to be unoccupied historic leks within the plan area (3 BAR H and Antelope Flats in GTNP and Simpson, formerly called Poverty Flats in the NER). 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 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 and additional searches in the Gros Ventre drainage in 2012 are warranted (Bryan Bedrosian and Doug Brimeyer pers. com).

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.

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 has been active in 2008 - 2011.

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 (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 has been given provisionally active status in spite of only be check for one year. In 2011, 12 males were counted on the lek (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 2010-2011 report (but not reported as leks in Table 1 The 3 Bar H, Antelope Flats, and the Simpson leks were inactive in 2011 and all but the McBride lek are likely unoccupied. Bark Corral West lek is not considered a separate lek in this table. Eight leks were considered active in 2011. It is our intent to try to resolve the status of these leks with the completion of the sage-grouse study by CBS in time for in time for the 2011-2012 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 dipped in 2009. 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 was 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.

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.

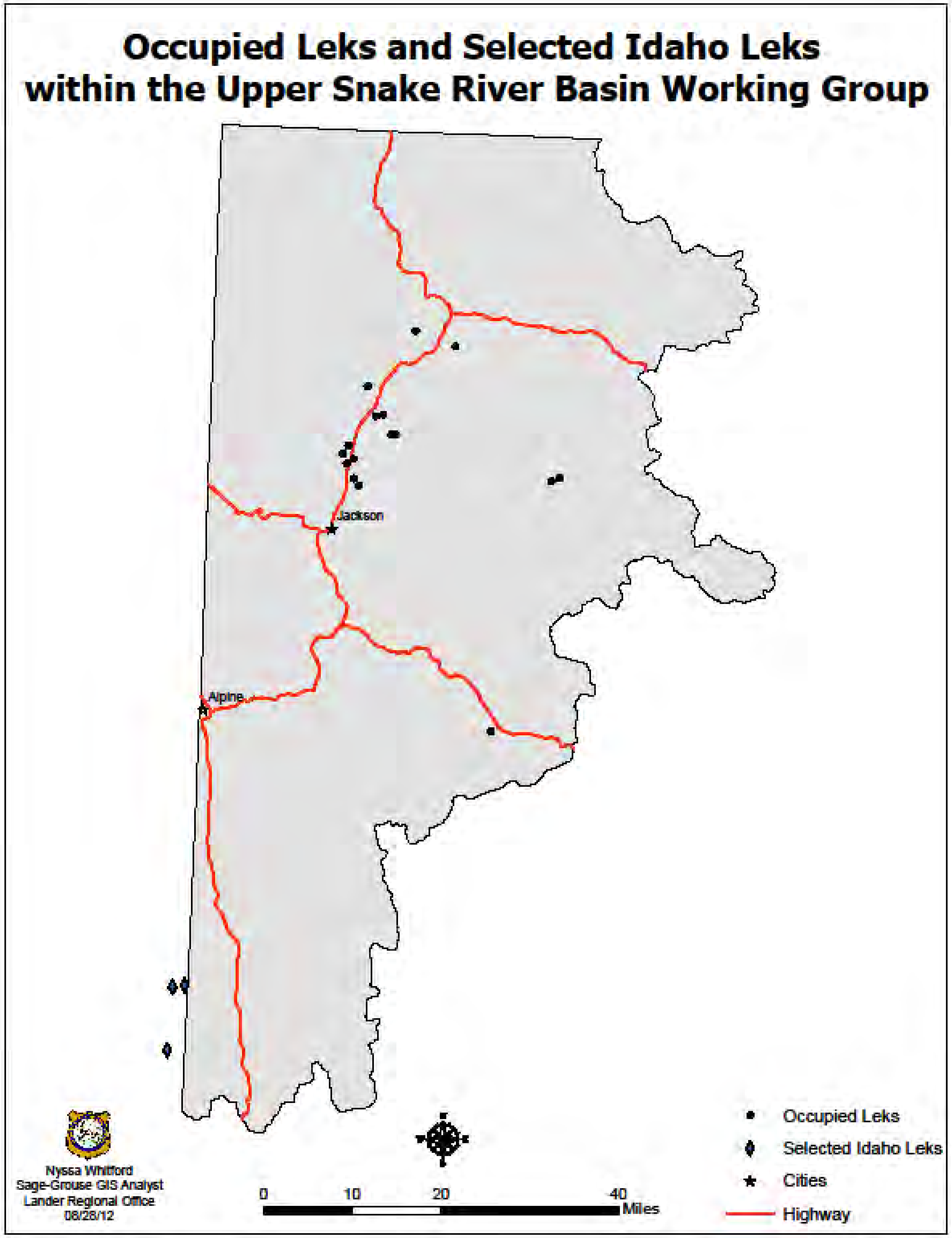


Figure 3. Occupied leks in the Upper Snake River Basin Working Group Area and adjacent selected leks in Idaho.

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 2011 the maximum count was 111 males with 5 males on the 2 leks in the Gros Ventre complex, 94 in the Jackson Hole complex, and 12 on the Clark Draw lek in the Hoback. The maximum total counts of males range from 214 in 1990 to 47 in 1999 to 165 in 2008 (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. 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. 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 (Figures 4 and 5).

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 (Bryan Bedrosian, pers.com.).

Analyzing lek data from 1985-2007 Garton et al. (*In press*) 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. *In press*). 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

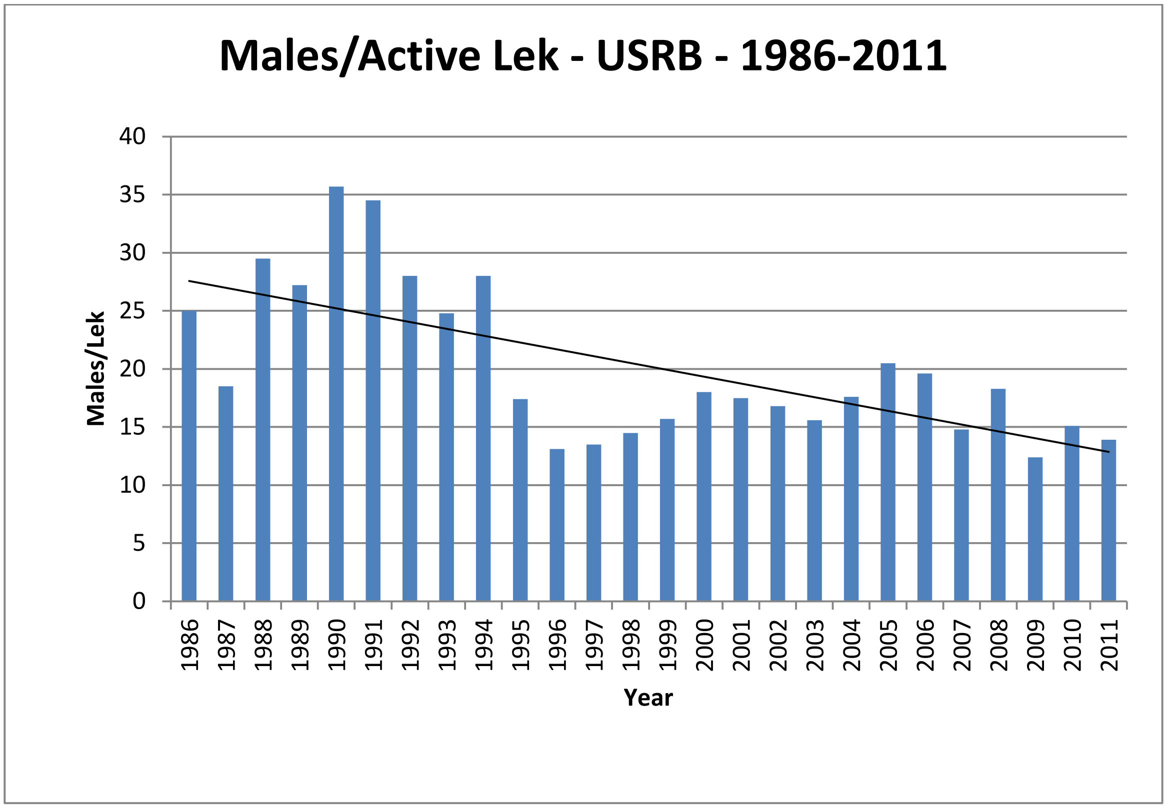
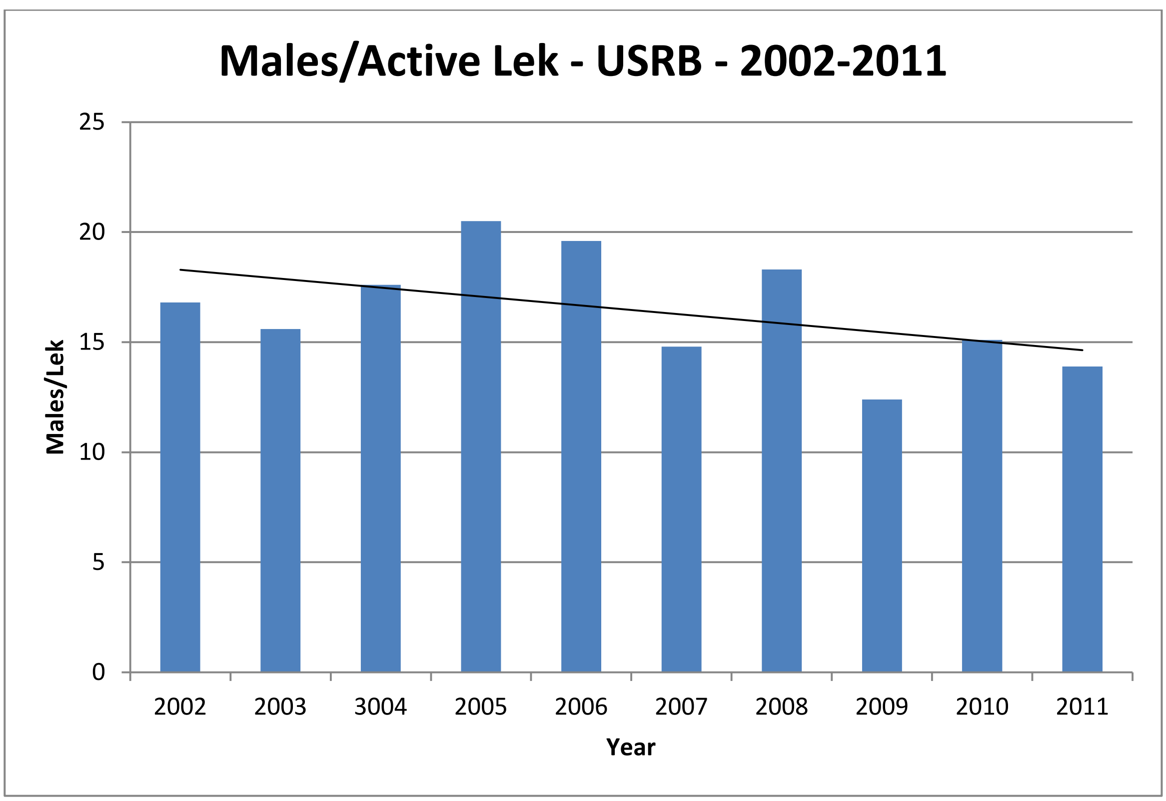


Figure 5



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 - 2010 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 in the Snake River Drainage. The closure was in effect for the 2006 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 (*In Press*), 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. Current habitat protection stipulations for sage grouse on BLM lands include:

1) Avoid surface disturbance or occupancy within a ¼ mile of the perimeter of occupied leks. 2) Avoid human activity between 8:00pm and 8:00am from March 1 – April 15 within a ¼ mile of the perimeter of occupied sage grouse leks.

3) Avoid surface disturbing activities, geophysical surveys, and organized recreational activities (events) which require a special use permit in suitable sage grouse nesting and early brood-rearing habitat within 2 miles of an occupied lek or in identified sage-grouse nesting and early brood-rearing habitat outside the 2-milebuffer from March 15 – July 15.

4). Where sage-grouse winter habitat has been designated, avoid human activity from November 15 – March 14.

These habitat protection measures are currently under review for core and non-core areas. Based on research in the Powder River Basin and the Pinedale area, it appears that current protective measures and timing stipulations 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 Current research suggests these stipulations do 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. 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 August. 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 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).

Special Projects

Jackson Hole Sage-grouse Project Completion Report: 2007-2009.

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 is attached in Appendix 1.

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) is attached as Appendix 2.

Returning Sagebrush to the Kelly Hayfields: A 150 Acre Restoration in Grand Teton National Park.

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 6). 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 7). 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 basic timeline:

May 2009
—Pre-treatment vegetation inventory.
June 2009
—Herbicide application to remove smooth brome and other non-native species.
Summer 2009
—Native seed collection and cleaning.
May 2010
—Post-treatment vegetation monitoring for efficacy of initial herbicide treatment and characterize the weed population that emerges from the soil seed bank.
June 2010
—Depending on results of monitoring, implement mowing, prescribed burn or herbicide spot spraying.
Summer 2010
—Native seed collection and cleaning.
September 2010
—Drill seed grasses and forbs.
September 2010
—"Island installation". Plant shrubs, forbs, and erect fences.
June 2011
—Continued vegetation monitoring and spot spray for noxious weeds.

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.
<u>September 2011</u>
—Seed cover crop (Elbo East Unit 309 acres)
<u>October 2011</u>
—Seed native grass mix (Hunter East/West Units and Elbo West Unit 230 acres).
<u>September 2012</u>
— Plant shrubs and forbs throughout prior seeded units when conditions are deemed suitable, and erect fences.
<u>June 2013</u>
—Continued vegetation monitoring and spot spray for noxious weeds.

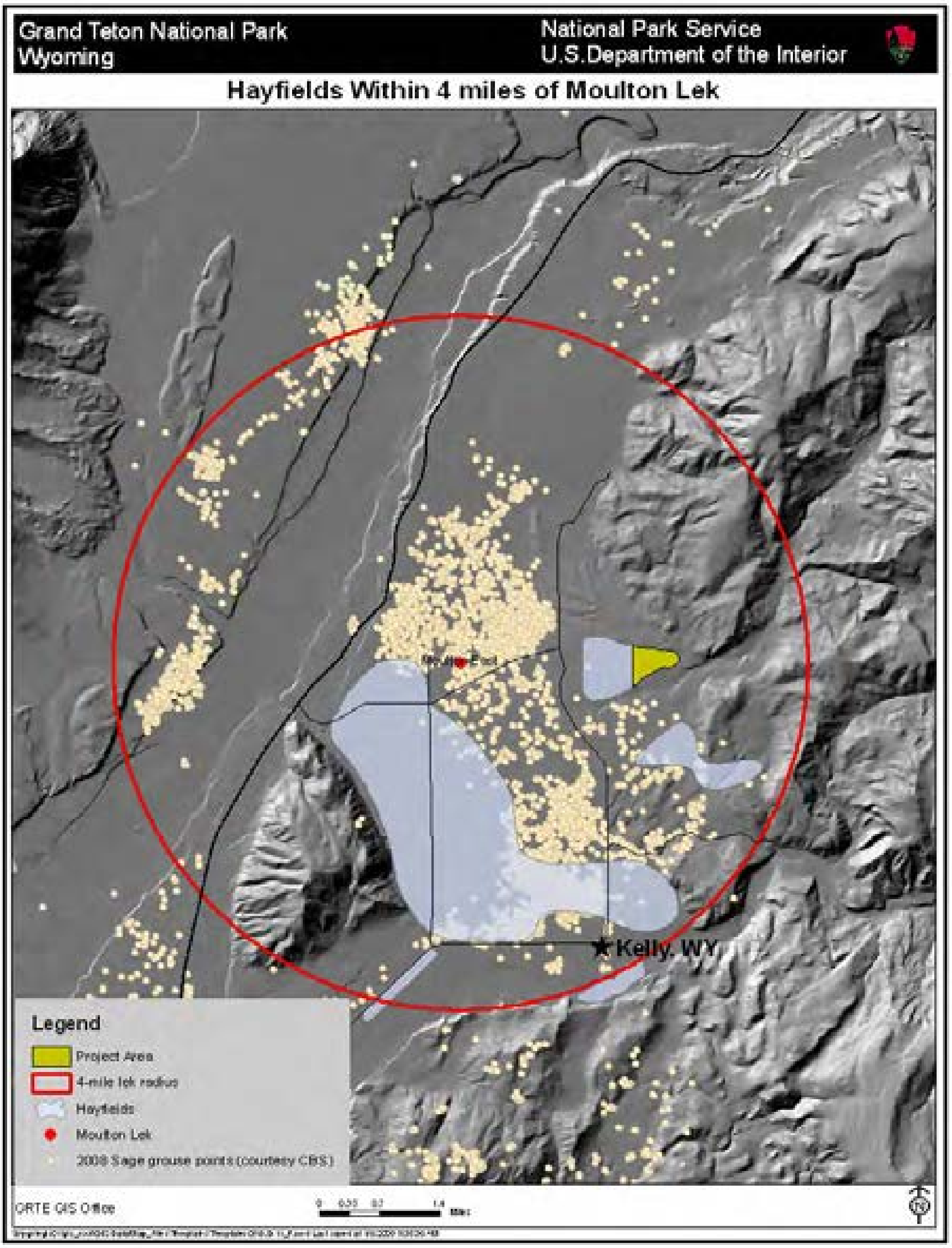

Grand Teton National Park
Wyoming
National Park Service
U.S.Department of the Interior
Hayfields Within 4 miles of Moulton Lek
Kelly, WY
Legend
Project Area
4-mile lek radius
Hayfields
Moulton Lek
2009 Sage grouse points (courtesy CBS)
GRTE GIS Office
Miles

Figure 6.

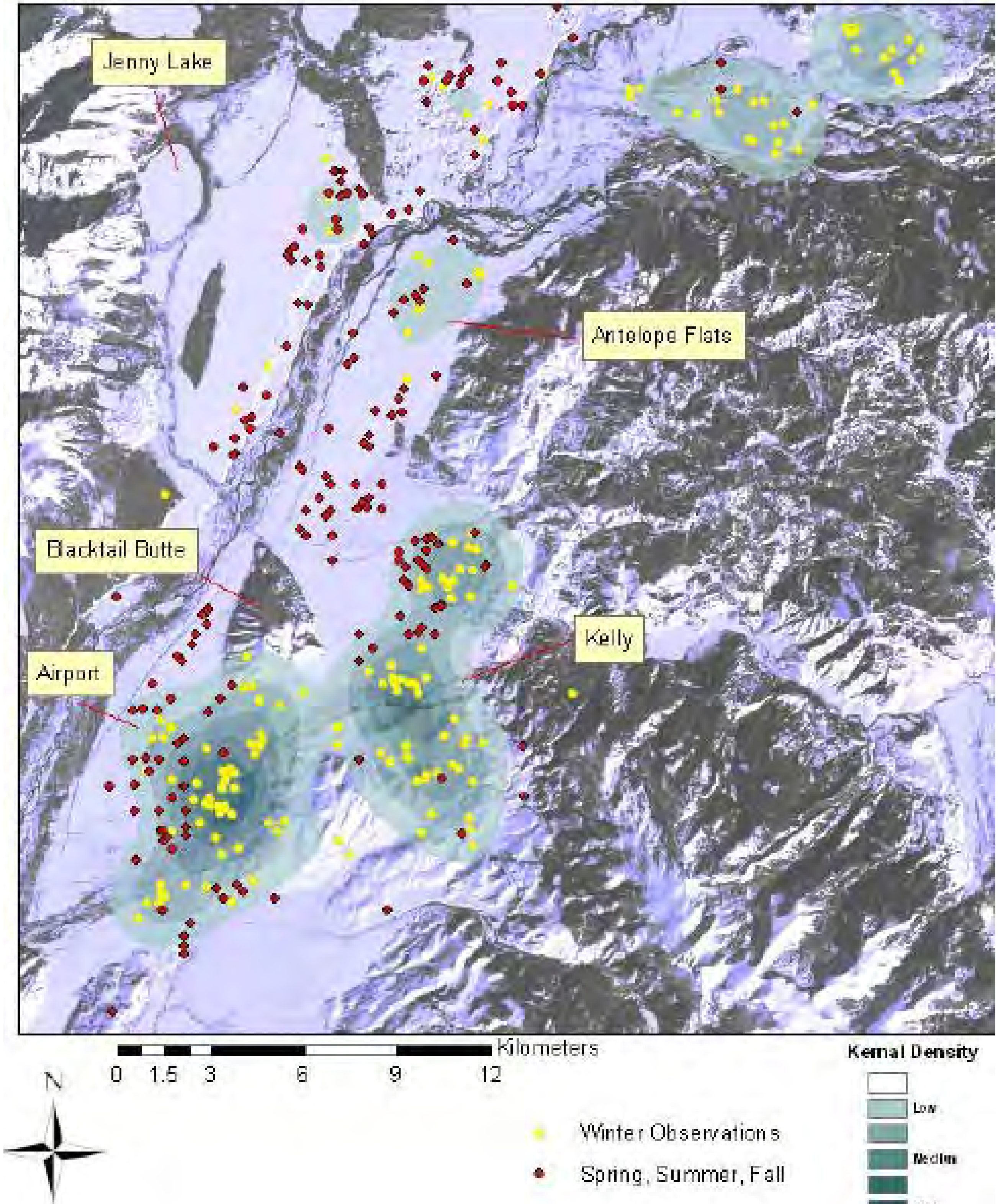


Figure 7. Grouse Density Mapping. Taken from the USBSG Conservation Plan.

Past Research Projects

Patterson, R.L. 1952. The sage grouse in Wyoming. Sage Books, Denver, Colorado, USA.

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

Bedrosian, B. and S. Walker. 2010. Sage-grouse baseline survey and inventory at the Jackson Hole Airport. Completion Report. Craighead Beringia South, P.O. Box 147, Kelly, WY 83011.

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.

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 sharply in 2011 to 111 males (Table 1). Lek data must be collected consistently between jurisdictions and follow the established WGFD protocol.

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 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 Wildlife Services, the National Park Service, and the Jackson Hole Airport Board to complete the wildlife assessment and design projects to minimize risks of sage-grouse strikes on aircraft.
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
10. Protect important breeding, nesting, and winter habitats used by the Jackson hole and Gros Ventre sage-grouse populations until areas burned in the past 20 years in prescribed or wildfires have recovered to provide functional habitat. Habitat losses associated with historic human footprint and more recent wildfires and prescribed burns appear to be significant.
11. 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.
12. Minimize impacts to sage-grouse breeding habitat in general sage-grouse habitat when conducting habitat project for other wildlife species, livestock range enhancementprojects , or fuels reduction projects.
12. Implement the USRBWG Sage-grouse Conservation Plan. Work to implement the strategies and projects identified in the plan.

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APPENDIX 1.

ESTIMATING SAGE GROUSE POPULATION DEMOGRAPHICS, PREDATION, AND CRITICAL HABITAT FOR RECOVERY IN JACKSON HOLE AND NORTHWEST WYOMING

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Co-Investigators: Derek Craighead and Ross Crandall

Acknowledgments

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Introduction

Sage-grouse populations have been declining across their range in recent years (Connelly et al. 2004, Schroeder et al. 2004), leading to the recent warranted finding for the endangered species

list. The main reason for population declines have been losses, degradation, and fragmentation of remaining sagebrush-steppe habitats across the West. The Jackson Hole valley of northwest Wyoming has been no exception to declining sage-grouse populations and habitat loss.
In Jackson Hole, habitat alteration has mainly occurred by wildlife, bison and elk grazing, conversion of sagebrush dominated habitats to agriculture, and infrastructure development. Jackson's main economic driver is tourism and, as such, there has been an increase in backcountry access, wildlife viewing, vehicles, biking, and overall human presence on the landscape. Beginning with the expansion of Grand Teton National Park to include the majority of the Jackson Hole valley (1946), there was a significant increase in the number of recreational visitors to the valley with a maximum number of annual visitors at 3.4 million people in 1970, but has been relatively stable at 2.5 million visitors per year for the past 15 years.

In Jackson Hole, several scientific studies have been undertaken to assess this relatively small isolated population of sage-grouse that occurs primarily on protected federal lands. In 1948, Robert Patterson began studying sage-grouse across Wyoming, including Jackson Hole. During the late 1940's, Patterson estimated that there were roughly 500 resident sage-grouse within Jackson Hole. However, he released 410 grouse into Jackson Hole from the Farson, WY area, from 1940-1949 which may have significantly affected both subsequent lek counts and population genetics, although not resulting in a significant population increase (Patterson 1952). Of the 359 released in 1948-49, 264 were male and 95 were female. Maximum male lek counts from the late 1940's indicated that roughly 175-200 males were displaying on leks in the southern half of the valley (Antelope Flats, McBride, Airport, Bark Corral). From surveys in successive years, it is known that at least a small proportion of the introduced individuals entered the breeding population in Jackson Hole (Patterson 1952). Based on current data and lek locations within the valley, Patterson likely underestimated the total population size within Jackson Hole. Given the likelihood of suitable habitat in the western and northern half of the valley at that point in time (west of the snake river, potholes and Spread Creek), it is possible that a significant portion of the population was not surveyed which lead to underestimates of population size.

Grand Teton National Park began keeping official records of annual lek counts beginning in 1986 with the exceptions of 1994 and 1995. Using those data, Holloran and Anderson (2004) estimated that the sage-grouse population in the Jackson Hole valley had declined 73% in the 55 years following Patterson's study. In an effort to understand limiting population factors for grouse in the Jackson valley, Holloran and Anderson initiated a detailed study of grouse with emphasis on habitat selection for nesting, brood rearing, and winter range from 1999-2003. During those years, Holloran and Anderson (2004) estimated that less than 200 grouse occupied the valley. However, due to similar issues as Patterson previously, that estimate likely underestimates the actual population size of sage grouse in Jackson Hole.
The probable demographic parameter(s) responsible for this decline has yet to be determined for the grouse population in this area. As a necessary first step in the long-term effective recovery and management of sage grouse in Jackson Hole, these limiting factors must be determined. Considering that the overall sage-grouse population within Jackson Hole is a relatively small, isolated population that primarily occurs on federally managed areas of restricted human use (Grand Teton National Park and the National Elk Refuge), it is crucial to thoroughly understand

the underlying dynamics and to protect the integrity and the unique genetic structure of this mountain valley population.

The purpose of this study was to implement an intensive, field-based, targeted research effort to track a portion of the population over the course of three years to specifically identify macro-habitat and micro-habitat requirements, habitat-correlated productivity limitations, and dispersal. In addition, this effort was designed to create long-term monitoring protocols and improved population viability modeling capabilities.

Project Goals:

This project gathered information to characterize and define the following goals:

1. Annual survival based on age and gender
2. Annual productivity rates
3. Re-nesting Rates
4. Nesting success
5. Brood sex ratios
6. Habitat differentiation by grouse and predators
7. Micro-scale movements
8. Seasonal movements and habitat use
9. Winter vegetation characteristics
10. Natal Dispersal

Project Objectives:

1. Critical Habitat Identification
2. Manage Sagebrush Fire Regimes
3. Accurate Population Modeling
4. Designing Long-Term Monitoring Protocols
5. Baseline Data for Future Research
6. Identifying Limiting Factor(s) for the Population
7. Identify Influence of Potential Predators

Study Area

The study area was defined post-hoc after following marked grouse for several years. The total area encompassing the sage-grouse use in Jackson Hole was 52,650 ha (Figure 1, 2). The majority of this area was within Grand Teton National Park (67%), with smaller proportions on the National Elk Refuge (18%), Bridger-Teton National Forest (5%) and private lands (10%). The majority of the study area is characterized by sagebrush-steppe habitat with three major river corridors (Snake, Buffalo, and Gros Ventre) comprised of various shrub spp., cottonwood, spruce, and fir trees, and a mixture of coniferous and deciduous trees on intermittent buttes. The sagebrush-steppe habitats within the valley are dominated by mixed stands of big sagebrush (*Artemisia spp.*) with the exception of the sagebrush habitats west of the Snake River (Timbered Island and Potholes) which include stands of low sagebrush (*A. arbuscula*) intermixed with stands of mountain big sagebrush. The study area vegetation has experienced very little change since described in Holloran and Anderson (2004).

Figure 1. Sage-grouse study area as defined by grouse movements within the valley.

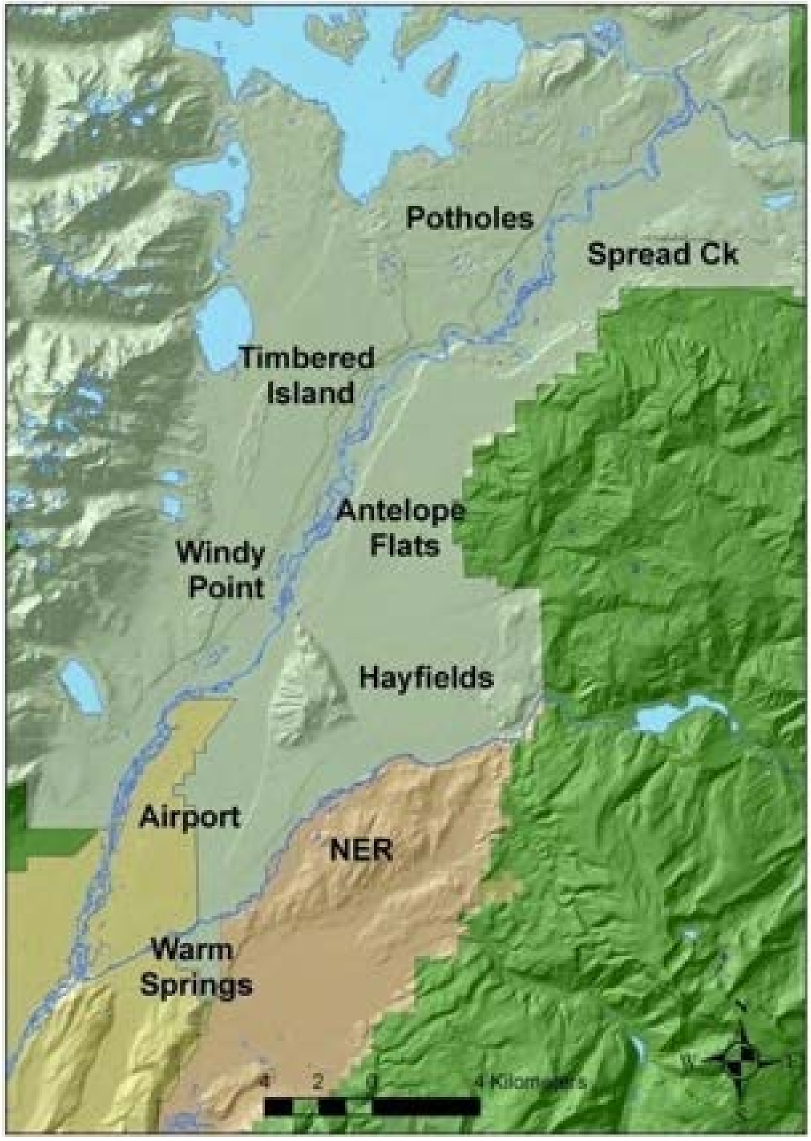

Figure 2. Land ownership of the study area and general location names referenced. Colored polygons correspond with land ownership (light green = NPS, dark green = USFS, orange = USFWS, yellow = private).

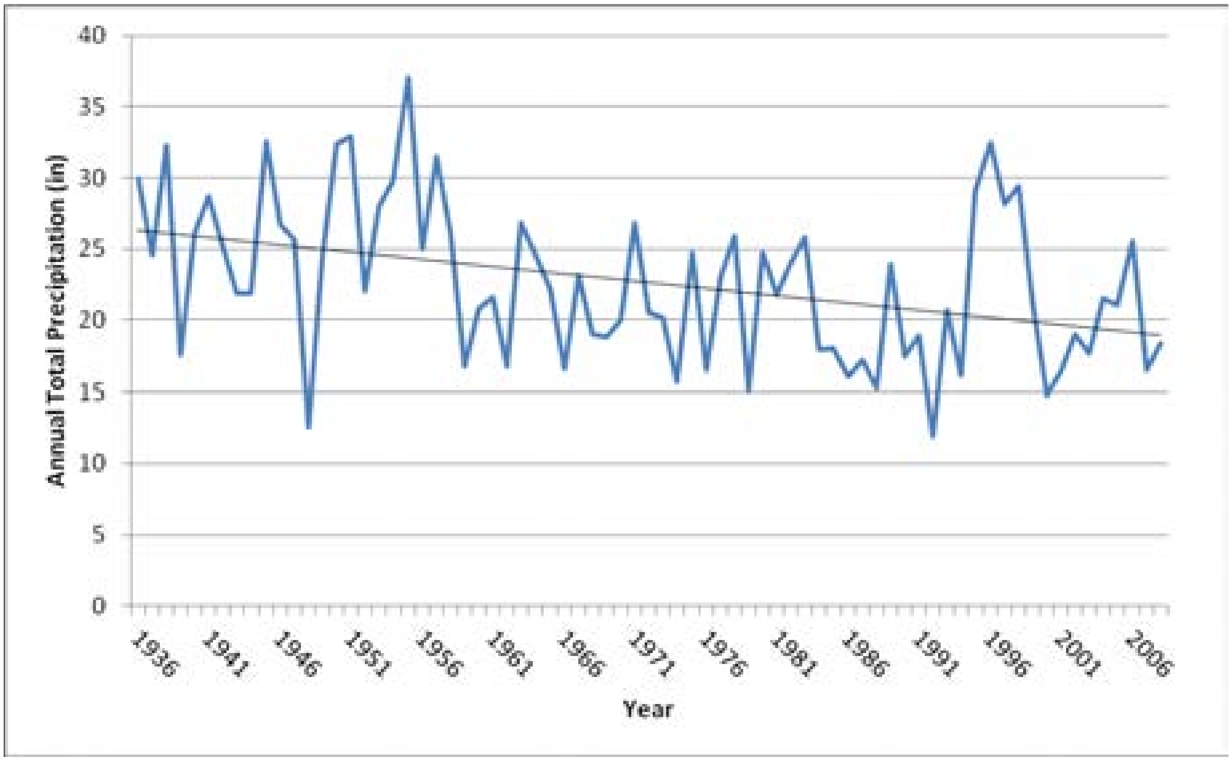

Figure 3. Annual precipitation from the Moose, WY weather station (blue) and the total precipitation (in inches) relative to the 72-yr average (red) for 1936-2008.

Jackson Hole is a mountainous valley that experiences long, cold winters and short, cool summers. The mean annual temperature was 36.5°C from 1935-2008 with little long term variation. Mean January temperatures over this period was 13.2°C and 60.0°C during August. The average total annual precipitation in the valley from 1936-2008 was 22.36 inches, but has been steadily decreasing at a rate of -0.1 inches/year. More recently, the annual precipitation within the valley has been below average 9 of the past 10 years (Figure 3). Most of the annual precipitation falls in the form of snow, typically from November – April, with the majority of snowfall accumulating from December-March. When relating the annual accumulation of precipitation and snowfall to the 72 yr average from 1936-2008, it appears there was a significant decrease in annual moisture beginning around 1960. Compared to more recent history (30 years), the total precipitation for 2006, 2007, and 2008 was 5.36, -3.72, and 1.41 inches relative to the average, respectively. Similarly, winter snowfall (Nov-Mar) for the winters of 2006-07, 07-08, and 08-09 was -41.3, 37.7, and 11.6 inches relative to the 30-yr average, respectively.

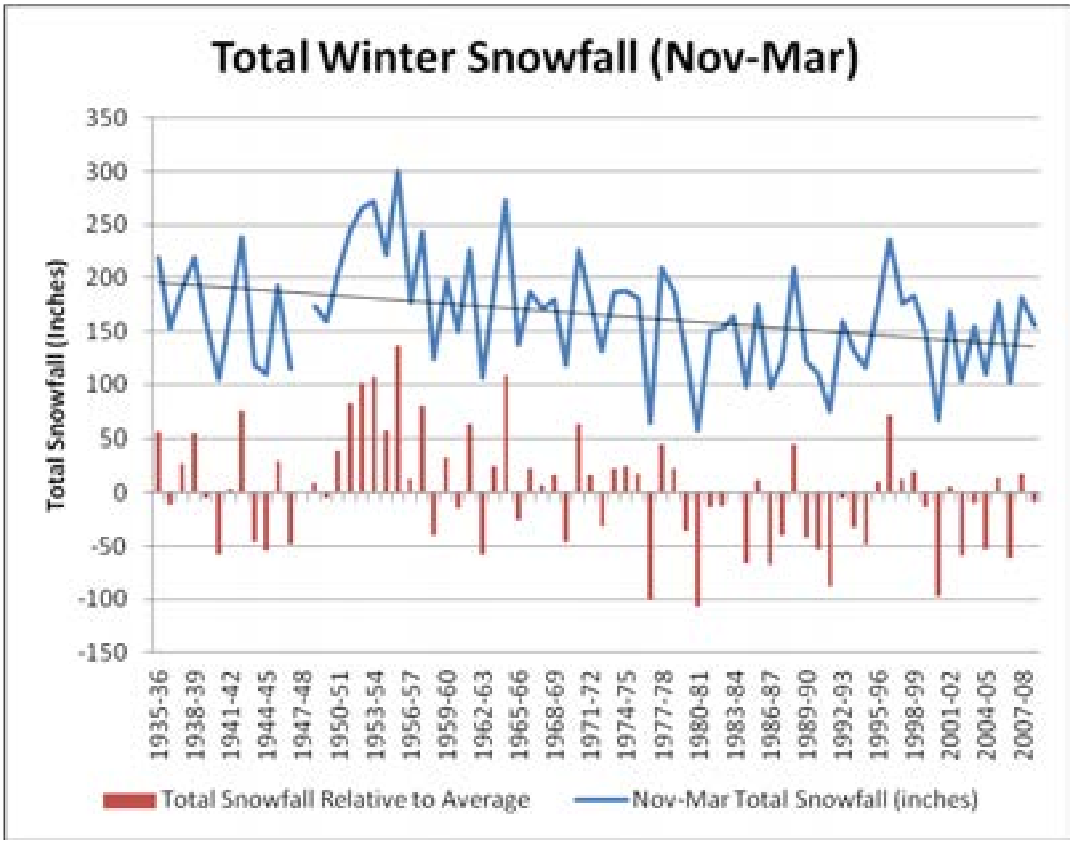

Figure 4. 73 year snowfall totals (in) for November through March at the Moose, WY weather station and the annual snowfall relative to the 73-yr average.

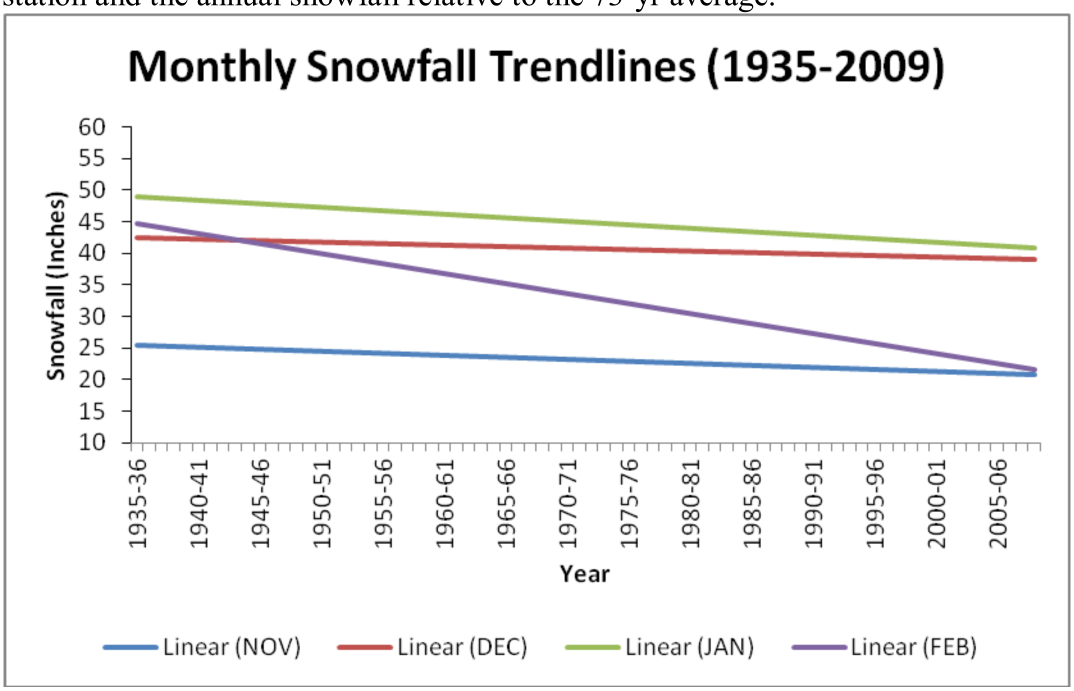

Figure 5. Monthly (Nov-Feb) snowfall trends from 1935-2009.

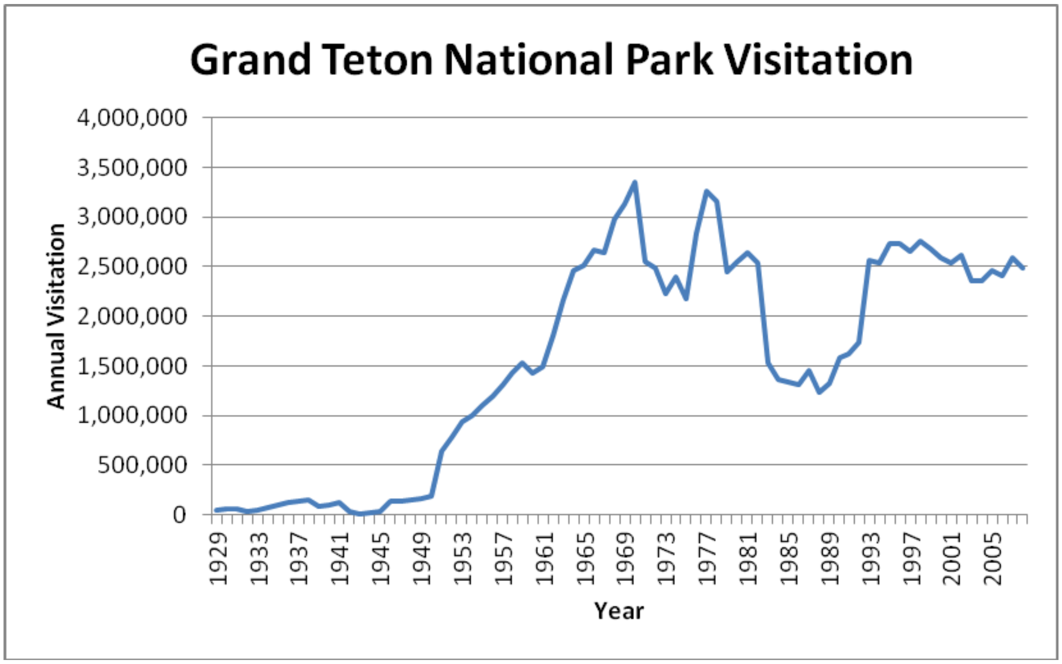

Figure 6. Annual visitation to Grand Teton National Park from 1929-2009.

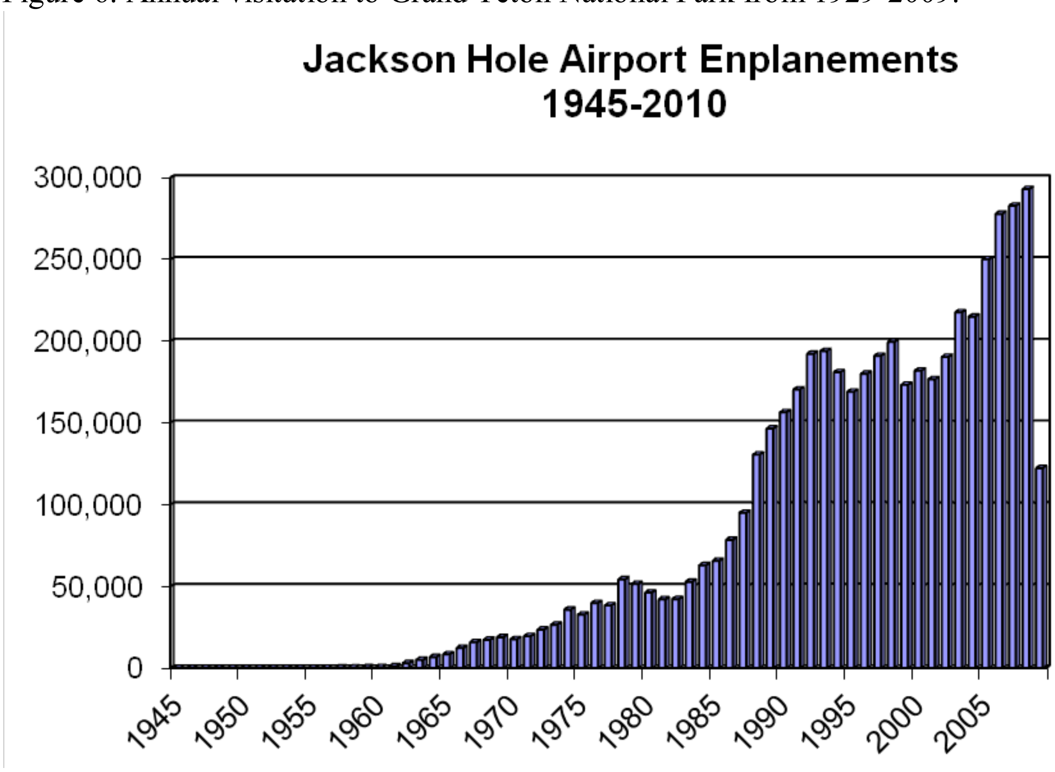

Figure 7. Total annual commercial enplanements at the Jackson Hole Airport from 1945-2010.

Methods

Lek Monitoring

In coordination with Grand Teton National Park and a variety of other agencies and individuals, we monitored all known leks 2-3 times per week and recorded maximum male attendance. All historic leks were visited at least once during peak season to assess occupancy. Further, we searched new areas suspected of containing a lek by aircraft in 2007 and by foot in all years.

Grand Teton National Park compiled annual lek count data for historical comparisons. Analyzing lek count data can be problematic. Using a total of maximum male counts from the valley assumes that all leks are found every year or a similar proportion of leks are counted. This assumption is likely not met during all survey years, as evidenced by the Timbered Island lek being present in the Patterson surveys, but not counted again until 2003. Further, there are several years in which only two main leks were monitored (Moulton and Airport) so a comparison of the average males/lek over all years cannot be accurate due to the proportion of small versus large leks being counted. However, it is important to try to utilize these data, as they can provide some insight into trends across years.

For all analyses of historical lek count data, we excluded the count data from Patterson (1952) due to the introduction of grouse into the valley during those years. We tested for relationships between the maximum male counts, the number of leks counted, weather, and visitors to Teton Park (as an index of human presence across the landscape). Weather variables tested were the total precipitation for the 12 months prior to the lekking season (April) to test for associations with precipitation and mortality, total precipitation from two years prior, winter snowfall in the year prior and two years prior to the count, and spring/summer precipitation (Apr – Aug) as a growing index from the year prior and two years prior to the count. We were testing the assumptions that maximum male counts were correlated to productivity and survival using these weather variables. Because yearling males attend leks less frequently and later in the season, maximum male counts likely reflect males two years or older (Walsh et al. 2004, Garton et al. 2007). Further, Holloran and Anderson (2002) found that productivity in Jackson Hole was significantly related to residual grass cover. Hence, we used spring/summer precipitation data from two and three years prior to the count as a covariate to test if annual grouse productivity is related to the number of adult (≥2 years) males counted. Likewise, snowfall from two years prior may influence survival of that cohort, etc.

We first tested all variables for correlations using Pearson's correlation tests. We found that the maximum male counts were significantly correlated to the number of leks counted ($P < 0.001$) and subsequently used maximum males counted/number of leks counted in the models. To help describe the predictive nature of the variables on the average maximum males/lek, we first used a best subsets regression with males/lek as the response to identify potential variables to include in the models. We then followed with general linear regression to formulate predictive models and P values associated with predictive variables.

Marking and tracking

Sage-grouse were captured by spot-lighting and hoop netting (Giesen et al. 1982, Wakkinen 1990) and using rocket-nets or net launchers on leks and areas of known concentrations (e.g., mineral piles). Grouse were classified by age (yearling or adult) based on feather characteristics (Crunden 1963) and shape (Eng 1955) of primaries 8-10 and by gender based on the undertail covert rachis color (females white and males black). Most grouse were outfitted with a radio transmitter. Females received either an 18-22g necklace style VHF transmitter (Holohil Systems Ltd., Carp, Ontario or Advanced Telemetry Systems, Inc., Insanti, MN) or a 30g solar, GPS/PTT transmitter (Microwave Telemetry Inc., Columbia, MD) that was fitted using the rump mount technique (Rappole and Tipton 1991) with ¼" Teflon ribbon as the harness material with elastic fitted inside for extra "give." Females were outfitted with a uniquely numbered aluminum band. Males were fitted with colored anodized aluminum bands based on capture location (nearest lek) to identify inter-lek movements and unique plastic color band combinations on the right leg for individual identification. A subsample of males received transmitters. In 2007, we outfitted VHF transmitters on males using the rump mount method or 45g solar GPS/PTT transmitters mounted in a similar fashion as females. In subsequent years, VHF transmitters were secured using the traditional necklace style attachment method. All transmitters were equipped with mortality sensors set to double the pulse rate after 4 hours of inactivity.

All birds marked with VHF transmitters were monitored 2-3 times per week throughout the course of the study. From April 2007 through March 2009, we obtained accurate locations on all individuals using one of two methods. During the winter months when birds tended to be more skittish and flush when approached, we obtained locations with quadrangulations. Four azimuths were taken for each individual within one hour and from a distance no greater than 2km away. Locations were estimated using LOAS (Ecological Software Solutions) with a Maximum Likelihood Estimator and a 95% chi-square confidence distribution to obtain error polygon estimates. After entering the azimuths into the program, we looked at all observer points to identify any obvious outliers. These were often typos in the UTMs and these corrections were made by consulting field notebooks. All bearings were then run through LOAS and sorted by error ellipse area. A suitable size cut-off of estimated error ellipses to visually examine was determined to be about 31,400 km^2. This size was chosen by examining individual error ellipses, and those that spanned more than one sagebrush habitat patch (e.g., hayfields) were deemed unsuitable. Some of these very large estimated areas could be corrected by reducing the suitable bearings for location calculations to three instead of four. There were numerous cases where quads simply did not project (and therefore don't appear in the LOAS output), and unfortunately this required going through each quad individually to locate problem azimuths. In many cases, this was solved by using three azimuths instead of four, but many were unusable. Final locations were excluded if the error ellipse area exceeded 5.28 km^2. In total, we obtained 631 locations during 2008 from bearing data.

The second method of obtaining locations from VHF grouse was by "walk-in" locations. Walk-in locations required hiking/skiing to within 100m of the grouse being tracked, determined by signal strength and "coming around" on the bird (the bird had been passed). The observer location, one bearing, and an estimated distance to the grouse are recorded. The location is later estimated by correcting for the bearing and distance using basic geometry. We calculated the maximum error for any given walk-in location as 0.03 km^2 based on the assumption that the observer is located on the perimeter of a circular error ellipse (maximum radius of 100m). GPS transmitters were set to receive GPS locations hourly from 07:00-21:00 hr and upload the stored locations via Argos satellites once every three days. Transmitters were tested for accuracy prior to deployment and found to be accurate within 5.6 m.

Nesting & Productivity

Beginning at the onset of lekking season and after sufficient snow melt, we began monitoring hen behavior for signs of nesting. When a hen was found to be localizing (within ca. 1 km^2 area) we obtained walk-in locations three times per week until the hen was re-located in the same spot consecutively. Once this happened, one observer then walked one very quick, tight circle around the nesting hen approaching no closer than 10 m to the nest, as to not flush the hen. The observer would take a host of waypoints while circling the hen which would be later projected in ArcMap 9.3 to help determine the center of the circle, thereby estimating the nest location.

Incubating hens would be monitored from at least 100 m away every Monday, Wednesday, and Friday to determine when they left the nest site. Immediately following the female leaving the nest site, we would search the area to determine nest status. Nests were determined to be successful if eggshells were present in the nest that had detached membranes and "clean" removal of the rounded end of the eggshell. We considered a nest predated if eggshell fragments were found with attached membranes, holes in the sides, chick or yolk remains, or scattered outside of the nest cup. At all nest locations, we recorded accurate UTMs, number of eggs found, species of vegetation the nest was located under, height of the cover, height of the canopy above the nest, canopy cover percentage, and nest opening direction. If predation was suspected, we thoroughly searched the area for signs of the predator, including searching for hair above the nest, eggshell remains, tracks, or any other pertinent data. All egg shells at the majority of nests in 2007 and 2009 were collected to analyze for gender of the chicks to determine sex ratios of broods by genetic analysis (Griffiths et al. 2001).

If hens were determined to have successfully hatched eggs, the female was flushed 15 d after hatching to obtain an early brood count. Again, if successful, the hen was flushed again at 30 d to determine success through late brood rearing. This was only done with hens wearing VHF transmitters since it was not possible to get real time locations of hens with GPS transmitters.

Raven/Grouse Interactions

See Appendix A

Winter Habitat Assessment

See Appendix B

Airport Study

See Appendix C

Chick Mortality Rates

See Appendix D

Winter Habitat Sampled in Summer

All of the previously collected information on winter habitat for sage grouse in the valley was collected during the summer months in locations the birds were documented in the previous winter. In order to determine how measurements of sagebrush habitat in summer correlate to measurements made in the winter, we re-sampled the winter habitat locations during the summer months. To accomplish this, plot locations were gathered using the Argos/GPS transmitters affixed to male and female sage grouse. We chose two location points per bird per week during the winter, one diurnal (feeding or loafing) point and one nocturnal (roost) point to account for potential differences in habitat selection between these two behaviors. The points were initially visited from December to March 2007-2008 to collect habitat characteristics. During the initial visits, we collected data on snow depth to determine the period with the greatest depth which defined peak winter conditions. During the duration of this study, that period was determined to be January 15-February 25 and we used this time period to define "critical winter habitat". Snow depth was the defining characteristic of the time period sampled since it has the greatest impact on amount of available resources (exposed sagebrush) for the grouse to utilize. With that time frame defined, the same locations were re-visited in August and September of 2008.

We went to sage-grouse use locations using hand held GPS devices (Etrex Vista, Garmin Ltd.). Once we arrived at location, the nearest shrub was found and considered plot center. We used 0.004 hectare circular plots as outlined by Beck (1977) to assess vegetation at sites. We measured the same circular plots to assess habitat in both the winter and summer. Vegetation characteristics recorded included species, height (minus flowering stalks), crown breadth of all shrubs located in plot, and the number of dead stems. Only information on shrubs was collected since that is the only vegetation available to grouse at wintering sites. Differing from Holloran and Anderson (2004), we took measurements only on live shrubs since dead steams are of little biological significance to a wintering sage-grouse. Site characteristics recorded include slope, aspect, and whether point was representative of surrounding area. All of the above variables were recorded at random points to assess habitat preference and for comparisons to previous studies. We analyzed measurements to determine the mean live sagebrush height, percent canopy cover, density and total shrub canopy cover for use points and random points.

Depending on normality of the data, either a 2 sample t-test or Mann-Whitney U test was used. For the analyses, we compared only vegetation points from the previous study that were in our study area. We removed data from locations that were collected outside of what we considered peak winter conditions (n=4) and data from use locations that were outside of our areas of critical winter habitat where we concentrated our sampling efforts (n=16) or both (n=2). We also removed random points that fell inside our critical winter habitat zone (n=9).

Population Estimates

We assessed total sage-grouse population estimates within the valley in two ways. First, we modeled total population size and growth using basic demographic parameters (both estimated from other studies and with data gathered during this study) and lek count data. Second, we developed a winter census protocol to directly count individuals while grouped on winter range. This was accomplished with the aid of volunteers from the community. The count was conducted the first or second week of February, which corresponded with peak snow depths within the valley. Using location data gathered the previous month, we assessed the areas being used by grouse and surveyed those patches of exposed sagebrush on foot (skis or snowshoes) to flush and count all grouse. Most areas were surveyed by a minimum of two observers, but a few patches were surveyed by one person (typically a researcher familiar with the patch and/or bird's behavior in that area). Surveys were performed concurrently and groups surveying adjacent areas were in communication in the event grouse flew into an adjacent survey area to prevent counting birds twice. Finding groups of sage-grouse was also aided by using radio-tagged birds in relevant locations.

We compared the two methods after adjusting for the pertinent demographic parameters. Specifically, lek counts from the spring prior to the winter census were adjusted for sex ratios, productivity that year, and summer/fall adult mortality rates. Then, the winter census was compared to the subsequent lek count after adjusting for sex ratios and observed winter mortality.

Habitat Loss

We examined the potential loss of sagebrush habitat in the southern half of Jackson Hole over the past 60 years due to human alteration of the landscape (e.g., urbanization and agriculture) and wildlife. We examined the southern half of the valley due to the known utility for wintering habitat. Habitat north of Ditch Creek was not examined since those areas are typically not available to wintering sage grouse due to snow depths. In our analysis, we assumed that sagebrush destroyed due to wildfire regenerated in a minimum of 35 years (Baker 2006) and any sagebrush fire >35yrs old was therefore considered potential wintering habitat again. We assessed habitat for three different time periods; pre-human settlement, 1945, and 2009. For 2009 and 1945, we visually examined aerial photographs, digitized non-useable habitat, and calculated total hectares of remaining habitat in AcrGIS 9.3. For the estimation of sagebrush habitat pre-settlement, we assumed that any human altered habitat in typical sagebrush soil types was intact sagebrush habitat. This assumption may, in fact, over estimate total sagebrush habitat due to any wildlife that may have occurred but is not known. Based on recent observations of movements by radio-marked sage grouse, we considered secondary roads (both paved and non-paved) to be of little consequence to habitat use. We considered a 100m buffer of primary roads (i.e., HWY 89) to be lost habitat due to avoidance we observed from marked sage-grouse.

RESULTS

Lek Monitoring

The NPS has conducted annual lek counts since 1986, with the exception of 1993. Further, there are lek count data from 1948-1951 (Patterson 1952) for the same lek complex. We helped conclude three years of lek monitoring within Jackson Hole from 2007-2009. During the early spring of 2008, we performed an aerial search for new leks, from which we identified a previously unknown lek in the potholes now called RKO (Figure 11) which was host to 12 strutting males in 2008 and 15 in 2009.

When analyzing historical counts, interpretation can be influenced if the number of leks is not included in the analysis (e.g., using total male count). The variation in total high and low counts is more pronounced than if the number of leks counted is taken into account. However, the males/lek index is also confounded by the fact that the total number of the leks surveyed influences the average number of males/lek counted. For example, in 2001-03, only Moulton and

Airport were surveyed. This would result in a larger males/lek average since only the two of the largest leks were surveyed.

Another important factor when trying to interpret lek count data to understand population trends or estimate total population size is the number of unknown leks within the study area (Walsh et al. 1991). One way of estimating the number of unknown leks in the valley is by using mark-recapture techniques of radio-marked sage-grouse and the Lincoln-Peterson estimator (Lincoln 1930, Peterson 1896) with Bailey's modification (Bailey 1951) to account for small sample size: $\hat{N} = \frac{n_1(n_2-1)}{(m_2-1)}$, where $\hat{N}$ = the estimated total number of leks, n_1 = the total number of currently active leks in Jackson Hole, n_2 = the total number of leks visited by radio-marked birds, and m_2 = the number of previously known leks visited by radio-marked birds. Basing the data on the three years of our study, there were a total of six active leks during the period of study; North Gap, Airport, Bark Corral, Moulton, Timbered Island, and RKO. We had radio-marked birds present at 4 previously known leks (N Gap, Airport, Moulton, and Timbered Island) and used marked birds to find the RKO lek. Using these data, we estimated the number of leks that theoretically should be present in the valley (Table 1).

Table 1. Estimate of the number of active leks in Jackson Hole based on mark-recapture techniques.

Known Leks in the Valley	Total Leks Visited by Marked Grouse	Previously Known Leks Visited by Marked Grouse	Estimate	SE	95% Lower Confidence Level	95% Upper Confidence Level
6	5	4	7.2	1.44	6	8

Trying to further investigate trends, the Airport and Moulton leks potentially provide more insight. These leks have been continuously monitored since 1986 and provide for relatively consistent comparisons among years due to the ease of surveying these leks and the consistent nature of monitoring. However, two alternate (or satellite) leks confound the use of these counts. From 1990-1996, Moulton east and west leks were both active and from 1993-1997 the Beacon lek was active. For the purpose of this analysis, we combined associated leks since the increase in leks was likely a result of a population increase and subsequent "overflow" of the previously occupied leks (Walsh 2004). From those combined data, a noticeable increase in male attendance was observed from roughly 1988 – 1995. However, it may not be correct to assume that the population has declined as a unit in recent years since the 1986 and 1987 counts are similar to recent years.

When comparing Jackson Hole to the rest of Wyoming, it appears that Jackson follows similar trends that statewide lek counts indicate. By using males/lek, the statewide averages indicate major declines in population size in 1987 and, again, in 1995-96 (Figure 8). This is mirrored in the Jackson Hole males/lek data (Figure 9,10), indicating this may be indicative of true trends. Unfortunately, if this is truly indicative of population trends, it likely means the Jackson population has been decreasing over the past several decades since the 1986-87 were the lowest in recorded history up until that point.

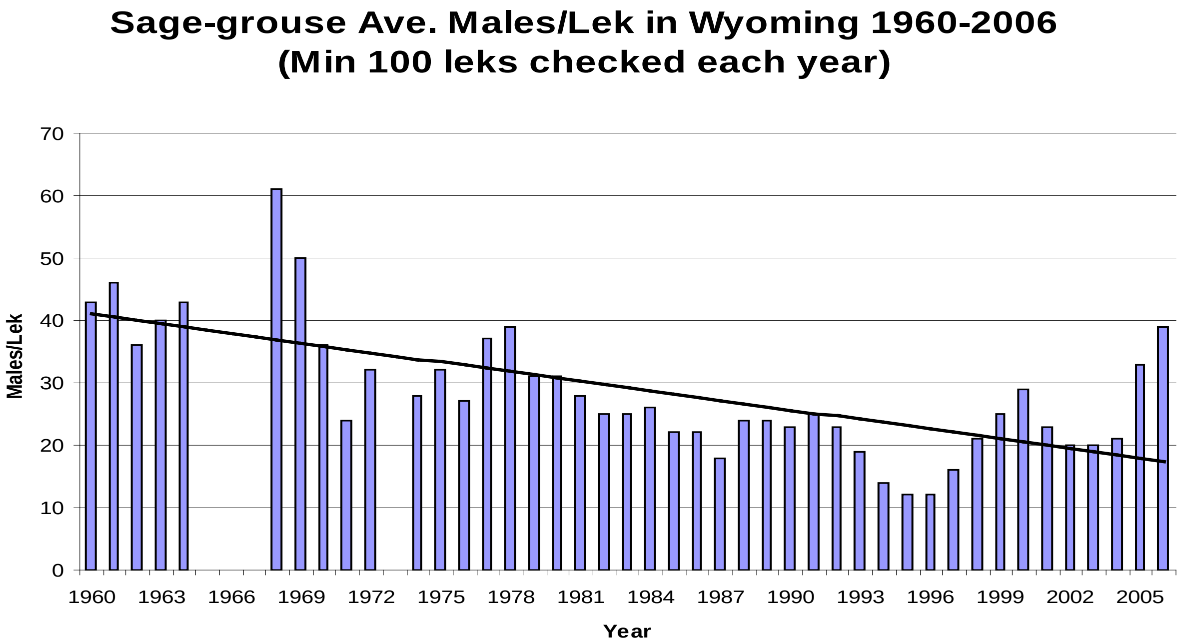

Figure 8. Average number of males counted/lek across Wyoming from 1960-2006. Data compiled by T. Christiansen.

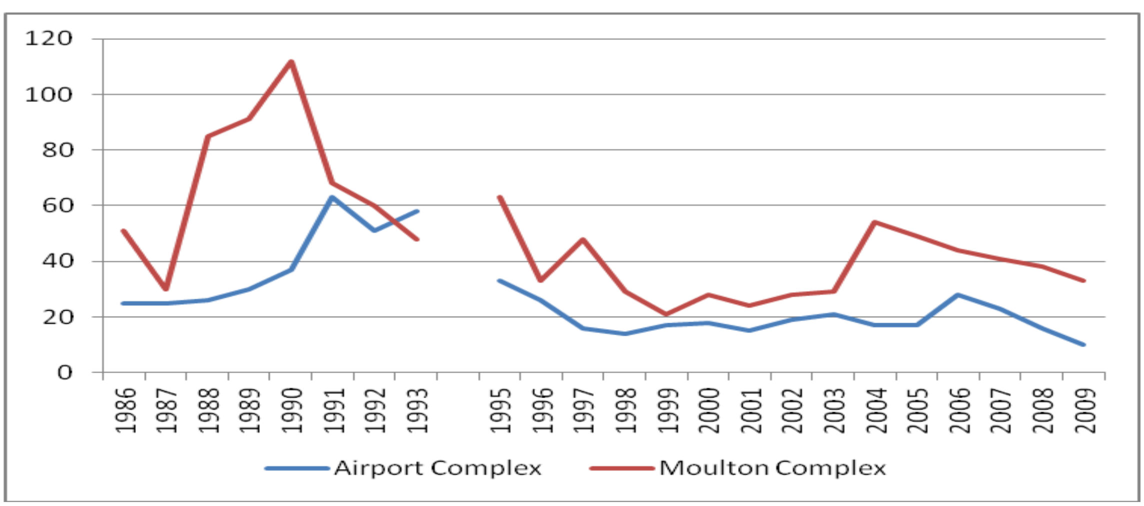

Figure 9. Total male counts at the Airport complex leks (combined Airport and Beacon leks) and the Moulton complex leks (Moulton east and west) from 1986-2009. No data were collected in 1994.

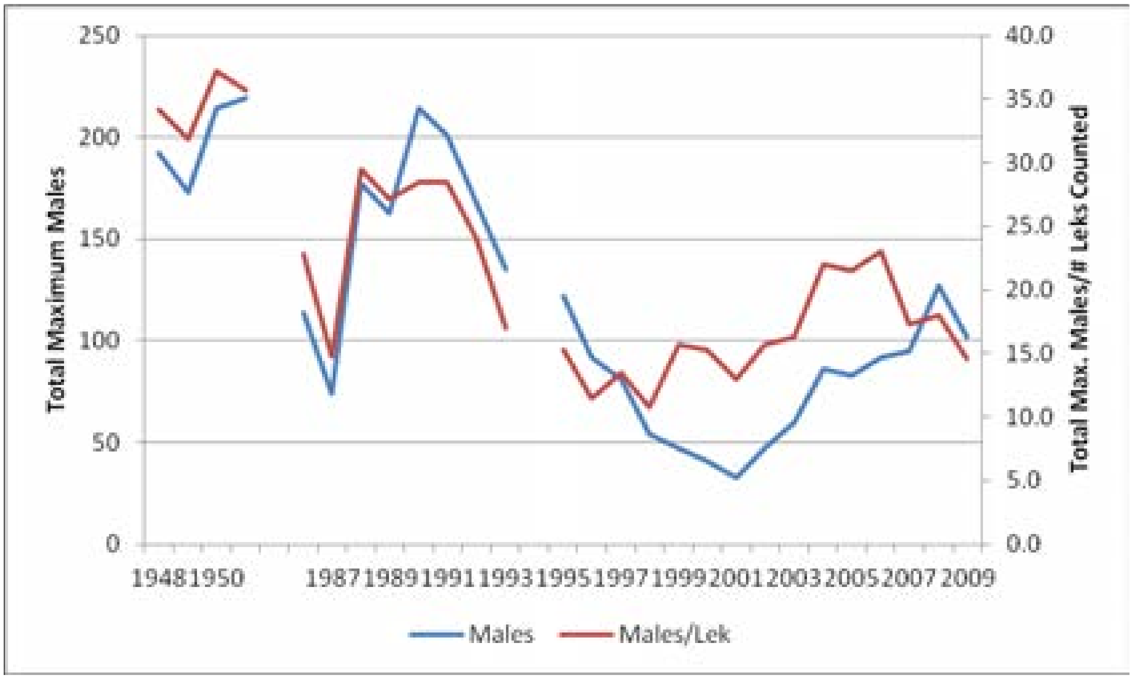

Figure 10. Total maximum males counted for all leks (blue) and the average number of males counted/lek within Jackson Hole (red).

The best subsets modeling of males/lek found that the number of visitors to Grand Teton National Park in the 12 months preceding the lek count was the best predictor of the average maximum males/lek (males/lek = 34.9 – (0.000007*visitors); $P < 0.001$, $r^2(adj) = 53.2$, Figure 13). No weather variables tested significantly increased the adjusted r^2 values (maximum increase was 2.6% with four predictors) or decreased the Mallow's c-p of the models when included.

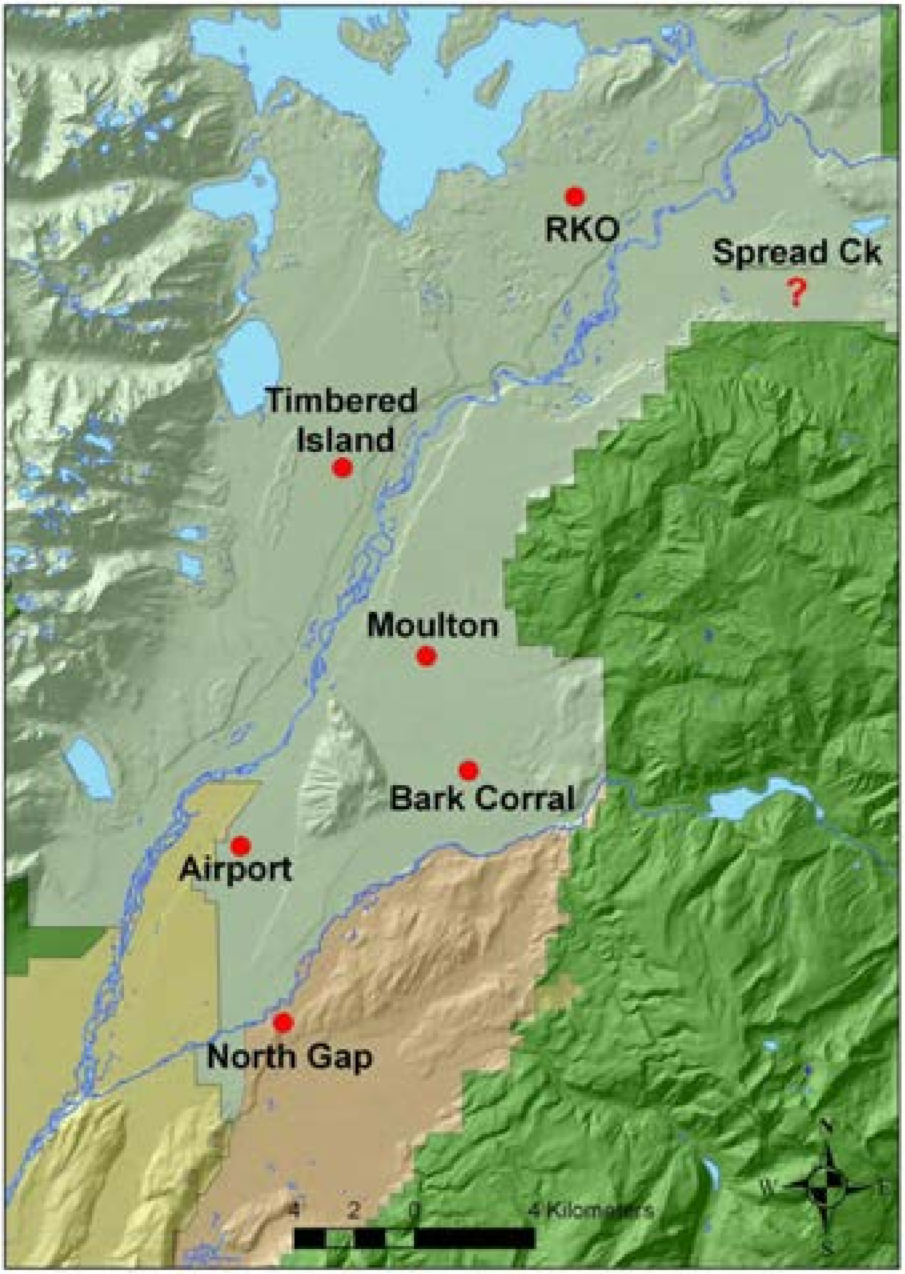

Figure 11. Lek locations during the study. Males were seen strutting at Spread Creek, but no matings or definitive location observed.

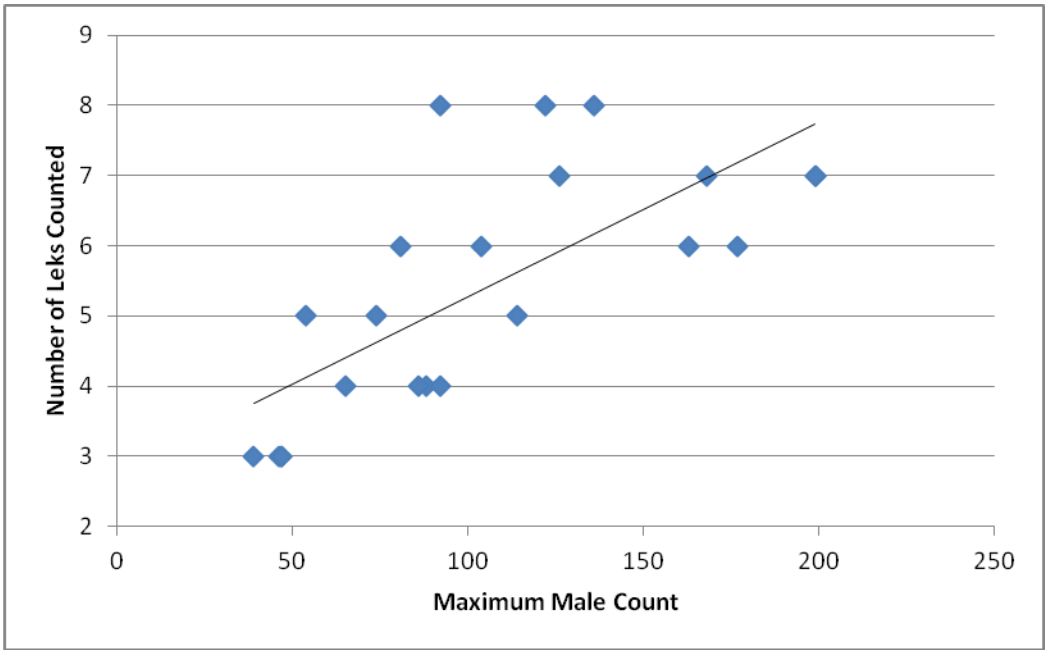

Figure 12. Linear relationship between maximum male counts for all leks combined (date within year not taken into account) and number of leks counted. $P < 0.001$, $F = 21.48$, $r^2 = 51.8$.

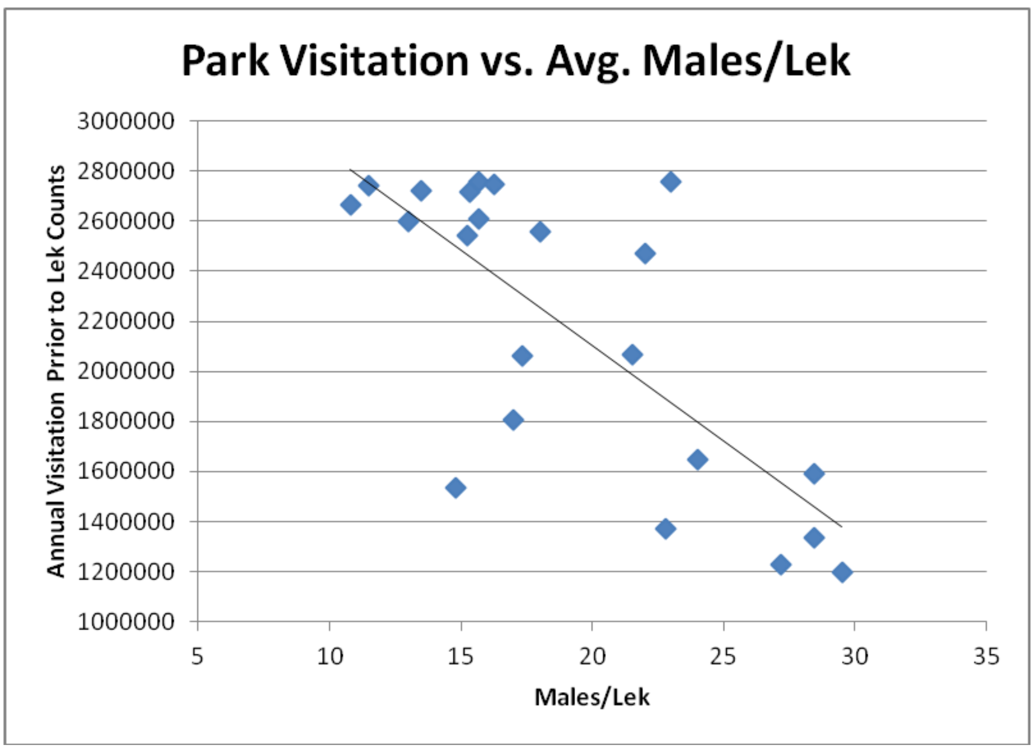

Figure 13. Relationship of maximum male lek counts/number of leks counted from 1986-2008 with corresponding recreational visitor numbers from Grand Teton National Park in the 12 months prior to the lek count (May-Apr). $P < 0.001$, $F = 29.4$, $r^2 = 55.5$

Locations

We collected >60,000 combined locations on sage-grouse in Jackson Hole over the course of this study (Figure 14). These data are currently being analyzed for home ranges, daily and seasonal movements in conjunction with covariates such as weather, age, gender, memory, habitat, and snow conditions using mechanistic home range models. We ran kernel analysis for the winter locations during peak conditions (January 15 – February 25) in the valley for a visual of winter habitat (Figure 15). We also ran a kernel analysis on all of the locations, combined, after reducing the GPS dataset to one location/day to mirror the VHF dataset (Figure 16). There is likely more summer use in the Timbered Island and Antelope Flats sections than depicted in the kernel analysis due to a smaller portion of grouse marked in these areas.

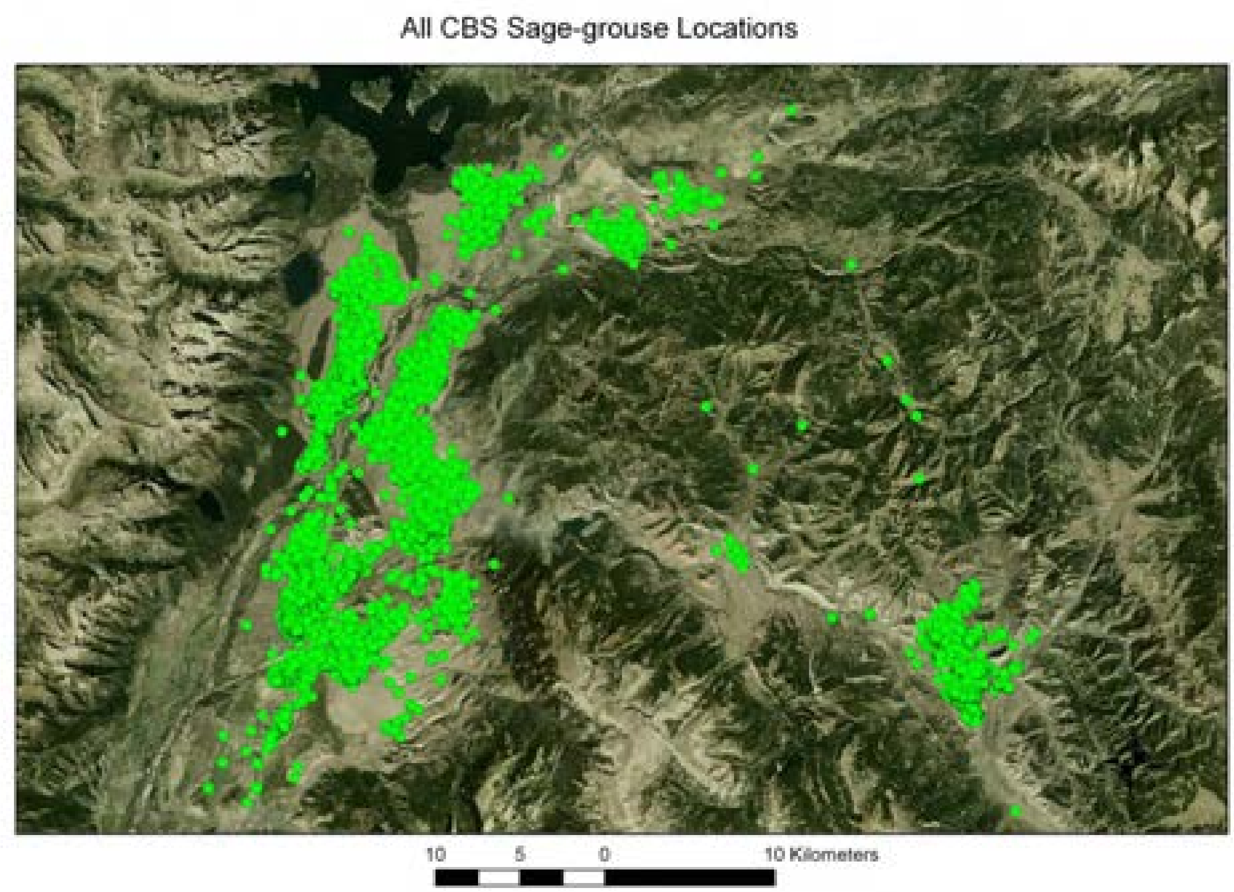

Figure 14. All sage-grouse locations in Jackson Hole (Gros Ventre included) from 2007-2009.

Figure 15. Kernel analysis of winter sage-grouse locations during peak winter conditions in Jackson Hole. Winter locations were used from January 15 – February 25, 2008 and 2009.

Figure 16. 95% Kernel of all sage-grouse locations from 2007-2009 in Jackson Hole after reducing the GPS dataset to one location/day.

Nest Location Movements

During the course of this study, 19 tracked females survived the winter of 2007/08 to nest again in 2009. Most hens nested in the same general area as the previous year. Further, re-nesting attempts that were made after a failed nest were also initiated in the same general area. This nest location movement data showed movements as little as 89m between consecutive nests and as great as 3.4km. We compared nest movement data for all nests combined, second nesting attempts during the same season, nest locations between years as well as the difference in distance moved between failed and successful nesting attempts. While the sample size was small, there was no significant difference found in the distance moved between two failed nests and two successful nests (P=0.52, W=40.0).

Table 2. Distance (in meters) between nesting attempts of the same female.

	N	Mean Distance (m)	SE	Median Distance (m)	Q1	Q3
All Nests	27	664	161	431	298	694
Re-Nests	12	808	251	638	313	740
Btw. Years	16	539	198	396	229	446
Btw. Failed Nests	6	574	153	567	274	830
Btw. Hatched Nests	5	450	70	409	342	579

Productivity

We were able to monitor a total of 54 hens for breeding success from 2007-2009. From those hens, we recorded a total of 75 nesting attempts (re-nests included). We assessed productivity both for the population and for yearlings separately, since yearlings have been found to have lower breeding success and re-nesting rates (Schroeder et al. 1999; Table 6). For three first nesting attempts (two in 2008 and one in 2009), we were unable to locate the exact nest site due to a predation event during the egg laying process. Because our protocol called for nesting locations after a hen had initiated incubating, we assumed these to be failed nesting attempts for the analysis due to the localizing behavior of the hens and the subsequent re-nests we located in the area after the hens re-visited leks.

After a hen left the nest, we examined the nest for signs of hatching or predation within 3 days of the hen leaving (typically 1-2 d). During the examinations of nest failures, we looked exhaustively for predator sign (hair, tracks, whitewash, etc.). However, it has been well documented that assessing predators based on nest sign can be problematic (Coates et al. 2008), so our results must be viewed with caution (Table 3). In 2007 and 2008, we collected any hair that was found at a nest sight (and predation sights of birds not on nests) and sent it to the Wyoming Game and Fish Wildlife Forensics Laboratory for species identification. Of the 13 nest site samples sent in; 7 contained under-fur hair and could not be identified, 1 coyote, 2 badger, 1 Canidae, and 2 Mustelidae (one likely skunk and one likely weasel).

For areas where sample size did not limit statistical tests, we examined nest successes and failures for a relationship with general nesting area. Those areas included the Hayfields (n = 13), south airport (n = 19), and north airport (n = 10). Using binary regression and nesting areas as factor variables, we found no difference in nest success between habitat patches ($P > 0.1$).
In 2007, one yearling female incubated an addled clutch for 95 days before we flushed her off the nest, breaking the previously documented incubation record of 76 days (Schroeder 1997).

Table 3. Causes of nest failures based on evidence found at the nest site. The "other" category includes one failure due to female death by yolk peritonitis, one un-hatched clutch and one researcher caused abandonment.

	N	% Mammal	% Avian	% Other	% Unk
2007	7	43	14	43	0
2008	18	72	0	0	28
2009	11	64	10	0	27
Total	36	60	8	14	18

Adjusted annual success was calculated in order to address the issue of missing initiated nests that failed during the egg laying period or during early incubation which could result in an artificially inflated nest success rate. This only applied to females outfitted with VHF transmitters due to the high degree of information obtained using GPS transmitters. The adjusted annual success was calculated following Johnson and Klett (1985) using the equation:

$$ANS=[(N_s/N_t)^{1/(h-f)}]^{h}$$

Where N_s = number of successful nests, N_t = total number of confirmed nests, h = mean age of a clutch at hatch which is equal to 34 (9 days for laying and 25 days of incubation; Patterson 1952:120), and f = mean age of a clutch when found which is calculated by back-dating from hatch date.

Table 4. Adjusted annual nest success for females outfitted with VHF transmitters in Jackson Hole, 2008-2009.

	N	% Successful	Adjusted Annual % Successful
2008	27	48.1 (13)	30.6
2009	13	61.5 (8)	50.3
Total	40	52.5	37.1

Table 5. Nesting success of all females monitored in Jackson Hole, WY from 2007-2009. Results expressed as percentages (N).

	N Hens	Initiation Rate (N)	% Successful on 1st Nest	Re-Nesting Rate	% Successful on 2nd Nest	Annual Nest Success	Annual Hen Success
2007	14	92.8 (13)	38.4 (5)	28.6 (2)	100	46.7	50
2008	25	96 (24)	33.3 (8)	50 (8)	24 (6)	43.8	58.3
2009	15	100 (15)	40 (6)	66.7 (6)	66.7 (4)	47.6	66.7
Total	54	96.3	37.2	48.4	68.1	45.6	56.8

Table 6. Nesting demographics of yearlings and adults (≥2 yrs) in Jackson Hole. Results expressed as percentages (N).

	Yearling							Adult						
	N	Initiated	Successful 1st Nest	Re-nest	Successful Re-Nest	Hen Success	Nest Success	N	Initiated	Successful 1st Nest	Re-nest	Successful Re-Nest	Hen Success	Nest Success
2007	7	86 (6)	17 (1)	20 (1)	100 (1)	33 (2)	29	7	100 (7)	57 (4)	33 (1)	100 (1)	71 (5)	63
2008	2	100 (2)	0 (0)	0 (0)	N/A	0 (0)	0	23	96 (22)	38 (8)	57 (8)	75 (6)	72 (14)	47
2009	0	N/A	N/A	N/A	N/A	N/A	N/A	15	100 (15)	47 (7)	63 (5)	80 (4)	71 (10)	56
TOTAL	10	90	17	20	50	33	29	44	98	47	56	85	71	55

Table 7. Clutch sizes of yearlings and adults and nesting attempt in Jackson Hole.

	Sample Size 1st nest (2nd nest)	Average # Eggs Hatched-1st Attempt	Average # Eggs Hatched-2nd Attempt	% Adult 1st Attempt	% Adult 2nd Attempt	Eggs Hatched/Adult-1st Attempt	Eggs Hatched/Juvenile-1st Attempt	Eggs Hatched/Adult-2nd Attempt	Eggs Hatched/Juvenile-2nd Attempt
2007	5(2)	4.80	5.50	80	50	5.5	2.00	7.00	4.00
2008	8(6)	8.13	6.67	100	100	8.13	N/A	6.67	N/A
2009	6(4)	8.17	4.75	100	75	8.17	N/A	4.75	N/A
Combined	19(12)	7.26	5.92	94.7	84.6	7.56	2.00	6.14	4.00

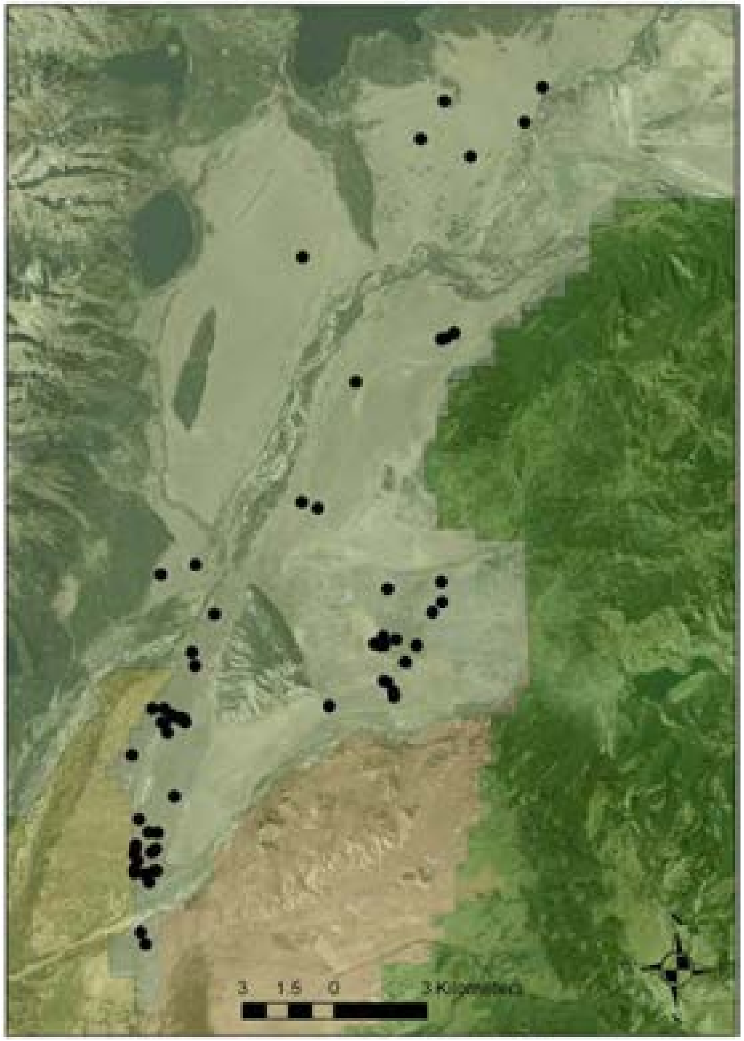

Figure 17. Sage-grouse nests located through radio-telemetry from 2007-2009 in Jackson Hole, WY

In total, we found 31 successful nesting attempts (from 75 total) over the three years (Figure 17). We looked for differences in clutch sizes between first and second nesting attempts and that first nests had slightly more eggs per nest than second attempts (Table 7, $P = 0.088$). We found no difference between clutch sizes of juveniles and adults (Table 7, $P = 0.17$).

We assessed brood success by flushing VHF hens that hatched eggs at 15 and 30 d post-hatch to correspond with early and late brood success. In 2008, there were 11 VHF hens that successfully hatched chicks. Of those, 9 had chicks 15 d post-hatch and 7 had chicks during the late brood count, meaning 63.6% for the broods survived. In 2009, there were 8 VHF hens that successfully hatched chicks. Of those, 4 had chicks present during the early brood count and only 2 had chicks when checked again at 30d post-hatch or 25%. This is summarized in Table 8. The average number of chicks present at the late brood count in 2008 was 2.67 and the number of chicks present in 2009 was 3.0, this was not significantly different ($P = 0.54$).

We compared the nest success of females with VHF transmitters against those with GPS transmitters to determine whether that potentially influenced nest success. We tested for differences using a Chi-Square analysis and found no significant difference (*P* = 0.14) between transmitter type and nest fate.

Table 8. Number of successful nests from hens monitored with VHF transmitter in 2008 and 2009 in Jackson Hole, WY. *N* represents total number of females with hatched nests.

	N	Successful Early Brood	Successful Late Brood
2008	11	9	7
2009	8	4	2
Combined	19	13	9

Table 9. Nest outcome of all female sage grouse monitored with VHF and GPS transmitters in 2008 and 2009. There was no difference in the proportions of successful and failed nests (P = 0.14).

	# Successful	# Failed
VHF	27	26
GPS	4	10

Table 10a, b, c. Vegetation characteristics at failed (a), successful (b) and all (c) nest sites. We found no differences between failed and successful nests for variables measures.

A. Failed Nests

	Number of Nests	Avg. Shrub Height	Avg. Height from Nest to Canopy	% of Live Canopy	Avg. % of Nest Covered	Most Frequent Nest Opening Direction
2007	2	0.60	0.35	100.00	100.00	S, NE
2008	16	0.76	0.24	73.00	73.75	S
2009	10	0.70	0.26	66.67	69.50	N
Combined	28	0.68	0.28	79.89	81.08	S

B. Successful Nests

	Number of Nests	Avg. Shrub Height	Avg. Height from Nest to Canopy	% of Live Canopy	Avg % of Nest Covered	Most Frequent Nest Opening Direction
2007	5	0.87	0.28	100.00	82.00	S
2008	14	0.86	0.27	53.33	82.86	W
2009	11	0.65	0.20	73.23	73.50	S, W
Combined	30	0.79	0.25	75.52	79.45	S, W

C. All Nests

	Number of Nests	Avg. Shrub Height	Avg. Height from Nest to Canopy	% of Live Canopy	Avg % of Nest Covered	Most Frequent Nest Opening Direction
2007	7	0.79	0.30	100.00	87.14	S
2008	30	0.80	0.26	66.00	78.00	S, W
2009	20	0.67	0.23	74.00	71.50	N, W
Combined	57	0.76	0.26	80.00	78.88	S, W

Movements During Egg Laying and Lay Rates

Sage grouse in Jackson lay up to 9 eggs/clutch and eggs are laid at a rate of 2 eggs/3 days (Schroeder et al. 1999), leading to a maximum of 13.5 days to lay an entire clutch. From our sample of hens with GPS transmitters, we could easily determine when the hen started localizing, and therefore laying.

From the sample of nests with known clutch sizes (determined after she left the nest, N = 6), we found that females laid an average of one egg every 1.17 days (Range = 1egg/d – 1egg/1.43d). Of the 11 hens with complete movement data prior to incubation, we found that hens localized for an average of 8.6d prior to incubation (SE = 0.7d, range = 5-14d) including re-nests. We found no difference in time localized between first and second nests (P = 0.394). We also calculated the size of the area used during egg laying using a 95% Kernel analysis and found a mean of 39.6ha (SE = 8.6, range = 10.6 - 101.8ha). We found no relationship between the number of days laying and home range size during that time (P = 0.855).

Winter Habitat Sampled in Summer

We sampled a total of 28 use points and 30 random points in the summer of 2008. Holloran and Anderson (2004) sampled a total of 52 use points and 76 random points from 1999-2003. For our data, there were no significant differences (P<0.05 for all) between diurnal and roost points so we combined them for the rest of the analyses. There were also no differences between males and females in use points so they too were combined for subsequent analyses.

When comparing use versus random points collected in the summer of 2008, there were significant differences in all characteristics except live sage density (plants/m^2) (P=0.24, W=726.0). Total shrub canopy cover was significantly taller at use points (P=0.00, t=6.34) as well as live sagebrush canopy cover (P=0.00, t=4.61). The average live sagebrush height at use points was also significantly taller than at random points (P=0.01, t=2.55). To summarize, areas used by sage grouse in winter had more canopy cover and taller sage plants than areas unused by sage grouse in the winter.

There were significant differences between the information that was collected in 2008 against the previous study in all characteristics with the exception of sage height (P=0.25, t=1.17). The total shrub canopy cover was significantly higher in the 2008 data (*P*=0.00, *t*=5.01) as well as the live sage canopy cover (*P*=0.00, *t*=4.64). Live sagebrush density was higher (*P*=0.01, *t*=-2.93) in the data collected in the previous study. Therefore the data outlining winter grouse habitat in 2004 showed areas with a higher density of sagebrush that was of similar height but less canopy cover than the data collected in 2008.

When we compared both studies random plots against each other, we found that the density recorded in the previous study was significantly higher than 2008 (*P*=0.006, *W*=774.5) but the sage canopy cover was significantly lower (*P*=0.003, *t*=3.08). Both sage height and total shrub canopy cover were not significantly different (*P*<0.05) between the studies.

Proximity of Grouse Nests to Raven Nests

We examined nest fate based on the distance of the grouse nest to the nearest raven nest to examine potential predation of grouse eggs by ravens. For this analysis we queried grouse nests that were located in our core raven study area in order to avoid inflated mean distances between nests due to undocumented raven nests. We found no significant differences for any year (2007-2009) and all years combined for the mean distance between sage grouse and raven nests (Table 11, $P \geq 0.05$).

Table 11. Summary of mean distance between sage grouse and raven nests.

	Number of nests	Avg. Distance to Raven Nest	Avg. Distance to Raven Nest-Failed	Avg. Distance to Raven Nest-Hatched
2007	11	1629	1561	1712
2008	27	895	834	960
2009	17	1169	1273	1052
Combined	55	1126	1121	1133

VHF and GPS transmitters

We tested the potential influence of GPS transmitters on the survival of sage grouse as well as nest success. From 2007-2009, we found a total of 15 nests from hens with GPS transmitters and 60 nests from hens with VHF transmitters. Using a chi-square test on the proportion of successful and failed nests, it appears that GPS transmitters may negatively influence nesting success ($P = 0.093$, $x^2 = 2.82$). Kaplan-Meyer survival estimates indicate that there is no difference in overall survivorship for grouse fitted with GPS transmitters (*P* = 0.388, Hazard Ratio = 1.42, 95% CI = 0.64-1.31; Figure 18). For only females, we similarly found no difference in survival rates between groups (*P* = 0.320, Hazard Ratio = 1.59, 95% CI = 0.64 – 4.0; Figure 19).

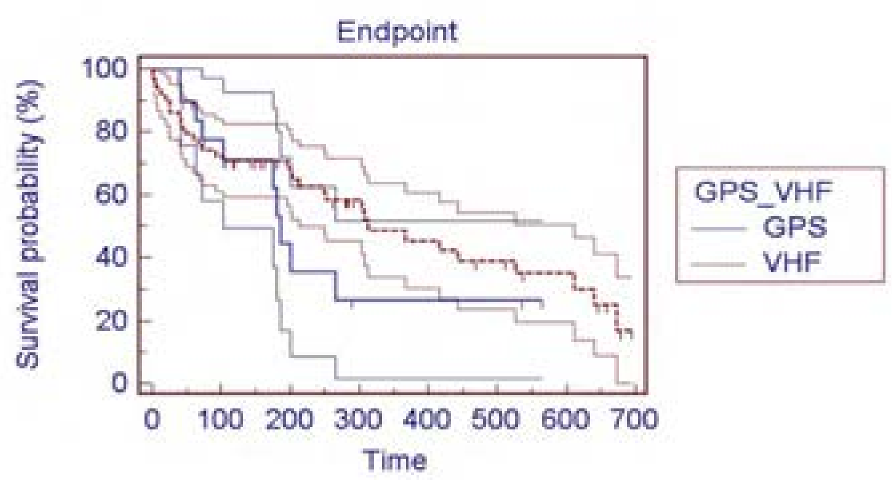

Figure 18. Kaplan-Meyer survival estimates for all sage grouse fitted with GPS and VHF transmitters with 95% CIs. Time = days after capture.

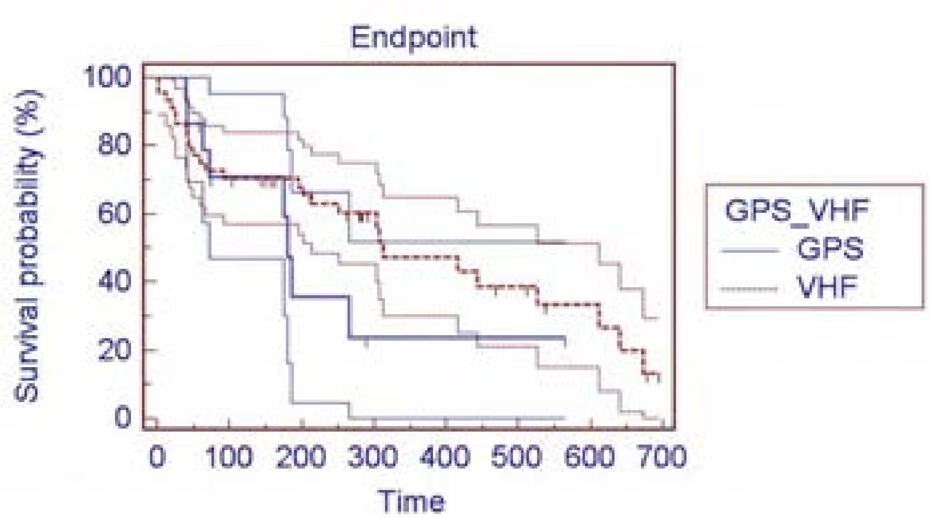

Figure 19. Kaplan-Meyer survival estimates for female sage grouse fitted with GPS and VHF transmitters with 95% CIs. Time = days after capture.

Survival

We were able to determine the cause of death for most outfitted birds (Table 12) using sign left around the carcasses and condition of the feathers and transmitters (e.g., bite marks). The most common cause of death for marked sage-grouse was predation by mammals, particularly coyotes. We also found that few mortalities occur in the late summer, fall, or early winter (Figure 19). There are high mortality rates of both females and males in the late winter and during lekking/nesting.

Table 12. Causes of death of marked sage-grouse in Jackson Hole, 2007-2009.

	Female	Male
Coyote	12	5
Unkn Mammal	13	6
Eagle	3	1
Great Horned Owl	1	0
Unkn Avian	7	0
Unknown	6	6
Yolk Peritonitis	1	0
Roadkill	1	0

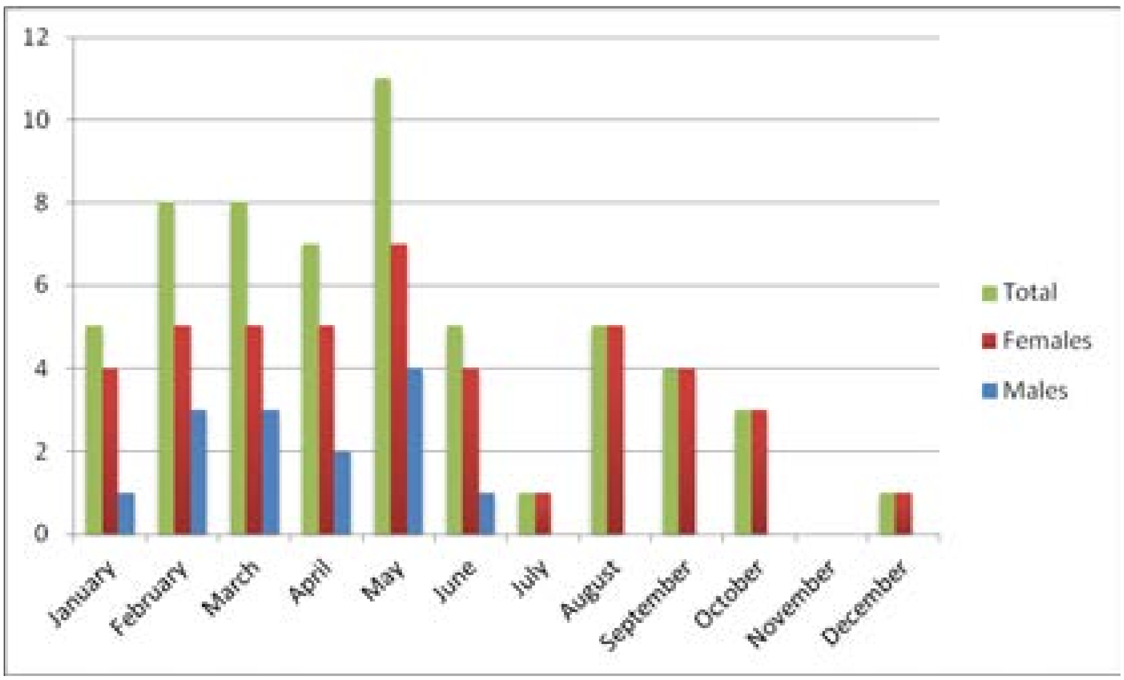

Figure 19. Frequency of mortalities by month from marked sage-grouse in Jackson Hole 2007-2009.

Habitat Loss

By our estimates, a maximum of 11,579 ha of sagebrush habitat existed in southern Jackson Hole pre-settlement (Figure 20). By 1945, 19% of winter habitat had been converted mainly to agricultural land. A total of 2,129 ha had been converted to agricultural lands, primarily west of Blacktail Butte (the Hayfields area), and 25 ha of sagebrush had been converted for the Jackson Hole Airport, leaving 9,425 ha of intact sagebrush (Figure 21). Most recently, we calculated a total of 6,674 ha sagebrush available to sage grouse (Figure 22). An estimated 20% of sagebrush habitat was lost since 1945 and 42% of habitat was lost from the maximum available sagebrush habitat pre-settlement. 1,145 ha have been lost since 1945 due to wildfire (south BTB, west BTB, Science School, and Kelly fires) and are recoverable. It will take at least until 2038 for these fires to have regenerated enough to support winter habitat (Baker 2006).

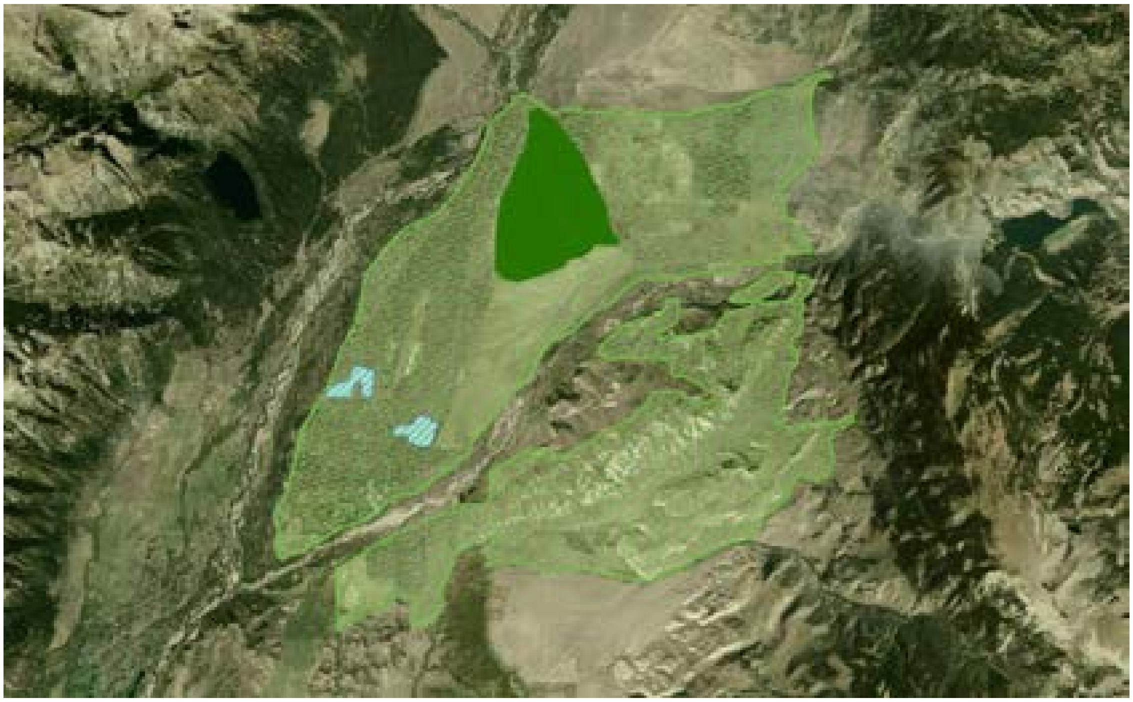

Figure 20. Estimated sagebrush habitat available to sage grouse in the southern half of Jackson Hole, pre-European settlement. Blue indicates wetlands and solid green indicates forested habitat.

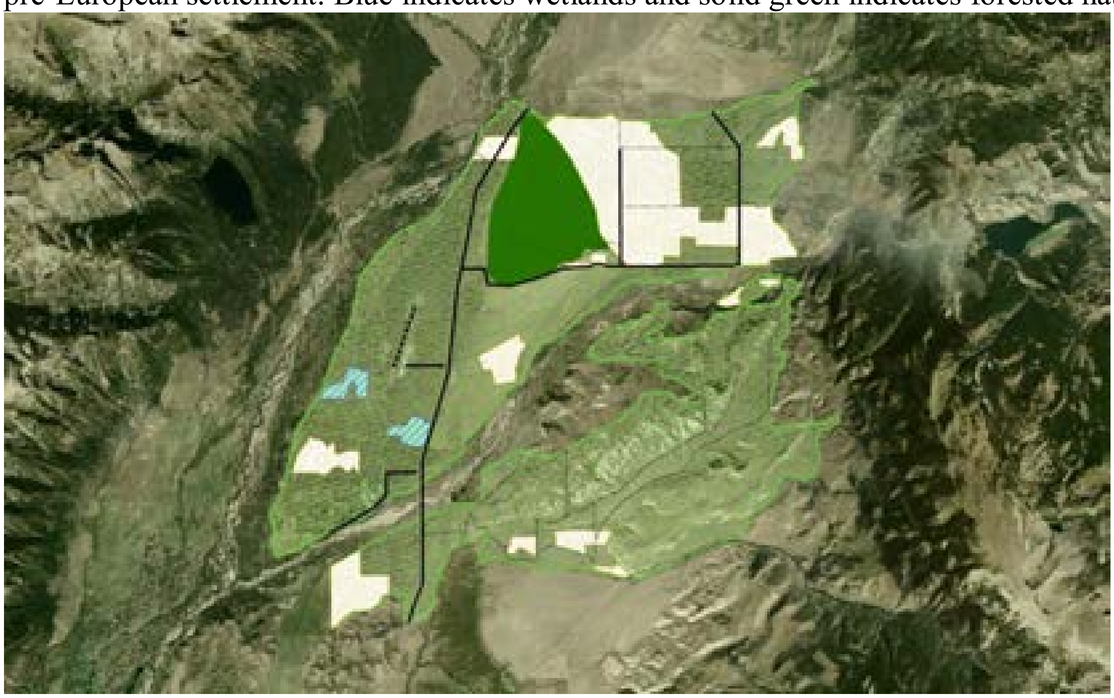

Figure 21. Estimated sagebrush habitat available to sage grouse in the southern half of Jackson Hole, 1945. Blue indicates wetlands, solid green indicates forested, white is agricultural lands (Bromus spp.), black are roads, and black hash is the Jackson Hole Airport. Digitized from 1945 aerial photographs.

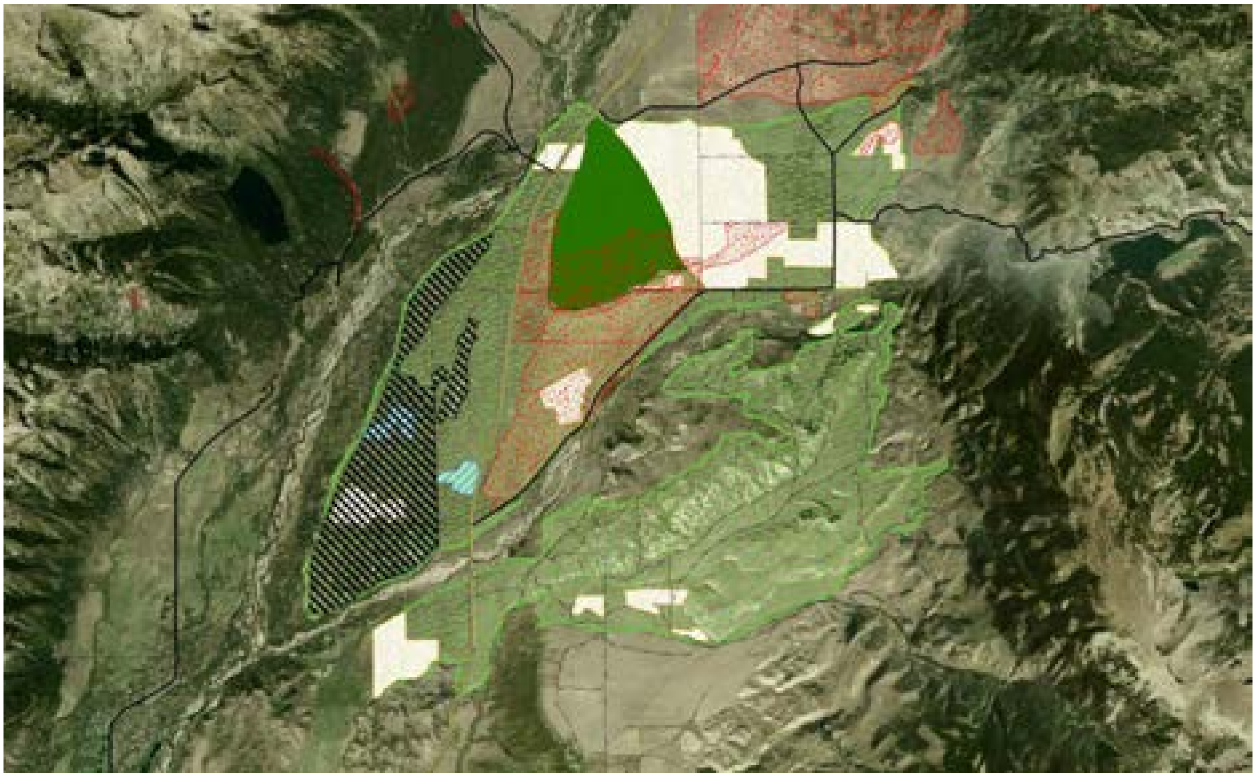

Figure 22. Estimated sagebrush habitat available to sage grouse in the southern half of Jackson Hole, 2009. Blue indicates wetlands, solid green indicates forested, white is agricultural lands (Bromus spp.), black are roads, black hash is the Jackson Hole Airport and urbanized neighborhoods, and red are recent wildfires (<20yrs). Digitized from 2009 aerial photographs.

Discussion

The sage grouse population in Jackson Hole has significantly declined from historical estimates, but appears to have been relatively stable over the past 15 years (Figures 9, 10). While estimates of population size based on leks counts over the long-term can be problematic, lek counts (particularly at Moulton and the Airport) may reflect population fluctuations in Jackson Hole. Changes to several areas of sage grouse ecology could be responsible for fluctuations that are not necessarily mutually exclusive. Nest success, mortality, longevity, and movements can all significantly alter population dynamics. Further, a host of influences (e.g., weather, predator populations, habitat quality) can alter each of these life history characteristics.

Lek Counts & Population Size

Understanding lek counts is challenging at best. There appears to be a temporal shift in lek counts across the valley. A large number of grouse (both male and female) begin to utilize the N Gap lek earliest and occupy leks to the north as the snow recedes. It is possible that the same male can be counted on as many as five leks during the same year, making the maximum male count unreliable. Slightly more robust is the average number of males/lek, but this measure is not free of association with inter-lek movements and can be strongly influenced if not all leks are surveyed. While we found an association with lek counts and the number of visitors in the Park, the cause of that association is not clear. Lek counts at the airport or combined airport and Moulton are not related to enplanements. This suggests that the number of visitors driving to the Park is causing these associations and there is likely little influence on strutting males by vehicles. However, a lower percentage of human presence on the landscape can have positive influences on many wildlife species since movements are likely influenced by human habitation. With increased human presence across the landscape, sage-grouse may avoid areas of disturbance or chronic human presence.

We found that in deep snow years a winter census of the population can be very effective to monitor overall population size. Coupling knowledge of winter habitat with radio-marked birds was very effective at finding virtually all the birds in the valley. The census requires at least 15-20 volunteers and a very coordinated effort, but the grouping behavior of the grouse, finding tracks, and limited search area made for valuable data collection. We were able to confirm the utility of this technique by using our nest success and survival rate data to correlate the winter census count and traditional population estimates using lek count data. We suggest conducting the winter census when conditions are favorable to augment lek count data. In years when snow depths are not conducive to surveys, traditional population estimation techniques are more adequate for this population.

There still appears to be one missing lek in Jackson Hole. Likely, this lek occurs in Spread Creek or Elk Ranch area where males have been seen strutting on several occasions but not consistently. Increased ground surveys coupled with several aerial flights may help find this lek. Both the Timbered Island and RKO leks move over the course of the spring as a result of snowmelt. Similarly, the males at the Airport lek begin strutting on the bench above the NPS gun range but move to the overrun as soon as it is snow free. This staging area above the NPS gun range is not a satellite lek. All marked males began at this location only to move to the airport and no activity was observed at the gun range after the start of lekking at the Airport. We witnessed the re-colonization of a historic lek, Bark Corral. While conjecture only, it appears that the decrease in the number of males at the Airport lek may be inversely related to an increase of males at Bark Corral. Future studies on inter-lek movements will help elucidate this relationship, if any.

Both the Airport and Bark Corral leks appear to have a disproportionate number of females attending these sites. Our re-location data from both males and females indicates use of multiple leks by both sexes. Most notably, several females captured at the Moulton lek were observed mating and/or nesting at the Airport. Given the low number of males present at the Airport lek, the high number of females observed utilizing this lek suggests a disproportionate importance for this lek. This may be due to the loss of habitat south of Blacktail Butte or the importance of winter habitat south of the airport. Both nesting and winter habitat were lost with the BTB fire in 2002. Many of the sage grouse that used this area were forced into habitat nearer the Airport which may have led to increased density of nesting attempts in that area. With the increases in disturbance at the Airport, males may have a difficult time getting accustomed to the disturbance which may result in the decreasing numbers observed at this lek in recent years. Female presence is not as affected by disturbances since they only attend leks for 1-3 days. However, with a decrease in mate selection, females may eventually seek alternate leks, which may account for the reformation of the Bark Corral lek.

There is a large amount of breeding habitat west of Blacktail Butte and south of the airport and few strutting males associated with these females. It appears that the N Gap lek is not a major lek for breeding. In all of the three years surveyed, we only documented two breeding events and less than five males occupy this lek throughout each breeding season. There are a large number of females and males associated with this lek early in the season, but there is little breeding activity. During this time, most of the birds are focused on feeding on the exposed soil in the area. Laboratory tests of this soil revealed high amounts of calcium relative to other samples. Of note, there was another area where we observed grouse feeding on soil in the early spring (Kelly dump) and tests showed similarly high levels of calcium, suggesting the grouse are actively seeking areas with this mineral concentration prior to egg formation.

The overall population size of sage-grouse in Jackson appears to mirror the statewide trend for the average males/lek, indicating a landscape level influence on population trends. The most obvious landscape variable that influences population fluctuations are weather related (e.g., moisture, drought).

Nest Success& Survival

The nest success rates we found for the Jackson Hole population of sage-grouse fall within the normal range for Wyoming (29-71% success; Connelly et al. 2010) and similar to Holloran and Andersen (2004). We found variable nest success across years but found that the average annual success of females (both first and second nesting attempt) was on the higher end of recorded success, indicating that nesting success is not a limiting factor for this population. This conclusion is further supported by our study and Bui et al. 2010, in which we found that nest predation by a very high population of breeding Common Ravens does not affect nest success. Similar to other studies, we found that yearling nesting success was significantly less than adults.

We found the majority of nest failures were due to predation. Mammalian predation accounted for 60% of the total nest failures and we suspected roughly half of those due to both coyotes and badgers, but also found evidence to suggest predation by foxes. Determining nest predators was difficult but identification was improved by the rapid response time of the field crew after a predation event (typically 1-2 days) and by hair analysis from the Wyoming Game and Fish Forensics Laboratory in Laramie. Avian predation was suspected to be by Common Ravens.

We found that the distance between re-nests of the same female were greater between first and second nests within the same year than between nests in successive years. Further, hens tended to nest closer to a successful nest site from the previous year than a failed nest from the previous year, indicated they may be selecting for preferred nesting areas that were proven successful.

We found a much higher percentage of females initiating nesting than most other studies in Wyoming (Connelly et al. 2010). This could be due to several factors but it is likely due to the intensity of monitoring. We tracked hens every 2-3 days during the nesting period and easily determined when a hen was localizing for nesting. Approximately 12 GPS locations/day enabled us to precisely determine when a hen had localized to nest and also if she abandoned nesting because of an egg predation event. We found extreme variability in brood survival to 30 d post-hatch between years. In 2008, we found 63% brood survival and 25% in 2009. Holloran and Andersen similarly found only 20% brood survival (9 of 45). We found no difference in the average brood count at 30 d post-hatch of broods that survived. We found that post-fledging juveniles have a slightly lower survival rate than adults, and that adults have a roughly 40% survival rate after being outfitted with a transmitter. We found no evidence that transmitter type (GPS of VHF) influenced survival of any age group, gender, or combined. However, more data needs to be collected on potential influences of GPS transmitters on nest success.

We found no influences of site specific nesting habitat selection for successful or failed nests, nor did proximity to Common Raven nests have an effect on success. It is our conclusion that nesting success and productivity is not a major limiting factor in the Jackson Hole population of sage-grouse at this time. However, chick survivorship and over-winter survival may be important factors in securing the viability of this population. One of the most vulnerable times for juvenile and adult survival is during the early spring period. During this time (late-Feb – March), the ambient temperatures rise enough to make a hard crust on the snow which greatly improves mammalian predator mobility. In all years, we documented significant mortality during this time. Further studies on chick survivorship in different areas of Jackson Hole may provide more insight into this life-history trait. We attempted more in-depth chick mortality studies but had difficulties with capturing chicks after they hatched and aborted this objective (Appendix C).

Habitat

There has been significant cumulative habitat loss in Jackson Hole in the past 60 years. There have been both permanent and temporary losses through habitat conversion (e.g., urbanization and agriculture) and wildlife. Our studies of winter habitat selection (Appendix B) indicated that very little habitat exists that can support this population in high snow-depth years. All of the grouse from west of the Snake and north of Antelope flats are funneled into the sections in the southern half of the valley in the winter. As winter progresses they are restricted to smaller areas of exposed sagebrush.

Grand Teton National Park and the National Elk Refuge should make all efforts possible to conserve all remaining winter sagebrush habitat while promoting growth and restoring lost habitat (e.g., hayfields). Important areas to protect include the airport area, hayfields area, warm springs and Long Hollow.

Management Recommendations

We conclude that the one of the main factors limiting this population is sagebrush habitat loss, particularly winter range. It is critical to conserve the remaining winter habitat patches while promoting other patches to mature into good winter habitat. Particularly, Grand Teton National Park should manage Spread Creek, Wolff Ridge and Uhl Hill in the north, north hayfields, airport and warm springs area in the south, and the National Elk Refuge should manage Long Hollow and the surrounding hills for large, mature sagebrush. Burning, irrigation and other activities that remove sagebrush should be avioded in these areas to maintain healthy sage-grouse populations in the valley.

One major threat to the viability of this population is also the activity at the Jackson Hole Airport. Any disturbance activities should be minimized during the lekking season (late Feb – June). This lek hosts a disproportionate amount of females for the number of males strutting there, indicating the importance of this lek to breeding females. Sage-grouse mortality from airplane strikes likely is not cause for population level effect concerns but can be minimized by adjusting flight times away from dawn and dusk.

Brood and winter mortality may play an important role in the current population level. While removal of predators typically does not increase breeding bird populations (Angelstam 1986, Cote and Sutherland 1997), we suggest limiting the growth of invasive predators, particularly foxes and potentially raccoons. There is a growing population of foxes in the southern half of the valley, mainly around the airport area. Feeding foxes by local residents must be stopped through proper education. Removal foxes in this area may improve sage-grouse survival in that area. However, if such measures are taken, it is critical to scientifically document any potential effects. It is also possible that the fire south of Blacktail Butte in 2002 also forced a large number of female sage-grouse to nest in the closest suitable habitat; south of the airport. By creating a patch of habitat with a larger than normal percentage of females/ha, the influence of anthropogenically subsidized mammalian predators, such as foxes, may be exacerbated. We recommend promoting nesting habitat in the area south of Blacktail Butte altered by fire.

The monitoring of leks should be continued annually. In addition to monitoring known leks, new leks also need to be searched for, annually. Lek should be monitored three times/week during peak season and twice otherwise. Leks should be monitored simultaneously to account for any inter-lek movements of males. We also suggest continuing winter censuses in years with adequate snowfall and volunteers. We suggest periodically studying the population of sage-grouse in Jackson Hole using GPS transmitters to document changes in habitat use, home ranges, nesting success and mortality. These studies should not be continuous or done so often or intensively as to potentially affect the population. We suggest a two or three-year study initiated every 10 years unless significant changes are detected via lek surveys.

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ADDITIONAL STUDIES

R. C. Crandall, B.E Bedrosian, and D.J. Craighead. 2010. Critical Winter Habitat Characteristics of Greater Sage-grouse in a High Altitude Environment. *In* Jackson Hole Sage-grouse Project Completion Report 2007-2009.Craighead Beringia South, P.O. box 147, Kelly, WY 83011.

Abstract:
We investigated critical winter habitat selection of a montane, isolated population of greater sage-grouse (*Centrocercus urophasianus*) during two above-average snow depth years, 2008 and 2009. With the aid of satellite GPS transmitters, we measured the habitat at 51 critical winter locations utilized by female sage-grouse. By measuring site and habitat characteristics within 0.004ha surrounding use points during the most critical winter time period (15 Jan – 25 Feb; as determined by maximum snow depths), we found that this population utilizes extremely marginal winter habitat based on recommendations for this species. Sage-grouse in our study area wintered in habitat with an average sagebrush canopy cover of 1.4% and average sagebrush height above snow of 14.3 cm. When we compared use locations with random locations to determine potential winter habitat selection, we found use sites had significantly more vegetation structure than random sites for all characteristics measured; sagebrush height above snow, density, crown cover, and cover index (density x height). Conversely, we found no difference between use and random locations for any site characteristic; snow depth, slope and aspect, suggesting that vegetative structure was the force behind winter habitat selection. We did find that use points in 2008 had significantly less exposed sagebrush than use points in 2009, likely a result of greater snowfall in 2008. Lastly, we detected no difference between diurnal and roost locations for any vegetative or site characteristic parameters measured. Our results indicate that sage-grouse can and do occupy extremely marginal winter habitat and it is likely a drive force limiting sage-grouse carry capacity in this high altitude environment. Therefore, we suggest that management practices in similar high altitude environments reflect conservation and protection of the existing winter habitat while promoting large, mature stands of sagebrush to help increase local sage-grouse populations.

ON-GOING STUDIES

Inter-Population Genetic Analysis

1. Genetic isolation, dispersal, connectivity, and population viability of Jackson Hole – PhD student Sarah Shulwitz, under direction of Dr. Jeff Johnson at the University of North Texas, is analyzing samples collected by CBS. Samples were collected from Jackson Hole, Gros Ventre, Pinedale, INEL in Idaho, Cody, Wind River Reservation, Kemmerer, and Central WY This study will assess the potential genetic isolation of the Jackson Hole and Gros Vente populations and will be able to determine the extent to which individuals migrate in and out of these

populations. Further, we will be able to document the direction of dispersal and determine source and sink populations. We will be working in collaboration with Dr. Jeff Johnson at the University of North Texas, who has been a pioneer in Prairie Chicken and Sage Grouse genetic research. Expected completion in 2013.

2. Genetic population analysis of the Pinedale sage-grouse population - PhD student Sarah Shulwitz, under direction of Dr. Jeff Johnson at the University of North Texas, is analyzing samples collected by Rusty Kaiser and Matt Holloran of sage-grouse in the Pinedale Region. Expected completion in 2013.

Critical Habitat Modeling

Habitat modeling project to produce probabilistic maps of sage-grouse space-use, and a proxy for fitness, for Jackson Hole and the Gros Ventre. By statistically relating our detailed demographic data to landscape scale variables, this project will produce sage-grouse habitat response models that can provide a visual illustration of how sage-grouse habitat preference and survival interact across the landscape. This will help identify the key factors that define sage-grouse habitat quality. – MS student Trapper Haynam will be working with Dr. Bob Crabtree at the University of Montana. Expected completion in 2013.

Other ongoing work:

1. Sage-grouse movements in Bondurant – Started in 2010, we are tracking one hen via GPS and anticipate outfitting several more if funding is available. Expected Completion 2012.

APPENDIX 2.

SAGE-GROUSE BASELINE SURVEY AND INVENTORY AT THE JACKSON HOLE AIRPORT

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Citation: Bedrosian, B. and S. Walker. 2010. Sage-grouse baseline survey and inventory at the Jackson Hole Airport. Completion Report. Craighead Beringia South, Kelly, WY

General Purpose:

There is an increasing demand on the Jackson Hole Airport (JHA) to accommodate increasing visitor use of the valley and surrounding areas. As such, there are inevitable changes that will occur to the JHA in the coming years including increased air traffic, vehicle traffic, and overall anthropogenic use that could affect the natural resources in and around the JHA. Specifically, the JHA is home to one of the valley's most important leks (i.e., breeding grounds) of the Greater Sage-grouse (*Centrocercus uropasianus*), which is currently a candidate for federal endangered species status. It is important to understand the current sage-grouse use patterns and habitat quality at the JHA in the event significant changes occur in the future. Without baseline data on the current status of grouse and the JHA, it will be difficult to interpret how changes to the JHA affect the sage-grouse in Jackson Hole. We quantitatively documented the current lekking behaviors and habitats available within the JHA during 2009. This study was not designed to assess the current influences the JHA has on sage grouse, but rather provide a base for future studies in the event changes (habitat or disturbance rates) occur within the JHA.

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Introduction:

There is currently a negative population trend for Greater Sage-grouse (*Centrocercus uropasianus*) in the Jackson Hole mountain valley of northwestern Wyoming (Holloran and Anderson 2004). While the current data indicates that the population has remained relatively stable for the past ten years, there has been a 50% decline of the population since 1950, indicating the population may be at risk for extirpation (Grand Teton National Park, unpubl. data). One of the ecologically most important leks and core sage grouse nesting and winter habitats occur in and around the JHA. The Upper Snake River Basin Working Group (USRBWG) suggests that "the single most important infrastructure feature in core sage grouse habitat in the Upper Snake River Basin Conservation Area is the existence and potential for expansion of the Jackson Hole Airport" (Bohne et al. 2008).

The lek at the JHA has historically been one of the valley's largest leks and has been active since at least the 1940's (Patterson 1956). Currently, the airport lek which is located at the north end of the Jackson Hole Airport's only runway in the grassy "over-run" area consists of roughly 10-15 males (unpubl. data) and associated females.. The grouse that utilize this lek are frequently subject to disturbances such as airplanes landing and taking off and being hazed by vehicles.

Past studies indicate that some anthropogenic disturbances, such as gas field surface activity and roadways negatively affect grouse populations (Lyon and Anderson 2003, Holloran 2005, Holloran et al. 2007, Dougherty et al. 2008). Natural predators have caused cessation of display activity, flight, and/or abandonment of leks for multiple days (Hartzler 1974, Bradbury et al. 1989). Several studies have found that an acoustic part of the male's display plays a significant role in attracting mates (Gibson and Bradbury et al. 1989, Gibson 1989, Dantzker 1999) and males may even choose lekking sites based on their acoustic abilities (Connelly et al. 2000). Therefore, noise disturbance is likely to affect lekking grouse. Braun et al. (2002) found that sage grouse attendance at leks within a mile of coal bed methane compressor stations in Wyoming was consistently lower than control (non-disturbed) sites. Holloran and Anderson (2005) also found lek activity decreased downwind of drilling activities. Braun (2006) suggests that all drilling stations be prohibited within 5.5 km of active leks and that compressor stations should have mufflers to reduce noise heard within 5.5 km of leks. Further, he suggests that *all* surface activity should be prohibited and roads present within 5.5 km should be seasonally closed during the sage-grouse breeding season (March-June).

The Jackson Hole Airport poses an anomaly to current disturbance impacts and grouse research. Not only is there an active airplane runway within yards of an active lek, airplane traffic is present throughout the breeding season and there are daily enplanements during prominent breeding hours. While the lek has not been abandoned as suggested by other research, it has experienced a decline in maximum male counts compared to historical numbers. However, it is unclear if this trend is due to overall population declines in the valley or increased disturbance at the lek.

Given that enplanements and other disturbance factors will likely increase over time at the JHA and associated lek, we described the current behaviors and available habitats so future studies can better understand direct effects of increased human activities on sage grouse in and around the JHA. Specifically, we documented strutting behaviors and breeding events during, pre- and post-enplanements, male placement over the breeding season and display rates. We also documented breeding display behavior as it relates to snow conditions and quantify available habitats within the airport perimeter.

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.

METHODS

BREEDING

Lek Observations

Daily observations of the lek were made from vehicles parked ca. 200 m from the lek center typically by one observer from the day the first males arrived on the lek until one week after no male grouse arrived. Grand Teton National Park (GTNP) lek count protocols were followed to determine lek attendance rates of both males and females. Following those protocols, the observers arrived at the lek at civil twilight and counted both male and female sage grouse every 15 minutes. In addition, the placement of each male and female was mapped on aerial photographs of the JHA every fifteen minutes. Males were mapped without regard to individual identity due to difficulty in recognizing individuals and extreme variation in movements. Matings were also documented and mapped opportunistically. We documented the percentage of males strutting during each 15-min lek count. This was the percentage of males displaying within a roughly 30-60 sec time period every 15 min. When analyzing the data, we restricted the analysis dealing with the percentage of males strutting to the first influx of females to the lek (18-30 April).

We mapped the snow free areas on the over-run from 3/24 to 4/20 on a regular basis using aerial photographs of the lek. These maps were then digitized into ArcMap 9.3. The area of the snow-free sections was then calculated using Hawth's tools. We predicted the snow free area of days not mapped by assuming a constant rate of melt between days. We used a linear regression to test for a relationship between snow melt and male attendance.

We gathered weather data from the Moose, WY weather station for the duration of the study to correlate to variables such as male and female attendance and strut rates. We first tested for correlations among weather variables and then used a best subsets regression using non-correlated variables to predict male and female attendance, excluding models with >2 variables.

We tested for relationships between the total percentage of males strutting with factors such as time after first light, time after first female arrival, and the percentage of females present using regression analysis. We also tested the difference in percentage of males strutting on days when females were present with days when no females attended the lek using t-tests.

Utilization Distributions and Territory Mapping

We placed numbered, small wooden stakes in a grid on the lek to help facilitate territory mapping. All males present in a given day were mapped on aerial photographs every 15 min. Displaying males were differentiated to help determine territory placement and boundaries. All males, regardless of display, were also marked to help map overall land use in the JHA by lekking males. Wing fights were also mapped, assuming these fights likely took place at/near territory boundaries. Locations of females were also noted, as they likely influenced the rates of wing fights and male placement. These mapping placements were later digitized in ArcGIS 9.3 to help facilitate delineating territory boundaries and lek use.

The utilization distribution (UD) of the males and females on the lek were calculated using kernel analysis from Hawth's Tools in ArcMap 9.3. All UDs were calculated with a smoothing factor of 10 and a cell size of 1 to obtain enough precision for the small area of the lek. We calculated the UD of all male locations (mapped every 15 minutes every day) to obtain the total area used during the main two months of April and May and for the total observation period (Mar – Jun). We further divided the UDs from the males into days when females were present and when they were absent to see if female attendance shifted the UD of the males. In addition to this, we calculated the UD of all female locations from April-May to visualize female use of the lek site. We tested the male UDs from days of female presence and absence using paired t-tests on the areas of each kernel percentage (5-65%).

The male territory locations were approximated using a point density analysis in the Spatial Analyst package in ArcMap. By weighting each male location relative to the nearest other male location on days when females were not present, the pattern of territory use can be explored. We documented male locations every 15 min but did not record each individual's identity. If a male was prone to display at his territory center, his locations would have a greater weight the more time he spent at that center and therefore creating a density dependant distribution based on territory placement. We used point density analysis for days prior to female arrival to determine initial territory establishment and again during the peak lekking season using days when females were not present due to perceived territory "breakdown" when females were present.

Disturbance Observations

We documented the type, duration, and general effect of the lek of any potential disturbance for the duration of the lekking season. To determine the potential effects of anthropogenic disturbances on the strutting behavior of males, we performed focal observations of random males from 1 May – 23 May. Focal observations were made mainly with the aid of video recordings that were later analyzed to determine the strut rate (pops/minute; as defined by Wiley 1973) for a 60 minute time period, beginning ca. 20 min after civil twilight. Proximity of females and males, aggressive interactions, any matings, and movements of the focus male were also recorded.

To determine the accuracy of using an average strut rate over a male's full 60 minutes, we correlated this average strut rate (number of struts/full observation time) with the number of minutes displaying/full observation time (percent time) and the number of struts/min during continuous strutting (not including zero values). We compared the strut rate of a focal male in the 5 min prior to a disturbance to 5 min post-disturbance using paired t-tests. Further, a single factor ANOVA was used to compare strut rate 5 minutes prior to a disturbance (# struts/5min), strut rate through the full length of a disturbance (# struts/n min), and 5 minutes after a disturbance (# struts/5min). We also used an individual's strut rate to examine for correlations between a male's display activity and other environmental factors on that same day. We tested strut rate for correlations with variables such as female attendance, weather and date using a regression analysis and used paired t-tests to compare the differences in strut rates due to female attendance.

VEGETATION MAPPING

Locations for vegetation sampling were chosen in a stratified, non-random design. We first delineated usable habitat (i.e., not paved or built upon) in ArcGIS 9.3 and then chose sampling locations roughly equidistant and in all habitat patches. We purposefully chose locations in most over-run sections due to previous observations of grouse in these areas in addition to the lek site and surrounding sage-steppe habitat.

At the pre-defined sampling points, we measured vegetation along two 30-m perpendicular line transects following Canfield (1941) and Holloran and Anderson (2004). The point center was located using hand-held GPS devices (Garmin) and permanently marked using a short (ca. 30-cm) piece of rebar with orange flagging to facilitate finding these location centers for subsequent studies. Using the line-intercept method, we estimated the total shrub canopy cover, sagebrush canopy cover, percent of live sagebrush, and percent dead sagebrush. We also measured maximum height (excluding flowering stalks), average canopy breadth, and species of each shrub encountered. Typically, these measurements did not apply to overrun plots, as they were devoid of shrubs.

To measure forbs and herbaceous vegetation at all sites, we used the Daubenmire (1959) methodology. We used a 20 x 50 cm quadrant to measure total herbaceous cover, bare ground, litter, residual grass cover, and forb cover at the plot center and 1.0 and 2.5 m on each transect. We identified all forbs to species and classified sage grouse food forbs based on Patterson (1952), Peterson (1970), Wallestad et al. (1975), and Barnett and Crawford (1994). We assessed food forbs based on information from Holloran (pers. comm.). We obtained a measure of forb diversity by calculating the average number of species in all Daubenmire quadrats within the plot. Following Holloran and Anderson (2004), we converted the Daubenmire (1959) categorical estimates into percentages for each of the 12 quadrates per plot and averaged the height and cover estimates to obtain single variable estimates for each plot.

We first investigated for potential differences between vegetation parameters measured using the line-intercept method among plots (excluding overrun plots) using ANOVA tests. We then tested for differences among all plots and between overrun and non-overrun plots for forb diversity and measures of understory as found using the Daubenmire method. We compared the non-overrun plots to vegetation plots measured at nest and brood rearing locations in the southern half of Jackson Hole as described by Holloran and Anderson (2004) using t-tests.

RESULTS

BREEDING

We began checking for male attendance March 11th and the date of 1st arrival was on the 13th (2 males). After the 13th of March, no males arrived until March 23rd at which point they attended the lek continuously. We attended the JHA lek daily from March 23rd through June 28th, for a total of 93 consecutive observation days (Figure 1). From March 23rd through April 13th, 1-2 males were consistently present on the hillside east of the airport pit. During this time, the snowpack covered the overrun section of the airport (Figure 2). In total, we counted a maximum of 10 males and 17 females for the season (Figure 1).

We attempted to correlate maximum male and female daily counts with a host of climatic information. Daily weather data was collected from the USGS Moose, WY weather station since the airport weather station did not record precipitation. We tested the following weather measurements with grouse numbers: date, minimum daily temperature (assuming this is indicative of early morning temperatures), maximum and minimum dew points, maximum and minimum humidity, minimum and maximum pressure, maximum wind speed, total precipitation, and a cloud cover index (0-8 scale). Using a best subsets regression, we found that the best model used minimum temperature and minimum dew point as predictors. The number of males can be predicted using the equation Max males = 1.04 + 0.311 Min Temperature - 0.201 Min Dewpoint ($P = 0.000$, $F = 14.37$, $r^2_{adj} = 24.1$). We found no such relationships for female attendance.

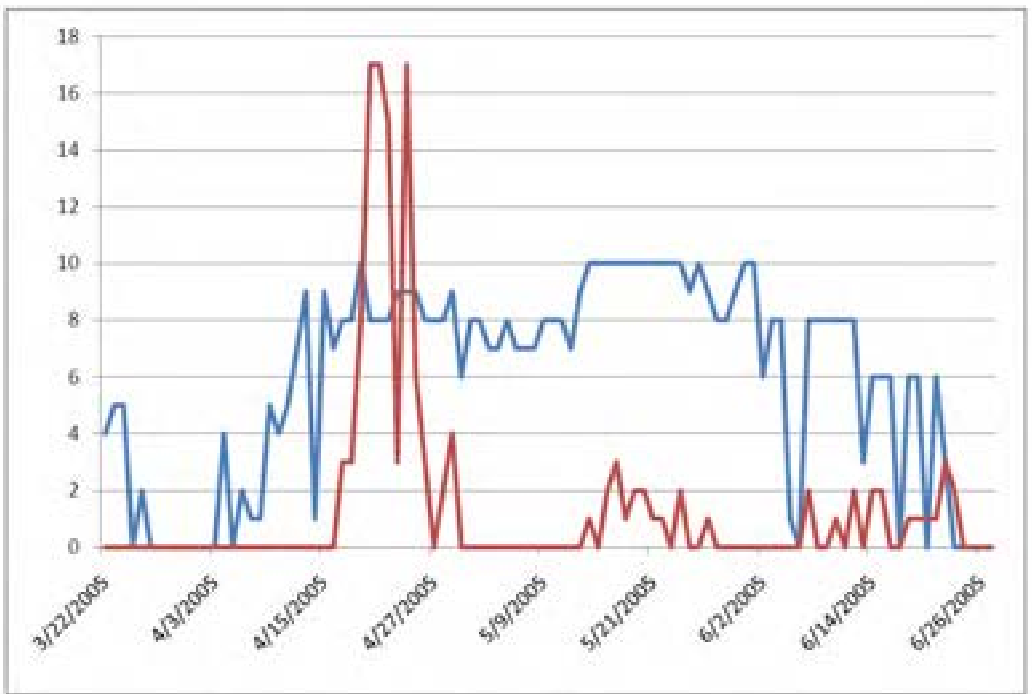

Figure 1. Male and female lek attendance at the Jackson Hole Airport, 2009

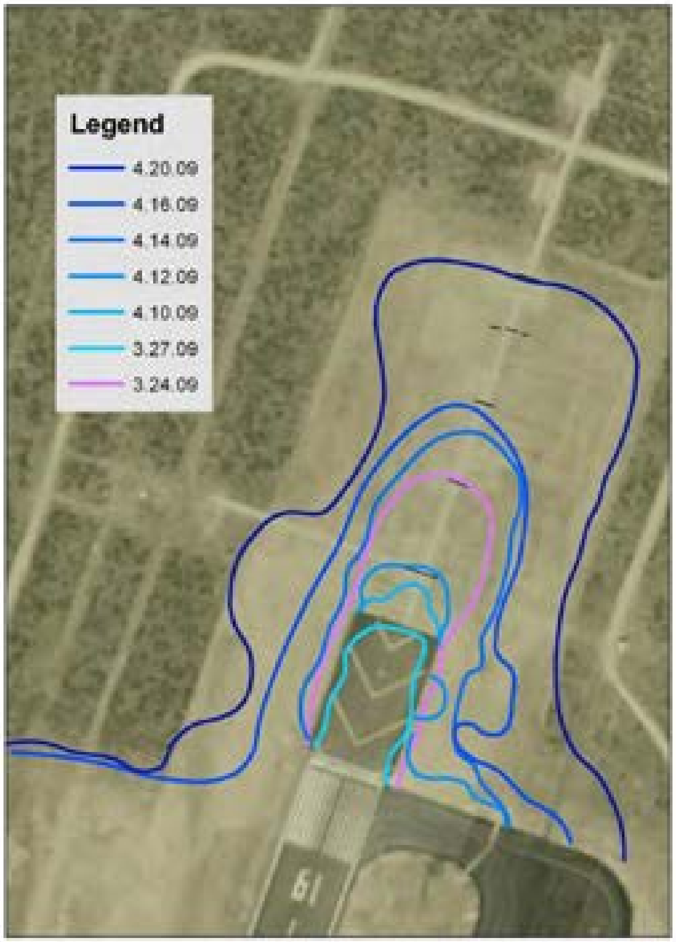

Figure 2. Snowpack regression during the 2009 lekking season.
Note that the snow-free area in pink (3.24.09) became snow covered again after heavy snowfall on 3.25.09

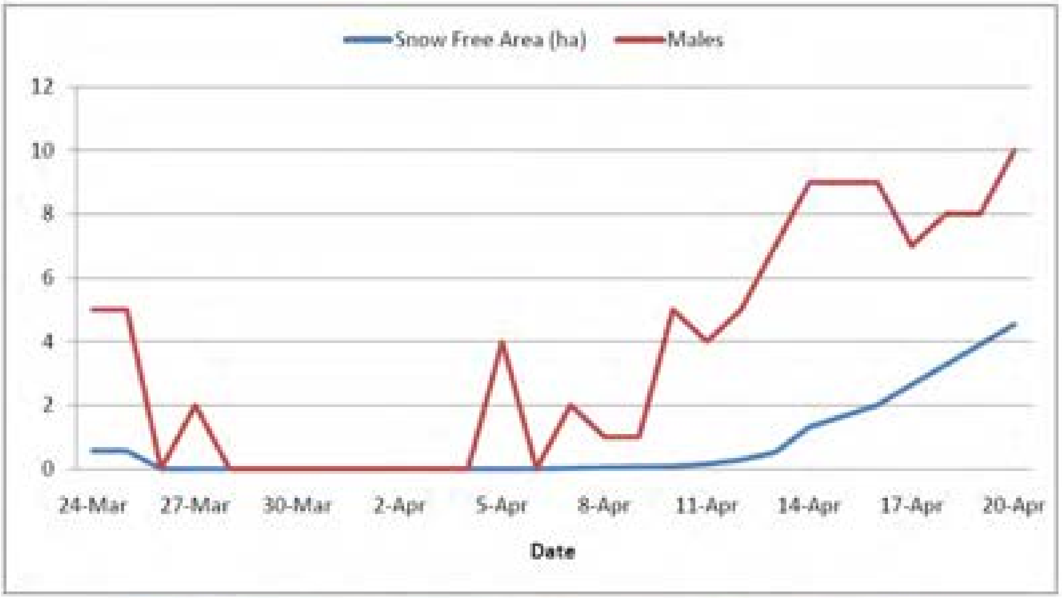

Figure 3. Positive relationship between the snow-free area on the lek and male attendance

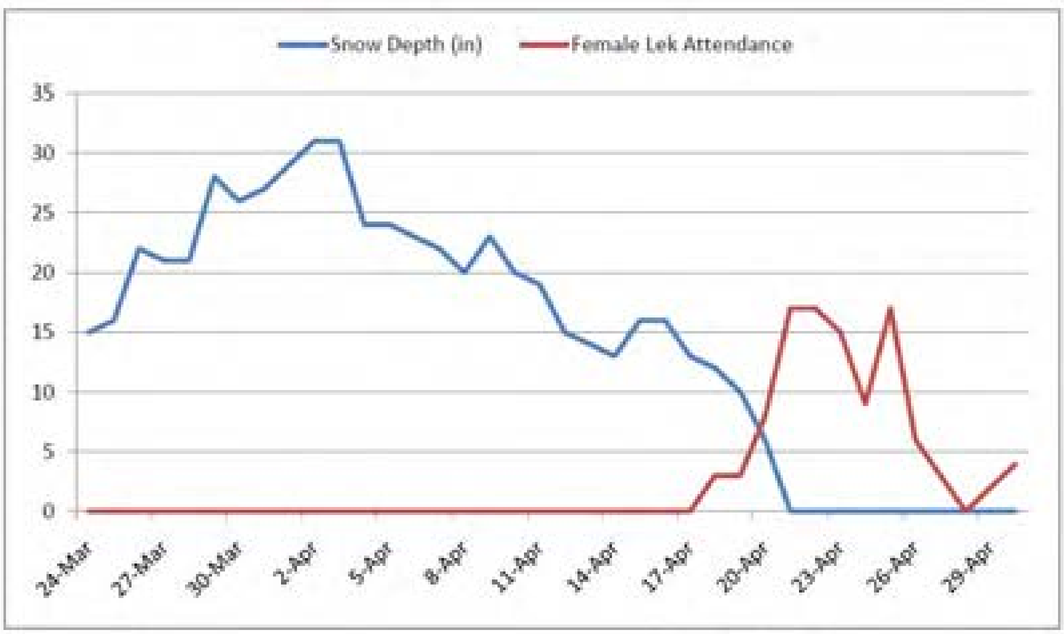

Figure 4. Negative relationship between snow depth (as measured at Moose, WY) and female lek attendance

We found that male attendance during the beginning of the lekking season (3/24 – 4/20) could be predicted by the amount of snow-free area on the over-run ($p < 0.01$, $r^2_{adj} = 58.9$, $F = 39.65$; Figure 3). Females did not start attending the lek until there were at least 3 ha of snow-free area on the overrun. Not surprisingly, the first females arrived at the lek 3 days prior to the Moose weather station recording 0.0 in of snow (Figure 4).

We found that the percentage of males strutting was inversely related to how long females were on the lek ($P < 0.001$, $r^2_{adj} = 28.3$, $F = 27.5$; fig 5). Further, we found a positive relationship between the percentage of males strutting and the percentage of female daily attendance rate ($P = 0.001$, $r^2_{adj} = 14.7$, $F = 12.55$). However, the relationship of male strutting with female attendance in the presence of time (multiple regression) is confounded by the fact that the female attendance is also inversely correlated to time. To account for this, we tested the percentage of males strutting with the time after the arrival of the hens on the lek using an ANOVA test and found that the percentage of males strutting decreased as the time after first hen arrival increased ($P = 0.006$, $F = 3.45$; fig 6). Excluding the lek counts in which no males were strutting, we calculated the average daily proportion of strutting males. Using a t-test, we found that the daily average proportion of strutting males was greater on days that females attended the lek ($P < 0.001$, $t = -6.14$, $df = 28$). The mean daily proportion of strutting males on days that females were present was 68% as compared to 36% when females were absent.

When possible, we recorded the direction the grouse exited the lek. This was most often by foraging and walking, but sometimes included flying off the lek. From the days recorded ($n = 56$), we found that the northern directions (N, NE and NW) accounted for 84% of the total movements away from the lek (fig 7). Only twice were the grouse observed to have moved in a manner from the lek that may have had the potential for airplane conflicts. These two observations were both made in the first three days the males first began attending the lek (March 24-25) and during a time in which no areas were snow free except for the paved areas of the JHA.

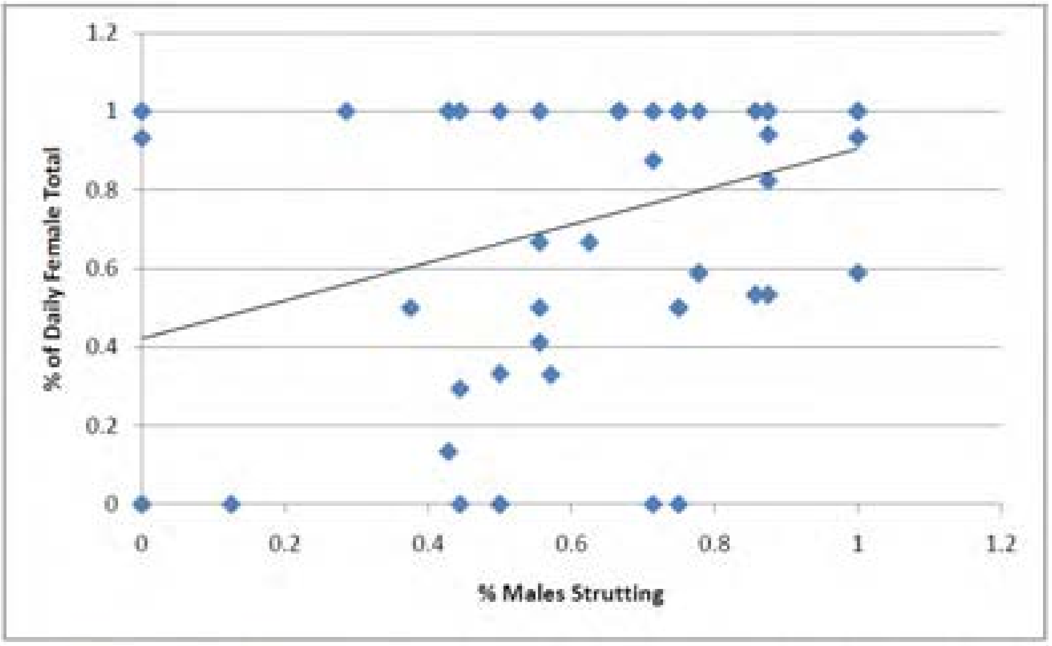

Figure 5. Significant positive relationship between the total percentage of males strutting and the percentage of total females present on the same day.

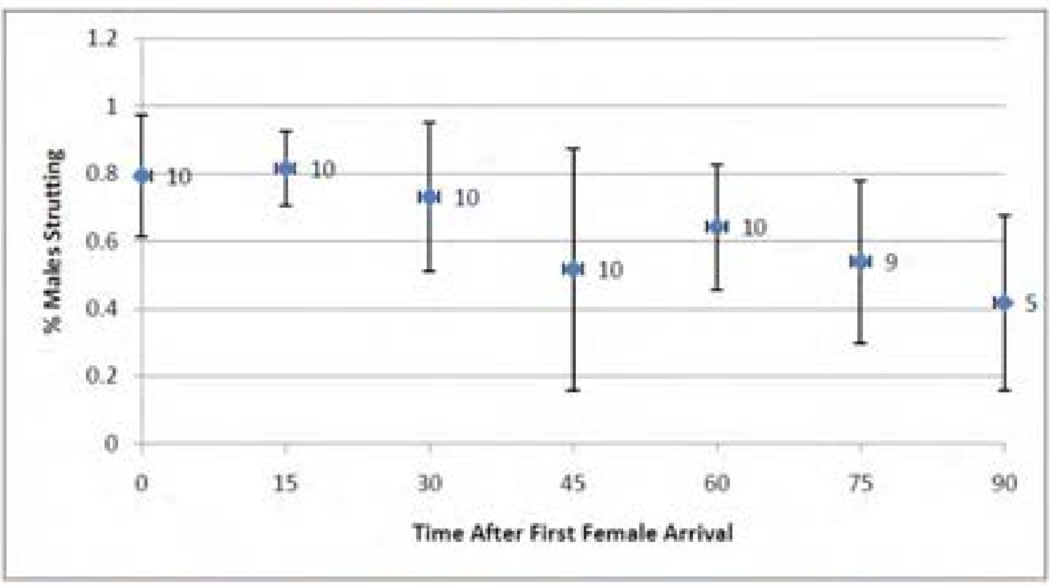

Figure 6. Significant relationship between the percentages of males strutting to the time after the first female arrived on the lek.

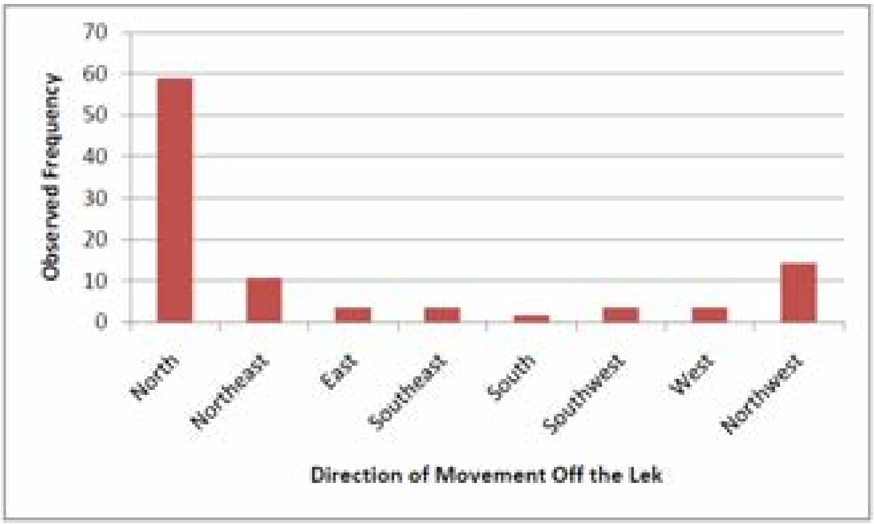

Figure 7. Direction frequency of movements off the lek.

We found a systematic tendency for males to utilize a smaller total area on days when females were present ($P < 0.001$, $t = -4.84$). Using utilization distributions (UD), it appears that the center of activity shifts north on days when females are present (fig 8). We also created female UDs for the duration of the lekking season (fig 9) and for the total observations of both males and females for the entire lekking season (fig 10).

We overlaid our general observations and impressions on top of the point density map to outline general territory locations in two ways. First, we used the point density analysis to determine the approximate territory locations at the beginning of the lekking season since territory establishment typically happens during this time (fig 11). We then estimated territory placement during the peak of lekking season using the days when females were not present (fig 12). Using the days when females were not present is important due to the shift in male UD during those days and the general breakdown of defended territory boundaries. Males tended to follow females and display where they were located rather than at defined territories. There appeared to be a large difference in territory placement after females arrived, counter to current theory on lek dynamics.

We opportunistically recorded matings. We recorded a total of 26 mating attempts between April 20th and June 8th (fig 8). Seventeen matings occurred in April, eight occurred in May and only one mating was observed in June.

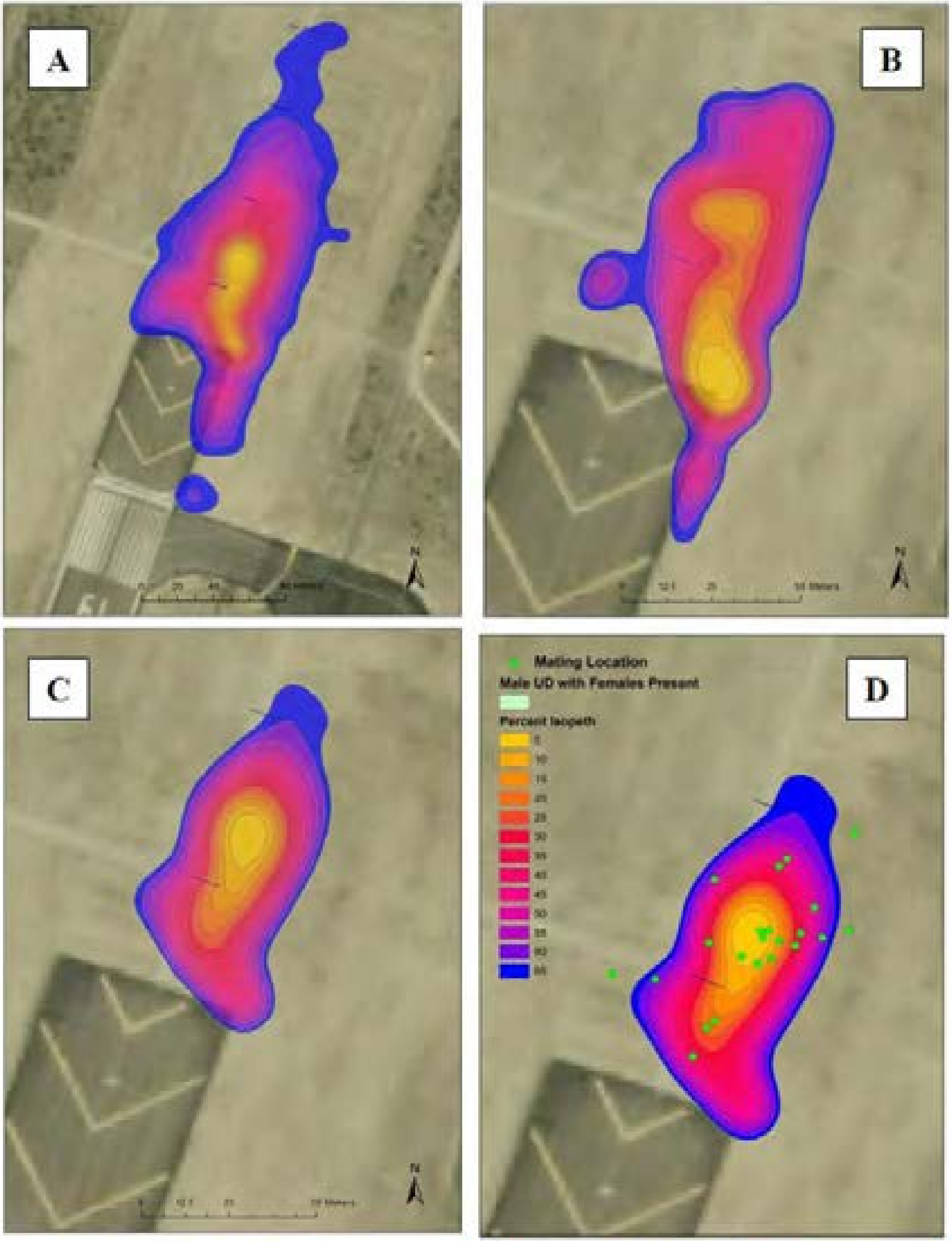

Figure 8. Kernel utilization distribution of sage-grouse on the JHA lek in 2009. A = UD of all male locations (every 15 min) from April - May. B = UD of all male locations on days when females were not present. C = UD of all male locations when females were present. D = C with mating locations overlaid.

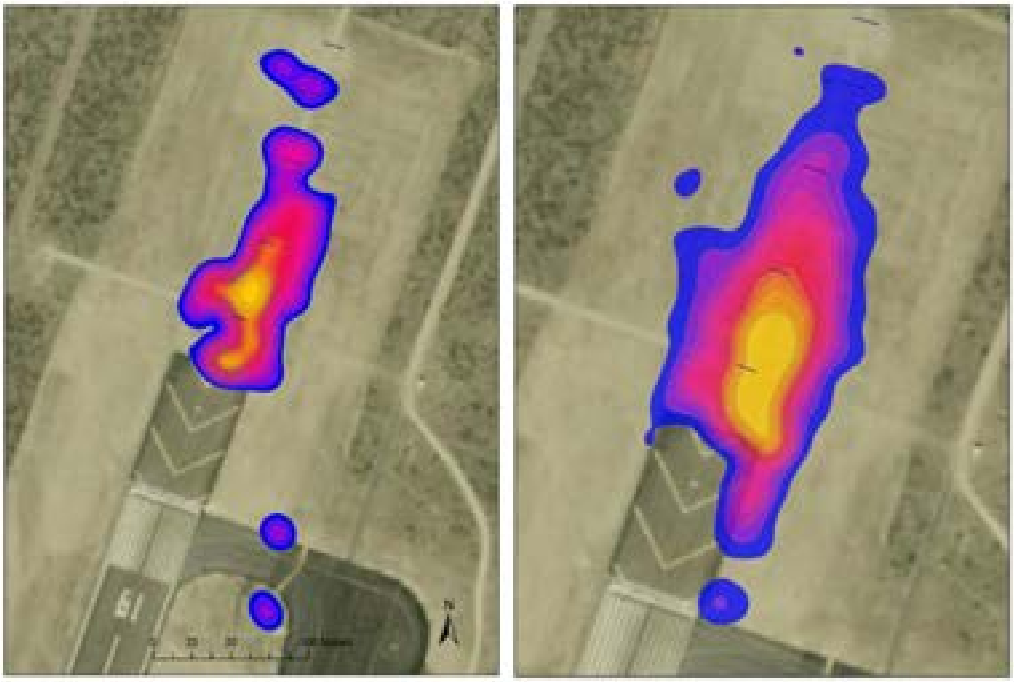

Figure 9 & 10. Kernel utilization distribution of females on the JHA lek, 2009 (left). Kernel utilization distribution of all locations (male and female) for the entire lekking season.

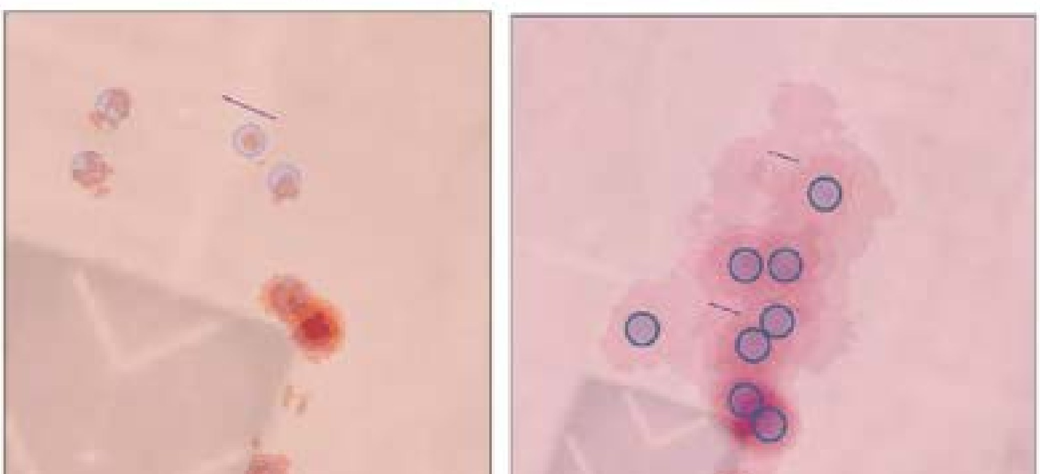

Figure 10 & 12. Estimated territory locations based on a point density analysis form days prior to female lek attendance (before 18 April 2009). Estimated territory locations based on a point density analysis from all days when females were not present. (right)

STRUT RATES & DISTURBANCES

We recorded and quantified the strut rates from focal males on 16 days between 24 March and 17 May 2009 using video recordings of the males. Females were present on four of those days. The mean observation time was 59 minutes (Table 1). The mean strut rate through males' total observation period was 2.085 struts per min (SD = 2.00) and the mean number of struts/minute during each bird's longest continual display was 3.991 (SD = 1.787). On average, males spent 42.4% of their observation time strutting based on number of minutes displaying during the observation period (SD = 31.653).

We found no relationships between the observation time and any strut rate variables (all P >0.05). All other variables were highly correlated with each other variable tested (Pearsons correlation; all P < 0.03). During each observation period, we identified the minute with the most struts. The highest number of struts recorded during that minute was 12, the lowest being zero (i.e. the focal male never strutted during the observation period). The average maximum number of struts per minute was 7.06 (SD = 2.515). We found that the strut rate was significantly higher when females attended the lek (P = 0.004, w = 78). The mean male strut rate was only 0.935 struts/min (SD = 0.46, n = 12) when females were absent, but averaged 5.22 struts/min (SD = 1.594, n = 4) when females were present. Not taking into account female presence, we found that strut rate can be predicted by minimum temperature in the presence of precipitation (P = 0.038, f = 4.26). Avg overall = - 2.49 + 0.179 Min Temp (°F) - 8.10 Precip (In).

We recorded all potential disturbances throughout the lekking season (fig 13, table 2). A sub-sample 15 focal days (one focal male per day) was used to examine the effects of disturbance on strut rate, or numbers of strut per minute. We examined the strut rate just prior to, during, and after an anthropogenic disturbance. We used departing flights to the south and vehicles on the lek as disturbances. The mean strut rate of individuals five minutes prior to disturbance was 2.186 struts/min (SD = 2.295, n = 15) and during and/or five minutes after a disturbance it was1.72 struts/min (SD = 2.217, n = 15). We found no evidence to suggest that disturbance had an effect on strut rate (P = 0.481, w = 250). Further separating the data into three categories of disturbance times (before, during and after a disturbance) failed to detect differences between treatments (f = 0.335, P = 0.717). We further investigated potential disturbance effects by testing two sub-sets of strut rates; when females were present and absent and failed to find significant differences. We found no significant relationships for all variables tested (all $P > 0.05$ for both sub-sets).

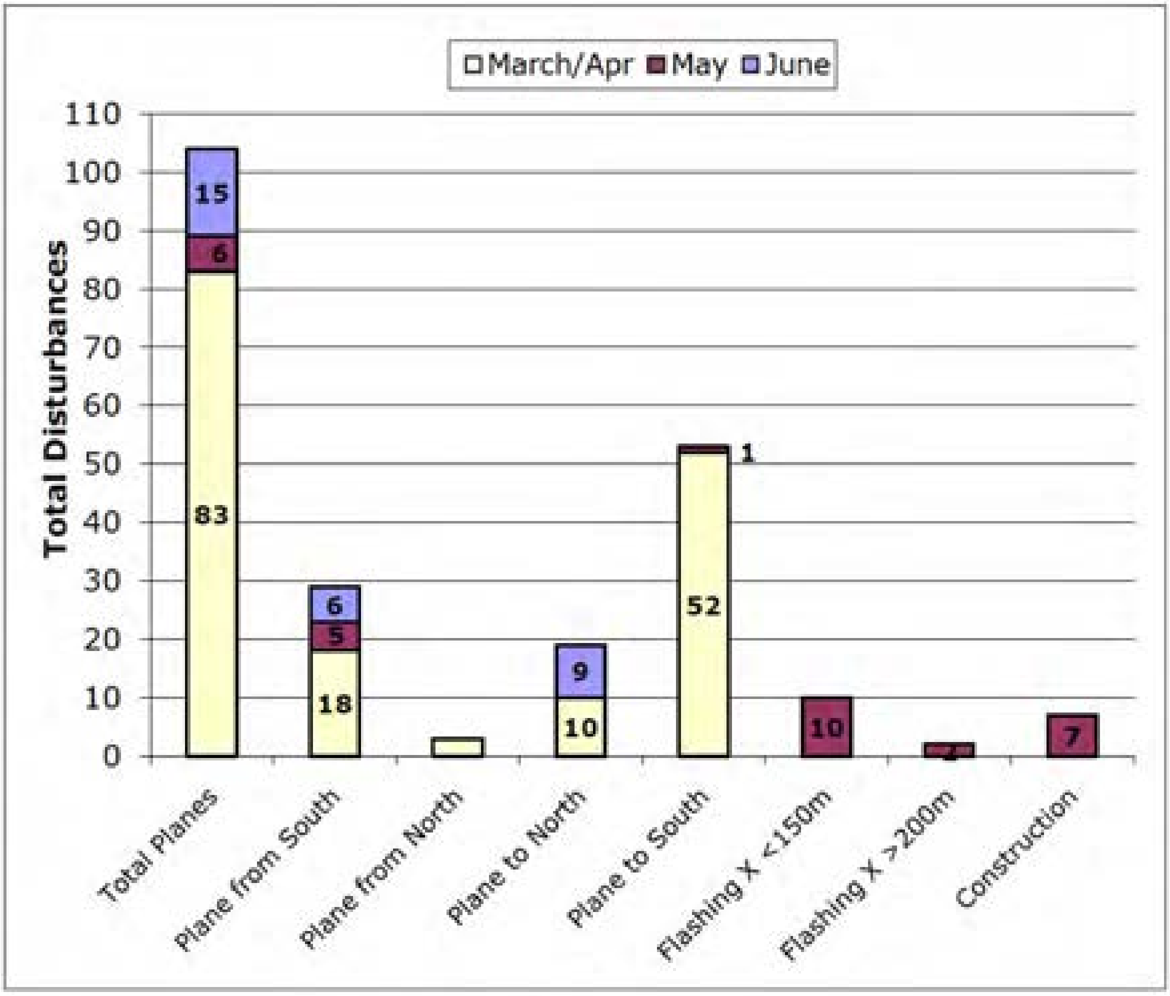

Figure 11. Number of anthropogenic disturbances to the JHA lek, 2009 by month.

Table 1. Strut rate summary statistics.

Date	Total Females Present	Time Recorded (min)	Time Displaying (%)	Max time continuous strutting (min)	Mean struts/min (total time)	Max struts/min	Mean struts/min (during display)
24-Mar	0	44	20.5	2	0.76	5	3.71
7-Apr	0	36	16.7	2	0.46	7	2.0
10-Apr	0	139	33.8	9	1.27	10	6.1
11-Apr	0	60	30.0	4	0.70	7	2.8
12-Apr	0	75	50.7	13	1.79	7	3.6
13-Apr	0	64	14.1	3	0.92	6	4.3
14-Apr	0	65	26.2	5	1.00	7	4.8
19-Apr	3	32	93.8	25	3.79	8	2.2
24-Apr	3	59	100.0	59	5.98	12	6.0
27-Apr	3	41	68.3	27	4.02	8	6.0
2-May	0	59	30.5	15	1.23	7	4.1
3-May	0	40	0.0	0	0.00	0	0.0
6-May	0	63	44.4	7	1.36	7	3.5
8-May	0	58	24.1	8	0.97	6	3.8
10-May	0	56	25.0	7	0.77	7	3.6
17-May	2	56	100.0	56	7.11	9	7.1
	Mean	59.19	42.37	15.13	2.01	7.06	3.99
	Range	(32 - 139)	(0 - 100)	(0 - 59)	(0 - 7.1)	(0 - 12)	(0 - 7.1)
	SD	24.4	31.7	18.3	2.1	2.5	1.8

Table 2. Disturbance frequencies and descriptions

Disturbance	Season Total (n=76)	Mar/April Total (n=24)	May Total (n=24)	June Total (n=22)	Description/ Effect
Total Planes	104	83	6	15	Includes incoming and outgoing planes, see below
Out to South	53	52	1	0	Most disruptive, jets facing birds, 200m within lek center
In from North	29	18	5	6	Planes fly low and directly above lek to land on north end of runway
Out to North	19	10	0	9	Planes fly overhead, but not as low, little effect
In from South	4	4	0	0	Land on south end, >1000m from lek, no effect
Vehicle <200m	67	27	40	0	Includes snow plows (in pairs), runway cleaners, security cars
Vehicle <100m	23	8	13	2	Includes snow plows, runway cleaners, security cars driving through lek
Canine	8	6	0	2	Coyote or fox within 200 m, little observed effect
Raptor	7	2	4	1	RLHA or unidentified hawk, caused flushing or cessation of activity
Purposeful Deterrence	5	3	2	0	Airport vehicles honking at or driving close to birds in an effort to move them
Construction	7	0	7	0	Newly paved runway or pavers on runway <200m from lek center
Flashing X Present	12	0	12	0	A large flashing "X" using a generator usually attached to a truck
X in lek center	6	0	6	0	X in lek center, on grassy over run, truck typically drives through to get X
X < 150m	4	0	4	0	Flashing on runway, <150m from lek center

Vegetation

We measured vegetation at a total of 20 plots within the JHA (fig 14, table 3). Of those, seven were located in over-run, or non-sage, areas of the airport. We recorded the herbaceous and forb cover at all sites and sage structure at 11 sites. We further classified the forb components by food forbs and cover forbs and tested for differences among similar sites (i.e., sage or over-run) and between sites.

We found differences between sage and over-run plots for all understory variables measured except total percent forb cover (table 4). However, while the total forb cover did not differ between site types, the forb diversity was significantly higher in the sage plots than over-run plots. Using ANOVA tests, we found no significant variation in live sage cover among sites ($P = 0.126$, $f = 1.53$, $df = 10$; table 5). We did find differences among sites for mean plot sage height ($P = 0.001$, $f = 3.04$, $df = 10$; fig 15).

To further investigate the importance of forb cover in the JHA, we analyzed the plots for food and cover forb components (table 6). To determine if the grouse could be attracted to the over-run sections of the JHA by food (in addition to lekking), we tested for differences between food forbs in the sage plots and the overrun plots. We found no differences between the sage and overrun plots for forbs that are important for adult sage-grouse. Because juvenile sage-grouse use a larger breadth of food forbs than adults, we also tested for differences between plots using all potential food forbs and found much more pronounced differences between the sage and over-run plots (tables 7, 8).

We compared the vegetation parameters measured within the JHA to a previous study that quantified nesting habitat in Jackson Hole (Holloran and Anderson 2004) to assess the habitat quality within the JHA. To conduct meaningful tests, we restricted the Holloran and Anderson (2004) data to nesting sites only in the southern half of Jackson Hole due to sage sub-species differences in other areas of the valley (i.e., the west side of the Snake River). Using only the sage plots within the JHA, we found differences in only percent bare ground and dead sage canopy cover (table 9). All of the important vegetation parameters for sage-grouse nesting were not different between the JHA and other used nest sites in the valley.

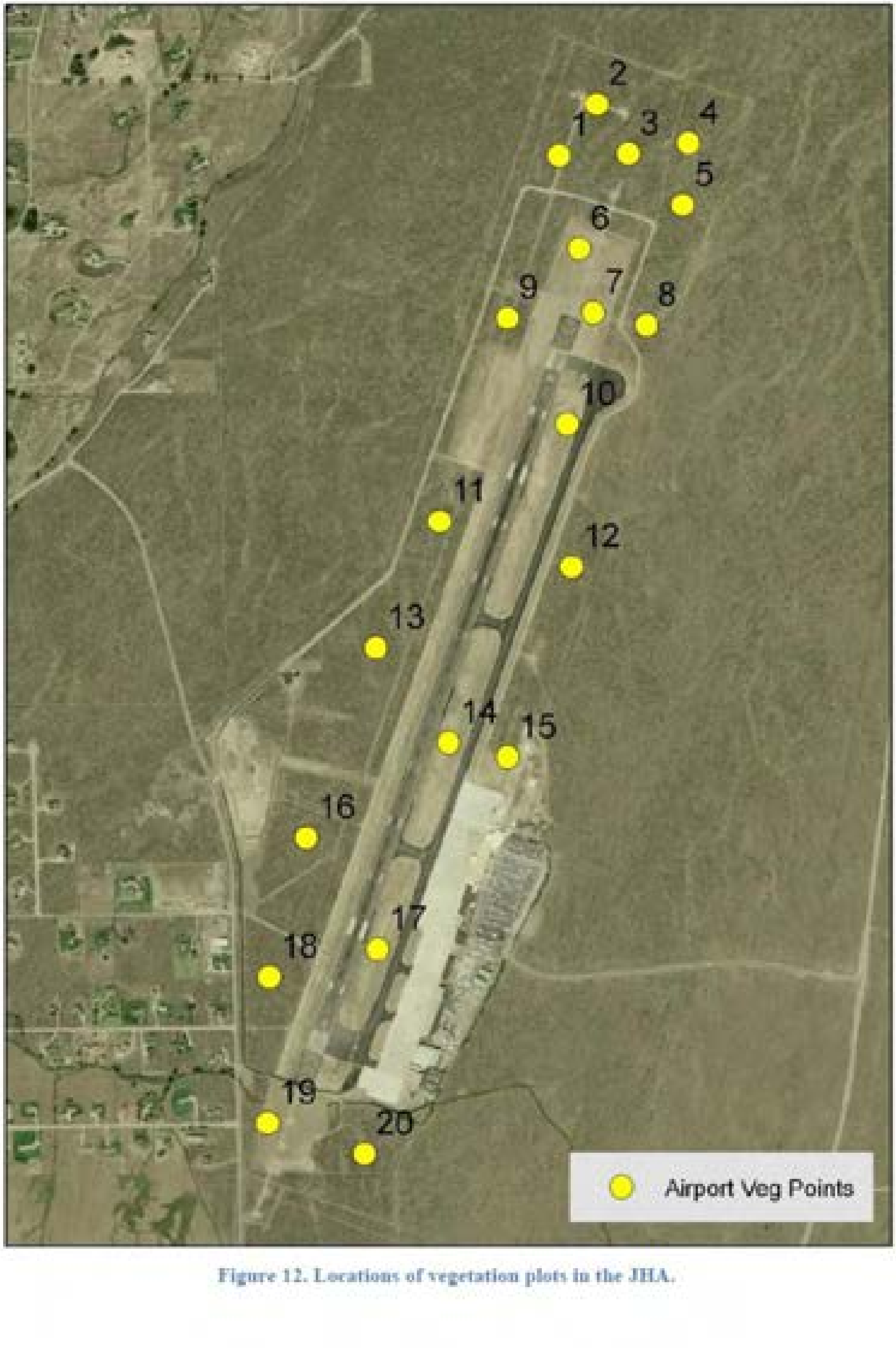

Figure 12. Locations of vegetation plots in the JHA.

Table 3. UTM (Nad 27) coordinates of vegetation plots measured in the JHA.

Plot Number	Longitude	Latitude
1	521540	4829497
2	521639	4829630
3	521720	4829502
4	521876	4829530
5	521862	4829369
6	521593	4829256
7	521630	2829090
8	521767	4829057
9	521407	4829076
10	521563	4828801
11	521232	4828550
12	521573	4828432
13	521066	4828223
14	521255	4827977
15	521407	4827939
16	520886	4827730
17	521071	4827441
18	520791	4827370
19	520786	4826991
20	521037	4826911

Table 4. Understory differences between sage and over-run plots.

	Sage Plots (SD)	Overrun Plots (SD)	P	T	df
Total Herbaceous Cover (%)	38.2 (12.8)	24.9 (10.2)	**0.0240**	-2.52	15
Total Grass Cover (%)	25.8 (11.8)	12.4 (8.4)	**0.0097**	-2.94	16
Live Grass (%)	67.2 (13.0)	89.3 (5.4)	**0.0001**	5.34	17
Total Forb Cover (%)	12.3 (6.5)	13.1 (5.4)	0.7900	0.28	14
Total Litter	18.7 (9.2)	8.4 (3.3)	**0.0026**	-3.56	16
Total Bare Ground (%)	27.2 (13.1)	54.2 (15.8)	**0.0031**	3.88	10
Forb Diversity	2.2 (0.8)	1.5 (0.2)	**0.0095**	-2.97	15

Table 5. Raw data and summary statistics for sage plots in the JBA.

Plot	Total Shrub Canopy Cover	Avg Live Shrub Height	Total Live Shrub Cover	Total Dead Shrub Cover	Avg Live Sage Height	Live Sage Cover	Dead Sage Cover	Live Bitterbrush Cover	Dead Bitterbrush Cover
1	40.42	55.31	38.3333	2.0833	58.0	29.8	2.1	8.6	0.0
2	19.23	49.00	16.8500	2.3833	50.2	11.7	1.6	5.2	0.8
3	34.97	50.42	31.9500	3.0167	53.5	22.0	3.0	10.0	0.0
4	46.00	60.94	43.4167	2.5833	65.1	23.7	2.0	19.8	0.6
8	25.50	53.00	23.5500	1.9500	51.8	15.2	1.2	8.4	0.8
9	35.02	53.72	32.6667	2.3500	52.5	29.0	2.4	3.2	0.0
12	31.13	52.29	28.7000	2.4333	53.2	22.2	1.4	6.5	1.0
13	24.48	57.28	21.9667	2.5167	57.4	17.3	2.5	4.7	0.0
16	38.50	64.31	35.1167	3.3833	64.6	18.9	3.4	17.4	0.0
18	41.62	64.75	37.2000	4.4167	64.3	21.2	1.0	16.1	3.4
20	38.33	50.07	32.0000	6.3333	49.4	20.2	4.6	11.8	1.7
Mean	**34.11**	**55.5541911**	**31.0682**	**3.0409**	**56.4**	**21.00**	**2.29**	**10.13**	**0.75**
SD	**8.20**	**5.60**	**7.81**	**1.29**	**5.92**	**5.39**	**1.07**	**5.52**	**1.04**

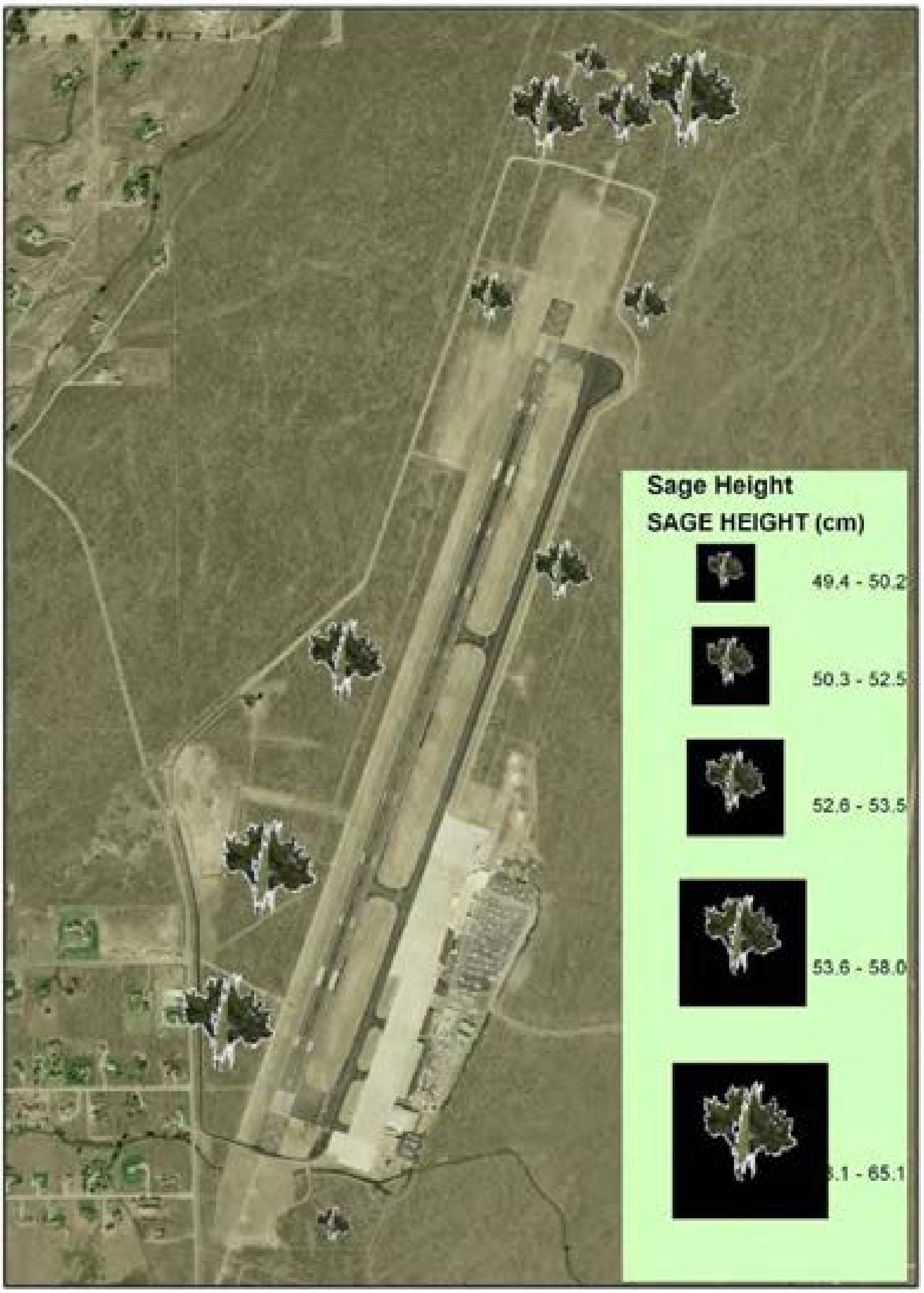

Figure 13. Visual representation of sage height measured at vegetation plots within the JHA.

Table 6. Forbs found at vegetation plots within the JHA and the food value for differing age classes of sage-grouse.

Scientific Name	Common Name	Sage Plots	Non-Sage Plots	Food Value*
Agoseris glauca	False Dandelion	X		b
Allamanda cathartica	Yellow Bell	X		c
Antennaria spp.	Pussytoes	X		a
Balsamorhiza sagittata	Arrowleaf Balsamroot	X		c
Castilleja thompsonii	Thompsons Paintbrush	X		
Comandra umbellata	Bastard Toadflax	X		
Crepis spp.	Hawksbeard	X		b
Delphinium spp.	Larkspur	X		
Erigeron spp.	Fleabane	X		b
Eriophyllum lanatum	Wooly Sunflower	X		b
Geranium viscosissimum	Sticky Geranium	X		
Lewisia pygmaea	Alpine Lewisia	X		
Lithophragma parvifolia	Woodland Star	X		c
Phlox longfolia	long leaf phlox	X		
Sedum spp.	Stonecrop	X		a
Senecio integerrimus	Western Groundsel	X		b
Vicia spp.	Vetch	X		b
Brassica spp.	Mustard	X	X	c
Collinsia parviflora	Maiden blue eyed Mary	X	X	c
Eriogonum umbellatum	Sulphr-flower Buckwheat	X	X	a
Hoary alyssum	hoary alyssum	X	X	
Lomatium dissectum	Desert Parsley	X	X	c
Lupinus spp.	Lupine	X	X	
Taraxicum officinale	Common Dandelion	X	X	
Asclepias spp.	Milkweed		X	b
Cerastium vulgatum	Mouseear Chickweed		X	
Matricaria perforata	Scentless Chamomile		X	b
Trifolium spp.	Clover		X	b

*a = adult food, b = adult/juvenile food, c = juvenile food

Table 7. Density (avg. plants/sq. m) of adult edible forbs* and cover forbs, bold equals significant difference.

	Edible Forbs (SD)	Cover Forbs (SD)	
Sage Plots	4.03 (0.91)	4.03 (0.84)	P = 1.0, T = 0.0
Non-Sage Plots	2.78 (1.00)	1.64 (0.46)	P = 0.33, T = -1.04
	P = 0.37, T = -0.93	**P = 0.022**, T = -2.51	

* based on Holloran 1999

Table 8. Density (avg. plants/sq. m) of edible forbs for all age classes* and cover forbs, bold equals significant differences.

	Edible Forbs	Cover Forbs	
Sage Plots	5.32 (1.08)	2.53 (0.52)	**P = 0.032, T = 2.33**
Non-Sage Plots	1.83 (0.59)	1.24 (0.34)	P = 0.41, T = 0.87
	P = 0.011, T = 2.85	P = 0.54, T = 2.07	

* based on Huwer 2004

Table 9. Vegetation characteristics at sage grouse nest sites* and the JHA vegetation plots.

Variable	Used Nest Sites (SD)	Airport Sage Plots (SD)	P	T	df
Sage Density	1.19 (.10)	1.03 (0.08)	0.24	1.21	22
Total Shrub Canopy Cover	37.4 (3.0)	34.1 (2.5)	0.42	0.83	22
Live Sage Canopy Cover	18.64 (2.6)	21.02 (1.6)	0.45	-0.78	20
Dead Sage Canopy Cover	3.75 (0.5)	2.29 (0.3)	**0.026**	2.4	20
Avg. Sage Height	58.7 (3.8)	56.4 (1.8)	0.57	0.57	18
Total Herbaceous Cover	37.6 (4.1)	38.2 (12.8)	0.91	-0.11	24
Total Forb Cover	9.87 (1.4)	12.33(1.8)	0.29	-1.08	23
Bare Ground Cover	2.86 (2.1)	27.2 (3.6)	**<0.001**	-5.8	19
Forb Diversity	1.85 (0.2)	2.19 (.22)	0.29	-1.08	24

*Holloran and Anderson (2004). Nests around BTB only

DISCUSSION

The sage-grouse lekking at the Jackson Hole airport is an anomaly to typical sage-grouse behavior. Virtually all other studies of disturbance at sage-grouse leks have found significant effects of noise, habitat alterations, and traffic on lek attendance and perseverance (e.g., Lyon and Anderson 2003, Aldridge 2005, Holloran et al. 2005, Walker et al. 2007). The lek at the Jackson Hole Airport has persisted since at least 1946 (Patterson 1952) despite frequent and substantial disturbances. However, considerable changes have taken place in the number of sage grouse utilizing this lek from former times. Patterson (1952) recorded as many as 73 males displaying in the late 1940's. In 2009, we had a maximum of 10 males recorded, which was the lowest recorded number of males on this lek in the past 50 years.

We found no one predominate factor that helps explain why sage grouse are using the airport as a lekking site. There are no major vegetative advantages to the over-run section of the airport for forage or predator deterrence. There is no difference in the immediate nesting habitat within the Jackson Hole Airport as compared to surrounding areas. Interestingly, what most would consider the biggest disadvantage of lekking at the JHA airport (disturbances) does not appear to significantly affect grouse behavior or mating. We found that major disturbances, such as vehicles driving through the lek and major commercial airplanes taking off <200 m away, had no effect on the sage grouse strutting behavior. Even further, the placement of a large (ca. 5m x 5m) flashing "X" with a running gas powered generator in the middle of the lek had no effect on male lek attendance. Female attendance during this time period was low, but also corresponded with the natural low in attendance due to the initiation of first nesting attempts (i.e. females were incubating).

Several patterns of lek utilization became apparent that may relate to public safety at the JHA. The most obvious is a very strong avoidance of the paved section of the runway and over-run during the lekking season by all grouse. Aside from an occasional grouse quickly moving across the paved over-run, the vast majority of documented movements and locations of both males and females was on the grassy over-run section north of the runway. On almost all days, we documented that the birds attending the lek would leave in a direction away from the runway. In fact, during our observations, we never documented birds leaving towards or crossing the runway after having left. After the end of daylight savings time, we observed few instances when the grouse were still present on the lek and the first commercial flight entered or left the JHA.

One notable sage grouse behavior we documented at the JHA was the tendency for females to attend the lek after the nesting season in mid to late June. The return of females with young to the JHA corresponds both to previous causal observations and the typically time period for bird strikes involving sage grouse. It is likely the broods and juveniles that are most involved in airplane strikes. There are no instances of females attending leks after nesting, barren or with young. Based on our observations of low food forb diversity and density, the occurrence of hens on the over-run is likely not a function of food availability.

The sage habitat in the JHA can and does support successful nesting of sage grouse. The habitat quality is no different than nesting habitat outside the JHA. As part of a concurrent study we documented two successful nests within the JHA perimeter, both in the northernmost section of sagebrush. It cannot be implied that greater nest success is achieved within the JHA perimeter since both of these nesting attempts were re-nests by adult hens, which typically have very high success rates (unpubl. data).

In future years, managers may address moving the sage-grouse lek from the JHA to an alternative location that is safer both for the birds and for humans. While we have no direct evidence to suggest if such a program would be a success or failure, some data from 2009 may be relevant. In May, the JHA contracted the re-pavement of the runway and the taxiway. During this time there was a plethora of intensive disturbances to the sage-grouse lek, including vehicles on the lek, human presence on and near the lek, loud construction noises, and a generator with a bright flashing "X" in the lek center. With the exception of minor displacement of grouse to the north to avoid the "X" (ca. 50-100m), we detected no difference in lek usage or behavior of the displaying grouse. Based on these observations, it would likely be extremely difficult find a viable way to deter grouse use of this area for breeding.

The use of the JHA for a lek may be a function of historical use with a gradual increase in disturbances over the years. In the 1940's when sage grouse were first using the JHA for a lek, the runway consisted of grass and had very little traffic, especially during the twilight hours of main lek attendance. Sage-grouse exhibit very high fidelity to lek sites across years and young birds learn and continue to use these sites over time. Without a shift in habitat quality (i.e., vegetation growth), there is often little impetus for grouse to move the lek site. Over the years, small annual increases in disturbances have occurred, likely allowing the strutting grouse to become accustom to increasing levels of disturbance.

In the 1940's, a lek site was located one mile southeast of the JHA that hosted roughly the same amount of males (Patterson 1952). This area has not been used for strutting since at least 1986, when GTNP began monitoring sage-grouse leks. There is currently a large brome grass dominated section located in roughly the same spot that is currently used for roosting throughout the summer and fall (unpubl data). The height of the brome grass likely precludes the sage-grouse from currently using this area as a lek site.

In the early 1990's the population of sage grouse was near the historical high density. Lek counts in 1991 documented a total of 63 males strutting on the over-run section of the JHA. The high population counts in GTNP lasted for at least four years and during that time a new lek was beginning to be formed in the JHA, further from the runway. That lek location was abandoned in 1999 as the grouse population in the valley sharply declined and a control tower was built on that site in 2001, precluding further use of this site for lekking. For several years, we have also observed sage-grouse lekking in or near the GTNP gun range (i.e., airport pit). Based on this study, we feel that this serves only as staging area for the grouse in the early lekking season when the over-run is still snow covered, as no grouse were observed at this location after they began using the JHA.

This study was designed to help assess effects of any future changes to the JHA and the associated sage-grouse lek. Movements of the lek center, matings, territory placement, and strutting behavior can all be easily assessed with a similar study in future years. Future monitoring will be needed to assess any long-term impacts that any new or sustained disturbances have on lek attendance. We suggest monitoring of the JHA lek using the methodologies outlined in this study to accurately detect any changes to grouse behaviors and habitat suitability on a five or ten year basis, coupled with annual monitoring of lek attendance. We suggest minimizing direct disturbances to the grouse while lekking (i.e., vehicle deterrence and construction within 200 m) until long-term impacts can be scientifically assessed. With the inevitable increase in anthropogenic use of the JHA, continued monitoring of the JHA lek will be critical to ensuring its persistence.

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Wind River/Sweetwater River Conservation Area
Job Completion Report

Species: **Greater Sage-grouse**
Mgmt. Areas: **8, 14, 18, & WRR**
Period Covered: **June 1, 2010 – May 31, 2011**
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 (58% Bureau of Land Management (BLM) and Bureau of Reclamation (BOR), or tribal lands on the Wind River Reservation (WRR – 26%). Approximately 12% 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

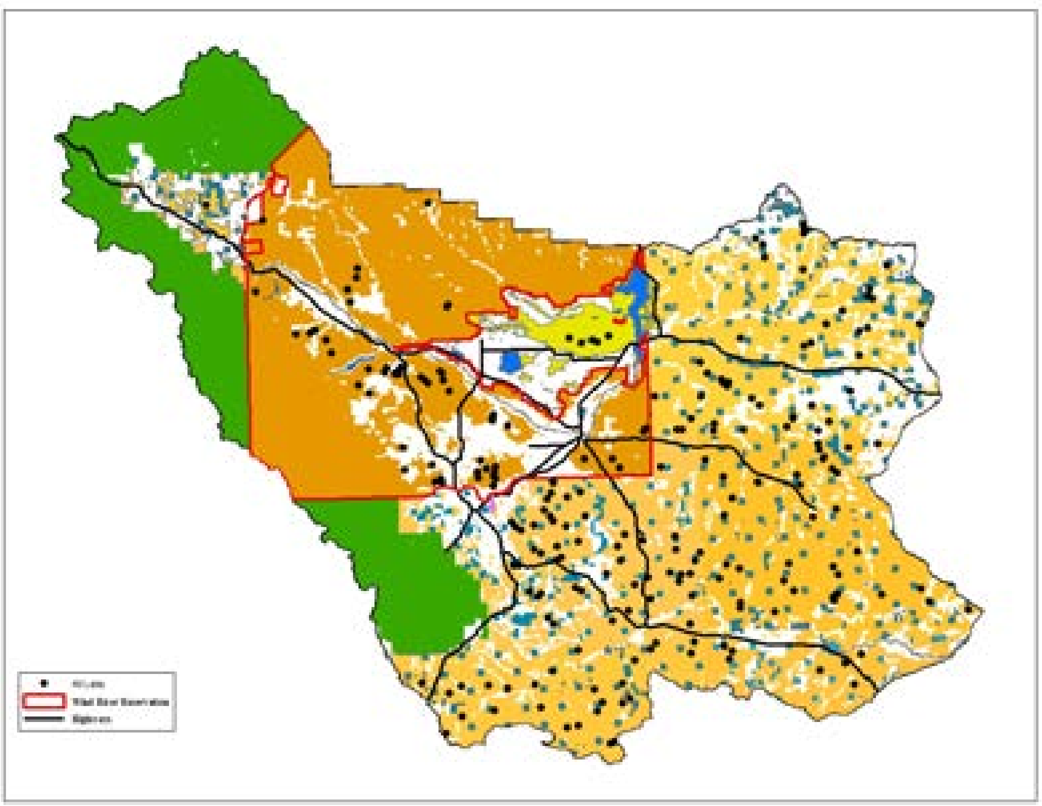

Figure 2. Land ownership within the WRSRCA (dots = leks). Source: WGFD, BLM.

The WRSRCA encompasses all of the WGFD's Small/Upland Game Management Areas 8, 14, 18, and the WRR (Figure 4). 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.

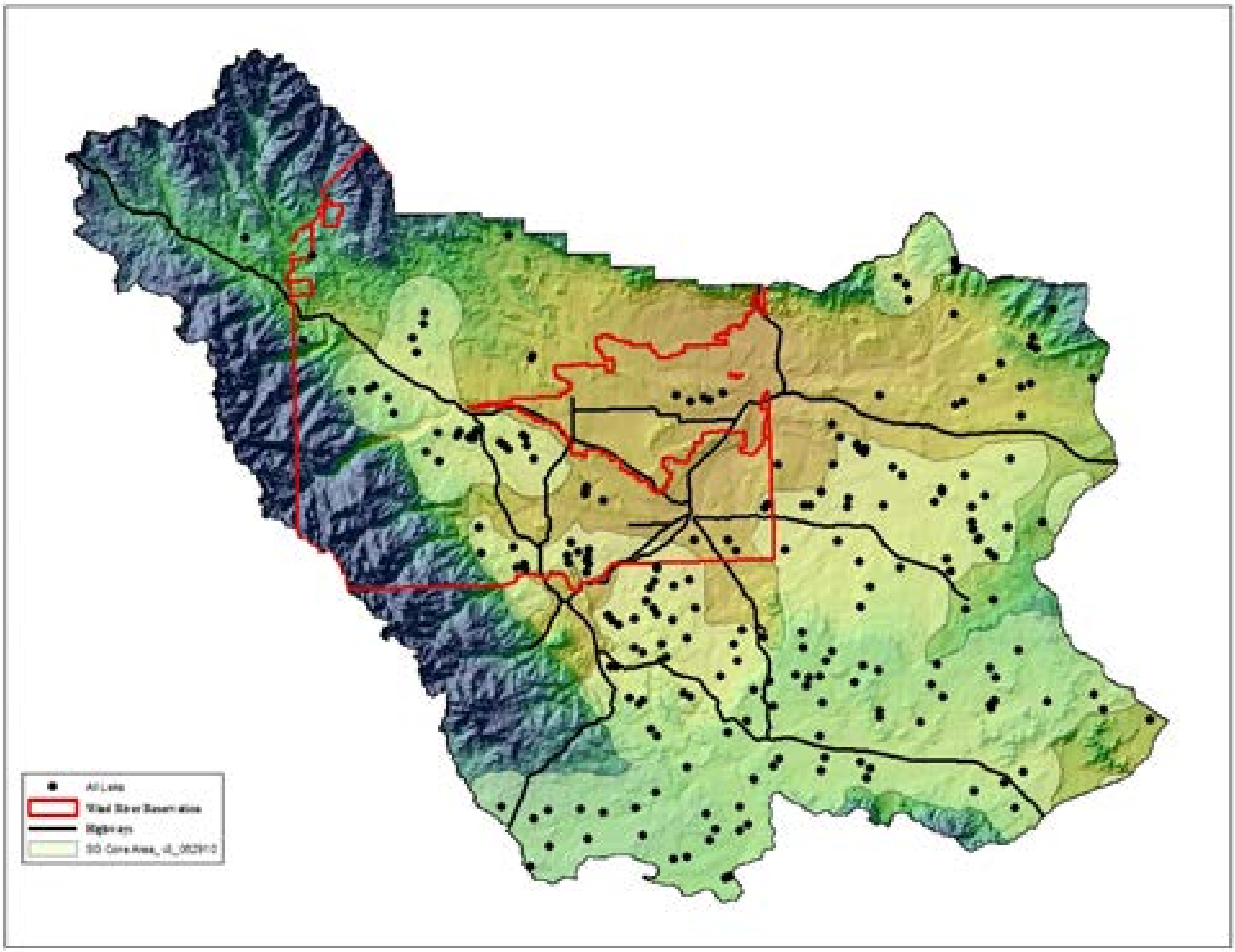

Figure 3. Wyoming Sage-Grouse Core Areas (Version 3, 2010) within the WRSRCA (dots=leks). Source WGFD.

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.

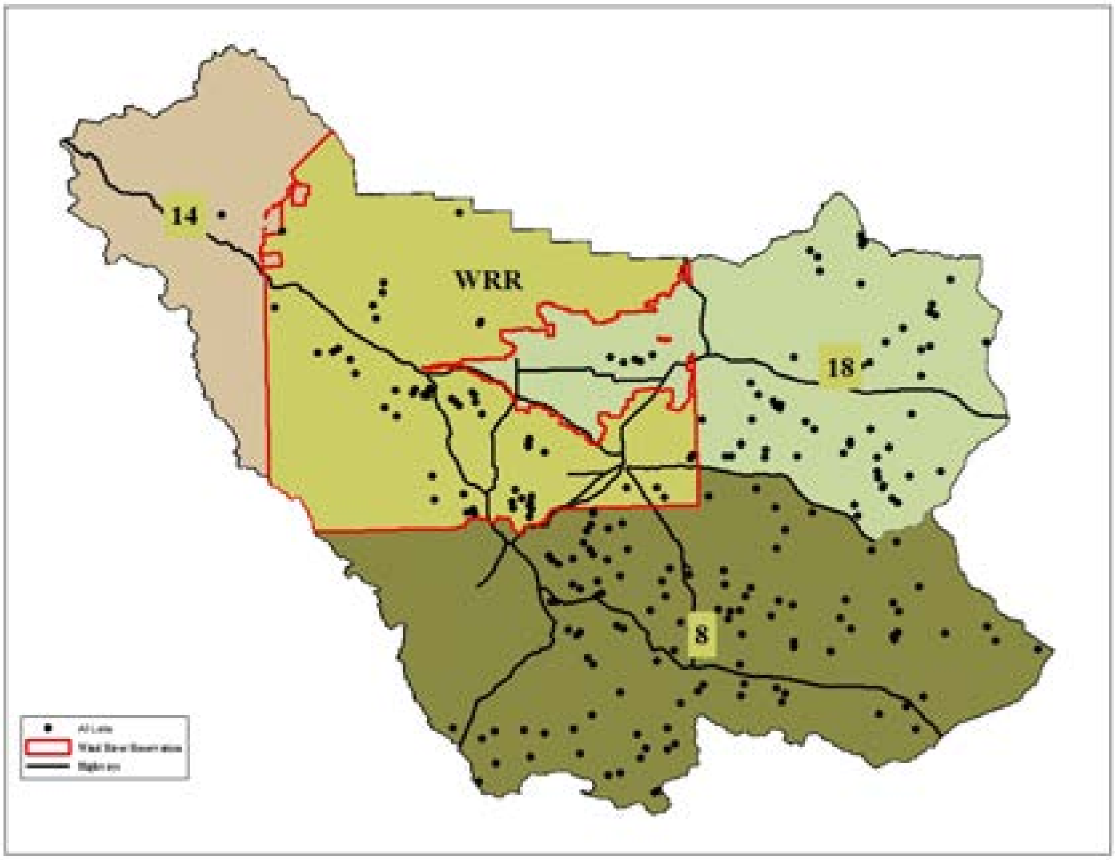

Figure 4. WGFD upland game bird management areas and known leks within the WRSRCA (dots=leks). Source WGFD.

Leks and Lek Complexes

Sage-grouse are generally found throughout the WRSRCA except in heavily forested, agriculturally developed, or urbanized areas. Sage-grouse lek sites 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 228 known occupied leks within the conservation area in 2011. 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, ninety (90) new or newly discovered leks have been documented in the WRSRCA.

Of the 228 known occupied leks in the WRSRCA, 121 were checked in 2011 by WGFD, BLM, USFWS, and SATFG, assisted by several researchers, consultants, and volunteers (Appendices A, B, and F). Of those checked, 54 were counted and 67 were surveyed. Of the 101 leks where status was confirmed, 91 (90%) were active and 10 (10%) were inactive. Data for 4 new leks were added in 2011. Average peak male attendance at count leks was 25.4, which is 14% lower than in 2010 (29.4) and 35.5% below the average since 2002 (39.4). Although average male attendance at leks declined across the WRSRCA, bad weather prevailed during the lek monitoring season in 2011, with deep snow and/or muddy roads limiting travel to numerous leks. These conditions may have contributed to attendance declines caused by poor monitoring conditions, whereas actual declines may have been less severe than observed.

A set of 18 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).

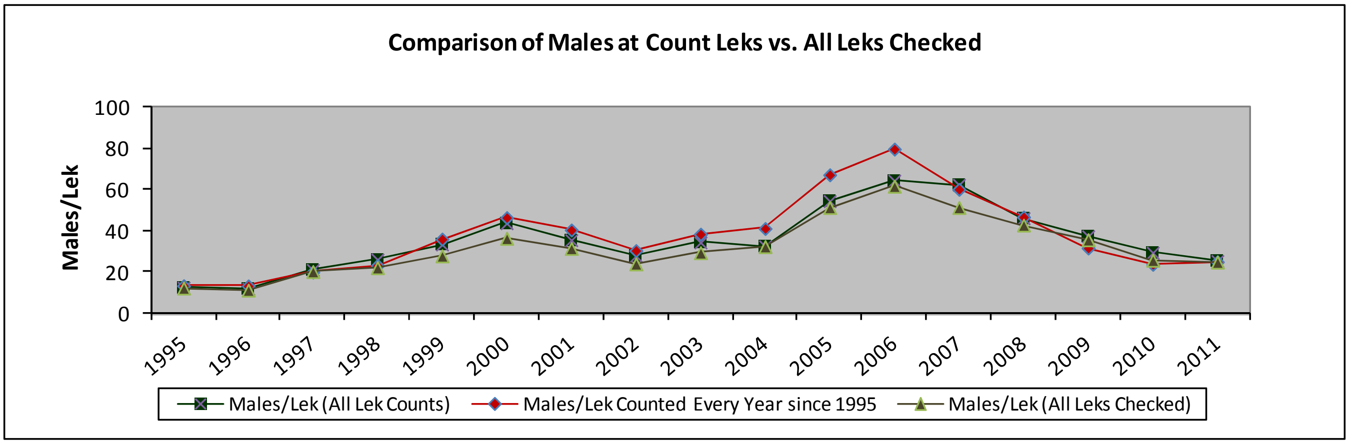

Figure 5. Male attendance trends for lek counts since 1995.

Of the 126 known complexes in the WRSRCA, 78 were checked in 2011 (Appendix C and G). Of those checked, 34 were counted and 44 surveyed. Of the 72 complexes checked where status was confirmed, 71 (98.6%) were active. The high percentage of active leks and complexes is somewhat biased since personnel concentrate monitoring efforts on leks known or thought to be active. Peak male attendance at complexes counted in 2011 averaged 43.6 males, 60% below that observed at the peak of male attendance in 2006 (109.9 males) and 35% below the average since 2002 (67.0 males). Because the number of complexes counted has varied and designations of several complexes changed over the past decade, direct comparisons from year to year should be made with caution.

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 2011, 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 54 leks being counted in 2011. 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 8,128 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, but rebounded rapidly in the late 1990s and early 21st century. However, since 2006, lek attendance has declined rapidly, with the average attendance in 2011 being 60% lower than in 2006. The average number of males observed/all leks checked was 24.9 in 2011, 34% below the average since 2002 (37.9).

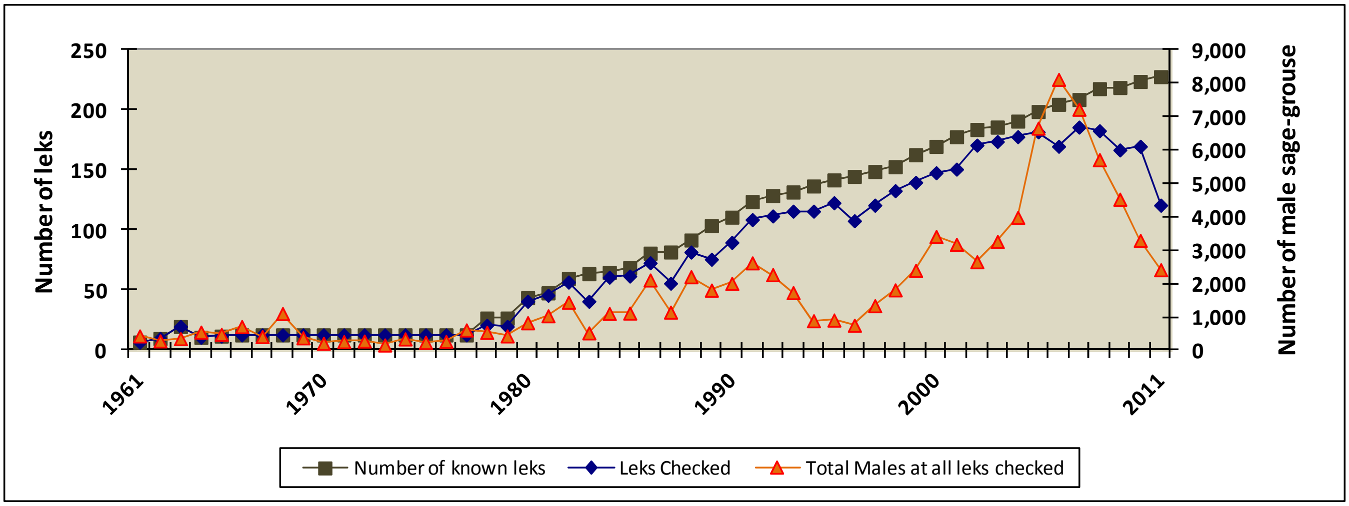

Figure 6. Lek numbers and total male attendance in WRSRCA, 1961 – 2011.

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 indicates wing data from hunter harvested birds during the 2010 hunting season yielded an average brood size of 1.2 chicks per hen, suggesting meager chick survival, (sample size shown includes chicks and hens only).

Table 1. Brood data from harvest wing barrels for Upland Bird Management Area 8, 2001 - 2010.

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Chicks/Hen	2.3	1.3	1.8	5.0	1.7	1.3	1.3	1.4	1.3	1.2
Sample Size	419	101	208	325	515	254	298	392	457	379

Hunting Season and Harvest

In 2010, the sage grouse hunting season increased in length by 1 day (Sept. 18 – 30). Harvest did not increase appreciably, in part due to a mid-week closing date. Likewise, hunter effort (days/bird) and birds/hunter statistics did not change noticeably, and have generally followed numbers of grouse and hunters since 2001 (Figures 7 and 8, Appendix E).

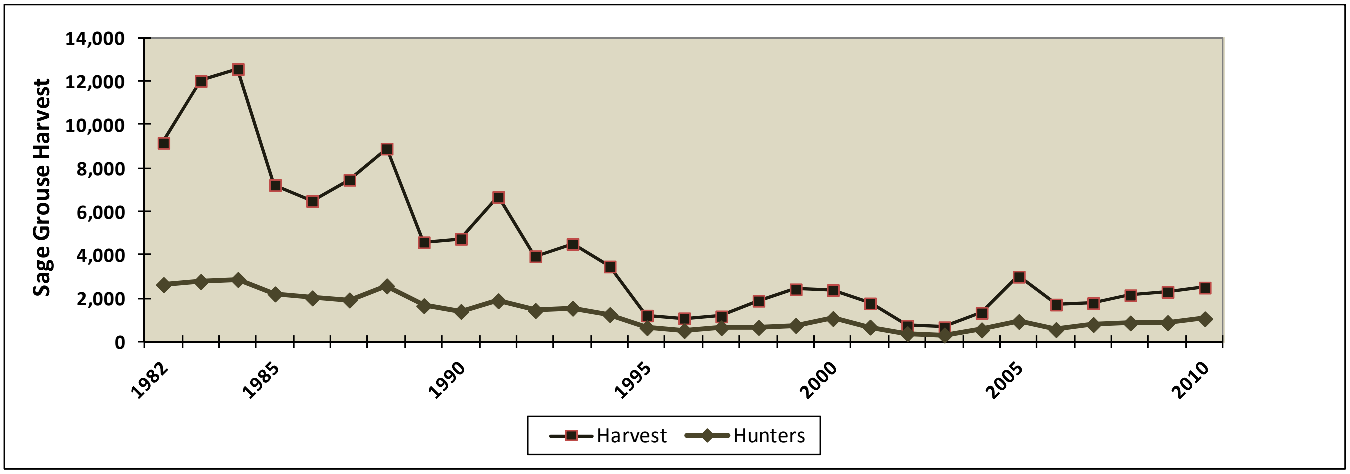

Figure 7. Total hunters and total sage-grouse harvested within the WRSRCA, 1982 – 2010.

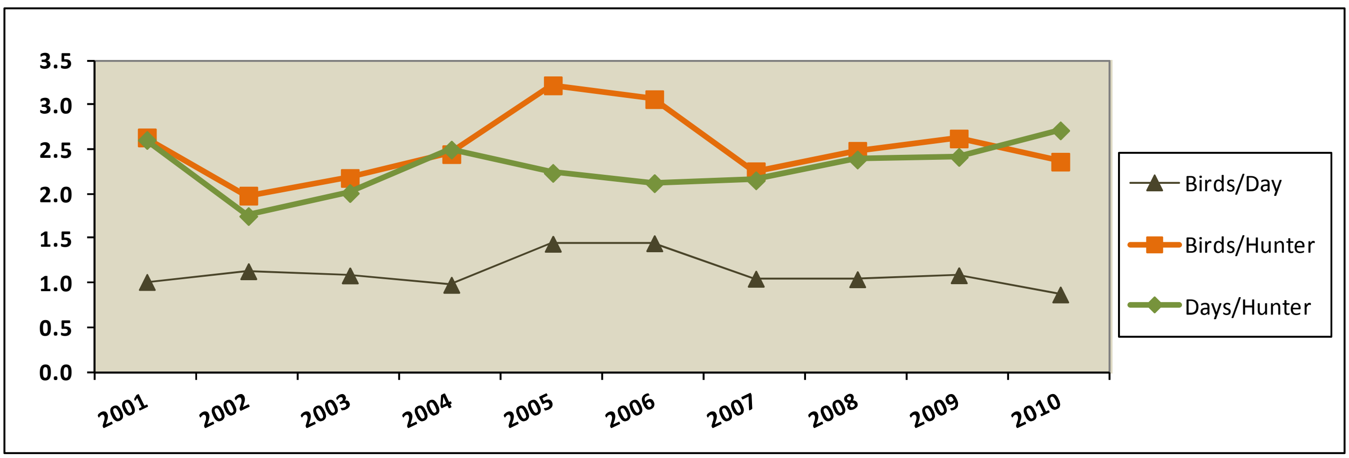

Figure 8. Hunter effort statistics for the WRSRCA from 2001 – 2010.

Weather

Generally favorable weather in 2004 and 2005 led to better habitat conditions and increased grouse numbers, validated by peak male lek attendance in 2006. However, spring and summer precipitation in 2006 was well below normal, which diminished habitat conditions and livestock use remained high on rangeland allotments in many locations. Field personnel remarked that resulting habitat conditions were among the worst ever observed. Sagebrush showed nearly no new growth; resulting from previous combinations of extremely dry weather, low vegetative vigor, and heavy cattle use. Spring precipitation improved substantially in 2010, with Lander and Riverton receiving precipitation 12% and 25% above normal, respectively. However, this improvement in precipitation did little to improve chick survival, as demonstrated by the reduced ratio of 1.2 chicks/hen observed in the wing barrel data for fall 2010. Lek attendance also declined in most of the WRSRCA in 2011, confirming poor chick recruitment in 2010, which was most likely due to cool, heavy rains and snow in 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.

Fifty Wyoming big sagebrush (*Artemisia tridentata wyomingensis*) tagged plants along each transect are measured in fall. Five measurements of current annual leader growth are recorded randomly on each tagged plant. Assessments of age and hedge class are also recorded for each plant. In 2010, sagebrush averaged 26 mm of new growth at the Moneta transect and 23.8 mm at the Yellowstone Ridge transect (Figure 9). In 2008, sagebrush production transects were established in Government Draw near Hudson, where mechanical sagebrush treatments of mowing and Lawson aerator were applied in February 2006. In 2010, after 4 years of regeneration in the treated sites, sagebrush leader growth was markedly greater in the mowed sites (37.7 mm) and aerated sites (59.2 mm), compared to the untreated control transect (29.3 mm).

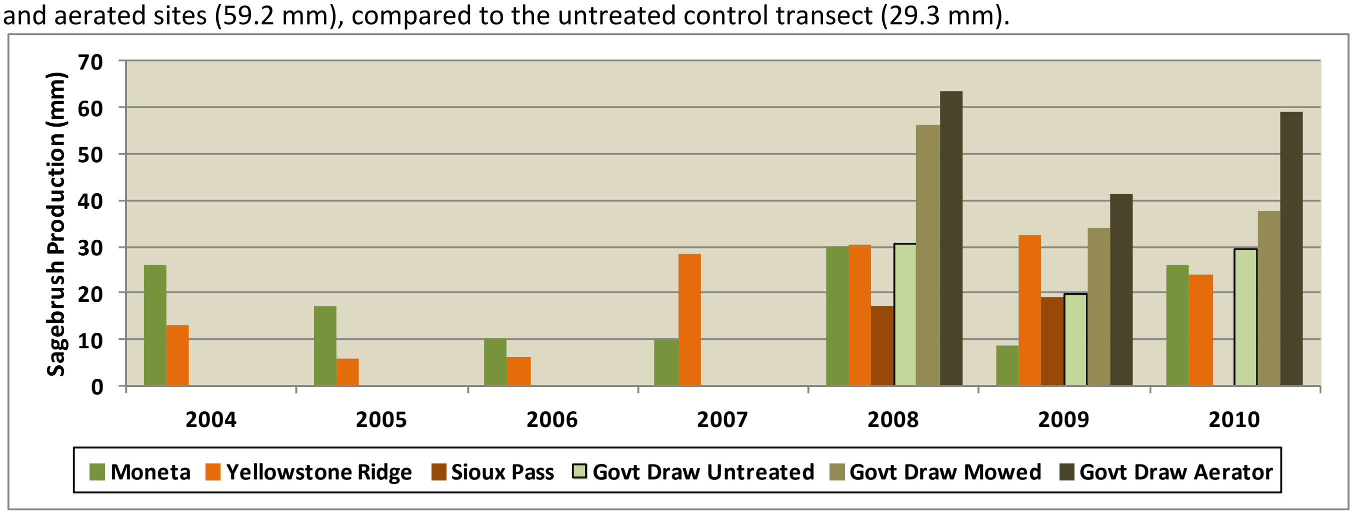

Figure 9. Sagebrush production at several transects in the WRSRCA, 2004 – 2010.

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

A series of fixed wing flights were conducted in late February 2008 to search for wintering sage-grouse flocks. A total of over 1,500 birds were observed in 3 days of flying. Most of the groups were scattered in areas with snow cover ranging from 30% to 100%. Two notable groupings were found. One of which had 5 groups of birds within 1 mile of each other totaling 245 (about 8 miles northeast of Jeffrey City). They were in the transition area between 100% snow cover and almost no snow. A less concentrated group had 205 birds on a single line (8 miles from one end to the other) in the area along Alkali Creek, north of Bison Basin. These birds weren't in the taller sagebrush along Alkali Creek, but were in the upland breaks within a mile or 2. Overall, 336 birds were found south of the Sweetwater River and north of Cyclone Rim, even though the snow cover was nearly 100% in most of the area, with almost no sagebrush showing above the snow. Detailed locations are recorded in the Wildlife Observation System database maintained by Wyoming Game & Fish Department. Several groups were gathered near leks, but several others were away from known leks. Since this survey was conducted just before breeding season, we plan to continue searching some of the more plausible areas for potential new leks. Winter snow depths and windy conditions were not conducive to flying winter use surveys in 2010 or 2011. Some sage grouse observations were recorded during mid-winter elk classification flights, but observations were not representative of winter “concentration” areas.

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.

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.

Diseases

In 2010, no cases of West Nile Virus (WNV) 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. Inventory and map sagebrush and other associated sage-grouse habitats for all seasons across the Wind River/Sweetwater River Local Conservation Area as time and funding allow.

4. Continue to collect summer brood data in conjunction with other duties.

5. Continue to collect age and sex composition of the harvest via wing collection and analyses.

6. Continue intensive lek counts in the Government Draw area south of Hudson.

7. Continue ground checks of all non-intensively monitored leks.

8. Continue to search for new or undiscovered leks in remote areas of WRSRCA.

9. 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 A. Sage-grouse lek characteristics within the WRSRCA, 2011.

Category	Number of Leks	Percent of Category
WGFD Region		
Lander	234	100
Classification		
Occupied	228	97.4
Unoccupied	6	2.6
Unoccupied Leks		
Abandoned	6	
Biologist District		
Wind River Reservation	60	25.6
North Lander	70	29.9
South Lander	104	44.4
County		
Carbon	1	0.4
Fremont	210	89.7
Hot Springs	6	2.6
Natrona	16	6.8
Sweetwater	1	0.4
Upland Bird Management Area		
14	1	0.4
18	61	26.1
8	112	47.9
WR	60	25.6

Category	Number of Leks	Percent of Category
Working Group		
Wind River/Sweetwater River	234	100
BLM Office		
Casper	10	4.2
Lander	214	91.5
Rock Springs	7	3.0
Worland	3	1.3
Game Warden District		
Dubois	1	0.4
East Rawlins	3	1.3
Lander	64	27.4
North Riverton	28	12.0
South Riverton	71	30.3
West Rawlins	9	3.8
Land Status		
Bureau of Land Management	130	55.6
Bureau of Reclamation	5	2.1
Private	28	12.0
Wind River Reservation	60	25.6
State Trust Land	11	4.7

Appendix B. Lek attendance summary at occupied leks in the WRSRCA, 2002-11.

a. Leks Counted

			Percent	Max Totals		Avg./Active Lek	
Year	Known	Counted	Counted	Males	Females	Males	Females
2002	183	33	18.0	922	310	27.9	9.4
2003	185	37	20.0	1271	438	34.4	11.8
2004	190	40	21.1	1300	545	32.5	13.6
2005	199	41	20.6	2229	613	54.4	15.0
2006	205	65	31.7	4179	1392	64.3	21.4
2007	209	74	35.4	4613	979	62.3	13.2
2008	218	73	33.5	3366	865	46.1	11.8
2009	219	67	30.6	2506	548	37.4	8.2
2010	224	55	24.6	1615	535	29.4	9.7
2011	228	54	23.7	1373	440	25.4	8.1

b. Leks Surveyed

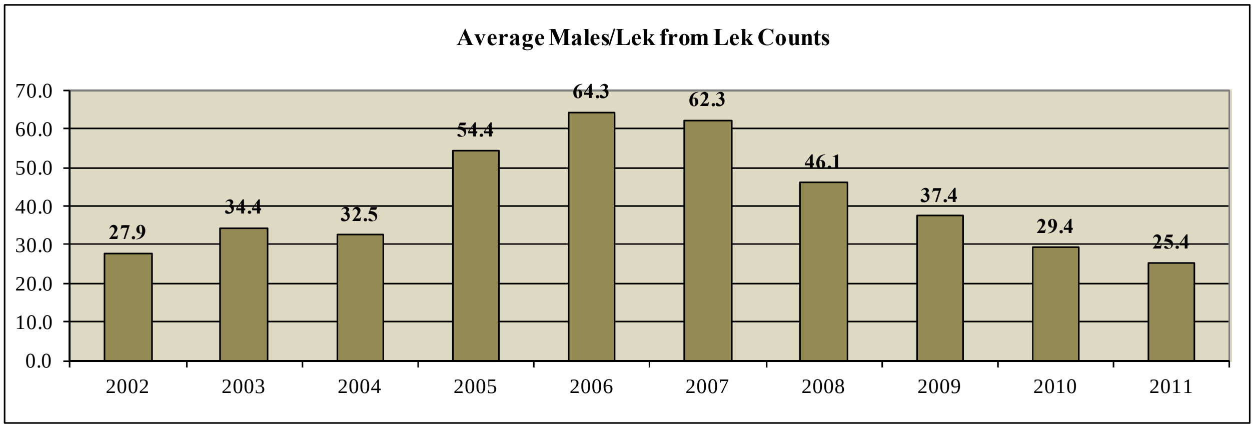
Year	Known	Surveyed	Percent Surveyed	Max Total	Avg Males/ Active Lek
2002	183	138	75.4	1738	22.3
2003	185	137	74.1	1997	27.0
2004	190	138	72.6	2691	32.4
2005	199	142	71.4	4438	49.3
2006	205	105	51.2	3949	58.9
2007	209	112	53.6	2621	39.1
2008	218	113	51.8	2409	38.2
2009	219	100	45.7	2029	33.8
2010	224	115	51.3	1684	23.1
2011	228	67	29.4	1047	24.3

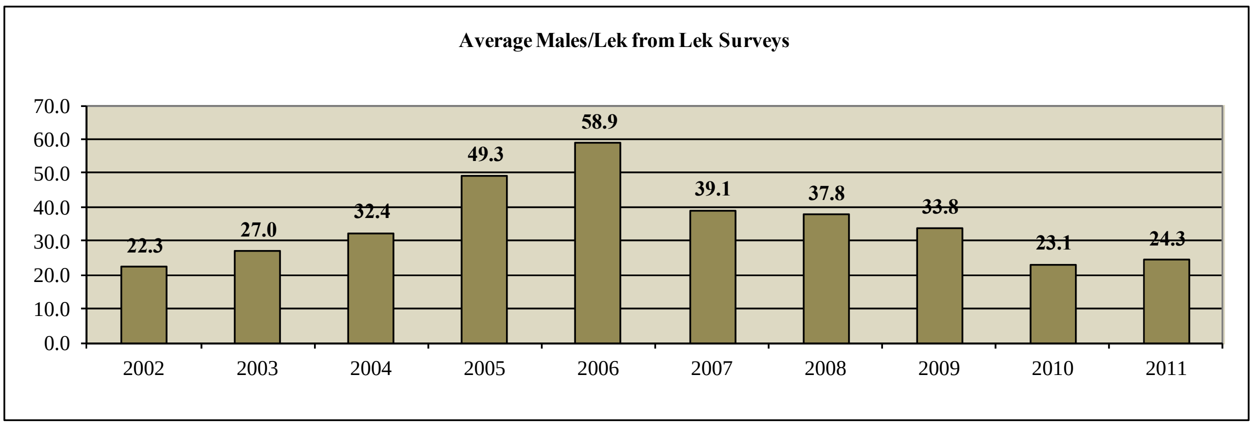
c. Leks Checked

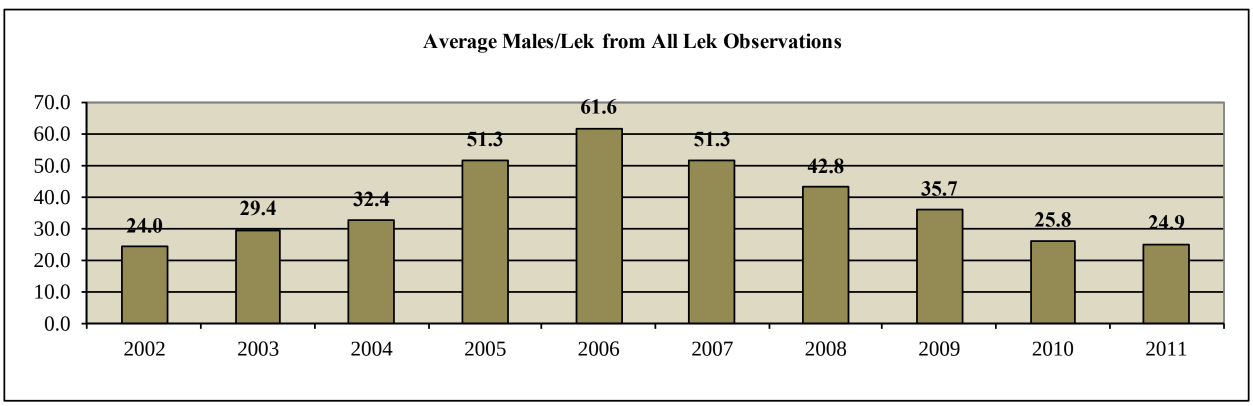
Year	Known	Checked	Percent Checked	Max Total	Avg Males/ Active Lek
2002	183	171	93.4	2660	24.0
2003	185	174	94.1	3268	29.4
2004	190	178	93.7	3991	32.4
2005	199	182	91.5	6667	51.3
2006	205	170	82.9	8128	61.6
2007	209	186	89.0	7234	51.3
2008	218	183	83.9	5719	43.0
2009	219	167	76.3	4535	35.7
2010	224	170	75.9	3299	25.8
2011	228	121	53.1	2420	24.9

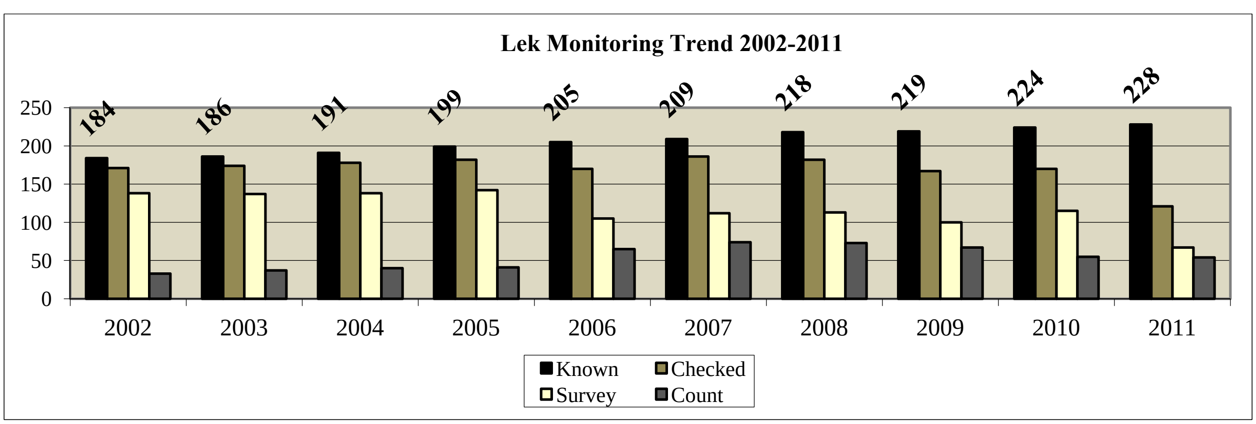
d. Lek Status

					Confirmed Status		
Year	Active	Inactive	Not Located	Unknown	Total	Active	Inactive
2002	107	10	1	65	117	91.5%	8.5%
2003	109	8	1	67	117	93.2%	6.8%
2004	113	11	1	65	124	91.1%	8.9%
2005	125	8	1	65	133	94.0%	6.0%
2006	124	12	1	68	136	91.2%	8.8%
2007	135	12	1	61	147	91.8%	8.2%
2008	129	15	1	73	144	89.6%	10.4%
2009	115	16	0	88	131	87.8%	12.2%
2010	120	11	0	93	131	91.6%	8.4%
2011	91	10	0	127	101	90.1%	9.9%


Average Males/Lek from Lek Counts
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
27.9
34.4
32.5
54.4
64.3
62.3
46.1
37.4
29.4
25.4
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011


Average Males/Lek from Lek Surveys
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
22.3
27.0
32.4
49.3
58.9
39.1
37.8
33.8
23.1
24.3
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011


Average Males/Lek from All Lek Observations
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
24.0
29.4
32.4
51.3
61.6
51.3
42.8
35.7
25.8
24.9
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011


Lek Monitoring Trend 2002-2011
250
200
150
100
50
0
184
186
191
199
205
209
218
219
224
228
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Known
Checked
Survey
Count

Appendix C. Lek complex attendance summary of occupied leks in the WRSRCA, 2002-11.

a. Lek Complexes Counted

Year	Number of Complexes`	Maximum Totals Males	Maximum Totals Females	Avg./Active Males	Avg./Active Females	Number of Leks
2002	24	920	306	38.3	12.8	53
2003	25	1362	463	54.5	18.5	55
2004	25	1462	603	58.5	24.1	55
2005	25	2412	630	96.5	25.2	66
2006	39	4287	1386	109.9	35.5	77
2007	47	4673	978	99.4	20.8	106
2008	48	3296	769	68.7	16.0	103
2009	47	2540	539	54.0	11.5	94
2010	35	1619	531	46.3	15.2	79
2011	34	1482	555	43.6	16.3	64

b. Lek Complexes Surveyed

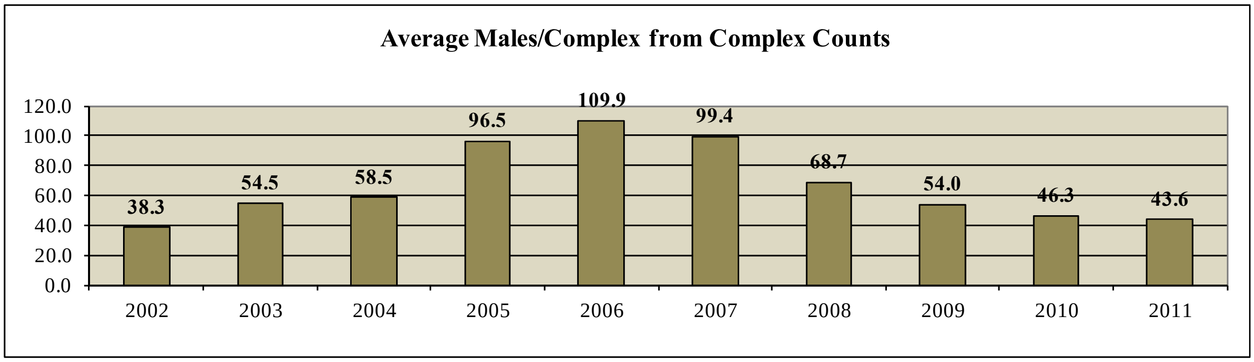
Year	Number Complexes	Max. Total Males	Avg. Males/ Active Complex	Number of Leks
2002	74	1644	28.3	124
2003	75	1832	32.7	124
2004	79	2457	41.0	131
2005	77	4126	67.6	123
2006	58	3436	78.1	101
2007	57	2229	47.4	94
2008	52	2078	50.7	94
2009	46	1834	44.7	89
2010	57	1474	28.9	105
2011	44	1015	28.2	68

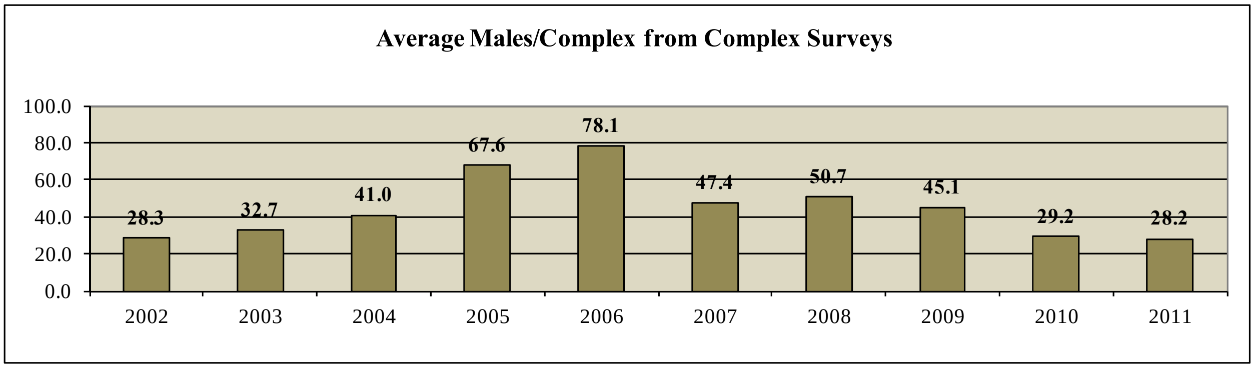
c. Lek Complexes Checked

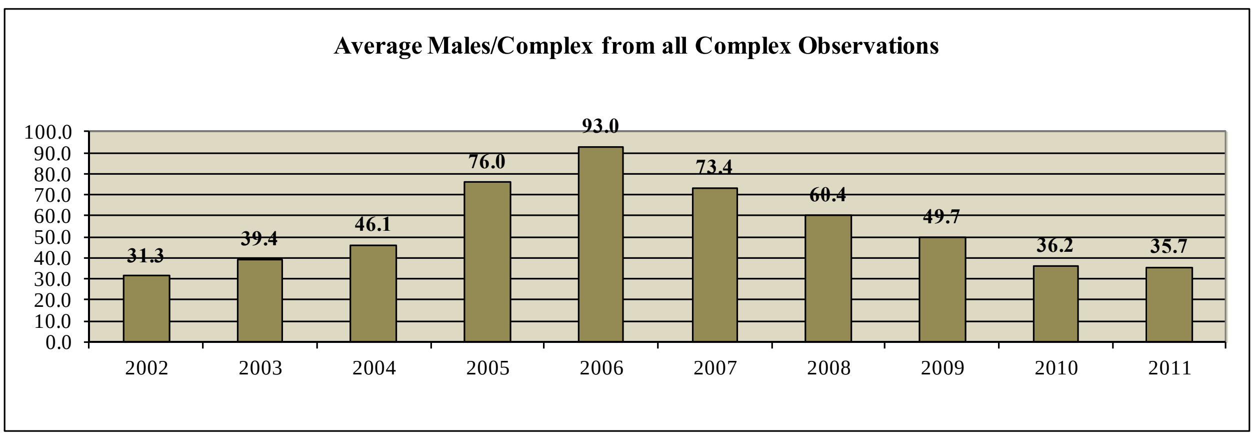
Year	Number Complexes	Max. Total Males	Avg. Males/ Active Complex	Number of Leks
2002	98	2564	31.3	177
2003	100	3194	39.4	179
2004	104	3919	46.1	186
2005	102	6538	76.0	189
2006	97	7723	93.0	178
2007	104	6902	73.4	200
2008	100	5374	60.4	197
2009	93	4374	49.7	183
2010	92	3093	36.0	184
2011	78	2497	35.7	132

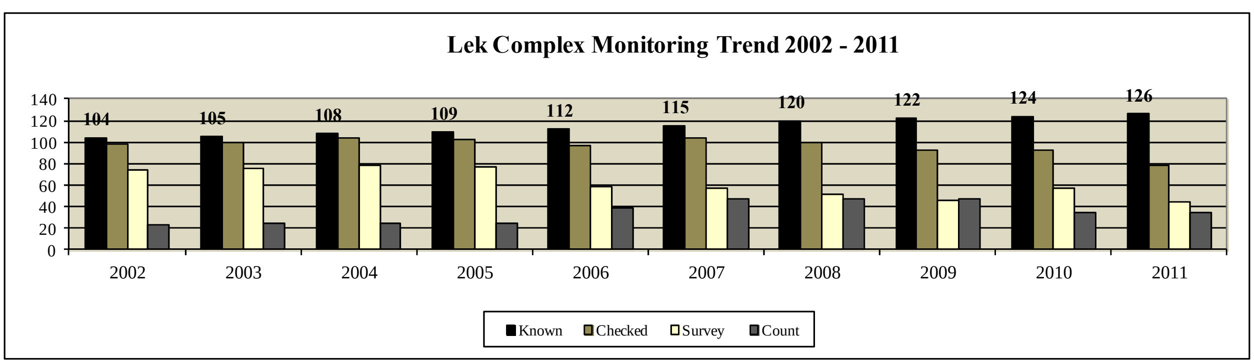
d. Lek Complex Status

	Number of Occupied Complexes				Known Status		
Year	Active	Inactive	Unknown	Total	Total	Active	Inactive
2002	80	2	22	104	82	97.6%	2.4%
2003	82	2	21	105	84	97.6%	2.4%
2004	83	3	22	108	86	96.5%	3.5%
2005	85	1	23	109	86	98.8%	1.2%
2006	82	1	29	112	83	98.8%	1.2%
2007	96	0	19	115	96	100.0%	0.0%
2008	91	0	29	120	91	100.0%	0.0%
2009	86	2	34	122	88	97.7%	2.3%
2010	86	1	37	124	87	98.9%	1.1%
2011	71	1	54	126	72	98.6%	1.4%


Average Males/Complex from Complex Counts
120.0
100.0
80.0
60.0
40.0
20.0
0.0
38.3
54.5
58.5
96.5
109.9
99.4
68.7
54.0
46.3
43.6
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011

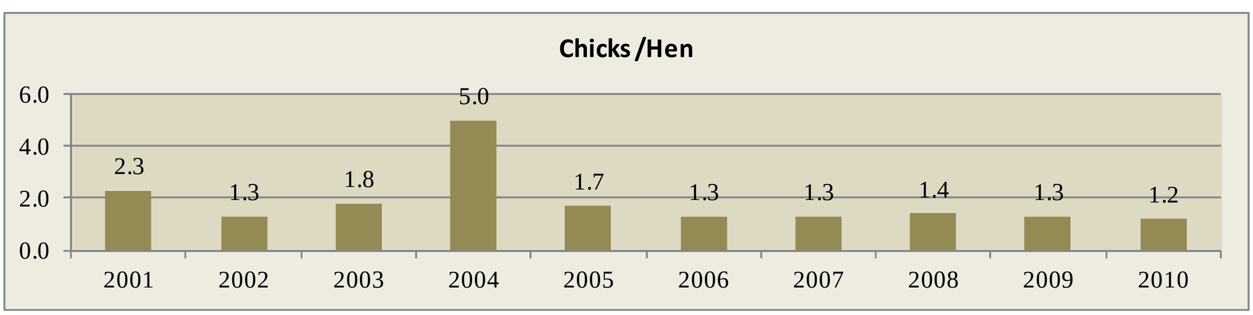

Average Males/Complex from Complex Surveys
100.0
80.0
60.0
40.0
20.0
0.0
28.3
32.7
41.0
67.6
78.1
47.4
50.7
45.1
29.2
28.2
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011


Average Males/Complex from all Complex Observations
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
31.3
39.4
46.1
76.0
93.0
73.4
60.4
49.7
36.2
35.7
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011


Lek Complex Monitoring Trend 2002 - 2011
140
120
100
80
60
40
20
0
104
105
108
109
112
115
120
122
124
126
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Known
Checked
Survey
Count

Appendix D. Sage-grouse wing analysis for the WRSRCA, Harvest Year 2010.

Adult Males:	76	**Percent of All Wings:**	16.0%
Adult Females:	144	**Percent of All Wings:**	30.3%
Adult Unknown:	0	**Percent of All Wings:**	0.0%
Total Adults:	**220**		
Yearling Males:	21	**Percent of All Wings:**	4.4%
Yearling Females:	32	**Percent of All Wings:**	6.7%
Yearling Unknown:	0	**Percent of All Wings:**	0.0%
Total Yearlings:	**53**		
Chick Males:	72	**Percent of All Wings:**	15.1%
Chick Females:	131	**Percent of All Wings:**	27.5%
Chick Unknown:	0	**Percent of All Wings:**	0.0%
Total Chicks:	**203**		
Unknown Sex/Age	0	**Percent of All Wings:**	0.0%
Total for all Sex/Age Groups:	**476**		
Chick Males:	72	**Percent of All Chicks:**	35.5%
Yearling Males:	21	**Percent of Adult and Yearling Males:**	21.6%
Adult Males:	76	**Percent of Adult and Yearling Males:**	78.4%
Adult and Yearling Males:	97	**Percent of Adults and Yearlings:**	35.5%
Total Males:	**169**	**Percent of All Sex/Age Groups:**	35.5%
Chick Females:	131	**Percent of All Chicks:**	64.5%
Yearling Females:	32	**Percent of Adult and Yearling Females:**	18.2%
Adult Females:	144	**Percent of Adult and Yearling Females:**	81.8%
Adult and Yearling Females:	176	**Percent of Adults and Yearlings:**	64.5%
Total Females:	**307**	**Percent of All Sex/Age Groups:**	64.5%
Chicks:	203	**Percent of All Wings:**	42.6%
Yearlings:	53	**Percent of All Wings:**	11.1%
Adults:	220	**Percent of All Wings:**	46.2%
Chicks/Hen:	**1.2**		



Appendix E. Sage-grouse hunting seasons, harvest, and wing analyses (2001-2010).

a. Season

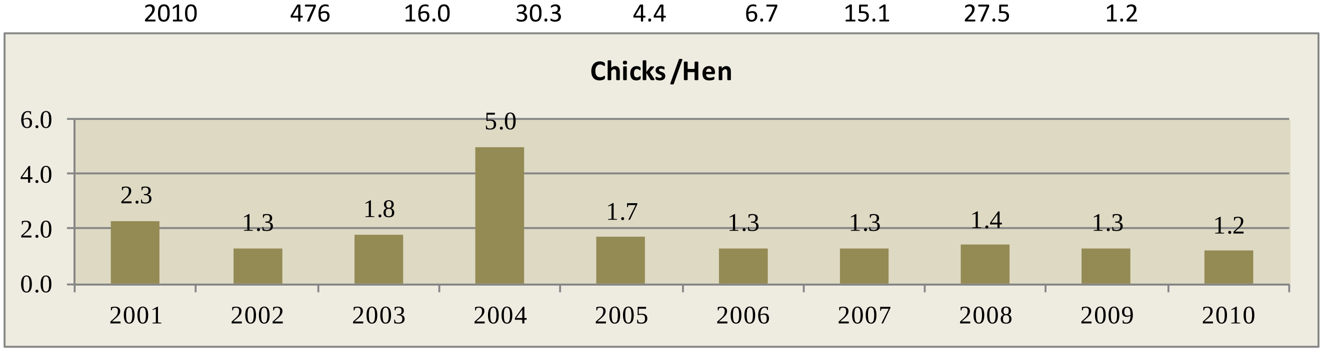
Year	Season Dates	Length	Bag/Possession Limit
2001	Sep 22-Oct 7	16	3/6
2002	Sep 28-Oct 6	9	2/4
2003	Sep 27-Oct 5	9	2/4
2004	Sept 23-Oct 3	11	2/4
2005	Sept 23-Oct 3	11	2/4
2006	Sept 23-Oct 3	11	2/4
2007	Sept 22-Oct 2	11	2/4
2008	Sept 22-Oct 2	11	2/4
2009	Sept 19-Sept 30	12	2/4
2010	Sept 18-Sept 30	13	2/4

b. Harvest

Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2001	1774	694	1922	0.9	2.6	2.8
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
Avg	1,799	702	1,664	1.1	2.5	2.3

c. Composition of harvest by wings collected

	Sample	Percent Adult		Percent Ylg		Percent Young		Chicks /Hen
Year	Size	Male	Female	Male	Female	Male	Female	
2001	467	7.9	20.8	2.4	6.2	22.7	40.0	2.3
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



Appendix F. Sage-grouse lek observations by complex in the WRSRCA, 2011.

Lek Name	Survey Date Mo.	Day	Time	Status	Observation Males	Females	Unk.	Observer	Method
Upland Bird Management Area 14									
Complex: Dubois									
Dubois	5	16		Active	10	0		C Thompson	Ground
Upland Bird Management Area 18									
Complex: 9 Mile									
9 Mile North	4	21	0645	Unknown	0	0		Greg Anderson	Ground
9 Mile South	4	21	0650	Active	36	0		Greg Anderson	Ground
Complex: Arrowhead									
Arrowhead - East	3	30	0715	Unknown	0	0		Greg Anderson	Ground
Arrowhead - West	3	30	0700	Active	37	2		Greg Anderson	Ground
Complex: Black Rocks									
Black Rocks	5	4	0545	Active	21	4		Greg Anderson	Ground
Complex: Bridger Trail									
Bridger Trail	4	19	0715	Unknown	0	0		Greg Anderson	Ground
Complex: Canyon Creek									
Canyon Creek - Ranch South	5	4	0615	Unknown	0	0		Greg Anderson	Ground
Canyon Creek - Red Hill	5	4	0700	Active	25	0		Greg Anderson	Ground
Canyon Creek - South	5	4	0730	Unknown	0	0		Greg Anderson	Ground
Canyon Creek - Stock Pond	5	4	0650	Unknown	0	0		Greg Anderson	Ground
Canyon Creek - Well	5	4	0620	Active			58	Greg Anderson	Ground
Complex: Canyon Creek - Ranch									
Canyon Creek - Ranch	5	4	0600	Unknown	0	0		Greg Anderson	Ground
Complex: Chalk Hills									
Chalk Hills	4	19	0630	Unknown	0	0		Greg Anderson	Ground
Complex: Conant Creek									
Conant Creek - North Twin	3	31	0645	Active	34	21		Greg Anderson	Ground
Conant Creek - South Twin	3	31	0630	Unknown	0	0		Greg Anderson	Ground
Complex: Davison Road									
Davison Road - 7 Mile	4	25	0620	Unknown	0	0		Greg Anderson	Ground
Complex: Davison Road - 12 Mile									
Davison Road - East 12	4	25	0715	Unknown	0	0		Greg Anderson	Ground
Davison Road - South 12 Mile	4	25	0700	Unknown	0	0		Greg Anderson	Ground
Falcon Nest	4	25	0740	Active	35	0		Greg Anderson	Ground
Complex: Davison Road - 8 Mile									
Davison Road - 8 Mile	4	25	0630	Active	19	0		Greg Anderson	Ground
Complex: Fuller Airstrip									
Fuller Airstrip	4	19	0625	Active	4	1		Greg Anderson	Ground
Complex: Iron Horse									
Birdsfoot	4	22	0610	Unknown	0	0		Greg Anderson	Ground
Iron Horse	4	22	0620	Active	10	0		Greg Anderson	Ground
Complex: Lysite Creek									
Davis Pass - West	5	6		Active	4	0		Greg Anderson	Ground
Lysite Creek - Bottom	5	6	0650	Unknown	0	0		Greg Anderson	Ground
Lysite Creek - Hill	5	6	0700	Active	2	0		Greg Anderson	Ground
Complex: Nebo									
Nebo	3	30	0815	Active	17		3	Greg Anderson	Ground
Complex: Ocla Draw									
Ocla Draw	4	22	0740	Active	8	0		Greg Anderson	Ground
Complex: Pipeline									
Pipeline	4	18	0645	Unknown	0	0		Chris Daubin	Ground
Pipeline	4	21	0600	Active	18	2		Greg Anderson	Ground
Pipeline	4	26	0640	Active	13	0		Chris Daubin	Ground
Willow Springs Draw	4	21	0615	Unknown	0	0		Greg Andreson	Ground
Complex: Powerline									
Powerline	3	31	0735	Active	37	12		Greg Anderson	Ground

Complex: South Bridger Creek								
South Bridger Creek	4	19	0645	Active	1	0	Greg Anderson	Ground
Complex: South Fuller Reservoir								
South Fuller Reservoir	3	30	0720	Unknown	0	0	Greg Anderson	Ground
Complex: Squaw Butte								
Squaw Butte East	4	21	0725	Active	49	2	Greg Anderson	Ground

Upland Bird Management Area 8

Complex: Agate Flats								
Agate Flats	4	12	0625	Active	27	21	Laurie Van Fleet	Ground
Agate Flats	4	21	0650	Active	21	1	Laurie Van Fleet	Ground
Agate Flats	4	21	0600	Active	24	0	UW - M. White	Ground
Agate Flats	4	29	0610	Active	14	0	Laurie Van Fleet	Ground
Agate Flats	5	6	0642	Active	28	1	Laurie Van Fleet	Ground
McIntosh Meadows	4	12	0620	Active	1	0	Laurie Van Fleet	Ground
McIntosh Meadows	4	21	0700	Active	0	0	Laurie Van Fleet	Ground
McIntosh Meadows	4	29	0622	Active	0	0	Laurie Van Fleet	Ground
McIntosh Meadows	5	6	0636	Active	0	2	Laurie Van Fleet	Ground
Complex: Antelope Springs								
Antelope Springs	4	15	0720	Active	15	1	Tom Ryder	Ground
Antelope Springs	4	21	0710	Active	3	0	Tom Ryder	Ground
Antelope Springs	5	5	0645	Active	11	0	Tom Ryder	Ground
Complex: Ballenger Draw								
Ballenger Draw	3	18	0840	Active	29	0	UC-Davis	Ground
Ballenger Draw	3	20	0755	Active	25	5	UC-Davis	Ground
Ballenger Draw	3	30	0709	Active	20	10	UC-Davis	Ground
Ballenger Draw	3	31	0717	Active	24	19	UC-Davis	Ground
Ballenger Draw	4	29	0600	Active	0	0	UC-Davis	Ground
Ballenger Draw	5	6	0630	Active	0	0	UC-Davis	Ground
Complex: Beulah Belle								
Beulah Belle Lake	4	21	0550	Active	21	2	Bill Brinegar	Ground
Complex: Bill's								
Bill's	4	13	0711	Active	36	0	Stan Harter	Ground
Complex: Black Rock								
Black Rock	4	7	0700	Inactive	0	0	Nick Scribner	Ground
Black Rock	4	16	0647	Inactive	0	0	Nick Scribner	Ground
Black Rock	4	22	0630	Inactive	0	0	Nick Scribner	Ground
Black Rock Draw	3	31	0635	Active	15	2	UW - L.	Ground
Black Rock Draw	4	1	0710	Active	39	3	Nick Scribner	Ground
Black Rock Draw	4	7	0713	Active	23	3	Nick Scribner	Ground
Black Rock Draw	4	16	0635	Active	45	2	Nick Scribner	Ground
Black Rock Draw	4	16	0559	Active	26	2	UW - L.	Ground
Black Rock Draw	4	22	0645	Active	29	0	Nick Scribner	Ground
Complex: Blackjack								
Blackjack	4	21	0730	Active	1	1	Laurie Van Fleet	Ground
Blackjack	4	29	0645	Active	62	0	Laurie Van Fleet	Ground
Blackjack	5	6	0710	Active	91	3	Laurie Van Fleet	Ground
Complex: Buffalo Creek								
Buffalo Creek	4	1	0650	Active	5	0	Nick Scribner	Ground
Buffalo Creek	4	7	0735	Active	5	2	Nick Scribner	Ground
Buffalo Creek	4	16	0615	Active	4	0	Nick Scribner	Ground
Buffalo Creek	4	22	0711	Active	2	0	Nick Scribner	Ground
Complex: Carmody Lake								
Carmody Lake	3	22	0658	Active	18	2	UW - K. Smith	Ground
Carmody Lake	3	30	0645	Active	32	8	UW - K. Smith	Ground
Carmody Lake	4	15	0600	Active	53	38	Tom Ryder	Ground
Carmody Lake	4	21	0555	Active	47	4	Tom Ryder	Ground
Carmody Lake	4	29	0540	Active	0	0	Tom Ryder	Ground
Carmody Lake	5	5	0530	Active	59	3	Tom Ryder	Ground
Complex: Carr Springs								
Carr Springs Draw	3	18	0742	Active	43	13	UC-Davis	Ground
Carr Springs Draw	3	31	0757	Active	30	18	UC-Davis	Ground
Carr Springs Draw	5	6	0605	Active	28	4	UC-Davis	Ground
Carr Springs NW	5	6	1500	Active	3	0	Stan Harter	Ground

West Carr Springs Draw	3	18	0705	Active	0	0	UC-Davis	Ground
West Carr Springs Draw	3	20	0659	Active	27	5	UC-Davis	Ground
West Carr Springs Draw	3	31	0631	Active	41	15	UC-Davis	Ground
West Carr Springs Draw	5	6	0529	Active	23	1	UC-Davis	Ground

Complex: Chugwater

Chugwater Reservoir	3	6	0725	Active	3	0	UC-Davis	Ground
Chugwater Reservoir	3	7	0700	Active	0	0	UC-Davis	Ground
Chugwater Reservoir	3	8	0715	Active	0	0	UC-Davis	Ground
Chugwater Reservoir	3	9		Active	0	0	UC-Davis	Ground
Chugwater Reservoir	3	10	0652	Active	9	0	UC-Davis	Ground
Chugwater Reservoir	3	11	0655	Active	17	0	UC-Davis	Ground
Chugwater Reservoir	3	12	0631	Active	1	0	UC-Davis	Ground
Chugwater Reservoir	3	13	0700	Active	7	0	UC-Davis	Ground
Chugwater Reservoir	3	14	0755	Active	7	0	UC-Davis	Ground
Chugwater Reservoir	3	15	0758	Active	16	0	UC-Davis	Ground
Chugwater Reservoir	3	16	0720	Active	6	0	UC-Davis	Ground
Chugwater Reservoir	3	17	0740	Active	23	0	UC-Davis	Ground
Chugwater Reservoir	3	18	0730	Active	26	0	UC-Davis	Ground
Chugwater Reservoir	3	19	0753	Active	19	6	UC-Davis	Ground
Chugwater Reservoir	3	19	0716	Active	24	2	UC-Davis	Ground
Chugwater Reservoir	3	20	0701	Active	27	3	UC-Davis	Ground
Chugwater Reservoir	3	20	0808	Active	20	5	UC-Davis	Ground
Chugwater Reservoir	3	21	0658	Active	24	0	UC-Davis	Ground
Chugwater Reservoir	3	21	0800	Active	14	1	UC-Davis	Ground
Chugwater Reservoir	3	22	0641	Active	25	0	UC-Davis	Ground
Chugwater Reservoir	3	22	0651	Active	21	2	UC-Davis	Ground
Chugwater Reservoir	3	23	0638	Active	23	11	UC-Davis	Ground
Chugwater Reservoir	3	23	0752	Active	29	2	UC-Davis	Ground
Chugwater Reservoir	3	24	0800	Active	19	0	UC-Davis	Ground
Chugwater Reservoir	3	24	0654	Active	18	16	UC-Davis	Ground
Chugwater Reservoir	3	25	0708	Active	28	17	UC-Davis	Ground
Chugwater Reservoir	3	25	0638	Active	30	9	UC-Davis	Ground
Chugwater Reservoir	3	26	0635	Active	21	21	UC-Davis	Ground
Chugwater Reservoir	3	26	0756	Active	23	1	UC-Davis	Ground
Chugwater Reservoir	3	27	0640	Active	36	20	UC-Davis	Ground
Chugwater Reservoir	3	28	0640	Active	25	50	UC-Davis	Ground
Chugwater Reservoir	3	28	0750	Active	22	55	UC-Davis	Ground
Chugwater Reservoir	3	29	0733	Active	23	42	UC-Davis	Ground
Chugwater Reservoir	3	29	0627	Active	28	26	UC-Davis	Ground
Chugwater Reservoir	3	30	0635	Active	29	37	UC-Davis	Ground
Chugwater Reservoir	3	30	0705	Active	28	38	UC-Davis	Ground
Chugwater Reservoir	3	31	0627	Active	32	28	UC-Davis	Ground
Chugwater Reservoir	3	31	0702	Active	27	36	UC-Davis	Ground
Chugwater Reservoir	4	1	0708	Active	28	40	UC-Davis	Ground
Chugwater Reservoir	4	1	0804	Active	29	7	UC-Davis	Ground
Chugwater Reservoir	4	2	0717	Active	26	8	UC-Davis	Ground
Chugwater Reservoir	4	3	0656	Active	39	47	UC-Davis	Ground
Chugwater Reservoir	4	4	0627	Active	35	16	UC-Davis	Ground
Chugwater Reservoir	4	4	0703	Active	40	14	UC-Davis	Ground
Chugwater Reservoir	4	5	0620	Active	36	21	UC-Davis	Ground
Chugwater Reservoir	4	6	0630	Active	34	18	UC-Davis	Ground
Chugwater Reservoir	4	6	0700	Active	42	10	UC-Davis	Ground
Chugwater Reservoir	4	7	0648	Active	29	12	UC-Davis	Ground
Chugwater Reservoir	4	7	0621	Active	34	11	UC-Davis	Ground
Chugwater Reservoir	4	8	0630	Active	35	10	UC-Davis	Ground
Chugwater Reservoir	4	8	0744	Active	36	4	UC-Davis	Ground
Chugwater Reservoir	4	9	0657	Active	35	13	UC-Davis	Ground
Chugwater Reservoir	4	9	0839	Active	46	3	UC-Davis	Ground
Chugwater Reservoir	4	11	0625	Active	42	14	UC-Davis	Ground
Chugwater Reservoir	4	12	0613	Active	44	10	UC-Davis	Ground
Chugwater Reservoir	4	13	0608	Active	33	2	UC-Davis	Ground
Chugwater Reservoir	4	14	0620	Active	44	6	UC-Davis	Ground
Chugwater Reservoir	4	15	0721	Active	40	2	UC-Davis	Ground
Chugwater Reservoir	4	16	0612	Active	40	0	UC-Davis	Ground

Chugwater Reservoir	4	17	0603	Active	30	0	UC-Davis	Ground
Chugwater Reservoir	4	18	0659	Active	35	4	UC-Davis	Ground
Chugwater Reservoir	4	19	0652	Active	34	5	UC-Davis	Ground
Chugwater Reservoir	4	20	0550	Active	34	4	UC-Davis	Ground
Chugwater Reservoir	4	21	0600	Active	33	1	UC-Davis	Ground
Chugwater Reservoir	4	21	0634	Active	35	0	UC-Davis	Ground
Chugwater Reservoir	4	22	0555	Active	36	1	UC-Davis	Ground
Chugwater Reservoir	4	23	0550	Active	37	3	UC-Davis	Ground
Chugwater Reservoir	4	24	0550	Active	40	5	UC-Davis	Ground
Chugwater Reservoir	4	25	0551	Active	38	4	UC-Davis	Ground
Chugwater Reservoir	4	25	0623	Active	42	1	UC-Davis	Ground
Chugwater Reservoir	4	26	0555	Active	42	1	UC-Davis	Ground
Chugwater Reservoir	4	27	0600	Active	36	4	UC-Davis	Ground
Chugwater Reservoir	4	28	0541	Active	45	11	UC-Davis	Ground
Chugwater Reservoir	4	29	0613	Active	35	6	UC-Davis	Ground
Chugwater Reservoir	4	29	0656	Active	36	0	UC-Davis	Ground
Chugwater Reservoir	4	30	0650	Active	39	0	UC-Davis	Ground
Chugwater Reservoir	4	30	0545	Active	31	6	UC-Davis	Ground
Chugwater Reservoir	5	1	0545	Active	41	1	UC-Davis	Ground
Chugwater Reservoir	5	1	0621	Active	22	2	UC-Davis	Ground
Chugwater Reservoir	5	6	0545	Active	32	4	UC-Davis	Ground
Chugwater Reservoir	5	6	0615	Active	29	6	UC-Davis	Ground
Chugwater Reservoir	5	9	0535	Active	20	2	UC-Davis	Ground
Chugwater Reservoir	5	9	0603	Active	23	0	UC-Davis	Ground
Complex: Coal Mine Gulch								
Coal Mine Gulch	4	5	0705	Active	16	1	Stan Harter	Ground
Coal Mine Gulch	4	18	0637	Active	20	0	Stan Harter	Ground
Coal Mine Gulch	4	26	0620	Active	16	2	Stan Harter	Ground
Upper Government Draw	4	5	0650	Active	20	22	Stan Harter	Ground
Upper Government Draw	4	18	0627	Active	22	4	Stan Harter	Ground
Upper Government Draw	4	26	0610	Active	21	2	Stan Harter	Ground
Complex: Cottontail								
Ballenger Reservoir	3	30	0740	Inactive	0	0	UC-Davis	Ground
Ballenger Reservoir	3	31	0835	Inactive	0	0	UC-Davis	Ground
Ballenger Reservoir	4	4	0718	Inactive	0	0	UC-Davis	Ground
Ballenger Reservoir	4	27	0700	Inactive	0	0	UC-Davis	Ground
Cottontail Reservoir	3	17	0717	Active	65	7	UC-Davis	Ground
Cottontail Reservoir	3	17	0729	Active	62	13	UC-Davis	Ground
Cottontail Reservoir	3	30	0801	Active	15	0	UC-Davis	Ground
Cottontail Reservoir	3	31	0845	Active	23	5	UC-Davis	Ground
Cottontail Reservoir	4	2	0750	Active	40	12	UC-Davis	Ground
Cottontail Reservoir	4	4	0700	Active	76	71	UC-Davis	Ground
Cottontail Reservoir	4	4	0655	Active	78	67	UC-Davis	Ground
Cottontail Reservoir	4	27	0649	Active	75	2	UC-Davis	Ground
Cottontail Reservoir	4	29	0641	Active	99	4	UC-Davis	Ground
Cottontail Reservoir	5	5	0648	Active	43	0	UC-Davis	Ground
Complex: Cottonwood Divide								
Chubby Springs	4	20	0615	Active	0	0	Brad Hovinga	Ground
Chubby Springs	4	26	0615	Active	2	0	Brad Hovinga	Ground
Chubby Springs	5	7	0545	Active	3	0	Brad Hovinga	Ground
Cottonwood Divide No. 1	4	20	0620	Abandoned	0	0	Brad Hovinga	Ground
Cottonwood Divide No. 1	4	26	0620	Abandoned	0	0	Brad Hovinga	Ground
Cottonwood Divide No. 1	5	7	0555	Abandoned	0	0	Brad Hovinga	Ground
Cottonwood Divide No. 2	4	20	0625	Active	4	0	Brad Hovinga	Ground
Cottonwood Divide No. 2	4	26	0630	Active	3	0	Brad Hovinga	Ground
Cottonwood Divide No. 2	5	7	0600	Active	2	0	Brad Hovinga	Ground
Complex: Coyote								
Coyote Lake	5	5	0645	Active	19	1	Stan Harter	Ground
Crofts	5	5	0655	Unknown	0	0	Stan Harter	Ground
Complex: Dickie Springs								
Dickie Springs	5	27	0558	Active	1	0	Courtney Rudd	Ground
Complex: Dickie Springs Creek								
Dickie Springs Creek	5	18	0635	Active	3	0	Stan Harter	Ground
Dickie Springs Creek	5	27	0634	Active	5	1	Courtney Rudd	Ground

Complex: Dishpan Butte									
Dishpan Butte	4	15	0625	Active	14	1		Tom Ryder	Ground
Dishpan Butte	4	21	0620	Active	0	0		Tom Ryder	Ground
Dishpan Butte	5	5	0550	Active	17	0		Tom Ryder	Ground
Complex: Dry Cheyenne									
Dry Cheyenne	4	19	0605	Active	37	1		Chris Daubin	Ground
Dry Cheyenne	4	27	0608	Active	39	1		Chris Daubin	Ground
Complex: Dry Lakes									
Dry Lakes	4	1	0755	Active	9	0		Nick Scribner	Ground
Dry Lakes	4	7	0630	Active	27	8		Nick Scribner	Ground
Dry Lakes	4	16	0703	Active	51	3		Nick Scribner	Ground
Dry Lakes	4	22	0620	Active	9	0		Nick Scribner	Ground
Complex: East Long Creek									
East Long Creek No. 1	4	16	0650	Active	18	1		Dan Bjornlie	Ground
East Long Creek No. 1	4	23	0615	Active	22	1		Dan Bjornlie	Ground
East Long Creek No. 1	4	29	0615	Active	4	0		Dan Bjornlie	Ground
East Long Creek No. 2	4	16	0730	Active	41	1		Dan Bjornlie	Ground
East Long Creek No. 2	4	23	0640	Active	32	0		Dan Bjornlie	Ground
East Long Creek No. 2	4	29	0630	Active	5	0		Dan Bjornlie	Ground
East Long Creek No. 3	4	16	0745	Active	0	0		Dan Bjornlie	Ground
East Long Creek No. 3	4	23	0700	Active	4	0		Dan Bjornlie	Ground
East Long Creek No. 3	4	29	0645	Active	9	0		Dan Bjornlie	Ground
Complex: Government Slide Draw									
Government Slide Draw	3	17	0726	Active	32	12		Tim Vosburgh	Ground
Government Slide Draw	4	20	0600	Active	56	2		UW - L.	Ground
Government Slide Draw	4	21	0730	Active	0	0		Stan Harter	Ground
Government Slide Draw	5	3	0740	Active	16	1		Stan Harter	Ground
Complex: Graham Road									
Graham Road	4	14	0636	Active	44	4		Stan Harter	Ground
Graham Road	4	27	0711	Active	45	4		Amy Adams	Ground
Complex: Gustin-Preacher									
Gustin Reservoir	3	14	0900	Active	11	0		UC-Davis	Ground
Gustin Reservoir	3	30	0851	Active	0	0	29	UC-Davis	Ground
Gustin Reservoir	4	7	0814	Active	26	9		UC-Davis	Ground
Gustin Reservoir	4	15	0813	Active	15	1		UC-Davis	Ground
Preacher Reservoir	3	14	0751	Active	8	0		UC-Davis	Ground
Preacher Reservoir	3	18	0640	Active	9	1		UC-Davis	Ground
Preacher Reservoir	3	19	0657	Active	7	0		UC-Davis	Ground
Preacher Reservoir	3	20	0636	Active	6	0		UC-Davis	Ground
Preacher Reservoir	3	21	0654	Active	8	4		UC-Davis	Ground
Preacher Reservoir	3	22	0812	Active	7	1		UC-Davis	Ground
Preacher Reservoir	3	23	0730	Active	10	4		UC-Davis	Ground
Preacher Reservoir	3	24	0657	Active	7	2		UC-Davis	Ground
Preacher Reservoir	3	24	0641	Active	8	1		UC-Davis	Ground
Preacher Reservoir	3	25	0652	Active	7	1		UC-Davis	Ground
Preacher Reservoir	3	26	0632	Active	6	1		UC-Davis	Ground
Preacher Reservoir	3	27	0735	Active	8	3		UC-Davis	Ground
Preacher Reservoir	3	28	0810	Active	7	0		UC-Davis	Ground
Preacher Reservoir	3	28	0701	Active	6	1		UC-Davis	Ground
Preacher Reservoir	3	29	0638	Active	7	1		UC-Davis	Ground
Preacher Reservoir	3	30	0646	Active	6	5		UC-Davis	Ground
Preacher Reservoir	3	30	0634	Active	8	2		UC-Davis	Ground
Preacher Reservoir	3	31	0648	Active	7	2		UC-Davis	Ground
Preacher Reservoir	4	1	0635	Active	6	7		UC-Davis	Ground
Preacher Reservoir	4	2	0653	Active	8	4		UC-Davis	Ground
Preacher Reservoir	4	2	0632	Active	6	5		UC-Davis	Ground
Preacher Reservoir	4	3	0645	Active	7	0		UC-Davis	Ground
Preacher Reservoir	4	4	0629	Active	6	2		UC-Davis	Ground
Preacher Reservoir	4	5	0605	Active	6	1		UC-Davis	Ground
Preacher Reservoir	4	6	0625	Active	7	1		UC-Davis	Ground
Preacher Reservoir	4	7	0619	Active	8	2		UC-Davis	Ground
Preacher Reservoir	4	8	0625	Active	6	1		UC-Davis	Ground
Preacher Reservoir	4	9	0617	Active	7	2		UC-Davis	Ground

Preacher Reservoir	4	11	0618	Active	8	1	UC-Davis	Ground
Preacher Reservoir	4	12	0643	Active	7	0	UC-Davis	Ground
Preacher Reservoir	4	13	0617	Active	7	0	UC-Davis	Ground
Preacher Reservoir	4	14	0558	Active	7	0	UC-Davis	Ground
Preacher Reservoir	4	15	0552	Active	7	0	UC-Davis	Ground
Preacher Reservoir	4	16	0550	Active	5	0	UC-Davis	Ground
Preacher Reservoir	4	17	0600	Active	6	0	UC-Davis	Ground
Preacher Reservoir	4	18	0554	Active	6	0	UC-Davis	Ground
Preacher Reservoir	4	19	0549	Active	5	0	UC-Davis	Ground
Preacher Reservoir	4	20	0552	Active	6	1	UC-Davis	Ground
Preacher Reservoir	4	21	0606	Active	5	0	UC-Davis	Ground
Preacher Reservoir	4	23	0536	Active	7	1	UC-Davis	Ground
Preacher Reservoir	4	25	0552	Active	7	1	UC-Davis	Ground
Preacher Reservoir	4	26	0542	Active	6	1	UC-Davis	Ground
Preacher Reservoir	4	27	0632	Active	0	0	UC-Davis	Ground
Preacher Reservoir	4	29	0539	Active	6	0	UC-Davis	Ground
Preacher Reservoir	4	30	0546	Active	6	0	UC-Davis	Ground
Preacher Reservoir	5	1	0524	Active	6	1	UC-Davis	Ground
Complex: Hall Creek								
Hall Creek No. 1	4	1	0740	Active	5	1	Stan Harter	Ground
Hall Creek No. 1	4	18	0738	Active	1	0	Stan Harter	Ground
Hall Creek No. 1	5	3	0622	Active	3	0	Stan Harter	Ground
Hall Creek No. 2	4	1	0750	Active	3	0	Stan Harter	Ground
Hall Creek No. 2	4	18	0745	Active	2	0	Stan Harter	Ground
Hall Creek No. 2	5	3	0604	Active	0	0	Stan Harter	Ground
Complex: Horseshoe								
Conant Fence	4	19	0701	Active	19	0	Chris Daubin	Ground
Conant Fence	4	27	0652	Active	14	0	Chris Daubin	Ground
Horseshoe Playa	4	18	0620	Active	20	2	Chris Daubin	Ground
Horseshoe Playa	4	26	0617	Active	22	1	Chris Daubin	Ground
Signor Ridge	4	15	0639	Active	16	1	Chris Daubin	Ground
Signor Ridge	4	25	0627	Active	18	2	Chris Daubin	Ground
Complex: Iturian								
Iturian	4	6	0825	Active	19	10	Stan Harter	Ground
Iturian	4	23	0655	Active	20	2	Stan Harter	Ground
Complex: Lander Cutoff								
Sharps Meadows Creek	5	18	0608	Active	17	0	Stan Harter	Ground
Complex: Lander Valley Reservoir								
Lander Valley Reservoir	3	15	0745	Active	31	0	UC-Davis	Ground
Lander Valley Reservoir	4	2	0640	Active	28	3	UC-Davis	Ground
Lander Valley Reservoir	4	9	0716	Active	28	2	UC-Davis	Ground
Lander Valley Reservoir	5	5	0550	Active	31	2	UC-Davis	Ground
Complex: Long Creek								
Cedar Rim Pipeline No. 1	4	15	0750	Abandoned	0	0	Oberlie/Vosburgh	Ground
Cedar Rim Pipeline No. 1	4	22	0615	Abandoned	0	0	Sue Oberlie	Ground
Cedar Rim Pipeline No. 1	4	29	0630	Abandoned	0	0	Sue Oberlie	Ground
Cedar Rim Pipeline No. 2	4	1	0720	Active	32	6	Oberlie/Vosburgh	Ground
Cedar Rim Pipeline No. 2	4	8	0730	Active	29	3	Oberlie/Vosburgh	Ground
Cedar Rim Pipeline No. 2	4	15	0640	Active	44	4	Oberlie/Vosburgh	Ground
Cedar Rim Pipeline No. 2	4	22	0625	Active	49	2	Oberlie/Vosburgh	Ground
Cedar Rim Pipeline No. 2	4	25	0601	Active	31	2	UW - M. White	Ground
Cedar Rim Pipeline No. 2	4	29	0645	Active	5	0	Oberlie/Vosburgh	Ground
Long Creek No. 3	4	8	0800	Inactive	0	0	Tim Vosburgh	Ground
Long Creek No. 3	4	15	0715	Inactive	0	0	Oberlie/Vosburgh	Ground
Long Creek No. 3	4	22	0700	Inactive	0	0	Sue Oberlie	Ground
Long Creek No. 3	4	29	0710	Inactive	0	0	Sue Oberlie	Ground
Long Creek No. 4	4	15	0655	Inactive	0	0	Oberlie/Vosburgh	Ground
Long Creek No. 4	4	22	0645	Inactive	0	0	Sue Oberlie	Ground
Long Creek No. 4	4	29	0700	Inactive	0	0	Sue Oberlie	Ground
Complex: McGraw Flats								
McGraw Flats No. 1	4	21	0630	Inactive	0	0	Brad Hovinga	Ground
McGraw Flats No. 1	4	27	0630	Inactive	0	0	Brad Hovinga	Ground
McGraw Flats No. 1	5	7	0715	Inactive	0	0	Brad Hovinga	Ground
McGraw Flats No. 2	4	21	0645	Active	58	3	Brad Hovinga	Ground

McGraw Flats No. 2	4	27	0645	Active	64	6		Brad Hovinga	Ground
McGraw Flats No. 2	5	7	0700	Active	50	0		Brad Hovinga	Ground
Complex: McTurk Draw									
McTurk Draw	3	31	0710	Active	4	0	3	Bill Skelton	Ground
McTurk Draw	4	8	0645	Active	0	0		Bill Skelton	Ground
McTurk Draw	4	21	0745	Active	3	0		Stan Harter	Ground
McTurk Draw	4	30	0640	Active	2	0	5	Bill Skelton	Ground
McTurk Draw	5	13	0650	Active	8	0		Bill Skelton	Ground
Complex: McTurk Ridge									
McTurk Ridge	3	31	0630	Active	20	0	9	Bill Skelton	Ground
McTurk Ridge	4	8	0625	Active	1	0		Bill Skelton	Ground
McTurk Ridge	4	30	0615	Active	21	0		Bill Skelton	Ground
McTurk Ridge	5	13	0635	Active	0	0		Bill Skelton	Ground
Complex: Mitten Springs									
Mitten Springs North	5	5	0735	Active	0	0		Stan Harter	Ground
Mitten Springs South	5	5	0730	Unknown	0	0		Stan Harter	Ground
Complex: Monument									
Monument Draw	3	6	0720	Active	0	0		UC-Davis	Ground
Monument Draw	3	7	0647	Active	0	0		UC-Davis	Ground
Monument Draw	3	8	0715	Active	0	0		UC-Davis	Ground
Monument Draw	3	9	0655	Active	0	0		UC-Davis	Ground
Monument Draw	3	10	0640	Active	0	0		UC-Davis	Ground
Monument Draw	3	12	0618	Active	0	0		UC-Davis	Ground
Monument Draw	3	13	0712	Active	5	0		UC-Davis	Ground
Monument Draw	3	14	0630	Active	0	0		UC-Davis	Ground
Monument Draw	3	17	0656	Active	8	0		UC-Davis	Ground
Monument Draw	3	19	0801	Active	18	0		UC-Davis	Ground
Monument Draw	3	20	0710	Active	16	4		UC-Davis	Ground
Monument Draw	3	22	0644	Active	14	0		UC-Davis	Ground
Monument Draw	3	23	0656	Active	25	9		UC-Davis	Ground
Monument Draw	3	24	0702	Active	23	15		UC-Davis	Ground
Monument Draw	3	25	0642	Active	12	4		UC-Davis	Ground
Monument Draw	3	26	0739	Active	14	17		UC-Davis	Ground
Monument Draw	3	27	0631	Active	13	8		UC-Davis	Ground
Monument Draw	3	28	0814	Active	24	3		UC-Davis	Ground
Monument Draw	3	29	0657	Active	13	3		UC-Davis	Ground
Monument Draw	3	29	0728	Active	18	0		UC-Davis	Ground
Monument Draw	3	30	0659	Active	5	6		UC-Davis	Ground
Monument Draw	3	30	0759	Active	6	0		UC-Davis	Ground
Monument Draw	3	31	0627	Active	17	11		UC-Davis	Ground
Monument Draw	4	1	0618	Active	13	0		UC-Davis	Ground
Monument Draw	4	1	0829	Active	8	4		UC-Davis	Ground
Monument Draw	4	2	0631	Active	21	12		UC-Davis	Ground
Monument Draw	4	3	0624	Active	13	3		UC-Davis	Ground
Monument Draw	4	3	0654	Active	8	4		UC-Davis	Ground
Monument Draw	4	4	0654	Active	21	12		UC-Davis	Ground
Monument Draw	4	5	0618	Active	11	4		UC-Davis	Ground
Monument Draw	4	6	0624	Active	15	8		UC-Davis	Ground
Monument Draw	4	7	0614	Active	11	4		UC-Davis	Ground
Monument Draw	4	8	0617	Active	13	5		UC-Davis	Ground
Monument Draw	4	9	0651	Active	24	12		UC-Davis	Ground
Monument Draw	4	11	0651	Active	15	1		UC-Davis	Ground
Monument Draw	4	12	0724	Active	12	0		UC-Davis	Ground
Monument Draw	4	13	0606	Active	9	0		UC-Davis	Ground
Monument Draw	4	14	0609	Active	12	0		UC-Davis	Ground
Monument Draw	4	15	0702	Active	16	0		UC-Davis	Ground
Monument Draw	4	16	0710	Active	2	0		UC-Davis	Ground
Monument Draw	4	17	0631	Active	0	1		UC-Davis	Ground
Monument Draw	4	18	0609	Active	15	2		UC-Davis	Ground
Monument Draw	4	20	0711	Active	8	0		UC-Davis	Ground
Monument Draw	4	21	0606	Active	8	2		UC-Davis	Ground
Monument Draw	4	21	0632	Active	11	0		UC-Davis	Ground
Monument Draw	4	22	0638	Active	9	1		UC-Davis	Ground
Monument Draw	4	23	0717	Active	11	1		UC-Davis	Ground

Monument Draw	4	26	0603	Active	11	1	UC-Davis	Ground
Monument Draw	4	27	0545	Active	10	1	UC-Davis	Ground
Monument Draw	4	28	0641	Active	13	2	UC-Davis	Ground
Monument Draw	4	28	0558	Active	12	6	UC-Davis	Ground
Monument Draw	4	29	0609	Active	11	3	UC-Davis	Ground
Monument Draw	4	30	0555	Active	11	1	UC-Davis	Ground
Monument Draw	5	1	0643	Active	6	0	UC-Davis	Ground
Monument Draw	5	9	0530	Active	4	0	UC-Davis	Ground
Complex: Nancy Creek								
Cottonwood Creek	3	19	0800	Inactive	0	0	Kim Olson	Ground
Cottonwood Creek	3	26	0815	Inactive	0	0	Kim Olson	Ground
Nancy Creek	3	19	0730	Active	2	0	Kim Olson	Ground
Nancy Creek	3	26	0720	Active	2	0	Kim Olson	Ground
Nancy Creek	4	4	0730	Active	11	11	Kim Olson	Ground
Nancy Creek	4	20	0700	Active	9	0	Kim Olson	Ground
Nancy Creek Reservoir	3	19	0715	Active	22	4	Kim Olson	Ground
Nancy Creek Reservoir	3	26	0705	Active	30	3	Kim Olson	Ground
Nancy Creek Reservoir	4	4	0700	Active	27	5	Kim Olson	Ground
Nancy Creek Reservoir	4	20	0645	Active	28	2	Kim Olson	Ground
Complex: Ninemile Draw								
Ninemile Draw	3	17	0846	Inactive	0	0	Tim Vosburgh	Ground
Ninemile Draw	4	26	0744	Inactive	0	0	Stan Harter	Ground
Complex: Ninemile Reservoir								
Ninemile Reservoir	3	17	0815	Active	30	8	Tim Vosburgh	Ground
Ninemile Reservoir	4	26	0725	Active	55	2	Stan Harter	Ground
Complex: North Bear Mountain								
North Bear Mountain	4	23	0735	Active	31	4	Stan Harter	Ground
Complex: North Long Creek								
Long Creek No. 1	5	7	0706	Unknown	0	0	Stan Harter	Ground
Long Creek No. 2	5	7	0720	Unknown	0	0	Stan Harter	Ground
Complex: North Sand Gulch								
North Sand Gulch	3	15	0808	Active	6	0	UC-Davis	Ground
North Sand Gulch	3	17	0825	Active	10	0	UC-Davis	Ground
North Sand Gulch	4	2	0719	Active	44	26	UC-Davis	Ground
North Sand Gulch	4	6	0630	Active	48	19	UC-Davis	Ground
North Sand Gulch	4	9	0635	Active	49	12	UC-Davis	Ground
North Sand Gulch	5	5	0605	Active	9	0	UC-Davis	Ground
Complex: Onion Flats								
Onion Flats No. 1	3	30	0700	Active	13	8	Brad Hovinga	Ground
Onion Flats No. 1	4	7	0700	Active	14	2	Brad Hovinga	Ground
Onion Flats No. 1	4	19	0700	Active	0	0	Brad Hovinga	Ground
Onion Flats No. 2	3	30	0640	Active	13	0	Brad Hovinga	Ground
Onion Flats No. 2	4	7	0645	Active	16	6	Brad Hovinga	Ground
Onion Flats No. 2	4	19	0715	Active	3	3	Brad Hovinga	Ground
Complex: Pacific Creek								
Pacific Creek Playa	5	18	0624	Active	0	0	Stan Harter	Ground
Pacific Creek Playa	5	27	0535	Active	9	0	Courtney	Ground
Complex: Picket Lake								
Picket Lake	4	12	0900	Active	24	3	Stan Harter	Ground
Complex: Rawlins Draw								
Rawlins Draw	4	13	0752	Active	27	0	Stan Harter	Ground
Complex: Sage Hen								
Sage Hen No. 1	4	12	0740	Inactive	0	0	Laurie Van Fleet	Ground
Sage Hen No. 1	4	21	0640	Inactive	0	0	Laurie Van Fleet	Ground
Sage Hen No. 1	4	29	0755	Inactive	0	0	Laurie Van Fleet	Ground
Sage Hen No. 1	5	6	0620	Inactive	0	0	Laurie Van Fleet	Ground
Sage Hen No. 2	4	12	0725	Active	8	0	Laurie Van Fleet	Ground
Sage Hen No. 2	4	21	0625	Active	3	0	Laurie Van Fleet	Ground
Sage Hen No. 2	4	29	0750	Active	0	0	Laurie Van Fleet	Ground
Sage Hen No. 2	5	6	0612	Active	0	0	Laurie Van Fleet	Ground
Sage Hen No. 3	4	12	0710	Active	32	5	Laurie Van Fleet	Ground
Sage Hen No. 3	4	21	0615	Active	21	3	Laurie Van Fleet	Ground
Sage Hen No. 3	4	29	0740	Active	17	0	Laurie Van Fleet	Ground

Sage Hen No. 3	5	6	0605	Active	29	1		Laurie Van Fleet	Ground
Sage Hen No. 4	4	12	0700	Inactive	1	0		Laurie Van Fleet	Ground
Sage Hen No. 4	4	21	0610	Inactive	0	0		Laurie Van Fleet	Ground
Sage Hen No. 4	4	29	0734	Inactive	0	0		Laurie Van Fleet	Ground
Sage Hen No. 4	5	6	0600	Inactive	0	0		Laurie Van Fleet	Ground
Complex: Scarlett Ranch									
Scarlett Ranch	4	1	0805	Active	24	3		Oberlie/Vosburgh	Ground
Scarlett Ranch	4	8	0835	Active	0	0		Oberlie/Vosburgh	Ground
Scarlett Ranch	4	15	0735	Active	25	2		Oberlie/Vosburgh	Ground
Scarlett Ranch	4	22	0720	Active	39	1		Sue Oberlie	Ground
Scarlett Ranch	4	29	0730	Active	3	0		Sue Oberlie	Ground
Complex: Soap Holes									
Ice Slough	3	31	0710	Inactive	0	0		Amy Adams	Ground
Ice Slough	4	20	0645	Inactive	0	0		Amy Adams	Ground
Ice Slough	4	27	0625	Inactive	0	0		Amy Adams	Ground
Soap Holes	3	29	0646	Active	44	8		UW - K. Smith	Ground
Soap Holes	3	31	0645	Active	53	4		Amy Adams	Ground
Soap Holes	4	13	0713	Active	55	4	60	Stan Harter	Ground
Soap Holes	4	20	0620	Active	70	6		Amy Adams	Ground
Soap Holes	4	27	0600	Active	62	8		Amy Adams	Ground
Complex: South Pass									
Fish Creek	5	18	0545	Active	54	5		Stan Harter	Ground
Pine Creek	5	18	0522	Active	32	6		Stan Harter	Ground
Complex: Split Rock									
Dry Draw	4	13	0729	Active	16	0		Stan Harter	Ground
Complex: Spring Creek									
Spring Creek	4	13	0642	Active	41	20		Stan Harter	Ground
Complex: Stampede									
Radio Tower Draw No. 2	4	15	0557	Active	29	5		UW - L.	Ground
Radio Tower Draw No. 2	4	19	0545	Active	28	1		UW - L.	Ground
Radio Tower Draw No. 2	4	23	0600	Active	0	0	19	UW - M. White	Ground
Complex: Twin Creek									
East Twin Creek	4	1	0714	Active	10	1		Stan Harter	Ground
East Twin Creek	4	18	0715	Active	41	3		Stan Harter	Ground
East Twin Creek	4	26	0655	Active	28	0		Stan Harter	Ground
Twin Creek	4	1	0700	Active	14	11		Stan Harter	Ground
Twin Creek	4	18	0700	Active	13	3		Stan Harter	Ground
Twin Creek	4	26	0640	Active	14	0		Stan Harter	Ground
Complex: Warm Springs									
Warm Alkali	4	6	0705	Active	9	18		Stan Harter	Ground
Warm Alkali	4	23	0627	Active	5	0		Stan Harter	Ground
Warm Springs No. 1	4	5	0630	Active	12	2		UW - K. Smith	Ground
Warm Springs No. 1	4	15	0655	Active	15	5		Tom Ryder	Ground
Warm Springs No. 1	4	20	0700	Active	8	0		UW - L.	Ground
Warm Springs No. 1	4	21	0650	Active	7	0		Tom Ryder	Ground
Warm Springs No. 1	4	23	0612	Active	10	2		Stan Harter	Ground
Warm Springs No. 1	5	5	0612	Active	10	1		Stan Harter	Ground
Warm Springs No. 1	5	5	0615	Active	10	1		Tom Ryder	Ground
Warm Springs No. 2	4	15	0705	Abandoned	0	0		Tom Ryder	Ground
Warm Springs No. 2	4	21	0700	Abandoned	0	0		Tom Ryder	Ground
Warm Springs No. 2	5	5	0630	Abandoned	0	0		Tom Ryder	Ground
Complex: West Long Creek									
West Long Creek No. 1	5	7	0625	Active	64	0		Stan Harter	Ground
West Long Creek No. 2	4	15	0815	Active	0	0		Oberlie/Vosburgh	Ground
West Long Creek No. 2	5	7	0605	Active	53	3		Stan Harter	Ground
Complex: Yellowstone Ranch									
Hays Draw	4	21	0645	Active	15	0		Stan Harter	Ground
Hays Draw	5	3	0711	Active	12	0		Stan Harter	Ground

Upland Bird Management Area: WR						
Complex: Alkali Butte						
Alkali Butte (#26)	3/19/2011 07:15	Unknown	0		D. Skates	Ground
Alkali Butte North (#39)	3/18/2011 06:51	Active	19	3	D. Skates	Ground
Alkali Butte North (#39)	4/21/2011 06:01	Active	19	6	D. Skates	Ground
Riverton Dome Oil Field (#25)		Unknown				
Complex: Bargee						
Bargee Stage Stop (#1)		Unknown				
Complex: Bighorn Draw						
Bighorn Butte (#4A)	4/5/2011 06:45	Unknown	0		M. Mazur	Ground
Bighorn Butte (#4B)	4/5/2011 07:15	Active	10		M. Mazur	Ground
Bighorn Butte (#4B)	4/15/2011 06:30	Active	11	2	M. Mazur	Ground
Bighorn Butte (#4C)	4/5/2011 07:30	Unknown	0		M. Mazur	Ground
Bighorn Butte (#4D)	4/5/2011 06:30	Active	24	12	M. Mazur	Ground
Bighorn Butte (#4D)	4/15/2011 06:25	Active	36	3	M. Mazur	Ground
Bighorn Draw (#3A)	4/27/2011 06:05	Unknown	0		P.Hnilicka	Ground
Bighorn Draw (#3B)	4/27/2011 06:05	Unknown	0		P.Hnilicka	Ground
Bighorn Draw (#3C)	4/27/2011 06:05	Unknown	0		P.Hnilicka	Ground
Complex: Boulder Flat						
Blue Trail (#31)	3/18/2011 07:45	Unknown	0		M. Mazur	Ground
Blue Trail (#31)	3/29/2011 07:00	Unknown	0		M. Mazur	Ground
Boulder Flat (#8)	3/25/2011 07:00	Unknown	0		M. Mazur	Ground
Fenceline (#6)		Unknown				
Mill Creek Southeast (#32)	3/25/2011 07:20	Active	0		M. Mazur	Ground
Mill Creek Southeast (#32)	4/1/2011 06:45	Active	30	12	M. Mazur	Ground
Mill Creek Southeast (#32)	4/13/2011 06:40	Active	26	1	M. Mazur	Ground
Mill Creek Southeast (#32)	4/19/2011 06:30	Active	21	1	M. Mazur	Ground
Mill Creek Southeast (#32)	4/26/2011 05:30	Active	30		M. Mazur	Ground
Northwest Draw (#7)	3/25/2011 07:15	Unknown	0		M. Mazur	Ground
Ray Lake (#17)	3/25/2011 08:00	Active	15	2	M. Mazur	Ground
Sacajawea (#29)	3/18/2011 07:15	Active	2		M. Mazur	Ground
Complex: Crowheart Butte						
Crowheart Butte (#9)		Unknown				
Dry Creek	3/31/2011 06:45	Active	18		P.Hnilicka	Ground
Ega Butte (#11)	3/31/2011 07:15	Unknown	0		P.Hnilicka	Ground
Ega Draw (#10)	3/31/2011 07:30	Unknown	0		P.Hnilicka	Ground
Complex: Dinwoody						
Dinwoody	3/28/2011 08:10	Unknown	0		P.Hnilicka	Ground
Complex: East Fork						
Upper Table South (#36)	4/11/2011 06:30	Active	25	7	P. Hnilicka	Ground
Complex: Lookout Butte						
Lookout Butte Bottom (#35)	4/1/2011 06:45	Active	2		P.Hnilicka	Ground
Lookout Butte Tank (#35A)	4/1/2011 06:55	Active	3	9	P.Hnilicka	Ground
Complex: Mule Butte						
Mule Butte North (#12)	3/16/2011 07:03	Active	12		D. Skates	Ground

Mule Butte North (#12)	4/19/2011 06:03	Active	24	7	D. Skates	Ground
Mule Butte Pump House (#34)	3/16/2011 07:33	Unknown	0		D. Skates	Ground
Mule Butte South (#14)	3/16/2011 07:13	Unknown	0		D. Skates	Ground
Mule Butte Windmill (#13)	3/16/2011 07:06	Unknown	0		D. Skates	Ground
Complex: Odie Ranch						
Big Table		Unknown				
Odie Ranch (#15)	3/15/2011 08:05	Unknown	0		P.Hnilicka	Ground
Spring Draw	3/15/2011 07:10	Active	20	3	P. Hnilicka	Ground
Complex: Riverton East						
Riverton East (#33A)	3/23/2011 06:45	Unknown	0		D. Skates	Ground
Riverton East (#33B)	3/23/2011 06:40	Unknown	0		D. Skates	Ground
Riverton East (#33C)	3/23/2011 06:55	Active	5	7	D. Skates	Ground
Riverton East (#33C)	4/21/2011 06:40	Active	3	1	D. Skates	Ground
Complex: Sage Creek						
Fred Harris (#37)	3/18/2011 07:15	Active	20	8	P.Hnilicka	Ground
Fred Harris (#37)	4/20/2011 06:10	Active	31	4	P.Hnilicka	Ground
Sage Creek Dry Pond (#20)	3/16/2011 07:25	Active	1		P. Hnilicka	Ground
Sage Creek Dry Pond (#20)	3/25/2011 08:07	Active	0	2	P. Hnilicka	Ground
Sage Creek Dry Pond (#20)	4/5/2011 06:50	Active	0	1	P. Hnilicka	Ground
Sage Creek Dry Pond (#20)	4/15/2011 06:30	Active	0		P. Hnilicka	Ground
Sage Creek Ridge (#18C)	4/15/2011 07:00	Unknown	0		P. Hnilicka	Ground
Sage Creek Sundance East (#19)	3/25/2011 06:40	Inactive	0		P. Hnilicka	Ground
Sage Creek Sundance North (#19)	3/16/2011 07:05	Active	0		P. Hnilicka	Ground
Sage Creek Sundance North (#19)	3/25/2011 06:44	Active	0		P. Hnilicka	Ground
Sage Creek Sundance North (#19)	4/5/2011 06:40	Active	2		P. Hnilicka	Ground
Sage Creek Sundance North (#19)	4/15/2011 06:20	Active	2		P. Hnilicka	Ground
Sage Creek Sundance Northwest (#19)	3/16/2011 07:30	Active	15		P. Hnilicka	Ground
Sage Creek Sundance Northwest (#19)	3/25/2011 07:00	Active	23	3	P. Hnilicka	Ground
Sage Creek Sundance Northwest (#19)	4/5/2011 07:15	Active	33	33	P. Hnilicka	Ground
Sage Creek Sundance Northwest (#19)	4/15/2011 06:35	Active	41	12	P. Hnilicka	Ground
Sage Creek Tank (#18)	4/15/2011 07:00	Unknown	0		P. Hnilicka	Ground
Winchester Draw (#21)	3/16/2011 08:00	Active	6	5	P. Hnilicka	Ground
Winchester Draw (#21)	3/25/2011 07:40	Active	0		P. Hnilicka	Ground
Winchester Draw (#21)	4/15/2011 07:05	Active	4		P. Hnilicka	Ground
Complex: Sharpnose						
Sand Hills (#38)	4/13/2011 06:46	Unknown	0		D. Skates	Ground
Sharpnose (#22)	3/15/2011 07:08	Active	46	8	D. Skates	Ground
Sharpnose (#22)	3/21/2011 08:00	Active	28		D. Skates	Ground
Sharpnose (#22)	4/1/2011 06:35	Active	43	50	D. Skates, C. Jones	Ground
Sharpnose (#22)	4/7/2011 06:45	Active	49	30	D. Skates, C. Jones	Ground

Appendix G. Sage-grouse lek complex status for WRSRCA, 2011.

Complex	Type	Status	Peak Males	Peak Females	Leks/ Complex
		Upland Bird Management Area 14			
Dubois	Survey	Active	10	0	1
		Upland Bird Management Area 18			
9 Mile	Survey	Active	36	0	2
Alkali Creek	Not	Unknown			3
Arrowhead	Survey	Active	37	2	2
Badwater	Not	Unknown			3
Badwater Canyon	Not	Unknown			1
Bass Lake Road	Not	Unknown			1
Big Flat	Not	Unknown			1
Black Rocks	Survey	Active	21	4	1
Bridger Trail	Survey	Unknown	0	0	1
Bushwacker - East	Not	Unknown			1
Bushwacker - West	Not	Unknown			1
Canyon Creek	Survey	Active	25	0	5
Canyon Creek - Ranch	Survey	Unknown	0	0	1
Chalk Hills	Survey	Unknown	0	0	1
Coal Bank Hills	Not	Unknown			1
Conant Creek	Survey	Active	34	21	2
Davison Road	Survey	Unknown	0	0	1
Davison Road - 12 Mile	Survey	Active	35	0	4
Davison Road - 8 Mile	Survey	Active	19	0	1
Devil's Slide	Not	Unknown			1
Dry Pond	Not	Unknown			1
East Canyon Creek	Not	Unknown			1
Fuller Airstrip	Survey	Active	14	2	1
Fuller Airstrip	Survey	Active	14	2	2
Iron Horse	Survey	Active	10	0	2
Jackpot	Not	Unknown			1
Lysite Creek	Survey	Active	6	0	4
Maverick Butte	Not	Unknown			1
Nebo	Survey	Active	17		1
Noble Ridge	Not	Unknown			1
Ocla Draw	Survey	Active	8	0	1
Oil Playa	Not	Unknown			1
Pipeline	Survey	Active	18	2	2
Pit	Not	Unknown			1
Powerline	Survey	Active	37	12	1
Sand Creek Bench	Not	Unknown			1
Sand Creek Ranch	Not	Unknown			1
Sand Draw	Not	Unknown			1
South Bridger Creek	Survey	Active	8	3	1
South Fuller Reservoir	Survey	Unknown	0	0	1
Squaw Butte	Survey	Active	49	2	1
Stock Pond	Not	Unknown			1
Windmill	Not	Unknown			1

Upland Bird Management Area 8

Agate Flats	Count	Active	45	21	2
Antelope Flats	Not Checked	Unknown			1
Antelope Springs	Count	Active	15	1	1
Ballenger Draw	Count	Active	29	19	1
Beaver Rim	Not Checked	Abandoned			1
Beulah Belle	Survey	Active	21	2	1
Bill's	Survey	Active	36	0	1
Black Rock	Count	Active	71	4	2
Blackjack	Count	Active	91	3	1
Buffalo Creek	Count	Active	5	2	1
Carmody Lake	Count	Active	59	38	1
Carr Springs	Count	Active	71	33	3
Cedar Rim Windmill	Not Checked	Abandoned			1
Chugwater	Count	Active	81	105	1
Coal Mine Gulch	Count	Active	42	23	2
Cottontail	Count	Active	154	138	2
Cottonwood Divide	Count	Active	5	0	3
Coyote	Survey	Active	19	1	2
Dickie Springs	Survey	Active	1	0	1
Dickie Springs Creek	Survey	Active	5	1	1
Dishpan Butte	Count	Active	17	1	1
Dobie	Not Checked	Unknown			1
Dry Cheyenne	Survey	Active	39	1	1
Dry Creek	Not Checked	Unknown			2
Dry Lakes	Count	Active	51	8	1
East Long Creek	Count	Active	59	2	3
Gas Hills	Not Checked	Unknown			1
Government Slide Draw	Count	Active	56	12	1
Graham Road	Survey	Active	45	4	1
Grassy Lake	Not Checked	Unknown			2
Gustin-Preacher	Count	Active	34	11	4
Hall Creek	Count	Active	8	1	2
Horseshoe	Survey	Active	22	2	4
Iturian	Survey	Active	20	10	1
Lander Cutoff	Survey	Active	17	0	1
Lander Valley Reservoir	Count	Active	31	3	1
Long Creek	Count	Active	49	6	4
Long Gulch	Not Checked	Unknown			1
McGraw Flats	Count	Active	64	6	2
McTurk Draw	Count	Active	8	0	1
McTurk Ridge	Count	Active	21	0	1
Mitten Springs	Survey	Active	0	0	2
Monument	Count	Active	31	17	1
Nancy Creek	Count	Active	38	16	3
Ninemile Draw	Survey	Inactive	0	0	1
Ninemile Reservoir	Survey	Active	55	8	1
North Bear Mountain	Survey	Active	31	4	1
North Long Creek	Survey	Unknown	0	0	2
North Sand Gulch	Count	Active	49	26	1
Onion Flats	Count	Active	30	8	2
Oregon Trail	Not Checked	Unknown			1
Pacific Creek	Survey	Active	9	0	1
Picket Lake	Survey	Active	24	3	2

Puddle Springs	Not Checked	Unknown			1
Radium Springs	Not Checked	Unknown			1
Rawlins Draw	Survey	Active	27	0	1
Sage Hen	Count	Active	41	5	4
Scarlett Ranch	Count	Active	39	3	1
Signor Pipeline	Not Checked	Unknown			1
Silver Creek	Not Checked	Unknown			1
Soap Holes	Count	Active	70	8	2
South Pass	Survey	Active	86	11	2
Split Rock	Survey	Active	16	0	1
Spring Creek	Survey	Active	41	20	1
Stampede	Count	Active	29	5	2
Twin Creek	Count	Active	54	12	3
Warm Springs	Count	Active	20	18	3
West Long Creek	Survey	Active	117	3	2
Willow Creek State	Not Checked	Unknown			1
Wilson Gulch	Not Checked	Unknown			1
Yellowstone Ranch	Count	Active	15	0	1

Upland Bird Management Area: WR

Alkali Butte	Not Checked	Active	19	6	3
Bargee	Not Checked	Unknown			1
Bighorn Draw	Survey	Active	36	12	7
Boulder Flat	Survey	Active	30	12	7
Crowheart Butte	Survey	Active	18		4
Dinwoody	Survey	Unknown	0		1
East Fork	Survey	Active	25	7	1
Lookout Butte	Survey	Active	3	9	2
Mule Butte	Survey	Active	24	7	4
Odie Ranch	Survey	Active	20	3	3
Riverton East	Survey	Active	5	7	3
Sage Creek	Count	Active	41	33	8
Sharpnose	Survey	Active	67	50	8
Willow Creek	Survey	Active	25	11	4

Sharpnose (#22)	4/13/2011 06:15	Active	60	11	D. Skates, C. Jones	Ground
Sharpnose (#22)	4/20/2011 05:59	Active	67	8	D. Skates, C. Jones	Ground
Sharpnose Draw	4/13/2011 06:32	Unknown	0		D. Skates	Ground
Sharpnose East	3/15/2011 07:41	Unknown	0		D. Skates	Ground
Sharpnose East	4/1/2011 07:15	Unknown	0		D. Skates	Ground
Sharpnose East	4/20/2011 06:21	Unknown	0		D. Skates	Ground
Sharpnose Reservoir		Unknown	0			
Sharpnose Southeast (#23A)	3/15/2011 07:59	Unknown	0		D. Skates	Ground
WyPo (#16)	3/14/2011 07:27	Unknown	0		D. Skates	Ground
WyPo (#16)	3/21/2011 07:15	Unknown	0		D. Skates	Ground
WyPo Pipeline (A)	3/14/2011 07:57	Unknown	0		D. Skates	Ground
WyPo Pipeline (A)	3/15/2011 08:10	Unknown	0		D. Skates	Ground
Complex: Willow Creek						
Little Sand Draw	4/13/2011 06:50	Active	17	11	P.Hnilicka, Christian,Autumn and Lissy	Ground
Meadow Creek (#28A)	3/24/2011 08:30	Active	25		P.Hnilicka, M. Hogan,M. Mazur	Ground
Meadow Creek (#28C)		Unknown				
Willow Creek Bench (#30)	3/24/2011 06:50	Active	13	4	P.Hnilicka, M. Hogan,M. Mazur	Ground