Wyoming

Sage-Grouse
Job Completion Report
2018

June 2018-May 2019

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Wyoming Game & Fish Dept.

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Wyoming Sage-Grouse Job Completion Report

Conservation Plan Area: **Statewide Summary**
Period Covered: **6/1/2018– 5/31/2019**
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INTRODUCTION

Wyoming is home to more greater sage-grouse than any other state. About 37% of the rangewide sage-grouse population lives in Wyoming and 90% of estimated historic habitat in Wyoming is still occupied by the bird. There are about 1,800 known occupied sage-grouse leks in Wyoming. Department personnel and others surveyed 87% of these leks in the spring of 2019. Results of the survey indicate 1,127 leks were confirmed active, 296 confirmed inactive, and 140 unknown or unchecked. The average number of males observed on leks was 20/active lek, a 21% change from the 26/active lek observed in the spring of 2018, suggesting a population decrease. However this figure is substantially higher than the low of 13/active lek reported in 1996.

Management of greater sage-grouse habitat in Wyoming is based on a "core area" strategy of limiting human disturbance in the most important sage-grouse habitats. This strategy is codified by a Governor's executive order. The Executive Order and related materials are available at: https://wgfd.wyo.gov/Habitat/Sage-Grouse-Management. The Core Areas are shown in Figure 1.

In 2015 the U.S. Fish and Wildlife Service issued a decision of "not warranted" for listing greater sage-grouse as threatened or endangered under the Endangered Species Act. This means the State of Wyoming maintains management authority over sage-grouse in Wyoming and management emphasis focuses on implementation of the core area strategy. 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 the need for a future listing. The Service plans to re-examine the issue in 2020 to ensure planned conservation efforts are implemented and the status of the species remains unwarranted for listing.

Since the mid-2000's, the Wyoming Legislature biennially appropriated over $1 million of General Funds to the sage-grouse program for the state's 8 local sage-grouse working groups (LWGs) (Figure 2) to allocate to local projects. The 2017 Legislature returned budget responsibility of the sage-grouse program back to the Department due to state budget shortfalls. This action shifted the funding burden from the state as a whole, based largely on mineral severance taxes, to hunters and anglers, the primary funding source of the WGFD. A hunting license fee increase specifically crafted to replace legislative funding was approved by the legislature and LWGs will maintain their existing role in recommending how funds will be allocated. The last of biennial legislative funds were allocated in FY 2017-2018.

The 2017 Legislature passed a bill allowing private bird farm operations to collect sage-grouse eggs from the wild for purposes of establishing a captive flock. The Department and

Commission promulgated regulations in Chapter 60 to permit this activity. However, no sage-grouse eggs have been collected from the wild for this purpose as of May 2019.

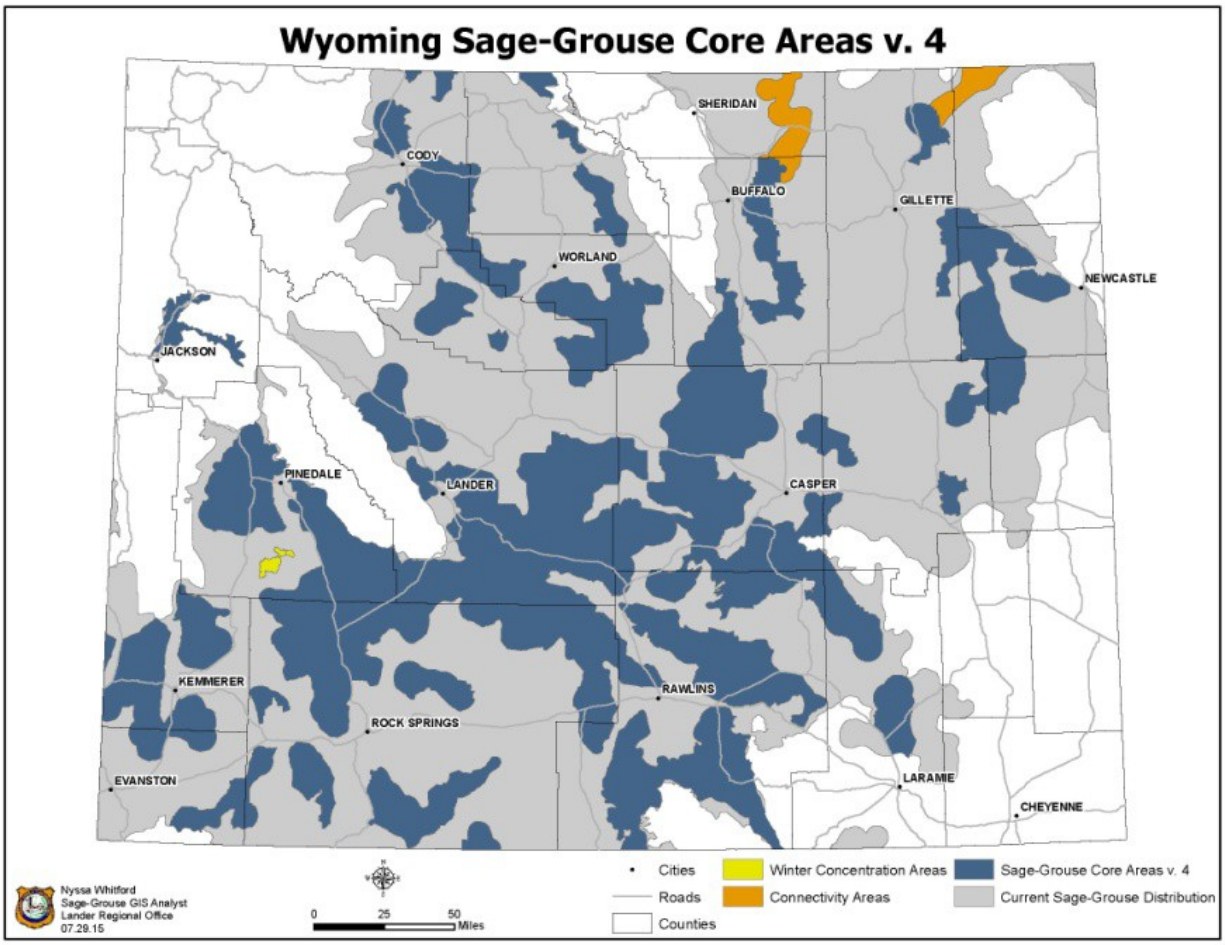


Figure 1. Wyoming Core Areas (version 4).

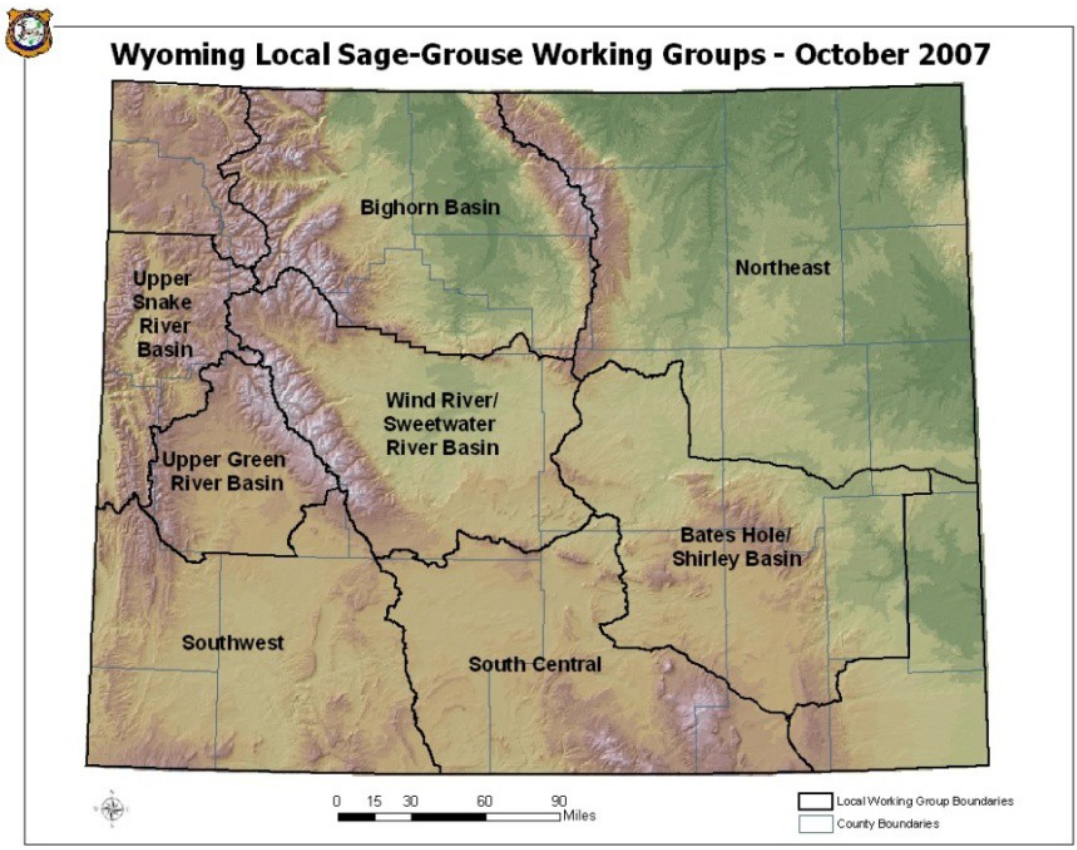


Figure 2. Wyoming Local sage-grouse working group boundaries.

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 individuals or sub-populations within 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 3). 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 3 and 4). However, available data sets and anecdotal accounts indicate long-term declines in Wyoming sage-grouse populations over the last six decades.

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) 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.

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 2). The 2004 JCR reviewed and summarized prior years' data in order to provide a historical perspective since that document was the first statewide JCR in memory. Additionally, Patterson (1952) provides an invaluable reference for sage-grouse, not only in Wyoming, but across the range of the species.

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 Wyoming were at their lowest levels ever recorded in the mid-1990s. From 1996-2006 however, the average size of leks increased to levels not seen since the 1970s. From 2006-2013, average lek size declined though not to levels recorded in the mid-1990s. Average lek size increased 112% from 2013 to 2016 but declined 44% from 2016 to 2019.

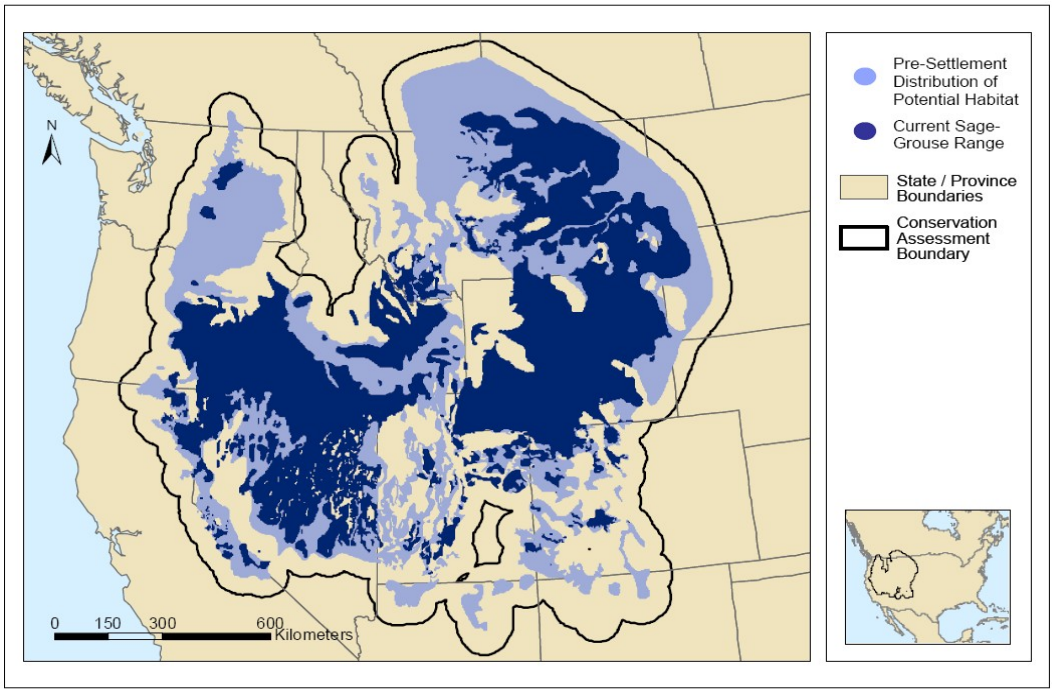


Figure 3. Current distribution of sage-grouse and pre-settlement distribution of potential habitat in North America (Schroeder 2004). For reference, Gunnison sage-grouse in SE Utah and SW Colorado are shown.

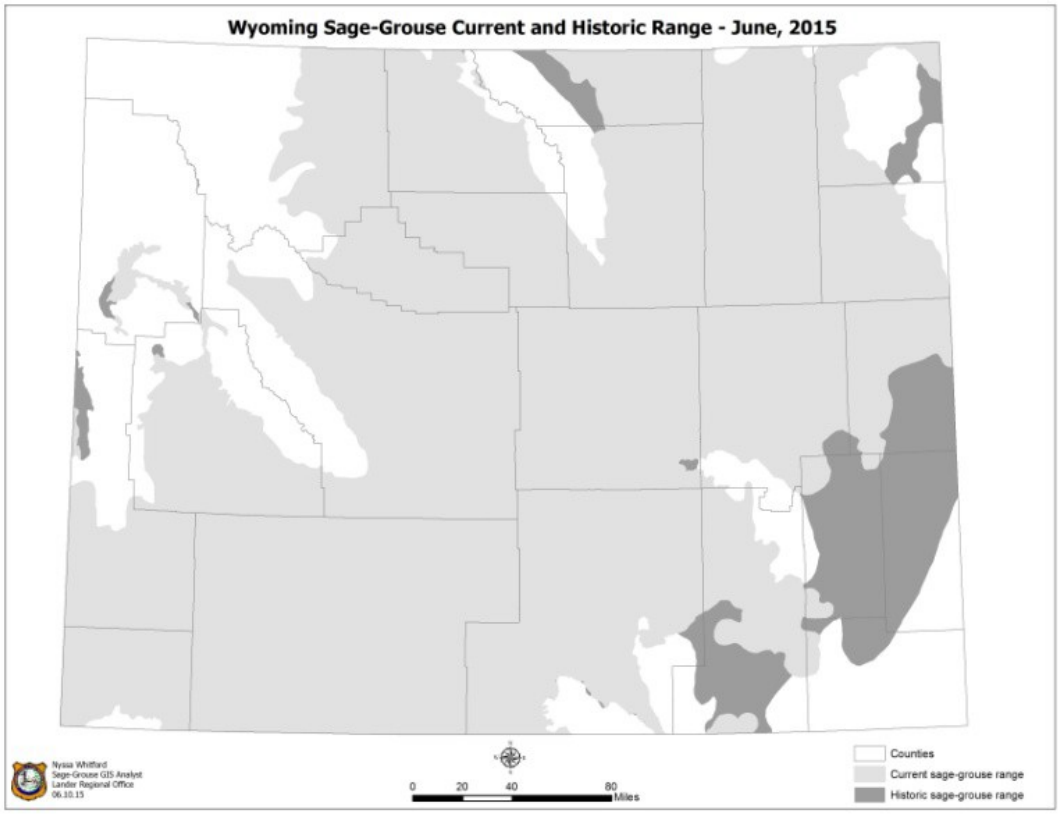


Figure 4. Sage-grouse range in Wyoming (updated 2015).

METHODS

Methods for collecting sage-grouse data are described in the sage-grouse chapter of the WGFD Handbook of Biological Techniques (Christiansen 2012), which is largely based on Connelly et al (2003). The definitions used in lek monitoring are attached (Attachment A).

RESULTS

Lek monitoring

While lek counts and surveys have been conducted in Wyoming since 1948, the most consistent statewide data were not collected until the mid-1990s. The number of leks checked in Wyoming has increased markedly since 1949. However, data from the 1950s through the 1970s is unfortunately sparse and by most accounts this is the period when the most dramatic declines of grouse numbers occurred. Some lek survey/count data were collected during this period as the historical reports contain summary tables but the observation data for most individual leks are missing, making comparisons to current information difficult. Concurrent with increased monitoring effort over time, the number of grouse (males) also increased (Figure 5). The increased number of grouse counted was not necessarily a reflection of a population increase; rather it was resultant of increased monitoring efforts.

The average number of males counted/lek decreased through the 1980s and early 90s to an all time low in 1995, but then recovered to a level similar to the late 1970s in 2006 (Figure 7). 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 exhibited recovery between 1995 and 2006 as the average size of leks increased and is generally interpreted to reflect an increasing population. The same cannot be said for the 2006-2013 period during which the average number of males observed on leks declined, though not to levels documented in the mid-1990s. From 2013-2016, average lek size increased 112%. In 2019, average lek size declined to an average of 20.1 males/active lek which is 22% lower than the 10-year (2009-2018) average of 25.1 males/active lek. Thus, there has been a long-term decline and short-term cyclic increases and decreases in the statewide sage-grouse population. The short-term trends in statewide populations are believed to be largely weather related. In the late 1990s, and again in 2004-05, timely precipitation resulted in improved habitat conditions allowing greater numbers of sage-grouse to hatch and survive. Drought conditions from 2000-2003 and again later in that decade are believed to have caused lower grouse survival leading to population declines. These trends are valid at the statewide scale. Trends are more varied at the local scale. Sub-populations more heavily influenced by anthropogenic impacts (sub-divisions, intensive energy development, large-scale conversion of habitat from sagebrush to grassland or agriculture, Interstate highways, etc.) have experienced declining populations or extirpation.

Past analyses suggest Wyoming sage-grouse populations are cyclic (Fedy and Doherty 2010, Fedy and Aldridge 2011). While weather and climate undoubtedly influence sage-grouse population cycles, such influences have not been quantified and factors other than weather

(predation, parasites) may also play a role. It is important to acknowledge and control for the cyclic nature of sage-grouse when conducting impact studies and monitoring grouse response to management.

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

Average female lek attendance is not reported since our data collection techniques are not designed to accurately capture these data and is therefore not a useful figure in assessing population trend.

Lek monitoring data for the 2019 breeding season are summarized in Tables 1a-d and Figures 6-11. Department personnel and others checked 87% (1,563/1,794) of the known occupied leks in 2019 (Table 1-c). Male attendance at all leks visited (counts and surveys) averaged 20.1 males per lek during spring 2019, a 21% decrease from the 25.6 males/lek observed in 2018 and a 52% change below the 41.8 males/lek observed in 2006. For the 10-year period (2010-2019), average male lek attendance ranged from 16.8 males/lek in 2013, the lowest average males per lek since 1997, to a high of 35.6 males/lek in 2016.

The proportion of active, occupied leks remained relatively stable at 79.9% in 2017, 79.6% in 2018, and 79.2% in 2019.

In 2019, 8,165 fewer male sage-grouse were observed on 50 fewer active leks checked. Cumulatively, the lek attendance data suggest there were fewer grouse in bio-year 2018 than in 2017. It is important to note that the number of leks sampled increased over the 10-year period and the same leks were not checked from year to year. However leks that were checked consistently over the same period demonstrated the same trends except in some local areas as described in the local JCRs.

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

While a statistically valid method for estimating population size for sage-grouse has not yet been applied in Wyoming, 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.

Five 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, 2015, Garton et al. 2011, Nielson et al. 2015). The trends reflected by these analyses are generally consistent with each other and with that shown in Figure 6. In 2013, WAFWA contracted with the University of Montana to develop better sampling designs and population trend estimators. This contract resulted in the development of a generalized integrated population model to estimate annual abundance from counts of males at breeding leks (McCaffrey and Lukacs 2016). This tool will be further tested and implemented as appropriate in Wyoming.

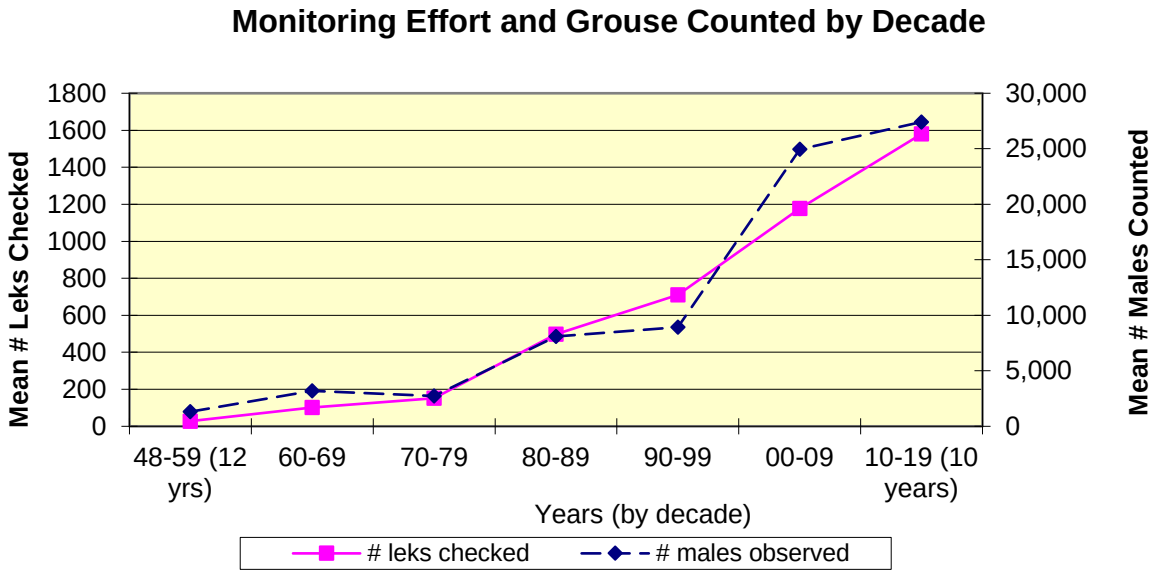


Figure 5. Mean annual numbers of leks checked (monitoring effort) and male grouse counted in Wyoming 1948-2019 by decade.

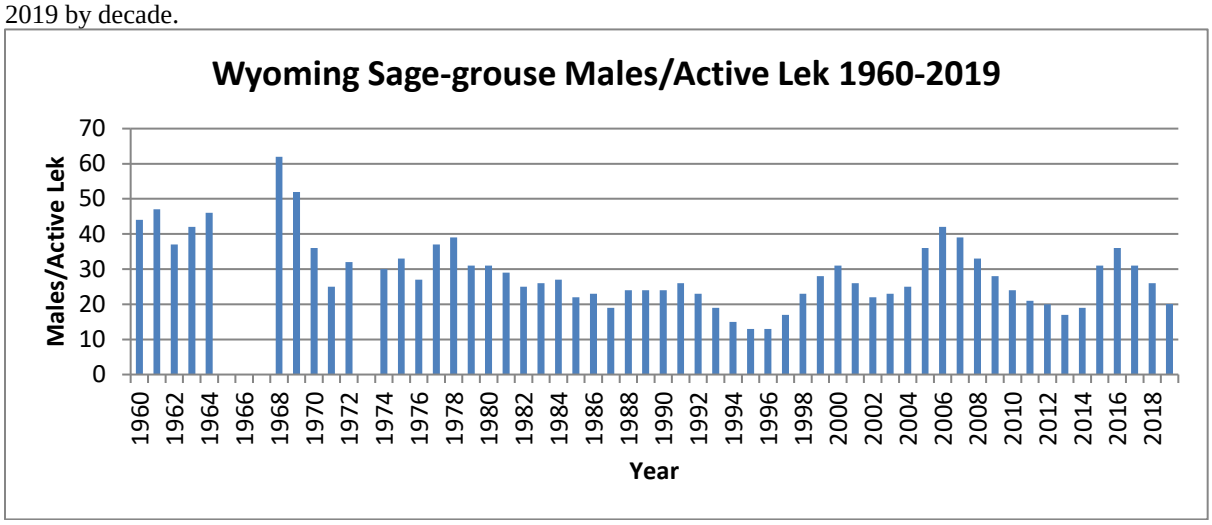


Figure 6. Average number of males per lek counted in Wyoming from 1960-2019 with a minimum of 100 leks checked each year.

Table 1a. Leks Counted

Year	Occupied	Counted	Percent Counted	Peak Males	Avg Males / Active Lek (2)
2010	1714	649	38	14167	27.1
2011	1750	646	37	11308	22.5
2012	1783	716	40	12661	23.0
2013	1795	646	36	10617	20.7
2014	1798	772	43	11466	20.6
2015	1828	742	41	19505	34.2
2016	1844	733	40	23388	40.3
2017	1833	691	38	18695	35.4
2018	1823	802	44	17133	28.2
2019	1794	694	39	11845	21.9

Table 1b. Leks Surveyed

Year	Occupied	Surveyed	Percent Surveyed	Peak Males	Avg Males / Active Lek (2)
2010	1714	822	48	11565	20.1
2011	1750	836	48	10143	18.7
2012	1783	821	46	8624	16.6
2013	1795	930	52	7657	13.4
2014	1798	841	47	8604	16.5
2015	1828	881	48	17005	27.7
2016	1844	950	52	19884	31.3
2017	1833	950	52	17872	28.1
2018	1823	811	44	12441	22.8
2019	1794	869	48	9564	18.3

Table 1c. Leks Checked

Year	Occupied	Checked	Percent Checked	Peak Males	Avg Males / Active Lek (2)
2010	1714	1471	86	25732	23.5
2011	1750	1482	85	21451	20.5
2012	1783	1537	86	21285	19.9
2013	1795	1576	88	18274	16.8
2014	1798	1613	90	20070	18.6
2015	1828	1623	89	36510	30.8
2016	1844	1683	91	43272	35.6
2017	1833	1641	90	36567	31.4
2018	1823	1613	88	29574	25.6
2019	1794	1563	87	21409	20.1

Table 1d. Lek Status

Year	Active	Inactive (3)	Unknown	Known Status	Percent Active	Percent Inactive
2010	1116	194	161	1310	85.2	14.8
2011	1081	219	182	1300	83.2	16.8
2012	1119	248	170	1367	81.9	18.1
2013	1116	286	174	1402	79.6	20.4
2014	1105	352	153	1457	75.8	24.2
2015	1215	273	135	1488	81.7	18.3
2016	1260	276	147	1536	82.0	18.0
2017	1202	302	137	1504	79.9	20.1
2018	1180	303	130	1483	79.6	20.4
2019	1127	296	140	1423	79.2	20.8

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

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

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

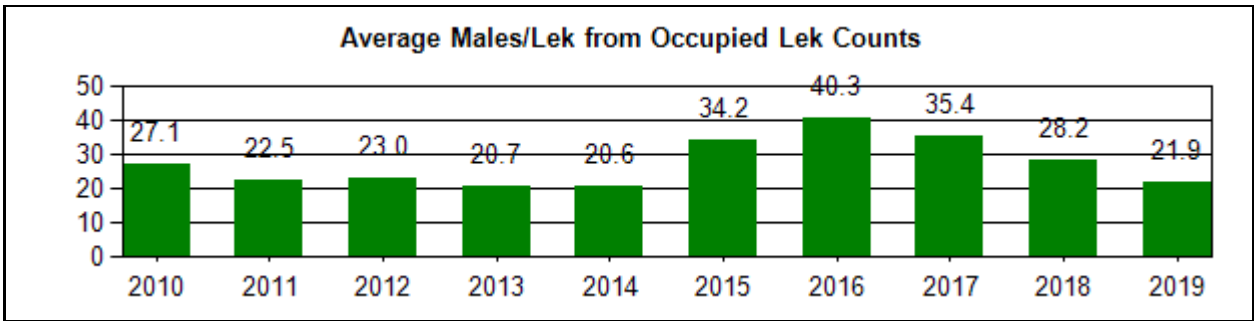


Figure 7. Average males/lek from occupied lek counts.

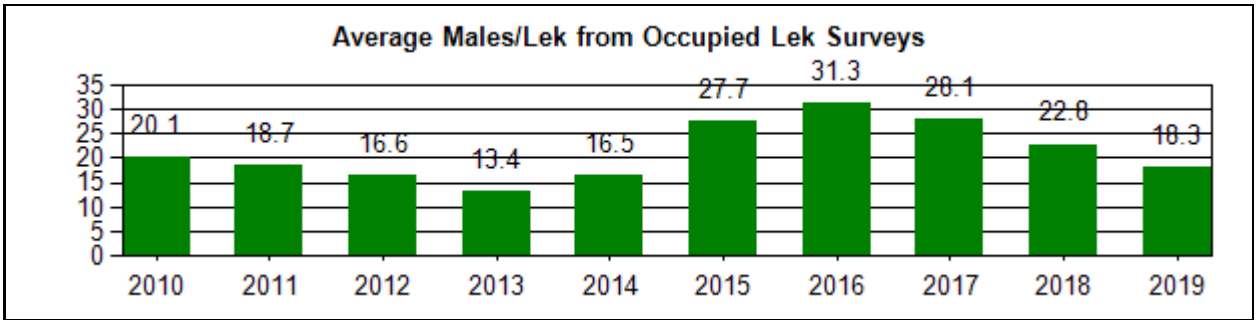


Figure 8. Average males/lek from occupied lek surveys.

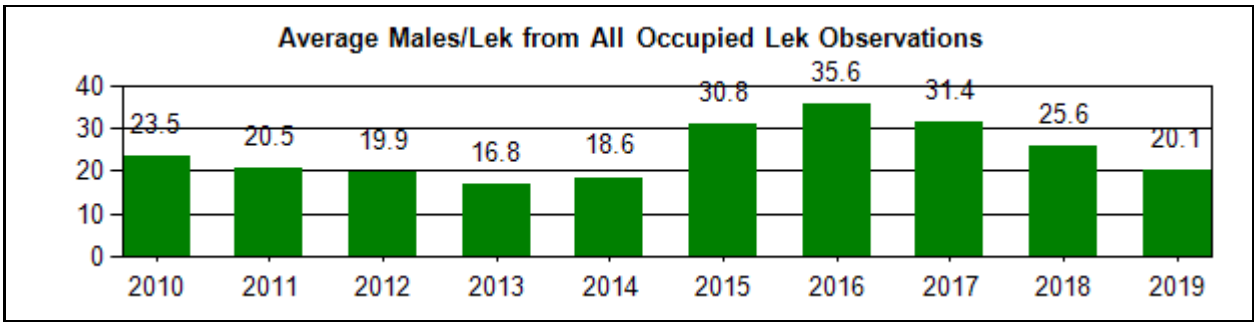


Figure 9. Average males/lek from all occupied leks checked (counts+surveys).

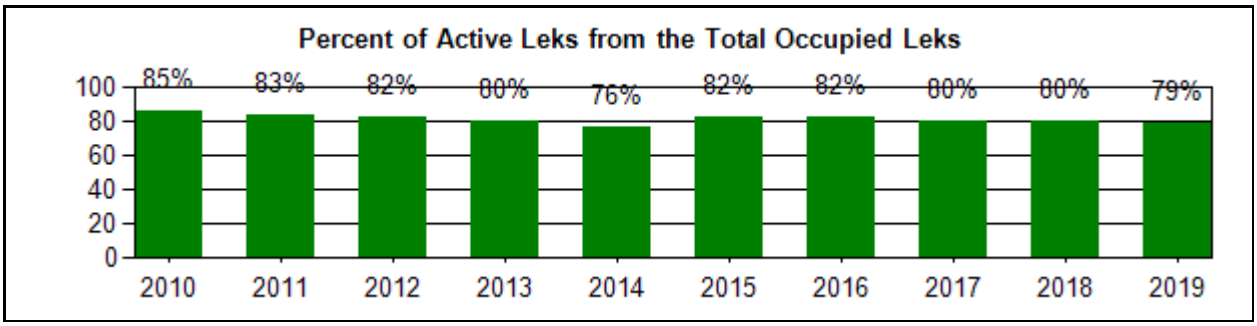


Figure 10. Percent active leks from the occupied leks checked with known status.

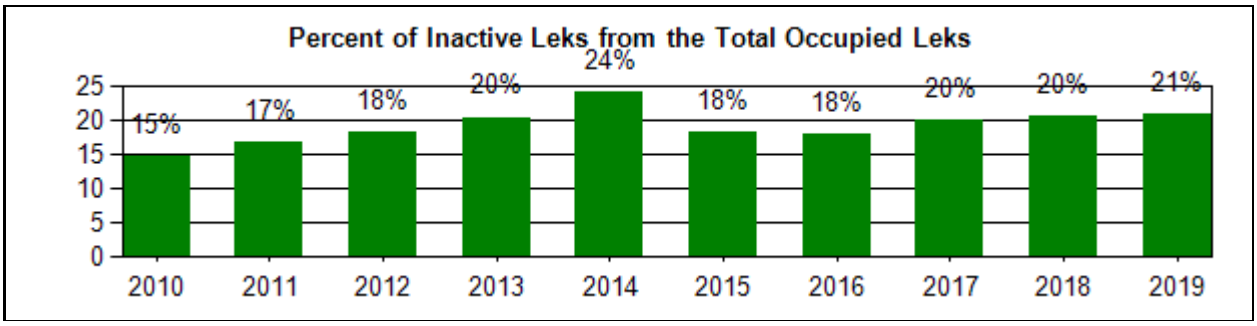
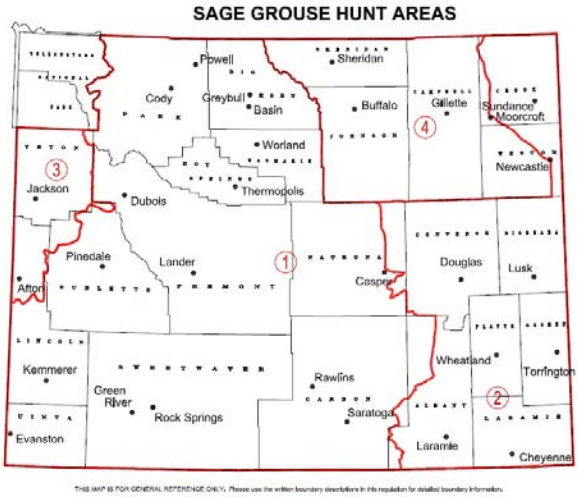


Figure 11. Percent inactive leks from the occupied leks checked with known status.

Hunting season and harvest

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

The 2018 hunting season (Figure 12, Table 2) for most of the state (Area 1) was 1 day longer than 2017 due to the calendar effect of opening the season on the third Saturday of September. In 2017 the third Saturday was September 16, but in 2018 it was September 15.



Area	Season Dates	Daily/Poss. Limits	Falconry
1	Sept. 15-Sept. 30	2/4	Sept. 1-Mar. 1
2, 3	Closed	Closed	Closed
4	Sept. 15-Sept. 17	2/4	Sept. 1-Mar. 1

Figure 12 and Table 2. 2017 sage-grouse hunting season map and regulations.

Hunting seasons and harvest in Wyoming are shown in Tables 3a-b. Due to concerns over low populations, the statewide hunting season was shortened 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 14).

Delaying and shortening the season and decreasing the bag limit dramatically decreased the numbers of sage-grouse hunters and their harvest. 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. The data presented in Table 3b and Figures 15-18 indicate hunter numbers and harvest increased between 2017 (3,576 hunters/7,817 birds) and 2018 (5,035 hunters/10,422). The trend in the number of birds harvested is generally correlated with lek attendance trends, although 2018 did not follow this pattern. The number of birds harvested is

estimated from a voluntary hunter survey.

Tables 3 a-b. Sage Grouse Hunting Seasons and Harvest Data

Year	Season Start	Season End	Length	Bag/Possesion Limit
2009-1	Sep-19	Sep-30	12	2/4
2009-4	Sep-19	Sep-21	3	2/4
2010-1	Sep-18	Sep-30	13	2/4
2010-4	Sep-18	Sep-20	3	2/4
2011-1	Sep-17	Sep-30	14	2/4
2011-4	Sep-17	Sep-19	3	2/4
2012-1	Sep-15	Sep-30	16	2/4
2012-4	Sep-15	Sep-17	3	2/4
2013-1	Sep-21	Sep-30	10	2/4
2013-4	Sep-21	Sep-23	3	2/4
2014-1	Sep-20	Sep-30	11	2/4
2014-4	Sep-20	Sep-22	3	2/4
2015-1	Sep-19	Sep-30	12	2/4
2015-4	Sep-19	Sep-21	3	2/4
2016-1	Sep-17	Sep-30	14	2/4
2016-4	Sep-17	Sep-19	3	2/4
2017-1	Sep-16	Sep-30	15	2/4
2017-4	Sep-16	Sep-18	3	2/4
2018-1	Sep-15	Sep-30	16	2/4
2018-4	Sep-15	Sep-17	3	2/4

Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2009	11162	4732	10812	1.0	2.4	2.3
2010	11057	4732	11434	1.0	2.3	2.4
2011	10290	4568	11186	0.9	2.3	2.4
2012	9869	4700	11342	0.9	2.1	2.4
2013	5726	3383	7672	0.7	1.7	2.3
2014	7094	3526	8642	0.8	2.0	2.5
2015	10498	4299	10231	1.0	2.4	2.4
2016	10526	4674	11476	0.9	2.3	2.5
2017	7817	3576	8646	0.9	2.2	2.4
2018	10422	5035	13092	0.8	2.1	2.6
Avg	9,446	4,323	10,453	0.9	2.2	2.4

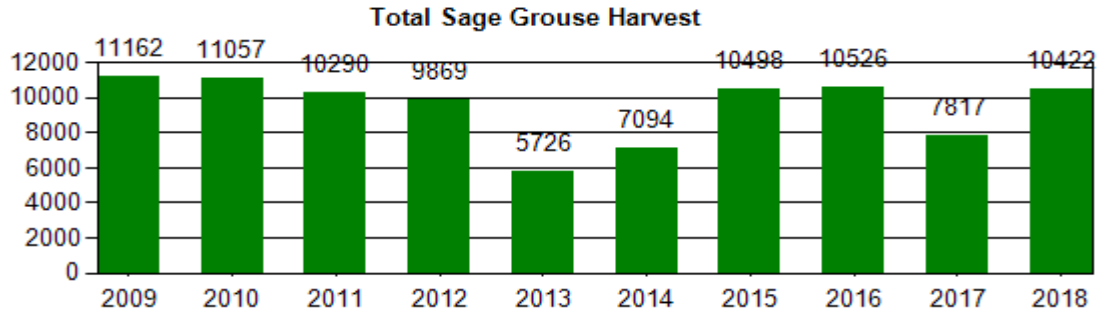


Figure 13. Wyoming statewide sage-grouse harvest 2009-2018.

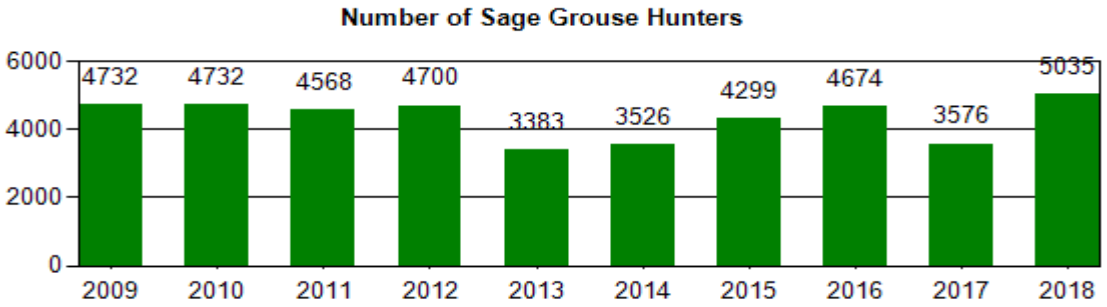


Figure 14. Wyoming statewide sage-grouse hunter numbers 2009-2018.

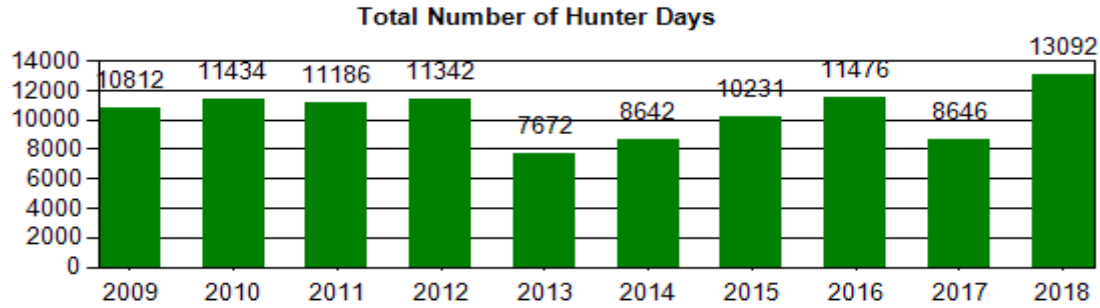


Figure 15. Wyoming statewide number of hunter days 2009-2018.

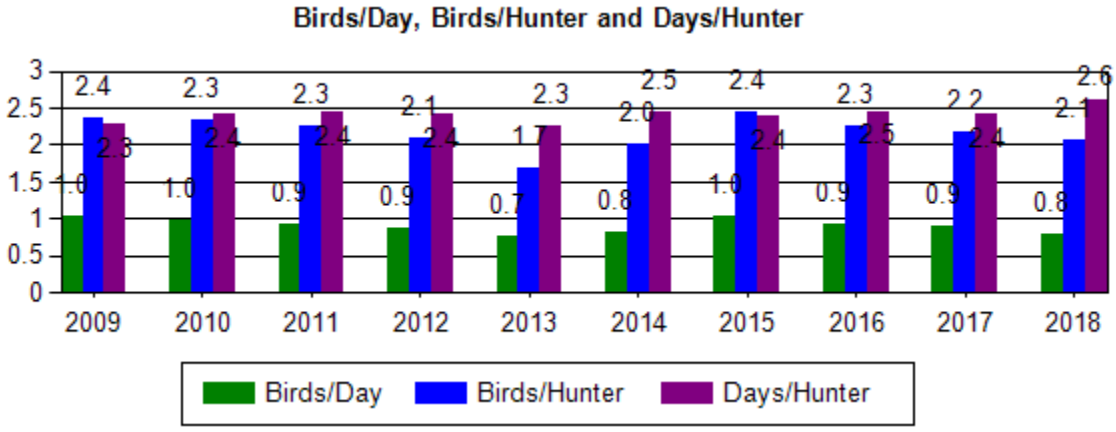


Figure 16. Wyoming statewide birds/day, birds/hunter and days/hunter 2009-2018.

The number of sage-grouse wings collected from hunters increased by 3% in 2018. In 2018, 2,112 wings were recorded (Table 4), which is 20% of the estimated harvest. This is equal to the 10-year average of 20% with most changes between years being minor.

The 2018 chick:hen ratio (based on harvested wing analysis) was 0.8 chicks per hen (Table 4 and Figure 17). This level of productivity is typically associated with a declining population. This is consistent with the 2019 lek data (all lek checks), which indicated an 21% decrease in the average numbers of males on leks (Table 5). When 1997-2018 data are pooled, average male lek attendance declined an average of 13% when chick:hen ratios the previous fall were less than 1.4:1, were closer to 0% change when chick:hen ratios the previous fall were 1.4 to 1.6:1 and increased an average of 32% when chick:hens ratios were 1.7:1 or higher. Additional data are required to strengthen the statistical basis of these analyses.

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

Table 4. Composition of Harvest by Wing Analysis

Year	Sample	Percent Adult		Percent Yearling		Percent Young		Chicks/
	Size	Male	Female	Male	Female	Male	Female	Hens
2009	2550	14.1	29.1	5.9	8.3	17.1	25.6	1.1
2010	2169	10.1	39.8	2.6	5.9	11.2	16.6	0.9
2011	2425	8.9	31.2	4.0	5.6	21.3	29.0	1.4
2012	1938	13.4	36.6	4.5	8.8	15.5	21.2	0.8
2013	1258	12.0	35.8	2.3	6.5	18.8	24.4	1.0
2014	1533	9.5	23.9	2.5	7.8	28.8	27.5	1.8
2015	2300	12.7	25.8	3.6	5.4	24.8	27.7	1.7
2016	2097	16.9	33.0	4.5	7.6	16.7	21.2	0.9
2017	2047	13.8	31.7	3.3	6.0	20.7	24.6	1.2
2018	2112	14.2	32.4	6.2	11.3	13.9	22.0	0.8

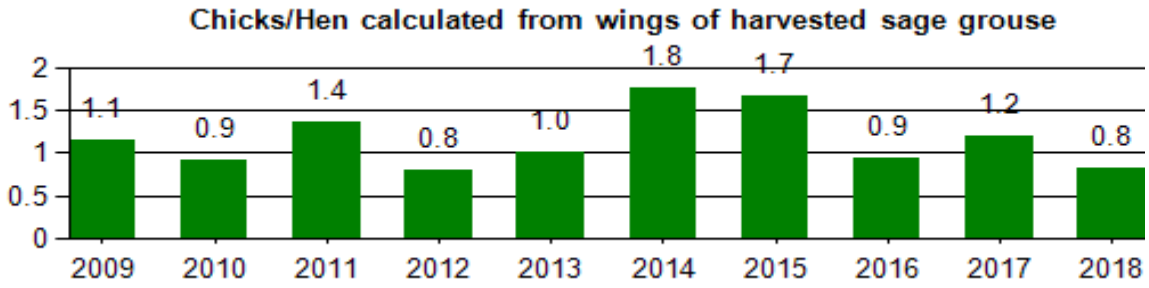


Figure 17. Chicks/Hen 2009-2018 based on wings from harvested grouse.

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

Year	Chicks:Hen (based on wings from harvested birds)	Change in male lek attendance the following spring
1997	1.9	+36%
1998	2.4	+21%
1999	1.8	+13%
2000	1.1	-20%
2001	1.6	-15%
2002	1.6	+3%
2003	1.5	+4%
2004	2.4	+57%
2005	2.0	+17%
2006	1.2	-5%
2007	0.8	-16%
2008	1.5	-16%
2009	1.1	-21%
2010	0.9	-13%
2011	1.4	-7%
2012	0.8	-16%
2013	1.0	+11%
2014	1.8	+66%
2015	1.7	+16%
2016	0.9	-11%
2017	1.2	-18%
2018	0.8	-21%

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, Blomberg et al 2014a/b, Caudill et al. 2014). 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 2009, 2010, and 2016 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.

Calendar year 2012 was the hottest, driest year documented in Wyoming since record keeping began 118 years previous (NOAA 2012). The lack of spring moisture in 2012 meant little production of important food plants and insects, therefore lower chick survival and more birds than usual were likely forced to move to either higher elevation or irrigated meadows and steam courses.

While 2013 saw increased precipitation over 2012, the residual effects 2012 continued to impact sage-grouse productivity. With the exception of mid-May snowstorms, most of Wyoming experienced favorable spring conditions in 2014 and 2015. Many areas of the state experienced heavy precipitation and even flooding in May 2016, which is correlated with that year's reduced nesting success and chick survival.

Habitat and seasonal range mapping.

While we believe that most of the currently occupied leks in Wyoming have been documented, other seasonal habitats such as nesting/early brood-rearing and winter concentration areas have not been identified. Efforts to map seasonal ranges for sage-grouse will continue by utilizing winter observation flights and the on-going land cover mapping efforts of the USGS (Fedy et al. 2014), BLM, WGF, the Wyoming Geographic Information Science Center (WYGISC) of the University of Wyoming and others.

CONSERVATION STRATEGIES

Endangered Species Act Status

In September 2015 the U.S. Fish and Wildlife Service issued a decision of "not warranted" for listing greater sage-grouse as threatened or endangered under the Endangered Species Act. This means the State of Wyoming maintains management authority over sage-grouse in Wyoming. 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 the need for a future listing. The Service plans to reexamine the issue in 2020 to ensure planned conservation efforts are implemented and the status of the species remains unwarranted for listing.

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

Management of greater sage-grouse habitat in Wyoming is based on a "core area" strategy of limiting human disturbance in the most important sage-grouse habitats. This strategy is codified by a Governor's executive order. The Executive Order and related materials are available at: https://wgfd.wyo.gov/Habitat/Sage-Grouse-Managementatt

The Core Area Strategy is being implemented across the state under the guidance of a state/federal interagency team of specialists which meets on a regular basis to discuss issues related to implementation of the strategy. A key component of the strategy's

implementation is the Density and Disturbance Calculation Tool (DDCT). This tool was developed by agency GIS specialists as an interactive, on-line application through the University of Wyoming's Geographic Information and Science Center. Training sessions are provided to industry and agency staff required to use the DDCT.

Conservation Planning

In 2000, the WGFD formed a citizen/agency working group for the purpose of developing a statewide strategy for conservation of sage-grouse in Wyoming. The working group completed its task and in 2003 The Wyoming Greater Sage-Grouse Conservation Plan (WGFD 2003) was approved by the Wyoming Game and Fish Commission. The State Plan was largely reliant on implementation by local working groups. The state's eight LWGs all submitted final conservation plans between 2006 and 2008. In 2012, the local working groups began the process of updating their plans with current information to make them consistent with the Wyoming Core Area Strategy, address the Service's 2010 listing decision and incorporate new science. This effort was completed in this reporting period. The updated plans were presented to the Wyoming Game and Fish Commission in March 2014.

From 2005-2017, Local Working Groups were allocated approximately $6.3 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 the Governor and approved by the legislature. The 2016 Legislature appropriated another $1.1 million for the 2017-18 biennium. Allocation of these funds began July 1, 2016. Subsequently, the 2017 legislature returned budget responsibility of the sage-grouse program back to the Department due to state budget shortfalls. This action shifted the funding burden from the state as a whole, based largely on mineral severance taxes, to hunters and anglers, the primary funding source of the WGFD. A hunting license fee increase specifically crafted to replace legislative funding was approved by the legislature and LWGs will maintain their existing role in recommending how funds will be allocated. The Wyoming Game and Fish Commission has allocated $548,000 annually since FY2019 to fund local working group projects.

During Fiscal Year 2019, nineteen (19) projects (Attachment C) were funded. Most of the projects are supported by multiple cost-sharing partners. Cumulatively, two-hundred- forty-three (243) projects have been approved since 2005. Projects include habitat treatments/restoration, improved range management infrastructure and grazing management plans, applied research, inventories, monitoring and public outreach.

OTHER ISSUES

Wyoming to North Dakota Translocation Project

In 2017, Wyoming Game and Fish Department personnel worked with their North Dakota Game and Fish Department counterparts, Utah State University researchers and others to capture and translocate 60 sage-grouse (40 females, 20 males) from Wyoming to North Dakota in an effort to prevent extirpation of the North Dakota population. The effort was repeated in

2018 (20 females, 20 males, 6 females with broods) and 2019 (20 males, 10 females with broods, 9 females without broods) and researchers will determine not only the success of the translocation, but the effects of translocation on the source population in Wyoming. This study is part of a larger collaborative effort involving translocation projects in Utah and California/Nevada. The following statistics are for the 2019 field season: Twenty-one (21) of the 40 chicks survived to 50-days-old. Eight (8) out of the 10 brooding hens survived to August 2019. Eight (8) of the 9 non-brooding hens survived to August 2019. Fifteen (15) of the 20 males survived to August 2019. Most of the birds stayed within 24 km of the release site. These statistics indicate that trapping, transporting, and releasing birds are not causing mass mortality.

Sage-grouse Bird Farm Legislation

The 2017 state legislature passed a billing allowing private bird farm operations to collect sage-grouse eggs from the wild for purposes of establishing a captive flock. The Department and Commission promulgated regulations in Chapter 60 to permit this activity. One permit contingent upon completion of infrastructure was issued to a facility in January 2019. However, the permittee did not collect sage-grouse eggs from the wild as of May 2019.

West Nile Virus

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

Monitoring efforts in 2018 again 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. No West Nile virus mortality was documented during this reporting period.

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 on oil and gas development impacts. One area of research need identified during the 2015 Core Area Strategy revision is identifying natural gas development impact thresholds relative to sage-grouse winter concentration areas. That topic is being pursued by the SGIT. Research relative to wind energy development also continues.

The results of these research efforts inform and guide management actions associated with the Wyoming Core Area Strategy.

RESEARCH AND PUBLICATIONS

See Attachment D for a compilation of current sage-grouse research being conducted in Wyoming. This information was compiled by Dr. Jeff Beck at the University of Wyoming. Attachment E is a listing of Wyoming-based research reports and peer-reviewed publications to date.

MANAGEMENT RECOMMENDATIONS

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

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

3) Test the sage-grouse population model developed by Paul Lukacs at the University of Montana in cooperation with USFWS and WAFWA.

4) Continue to refine and de-bug the sage-grouse database and Job Completion Report intranet program.

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

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.

8) Continuously evaluate participation in the North Dakota translocation project.

9) Regulate and enforce the sage-grouse bird farm law (House Enrolled Act No. 91 of the 64th Legislature of the State of Wyoming) in a manner that is compliant with the intent of the law and protects wild populations of sage-grouse to the extent possible. Monitor and document the outcomes and implications of the law and regulations and report results to policy makers and the public.

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Attachment A:
Wyoming Sage-Grouse Lek Definitions:
(Revised November 2012)

The following definitions have been adopted for the purposes of collecting and reporting sage-grouse lek 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 observation of two or more male sage-grouse engaged in courtship displays. Before a suspected lek is added to the database, it must be confirmed by a survey conducted 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 years when populations peak. Such areas usually fail to become established leks. Therefore, a site with small numbers of strutting males (<5) should be confirmed active for two years before the site is added to the lek database.

Satellite Lek – A relatively small lek (usually less than 15 males) within about 500 meters of a large lek often documented 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 associated satellite leks (if present). Perimeters of all leks should be mapped by experienced observers using accepted protocols (Section 1.b.v below); larger leks should receive higher priority. Perimeters may vary over time as population levels or habitat and weather conditions fluctuate. However, mapped perimeters should not be adjusted unless grouse use consistently (2+ years) demonstrates the existing perimeter is inaccurate. The lek location must be identified and recorded as a specific point **within** the lek perimeter. This point may be the geographic center of the perimeter polygon calculated though a GIS exercise, or a GPS waypoint recorded in the field, which represents the center of breeding activity typically observed on the lek.

Lek Complex - A cluster of leks within 2.5 km (1.5 mi) of each other, between which male sage-grouse may interchange from day to day.

Lek Count - A census technique that documents the number of male sage-grouse observed attending a particular lek, lek complex, or leks along a lek route based on repeated observation.

- 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 group of leks in relatively close proximity that represent part or all of a discrete breeding population/sub-population. Leks should be counted on routes to facilitate replication by other observers, increase the likelihood of recording satellite leks, and account for shifts in distribution of breeding birds. Lek routes should be set up so an observer following criteria described under "Lek Count" can count all leks within 1.5 hours.

Lek Survey - A monitoring technique designed primarily to determine whether leks are active or inactive. Obtaining accurate counts of males attending is secondary.

- 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. When large numbers of leks are surveyed (50+) the resulting trends of lek attendance over time mirror that of lek counts.

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 indicates no strutting activity took place throughout a strutting season. Absence of strutting grouse during a single visit is not sufficient documentation to establish a lek is inactive. This designation requires documentation no birds were present on the lek during at least 2 ground surveys separated by at least 7 days. The surveys must be conducted under ideal conditions (site visits between April 1 and May 7, no precipitation, light or no wind, ½ hour before to 1 hour after sunrise) or a ground check of the exact lek location late in the strutting season (after 4/15) during which sign (droppings/feathers) of strutting

activity is not found. Data collected by aerial surveys cannot be used to designate inactive status.

- **unknown** – Leks for which active/inactive status has not been documented during the course of a strutting season. Excepting leks not scheduled to be checked in a particular year, the "unknown" status designation should be applied only in rare instances. Each lek should be checked enough times to determine whether it is active or not. It is preferable to conduct two good field checks every other year and confirm the lek is "inactive" rather than check it once every year and have it 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** – Two classifications of unoccupied leks are "destroyed" and "abandoned" (defined below). 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 as active in the last ten years, but survey information is insufficient to designate the lek as unoccupied. Undetermined lek sites are not protected through prescribed management actions during surface disturbing activities until sufficient documentation is obtained to confirm the lek is occupied. This status should be applied only in rare instances (also see "unknown" above).

Attachment B: Wyoming sage-grouse projects funded by Wyoming Game & Fish Commission in FY2019

Project Name	Fiscal Year	Local Working Group	Total Cost	SG $	Project Description	Partners	Status
225-Sagebrush Explorers: Educating Youth	2019	Bates Hole/ Shirley Basin	$31,000	$10,800 approved/spent	Educate Wyoming's youth through lek viewing opportunities, field trips, sagebrush curriculum, posters, books, and online resources	Audubon Rockies, USFWS, Private donor	Complete
226- Habitat Restoration for the Jackson Hole Airport	2019	Upper Snake River Basin	$85,000	$20,000 approved/spent	Restore 162 acres of previously disturbed and nonnative vegetation areas surrounding the Jackson Airport	Grand Teton National Park, Jackson Hole Airport	Complete
227-Modifying Fences in Pinedale and Jackson Hole	2019	Upper Snake River Basin	$24,700	$11,000 approved; $10,875.85 spent	The proposed project involves modifying approximately 9 miles of existing barb-wire fences. Options: conversion to a drop fence, installing a wood top rail, supplementing current markers with black markers	Jackson Hole Wildlife Foundation, BLM	Complete
228-Geophagy in Pinedale Area	2019	Upper Green River Basin	$347,722	$19,800 approved/spent	Research on effects of geophagy on wintering sage-grouse	Utah State University, BLM, Teton Raptor Center	On-going
229-Douglas Core Area Restoration Stage 2	2019	Northeast	$551,000	$20,000 approved/spent	Decommissioning of project infrastructure, fencing, exclosures, fabric mulch after wildfire restoration	Wyoming Community Foundation, Douglas Core Area Restoration Team, Private landowners	On-going
230-Saban Juniper Removal	2019	Big Horn Basin	$124,000	$15,000 approved/spent	Mechanical juniper removal from sage-grouse habitat	Private landowner, NRCS	Complete
231-Sublette County Cheatgrass	2019	Upper Green River Basin	$600,000	$44,200 approved/spent	Treat cheatgrass within the Hold-the-Line project area	Sublette County Weed & Pest, NRCS	Complete
232-Putney Flats Cheatgrass	2019	Big Horn Basin	$30,000	$15,000 approved/spent	Aerial cheatgrass treatments	Hot Springs County Weed & Pest	Complete

Attachment B: Wyoming sage-grouse projects funded by Wyoming Game & Fish Commission in FY2019

233-Little Mountain Cheatgrass	2019	Big Horn Basin	$23,500	$20,000 approved/spent	Aerial cheatgrass treatments	Big Horn County Weed & Pest	Complete
234-Sage Junction Cheatgrass	2019	Southwest	$109,000	$25,000 approved/spent	Aerial cheatgrass treatments	Lincoln County Weed & Pest, BLM	Complete
235-Avian & Mammalian Predators in Core vs. Non-core	2019	Many	$214,900	$55,500 approved/spent	Research to evaluate avian and mammalian predators relative to core vs. non-core and anthropogenic disturbance	Oregon State University	On-going
236-Response of SG to sagebrush treatments Phase IV	2019	Many	$1,481,831	$120,026 approved/spent	Continuing research to determine sage-grouse demographic and habitat use response to sagebrush treatments	University of Wyoming, Kelly Ornith. Research Fund, BLM, WY Reclamation & Restoration Center, WWNRT	On-going
237-Resource Selection Overlap with Co-occuring Species	2019	Many	$649,165	$39,950 approved/spent	Research of how resource selection of sage-grouse compares with feral horses, pronghorn, and Columbian sharp-tailed grouse.	University of Wyoming-Agricultural Experiment Station, BLM, WGFD, WY Dept of Agriculture, USFS	On-going
238-Improving Habitat Restoration Success	2019	Northeast	$500,089	$40,000 approved/spent		University of Waterloo, BLM, private landowners	On-going
239-Lander South Hudson Weeds	2019	Wind River/ Sweetwater River	$128,700	$21,500 approved/spent	Noxious weed surveys and treatment	Fremont County Weed & Pest, BLM	On-going
240-2018 Natrona Cheatgrass BLM	2019	Bates Hole/ Shirley Basin	$238,000	$12,000 approved/spent	Treat ~9550 acres of cheatgrass	BLM	Complete
241-Habitat Restoration in Northeast WY: Year 3	2019	Northeast	$30,367	$15,000 approved; $5,012.83 spent	Research on reclamation seeding success at coal bed natural gas sites by comparing species composition to seed mixes	BLM, University of Wyoming, University of Waterloo, private landowners	On-going
242-Heward 7E Livestock Watering System	2019	Bates Hole/ Shirley Basin	$101,510	$12,700 approved/spent	Develop livestock watering systems to distribute livestock for rangeland health	Medicine Bow Conservation District,	On-going

Attachment B: Wyoming sage-grouse projects funded by Wyoming Game & Fish Commission in FY2019

						Landowner, USFWS Partners	
243- Natrona Cheatgrass W&P	2019	Bates Hole/ Shirley Basin	$130,100	$12,000 approved/spent	Aerial cheatgrass treatments	Natrona County Weed & Pest, WWNRT, Mule Deer Initiative	Complete

Attachment C

GREATER SAGE-GROUSE RESEARCH CONDUCTED IN WYOMING IN 2019

Presented to State of Wyoming and Wyoming Game and Fish Department

Compiled by:

Dr. Jeff Beck
Department of Ecosystem Science and Management
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December 23, 2019

Research studies are listed alphabetically by last name of lab or principal investigator. Please feel free to contact labs or principal investigators with specific questions.

Male Greater Sage-Grouse on a Lek in Central, Wyoming, Spring 2019
Photo by Ella Bishop-Heil

1. EVALUATING BIODIVERSITY OF SAGEBRUSH-DEPENDENT SPECIES WITHIN SAGE-GROUSE HABITAT: AN EXAMPLE FROM THE WYOMING BASINS

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Sagebrush (*Artemisia* spp.) steppe ecosystems have experienced drastic changes resulting in loss, fragmentation, and degradation of remaining habitat. As a result, sagebrush-dependent fauna have experienced population declines. Threats to list the Greater Sage-grouse (*Centrocercus urophasianus*) under the Endangered Species Act have resulted in west-wide conservation efforts to protect sage-grouse habitats, actions presumed to also benefit other sagebrush fauna. To evaluate the effectiveness of using Sage-grouse to conserve biodiversity of sagebrush-dependent species, we first developed and compared data-driven spatial occupancy and abundance models for seven sagebrush obligate/associated species across the greater Wyoming Basins Ecoregional Assessment (WBEA) area (345,300 km^2). Our models predicted 63,784 km^2 of optimal Sage-grouse habitat. Protection of these areas for conservation may provide added benefits for some species, such as Sage-Thrashers (*Oreoscoptes montanus*), where 73% of predicted breeding habitat was captured across the range of Sage-grouse in the WBEA area. However, Brewer's sparrows (*Spizella breweri*) may not be as well protected by the Sage-grouse umbrella, with only 39% of predicted breeding habitat captured across the range of Sage-grouse within the WBEA. Mapping biodiversity hotspots using models of four songbirds (Brewer's Sparrow, Sage Thrasher, Sagebrush Sparrow (*Artemisiospiza nevadensis*), Green-tailed Towhee (*Pipilo chlorurus*)), pronghorn (*Antilocarpa Americana*), and Greater short-horned lizard (*Phrynosoma hernandesi*), Sage-grouse habitat will capture an estimated 40-60% of biodiverse areas containing ≥4 (of 6) species of conservation concern. If Sage-grouse are to be an effective umbrella for sagebrush ecosystems, biodiversity of other sagebrush species should be considered in conservation efforts. We will submit a peer-reviewed manuscript summarizing this work in early 2020.

Funding provided by: Western Association of Fish and Wildlife Agencies Sagebrush Science Initiative, and U.S. Geological Survey

2. MULTI-SCALE STATEWIDE WYOMING GREATER SAGE-GROUSE TRENDS DETERMINED BY POPULATION VIABILITY ANALYSIS

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We are investigating trends for Wyoming Greater Sage-grouse populations at multiple scales and management boundaries using population viability analysis (PVA) to determine local- and meta-population dynamics. Our objective was to use lek count data provided by the WGFD to determine the population growth rate (λ) state-wide, by local Working Group Areas, Core Areas, Core Areas by Working Group Areas, and at nine nested spatial scales based on lek clusters. See "Hierarchical Clustering of Greater Sage-Grouse Leks to Improve upon the Detection of Population Persistence, Sinks, and Sources" by O'Donnell et al. (2019) for cluster development specifics. We used average peak male counts per lek annually (1993-2015) in a PVA to evaluate density-independent (DI) and density-dependent (DD) models to estimate λ for each management area-based population. Population trends determined by management areas are relevant as these boundaries are used to implement management plans and limit development disturbances at leks. Clusters are defined by fine- and broad-scale habitat and climate attributes relevant to sage-grouse biology; therefore, trends within these clusters are more likely to be correlated and yield more precise trend estimates than other population demarcations. We developed our suite of models and applied them by Working Group and Core Areas; we finalized the development of lek clusters and applied the PVA across cluster scales using lek count data (1993-2017). We published our management areas-based PVA and a correction to our publication in 2018 and we submitted a manuscript for peer-review assessing sage-grouse population viability by clusters in late 2019.

Funding provided by: U.S. Geological Survey and Wyoming Landscape Conservation Initiative through USGS.

Publications:

Edmunds, D.R., C.L. Aldridge, M.S. O'Donnell, A.P. Monroe, P.S. Coates, and B.S. Cade. *In Review.* Greater sage-grouse trends across nested hierarchical spatial scales in Wyoming. *Journal of Wildlife Management*.

Edmunds, D.R., C.L. Aldridge, M.S. O'Donnell, and A.P. Monroe. 2018. Erratum: Greater sage-grouse population trends across Wyoming. *Journal of Wildlife Management* 82(8):1808-1808. doi:10.1002/jwmg.21560.

Edmunds, D.R., C.L. Aldridge, M.S. O'Donnell, and A.P. Monroe. 2018. Greater sage-grouse population trends across Wyoming. *Journal of Wildlife Management* 82(2):397-412. doi:10.1002/jwmg.21386.

3. GREATER SAGE-GROUSE RESPONSES TO FUTURE CUMULATIVE AND INTERACTING CLIMATE AND ENERGY DEVELOPMENT IN WYOMING

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The abundance and distribution of Greater Sage-grouse in Wyoming depends on future habitat changes, including oil and gas development and climate-induced changes in habitat. Yet, we have a poor understanding of the potential magnitude of these effects and how these stressors may shape future sage-grouse habitats and populations. We developed a series of future landscape maps for the Wyoming Landscape Conservation Initiative (WLCI) area of southwestern Wyoming. We simulated future loss and fragmentation of sagebrush habitats resulting from oil and gas development and associated roads infrastructure. Models were parameterized using realistic oil and gas development scenarios, using algorithms previously developed in southwestern Wyoming. Future climate scenarios were incorporated as climate-induced changes in vegetation. Future landscape maps were used to update seasonal habitat selection maps and influence future Sage-grouse habitat use. In oil and gas scenarios, avoidance of infrastructure and fitness consequences were enacted for some life stages within a spatially explicit individual-based model. We quantified a possible range of impacts of climate and development stressors on sage-grouse distribution, abundance, and persistence. Results indicate that long-term changes in climate or development could substantively re-shape existing Sage-grouse populations. Consideration of only one stressor could underestimate expected population changes. The findings of this project are now published.

Funding provided by: U.S. Geological Survey and Wyoming Landscape Conservation Initiative through USGS

Publication: Heinrichs, J.A, M.S. O'Donnell, C.L. Aldridge, S.L. Garman, and C.G. Homer. 2019. Influences of potential oil and gas development and future climate on sage-grouse declines and redistribution. *Ecological Applications* 29(6): 116-1131. doi:10.1002/eap.1912.

4. HIERARCHICAL CLUSTERING OF GREATER SAGE-GROUSE LEKS TO IMPROVE UPON THE DETECTION OF POPULATION PERSISTENCE, SINKS, AND SOURCES

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Population monitoring is vital to conservation and management of wildlife; yet, population survey data are commonly limited to single geographic extents and rarely account for processes occurring across spatial and temporal scales. To support a statistically repeatable and hierarchical framework for long-term monitoring, we developed a method to construct hierarchically nested groupings of similar habitats represented as spatial boundaries of population structures. Our approach relied on a clustering algorithm (Spatial "K"luster Analysis by Tree Edge Removal), where we explicitly included habitat selection at multiple scales surrounding leks (breeding grounds), and we modified the process to include constraint-based rules of connectivity between habitat. We applied this framework to Greater sage-grouse (*Centrocercus urophasianus*) in two disparate ecological contexts (Nevada and Wyoming). The connectivity rules consisted of inter-lek movement distances (isolation-by-distance; 15 km) and resistance to movements (barriers) between leks, increasing the biological realism of connectedness. The selection of habitat type and habitat scales varied across the geographic extents as well as across cluster levels. In Nevada, the finest-scaled cluster level captured ~90% of sage-grouse movements, where each bird was assigned to a home cluster, while mid-level scales captured ~97%–99% of movements. This approach can support scale-dependent management and research needs including population and habitat monitoring to inform conservation and adaptive management practices. We completed the pilot study (2019 publication below) for Nevada and Wyoming, and we are working with all 11 western state wildlife agencies to finalize a range-wide Greater sage-grouse population monitoring framework.

Funding provided by: U.S. Geological Survey and the Bureau of Land Management
Publication:

O'Donnell, M. S., D. R. Edmunds, C. L. Aldridge, J. A. Heinrichs, P. S. Coates, B. G. Prochazka, and S. E. Hanser. 2019. Designing multi-scale hierarchical monitoring frameworks for wildlife to support management: a sage-grouse case study. *Ecosphere* https://doi.org/10.1002/ecs2.2872.

5. THE COMPLEXITIES OF SAGE-GROUSE LONG-TERM MONITORING DATABASE SYSTEMS

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The Wyoming Game and Fish Department (WGFD) maintains a database of Greater sage-grouse lek locations and annual lek counts. Because of the importance of these data and repetitive use by researchers and managers for population trend monitoring, we developed program R code to use these data for long-term monitoring based on policies defined in the WGFD Handbook of Biological Techniques (Chapter 12; Christiansen 2012; p. 12-8). Although these standards did not apply to data collected prior to the mid-1990s, we apply them across all years for the trend analyses. The impetus for these efforts was threefold: 1) provide results and tools to WGFD, 2) standardize workflows, and 3) support ongoing sage-grouse research (e.g., see Edmunds et al. (2019) and O'Donnell et al. (2019) [Clusters]). Our code extracts observations meeting the four main criteria for counts as defined in the handbook: 1) ground counts, 2) time constraints of 30 minutes before and 90 minutes post sunrise (modified from 60 minutes based on Monroe et al. 2016), 3) no precipitation, and 4) wind speeds ≤10 mph. Due to similar efforts for compiling a national range-wide Greater Sage-grouse lek database that could support the development of a range-wide hierarchical population monitoring framework (see O'Donnell et al. (2019) and "Hierarchical Clustering…" abstract), we employed similar methods to clean up data entry errors and standardize definitions for all 11 state lek databases. We migrated the code to open-source Python libraries, and we incorporated many quality control measures for verifying data integrity. We will release the software (some obfuscation of hardcoded pieces will exist), and states can adjust code based on their definitions or geographic region of interest (lek data not included).

Funding provided by: U.S. Geological Survey and Wyoming Landscape Conservation Initiative through USGS

6. PREDICTING POST-DISTURBANCE RECOVERY OF SAGEBRUSH ECOSYSTEMS USING REMOTE SENSING PRODUCTS

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The historic loss of vegetation and subsequent recovery trajectories after disturbances in sagebrush ecosystems are not well understood at broad spatial and temporal scales. Establishing rates of sagebrush recovery and estimating time to recovery will aid in characterizing restoration and management efforts and inform effective sagebrush restoration strategies. Recently, we have assembled spatial datasets characterizing disturbance-specific information from energy development, fire, mechanical, and chemical treatments within Wyoming. By pairing these spatial datasets with historic sagebrush habitat maps (SBMap; percent cover by 30-m pixels; every 2−5 years from 1985– 2015, see publications by Homer and others) within the Wyoming Landscape Conservation Initiative region (WLCI), we can evaluate the rate of 'ecological recovery' as well as the time to recovery (relative to current sagebrush cover). We demonstrate this approach by examining variation in recovery rates among 375 former well pads in WLCI, evaluating the contribution of weather, soils, and other factors on sagebrush recovery rates. We then used model estimates to predict recovery rates and times across the WLCI. The resulting prediction surfaces will aid in identifying sagebrush and habitat recovery expectations and directly inform management efforts outlined within the Secretarial Order 3336 and within the recently revised BLM and USFS resource management plans. Our peer-reviewed manuscript was published in the fall of 2019. We received support to extend this approach to a suite of other disturbance types and vegetation treatments across Wyoming, and to evaluate recovery trends under different future climate scenarios and examine economic implications.

Funding provided by: U.S. Geological Survey, the Bureau of Land Management, and the Wyoming Landscape Conservation Initiative through USGS

Publication:

Monroe, A.P., C.L. Aldridge, M.S. O'Donnell, D.J. Manier, C.G. Homer, and P.J. Anderson. 2020. Using remote sensing products to predict recovery of vegetation across space and time following energy development. *Ecological Indicators* 110:105872. https://doi.org/10.1016/j.ecolind.2019.105872

7. PRIORITIZING LANDSCAPES FOR BIRD-FRIENDLY RANCHING

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Widespread declines of bird populations breeding in North American rangelands are well-documented, and implementing approaches that sustain the livelihoods of ranchers while offering opportunities for wildlife has potential to attenuate or reverse these trends. In the Powder River – Thunder Basin of Wyoming, Audubon Rockies is working to establish their Conservation Ranching program, a market-based approach connecting conservation-conscious consumers to ranchers employing bird-friendly management practices. To increase efficiency of this effort, we are developing a landscape prioritization framework that identifies areas for bird conservation and establishes a monitoring program to evaluate outcomes. Using bird surveys conducted with the Integrated Monitoring in Bird Conservation Regions (IMBCR) protocol from 140 survey locations (2009−2018) across the Powder River – Thunder Basin, we built hierarchical community models to estimate passerine distribution and abundance across multiple scales while accounting for variation in detectability. We are then creating spatially-explicit predictions for each species as well as community-level metrics over the study area. These maps will identify areas with potential for high bird abundances, where the Conservation Ranching program could be prioritized. We also evaluated relationships with more fine-scale habitat components, which could inform pasture-level management for each species. Additionally, our framework establishes a baseline for continued monitoring as the Conservation Ranching program is implemented across the landscape, clarifying the link between consumers and on-the-ground conservation.

Funding provided by: Audubon Rockies, Margaret A. Cargill Foundation, and U.S. Geological Survey

8. SOUND LEVELS AT GREATER SAGE-GROUSE LEKS IN THE PINEDALE ANTICLINE PROJECT AREA, WYOMING, APRIL, 2013–2019

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Skip Ambrose and Chris Florian, Western Bioacoustics, Inc., Castle Valley, UT

The Bureau of Land Management's Pinedale Anticline Project Area Supplemental EIS developed a "Wildlife Monitoring and Mitigation Matrix" that identified species to be monitored and criteria to be monitored. Greater Sage-grouse were identified as a species to be monitored, and one criterion for this species was sound levels at leks. The objective of this project was to monitor sound levels at Greater Sage-grouse leks in the Pinedale Anticline Project Area (PAPA) south of Pinedale, WY, and determine if sound levels exceeded 10 dB over background ambient sound levels. The background ambient sound level (L_{A90}) in sagebrush habitats in rural, undeveloped Wyoming is 14.0 dB. A total of 2,938 hours of acoustic data were collected at 20 leks in the PAPA in 2019; 2,046 hours (70%) had L_{A50} levels > 24 dB. Of the 20 leks in the PAPA, 13 had L_{A50} >24 dB (11 of these had declining trends), and 7 had L_{A50} <24 dB (1 of these had declining trends). From 2013–2019, 17,407 hours of acoustic data were collected at 20 leks in the PAPA. Average sound levels for all hours for all leks were L_{Aeq} = 30.2 dB, L_{A50} = 25.9 dB, and L_{A90} = 25.9 dB. Available evidence suggests that when gas field sound levels (L_{A50}) exceed 24 dB (10 dB over background levels of 14 dB), grouse populations decline.

Funding: Pinedale Anticline Project Office, Bureau of Land Management, Pinedale, WY.

9. IDENTIFICATION OF WINTER CONCENTRATION AREAS IN SOUTH-CENTRAL WYOMING

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Availability and use of winter habitat by greater sage-grouse (*Centrocercus urophasianus*) has the potential to influence viability of sage-grouse populations and should receive considerable attention when prioritizing areas for sage-grouse habitat conservation. The Wyoming Sage-grouse Executive Order outlines the need to identify Winter Concentration Areas (WCAs), defined as winter habitats where sage-grouse consistently aggregate in groups of 50 or more individuals. Unfortunately, documentation of WCAs lags behind our knowledge of sage-grouse winter habitat requirements and space use during other critical periods. Our study was designed to detect locations of unknown WCAs while assessing abundance and resource selection to refine our understanding of winter habitats and critical use areas for sage-grouse. We used aerial infrared videography in winter 2017 to identify potential WCAs in south-central and southwest Wyoming to evaluate abundance and winter habitat selection as influenced by biological attributes, environmental, and anthropogenic features across the region. We located 4,859 individuals comprising 132 flocks across our study area. Flocks occurred in Core Areas more than expected, but a biologically meaningful number of sage-grouse flocks were located outside of Core Areas. Our results and survey technique provide a potential framework for identifying sage-grouse WCAs with implications for improving protection of all seasonal habitats for sage-grouse conservation.

Funding provided by: Wyoming Game and Fish Department, Wyoming Sage-grouse Conservation Fund; South-Central and Southwest Local Sage-grouse Work Groups.

Publication:

Smith, K. T., J. B. Dinkins, and J. L. Beck. 2019. Approaches to delineate greater sage-grouse winter concentration areas. *Journal of Wildlife Management* 83:1495–1507.

10. MANAGEMENT GUIDELINES FOR GREATER SAGE-GROUSE WINTER CONCENTRATION AREAS

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

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During 2018, we initiated a project with an overall goal to generate management recommendation guidelines for greater sage-grouse winter concentration areas in Wyoming using a 2-phase approach. Phase 1 will utilize currently-available data from sage-grouse equipped with GPS transmitters throughout Wyoming to address 3 main objectives: 1) identify the timing of sage-grouse presence on winter range, 2) identifying the interaction between snow cover/depth and sagebrush cover/height relative to sage-grouse winter habitat selection, and 3) identify thresholds of sage-grouse response to anthropogenic disturbance in winter. During 2018, we acquired existing datasets from multiple sage-grouse research projects across Wyoming that utilized GPS transmitters to obtain location data. We also began digitizing anthropogenic surface disturbance and started acquiring snow data for these study areas. The study areas contained a range of anthropogenic infrastructure and surface disturbance. Results from Phase 1 will form the basis from which disturbance management guidelines can be developed. Phase 2 will assess the effectiveness of these guidelines applied to a novel area located in the southern Red Desert and Sierra Madre region of Wyoming. This novel area is ideal because it contains areas of heavy disturbance, areas of little disturbance, and areas of proposed new disturbance. This area also has documented sage-grouse winter concentration areas outside Core Areas used by grouse that breed inside Core Areas. For Phase 2, during 2018 and 2019, we captured and equipped 58 adult female sage-grouse with GPS transmitters with plans to maintain a sample of 50 individuals for the duration of our study.

Funding provided by: Wyoming State Office of the Bureau of Land Management; Sublette County Conservation District; Wyoming Game and Fish Department; and South-Central, Southwest, and Wind River/Sweetwater River Local Sage-grouse Working Groups.

11. RESPONSE OF GREATER SAGE-GROUSE TO HUMAN ACTIVITY AND DEVELOPMENT IN THE NORMALLY PRESSURED LANCE AREA

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Our proposed research focuses on quantifying changes in the mortality risk, physiological stress, seasonal movements, and avoidance of wintering greater sage-grouse (*Centrocercus urophasianus*) to the Normally Pressured Lance (NPL) Project in Sublette County, Wyoming. The NPL encompasses 140,859 acres (96% of which is public land administered by the Bureau of Land Management [BLM]) south and west of the existing Jonah Field. Here, long-term development potential includes a maximum of 3,500 directionally drilled wells over 10 years that will produce oil and natural gas. A total of 35,000 acres of the Alkali Creek and Alkali Draw winter sage-grouse concentration areas overlay the NPL where upwards of 1,500 grouse aggregate during many winters, indicating the need for better information to guide grouse conservation efforts in the project area. We began field work by deploying 28 GPS transmitters during February 2019 within the winter concentration areas that occur in the NPL. During 2019, 21,630 grouse locations were collected from these transmitters. Our study design calls for 100 GPS transmitters to be deployed equally split between the NPL treatment area and nearby control areas outside the NPL where development will not occur. So far, we have deployed half of these transmitters during December 2019. Field work is planned to continue through winter 2022–2023.

Funding provided by: Jonah Energy, LLC, Wyoming Game and Fish Department

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

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Wyoming big sagebrush (*Artemisia tridentata wyomingensis*) has been treated through chemical application, mechanical treatments, and prescribed burning to increase herbaceous forage species released from competition with sagebrush overstory. Originally intended to provide more forage for livestock, these techniques have been applied to improve habitat for sagebrush wildlife species including greater sage-grouse (*Centrocercus urophasianus*). Treatments are intended to rejuvenate sagebrush plants and increase herbaceous production. Studies evaluating habitat treatments have reported varied results and generally lack the replication necessary for evaluation of demographic rates and fine-scale habitat use of sage-grouse in response to treatments. Our study, centered near Jeffrey City, Wyoming is designed as a Before-After Control-Impact study with 3 years of pre-treatment and 6 years of post-treatment data comparing demographic rates and habitat selection patterns within treated and non-treated sites. We initiated our study in spring 2011 by capturing female sage-grouse and affixing VHF necklace-mounted or GPS rump-mounted transmitters to measure nest and brood-rearing success, and adult female survival. During winter 2014, we mowed 489 ha (1,208 acres) of sagebrush habitats across 2 mowing treatment areas and applied tebuthiuron to 607 ha (~1,500 acres) across 2 herbicide treatment areas in May 2014. We have monitored demographic parameters from n = 625 marked females. Identifying sage-grouse demographic and habitat use responses will aid in determining the efficacy of habitat treatments intended to enhance habitat for sage-grouse and other species associated with the sagebrush biome. Our field study was funded through summer 2019; we will perform final analyses during 2020.

Funding provided by: Wyoming Game and Fish Department, Wyoming Sage-grouse Conservation fund; Bates Hole/Shirley Basin, Bighorn Basin, South-Central, Southwest, Upper Green River, Upper Snake River and Wind River/Sweetwater River Local Sage-grouse Work Groups; Wyoming Reclamation and Restoration Center; Wyoming Wildlife and Natural Resource Trust; Land Field Office-Bureau of Land Management; and Margaret and Sam Kelly Ornithological Research Fund.

Publications:

Smith, K. T., J. R., LeVan, and J. L. Beck. 2019. Forb and invertebrate response to treatments for greater sage-grouse in Wyoming big sagebrush. *Rangeland Ecology and Management* 72:791–795.

Smith, K. T., A. C. Pratt, J. L. LeVan, A. M. Rhea, and J. L. Beck. 2019. Reconstructing greater sage-grouse chick diets: diet selection, body condition, and food availability at brood-rearing sites. *The Condor: Ornithological Applications* 121: 1–12.

Pratt, A. C., K. T. Smith, and J. L. Beck. Prioritizing seasonal habitats for comprehensive conservation of a partially migratory species. *Global Ecology and Conservation* 17:e00594.

Smith, K. T., J. S. Forbey, and J. L. Beck. 2018. Effects of mowing and tebuthiuron treatments on the nutritional quality of Wyoming big sagebrush. *Rangeland Ecology and Management* 71:417–423.

Smith, K. T., J. L. Beck, and C. P. Kirol. 2018. Reproductive state leads to intraspecific habitat partitioning and survival differences in greater sage-grouse: implications for conservation. *Wildlife Research* 45:119–131.

Smith, K. T., and J. L. Beck. 2018. Sagebrush treatments influence annual population change for greater sage-grouse. *Restoration Ecology* 26:497–505.

Smith, K. T., J. L. Beck, and A. C. Pratt. 2016. Does Wyoming's Core Area Policy protect winter habitats for greater sage-grouse? *Environmental Management* 58:585–596.

13. FREE-ROAMING HORSE IMPACTS ON SAGE-GROUSE NEST SITE SELECTION AND SUCCESS

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

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Feral horses have been cited as potential threats to greater sage-grouse (*Centrocercus urophasianus*) populations. Direct impacts can include disturbance of leks and trampling of nests or chicks. Potential indirect impacts primarily involve habitat alteration through decreased native grass and shrub cover, and overall vegetation height, along with increases in exotic grass cover and dominance of unpalatable forbs. Though feral horses are thought to negatively impact sage-grouse, quantitative investigation is lacking. Our project objectives include evaluating: 1) the impact that free-roaming horses have on greater sage-grouse nest site selection and success measured from marked female sage-grouse, and 2) the relative degree in which horse utilization, modeled from horse dung transects, compares to utilization distributions modeled from locations acquired from GPS-equipped feral mares. During August 2019 we recorded the density of horse dung along 225, 1-km transects across two study areas. We have marked sage-grouse in the Jeffrey City study area in central Wyoming and marked sage-grouse and feral mares in the Red Desert in south central Wyoming. In conjunction with other habitat features, we will use transects to generate a spatial prediction of relative horse density to evaluate the relationship between horse density and nest and brood site selection and success. We have a unique opportunity to validate predictive layers created by horse dung transects in the Red Desert study area with the probability surface modeled from locations of free-roaming horses equipped with GPS collars. This information will assist grouse scientists and managers in better understanding the potential impacts of free-roaming horses on sage-grouse populations.

Funding provided by: Wyoming Sage-grouse Conservation fund; Bighorn Basin, South-Central, Southwest and Wind River/Sweetwater River Local Sage-grouse Work Groups.

14. RESOURCE SELECTION OVERLAP BETWEEN GREATER SAGE-GROUSE AND CO-OCCURRING SPECIES

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Our project aims to address how resource selection and space use of greater sage-grouse compares with three co-occurring species: feral horses (*Equus ferus caballus*), pronghorn (*Antilocapra americana*), and sharp-tailed grouse (*Tympanuchus phasianellus*) in southern Wyoming. This information will elucidate how these species partition resources and identify potential areas of conservation concern for sage-grouse populations. Our sage-grouse, feral horse, and pronghorn investigation is focused around the BLM-administered Wild Horse Adobe Town Herd Management Area in Carbon and Sweetwater counties. Our sage-grouse and sharp-tailed grouse investigation is focused along the western slope of the Sierra Madre Range in Carbon County. During 2017, we captured and equipped 37 adult female feral horses and 35 adult female pronghorn with GPS transmitters. Between 2017 and 2019, we captured and equipped 213 adult female and 57 male sharp-tailed grouse with VHF transmitters. During 2018 and 2019, we captured and equipped 58 adult female sage-grouse with GPS transmitters. Our project will help clarify whether management actions for these other important species will benefit or adversely impact sage-grouse conservation, and vice-versa. Our study is in collaboration with other research projects investigating the ecology and management of feral horses; genetic relationships, demography, and resource selection of sharp-tailed grouse; and the winter ecology of sage-grouse.

Funding provided by: Bureau of Land Management; University of Wyoming–Agricultural Experiment Station; Wyoming Game and Fish Department; South-Central, Southwest, and Wind River/Sweetwater River Local Sage-Grouse Working Groups; Wyoming Governor's Big Game License Coalition; Wyoming Wildlife Federation; and U.S. Forest Service.

15. LANDSCAPE MANAGEMENT FOR SAGEBRUSH AND GRASSLAND BIRD GUILDS IN THUNDER BASIN, WYOMING

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The Thunder Basin National Grasslands (TBNG) of northeastern Wyoming are composed of a heterogeneous mosaic of sagebrush (*Artemisia spp.*), short-grass and mixed-grass plant communities. Portions of TBNG have been designated as core area for greater sage-grouse (*Centrocercus urophasianus*), and are also important for other sagebrush bird species. However, the grassland also contains some of the largest complexes of black-tailed prairie dogs (*Cynomys ludovicianus*) in North America; these colonies provide important habitat for shortgrass bird species (e.g. mountain plover [*Charadrius montanus*]), and are also prioritized as a reintroduction zone for the endangered black-footed ferret (*Mustela nigripes*). Because conservation of diverse species in the same landscape requires spatial optimization of management approaches, we initiated a study in 2015 to determine how shortgrass and sagebrush bird species are influenced by the composition and spatial configuration of habitat patches in the Thunder Basin landscape. From 2015-2017 we surveyed birds on transects placed across sage grouse leks ("sagebrush," n=10), prairie dog colonies ("shortgrass," n = 10), and also across edges between colonies and adjacent habitat ("edge," n = 41). In 2018, we collected data on a subset of these transects to track avian response to plague (*Yersina pestis*) in prairie dogs. We have published one paper examining the effect of disturbance on birds (Duchardt et al. 2018), but will continue to use these data to generate models of single species density as a function of local and landscape habitat variables. We are especially interested in how the size and configuration of prairie dog colonies influences sagebrush species in this landscape. However, because sage grouse have low detectability on point counts, we will use lek data to examine sage grouse response to colony abundance and configuration in the landscape, and compare these responses with sagebrush passerines including Brewer's sparrow (*Spizella breweri*) and sage thrasher (*Oreoscoptes montanus*).

Publications – Peer-reviewed:

Duchardt, C.J., Augustine, D.M., and Beck, J.L. Sagebrush bird responses to natural and anthropogenic disturbance at the eastern edge of the sagebrush steppe. (*In prep, Journal of Wildlife Management*).

Duchardt, C.J., Beck, J.L., and Augustine, D.M. 2020. Drivers of mountain plover habitat selection and nest survival on large prairie dog colonies. *The Condor: Ornithological Applications* 122:In press.

Duchardt, C.J., Augustine, D.M., and Beck, J.L. 2019. Threshold responses of grassland and sagebrush birds to disturbance by an ecosystem engineer. *Landscape Ecology* 34:895–909

Duchardt, C. J., L. M. Porensky, D. J. Augustine, and J. L. Beck. 2018. Disturbance shapes avian communities on a grassland–sagebrush ecotone. *Ecosphere* 9(10):e02483.

Publications – Extension

Duchardt, C.J. and Connell, L.C. 2018. Sharing Fences. Western Confluences Magazine (in press)

Duchardt, C.J. and Scasta, J. D. 2017. Welcome to Thunder Basin. Thunder Basin Ecology Factsheet Series. University of Wyoming Extension. B-1288.1.

Duchardt, C.J. and Scasta, J. D. 2017. Birds of Thunder Basin: Sagebrush specialists. Thunder Basin Ecology Factsheet Series. University of Wyoming Extension. B-1288.2.

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  - Program in Ecology Travel Grant ($500)
  - University of Wyoming College of Ag. and Natural Resources Grant ($2,500)
  - Prairie Biotic Inc ($1,500)

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

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Wyoming contains 70% of the world's bentonite clay deposits, and mines in the Bighorn Basin produce >50% of Wyoming's annual supply. Bentonite is extracted by open-pit mining that leads to disturbance, fragmentation, and loss of sagebrush habitat. Plans call for mining to increase in sagebrush communities; therefore, our primary study objective was to monitor (for 4 years; 2011–2015) the demographic rates and habitat selection patterns of greater sage-grouse in areas with greater (Shell) and lesser (Hyattville) amounts of bentonite mining activity. We monitored female survival, nest success, and brood survival with radio telemetry. To help guide reclamation we sampled vegetation in microhabitat plots at nests, early-brood locations, and at paired random locations. Our second study objective was to describe the migration behavior of these populations using GPS-marked grouse. Observations have indicated a wide variety of migratory behavior including differences in the proportion of each population that was migratory, timing, distance, duration, destination, and differences among seasons. We have finished analyses and manuscript writing relative to our research objectives.

Funding provided by: American Colloid Company, Big Horn Basin Local Sage-Grouse Working Group, and the Margaret and Sam Kelly Ornithological Research Fund.

Publications:

Pratt, A.C., and J.L. Beck. *In review*. Do greater sage-grouse exhibit maladaptive habitat selection?

Pratt, A.C., and J.L. Beck. 2019. Greater sage-grouse response to bentonite mining. *Journal of Wildlife Management* 83:866–878.

Pratt, A.C., K.S. Smith, and J.L. Beck. 2019. Prioritizing seasonal habitats for comprehensive conservation of a partially migratory species. *Global Ecology and Conservation* 17:e00594.

Pratt, A. C., K. T. Smith, and J. L. Beck. 2017. Environmental cues used by greater sage-grouse to initiate altitudinal migration. *The Auk: Ornithological Advances* 134:628–643.

17. EXPLORING DISTURBANCE THRESHOLDS: GREATER SAGE-GROUSE REPRODUCTIVE RATES AND PATTERNS OF HABITAT USE RELATED TO THE PHYSICAL FOOTPRINT OF ENERGY DEVELOPMENT

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Energy infrastructure and associated habitat loss, can lead to reduce reproductive rates across a variety of species including the greater sage-grouse (*Centrocercus urophasianus*). Our goal was to refine our understanding of how the physical footprint of energy development relates to sage-grouse nest and brood survival. Because our survival analyses were conditional upon the amount of surface disturbance female sage-grouse were exposed to during these reproductive stages, we quantified levels of exposure and compared them to the surface disturbance levels of the surrounding habitats. We utilized data from 6 study areas in Wyoming containing 4 primary types of renewable and nonrenewable energy development. Our research focused on press disturbance which is disturbance sustained after initial disturbance and associated with existing energy infrastructure and human activity. Our results suggest exposure to press disturbance during nesting and brood-rearing was related to lower nest and brood survival, which manifested at different spatial scales. Our analysis of nest survival suggested that the likelihood of failure was positively associated with the proportion of press disturbance within an 8.0-km² area. Broods exposed to any press disturbance within a 1-km^2 area were less likely to survive compared to broods not exposed to press disturbance. The exposure of nesting and brood-rearing sage-grouse to press disturbance suggested females consistently used habitats with lower disturbance levels during these reproductive periods. Greater than 90% of nest and brood-rearing locations were in habitats with less than 3% press disturbance within a 2.7-km^2 (1 mi^2) area. Our research informs better understanding of biological tradeoffs related to the physical footprint of energy development and regulations designed to conserve impacted sage-grouse populations in the sagebrush (*Artemisia* spp.) biome.

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Publication:

Kirol, C, P., K. T. Smith, N. E. Graf, J. B. Dinkins, C. W. LeBeau, T. L. Maechtle, A. L. Sutphin, and J. L. Beck. Greater sage-grouse response to the physical footprint of energy development. *Journal of Wildlife Management* (revised and in review).

18. GREATER SAGE-GROUSE TRANSLOCATION FROM WYOMING TO NORTH DAKOTA

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Wildlife translocations and population augmentations continue to occur and are an important management option for wildlife managers. Many grouse populations are imperiled and managers have used translocation techniques for various species and populations. Past efforts have often lacked monitoring of the translocated individuals and we are often left with little information to understand how or why the management action was a success or failure. The majority of grouse translocation efforts with monitoring have often failed in the short term, or if some immediate success, then in the long-term. There is no information currently concerning impacts to the source population or the comparison of population dynamics between the source and translocated birds. We translocated 40 female and 20 male sage-grouse during the spring of 2017. In 2018, we translocated 20 females and 20 males in the spring and captured, translocated, and released 6 additional brood hens with their chicks in the augmented population. In 2019, we translocated 20 males in the spring, 10 brood hens with their chicks and 10 non-brood hens during the brooding period (i.e., early June to mid-July). All translocated birds were from the Stewart Creek area, north of Rawlins, WY to southwest North Dakota, where sage-grouse numbers have been declining for several years. All translocated birds were radio-marked and monitored for survival and reproductive rates. In addition to birds that were translocated or were released at the capture site with the potential to be translocated as brood hens, we also maintained a sample of 20 radio-marked female sage-grouse within the source population and monitored survival and reproduction. For spring translocated females in 2017 and 2018, we used artificial insemination (AI) techniques on a treatment group, with sham and control samples as well, to see if AI influences reproductive rates of females. These same techniques are being used in the Bi-State population in California and a population in west-central Utah. During June and July of 2018 we translocated 6 brood hens and 26 chicks. All captured and translocated brood hens and chicks were radio-marked in 2018 and 2019. We used a soft-release method by containing the chicks and brood hen in a specially designed brood box, which separated the hen from the chicks with a removable divider, but allowed vocalizations to occur. Once in North Dakota, the brood box was put in a release pen approximately 8 x 6 feet and 20 inches tall and the divider was removed and a door opened on the chick's side of the brood box into the release pen. To go into the release pen the brood hen was forced to move through her chicks. To release the brood into their new natural environment, one entire 8-foot side of the release pen was raised once the hen and chicks had acclimated to each

other again within the release pen. We constructed drift fences in a V-shape using chicken wire to guide the brood into sagebrush cover at the release site and reduce the risk of separation occurring between the chicks and hen. In 2018, 3 broods with 7 chicks total between all broods, successfully fledged with at least one chick surviving to 50 days. However, for one of these broods the adult female was found positive for Avian TB and we were required to dispatch the brood hen and her 3 chicks at 48 days post-hatch. In 2019, of the 40 chicks translocated in 10 broods, 23 chicks survived ≥ 50 days post-hatch. Of the 23 chicks that survived, 12 of them were recaptured in August and marked with adult necklace style VHF transmitters. We are currently processing data and preparing analyses to compare techniques and develop translocation protocols based on the comparison of translocated and source populations. We also plan on publishing a thesis and submitting a couple publications for peer-review based on this research.

Funding provided by: North Dakota Game and Fish Department and Wyoming Game and Fish Department

19. GREATER SAGE-GROUSE GEOPHAGY DURING THE WINTER

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Greater sage-grouse have been documented eating soil during the winter near Pinedale, WY. Our objectives included 1) understand why this behavior is happening, including what nutrient the birds are seeking, 2) how this behavior affects winter habitat selection, and 3) if this behavior influences survival and reproductive rates the following spring and summer. We are trapping and radio-marked up to 30 individual grouse each year for the winters of 2017-18 and 2018-19. We will monitor their movements and habitat selection. We are also collecting soil samples at geophagy sites and at random sites across the study area to assess differences. We will collect sagebrush leaf samples at feeding sites from plants that are fed on and plants in the area that are not selected to evaluate any differences in nutrient content. We will also collect sage-grouse fecal pellets from flocks with radio-marked birds to see if we can detect any differences in micro nutrients based on time since visiting a geophagy site. Samples of calcium, salt, and phosphorous will be placed at geophagy sites to see if visiting sage-grouse will select for one or more of these nutrients. During the following spring and summer we will follow radio-marked females to monitor their reproductive rates and assess whether geophagy behavior can be related to reproductive rates. In December 2017 we radio-marked 20 sage-grouse with store-on-board GPS radios. We also had an additional 10 or more VHF radio-marked grouse. As of January 1, 2018 16 of the 20 GPS radios had a software glitch that caused the GPS units to fail. We were not able to replace this sample of birds until late February 2018. All GPS units had a paired VHF radio, and we attempted to use VHF data loggers at known geophagy sites to record visitation rates. We receive funding to order 18 additional GPS-PTT ARGOS enabled units for the 2018-19 winter field season. This sample of GPS radios, combined with our existing sample from February 2018, should provide a large amount of location and movement data for this upcoming field season. We collected ~ 20 samples of vegetation and pellets last field season, and will continue this effort this coming winter. At the end of the 2018-19 field season all known geophagy sites had soil samples recorded. The current graduate student, Scott Fox, is currently developing his thesis. Another graduate student, Chuck Carpenter III, has begun work on this project during the 2019 spring and summer field season. Chuck's objectives are to monitor the reproductive activities and survival of female sage-grouse (in 2019, the females that were monitored during the 2018-2019 winter) which have location data from the previous winter. We want to evaluate the impacts of geophagy behavior on survival and reproduction the following breeding and brooding seasons. Chuck is currently capturing female sage-grouse to gather GPS location data from them this 2019-2020 winter and then monitor them

during the 2020 field season. We plan on 2 or more peer-reviewed publications concerning this research following the publication of theses.

Funding provided by: Bureau of Land Management Pinedale Field Office, Southwest Wyoming Sage-Grouse Local Working Group

20. COMPARISON OF AVIAN AND MAMMALIAN PREDATORS IN SAGE-GROUSE CORE AND NON-CORE AREAS: ASSESSING PREDATOR ABUNDANCE AND RESPONSES TO ANTHROPOGENIC FEATURES

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Greater sage-grouse (*Centrocercus urophasianus*: hereafter sage-grouse) abundance and distribution in western North America has declined over the last century. Many factors have contributed to this decline, including habitat loss and fragmentation from human development with an associated potential for increased predation rates from avian and/or mammalian predators. In addition, sage-grouse avoid areas with higher avian predator densities. While human development influences sage-grouse demographic rates and habitat selection, development also provides an increased number of perch and nesting structures used by avian predators—including ravens that can negatively influence sage-grouse nest success. Wyoming's Sage-grouse Core Areas were developed to add protections to important habitat for sage-grouse by reducing human development within Core Areas. Core Areas have maintained higher sage-grouse trends compared to Non-Core Areas, which could be partially explained by reduced predation rates. However, we lack a study comparing predator abundance within and outside Core Areas. We performed avian point counts along 8.05-km transects during summers 2017 and 2018. This information will be added to BBS data and human disturbance data previously calculated. We deployed trail cameras at scent stations and performed 500-m scat/badger burrow transects to survey for mammals during the 2018 summer. Scent stations and transects (avian, scat, burrow) were stratified between Core and Non-Core Areas in the Wyoming Basin. Preliminary results and analyses are currently being generated to determine (1) what habitat or structural factors are associated with higher predator and songbird abundance, and (2) if avian and mammalian predator abundance differs between Core and Non-Core Areas.

Funding provided by: Bates Hole/Shirley Basin, Big Horn Basin, South Central, Wind River/Sweetwater River, and Southwest Wyoming Sage-Grouse Local Working Groups; and Oregon State University

Table 1. Sample sizes of completed data collection as of 2018.

Avian Predator Transects/Point Counts	400 transects/2,293 point counts
Deployed Scent Stations	117
Scat and Badger Burrow Transects	176 (98 repeated)

21. INTERACTIVE EFFECTS OF HABITAT, LIVESTOCK PRESENCE, AND PREDATORS ON GREATER SAGE-GROUSE DEMOGRAPHY AND SEASONAL HABITAT

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Greater sage-grouse (*Centrocercus urophasianus*: hereafter "sage-grouse") distribution and abundance in western North America has declined over the last century, which has prompted multiple petitions to the U.S. Fish and Wildlife Service to list sage-grouse throughout its range. Habitat loss and degradation are the predominant factors attributed to these declines, but predation in some contexts may also contribute to declines. Livestock grazing has been identified as one of the potential threats to sage-grouse habitat and populations, which has been based on vegetation changes associated with grazing. From a community ecology perspective, very little is known about potential benefits or threats of livestock management interactions with other ecosystem processes on sage-grouse habitat and populations. This study aims to evaluate the variation in predator communities and interactions with livestock presence on sage-grouse demographic rates and habitat use through the use of camera traps on the landscape and data collected from GPS units on livestock in the Bighorn Basin. Our objectives for this study include evaluating the influence of predators relative to habitat and livestock on sage-grouse habitat use and adult hen, nest, or brood survival, evaluating the difference in predator abundance and community composition relative to cattle presence, and monitoring and quantifying seasonal habitat use and adult survival (including winter) of sage-grouse related to habitat characteristics and weather. The primary assessments will include relationships of sage-grouse habitat use and demographic rates in areas with different livestock presence and timing of use, in addition to the predator composition in relation to livestock presence.

Funding Sources: Bureau of Land Management, Big Horn Basin Sage-Grouse Local Working Group

22. IMPROVING SUCCESS IN HABITAT RESTORATION FOR SAGEBRUSH OBLIGATE WILDLIFE: ASSESSMENT OF AVIAN HABITAT USE AND VEGETATION COMPOSITION IN SAGEBRUSH STEPPE RECLAMATION ACTIVITIES

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To improve outcomes of habitat restoration for sage-grouse (*Centrocercus urophasianus*) and other sagebrush dependent birds, we need to understand relationships between distribution and composition of plant communities on reclaimed sites in relation to habitat use and population fitness of sagebrush species. Generally speaking, how can we best restore birds when restoring sagebrush habitat? We initiated research in the summer of 2016 to assess the influence of reclamation activities on habitat use, movements and population fitness of sagebrush-obligate/associate birds. Our study is in the Powder River Basin in an area that has undergone large-scale reclamation of coal bed natural gas infrastructure. Our focal species include sage-grouse and passerines using sagebrush habitats during the breeding season. This study area is ideal because it contains a gradient of disturbance types, representing different stages of energy development, from non-impacted sites, reclaimed sites, and active energy development sites. Our primary objectives are to assess the response of these species across the gradient of energy development, reclaimed, and control areas. We have completed three field seasons (2016 - 2019) and published two manuscripts associated with this research.

Funding provided by: BLM-Buffalo Field Office, Northeast Sage-Grouse Working Group, the Wyoming BLM-State Office, Canadian Foundation for Innovation, Natural Sciences and Engineering Research Council of Canada.

Publications:

Barlow, N.L, C.P. Kirol, K.E. Doherty, and **B.C. Fedy.** *In press*. Does the umbrella-species concept work at fine spatial scales? Journal of Wildlife Management.

A.L. Sutphin, T.L. Maechtle, C.P. Kirol, and **B.C. Fedy**. 2018. A mobile tool for capturing greater sage-grouse. Wildlife Society Bulletin. DOI: 10.1002/wsb.899

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

Contact: Dr. Brad Fedy; E-mail: bfedy@uwaterloo.ca; Phone: (519) 888-4567 ext. 32706

Principal Investigators

Dr. Brad Fedy, School of Environment, Resources and Sustainability, University of Waterloo, Waterloo, Ontario, Canada
Dr. Sara Oyler-McCance, U.S. Geological Survey, Fort Collins Science Center, Fort Collins, CO 80526, USA

Greater sage-grouse population connectivity has been identified as a priority management issue by multiple state and federal management agencies. We are working on a large-scale project to assess levels of population connectivity using genetic approaches. This project assisted in the delineation of related populations and described possible sub-population boundaries. The research also identified likely barriers to the movement of individuals among populations. 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 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 published 4 peer-reviewed manuscripts associated with this research.

Funding provided by: U.S. Bureau of Land Management, Wyoming Game and Fish Department, U.S. Geological Survey.

Publications:

Row, J.R., S.T. Knick, S.J. Oyler-McCance, S.C. Lougheed, and B.C. Fedy. 2017. Developing approaches for linear mixed modeling in landscape genetics through landscape-directed dispersal simulations. Ecology and Evolution. DOI: 10.1002/ece3.2825

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Row, J. R., S. J. Oyler-McCance, J. A. Fike, M. S. O'Donnell, K. E. Doherty, C. L. Aldridge, Z. H. Bowen, and B. C. Fedy. 2015. Landscape characteristics influencing the genetic structure of greater sage-grouse within the stronghold of their range: a holistic modeling approach. Ecology and Evolution 15.

24. GREATER SAGE-GROUSE MOVEMENT PATTERNS NEAR AN EXISTING WIND FARM

Contact: Jenn Hess; Email: jenn@hwa-wildlife; Phone: (307) 742-5440

Jennifer Hess[1], Chad Olson[1], Darren Long[2]

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[2] Bureau of Land Management, Wyoming State Office, Cheyenne, Wyoming

Existing peer-reviewed research on the potential effects of wind energy on greater sage-grouse is fairly limited. Currently there is little to no information on site fidelity, recruitment or dispersal of sage-grouse in relation to energy development, specifically wind energy. Adult sage-grouse are known to have a high site fidelity, which can limit their ability to adapt to changes in their environment. But no information exists for sage-grouse movement from natal to initial breeding areas. For our research project, the specific objectives were to: (1) quantify multi-scale resource selection/avoidance in sage-grouse within the wind farm, (2) generate data-driven high-resolution maps of seasonal habitat (nesting, late brood-rearing/summer, and winter) at the landscape scale, and (3) investigate natal dispersal while also examining brood-rearing habitat use, fecundity, survival, and second year use by chicks in wind farm areas.

Female sage-grouse were captured by nocturnal spot-lighting in spring 2019. We equipped female greater sage-grouse with solar-powered ARGOS/GPS transmitters in and around the wind farm near Hanna, Wyoming. Following successful hatching and chicks surviving to 75 days, a total of 10 chicks/juveniles were outfitted with a 6g ARGOS/GPS transmitter. The project is currently ongoing and we hope future funding will allow us to create several peer-reviewed publications from the research work.

Funding provided by: Bureau of Land Management

25. USGS UPDATED SHRUBLAND COMPONENTS IN WYOMING

Contact: Dr. Collin Homer, email, homer@usgs.gov, Phone (208) 426-5213, U.S. Geological Survey, 970 Lusk Street, Boise, Idaho

The USGS in collaboration with the BLM produced a remote sensing-based quantification of Wyoming shrub lands in 2015. Some mountain geographies including the Wind River and Yellowstone Park areas were excluded. These areas have now been mapped, which means all of Wyoming is now represented in the latest release of these products. Nine individual products are available with values representing the proportion (fractional vegetation) of each target component for every 30 m pixel. Component products include percent shrub, percent sagebrush, percent big sagebrush, percent herbaceous, percent annual herbaceous, percent litter, percent bare ground, shrub height and sagebrush height. A modeling process has been developed to take the 2015 database of mapped components back in time to 1984, and forward in time to 2018 using the Landsat archive, creating a 34-year record of component change across Wyoming. These new back in time products are being analyzed to understand trend analysis, especially in regard to climate change. Newly filled base component products are now available for download from www.mrlc.gov. Back in time change products for Wyoming, will also soon be available on www.mrlc.gov.

Funding provided by: U.S. Geological Survey, BLM

Publication: Pending

26. SAGE-GROUSE HABITAT RESTORATION IN NORTHEASTERN WYOMING: EVALUATING REVEGETATION OUTCOMES

Contact: Dr. Kristina M Hufford; E-mail: khufford@uwyo.edu; (307) 766-5587

Kristina M. Hufford and Sara Burns

University of Wyoming, Department of Ecosystem Science and Management, 1000 East University Avenue, Laramie, WY 82071

Greater sage-grouse conservation measures in Wyoming include large revegetation programs to restore landscapes disturbed by energy extraction. If we are to understand the effectiveness of current conservation practices, studies are needed of reclamation seeding outcomes. Few studies examine differences in the seed mix and established vegetation at reclamation sites. We compared reclamation seed mixes with reclamation outcomes for vegetation in the Powder River Basin. Over two years, we surveyed vegetation on 16 reclaimed coalbed methane (CBM) well pads and 10 active (interim reclaimed) well pads using the Assessment, Inventory and Monitoring (AIM) protocol. Each reclaimed site was paired with nearby, undisturbed rangeland site to contrast reclaimed vegetation with intact plant communities. Preliminary findings for the first 16 well pads indicate that reclaimed vegetation does not resemble nearby, undisturbed vegetation. Reclaimed well pads had higher cover of introduced plant species and lower cover of native species relative to undisturbed sites. The difference in vegetation outcomes was underpinned by 23 species, nine of which are introduced, invasive species. The absence of sagebrush in the seed mix had the greatest impact on dissimilarity between reclaimed and undisturbed sites. Of the seven species in the seed mix, 54% were found on average in reclaimed sites in 2017 and 69% were present in 2018. These species represented an average of 38% cover on the well pads (with a range of 15 – 79%). We found no significant difference in cover between observation years. Early conclusions are that seeding does improve establishment of native species, but establishment success varies for species included in the seed mix. Future analyses aim to identify factors that influence successful establishment of planted species and the quality of resulting habitat.

Funding provided by: Wyoming Game and Fish Department, Bureau of Land Management, and Wyoming Wildlife and Natural Resources Trust

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

Contact: Jon Kehmeier; Email: jkehmeier@swca.com; Phone: (303) 468-6904

Jon Kehmeier and Nate Wojcik, SWCA Environmental Consultants

Power Company of Wyoming (PCW) has proposed to construct the Chokecherry and Sierra Madre Wind Energy Project (CCSM Project) south of Rawlins in Carbon County, Wyoming. A before-after-control-impact (BACI) design is being used to evaluate the impacts of wind energy development on greater sage-grouse. The research area consists of two treatment areas where wind energy development will occur and three control areas without any wind energy development. Generally, the research effort will evaluate pre-, during, and post-construction habitat selection, population demographics, general movement and distribution patterns, and lek attendance trends and dynamics. Our current design calls for maintaining between 40 and 50 females tagged with GPS PTTs. Approximately 6 years of pre-construction data were collected prior to the initiation of construction. Construction activities for the project began in fall 2016 and are ongoing. Currently we are analyzing and characterizing pre-construction demographics, space use, and habitat selection. Data are continuously being collected during construction activities. Subsequent years of research will begin to evaluate the response of sage-grouse to the construction and operations of the CCSM Project.

Funding provided by: Power Company of Wyoming

28. SPATIAL VARIABILITY OF SOIL CLIMATE AND MOISTURE BUDGETS WITHIN SAGEBRUSH ECOSYSTEMS: AN ENHANCEMENT OF RESISTANCE AND RESILIENCE TO IMPROVE CONSERVATION

Contact: Michael O'Donnell; Email: odonnellm@usgs.gov; Phone: (970) 226-9407 or Daniel Manier; E-mail: manierd@usgs.gov; Phone: (970) 226-9230

Michael O'Donnell[1,2] and Daniel Manier[1]

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Understanding the drivers defining sagebrush ecosystem distributions and dynamics is important for habitat management, restoration and mitigation. Resistance and resilience concepts (R&R) provide a useful framework for understanding these drivers, which advantageously have been related to soil temperature and moisture classifications. Attribution of soil climate regimes within the Natural Resources Conservation Service soils data have therefore been used to define spatially explicit R&R classifications. Our objective was to improve the spatial discrimination of the R&R and enhance the information available for management of sagebrush habitats. Within the Wyoming Landscape Conservation Initiative (WLCI) area, we developed a spatially explicit model of soil conditions using the Newhall Simulation Model (NSM). We used the NSM for evaluating the interactions of temperature and moisture conditions with soils by simulating evapotranspiration and movement of water in surface soils. We incorporated probabilistic soil data to define available water capacity and gridded climate data to represent spatial variability in drivers of ecosystem conditions. We also adjusted monthly climate data to account for temporal lags of water release via snow depletion rates. This approach resulted in detailed spatial discrimination of variability in temperature and moisture regimes and estimation of seasonal soil moisture budgets. These results improve our understanding of growing conditions related to the distribution and dynamics of sagebrush, disturbance effects and recovery rates, distribution of invasive plants and invasion risk, site potential for state-and-transition simulations, climate effects, and site quality for landscape mitigation. We are expanding these efforts range-wide with 30-year average and forecasted climate conditions. We will release all data products and related software, as well as produce two journal publications (expected in 2020; 1) Wyoming NSM application without climate change; 2) range-wide NSM application with climate forecasts).

Funding provided by: U.S. Geological Survey, Ecosystems Program, science support for the Wyoming Landscape Conservation Initiative and the North Central Climate Adaptation Science Center

29. PROBING THE SAGE-GROUSE GENOME FOR SIGNATURES OF ADAPTIVE GENETIC VARIATION

Contact: Kevin Oh, Email: kevinpboh@gmail.com, or Dr. Cameron Aldridge; E-mail: Cameron.Aldridge@colostate.edu; Phone: (970) 226-9433, or Dr. Sara Oyler-McCance E-mail: oylers@usgs.gov; Phone: (970) 226-9197

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Identifying and maintaining genetic adaptations to environmental variation is key for developing sound conservation and management strategies. Genomics can greatly augment our ability to precisely characterize the genetic basis of important adaptations within extant populations. We have generated the first high-quality genome assemblies for both Gunnison and greater sage-grouse. We assembled a reference genome and performed whole-genome sequencing across sage-grouse from both species and six populations, including Jackson Hole, WY. Our recent work on adaptive genetic variation has identified a suite of single-nucleotide polymorphisms (SNPs) to demonstrated elevated rates of divergence among sage-grouse populations at the range-wide level. Some of these are present in biochemical pathways that may be important as counter-adaptations to toxic plant secondary metabolites (PSM) produced by sagebrush (*Artemisia* spp.) as a defense against herbivory. We have also accumulated additional tissue samples and conducted a restriction associated DNA sequencing study (RAD-Seq) of additional samples including a group from southwestern WY to evaluate variation in these candidate genes across the range. We work is summarized in peer-reviewed manuscript published in 2019.

Funding provide by: U.S. Geological Survey

Publication:

Oh, K.P., C.L. Aldridge, J.S. Forbey, C.Y. Dadabay, and S.J. Oyler-McCance. 2019. Conservation genomics in the sagebrush sea: population divergence and adaptive metabolic variation in sage-grouse (*Centrocercus* spp.). Genome Biology and Evolution 11(7): 2023-2034. doi: 10.1093/gbe/evz112

30. MAPPING SAGE-GROUSE LEKS TO LINK DIET, HABITAT STRUCTURE, AND BEHAVIOR

Contact: Dr. Gail Patricelli; Email: gpatricelli@ucdavis.edu

Dr. Gail Patricelli, Dr. Alan Krakauer, Ryane Logsdon and Eric Tymstra, U of California Davis

Dr. Jennifer Forbey and Chelsea Merriman, Boise State University

The goal of this project is to understand how sage-grouse use their microhabitats on and off the lek and how those choices may affect health and reproductive success. During the 2017 mating season, we conducted multi-point TLS (a ground-based Terrestrial LiDAR Scanning) for 5 study leks in the Government Draw area near Hudson, Wyoming (Fremont County). These scans are being queried for the cover, horizontal concealment, and other relevant metrics to measure ecologically important features of the lek microhabitat. We also collected videos of the sage-grouse space use on the lek in experimental interactions with robotic female sage-grouse. We have analyzed these videos and we are now connecting behavioral observations to TLS scans to determine which microhabitat features are important for both male and female sage-grouse on leks. We are also examining sage-grouse dietary preferences off the lek. From 2014-2017 we used radio telemetry tags to find foraging and roost sites, and we conducted transects around leks. At these sites, and random sites, we collect samples of browsed and unbrowsed sagebrush and habitat measures. This will help us to assess preferred habitat and forage at the chemical level. Fecal samples collected from leks are being analyzed for a byproduct of detoxification (glucuronic acid) and metabolites of stress-associated hormones (corticosterone); this will allow us to link dietary toxin intake to lek position and behavior. In 2018-2019, we did the same at leks in the Bi-State population (Mono County, California). Samples from WY and CA are currently being analyzed in the Forbey lab.

Funding: Bureau of Land Management, State of Wyoming, National Science Foundation, USGS, University of California Davis, Boise State University

Attachment D:
Wyoming Sage-Grouse Research Reports (through May 31, 2019)

Part I. Final research reports from Wyoming sage-grouse research or theses and dissertations from university research efforts. It does not include annual agency monitoring reports or popular press articles.

Part II. Wyoming sage-grouse research articles published in peer-reviewed journals or books.

Only research reports concerning Wyoming sage-grouse are included. Studies on related subjects, (e.g. sagebrush, cheatgrass, other geographical areas) are important, but too numerous to include in this attachment.

Part I. Research theses, dissertations and reports.

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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.

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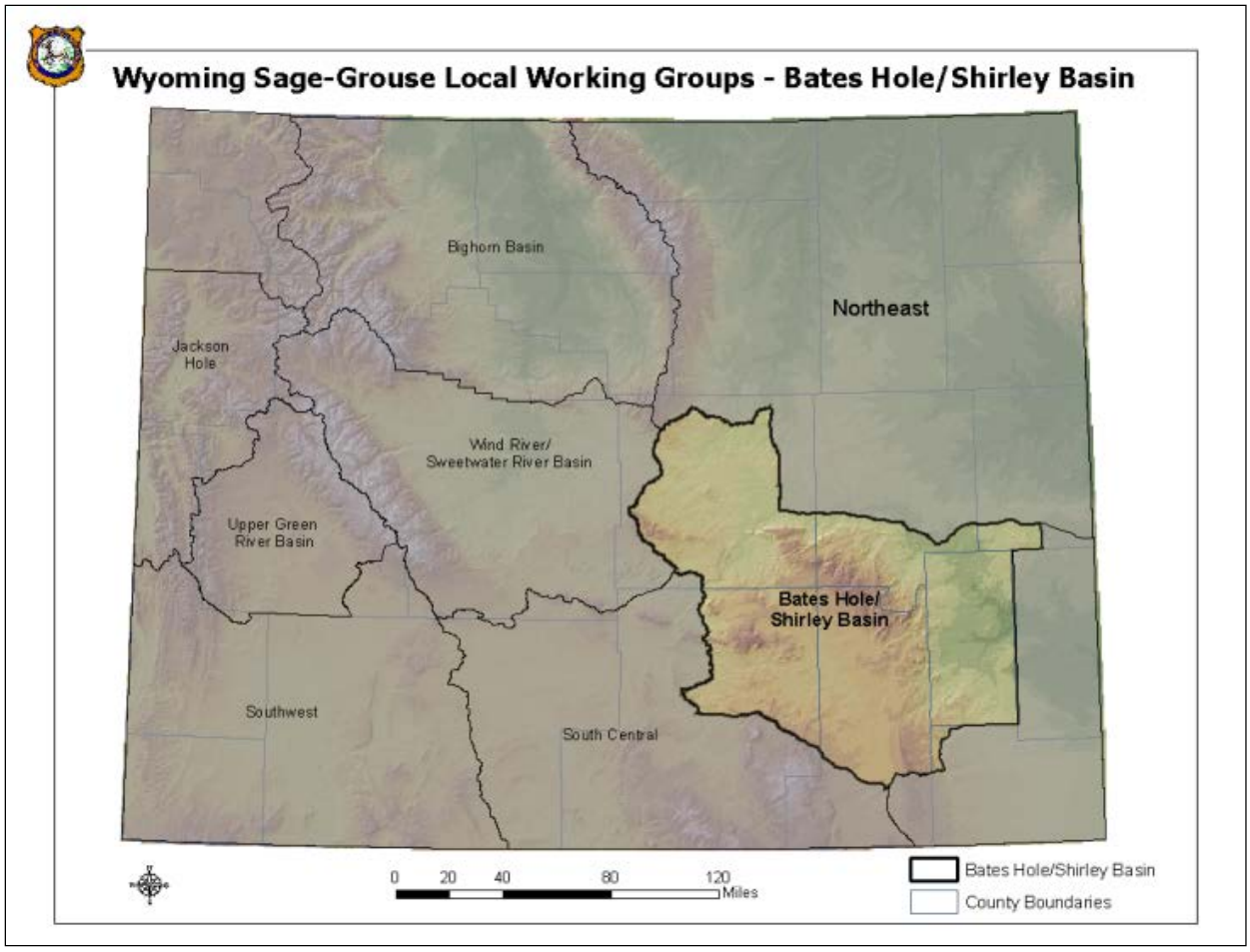
Bates Hole – Shirley Basin Conservation Area
Job Completion Report

Species: Greater Sage-grouse
Management Area(s): F – (portions of Casper and Laramie Regions)
Period Covered: June 1, 2018 – May 31, 2019
Prepared By: Justin Binfet, Casper Wildlife Management Coordinator



Sage Grouse Lek Characteristics

Working Group: Bates Hole

Region	Number	Percent
Casper	127	40.1
Lander	2	0.6
Laramie	188	59.3

Working Group	Number	Percent
Bates Hole	317	100.0

Classification	Number	Percent
Occupied	216	68.1
Undetermined	17	5.4
Unoccupied	84	26.5

BLM Office	Number	Percent
Casper	127	40.1
Lander	2	0.6
Newcastle	1	0.3
Rawlins	187	59.0

Biologist	Number	Percent
Casper	118	37.2
Douglas	8	2.5
Laramie	109	34.4
Saratoga	72	22.7
Sinclair	2	0.6
Wheatland	8	2.5

Warden	Number	Percent
Cheyenne	2	0.6
Douglas	3	0.9
East Casper	38	12.0
East Rawlins	2	0.6
Elk Mountain	69	21.8
Glenrock	7	2.2
Lusk	1	0.3
Medicine Bow	71	22.4
North Laramie	40	12.6
West Casper	78	24.6
Wheatland	6	1.9

County	Number	Percent
Albany	77	24.3
Carbon	108	34.1
Converse	10	3.2
Laramie	2	0.6
Natrona	113	35.6
Niobrara	1	0.3
Platte	6	1.9

Land Status	Number	Percent
BLM	107	33.8
BOR	1	0.3
Private	182	57.4
State	27	8.5

Management Area	Number	Percent
F	317	100.0

Lek Status	Number	Percent
Active	154	48.6
Inactive	116	36.6
Unknown	47	14.8

Sage Grouse Job Completion Report

Year: 2010 - 2019, Working Group: Bates Hole

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

a. Leks Counted

Year	Occupied	Counted	Percent Counted	Peak Males	Avg Males / Active Lek (2)
2010	213	109	51	2485	27.0
2011	216	103	48	1670	19.9
2012	216	77	36	1222	20.0
2013	221	77	35	969	16.4
2014	222	86	39	1261	19.4
2015	223	102	46	2869	33.0
2016	224	86	38	2893	40.2
2017	225	79	35	2207	35.6
2018	220	109	50	1944	24.0
2019	218	89	41	1474	21.1

b. Leks Surveyed

Year	Occupied	Surveyed	Percent Surveyed	Peak Males	Avg Males / Active Lek (2)
2010	213	63	30	852	17.8
2011	216	93	43	895	14.9
2012	216	90	42	779	13.0
2013	221	99	45	814	14.0
2014	222	121	55	928	13.4
2015	223	94	42	1677	26.6
2016	224	103	46	2298	31.9
2017	225	124	55	2143	29.0
2018	220	80	36	1105	20.5
2019	218	99	45	1060	20.4

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

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

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

Sage Grouse Job Completion Report

Year: 2010 - 2019, Working Group: Bates Hole

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

c. Leks Checked

Year	Occupied	Checked	Percent Checked	Peak Males	Avg Males / Active Lek (2)
2010	213	172	81	3337	23.8
2011	216	196	91	2565	17.8
2012	216	167	77	2001	16.5
2013	221	176	80	1783	15.2
2014	222	207	93	2189	16.3
2015	223	196	88	4546	30.3
2016	224	189	84	5191	36.0
2017	225	203	90	4350	32.0
2018	220	189	86	3049	22.6
2019	218	188	86	2534	20.8

d. Lek Status

Year	Active	Inactive (3)	Unknown	Known Status	Percent Active	Percent Inactive
2010	142	12	18	154	92.2	7.8
2011	157	32	7	189	83.1	16.9
2012	131	25	11	156	84.0	16.0
2013	123	40	13	163	75.5	24.5
2014	138	48	21	186	74.2	25.8
2015	154	33	9	187	82.4	17.6
2016	146	22	21	168	86.9	13.1
2017	148	45	10	193	76.7	23.3
2018	137	44	8	181	75.7	24.3
2019	132	37	19	169	78.1	21.9

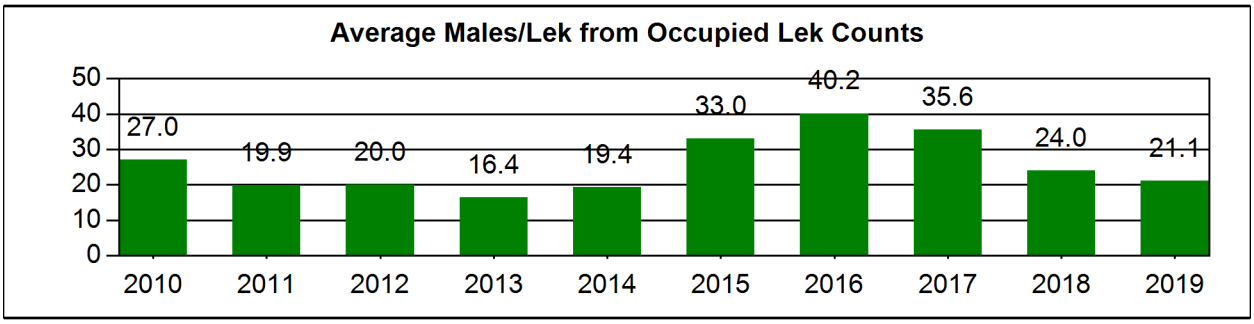
1) Occupied - Active during previous 10 years (see official definitions)

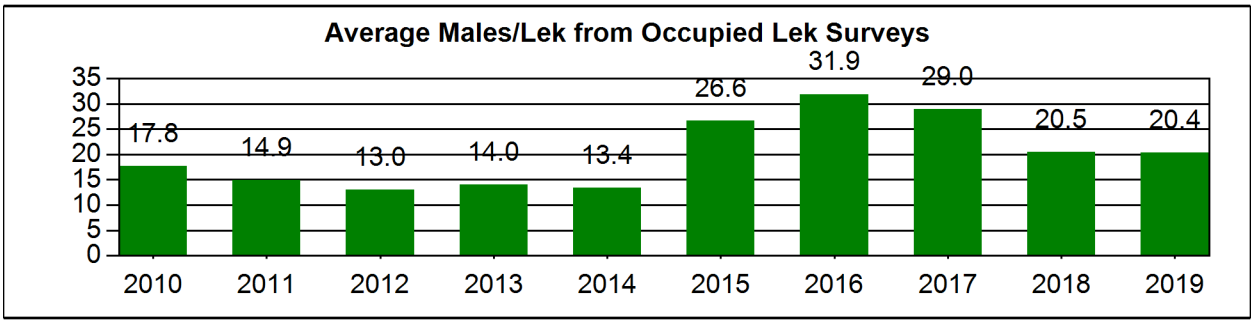
2) Avg Males/Active Lek - Includes only those leks where one or more strutting males were observed. Does not include "Active" leks where only sign was documented.

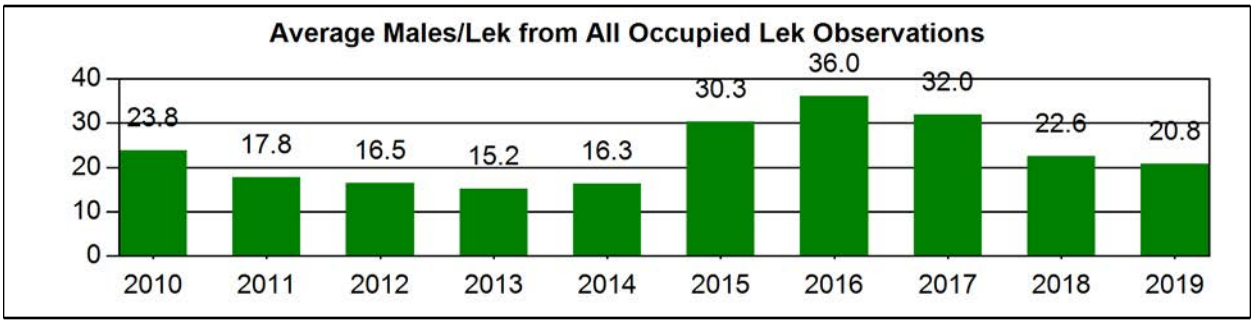
3) Inactive - Confirmed no birds/sign present (see official definitions)

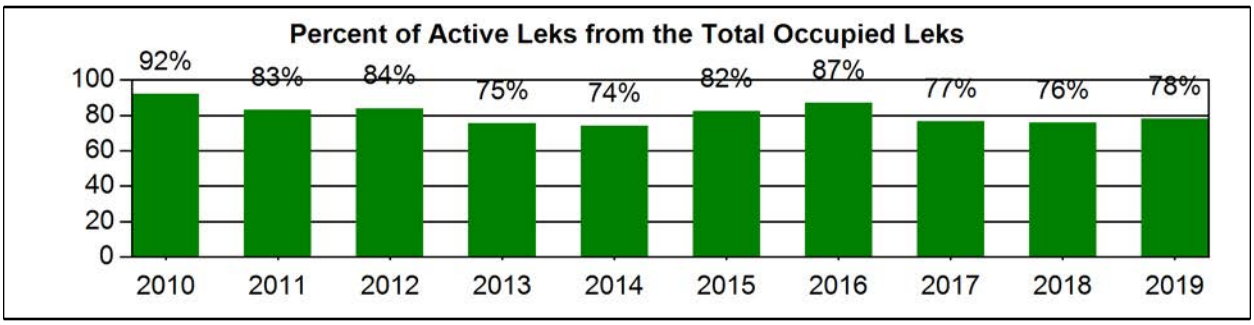
Sage Grouse Occupied Lek Attendance Summary

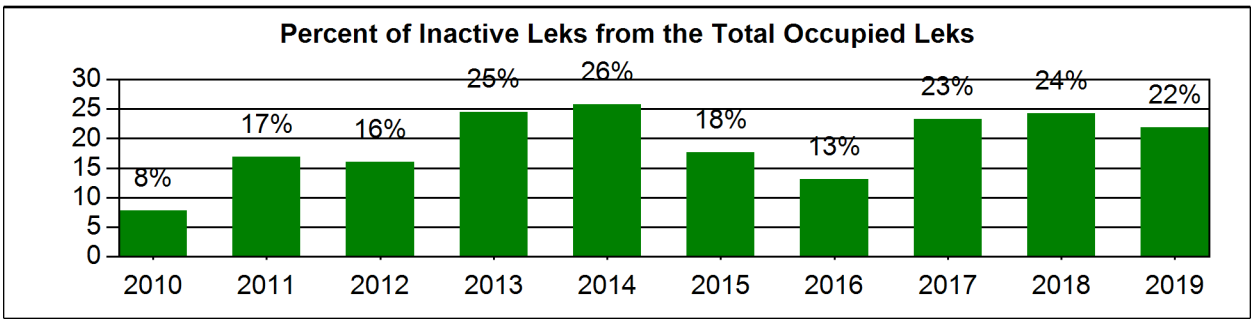
Year: 2010 - 2019, Working Group: Bates Hole











Sage Grouse Job Completion Report

Year: 2010 - 2019, Working Group: Bates Hole

3. Sage Grouse Hunting Seasons and Harvest Data

a. Season

Year	Season Start	Season End	Length	Bag/Possesion Limit
2010	Sep-18	Sep-30	13	2/4
2011	Sep-17	Sep-30	14	2/4
2012	Sep-15	Sep-30	16	2/4
2013	Sep-21	Sep-30	10	2/4
2014	Sep-20	Sep-30	11	2/4
2015	Sep-19	Sep-30	12	2/4
2016	Sep-17	Sep-30	14	2/4
2017	Sep-16	Sep-30	15	2/4
2018	Sep-15	Sep-30	16	2/4

b. Harvest

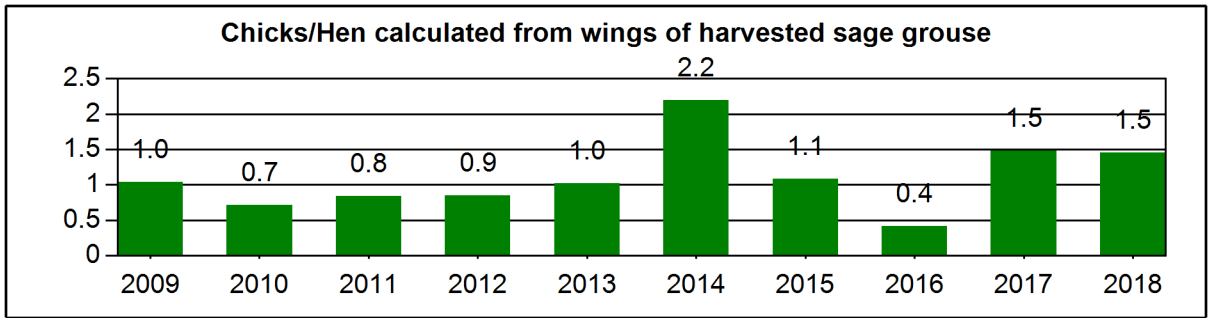
Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2010	1027	480	1001	1.0	2.1	2.1
2011	1117	514	981	1.1	2.2	1.9
2012	688	415	852	0.8	1.7	2.1
2013	488	399	670	0.7	1.2	1.7
2014	588	352	804	0.7	1.7	2.3
2015	837	380	889	0.9	2.2	2.3
2016	869	466	869	1.0	1.9	1.9
2017	621	315	688	0.9	2.0	2.2
2018	805	464	993	0.8	1.7	2.1
Avg	782	421	861	0.9	1.8	2.1

Sage Grouse Job Completion Report

Year: 2009 - 2018, Working Group: Bates Hole

4. Composition of Harvest by Wing Analysis

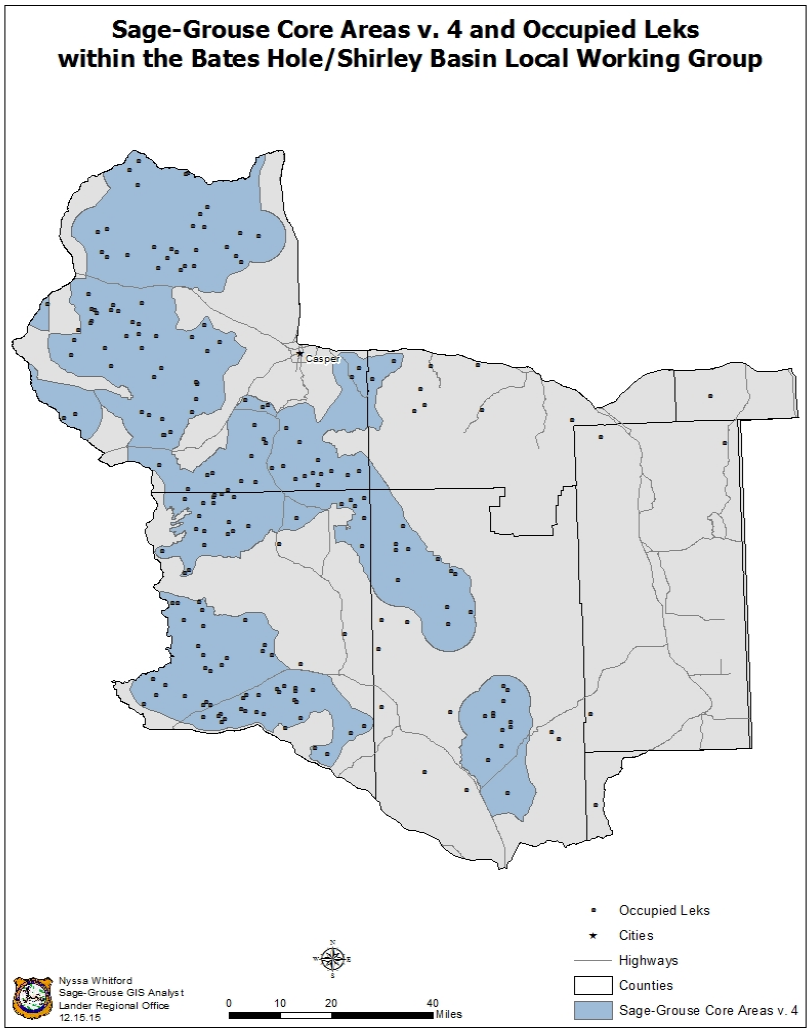
Year	Sample Size	Percent Adult		Percent Yearling		Percent Young		Chicks/ Hens
		Male	Female	Male	Female	Male	Female	
2009	314	12.7	26.1	9.2	12.1	17.8	22.0	1.0
2010	284	13.0	35.2	5.6	12.3	13.4	20.4	0.7
2011	224	17.9	34.8	4.9	7.1	15.6	19.6	0.8
2012	145	20.7	33.8	1.4	8.3	19.3	16.6	0.9
2013	187	9.1	26.2	4.3	16.6	24.1	19.8	1.0
2014	190	10.5	16.8	2.1	10.5	30.5	29.5	2.2
2015	253	14.6	31.6	5.5	6.7	22.9	18.6	1.1
2016	217	19.4	33.2	10.1	16.6	11.5	9.2	0.4
2017	145	20.0	23.4	4.8	6.9	20.0	24.8	1.5
2018	168	15.5	25.0	4.2	7.7	19.0	28.6	1.5



Lek Monitoring

Sage-grouse, and therefore occupied leks, are well distributed throughout most of the BHSBLWG area, although much of the Laramie Range does not provide suitable habitat and most of the historic range in Platte County is no longer occupied due to large scale conversions of sagebrush grasslands to cultivated fields (Figure 1). The Wyoming Game and Fish Department summarizes lek monitoring data each year. As of spring 2019, there are 216 known occupied leks, 84 unoccupied leks, and 17 leks of an undetermined classification within the BHSBLWG area. Lek definitions are presented each year in the statewide Job Completion Report and are included in the monitoring protocol (Christiansen 2012). Undoubtedly, there are leks within the BHSBLWG area that have not yet been identified, while other un-discovered leks have been abandoned or destroyed. The majority of leks classified as "undetermined" lack sufficient data to make a valid status determination. In these cases, historic data indicates these leks were viable at one point, with the leks subsequently being either abandoned or moved. However, location data is either generic or suspect in many of these cases, further confounding the ability to determine the status of these leks.

Figure 1. Sage-grouse lek distribution and core areas within the BHSBLWG area, 2015.



Lek counts and lek surveys have been conducted within the area since the late 1950's, although historically on only a small number of leks. Since 2000, lek monitoring effort has expanded significantly, resulting in increasing numbers of leks being monitored over time and enabling meaningful comparisons of current sage-grouse data to a running 10-year average. In 2019, WGFD personnel, BLM personnel, volunteers and consultants combined efforts to check 188 of the 218 (86%) known occupied leks in the BHSBLWG area. A total of 89 occupied leks were counted while 99 were surveyed, with annual status being confirmed on 169 occupied leks in 2019. Of these, 132 (78%) were active and 37 (22%) were inactive.

It is important to consider trends in the numbers of active versus inactive leks in addition to average male lek attendance when analyzing population trend. During a period of population decline, male lek attendance decreases while the number of inactive leks typically increases. The converse occurs with an increasing population. The percentage of active occupied leks (that were checked) generally decreased in the BHSBLWG area as sage-grouse numbers declined from 2006-2013. Conversely, the percentage of active occupied leks increased for three consecutive years from 2014-2016 as this population grew. In addition, some new leks were discovered during this timeframe while other smaller leks again became active after periods of inactivity. Following a recent population peak in 2016, the percentage of active occupied leks declined through 2018, although there was a modes increase over this past year. Generally declining trends in the percentage of occupied leks being active, coupled with declines in male lek attendance, suggest sage-grouse numbers are continuing to trend downward within the BHSBLWG area.

There is always some variation in the annual percentage of occupied leks being active. This variation can be attributed to both population fluctuations and survey effort. Survey effort has been relatively consistent over the past 10 years in the BHSBLWG area, with the total number of occupied leks checked ranging from 213 – 225. However, leks that are not checked in some years tend to be smaller, more difficult to access, or have been compromised in some manner (e.g. due to disturbance). Both disturbed and smaller leks have a higher probability of becoming inactive during a population nadir, such as that of 2013. Regardless, it is important to continue to monitor as many leks as possible, including smaller and marginal leks, to ensure they are classified appropriately (i.e. occupied, unoccupied or undetermined). Where sufficient monitoring data has shown a lek is no longer occupied, it is reclassified as unoccupied as per established protocol.

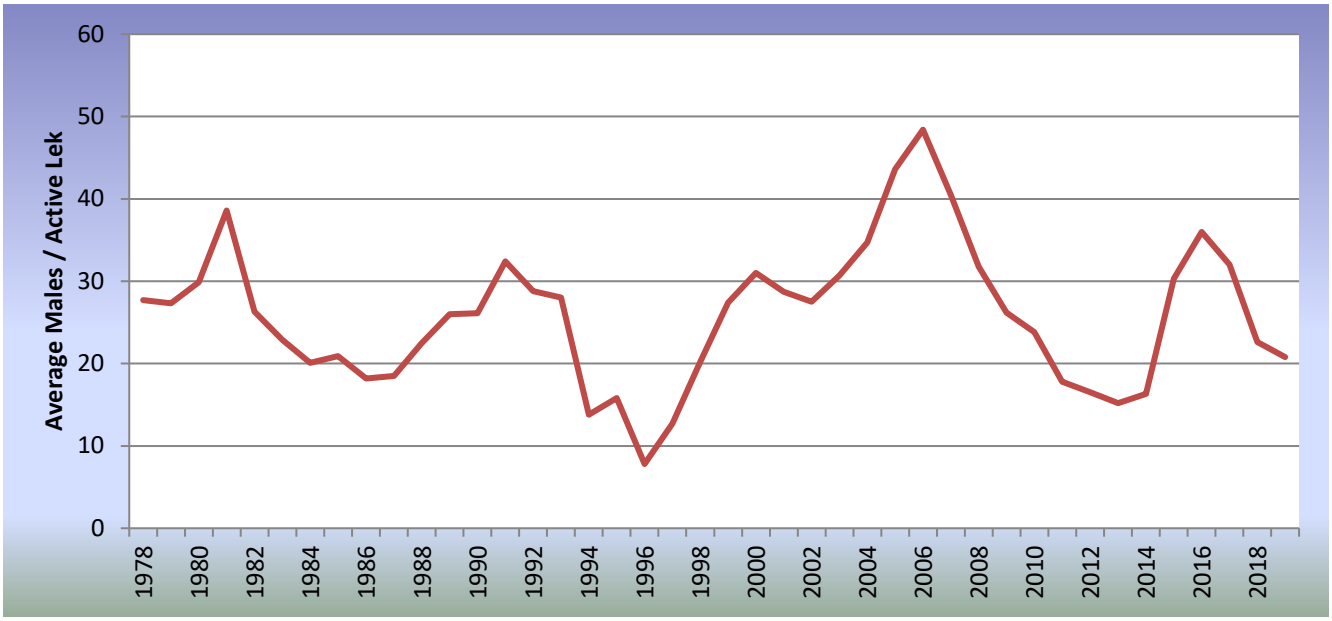
Population Trend

Monitoring male attendance on leks provides a reasonable index of sage-grouse population trend over time. Nevertheless, these data must be interpreted with caution 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 exhibit cyclic patterns (Fedy and Doherty 2010); 4) the effects of unlocated or unmonitored leks that have become inactive cannot be quantified; and 5) lek sites may change over time. Both the number of active leks and the number of males attending these leks must be quantified over time to estimate population trend. 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.

Despite the aforementioned considerations regarding the interpretation of male lek attendance data, average peak male lek attendance obtained through surveys are strongly correlated with those obtained via lek counts in years when sample sizes exceed 50 leks (Fedy and Aldridge 2011). Since 1978, a minimum of 50 leks have been checked within the BHSBLWG area in all but 4 years (1992-1995) to

determine annual population trend. The average number of males observed per active surveyed lek has fluctuated substantially over that time frame within the BHSBLWG area (Figure 2).

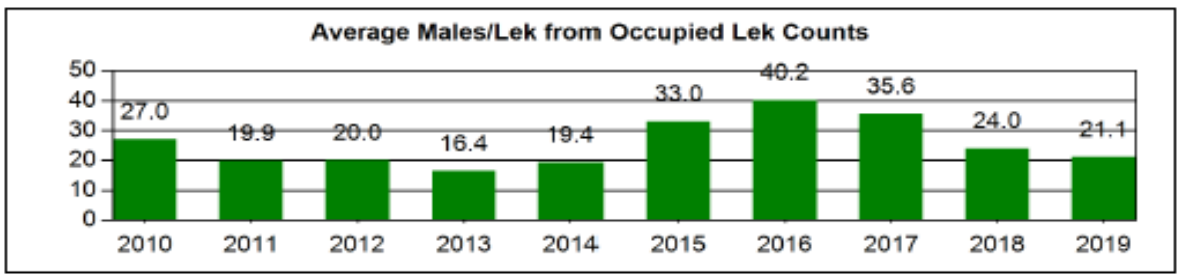
Figure 2. Mean number of peak males per active lek checked within the BHSBLWG area, 1978 – 2019.



*From 1978-1990, an average of 86 leks were checked each year.
*From 1991-1999, an average of 54 leks were checked each year.
*From 2000-present, an average of 163 leks were checked each year.

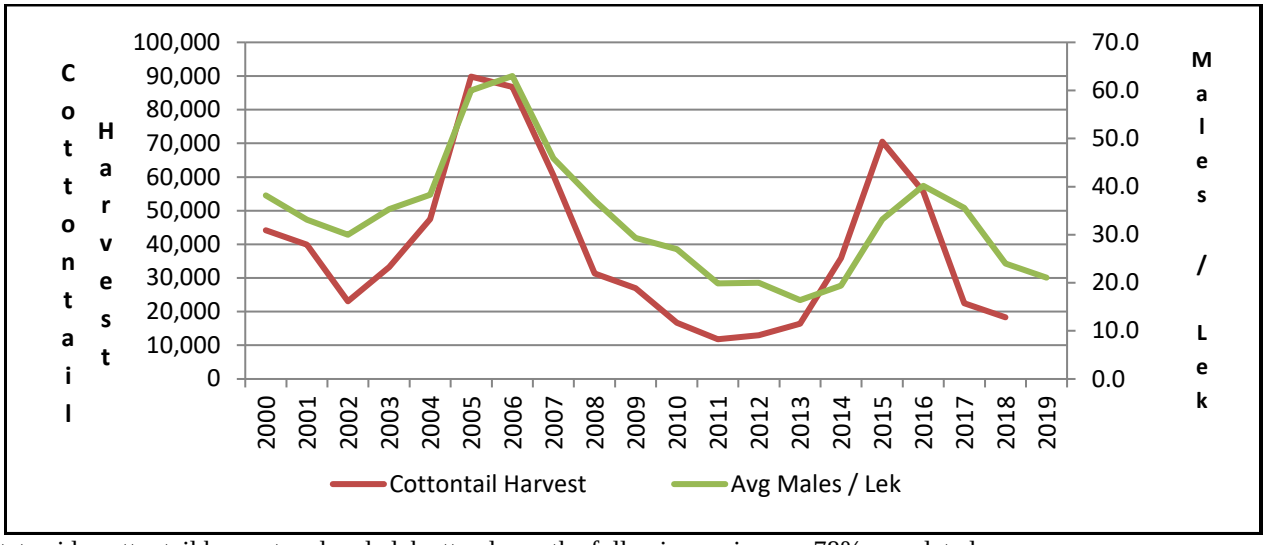
Based on the mean maximum number of males observed per counted lek, sage-grouse populations declined considerably from 2006 through 2013 in the BHSBLWG area (Figure 3). In fact, the 2013 nadir was the lowest average recorded male lek attendance since intensive lek monitoring began in 2000. However, male lek attendance increased significantly through 2016, which marked a cyclical peak with a mean maximum number of males per counted lek increasing to 40.2. Male lek attendance has since declined sharply over the past three years, with an average of 21.1 in 2019. This steep decline was likely a function of declining chick production and/or survival in 2015 and 2016, followed by only moderate chick production in 2017 and 2018. Based on long-term cyclical trends in male lek attendance in the BHSBWLG area (and for sage-grouse populations in general), the current decline in male lek attendance will likely continue as this population has been trending downward over the past three years.

Figure 3. Mean number of peak males per count lek within the BHSBLWG area, 2010 – 2019.



The recent decline in sage-grouse lek attendance is also strongly correlated with the substantial downturn in cottontail rabbit populations throughout most of the BHSBLWG area. There is a strong likelihood that some prey shifting occurs whereby predation pressure on sage-grouse increases during cottontail population downturns and decreases during periods of high cottontail densities. Sage-grouse population cycles are highly correlated with those of cottontail rabbits over a long period of time (Fedy and Doherty 2010). The only cottontail rabbit data now collected in Wyoming is the estimated annual statewide harvest, which is highly correlated with cottontail densities and therefore serves as a reasonable indicator of population trend. When comparing statewide cottontail harvest data to the following spring's lek attendance data in the BHSBLWG area, there is an 78% correlation. Within the BHSBLWG area over the past ten years, both sage-grouse populations and cottontail rabbit densities (inferred through statewide cottontail harvest) increased through 2015-2016, but subsequently declined through 2019 (2019 cottontail harvest data is not yet available) (Figure 4). Anecdotal observations of rabbit densities from WGFD field personnel corroborate this, as there has been a noticeable decline in cottontail densities over the past three years.

Figure 4. Statewide Wyoming Cottontail Harvest and Average Males/Lek (BHSBLWG), 2000 – 2019.



*Statewide cottontail harvest and male lek attendance the following spring are 78% correlated.

Productivity

Classifying wings based on sex and age from harvested sage-grouse provides a meaningful indicator of annual sage-grouse chick productivity. During fall hunting seasons, hunters predominantly select for hens and chicks, and typically do not differentiate between the two. Sampling bias is therefore assumed to be minimal when analyzing the ratio of chicks per hen in hunter harvested sage-grouse wings. However, hunter selectivity and sage-grouse habitat use do result in adult and yearling males being under-represented in the harvest compared to their proportion of the population. Summer brood surveys are also conducted periodically, but do not provide as reliable an indicator of chick productivity given they are not conducted in a systematic and repeatable manner and sample sizes are low. 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. Brood survey data will therefore not be discussed here.

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). These thresholds do not seem to directly apply in the BHSBLWG area as sage-grouse populations increased from 2013-2016 despite relatively poor chick production (as measured by wing data) in all but one year. Obviously, additional factors must be considered when assessing changes in population trend such as fluctuations in adult female survival, changes in predation, etc. In addition, as populations are increasing, relatively less chick production is needed to fuel continued population growth. Over the last 10 years, estimated productivity from wing-barrel data has fluctuated between 0.4 and 2.2 chicks per hen within the BHSBLWG area, although this ratio has only exceeded 1.5 in one of the past 10 years. Reasons for continued relatively low chick production (as measured by wing data) in the BHSBLWG area are unknown. Spring / early summer weather conditions have been relatively normal, and have not experienced any unusual cold, wet conditions that can cause widespread elevated chick mortality following hatch.

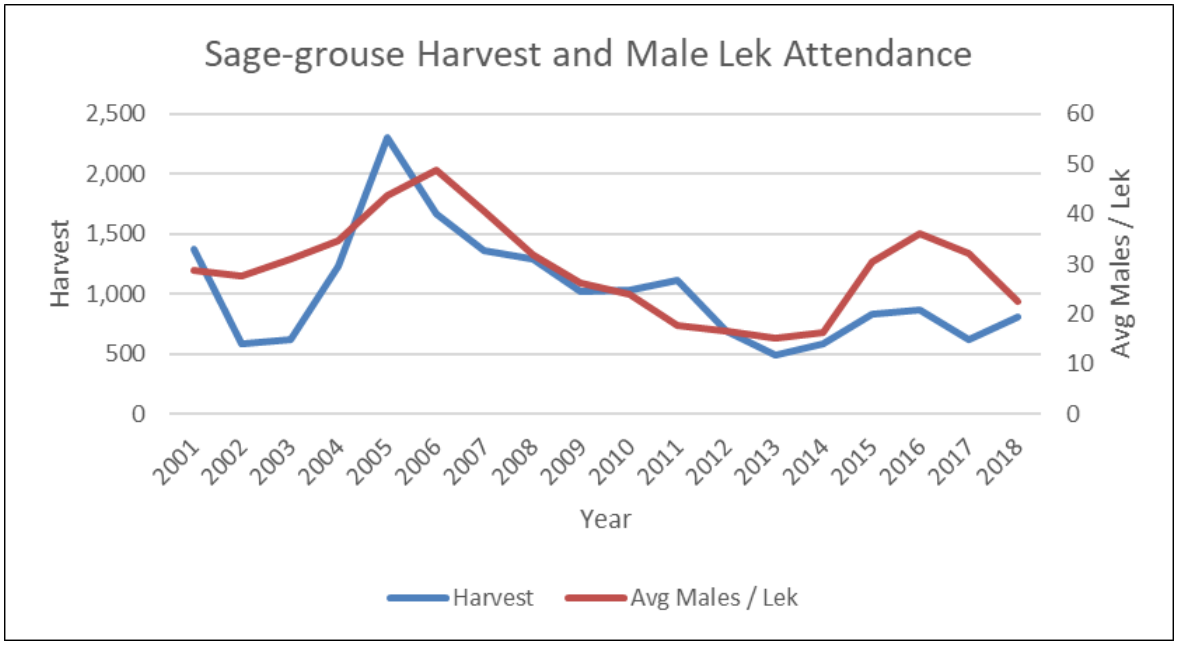
Based on wing data within the BHSBLWG area, chick productivity/survival was excellent in 2014 with an observed 2.2 chicks per hen, which allowed for significant population increase. However, chick production has since declined, and was extremely poor in 2016 with a ratio of 0.4. The 2016 ratio was the lowest chick/hen ratio ever recorded using wing data within the BHSBLWG area (dating back to 1976). While chick production/survival increased to moderate levels in 2017 and 2018 (1.5 chicks/hen), the improved productivity has not been enough to offset continued population decline as evidenced by declining male lek attendance over the past three years.

Harvest

Hunter and harvest statistics provide insight into trends in wildlife populations. Typical of upland game bird populations, there has typically been a direct correlation between sage-grouse population levels and hunter effort and harvest when hunting seasons are consistent over time. As sage-grouse numbers decrease, hunter harvest generally declines. Conversely, when populations increase, sage-grouse hunting effort and harvest generally increases. Harvest data specific to the BHSBLWG area was obtainable starting in 1982. Prior to 1982, harvest data was recorded by county and not by management areas. Since 1982, overall sage-grouse harvest has declined considerably within the BHSBLWG area.

Harvest peaked in 1983 at ~14,200 birds and subsequently declined to an historic low of 488 in 2013. Following a period of steadily increasing harvest from 2013-2016, sage-grouse harvest declined to an estimated 621 birds in the BHSBLWG area in 2017 but modestly increased to 805 in 2018. Over the past ten years, trends observed in harvest data generally mirror those observed in male lek attendance within the BHSBLWG area (Figure 5). However, it is interesting to note that the 2018 harvest was similar to that of 2016 (N=869) during the last population peak. Despite an uptick in sage-grouse populations through 2016, hunter harvest did not increase commensurately as compared to the previous population peak in 2006. Although there has been a long history of hunter effort being correlated with sage-grouse population trends, the increasingly disparate gap between hunter harvest and sage-grouse population trend over this past cycle may be signifying a waning overall general interest in sage-grouse hunting. Hunter numbers have declined considerably over the long-term, which is also due to conservative seasons being implemented over the past two decades. Hunter participation and harvest declined dramatically in Wyoming when the Wyoming Game and Fish Commission moved the hunting season to later in September in 1995, and then reduced the bag limit and shortened the hunting season in 2002 (WGFD 2008). This reduced hunter harvest occurred in spite of a concurrent sage-grouse population increase (based on males/lek), demonstrating the effects increasingly conservative hunting seasons have had on hunter participation in recent years.

Figure 5. Total sage-grouse harvested per year and the average number of males per active lek checked within the BHSBLWG area, 2001 – 2018.



Managers are unable to quantify population response to changes in harvest levels within the BHSBLWG area. Research suggests harvest pressure can be an additive source of mortality within small isolated sage-grouse populations, but is generally compensatory at levels under 11% of the preseason population (Braun and Beck 1985, Connelly et al. 2000, Sedinger et al. 2010).

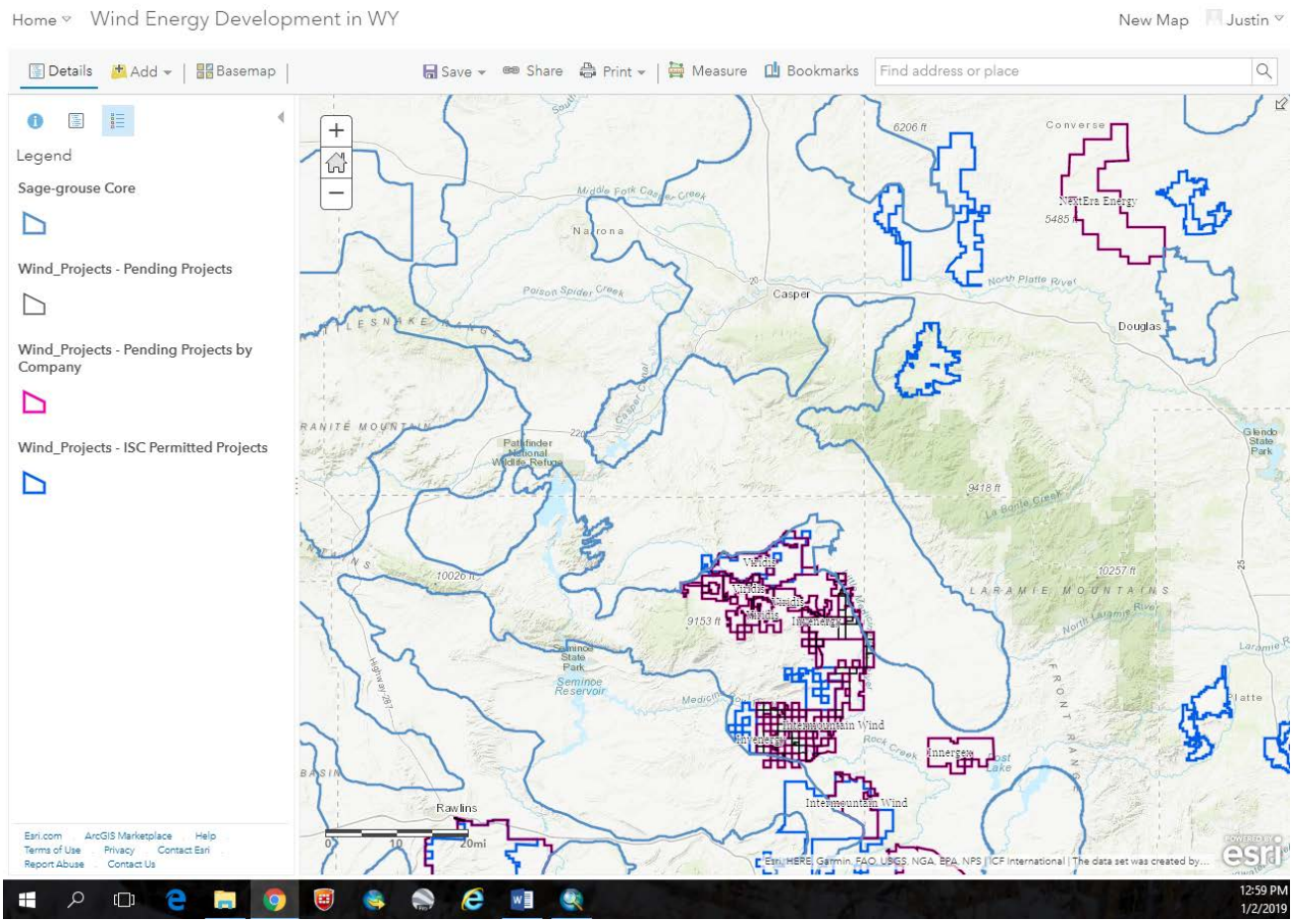
Habitat

There is little doubt sage-grouse habitat quality has declined over the past several decades throughout the BHSBLWG area. Increased human-caused disturbance (i.e., oil/gas, coal, uranium, and wind energy development), improper grazing by livestock and wildlife, sagebrush eradication programs, and long-term drought have all combined to negatively impact sage-grouse and their habitats. As the level of concern for sage-grouse and sagebrush ecosystems has risen, large-scale sagebrush eradication programs have been largely abandoned, and significant portions of the landscape are now enrolled in grazing systems which are designed to be sustainable and promote healthy rangelands. In addition, various habitat improvement projects have been planned and/or implemented throughout the BHSBLWG area. However, there is much debate among wildlife managers, habitat biologists, researchers, and rangeland specialists as to the efficacy of various forms of habitat treatments within sagebrush ecosystems. Given the long timeline required to reestablish sagebrush following treatment and the difficulty in measuring sage-grouse population level response to such treatments, habitat projects 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.

Of particular concern to sage-grouse within the BHSBLWG area is the substantial expansion of large-scale industrial wind development within Shirley Basin. Several new projects are currently in various stages of permitting, with construction underway on one large wind farm in eastern Shirley Basin, and more being planned for additional new wind developments over the next two years (Figure 6). Should

all or most of these projects come to fruition, they could cumulatively result in the installation of several thousand new wind turbines throughout Shirley Basin. Some of the larger proposed developments are slated to occur within sage-grouse habitat, and could pose significant cumulative impacts to sage-grouse over a large landscape depending upon project scale and siting. Although the current Executive Order (2015-4) prohibits wind development within core areas pending further research, some substantial sage-grouse habitats within Shirley Basin were not included within the most recent version (Version 4) of core areas as wind development was already in the permitting stage. Much of the proposed development is immediately adjacent to core areas.

Figure 6. Existing and proposed (in permitting process) wind development within the BHSBLWG area, 2018.



Disease

There were no confirmed cases of West Nile virus (WNv) in sage-grouse within the BHSBLWG area during this reporting period. Normal monitoring efforts were in place. These consisted of requesting researchers with radio-marked birds to monitor for mortality in late summer and attempt to recover and submit carcasses of dead birds to the Wyoming State Vet Lab for necropsy. WGFD field personnel, other agency personnel and the public (via press release), especially ranchers and hay farmers, were also asked to report dead sage-grouse in a timely fashion. The extent of WNv infection and its effects on sage-grouse populations throughout the BHSBLWG area is unknown, but potentially significant in years when outbreaks occur.

Bates Hole / Shirley Basin LWG Conservation Plan Addendum

The BHSBLWG Conservation Plan was updated to reflect major state and federal policy changes in 2013. A Conservation Plan Addendum was completed in July 2013 and is available on the Wyoming Game and Fish Department website at:

https://wgfd.wyo.gov/WGFD/media/content/PDF/Habitat/Sage%20Grouse/SG_BSBASIN_CONSVPLAN.pdf.

Special Studies

The following special studies have been or are currently being conducted within the reporting period within the BHSBLWG area:

In addition to a 2016 completion report, Western EcoSystems Technology, Inc. provided two reports on the effects of wind energy development on sage-grouse habitat selection, survival and population demographics for the Simpson Ridge Wind Energy Project, Carbon County, Wyoming (LeBeau et al. 2016, LeBeau et al. 2017a, LeBeau et al. 2017b). In summary, the consulting firm was hired to conduct a long-term research project to evaluate the impacts to sage-grouse from wind energy development within a defined core area. A technical committee was assembled to define research methodology and objectives. The committee included representation from state and federal agencies as well as reputable sage-grouse researchers. This research was partially funded from local sage-grouse working group funds. Field work was initiated in 2009 and continued through 2015. In addition, a master's thesis was completed summarizing male lek attendance, seasonal habitat selection, and survival within this study area (LeBeau 2012). Some results from this thesis were also published in a peer-reviewed journal (LeBeau 2014) with additional publications that followed.

The following two abstracts were included in the "Greater Sage-grouse Research Conducted in Wyoming in 2019" summary compiled by Dr. Jeff Beck from the University of Wyoming:

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

   Kurt T. Smith[1], Jeffrey L. Beck[1], Jason LeVan[1], Anna D. Chalfoun[2], Jason D. Carlisle[3], Jen S. Forbey[4], Stan Harter[5], and Leah Yandow

   [1]University of Wyoming, Department of Ecosystem Science and Management, 1000 East University Avenue, Laramie, WY 82071

   [2]University of Wyoming, Department of Zoology and Physiology, USGS Wyoming Cooperative Fish and Wildlife Research Unit, 1000 East University Avenue, Laramie, WY 82071

   [3]Western Ecosystems Technology, Inc., 200 South 2nd St., Suite B, Laramie, WY 82070

   [4]Boise State University, Department of Biological Sciences, Boise, Idaho 83725

   [5]Wyoming Game and Fish Department, Lander Regional Office, 260 Buena Vista Drive, Lander, Bureau of Land Management, Lander Field Office, 1335 Main Street, Lander, WY 82520

Wyoming big sagebrush (Artemisia tridentata wyomingensis) has been treated through chemical application, mechanical treatments, and prescribed burning to increase herbaceous forage species released from competition with sagebrush overstory. Originally intended to provide more forage for livestock, these techniques have been applied to improve habitat for sagebrush wildlife species including greater sage-grouse (Centrocercus urophasianus). Treatments are intended to rejuvenate sagebrush plants and increase herbaceous production. Studies evaluating habitat treatments have reported varied results and generally lack the replication necessary for evaluation of demographic rates and fine-scale habitat use of sage-grouse in response to treatments. Our study, centered near Jeffrey City, Wyoming is designed as a Before-After Control-Impact study with 3 years of pre-treatment and 6 years of post-treatment data comparing demographic rates and habitat selection patterns within treated and non-treated sites. We initiated our study in spring 2011 by capturing female sage-grouse and affixing VHF necklace-mounted or GPS rump-mounted transmitters to measure nest and brood-rearing success, and adult female survival. During winter 2014, we mowed 489 ha (1,208 acres) of sagebrush habitats across 2 mowing treatment areas and applied tebuthiuron to 607 ha (~1,500 acres) across 2 herbicide treatment areas in May 2014. We have monitored demographic parameters from n = 625 marked females. Identifying sage-grouse demographic and habitat use responses will aid in determining the efficacy of habitat treatments intended to enhance habitat for sage-grouse and other species associated with the sagebrush biome. Our field study was funded through summer 2019; we will perform final analyses during 2020.

2. GREATER SAGE-GROUSE MOVEMENT PATTERNS NEAR AN EXISTING WIND FARM

Jennifer Hess[1], Chad Olson[1], Darren Long[2]

[1]HWA Wildlife Consulting, LLC, 2308 South 8th Street, Laramie, Wyoming 82070

[2] Bureau of Land Management, Wyoming State Office, Cheyenne, Wyoming

Existing peer-reviewed research on the potential effects of wind energy on greater sage-grouse is fairly limited. Currently there is little to no information on site fidelity, recruitment or dispersal of sage-grouse in relation to energy development, specifically wind energy. Adult sage-grouse are known to have a high site fidelity, which can limit their ability to adapt to changes in their environment. But no information exists for sage-grouse movement from natal to initial breeding areas. For our research project, the specific objectives were to: (1) quantify multi-scale resource selection/avoidance in sage-grouse within the wind farm, (2) generate data-driven high-resolution maps of seasonal habitat (nesting, late brood-rearing/summer, and winter) at the landscape scale, and (3) investigate natal dispersal while also examining brood-rearing habitat use, fecundity, survival, and second year use by chicks in wind farm areas.

Female sage-grouse were captured by nocturnal spot-lighting in spring 2019. We equipped female greater sage-grouse with solar-powered ARGOS/GPS transmitters in and around the wind farm near Hanna, Wyoming. Following successful hatching and chicks surviving to 75 days, a total of were outfitted with a 6g ARGOS/GPS transmitter. The project is currently ongoing and we hope future funding will allow us to create several peer-reviewed publications from the research work.

Recommendations

1. Enhance understanding of *long-term* impacts to sage-grouse from large-scale industrial wind through continued research in addition to the research that was conducted within the 7-Mile Hill / Simpson Ridge wind development areas (LeBeau et al., 2016).

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

3. Continue efforts to document sage-grouse use in ephemeral / mesic drainages where sagebrush has been removed to enhance herbaceous grass and forb production for the benefit of early and late brood rearing habitats.

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

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

6. If possible, attempt to survey all leks each year while maintaining counts on all designated count leks. Encourage the public, volunteers, and especially landowners to report lek activity and assist with lek surveys and counts.

7. Continue to monitor inactive or unoccupied leks to adjust classification designation as appropriate.

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

9. Continue to inventory abandoned leks to ensure they are appropriately classified and determine whether or not they should continue to remain in the database as per protocol.

Relevant Research

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Big Horn Basin Conservation Area Job Completion Report

Species: Greater Sage-grouse
Management Area(s): B - Cody Region
Period Covered: 6/1/2018 – 5/31/2019
Prepared by: Sam Stephens, Greybull Wildlife Biologist

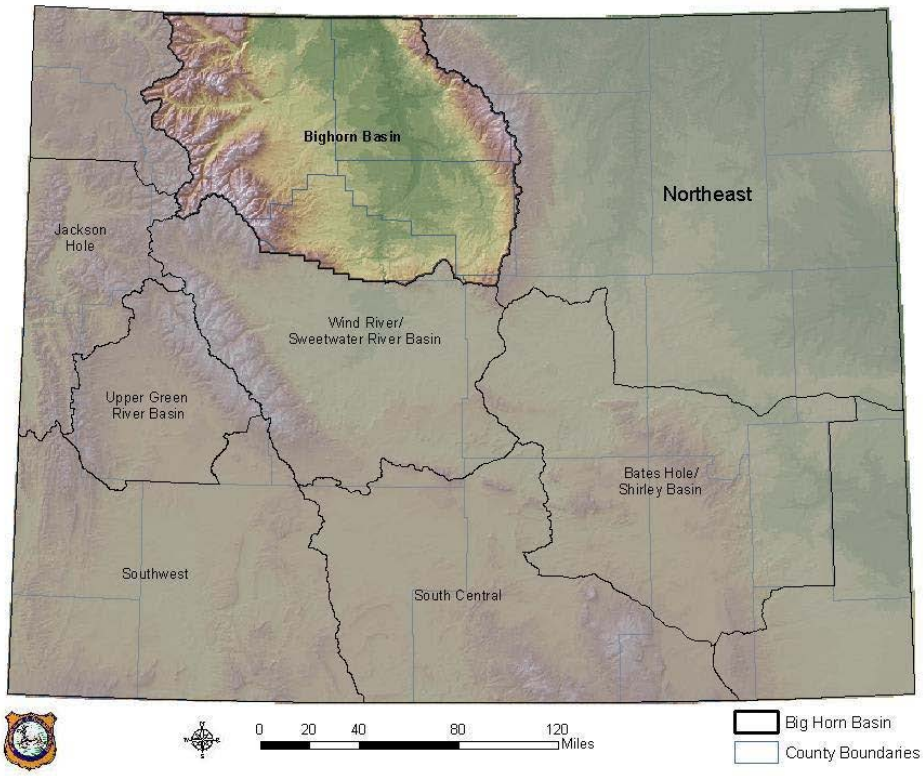


Table 1

Sage Grouse Lek Characteristics

Working Group: Big Horn Basin

Region	Number	Percent
Cody	309	100.0

Working Group	Number	Percent
Big Horn Basin	309	100.0

Classification	Number	Percent
Occupied	236	76.4
Undetermined	35	11.3
Unoccupied	38	12.3

BLM Office	Number	Percent
Cody	114	36.9
Worland	195	63.1

Biologist	Number	Percent
Cody	85	27.5
Greybull	52	16.8
Worland	172	55.7

Warden	Number	Percent
Greybull	23	7.4
Lovell	31	10.0
Meeteetse	32	10.4
North Cody	24	7.8
Powell	13	4.2
South Cody	28	9.1
Ten Sleep	52	16.8
Thermopolis	48	15.5
Worland	58	18.8

County	Number	Percent
Big Horn	48	15.5
Hot Springs	61	19.7
Park	104	33.7
Washakie	96	31.1

Land Status	Number	Percent
BLM	205	66.3
BOR	3	1.0
Private	82	26.5
State	19	6.1

Management Area	Number	Percent
B	309	100.0

Lek Status	Number	Percent
Active	171	55.3
Inactive	95	30.7
Unknown	43	13.9

Sage Grouse Job Completion Report

Year: 2010 - 2019, Working Group: Big Horn Basin

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

a. Leks Counted

Year	Occupied	Counted	Percent Counted	Peak Males	Avg Males / Active Lek (2)
2010	223	74	33	1495	21.7
2011	231	64	28	905	16.2
2012	234	53	23	815	17.0
2013	236	42	18	501	12.5
2014	233	68	29	823	14.4
2015	243	53	22	1108	26.4
2016	249	86	35	2258	30.5
2017	251	56	22	1636	34.8
2018	242	60	25	1115	24.2
2019	241	58	24	873	17.1

b. Leks Surveyed

Year	Occupied	Surveyed	Percent Surveyed	Peak Males	Avg Males / Active Lek (2)
2010	223	109	49	1243	15.0
2011	231	121	52	989	12.8
2012	234	126	54	777	8.8
2013	236	148	63	749	8.2
2014	233	90	39	517	9.2
2015	243	139	57	2265	20.4
2016	249	140	56	2053	23.3
2017	251	175	70	2286	19.2
2018	242	153	63	1434	14.2
2019	241	138	57	854	9.8

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

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

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

Sage Grouse Job Completion Report

Year: 2010 - 2019, Working Group: Big Horn Basin

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

c. Leks Checked

Year	Occupied	Checked	Percent Checked	Peak Males	Avg Males / Active Lek (2)
2010	223	183	82	2738	18.0
2011	231	185	80	1894	14.2
2012	234	179	76	1592	11.7
2013	236	190	81	1250	9.5
2014	233	158	68	1340	11.9
2015	243	192	79	3373	22.0
2016	249	226	91	4311	26.6
2017	251	231	92	3922	23.6
2018	242	213	88	2549	17.3
2019	241	196	81	1727	12.5

d. Lek Status

Year	Active	Inactive (3)	Unknown	Known Status	Percent Active	Percent Inactive
2010	146	9	28	155	94.2	5.8
2011	130	12	43	142	91.5	8.5
2012	143	10	26	153	93.5	6.5
2013	132	9	49	141	93.6	6.4
2014	115	23	20	138	83.3	16.7
2015	154	27	11	181	85.1	14.9
2016	173	26	27	199	86.9	13.1
2017	171	35	25	206	83.0	17.0
2018	152	34	27	186	81.7	18.3
2019	148	41	7	189	78.3	21.7

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

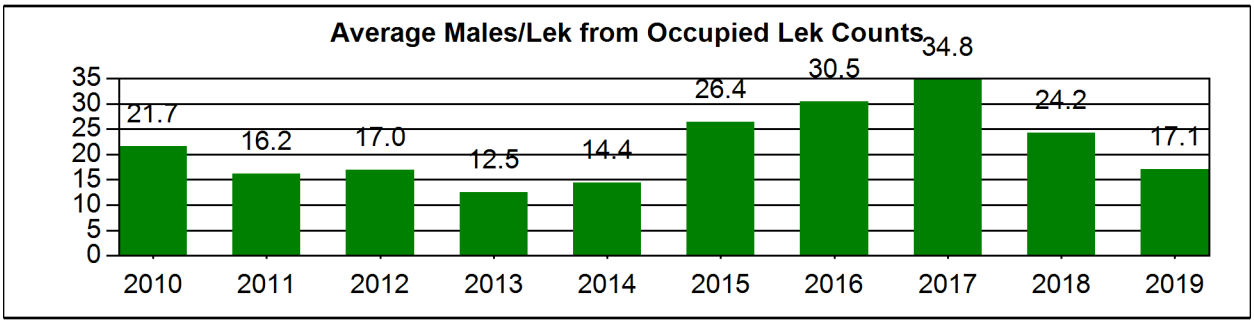
2) Avg Males/Active Lek - Includes only those leks where one or more strutting males were observed. Does not include "Active" leks where only sign was documented.

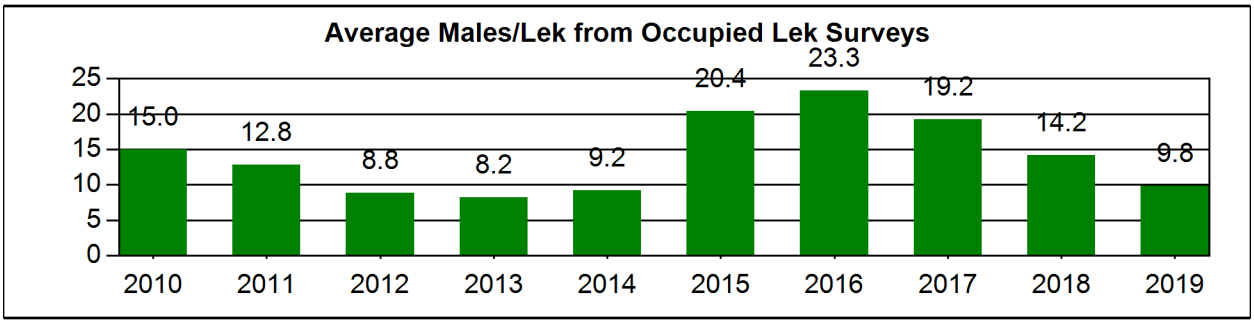
3) Inactive - Confirmed no birds/sign present (see official definitions)

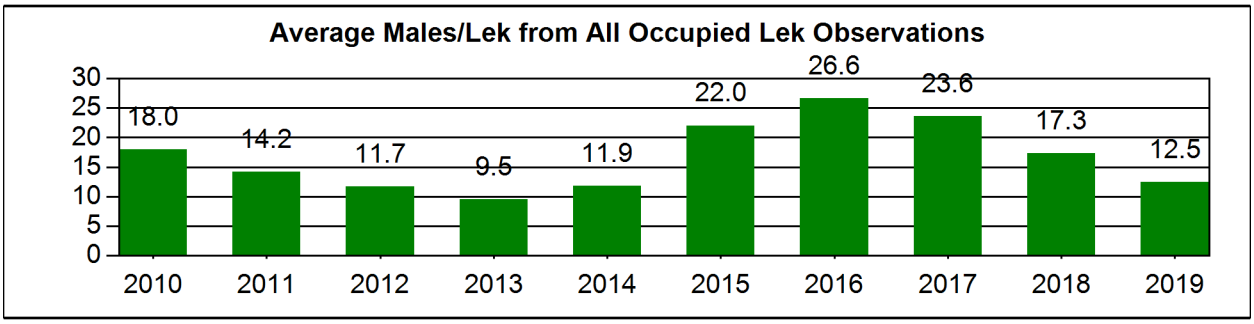
Figure 1

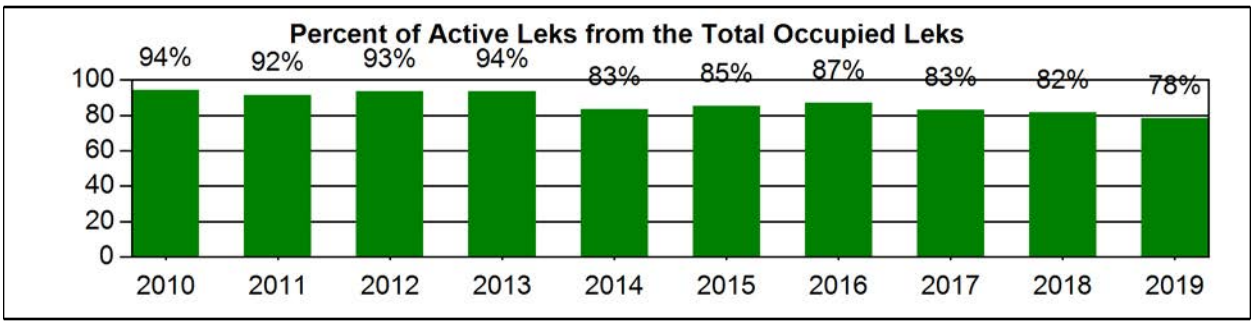
Sage Grouse Occupied Lek Attendance Summary

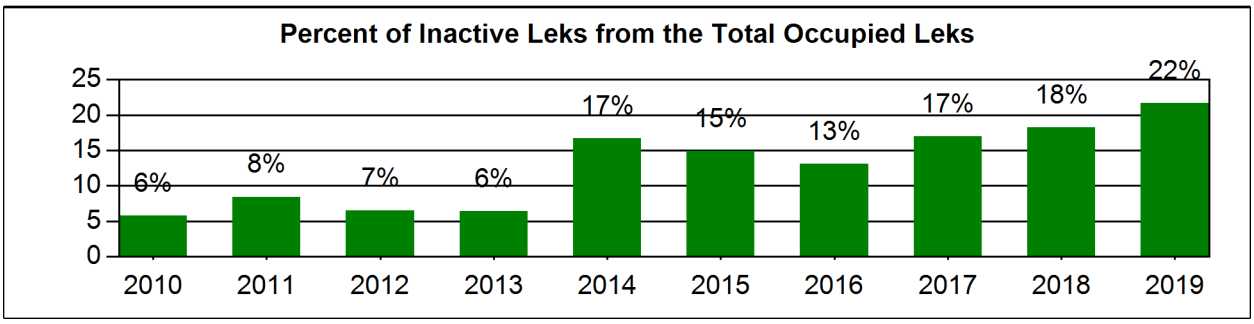
Year: 2010 - 2019, Working Group: Big Horn Basin











Sage Grouse Job Completion Report

Year: 2009 - 2018, Working Group: Big Horn Basin

3. Sage Grouse Hunting Seasons and Harvest Data

a. Season

Year	Season Start	Season End	Length	Bag/Possesion Limit
2009	Sep-19	Sep-30	12	2/4
2010	Sep-18	Sep-30	13	2/4
2011	Sep-17	Sep-30	14	2/4
2012	Sep-15	Sep-30	16	2/4
2013	Sep-21	Sep-30	10	2/4
2014	Sep-20	Sep-30	11	2/4
2015	Sep-19	Sep-30	12	2/4
2016	Sep-17	Sep-30	14	2/4
2017	Sep-16	Sep-30	15	2/4
2018	Sep-15	Sep-30	16	2/4

b. Harvest

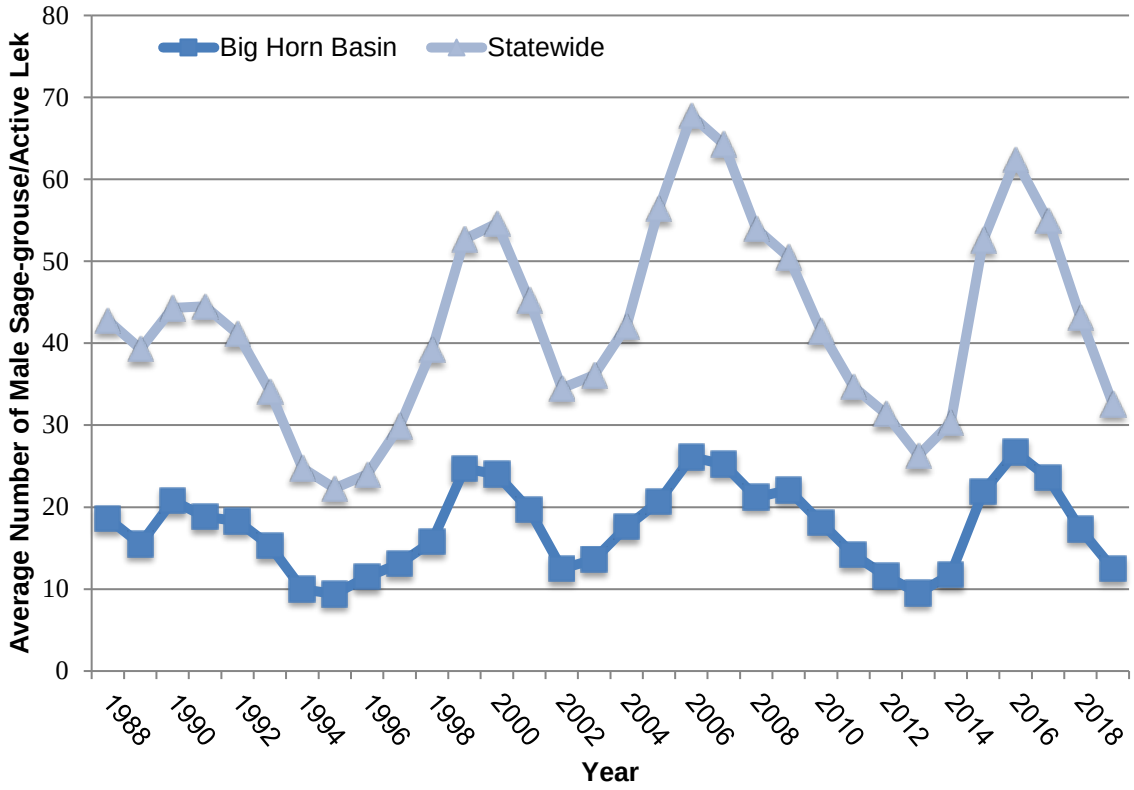
Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2009	472	264	518	0.9	1.8	2.0
2010	545	278	655	0.8	2.0	2.4
2011	354	294	867	0.4	1.2	2.9
2012	457	290	609	0.8	1.6	2.1
2013	206	206	513	0.4	1.0	2.5
2014	524	303	708	0.7	1.7	2.3
2015	729	411	947	0.8	1.8	2.3
2016	594	302	868	0.7	2.0	2.9
2017	635	300	745	0.9	2.1	2.5
2018	648	418	1351	0.5	1.6	3.2
Avg	516	307	778	0.7	1.7	2.5

Lek Monitoring

In spring 2019, 58 leks were counted in the Basin, resulting in an average of 17.1 males per lek (Table 2a). We surveyed 138 leks (2010-19 average=133.9; Table 2b), for a total of 241 leks checked during the 2019 season (2010-19 average=238.3; Table 2c). To evaluate long-term population trends, we combine and average survey and count lek data since the count protocol was not used during the late 1980s and early 1990s. Fortunately, long-term data sets from Wyoming and neighboring states indicate similar trends from both counts and surveys (Fedy and Aldridge 2011; Figure 2).

The average number of male sage-grouse on both counted and surveyed leks declined from the 2018 average peak male count of occupied leks of 17.3 to 12.5 in 2019 (Table 2c), indicating a continued suppression in the population (Figure 2). Sage-grouse populations cycle on approximate 7 to 10-year intervals (Fedy and Doherty 2010; Figure 2). During a suppression in population performance, we would expect an increase in the number of inactive leks. In 2019 the number of inactive leks increased from 34 in 2018 to 41 in 2019. With 2 years of data indicating a reduction in sage-grouse abundance, the positive trend from 2014-2017 has been reversed (Figure 2).

Figure 2. Trends in average male attendance for all lek observations in the Big Horn Basin and statewide, 1988-2019.



Production Surveys

Four sage-grouse broods were documented in 2019 (Table 4). Sample sizes (number of groups observed) from 2011-2019 were too small to estimate chick production (chicks/brood or chicks/hen) in the Basin. Low sample sizes are likely a product of lack of effort by field personnel, because sage-grouse brood data is opportunistically collected while performing other duties during July and August. A direct connection between effort (time spent surveying for broods) and number of broods observed was presented in previous Job Completion Reports.

Table 4. Brood survey data collected by Wyoming Game & Fish Department personnel in the Bighorn Basin, 2010-19.

Year Observed	Broods	Chicks	Hens	Chicks/brood	Chicks/hen
2009	26	104	33	4.0	3.2
2010	17	64	17	3.8	3.8
2011	N/A	N/A	N/A	N/A	N/A
2012	8	26	8	3.3	3.3
2013	8	30	9	3.8	3.3
2014	6	31	27	5.2	1.1
2015	13	69	24	5.3	2.9
2016	8	21	5	2.6	4.2
2017	5	32	7	6.4	4.6
2018	5	22	6	4.4	3.7
2019	4	15	4	3.8	3.8
2009-19 average	**10**	**41.4**	**14**	**4.3**	**3.4**

Harvest

Average (1982-1994) annual harvest 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). During 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). During the most recent period (2009-2018), hunters averaged 1.7 birds/hunter and 2.5 days/hunter. In 2018, 418 hunters in the Big Horn Basin harvested 648 sage-grouse (1.6 birds/hunter); spending 1351 hunter-days afield (3.2 days/hunter) during the 16-day hunting season. The static nature of sage grouse harvest from 2017 to 2018 is likely an artifact of an extended hunting season, offsetting a suppressed sage grouse population. Fewer sage-grouse in the population equates to a similar harvest of birds, with hunters expending more effort in 2018 than in 2017 (3.2 and 2.5 days/hunter respectively).

Habitat

Sage grouse habitat within the Bighorn Basin exists predominantly in low precipitation zones ranging from 5-9" to 7-12" annually. Vegetation communities within the Basin are diverse and vary according to soil type, annual precipitation, and elevation. Major vegetation communities in the Basin include sagebrush steppe, saltbush badlands, irrigated agricultural lands, cottonwood dominated riparian corridors, mixed mountain shrub, and mixed conifer forests with interspersed aspen stands at higher elevations.

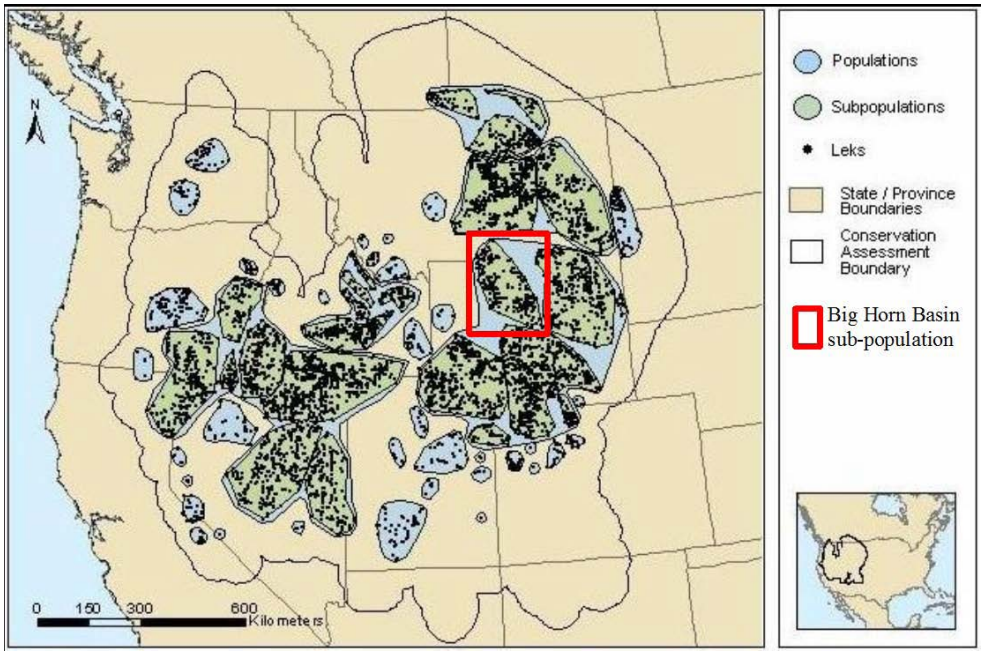
Connelly et al. (2004) recognized sage-grouse in the Basin as a distinct sub-population (Figure 3). Mountain ranges to the east and west restrict most sage-grouse movement due to unsuitable habitat. There are several leks near the Wyoming/Montana state line with movement between states

occurring. Copper Mountain, the Owl Creek Mountains, and the southern Bighorn Mountains provide suitable habitat serving as travel corridors to adjacent populations.

In 2019, 309 sage-grouse leks are known to occur in the conservation area with 236 leks known to be occupied and 38 leks known to be unoccupied (Table 1). Undetermined leks (n=35) need additional observations before being reclassified as occupied or unoccupied. A majority of leks (66%) occur on BLM managed land and 27% of leks occur on private land (Table 1). There are likely other leks in the Basin not yet discovered.

Figure 3. Discrete populations and subpopulations of sage-grouse in western North America, with the Big Horn Basin sub-population surrounded by the red rectangle. (Adapted from Connelly et. al. 2004).

Figure 3. Big Horn Basin Conservation Area in Wyoming.



Conservation Planning

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

The BHBLWG's local plan identifies factors and impacts that may influence sage-grouse populations in the Basin, and outlines goals and objectives to address habitats, populations, research and education. Strategies and commitments in the local plan are designed to improve sage-grouse habitats and populations in the Basin. The local plan was updated in 2013 and highlights completed and ongoing projects in the Basin in addition to summarizing state- and

nation-wide policy and programs. The updated plan can be viewed at the WGFD website: https://wgfd.wyo.gov/Habitat/Sage-Grouse-Management.

Most recently, the BHBLWG met in June of 2019 to discuss project funding allocation to sage grouse research and habitat improvement projects. The group agreed to grant the $75,000 amongst multiple habitat improvement and research projects which included: $10,000 to the Park County Weed and Pest District for cheatgrass treatment in the Dry Creek Basin, $51,000 to Oregon State University and the USDA for research conducted in Park County investigating the interactive effects of livestock, predators, and habitat on sage-grouse demography, $11,000 to the University of Wyoming to continue research investigating the response of sage-grouse to treatments in Wyoming Big Sagebrush, and $3,000 to the Bureau of Land Management for continued herbicidal application as a means of protecting a large proportion of Sage Grouse Core Area from wildfire in Washakie County.

Conclusions and Recommendations

For the 2018 biological year sage grouse populations in the Bighorn Basin appear to be on a downward trend from the previous upswing seen in 2016 and 17. 2019 lek attendance data and brood count surveys suggest that for the 2019 biological year, the suppression of population performance will likely continue. Sage-grouse in the Basin face threats, but are not in danger of foreseeable extirpation, and on-going conservation efforts are intended to mitigate some anthropogenic impacts. Research and monitoring are important to help identify limiting factors, important habitats, and to track populations.

- Conduct brood surveys whenever work schedules allow, and enlist volunteers where practical.
- Formalize winter use area mapping in coordination with Worland and Cody BLM offices
- Continue to be WGFD liaison for ongoing and new research projects, as much as possible.
- Work closely with local ranchers, farmers, energy companies, and other landowners whenever possible on sage-grouse habitat (especially early brood-rearing) and riparian enhancement projects.
- Assist the Bighorn National Forest and Bureau of Land Management Bighorn Basin/Wind River District with prescribed burning plans targeting sage-grouse habitats in the Basin.

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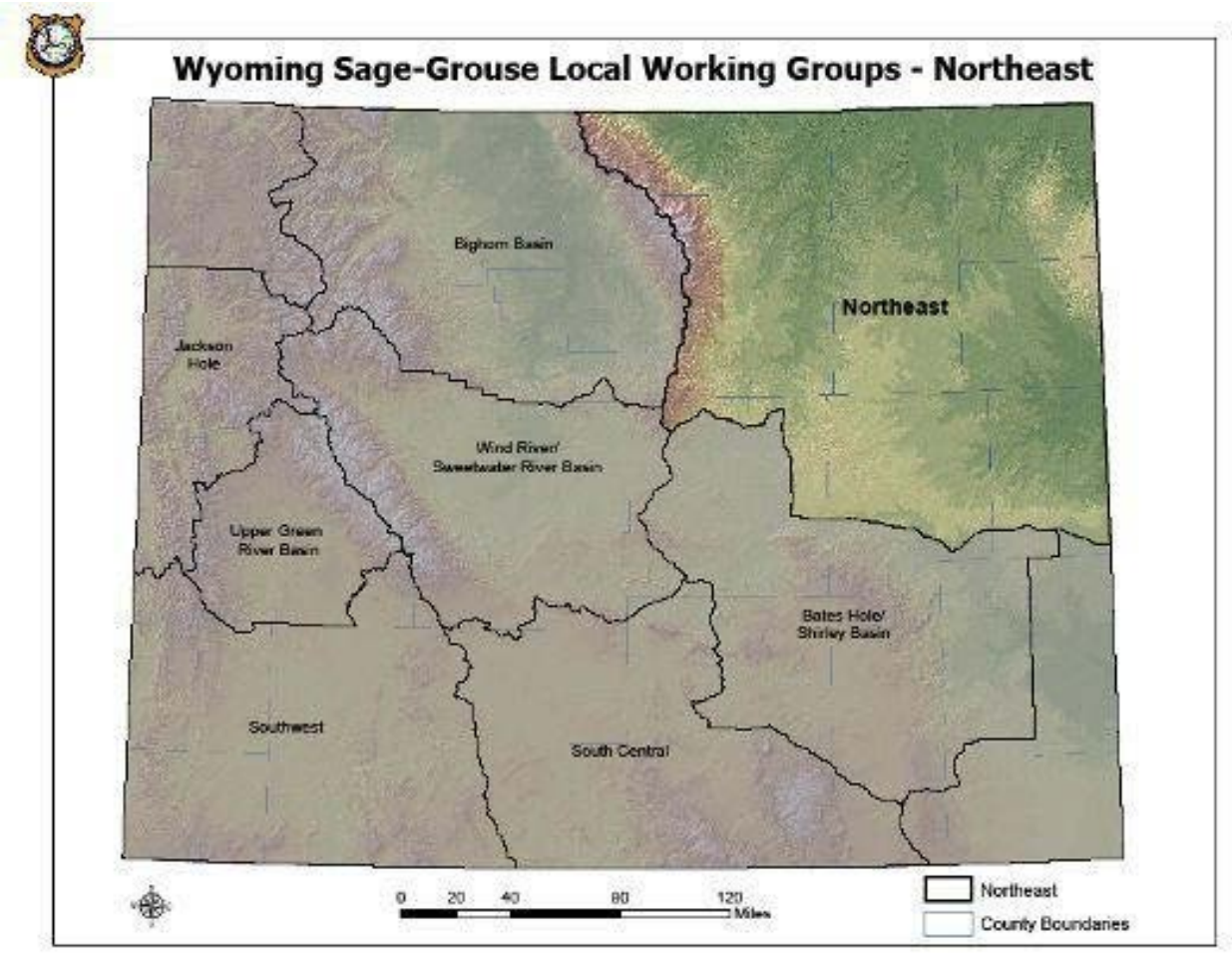
Northeast Conservation Area

Job Completion Report

SPECIES: **Sage-grouse**
DAU NAME: **Northeast Wyoming Working Group**
Period Covered: **6/1/2018 – 5/31/2019**
Prepared by: **Dan Thiele, Wildlife Management Coordinator**



Sage Grouse Job Completion Report

Year: 2010 - 2019, Working Group: Northeast

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

a. Leks Counted

Year	Occupied	Counted	Percent Counted	Peak Males	Avg Males / Active Lek (2)
2010	405	177	44	1561	13.7
2011	412	173	42	1134	11.7
2012	416	240	58	1860	13.0
2013	408	107	26	713	10.5
2014	405	197	49	932	9.7
2015	397	189	48	1933	16.2
2016	393	168	43	1962	20.2
2017	376	165	44	1845	20.1
2018	371	176	47	1376	13.8
2019	358	149	42	1106	12.6

b. Leks Surveyed

Year	Occupied	Surveyed	Percent Surveyed	Peak Males	Avg Males / Active Lek (2)
2010	405	177	44	635	7.9
2011	412	189	46	652	8.2
2012	416	148	36	476	9.5
2013	408	249	61	940	8.5
2014	405	162	40	700	10.0
2015	397	147	37	1065	16.1
2016	393	179	46	1708	19.2
2017	376	152	40	1354	16.5
2018	371	108	29	654	12.3
2019	358	140	39	801	11.3

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

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

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

Sage Grouse Job Completion Report

Year: 2010 - 2019, Working Group: Northeast

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

c. Leks Checked

Year	Occupied	Checked	Percent Checked	Peak Males	Avg Males / Active Lek (2)
2010	405	354	87	2196	11.3
2011	412	362	88	1786	10.1
2012	416	388	93	2336	12.1
2013	408	356	87	1653	9.3
2014	405	359	89	1632	9.8
2015	397	336	85	2998	16.2
2016	393	347	88	3670	19.7
2017	376	317	84	3199	18.4
2018	371	284	77	2030	13.3
2019	358	289	81	1907	12.0

d. Lek Status

Year	Active	Inactive (3)	Unknown	Known Status	Percent Active	Percent Inactive
2010	198	108	48	306	64.7	35.3
2011	183	111	68	294	62.2	37.8
2012	199	115	74	314	63.4	36.6
2013	180	120	56	300	60.0	40.0
2014	168	134	57	302	55.6	44.4
2015	188	92	56	280	67.1	32.9
2016	192	109	46	301	63.8	36.2
2017	176	97	44	273	64.5	35.5
2018	157	98	29	255	61.6	38.4
2019	161	77	51	238	67.6	32.4

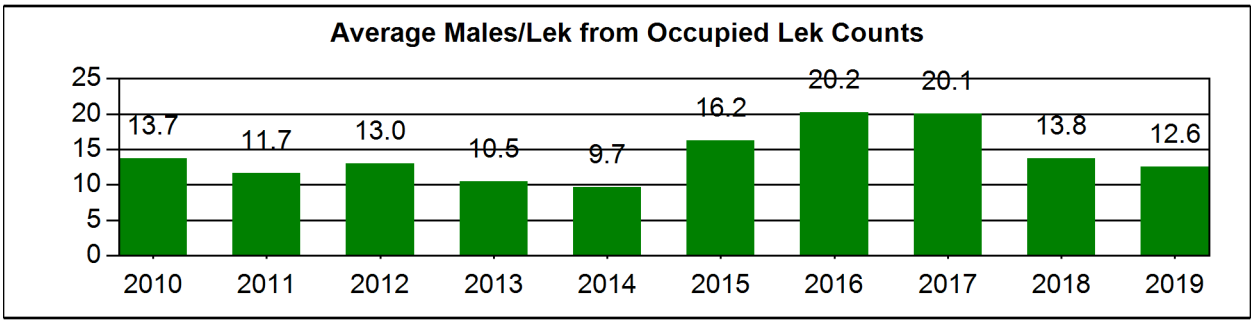
1) Occupied - Active during previous 10 years (see official definitions)

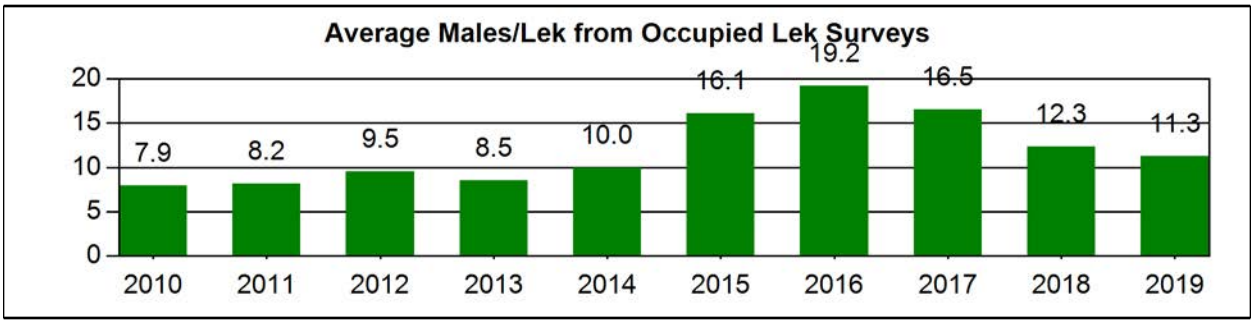
2) Avg Males/Active Lek - Includes only those leks where one or more strutting males were observed. Does not include "Active" leks where only sign was documented.

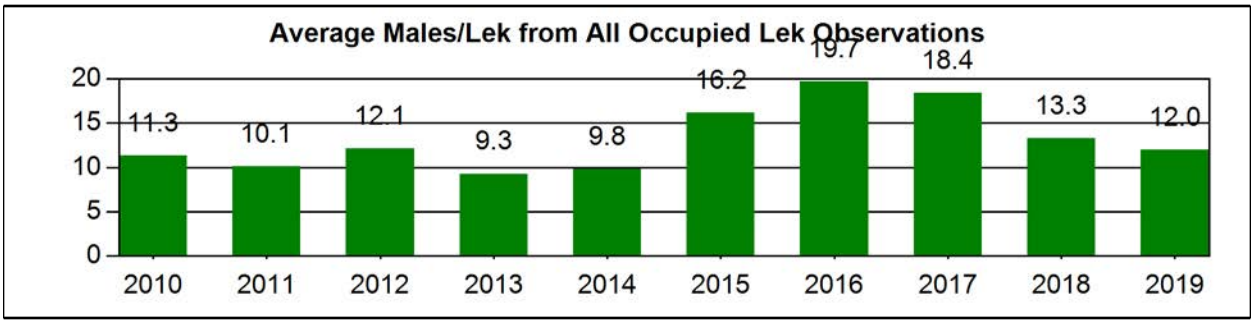
3) Inactive - Confirmed no birds/sign present (see official definitions)

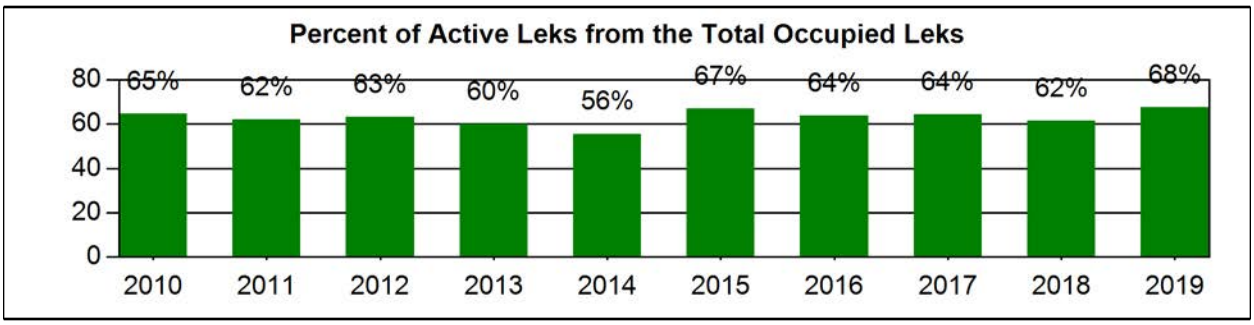
Sage Grouse Occupied Lek Attendance Summary

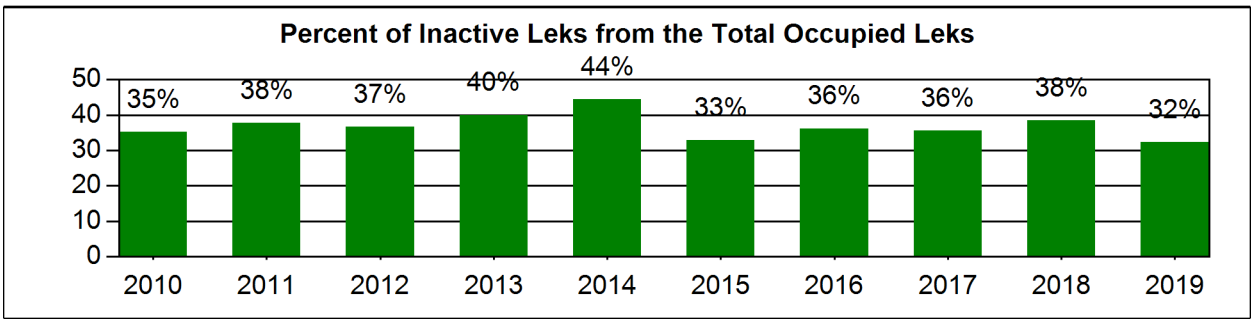
Year: 2010 - 2019, Management Area: C, Working Group: Northeast











Sage Grouse Job Completion Report

Year: 2009 - 2018, Management Area: C, Working Group: Northeast

3. Sage Grouse Hunting Seasons and Harvest Data

a. Season

Year	Season Start	Season End	Length	Bag/Possesion Limit
2009	Sep-19	Sep-30	12	2/4
2010	Sep-18	Sep-30	13	2/4
2011	Sep-17	Sep-30	14	2/4
2012	Sep-15	Sep-30	16	2/4
2013	Sep-21	Sep-30	10	2/4
2014	Sep-20	Sep-30	11	2/4
2015	Sep-19	Sep-30	12	2/4
2016	Sep-17	Sep-30	14	2/4
2017	Sep-16	Sep-30	15	2/4
2018	Sep-15	Sep-30	16	2/4

b. Harvest

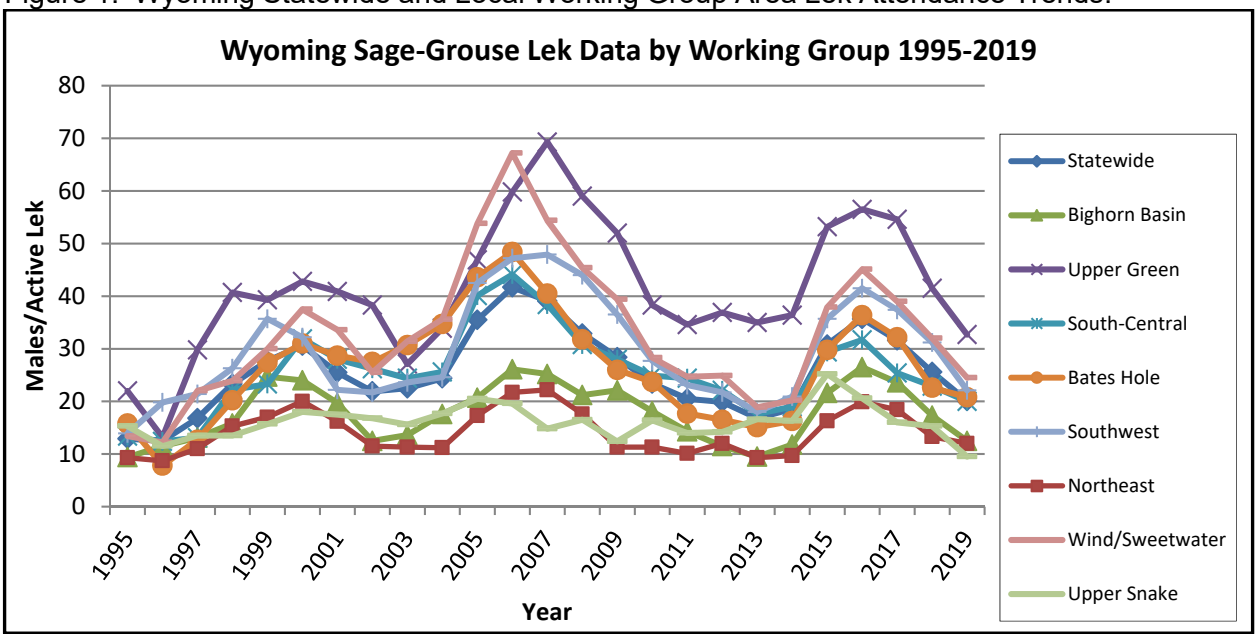
Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2009	311	230	559	0.6	1.4	2.4
2010	129	117	202	0.6	1.1	1.7
2011	158	124	173	0.9	1.3	1.4
2012	405	218	404	1.0	1.9	1.9
2013	27	82	249	0.1	0.3	3.0
2014	123	137	242	0.5	0.9	1.8
2015	314	228	400	0.8	1.4	1.8
2016	89	129	265	0.3	0.7	2.1
2017	118	145	344	0.3	0.8	2.4
2018	245	200	479	0.5	1.2	2.4
Avg	192	161	332	0.6	1.1	2.1

Lek Monitoring

Northeast Wyoming has one of the lowest average male lek attendance rates in the state, averaging 12 males per active lek in 2019 compared to the statewide average of 20 males per active lek (Figure 1). Most leks in northeast Wyoming are small with less than 20 males. In years when grouse are at the peak of their population cycle less than 10% of the active leks have greater than 50 males at peak count. Only the Jewell Draw lek exceeded 50 males in 2019 with 66 males.

Average male lek attendance in northeast Wyoming has decreased significantly over the years. Figure 2 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 2015-2017, however, the long-term trend remains a concern.

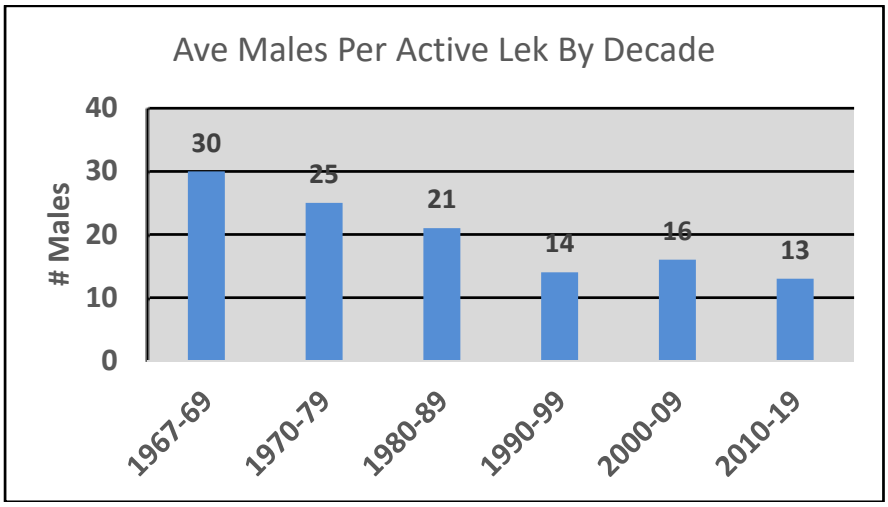
Figure 1. Wyoming Statewide and Local Working Group Area Lek Attendance Trends.



Lek monitoring efforts increased substantially beginning in 2000 due to concerns over range wide declines in sage-grouse populations. Additionally, coalbed natural gas (CBNG) development in the Powder River Basin resulted in extensive survey work to meet federal permitting requirements. The WGFD, BLM, U.S. Forest Service, private consultants, landowners and volunteers participate in ground and aerial monitoring of leks.

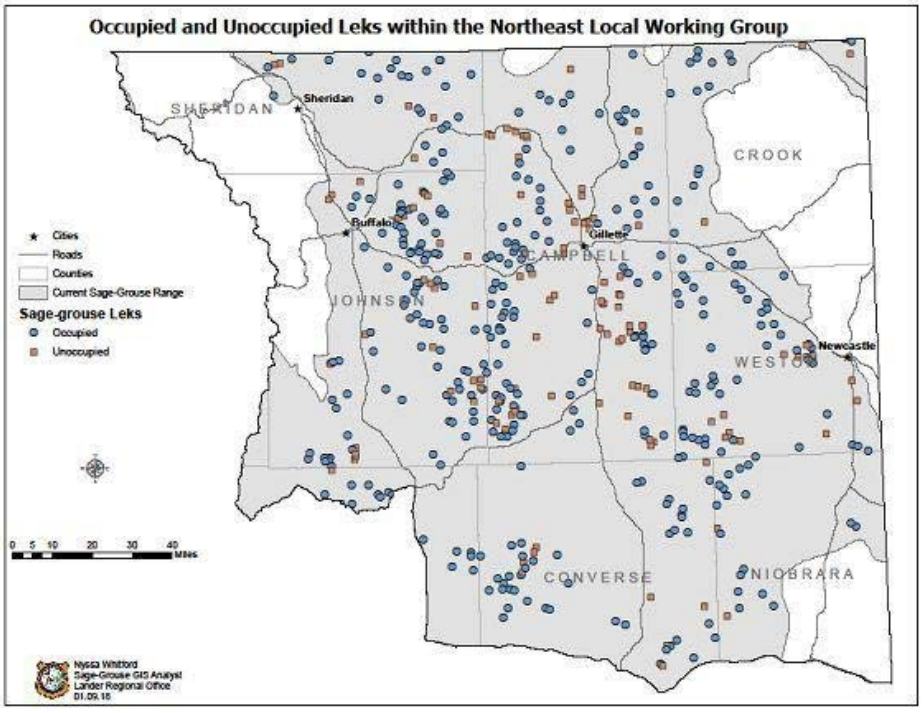
Sage-grouse lek monitoring efforts are accomplished through lek counts, lek surveys and searches for new leks. The Sheridan Region received additional funds from the Bureau of Land Management for sage-grouse surveys for the 18th consecutive year. This funding was used for aerial surveys to monitor known leks and fly grid searches for new leks in those areas with seemingly adequate habitat, but no previously known leks.

Figure 2. Average Number of Males per Active Lek by Decade for Northeast Wyoming Leks.



Following the 2019 lek monitoring period, there are 576 documented leks in the NEWLWGA distributed over various land ownership and management authority boundaries (Figure 3 and Table 1). Of this total, 354 are classified as occupied leks. The 354 occupied leks is less than the 576 total leks because unoccupied leks (abandoned or destroyed) are not considered potentially active and undetermined leks have had no documented activity in the past 10 years. During the 2019 breeding season, 149 leks were counted, representing 42% of known occupied leks (JCR Table 1a). The average number of males per active lek from lek counts was 12.6, below the 13.8 males/active lek in 2018 and well below the 20.2 males/active lek in 2016. The 2019 lek count suggests the sage-grouse population decreased after peaking in 2016 and 2017. The previous cycle peaked at 28.0 males/active lek in 2006.

Figure 3. Sage-grouse Leks in the Northeast Wyoming Working Group Area.



Lek count routes were established in 2000 to better document the actual number of male sage-grouse attending 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. Department lek count data, along with the lek counts from the BLM, private consultants and volunteers, significantly improve the opportunity to better evaluate population trends.

Table 1. Northeast Wyoming Working Group Area Sage-grouse Lek Characteristics for the 576 known leks in 2019.

Region	Number	Percent
Casper	153	26.6%
Sheridan	423	73.4%

Classification	Number	Percent
Occupied	354	61.5%
Unoccupied	144	25.0%
Undetermined	78	13.5%

Biologist	Number	Percent
Buffalo	72	12.5%
Casper	14	2.4%
Douglas	62	10.8%
Gillette	262	45.5%
Newcastle	77	13.4%
Sheridan	89	15.5%

County	Number	Percent
Bighorn, MT	1	0.2%
Campbell	201	34.9%
Carter, MT	1	0.2%
Converse	57	9.9%
Crook	27	4.7%
Johnson	138	24.0%
Natrona	15	2.6%
1Niobrara	23	4.0%
Powder River, MT	1	0.2%
Sheridan	35	6.1%
Weston	77	13.4%

Management Area	Number	Percent
C	576	100.0%

Working Group	Number	Percent
Northeast	576	100.0%

BLM Office	Number	Percent
Buffalo	376	65.3%
Casper	72	12.5%
Newcastle	128	22.2%

Game Warden	Number	Percent
Buffalo	73	12.7%
Dayton	24	4.2%
Douglas	26	4.5%
East Casper	5	0.9%
Glenrock	30	5.2%
Kaycee	58	10.1%
Lusk	23	4.0%
Moorcroft	79	13.7%
Newcastle	62	10.8%
North Gillette	68	11.8%
Sheridan	13	2.3%
South Gillette	108	18.8%
Sundance	6	1.0%
West Casper	1	0.2%

Land Status	Number	Percent
BLM	54	9.4%
Private	448	77.8%
State	39	6.8%
US Forest Service	35	6.1%

Land Status	Number	Percent
Active	191	33.2%
InActive	203	35.2%
Unknown	182	31.6%

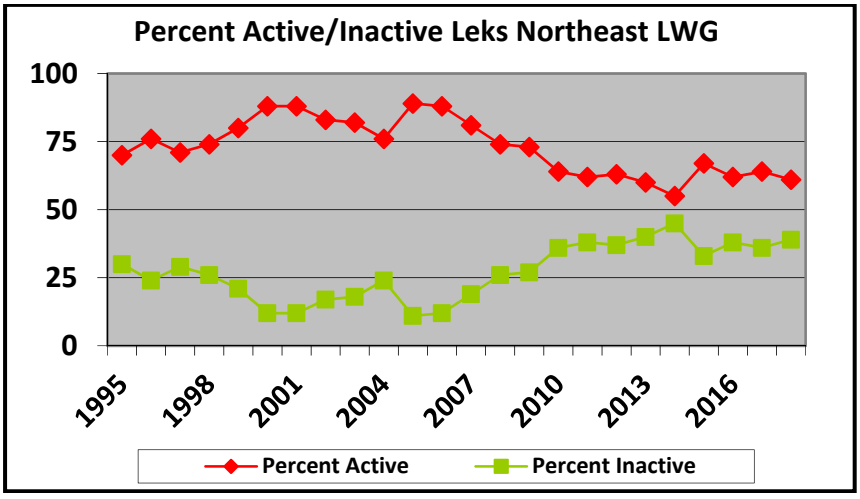
The number of known occupied leks checked by lek counts and lek surveys combined was 289 leks, or 81% of the known occupied leks (JCR Table 1c), exceeding the objective of 80% of occupied leks checked. The average number of males/active lek was 12.0 compared to

13.3 males/active lek in 2018. The 2019 average attendance represents a 10% decrease from last year and 39% decrease since 2016. For the 10-year period, 2010-2019, the number of males/active lek has ranged from 9.3 in 2013 to 19.7 in 2016. These numbers and trends are comparable to the lek count data. One-hundred-sixty-one leks were documented as active with peak male attendance ranging from 1 to 66 males. The three leks with the highest number of males were Jewell Draw with 66 males, Sony Top with 49 males and Watsabaugh 1 with 48 males. No lek has exceeded 100 males since 2007. The median peak male attendance was 9, down from 11 in 2018.

In total, there were 1,112 recorded observations of sage-grouse lek visits in 2019. Visits were very similar to 2018 but nearly 900 fewer lek visits than were recorded in 2008. The decline is due to reduced survey effort resulting from decreased CBNG development activity and a coordinated effort of agencies and consultants to reduce excessive visits to leks. Coordination between agencies and consultants prior to the survey season helped to reduce duplication of effort. In areas of energy development where companies are required to conduct wildlife surveys, a large number of leks were being surveyed more than the required number of times because one or more companies with neighboring leases would survey the same leks due to monitoring buffers extend beyond their respective leases. This problem was most prevalent in the CBNG fields where monitoring buffers of Plan of Development (POD) boundaries overlap adjacent leases resulting in multiple visits to leks. Although some leks still experience more lek visits than necessary, the frequency has been greatly reduced. Likewise, aerial monitoring of leks counted or surveyed from the ground has been discouraged to minimize disturbance.

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

Figure 4. Trends in Active and Inactive Leks, 1995-2019.



Lek status as determined from lek counts and lek surveys shows 238 leks with confirmed lek status. Sixty-eight percent of the leks (n=161) with confirmed status were determined to be active (JCR Table 1d), meaning strutting males or sign of leking activity (feathers/droppings)

were observed at the lek site. Seventy-seven leks (32%) were determined to be inactive based on multiple ground visits and/or checks for sign (feathers/droppings) late in the strutting season. Until 2015, both the average number of males per active lek and the percentage of active leks trended down, suggesting a notable decrease in the population (Figure 4). In 2019, the percentage of active leks decreased slightly while the number of males per active lek decreased notably suggesting a lower population. A number of monitored leks (n=51) have an unknown activity status. This category includes leks that 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. A list of sage grouse definitions is available in the statewide JCR and the Biological Techniques Manual (Christiansen 2012).

Comparisons of core and non-core area lek monitoring results shows that core areas have a similar number of males per active lek (12.2 vs 11.7) but confirmed lek activity is notably higher in core areas (77 vs. 59%). This suggests the core area policy may be successful at maintaining lek persistence. However, it should be noted that core areas in Northeast Wyoming do not encompass all priority habitats which likely contributes to the discrepancy in average male lek attendance figures. Furthermore, in 2019, only 50% of occupied leks were in core areas. Some inconsistencies remain in complying with monitoring protocol and monitoring some leks on a regular basis. Some leks have not been documented as active in many years which may be due to inaccurate locations based on legal descriptions. Continued efforts at determining the exact location and status of these leks are needed. As birds on a lek are observed, UTM coordinates are recorded using GPS. GPS locations for lek sites should make future surveys more efficient even with changes in personnel. Furthermore, with the high amount of activity around leks in areas of energy development, caution must be taken to ensure that strutting activity represents an actual lek and not birds displaced from established leks.

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 the population over time in response to environmental conditions and other influences. However, it must be noted 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 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 5. Northeast Wyoming Working Group Male Sage-grouse Lek Attendance 1967- 2019.

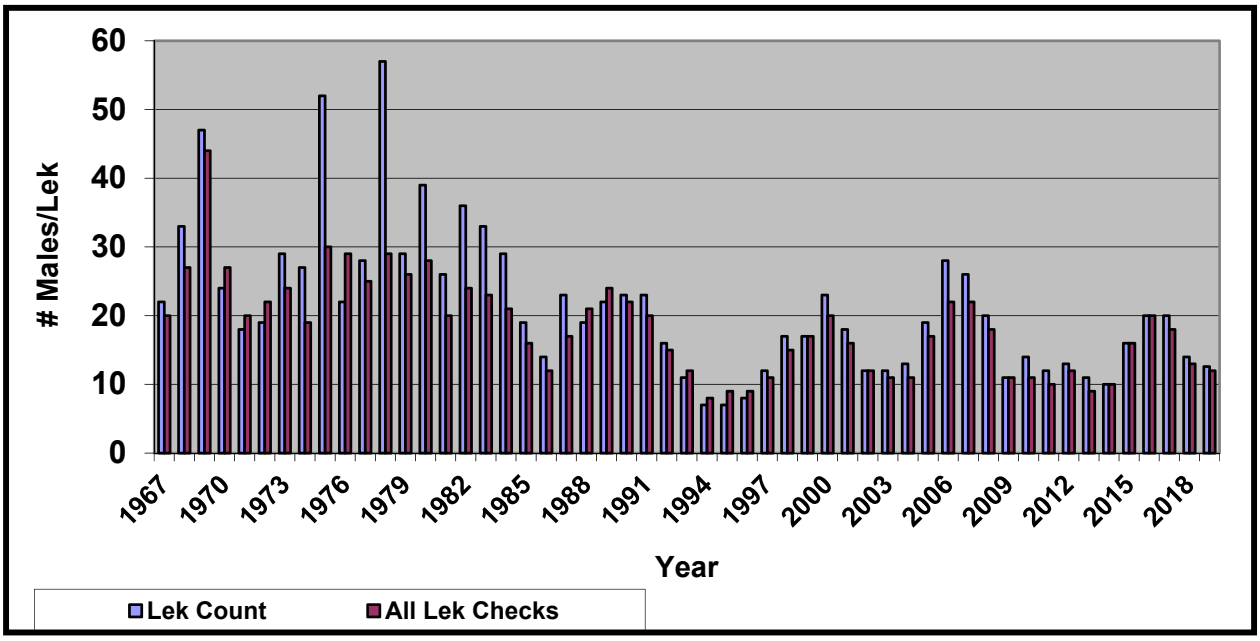


Figure 5 shows the average number of males/active lek for lek counts and all lek monitoring (counts and surveys) combined from 1967 to 2019 for the NEWLWGA. If the average number of males/active lek is reflective of the population, the trend suggests about a 10-year cycle of periodic highs and lows. Of concern, however, is that with the exception of the 2006 peak, subsequent peaks in the average male lek attendance are usually lower, or similar, to previous peaks. Likewise, periodic lows in the average male attendance are generally lower, or similar, to the previous low. The long term trend suggests a steadily declining population through the late 1980's followed by a more stable population. Sage-grouse numbers most recently peaked in 2016 and 2017, followed by a decrease in 2018 and 2019. This trend reflects the trends in other working group areas (Figure 1).

The number of known leks increased from 2000 to 2010 primarily due to increased survey effort associated with CBNG activities. However, even with the increased number of known leks, the percentage of active leks remains well below that observed in the past. While the number of leks present historically cannot be known, recent monitoring confirms the number and proportion of active leks has declined.

Harvest

The Northeast Working Group area is comprised of Hunt Area 4 and portions of Hunt Areas 1 and 2 (Figure 6). A very small amount of Hunt Area 1 occurs in the southwestern most extent of the area while Hunt Area 2 is closed to hunting. In Hunt Area 4, a very conservative hunting season was implemented beginning in 2010 due to continuing concerns of decreasing lek attendance trends.

Although sage-grouse numbers have decreased long-term, an adequate population exists to support the conservative hunting season. Over 1,900 males were observed during 2019 lek monitoring efforts with most of these birds in the portion of the NEWLWGA included in Hunt Area 4. This number far exceeds the 100 male minimum threshold recommended to support

a hunting season in the sage-grouse management guidelines (Connelly, et. al 2000). In 2010, 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* (Christiansen 2010).

The 2018 harvest survey estimated 245 sage-grouse were harvested by 200 hunters who spent a total of 479 days hunting during the Hunt Area 4 three day season. The average number of birds harvested per hunter day was 0.5. The average number of sage-grouse harvested per hunter was 1.2 and the average number of days hunted was 2.4.

The 2018 sage-grouse harvest more than doubled from the 118 birds harvested in 2017. Recent low harvest levels have been attributed to the three day season, private land access and publicity about lower bird numbers and the bird's plight which likely reduces hunter interest. The ten-year average (2009-2018) is 192 birds, with harvest ranging from a low of 27 birds in 2013 to a high of 405 birds in 2012. More than 2,500 birds were harvested as recently as 2000 when a 16 day season was in place. Hunter days increased 39% from the 344 days hunted in 2017, but remains well below the 1,649 days logged in 2005. It should be noted that statistical variance for harvest data is likely high given the limited number of hunters in this hunt area and varying response rates.

Figure 6. Northeast Wyoming Sage-grouse Hunt Areas.

In past years a limited number of sage-grouse wings were collected during the hunting season, primarily in the eastern portion of the Area. Sample sizes were small due to the low harvest and the difficulty to strategically placing enough collection barrels along the many roads and highways within the area. Composition of the harvest as determined by analysis of wings deposited by hunters in wing barrels can provide insight into current year's chick production, although in most years the sample was too small to allow for reliable interpretation of the sample. No wings were collected during the 2018 hunting season.

Weather

Weather during the 2018 biological year (June 2018–May 2019) was wetter and cooler than average due to above average June, December and May precipitation and below average February, March and May temperatures (Figures 7 and 8). Precipitation was 17% above average resulting from high December (+0.25 inches) and May precipitation (+2.71 inches). Early summer (June +1.3° and July +1.8°)and winter (December +2.8°, January +2.2°) temperatures were above average while October (-2.0°), February (-12.5°), March (-5.6°), and May (-4.4°) temperatures were well below average. The above average spring 2018 precipitation provided for good forage growth which carried over into early 2019. However, the cold, wet May 2019 weather likely negatively affected early season nest success.

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

Figure 7. 2018 Bio-Year: Monthly Precipitation Data (in), Wyoming Climate Division 5.

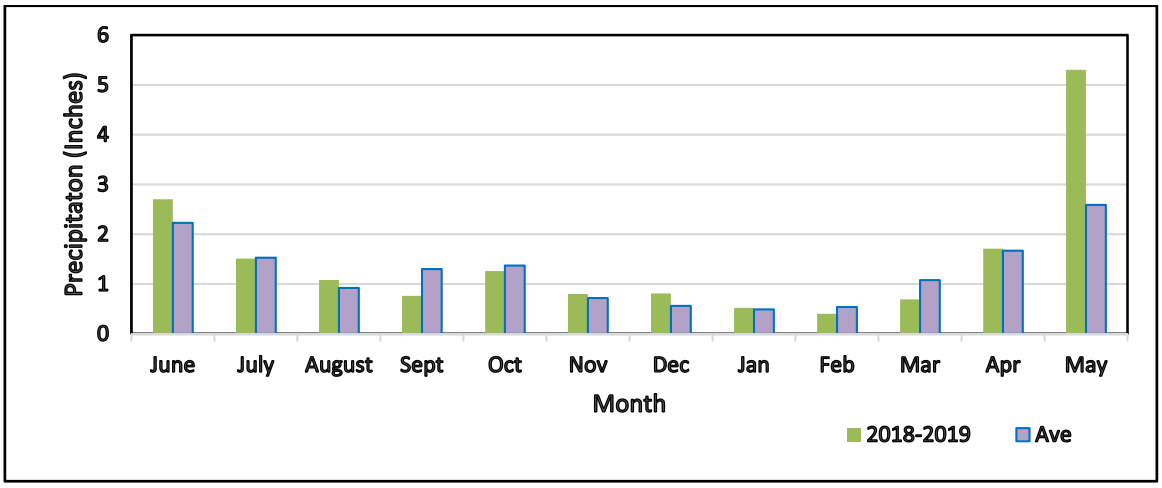
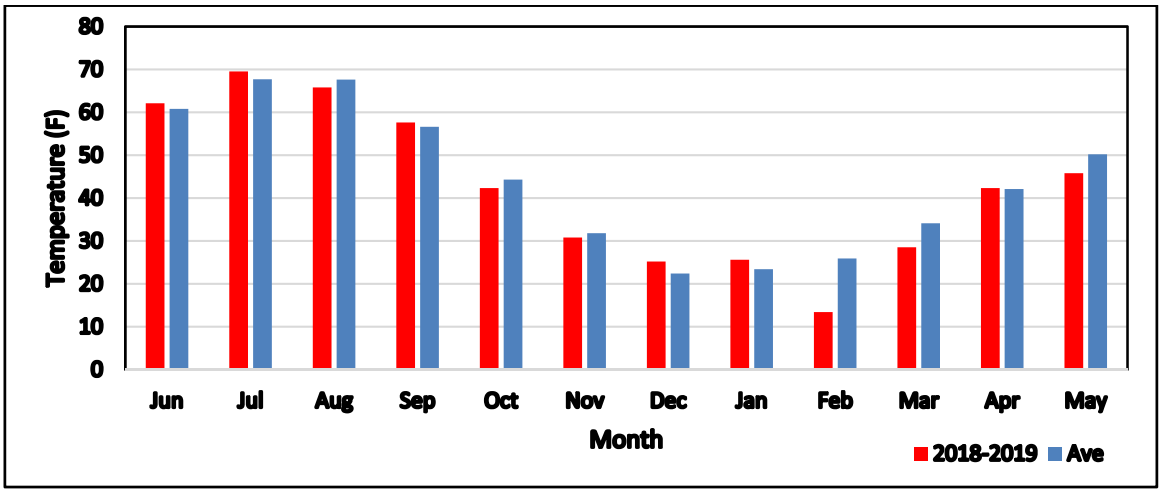


Figure 8. 2018 Bio-Year: Monthly Temperature Data (°F), Wyoming Climate Division 5



Report Notice

Variation in this report from previous years' reports is expected because of new data added to the lek database. Old records are added each year as data become available and newly discovered leks are added to the database. 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.

Disease

No West Nile virus (WNv) mortality was reported for northeast Wyoming in 2018 and no major mortality events have been documented since 2003 when WNv was first documented in sage-grouse in the Powder River Basin. However, there are fewer radio marked sage-grouse being monitored by researchers which decreases the likelihood of finding mortalities. Based on human diagnosed cases of WNv, outbreaks occurred in 2003 and 2007. Sage-grouse in North and South Dakota were reported to have suffered large losses to WNv in 2007 and there may have been undetected impacts in Wyoming. Because of the difficulty in monitoring WNv in sage-grouse, human and livestock cases can provide an indication of WNv prevalence in a given year. Four human cases and 16 equine cases were identified in 2018.

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

Habitat

Habitat conditions in 2018 were good following above normal spring precipitation. Above normal March, May and June precipitation (+17%) compensated for below normal April precipitation. The Palmer Drought Index, a measure of long-term meteorological conditions, showed the Powder River and Tongue River drainages were mid-range for the biological year whereas the Belle Fourche River drainage and the Cheyenne/Niobrara River drainages were moderate to extremely moist through the biological-year. The average spring 2018 forage production provided for moderate residual vegetation into 2019. May 2019 precipitation was double the normal providing for excellent herbaceous forage production throughout the area. Above average June and July precipitation extended green-up through July. Yellow sweet clover production was exceptional.

Habitat Impacts

Most occupied habitat for sage-grouse is held in private ownership. Approximately 75 percent of known leks are found on private land with the remaining 25 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 currently or historically 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. Historically, large parcels of sagebrush habitat were converted either to grasslands or crops. Limitations of remote sensing technology have prevented quantifying and mapping these conversions.

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 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). At the peak of the CBNG play, more than 18,300 wells were in production (August 2008) with production peaking in January 2009 at 49,459,629 Mcf of methane gas (WOGCC 2019). 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. Since 2009, development and production has declined as CBNG leases have been drilled and natural gas prices decreased. In May 2019, the Wyoming Oil and Gas Conservation Commission reported that 4,779 producing wells yielded 7,969,012 Mcf of methane gas (WOGCC 2019). Federal mineral leases provided for 73% of the production while fee leases accounted for 20% and State leases 7%. In addition to producing wells there are 4,503 shut in wells. This compares to May 2018 when 5,349 producing wells yielded 9,881,365 Mcf of methane gas. Nearly 72,000 permits to drill have been issued, although many have expired. Many wells drilled early in the play have completed the production phase of development and are now being plugged and abandoned. Furthermore, low gas prices currently hamper the economic viability of CBNG production operations. Drilling new wells is occurring primarily to hold existing leases.

Deep well oil and gas development has increased in recent years with new technologies enabling horizontal and directional drilling. While CBNG activity decreased, the interest in deep drilling has fluctuated with inconsistent oil prices. In 2019, counties comprising the NEWLWGA had 304 oil wells started (spud) including 250 horizontal wells, 16 directional wells and 38 conventional wells (WOGCC 2019). One natural gas well was started. The vast majority of the drilling is occurring in Converse and Campbell Counties. Exploration utilizing horizontal drilling has increased markedly from 10 wells in 2007 to 365 wells in 2014 after which activity decreased to 118 wells in 2016. Deep wells require large well pads and large amounts of truck traffic to deliver water, sand, etc for drilling and fracking.

Considerable debate occurred on the effects of energy development on sage-grouse. Peer reviewed research findings show significant impacts (Walker et al. 2007, Doherty et al. 2008, Doherty et al. 2010, Harju et al. 2010 and others). These findings have yet to be accepted by some people and this has contributed to uncertainty in the public and political arenas as to the real effects of energy development. Furthermore, many continue to blame predation while some in the energy industry point to continued hunting of the species given that they are being asked for increased mitigation measures in areas of development.

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

Northeast Local Working Group Threats Identification

Sage-grouse are influenced by many factors, both individually and cumulatively. Habitat loss and fragmentation, direct mortality and disturbance affect sage-grouse populations. In 2006,

the NEWLWG 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 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.

Wyoming Core Area Strategy

The Wyoming Sage-Grouse Core Area Strategy (CAS) is based on a series of Executive Orders issued by former Governor Dave Freudenthal and current Governor Matt Mead. The CAS is designed to coordinate sage grouse conservation efforts across the State of Wyoming and directs state agencies to work to maintain and enhance greater sage grouse habitat in Wyoming with the goal of precluding the need to list sage-grouse under the Endangered Species Act. The current Executive Order (2015-4) was signed by Governor Mead in July of 2015. The Executive Order is available at: https://wgfd.wyo.gov/Habitat/Sage-Grouse-Management .

Core areas (Figure 9) were designated with the objective of identifying habitats that supported most of Wyoming's sage-grouse. Statewide, core areas account for approximately 36% of the current sage-grouse range while encompassing leks with 78% of the 2012-2014 peak males. However, in the NEWSGLWGA, core areas were designated based on CBNG development patterns along with lek density data thereby encompassing leks supporting only 49% of the 2012-2014 peak males.

Gamo and Beck (2017) determined 72% of development projects located within Wyoming core areas were in compliance with the executive order. Non-compliant projects were generally operating under valid, existing rights and therefore not subject to provisions of the executive order. Those projects were reviewed further, and operators often agreed to implement mitigation practices that included locating structures within previously disturbed sites, site-specific avoidance of sage-grouse habitat, and habitat restoration. Gamo and Beck's analysis demonstrated that the CAS has been generally effective at conserving sage-grouse populations by managing anthropogenic disturbances. However, it also indicated additional actions are needed to conserve sage-grouse in northeast Wyoming where many developments were in place or permitted prior to the implementation of the CAS (Gamo and Beck 2017).

BLM Powder River Basin Restoration Program

For the reporting period, the program reported the following accomplishments within northeast Wyoming core areas:

- 330 acres of treatment of conifer encroachment in the North Gillette Core Area - removed by the Montana Conservation Corp
- Two unpermitted reservoirs were reclaimed this year to help manage for mosquito habitat/West Nile virus for a total of 10 reservoirs reclaimed
- Planted about 1,600 sagebrush seedlings on reclaimed CBNG site in sage-grouse habitat. Seed was collected on public land south of the Schoonover Road in the fall of 2018 and planted/propagated by Sheridan County Experiment & Research Center and planted June 2019.

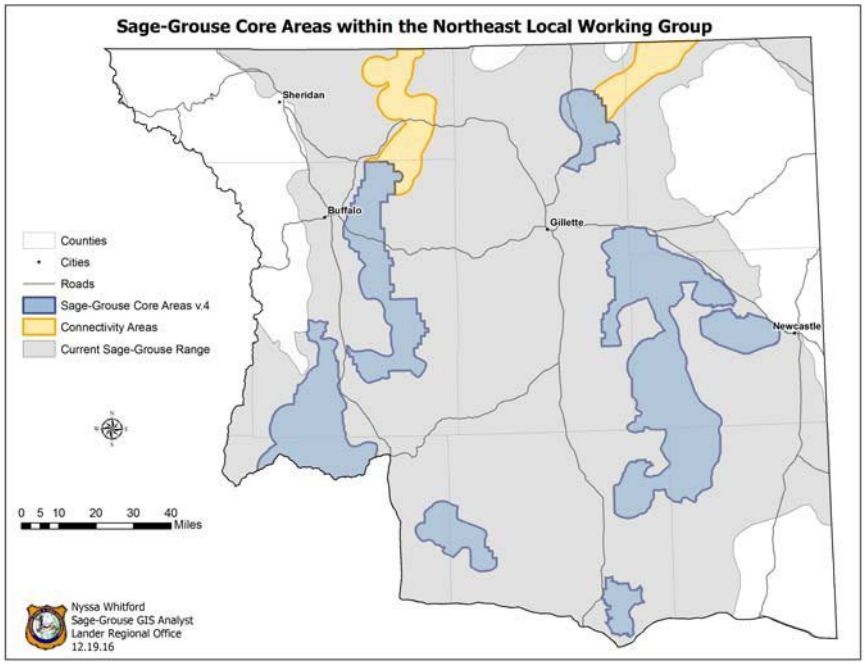
- 900 acres of cheatgrass treatment in the Buffalo Core Area – this is a joint fuels management/greater sage-grouse habitat improvement project

- Assisting NRCS Gillette Field Office and Campbell County Conservation District with riparian project on the Little Powder River

- Assisted Spring Creek Grazing Association, Campbell County, NRCS, Campbell County Conservation District and the US Forest Service replacing old woven-wire fence with wildlife/sage-grouse friendly fence

- Formation of working group in addressing habitat restoration of the Deer Creek fire (2017) in the Buffalo Connectivity Area (Sheridan County)

Figure 9. Northeast Wyoming Sage-grouse Core Area and Connectivity Areas (version 4).



Douglas Core Area

Sage-grouse peak lek attendance within the Douglas Core Area (DCA) totaled 20 males in 2019. This was one more than the peak male count in 2018, but still showing a significant reduction from the 2017 count of 43 males. Three of the six occupied leks were active, which is one more than in 2018. There have been no changes in lek classifications since 2016.

The DCA has experienced a substantial increase in energy development over the past several years. Due to the high density of oil and gas development coupled with a large wildfire that eliminated sagebrush cover over the landscape, all permitted disturbance within the DCA exceeds thresholds established by the Governor's 2011-5 E.O.. Because the majority of the permitted activities are being developed under valid and existing rights secured prior to core area designation, development has continued to occur despite exceeding disturbance thresholds. To mitigate this, the Wyoming Governor's Office, the Department and other partners have worked closely with industry to identify a plan of development and establish a large industry funded restoration effort guided by a multi-disciplinary restoration team. The plan of development, which

was renewed in 2018 and is valid until 2022, includes practices such as avoiding key habitat areas, minimizing disturbance and significantly reducing traffic during breeding and nesting seasons. The Restoration Team has identified, and is currently implementing, multiple projects beneficial to sage-grouse within the DCA including sagebrush restoration, cheatgrass control and a West Nile virus management program. Additionally, the team has sponsored multiple research projects through two graduate research students with the goal of developing best management practices for sagebrush restoration. The team has recently been working to disseminate results from these projects. To date, the team has planted over 100,000 sagebrush plants and has leveraged additional partner funds to continue sagebrush restoration, cheatgrass management and mesic habitat improvement work. Lastly, the team refined the disturbance data layer for the DCA by documenting suitable habitat per the 2015 Executive Order guidelines.

NRCS Sage-grouse Conservation Initiative

NRCS SGI contracts for FY2019 within the NEWSGLWGA consisted of four contracts totaling 14,985 acres.

- Campbell County – 1 contract for 5,942 acres
- Converse County – no contracts
- Crook County – no contracts
- Johnson County – no contracts
- Niobrara County – no contracts
- Natrona County – no contracts
- Sheridan County – 3 contracts for 9,043 acres
- Weston County – no contracts

In addition to the SGI program, conservation projects implemented through the EQUIP program benefit sage-grouse and sagebrush habitat.

Information on the Sage-grouse Initiative is available at http://www.sagegrouseinitiative.com.

Conservation Planning

The Local Working Group schedule was scaled back following completion of the conservation plan addendum in 2013. The plan and other LWG information is available on the WGFD website at http://gf.state.wy.us/wildlife/wildlifemanagement/sagegrouse/index.asp.

The Working Group held one meeting during the reporting period. The new Sage-grouse/Sagebrush Biologist, Leslie Schrieber, was introduced to the group. The group received updates on the Executive Order revision and worked on developing recommendations to address the Buffalo Connectivity adaptive management trigger. No Wyoming Sage-grouse Conservation Fund dollars were available for this reporting period.

U.S. Fish and Wildlife Service Candidate Conservation Agreements With Assurances (CCAA)

A CCAA is a voluntary agreement between the U. S. Fish and Wildlife Service (USFWS) and a non-federal landowner(s) on non-federal lands that provides assurances that landowners covered by a CCAA will not be subject to additional restrictions if the sage-grouse is listed under the Endangered Species Act. Landowners must agree to implement agreed upon conservation actions on their property to remove or reduce threats to the sage-grouse.

For the reporting period, there were no additional sign-ups or withdrawals.

Sage-grouse Research

On-going research conducted by Dr. Brad Fedy and Chris Kirol of the University of Waterloo, Alberta continues with support from the BLM State Office, BLM Buffalo Field Office and the NEWSGLWG. The three-year study, Improving Success in Habitat Restoration for Sage-grouse and Other Sagebrush Birds, is being conducted northeast of Buffalo in a mix of areas including active CBNG energy development, reclaimed CBNG fields, and non-developed habitat (CORE). Specific to sage-grouse, the research aims to quantify the influence of reclamation on seasonal habitat use, nest success, brood survival and movements.

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RECOMMENDATIONS

1. Continue to participate in the Northeast Wyoming Local 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 to benefit sage-grouse.
2. Continue to 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. Annually monitor 80% of the occupied leks in the local working group area.
4. Continue WNv monitoring.
5. Continue to 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 2020 for lek searches and surveys. All leks should be checked at least once every three years. All leks should be recorded in UTMs (NAD 83) using GPS.
7. The sage-grouse database should be maintained and used to store and report sage-grouse data. Any old records that have not been included should be added to the database. Current records should be reviewed to eliminate leks without adequate documentation to support a lek designation.
8. The Working Group should continue to solicit habitat projects on private lands that will have benefit for sage-grouse.
9. The WGFD Regions should continue to recommend protection of occupied sage-grouse leks during environmental commenting and promote their protection on private land projects.
10. Additional effort is needed to document the status of undetermined leks. Encourage reporting of lek activity from the public and in particular landowners.
11. Better document wintering sage-grouse locations and develop a seasonal range map for sage-grouse for the Working Group Area.
12. Continue to map lek perimeters to ensure adequate buffer distance in protecting leks.

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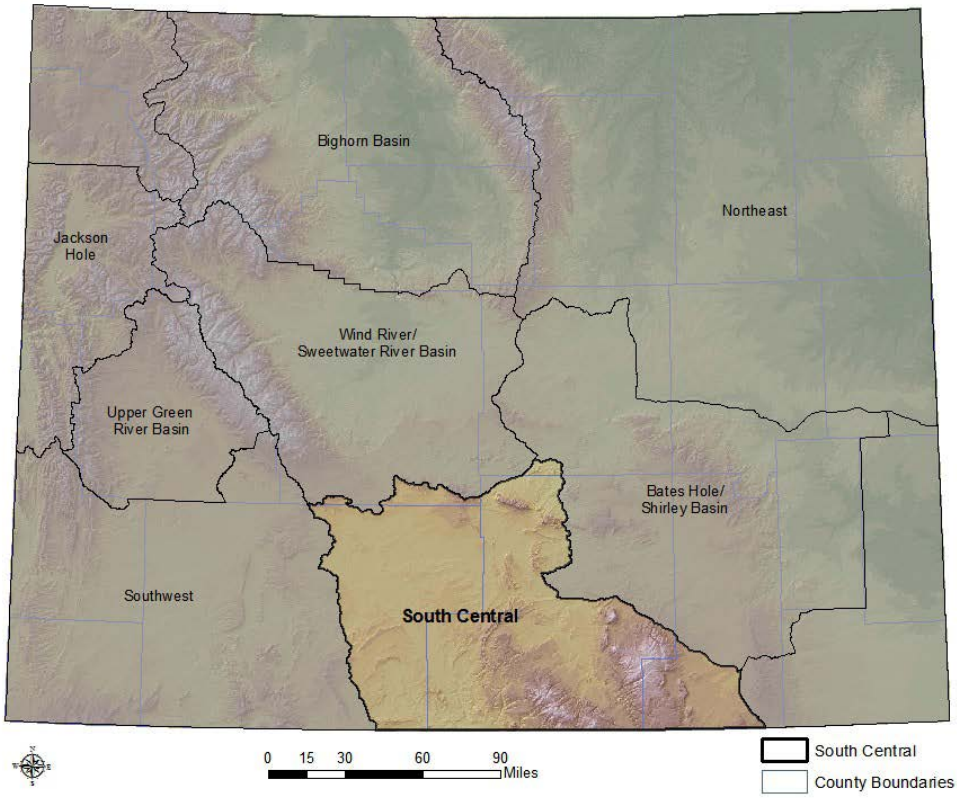
South-Central Conservation Area
Job Completion Report

Species: Greater Sage-grouse
Mgmt. Areas: H
Period Covered: June 1, 2018- May 31, 2019
Prepared by: Teal Cufaude, Saratoga Wildlife Biologist



Sage Grouse Lek Characteristics

Management Area: H, Working Group: South Central

Region	Number	Percent
Green River	135	33.7
Lander	210	52.4
Laramie	56	14.0

Working Group	Number	Percent
South Central	401	100.0

Classification	Number	Percent
Occupied	262	65.3
Undetermined	70	17.5
Unoccupied	69	17.2

BLM Office	Number	Percent
Casper	2	0.5
Lander	26	6.5
Rawlins	356	88.8
Rock Springs	17	4.2

Biologist	Number	Percent
Baggs	122	30.4
Green River	14	3.5
Laramie	5	1.2
Saratoga	51	12.7
Sinclair	194	48.4
South Lander	15	3.7

Warden	Number	Percent
Baggs	121	30.2
East Rawlins	105	26.2
Elk Mountain	6	1.5
Lander	2	0.5
Rock Springs	14	3.5
Saratoga	45	11.2
South Laramie	5	1.2
West Rawlins	103	25.7

County	Number	Percent
Albany	5	1.2
Carbon	264	65.8
Fremont	13	3.2
Natrona	2	0.5
Sweetwater	117	29.2

Land Status	Number	Percent
BLM	226	56.4
LocalGov	1	0.2
Private	145	36.2
State	28	7.0
USFWS	1	0.2

Management Area	Number	Percent
H	401	100.0

Lek Status	Number	Percent
Active	195	48.6
Inactive	154	38.4
Unknown	52	13.0

Sage Grouse Job Completion Report

Year: 2010 - 2019, Management Area: H, Working Group: South Central

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

a. Leks Counted

Year	Occupied	Counted	Percent Counted	Peak Males	Avg Males / Active Lek (2)
2010	265	52	20	1528	33.2
2011	262	49	19	1272	31.0
2012	273	55	20	1490	28.1
2013	278	94	34	1662	21.9
2014	281	100	36	1607	21.4
2015	282	89	32	1915	32.5
2016	286	72	25	2381	39.0
2017	286	95	33	2176	29.4
2018	285	113	40	2210	24.6
2019	279	131	47	2419	22.0

b. Leks Surveyed

Year	Occupied	Surveyed	Percent Surveyed	Peak Males	Avg Males / Active Lek (2)
2010	265	170	64	2849	21.9
2011	262	157	60	2460	22.0
2012	273	179	66	2214	19.3
2013	278	159	57	1564	14.9
2014	281	176	63	2016	17.8
2015	282	170	60	3224	27.8
2016	286	192	67	3707	28.1
2017	286	162	57	2465	22.6
2018	285	153	54	2005	21.3
2019	279	127	46	1081	16.6

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

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

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

Sage Grouse Job Completion Report

Year: 2010 - 2019, Management Area: H, Working Group: South Central

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

c. Leks Checked

Year	Occupied	Checked	Percent Checked	Peak Males	Avg Males / Active Lek (2)
2010	265	222	84	4377	24.9
2011	262	206	79	3732	24.4
2012	273	234	86	3704	22.0
2013	278	253	91	3226	17.8
2014	281	276	98	3623	19.3
2015	282	259	92	5139	29.4
2016	286	264	92	6088	31.5
2017	286	257	90	4641	25.4
2018	285	266	93	4215	22.9
2019	279	258	92	3500	20.0

d. Lek Status

Year	Active	Inactive (3)	Unknown	Known Status	Percent Active	Percent Inactive
2010	181	13	28	194	93.3	6.7
2011	160	24	22	184	87.0	13.0
2012	177	32	25	209	84.7	15.3
2013	193	44	16	237	81.4	18.6
2014	198	71	7	269	73.6	26.4
2015	185	53	21	238	77.7	22.3
2016	198	53	13	251	78.9	21.1
2017	188	54	15	242	77.7	22.3
2018	192	53	21	245	78.4	21.6
2019	189	49	20	238	79.4	20.6

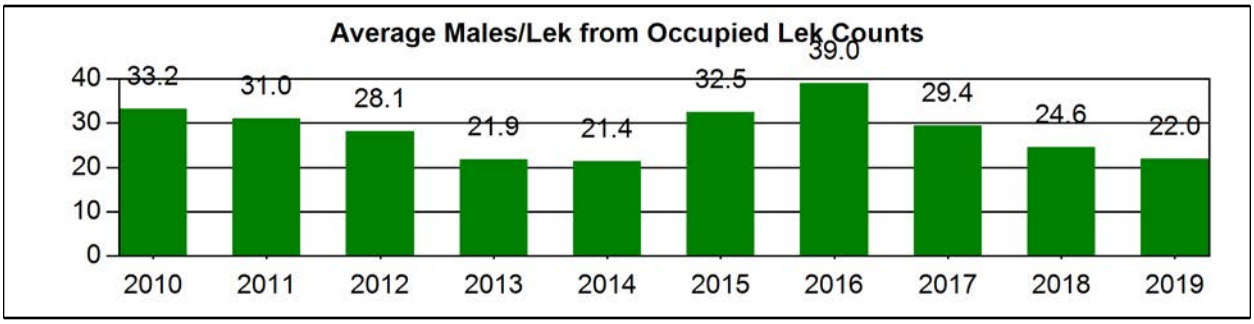
1) Occupied - Active during previous 10 years (see official definitions)

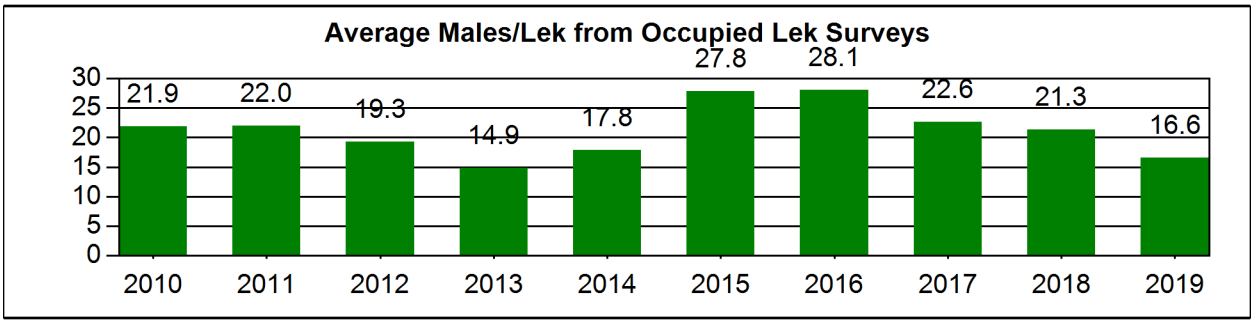
2) Avg Males/Active Lek - Includes only those leks where one or more strutting males were observed. Does not include "Active" leks where only sign was documented.

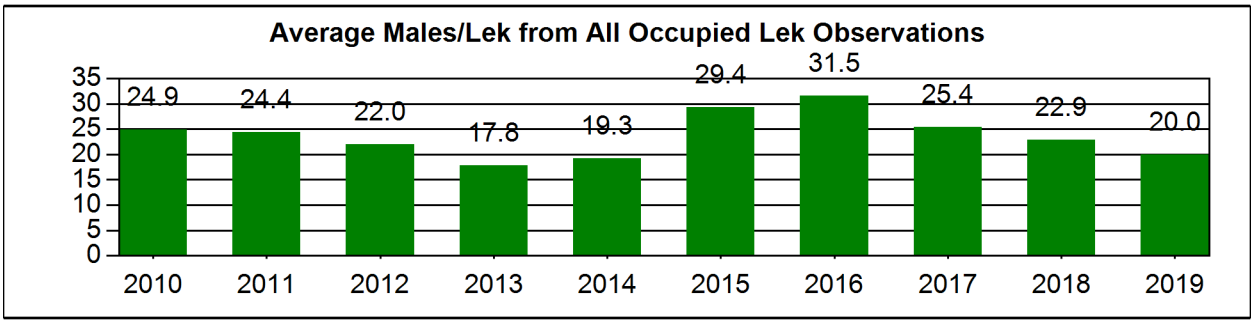
3) Inactive - Confirmed no birds/sign present (see official definitions)

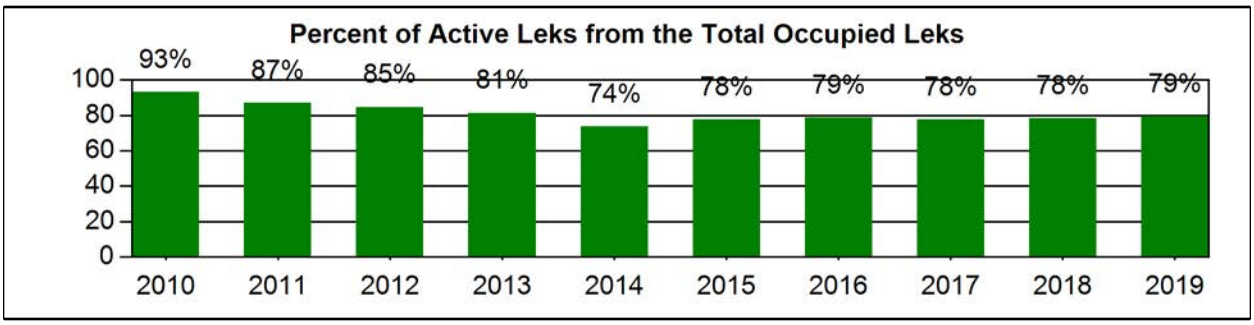
Sage Grouse Occupied Lek Attendance Summary

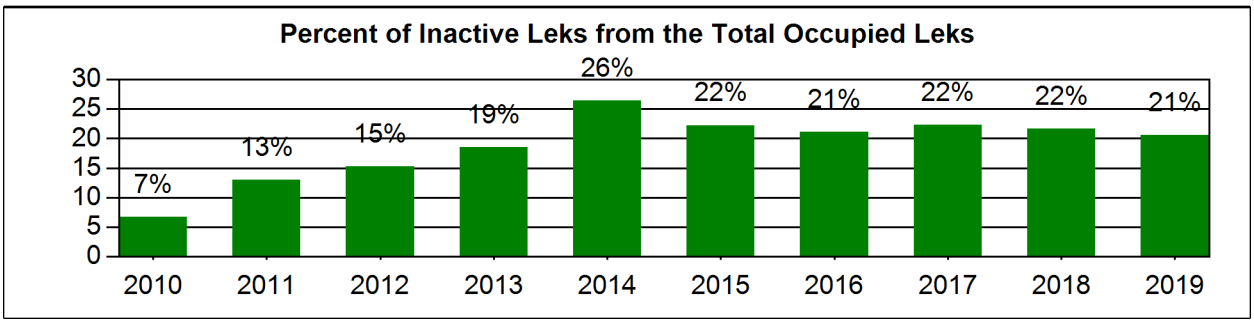
Year: 2010 - 2019, Management Area: H, Working Group: South Central











Sage Grouse Job Completion Report

Year: 2009 - 2018, Management Area: H, Working Group: South Central

3. Sage Grouse Hunting Seasons and Harvest Data

a. Season

Year	Season Start	Season End	Length	Bag/Possesion Limit
2009	Sep-19	Sep-30	12	2/4
2010	Sep-18	Sep-30	13	2/4
2011	Sep-17	Sep-30	14	2/4
2012	Sep-15	Sep-30	16	2/4
2013	Sep-21	Sep-30	10	2/4
2014	Sep-20	Sep-30	11	2/4
2015	Sep-19	Sep-30	12	2/4
2016	Sep-17	Sep-30	14	2/4
2017	Sep-16	Sep-30	15	2/4
2018	Sep-15	Sep-30	16	2/4

b. Harvest

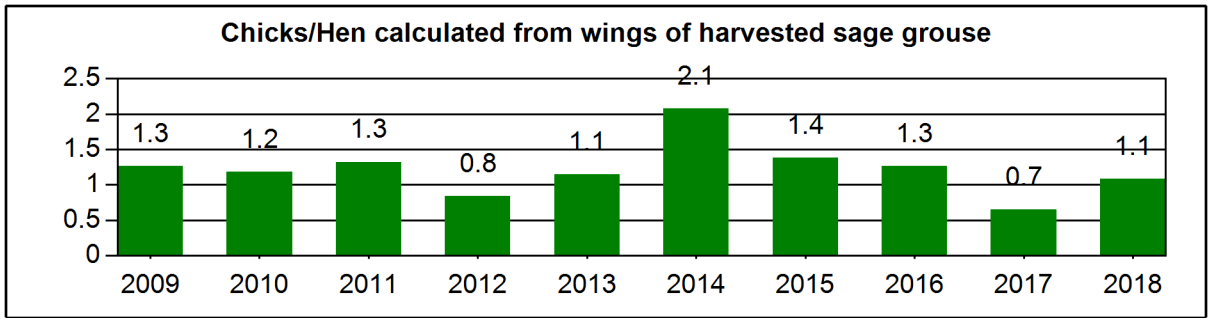
Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2009	1619	726	1474	1.1	2.2	2.0
2010	1126	487	1165	1.0	2.3	2.4
2011	1261	591	1483	0.9	2.1	2.5
2012	1194	636	1382	0.9	1.9	2.2
2013	624	437	928	0.7	1.4	2.1
2014	612	391	934	0.7	1.6	2.4
2015	776	457	963	0.8	1.7	2.1
2016	911	477	1162	0.8	1.9	2.4
2017	501	363	846	0.6	1.4	2.3
2018	903	500	1245	0.7	1.8	2.5
Avg	953	507	1,158	0.8	1.8	2.3

Sage Grouse Job Completion Report

Year: 2009 - 2018, Management Area: H, Working Group: South Central

4. Composition of Harvest by Wing Analysis

Year	Sample Size	Percent Adult		Percent Yearling		Percent Young		Chicks/ Hens
		Male	Female	Male	Female	Male	Female	
2009	282	15.2	23.8	8.5	9.9	15.6	27.0	1.3
2010	230	10.4	33.9	1.3	6.5	13.0	22.2	1.2
2011	271	11.8	29.2	3.0	7.4	20.7	27.7	1.3
2012	220	10.0	38.2	5.5	7.7	15.5	23.2	0.8
2013	107	14.0	36.4	1.9	1.9	15.9	27.1	1.1
2014	146	10.3	23.3	3.4	4.8	30.8	27.4	2.1
2015	192	10.4	30.7	2.6	5.7	24.5	26.0	1.4
2016	174	21.8	27.0	4.0	5.7	16.1	25.3	1.3
2017	123	13.8	39.8	5.7	8.9	16.3	15.4	0.7
2018	131	20.6	26.7	6.1	8.4	20.6	17.6	1.1



Lek Monitoring

For biological year 2018, 401 sage-grouse leks were known to occur in the South-Central Conservation Area (SCCA). In the SCCA, the majority of known leks (56%) occur on Bureau of Land Management (BLM) managed lands and 36% occur on private land. There are likely other occupied leks in the SCCA that have not yet been documented (Figure 1).

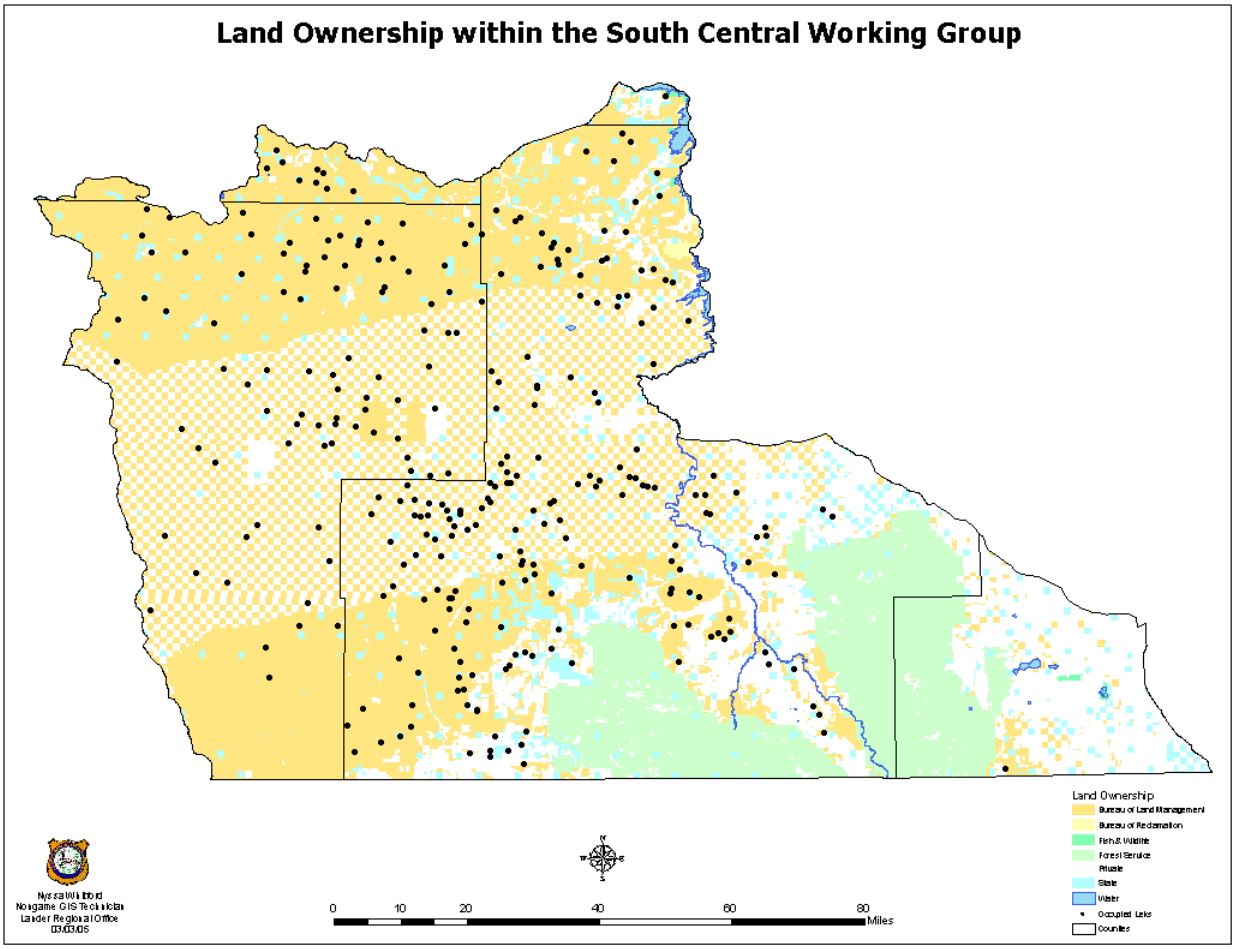


Figure 1. Landownership and sage-grouse lek locations within the SCCA, Wyoming.

Leks in the SCCA are monitored by Wyoming Game and Fish Department (WGFD), United States Forest Service (USFS) and BLM personnel, environmental consultants, and volunteers. Lek monitoring techniques are described in Christiansen (2012). During the 2019 lekking season, 258 leks were monitored. This represented checking 92% of the occupied status leks in the SCCA. This rate of effort was 1% less than in 2018; however it was 3% greater than the 10-year average (Table 1c).

A total of 131 leks were *counted* in the SCCA, resulting in an average of 22 males per lek. A total of 127 leks were *surveyed* resulting in an average of 16.6 males per lek. To evaluate long-term population trends, average lek *survey* and *count* data are combined, because the more stringent count protocol was not used during the late 1980s and early 1990s. Fortunately, long-term data sets from Wyoming and neighboring states indicate similar trends from both *counts*

and *surveys* (Fedy and Aldridge 2011). In 2019, the peak male lek attendance totaled 3,500 males in the SCCA. This was a 17% decrease from 2018. The average number of male sage-grouse on both *counted* and *surveyed* leks continued its downward trend from 22.9 in 2018 to 20 in 2019 indicating a downswing in the population. Figure 2 illustrates the trends in average peak males per lek for all sage-grouse conservation areas in Wyoming, as well as the statewide average. Sage-grouse populations in Wyoming cycle on approximately 6 to 8-year intervals (Row and Fedy 2017). During a downswing in the population, we would expect an increase in the number of inactive leks. However, the proportion of occupied leks which were considered inactive decreased slightly from 22% in 2018 to 21% in 2019. In 2019, the management status for 20 leks (8%) was unknown because they were not monitored (Table 1a-d).

The recent male per lek averages along with the observed chick per hen ratios in hunter submitted wings indicate that the sage-grouse population in the SCCA had been slightly decreasing during this reporting period.

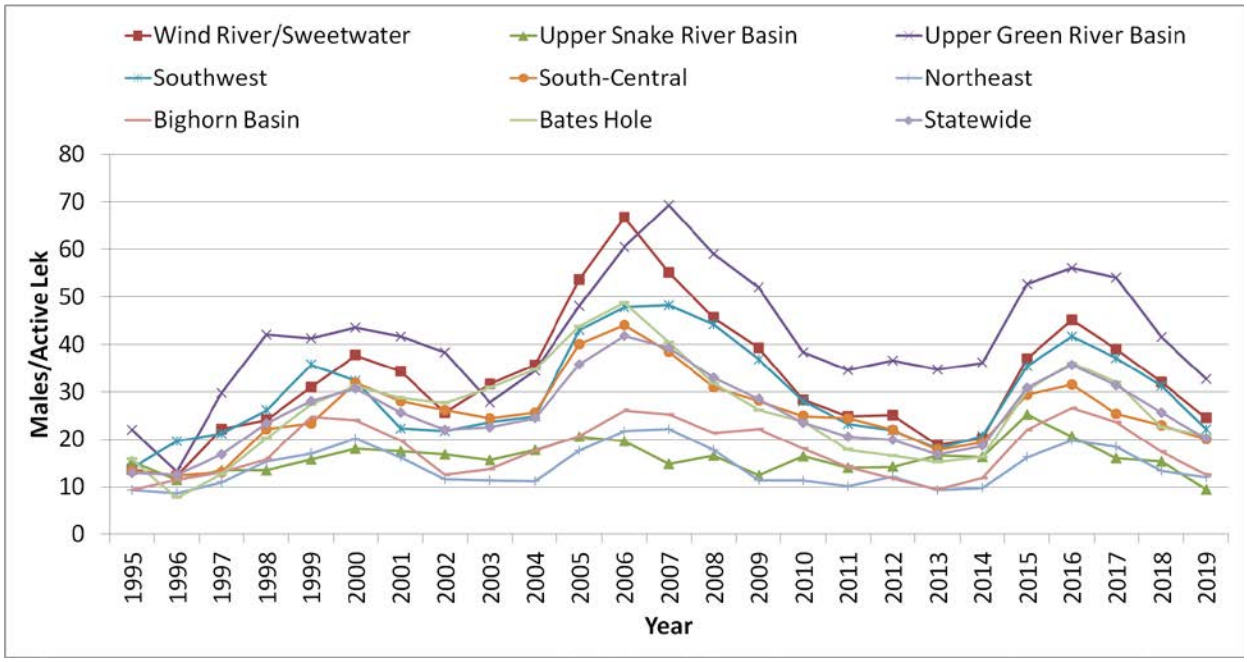


Figure 2. 1995-2019 Average peak male sage-grouse lek attendance, by Conservation Area and Statewide, Wyoming.

Harvest

The 2018 sage-grouse hunting season in the SCCA, was from 15 September to 30 September (16 days), and allowed for the harvest of 2 sage-grouse per day and 4 in possession (Table 3a). The 2018 upland harvest survey indicated 500 hunters spent 1,245 days to harvest 903 sage-grouse in the SCCA. This equals approximately 0.7 birds per day, 1.8 birds/hunter, and 2.5 days/hunter (Table 3b). Birds/hunter rates increased slightly from the 2017 hunting season indicating hunters were generally more successful. Compared to the 2017 season, when hunting regulations were similar with the exception of 1 less day in the 2017 season length; 2018 hunter numbers increased by 37%, the birds/day increased by 17%, and the days/hunter increased by 9%.

Generally, during the past 10 years, overall harvest appeared to be correlated to both hunter numbers and sage-grouse abundance.

Hunter-harvested sage-grouse wings have been collected annually and are used for estimating productivity. Wings were collected in barrels set out 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 per hen are calculated and used as a measure of productivity. While there are biases associated with the hunter selectivity of different age/sex groups of sage-grouse, trends still provide yearly comparisons of relative chick production. During the 2018 hunting season, WGFD collected 131 wings from wing barrels within the SCCA, which was 15% of the estimated harvest of 903 birds. This was a 6% increase in the total number of wings when compared to the 123 wings collected in 2017. Age and sex composition of the wings indicated the proportion of chicks per hen increased from 0.7 in 2017 to 1.1 in 2018 (Table 4). Statewide analyses of wing data from harvested sage-grouse have suggested chick per hen ratios of 1.4-1.7 typically results in relatively stable populations as determined by lek counts the following year. Given the ratio for chicks in the 2018 harvest, we believe we will see a slight decline in male lek attendance rates during the next few strutting seasons.

Habitat

- *Compiled by WGFD Terrestrial Habitat Biologist, Katie Cheesbrough*

Much of the sage-grouse habitat in the SCCA is comprised of a relatively intact sagebrush ecosystem, which is trending toward older age classes. The short-term condition of these sagebrush communities is primarily dependent on the type, amount, and timing of annual precipitation. Although mature sagebrush are important to sage-grouse for both forage and cover, especially in the winter, a monoculture of older and decadent stands may lead to lower nutrient content within this important forage source. Additionally, we continue to see the proliferation of cheatgrass throughout sagebrush communities within the SCCA, reducing native plant density and diversity as well as increasing the risk of large fires that have the potential to devastate sage-grouse habitats. Livestock grazing is a predominate use of sage-grouse habitat in the SCCA. In the first half of the 20th century, much of the sage-grouse habitat in the SCCA provided winter grazing for hundreds of thousands of both domestic sheep and cattle. In the later part of the last century, sheep numbers declined dramatically while cattle became the primary species of livestock using the SCCA. Improved grazing management on both public and private lands during the last few decades has generally led to improved habitat for sage-grouse and other sagebrush obligates. Feral horses continue inhabit the western and northern portions of the SCCA. Energy development and mineral extraction are secondary uses of sage-grouse habitat within the SCCA. A majority of the energy development is associated with producing natural gas from both deep gas and coalbed methane sources, with wind energy development becoming more common in the northern part of the SCCA. Energy development has directly and indirectly reduced the functionality of sage-grouse habitat in portions of the SCCA. Past and present uranium mining has also contributed to reducing sage-grouse habitat in the SCCA. The Interstate 80/UPRR transportation corridor bisects the SCCA east to west and is a major cause of habitat fragmentation. Large-scale wind farm developments have begun over the past few years in the northern part of the SCCA, introducing new challenges within sage-grouse habitat. Additionally,

continued urban/rural development within sagebrush communities continues to fragment sage-grouse habitat.

The 2018 growing season precipitation (April – July) within the SCCA was notably low, approaching levels as low as the 2012 drought year. Annual vegetation monitoring in the area showed low grass and forb production, correlating with the low growing season precipitation. Forbs are an extremely important part of the sage-grouse diet in the spring and throughout the summer, especially for juveniles. Although grasses don't make up a significant part of the sage-grouse diet, good grass production provides better hiding cover from predators. As such, low vegetation production in 2018 could have had some impacts to sage-grouse nutrition and survival. Additionally, south-central Wyoming experienced a cooler than average spring with late snowstorms and residual snowpack throughout May. The spring weather conditions could have altered the timing of peak lekking as well as lek attendance. In an effort to mitigate habitat issues related to cheatgrass in sage grouse habitats extensive large-scale, aerial herbicide treatments continue to be conducted throughout the SCCA. In the fall of 2018, over 5,350 acres of aerial cheatgrass herbicide treatments were completed.

Disease

There were no cases of West Nile Virus in sage-grouse, or other diseases detrimental to sage-grouse documented within the SCCA in biological year 2018.

Conservation Planning

The South Central Local Working Group (SCLWG) was established in September of 2004 and they completed their Sage-grouse Conservation Plan (Plan) in 2007. In 2014, the SCLWG adopted an addendum to their Plan which is available at https://wgfd.wyo.gov/Habitat/Sage-Grouse-Management/Sage-Grouse-Local-Working-Groups.This addendum documented conservation action such as research and habitat projects the SCLWG had supported since their Plan was completed, as well as how these projects addressed the goals and action items identified in the Plan.

The SCLWG held one meeting during this reporting period. During this meeting, the results of a recent Local Working Group Survey were presented and the SCLWG discussed the Wyoming Sage-grouse Executive Order 2015-4. During this reporting period, Governor Gordon requested public input on Executive Order 2015-4. Per this request, the SCLWG submitted comments.

In July 2019, the SCLWG received updates on the new Wyoming Executive Order 2019-3. The SCLWG also allocated FY 2020 funds provided by the Wyoming Sage-Grouse Conservation Fund. The SCLWG awarded a total of $57,452.86 to following conservation projects:

1. Response of greater sage-grouse to treatments in Wyoming big sagebrush
2. Comparison of avian and mammalian predators to sage-grouse core and non-core areas: assessing predator abundance and responses to anthropogenic features
3. Resource selection overlap between greater sage-grouse and co-occurring species
4. Free-roaming horse impacts on sage-grouse nest site selection and success
5. Coad Mountain spring development

Special Projects

The North Dakota Greater Sage-Grouse Translocation Project continued in biological year 2018. During the spring of 2019, researchers captured sage-grouse near Stewart Creek, in the northern portion of the SCLWG area and translocated them to southwest North Dakota. Capture and release techniques were modified from 2018 to 2019 with some success. Crews were able to capture and translocate 20 males, 10 brood hens with 40 chicks (age 7-28 days), and 6 non-brood hens. This translocation effort was done in an effort to supplement North Dakota's remnant sage-grouse population. Translocation success and the impacts to the Stewart Creek source population are being studied by Utah State University and U.S. Geological Survey researchers.

Management Recommendations for the SCCA

1. Continue to monitor a minimum of 80% of the occupied leks in the SCCA.
2. Update all lek observers on WGFD survey protocols, and familiarize them with standardized datasheets.
3. Expand lek searches to ensure all active leks within the SCCA have been identified.
4. Support WGFD and BLM efforts to address mitigation and reclamation issues.
5. Support research efforts to identify seasonal habitats, especially winter concentration habitat.
6. Coordinate with BLM and USFS to ensure development and habitat treatments in sage-grouse Core area comply with WY-EO-2019-3.
7. Continue to build partnerships with private landowners to maintain or improve sage-grouse habitat on private lands through mutually beneficial habitat projects.

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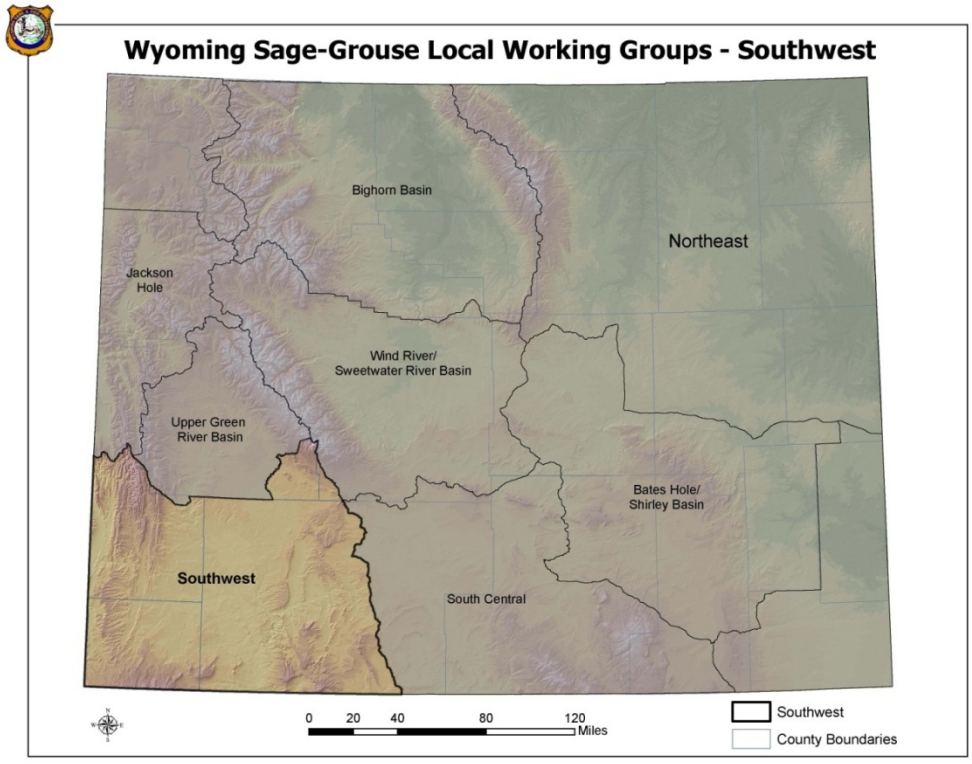
Southwest Conservation Area
Job Completion Report

Species: Greater Sage-grouse
Management Areas: G, Green River Region
Biological Year: June 1, 2018 – May 31, 2019
Prepared by: Patrick Burke, Green River Wildlife Biologist



Sage Grouse Lek Characteristics

Working Group: Southwest

Region	Number	Percent
Green River	401	88.3
Pinedale	53	11.7

Working Group	Number	Percent
Southwest	454	100.0

Classification	Number	Percent
Occupied	336	74.0
Undetermined	9	2.0
Unoccupied	109	24.0

BLM Office	Number	Percent
Kemmerer	199	43.8
Pinedale	14	3.1
Rawlins	4	0.9
Rock Springs	237	52.2

Biologist	Number	Percent
Green River	168	37.0
Mountain View	232	51.1
Pinedale	53	11.7
South Lander	1	0.2

Warden	Number	Percent
Cokeville	56	12.3
Evanston	36	7.9
Green River	75	16.5
Kemmerer	71	15.6
Mountain View	51	11.2
Rock Springs	112	24.7
South Pinedale	53	11.7

County	Number	Percent
Fremont	4	0.9
Lincoln	137	30.2
Sublette	34	7.5
Sweetwater	212	46.7
Uinta	67	14.8

Land Status	Number	Percent
BLM	313	68.9
BOR	15	3.3
National Park	2	0.4
Private	107	23.6
State	16	3.5
USFS	1	0.2

Management Area	Number	Percent
G	454	100.0

Lek Status	Number	Percent
Active	268	59.0
Inactive	98	21.6
Unknown	88	19.4

Sage Grouse Job Completion Report

Year: 2010 - 2019, Working Group: Southwest

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

a. Leks Counted

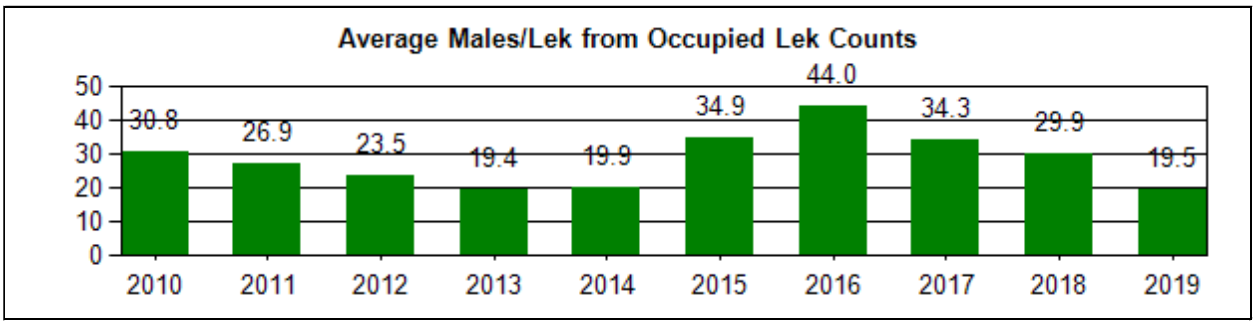
Year	Occupied	Counted	Percent Counted	Peak Males	Avg Males / Active Lek (2)
2010	288	77	27	2214	30.8
2011	297	73	25	1855	26.9
2012	303	81	27	1719	23.5
2013	310	116	37	1955	19.4
2014	312	96	31	1613	19.9
2015	318	70	22	2197	34.9
2016	327	94	29	3744	44.0
2017	336	97	29	2950	34.3
2018	341	103	30	2663	29.9
2019	340	86	25	1423	19.5

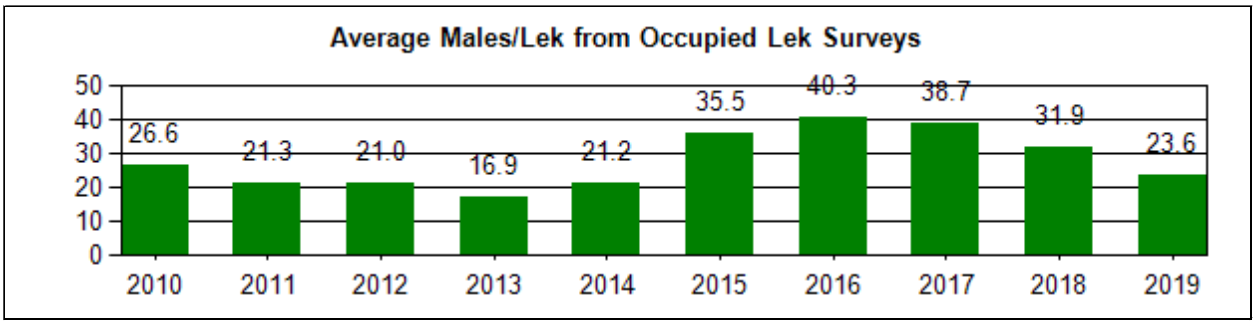
b. Leks Surveyed

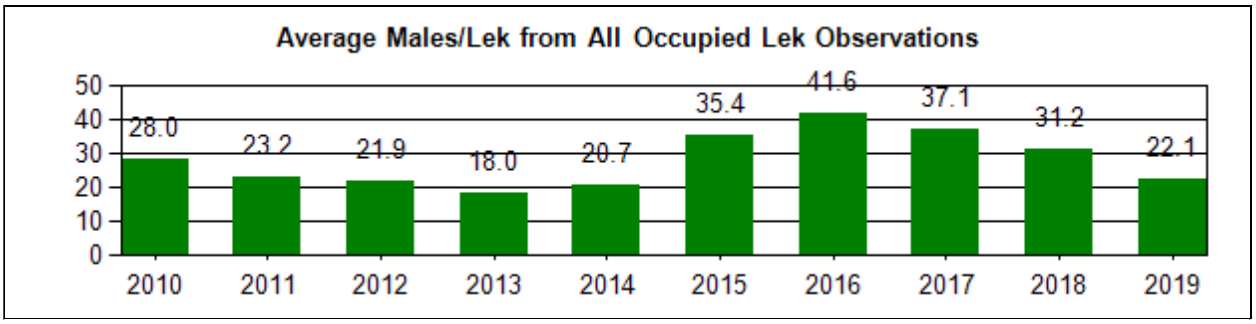
Year	Occupied	Surveyed	Percent Surveyed	Peak Males	Avg Males / Active Lek (2)
2010	288	183	64	3753	26.6
2011	297	165	56	2893	21.3
2012	303	183	60	2871	21.0
2013	310	177	57	2254	16.9
2014	312	191	61	3177	21.2
2015	318	224	70	6256	35.5
2016	327	213	65	6488	40.3
2017	336	204	61	5991	38.7
2018	341	212	62	5357	31.9
2019	340	202	59	3091	23.6

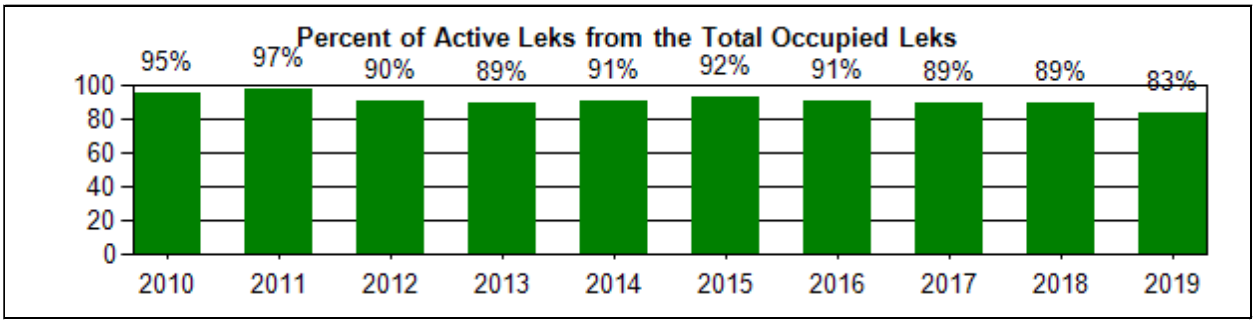
Sage Grouse Occupied Lek Attendance Summary

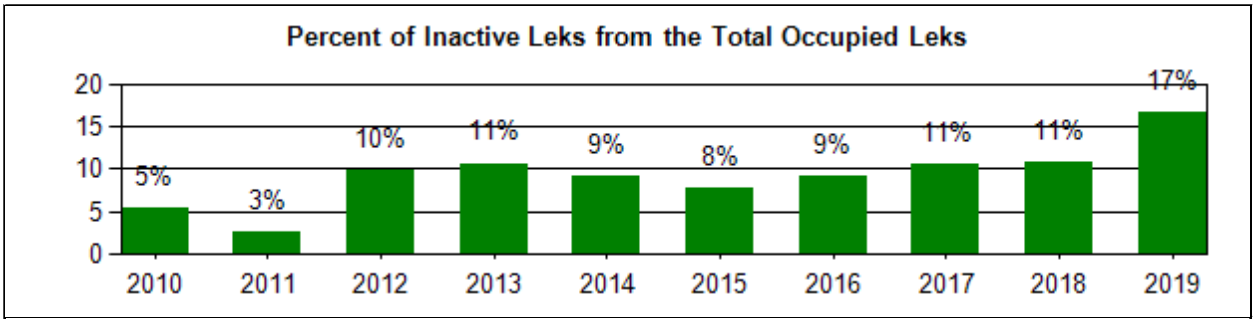
Year: 2010 - 2019, Working Group: Southwest











Sage Grouse Job Completion Report

Year: 2009 - 2019, Working Group: Southwest

3. Sage Grouse Hunting Seasons and Harvest Data

a. Season

Year	Season Start	Season End	Length	Bag/Possesion Limit
2009	Sep-19	Sep-30	12	2/4
2010	Sep-18	Sep-30	13	2/4
2011	Sep-17	Sep-30	14	2/4
2012	Sep-15	Sep-30	16	2/4
2013	Sep-21	Sep-30	10	2/4
2014	Sep-20	Sep-30	11	2/4
2015	Sep-19	Sep-30	12	2/4
2016	Sep-17	Sep-30	14	2/4
2017	Sep-16	Sep-30	15	2/4
2018	Sep-15	Sep-30	16	2/4

b. Harvest

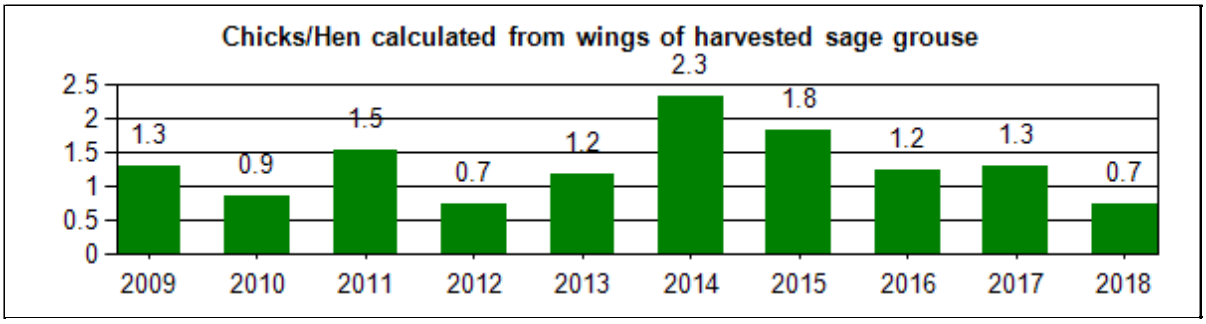
Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2009	4236	1645	4014	1.1	2.6	2.4
2010	4225	1788	4048	1.0	2.4	2.3
2011	3901	1709	4276	0.9	2.3	2.5
2012	3737	1775	4503	0.8	2.1	2.5
2013	2513	1307	3139	0.8	1.9	2.4
2014	2645	1165	2835	0.9	2.3	2.4
2015	4479	1586	4057	1.1	2.8	2.6
2016	4163	1672	4036	1.0	2.5	2.4
2017	3590	1421	3675	1.0	2.5	2.6
2018	3410	1630	3873	0.9	2.1	2.4
Avg	3,690	1,570	3,846	1.0	2.3	2.5

Sage Grouse Job Completion Report

Year: 2009 - 2018, Working Group: Southwest

4. Composition of Harvest by Wing Analysis

Year	Sample Size	Percent Adult		Percent Yearling		Percent Young		Chicks/ Hens
		Male	Female	Male	Female	Male	Female	
2009	887	11.7	30.0	4.4	6.7	20.0	27.3	1.3
2010	696	2.6	51.0	0.6	0.9	2.9	3.6	0.9
2011	998	6.1	31.9	2.9	4.3	23.9	30.9	1.5
2012	581	10.0	38.9	4.6	10.3	16.5	19.6	0.7
2013	390	9.2	38.5	1.5	2.3	20.5	27.9	1.2
2014	517	5.6	20.7	2.3	7.0	33.5	30.9	2.3
2015	860	13.5	25.1	3.1	4.3	27.4	26.5	1.8
2016	949	15.2	30.5	4.2	5.6	19.9	24.7	1.2
2017	813	9.5	31.0	2.8	7.0	22.6	27.1	1.3
2018	827	12.0	33.4	6.5	13.4	13.1	21.6	0.7



Lek Monitoring

A total of 340 occupied leks were known to exist in the SWSGCA during the 2019 lekking season. Of these 340 occupied leks, 288 of them were checked, with 86 of those checks being lek counts with three or more visits during the breeding season, with the remaining 202 checks consisting of lek surveys where less than three lek visits were made during the breeding season. In 2018, 89% of the known leks were checked at least once during the lekking season; in 2019, however, that percentage decreased to 85% of the known leks being checked. The lower visitation rate in 2019 was largely caused by the above average snow that the region received during the 2018-2019 winter. This increased snow pack resulted in many leks being inaccessible during the spring months because of persistent snow and muddy roads caused by melting snow.

Of the 454 known lek sites in the SWSGCA in 2019, 268 of them were documented as being active, 98 were classified as being inactive and 88 leks were of unknown or undetermined status. All lek monitoring data from 2019, along with data from the past ten years for comparison are summarized in Appendix B Tables 1 a-d and JCR Data Figures 2 a-e.

Because of the quantity of leks in the SWSGCA, data collection efforts have focused on lek surveys, which involved at least one visit to the lek during the breeding season over lek counts, which are more labor intensive and involve three or more visits during the breeding season. Fedy and Aldridge (2011) determined that population trends demonstrated by lek surveys are the same as those indicated by lek counts as long as the number of leks surveyed exceeds 50 leks in an area.

Since only "occupied" leks are being reported on Appendix B Tables 1 a-d, it is important to consider trends in the numbers of active versus inactive leks in addition to the average size of active leks. During a period of population decline, the size of active leks typically declines and the number of inactive leks increases. The converse is typically true of an increasing population. Therefore the magnitude of both increases and decreases is usually greater than what is indicated by the average lek size alone. The proportion of known status leks that were active in the SWSGCA has remained relatively steady over the 10-year reporting period varying from 89-97% active. The proportion active for the 2019 lekking season however, was below this range with only 83% of the checked leks being active. This lower proportion of leks being determined to be active can be attributed to the lower overall population of grouse in 2019 and also due to the fewer leks that were checked in 2019 due to the muddy conditions present throughout the lekking season.

Monitoring the total number of males on a lek is used as an index of trend, but these data should be viewed with caution for several reasons: 1) the survey effort and the number of leks surveyed/counted has varied over time, 2) it can be safely assumed that not all leks in the area have been located, 3) sage-grouse populations can exhibit cyclic patterns over approximately a decade long period, 4) the effects of un-located or un-monitored leks that have become inactive cannot be quantified or qualified, and 5) lek sites may shift over time. Both the number of leks and the number of males attending these leks must be quantified in order to estimate population trend.

The average number of males per active lek for all leks checked (both counted and surveyed) during the 2019 lekking season was 22.1 males per active lek. This is a 71% decrease from the 31.2 males per active lek observed in 2018, and a 47% decrease from the 41.6 males per active lek documented in 2016. The 2019 average number of males per active lek is also below the recent average of 28.5 males per active lek. The average number of males in attendance on the 102 count leks in 2019 was 19.5 males per lek. This number is the lowest number observed since 2013, when

the 19.4 males per count lek was observed, and is down significantly from the 44 males per count lek seen in 2016. For the 202 leks that were surveyed in 2019, the average lek had 23.6 males in attendance, which is above the recent average of 28.1, and down substantially from 2016's and 2017's observed values of 40.2 and 38.7 males per survey lek.

It is important to note that data collection efforts have increased considerably since the early 2000's. In 2000, only 63% of known occupied leks were checked, but in recent years, the number annually checked is usually above 90% of the known occupied leks. In addition, efforts by WGFD personnel, volunteers, and other government and private industry biologists have led to increased numbers of known leks.

Currently, no method exists to estimate total sage-grouse population size in a statistically significant way. However, the recent male per lek averages along with the observed chick per hen ratios in hunter submitted wings indicate that the sage-grouse population in southwest Wyoming had been slightly decreasing during this reporting period.

Harvest

The 2018 hunting season for sage-grouse in the SWSGCA ran from September 15 to September 30 and allowed for a daily take of 2 birds with a limit of 4 grouse in possession (Appendix B Table 2 a). The 2018 season was consistent with how the season has been run since 2002 when the season opening date was moved to the third Saturday in September and the daily bag limit was reduced to 2 birds and a possession limit of 4 birds. The sage-grouse season had historically 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 2009 through 2018 hunting seasons in this report. Note that for 2007-2009 the data for all birds harvested in Management Areas 4, 5, 6, and 7 were included in the SWSGCA report even though a portion of Area 7 was located in the UGRBSGCA (Figure 3). 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 SWSGCA report.

Based on harvest survey estimates, 1,630 hunters harvested 3,410 sage-grouse during the 2018 hunting season (Table 3b). This is down slightly from the 3,590 birds reported harvested in 2017, but is still higher than the estimated harvest s of 2013 and 2014, when 2,500 to 2,600 grouse were harvested. 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, weather conditions, and hunter participation levels over that period.

Wings are collected each hunting season via voluntary hunter submission to allow for the determination of the sex and age of harvested birds. Successful hunters submitted 827 grouse wings from the 2018 hunting season (Table 4). This represents just over 24% of the estimated

total harvest for 2018, which is slightly about the average submission rate of around 18%-19%, but it is down from the 2011 submission rate, when over one-quarter of the estimated harvest was submitted for age analysis.

The most important ratio obtained from the wing analysis is the chick to hen ratio; this ratio provides a general indication of chick recruitment. 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.

In general it appears that chick:hen ratios of about 1.3:1 to 1.7:1 result in relatively stable grouse populations, while chick:hen ratios of 1.8:1 or greater result in increasing grouse numbers and ratios below 1.2:1 result in subsequent declines. The chick:hen ratio as determined from hunter submitted wings for the 2018 hunting season was 0.7 chicks/hen (Table 4). This ratio suggests a slightly decreasing grouse population. This observed chick:hen ratio corresponds well with the decreased male lek attendance seen in the spring of 2019.

Weather

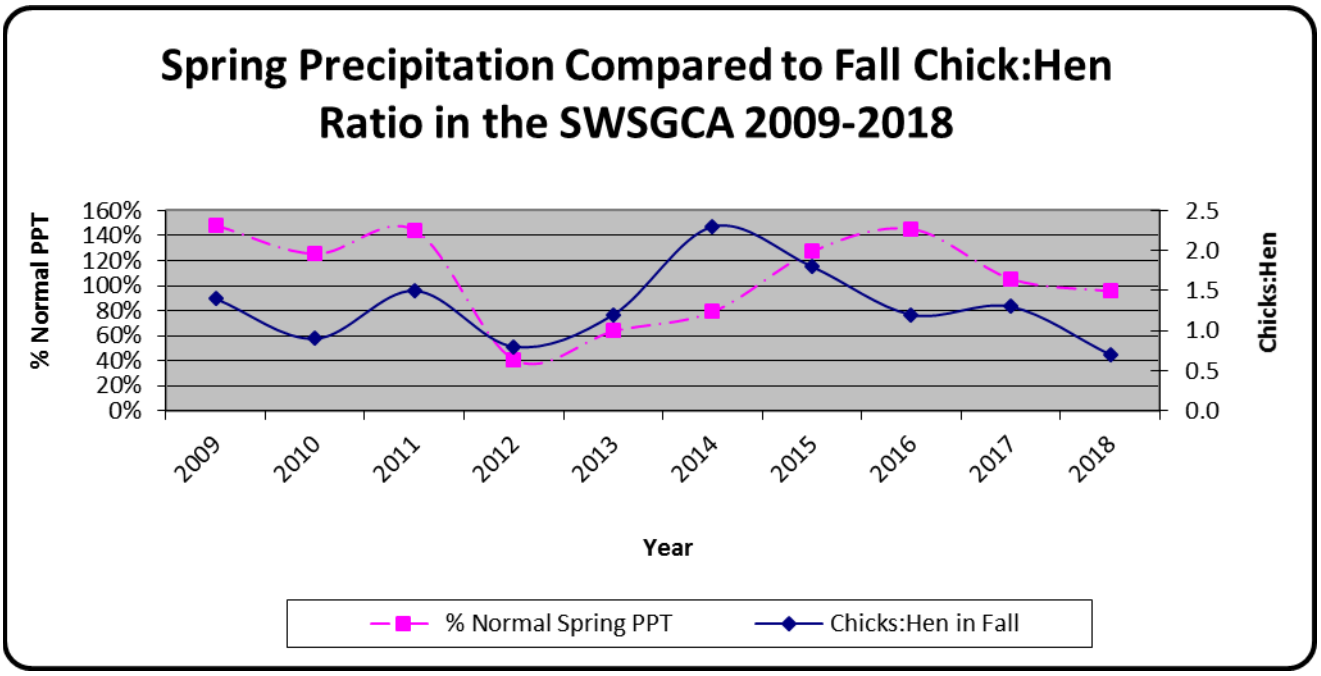
Spring habitat conditions are one of the most important factors in determining nesting success and chick survival for sage-grouse. Specifically, shrub height and cover, live and residual grass height and cover, and forb production, all have a large impact on sage-grouse nesting and brood rearing success. 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.

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 severe winters.

The spring (March-June) precipitation and fall chick:hen ratios (as determined by hunter submitted wings) are given in Table 5 and Figure 4. 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 also tend to be below average. However, periods of prolonged cold, wet weather may have adverse effects on hatching success, plant and insect phenology and production and chick survival.

Table 5. Spring precipitation compared to fall chick:hen ratios in the SWSGCA 2009-2018. 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
2009	148%	1.4
2010	126%	0.9
2011	144%	1.5
2012	41%	0.7
2013	64%	1.2
2014	79%	2.3
2015	128%	1.8
2016	145%	1.2
2017	105%	1.3
2018	96%	0.7



HABITAT AND SEASONAL RANGE MAPPING

While new leks are still being located in the SWSGCA, we believe that the majority of the currently occupied leks have been documented, however important other seasonal habitats such as winter concentration areas and especially nesting/early brood-rearing areas have not yet been adequately identified.

CONSERVATION PLANNING/IMPLEMENTATION

Since 2005, Local Working Groups have supported implementation of local sage-grouse conservation projects with funding appropriated from State of Wyoming General Fund as requested by the governor and approved by the legislature. In early 2017 funding of the sage-grouse program was transferred from the legislature back to the WGFD. A license fee increase was passed by the legislature to fund this change. See Table 2 for a list of the projects implemented in, or on behalf of, the SWSGCA during the reporting period.

Table 2. Projects funded in part by the SWSGLWG, 2018.

Project Name	Project Description	Partners
Free roaming horse impacts on sage-grouse nest site selection	One segment of a multi-year project exploring potential competition between feral horses and native wildlife and the impacts those horses have on the landscape. This project specifically looks at sage-grouse nest site selection in the face of large numbers of feral horses.	University of Wyoming, Jeff Beck, WGFD, BLM RSFO and BLM RFO, SWLWG and SCLWG, WWNRT
Resource selection overlap between sage grouse and co-occurring species	This project aims to address how resource selection of greater sage-grouse compares with three co-occurring species: feral horses, pronghorn, and Columbian sharp-tailed grouse in southcentral and southwestern Wyoming. This information will elucidate how these species partition resources and potential areas of concern for sage-grouse populations.	University of Wyoming, Jeff Beck, UW Ag Exp. Station, WDA, WGFD, BLM RSFO and BLM RFO, multiple LWGs including SWLWG and SCLWG
Response of SG to sagebrush treatments Phase IV	Continuing research to determine sage-grouse demographic and habitat use response to sagebrush treatments.	University of Wyoming, Kelly Ornith. Research Fund, BLM, WY Reclamation & Restoration Center, WWNRT, multiple LWGs
Habitat quality of core areas relative to avian and mammalian predators	Research to compare avian and mammalian predator abundance in and out of core areas. Map predator densities. Evaluate predator removal activities.	BHB LWG, BHSB LWG, SW LWG, Oregon State Univ.

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.

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RECOMMENDATIONS

1) Identify important seasonal habitats, especially brood rearing areas.

2) Continue to implement provisions of the Governor's executive order for sage-grouse core area management.

3) Continue implementation of the SWSGCA Conservation Plan.

4) Continue expanded lek searches to ensure that all active leks within the SWSGCA have been identified.

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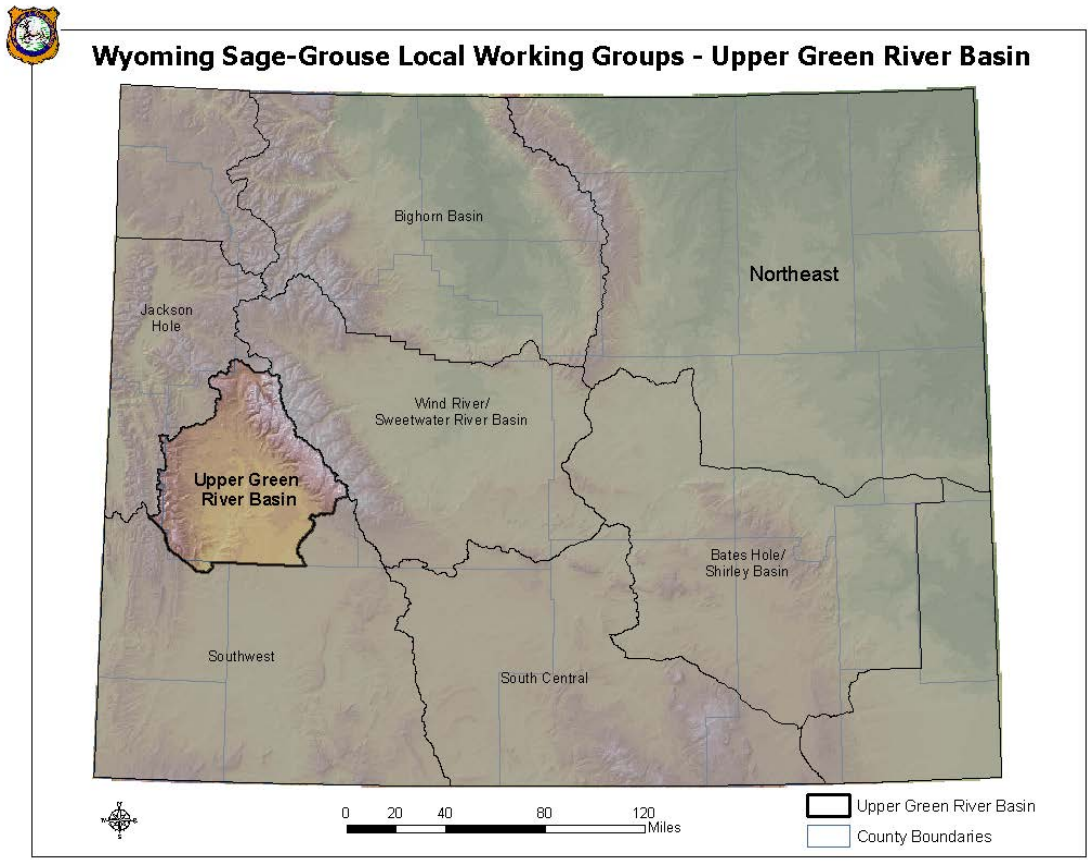
Upper Green River Basin Working Group Area
Job Completion Report

Species: Greater Sage-grouse
Conservation Plan Area: Upper Green River Basin
Period Covered: 6/1/2018 – 5/31/2019
Prepared by: Dean Clause, Pinedale Wildlife Biologist



Sage Grouse Lek Characteristics

Management Area: D, Working Group: Upper Green River

Region	Number	Percent
Pinedale	165	100.0

Working Group	Number	Percent
Upper Green River	165	100.0

Classification	Number	Percent
Occupied	137	83.0
Unoccupied	28	17.0

BLM Office	Number	Percent
Pinedale	152	92.1
Rock Springs	13	7.9

Biologist	Number	Percent
Pinedale	94	57.0
Thayne	71	43.0

Warden	Number	Percent
Big Piney	83	50.3
North Pinedale	24	14.5
South Pinedale	58	35.2

County	Number	Percent
Lincoln	2	1.2
Sublette	163	98.8

Land Status	Number	Percent
BLM	136	82.4
Private	19	11.5
State	10	6.1

Management Area	Number	Percent
D	165	100.0

Lek Status	Number	Percent
Active	111	67.3
Inactive	52	31.5
Unknown	2	1.2

Sage Grouse Job Completion Report

Year: 2010 - 2019, Management Area: D, Working Group: Upper Green River

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

a. Leks Counted

Year	Occupied	Counted	Percent Counted	Peak Males	Avg Males / Active Lek (2)
2010	127	92	72	3099	41.9
2011	131	100	76	2692	31.7
2012	132	117	89	3514	36.6
2013	130	116	89	3125	34.3
2014	130	111	85	3207	36.9
2015	134	109	81	4667	53.6
2016	138	117	85	5229	55.0
2017	137	97	71	4206	54.6
2018	140	116	83	4039	41.6
2019	137	69	50	2071	34.5

b. Leks Surveyed

Year	Occupied	Surveyed	Percent Surveyed	Peak Males	Avg Males / Active Lek (2)
2010	127	30	24	573	26.0
2011	131	25	19	943	47.2
2012	132	6	5	149	37.3
2013	130	8	6	280	40.0
2014	130	14	11	290	29.0
2015	134	22	16	923	48.6
2016	138	19	14	886	63.3
2017	137	30	22	1091	52.0
2018	140	18	13	484	40.3
2019	137	62	45	1489	30.4

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

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

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

Sage Grouse Job Completion Report

Year: 2010 - 2019, Management Area: D, Working Group: Upper Green River

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

c. Leks Checked

Year	Occupied	Checked	Percent Checked	Peak Males	Avg Males / Active Lek (2)
2010	127	122	96	3672	38.3
2011	131	125	95	3635	34.6
2012	132	123	93	3663	36.6
2013	130	124	95	3405	34.7
2014	130	125	96	3497	36.1
2015	134	131	98	5590	52.7
2016	138	136	99	6115	56.1
2017	137	127	93	5297	54.1
2018	140	134	96	4523	41.5
2019	137	131	96	3560	32.7

d. Lek Status

Year	Active	Inactive (3)	Unknown	Known Status	Percent Active	Percent Inactive
2010	95	27	0	122	77.9	22.1
2011	104	21	0	125	83.2	16.8
2012	101	22	0	123	82.1	17.9
2013	98	26	0	124	79.0	21.0
2014	98	27	0	125	78.4	21.6
2015	106	25	0	131	80.9	19.1
2016	109	24	3	133	82.0	18.0
2017	98	29	0	127	77.2	22.8
2018	109	24	1	133	82.0	18.0
2019	109	22	0	131	83.2	16.8

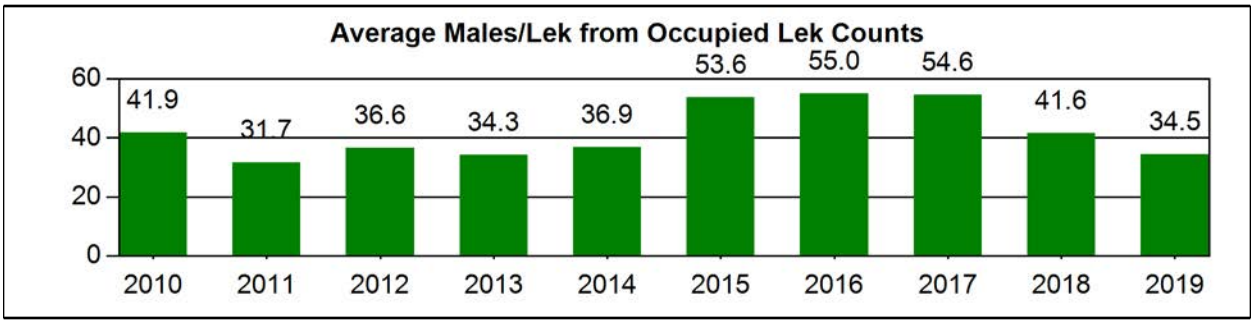
1) Occupied - Active during previous 10 years (see official definitions)

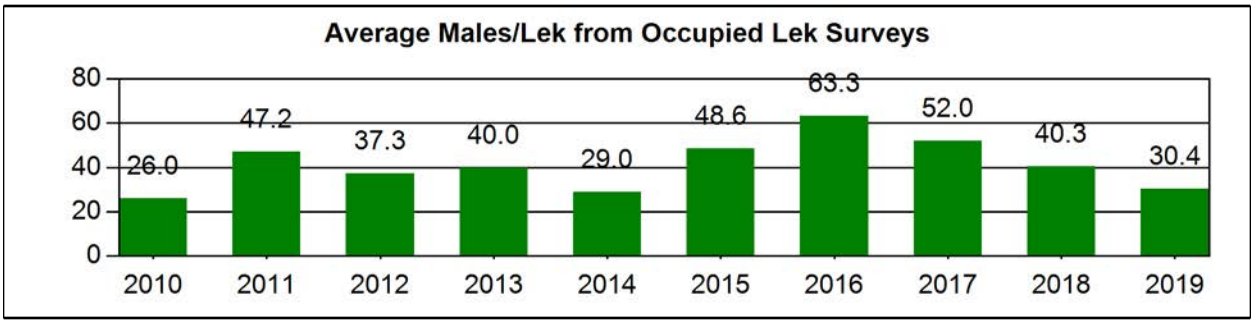
2) Avg Males/Active Lek - Includes only those leks where one or more strutting males were observed. Does not include "Active" leks where only sign was documented.

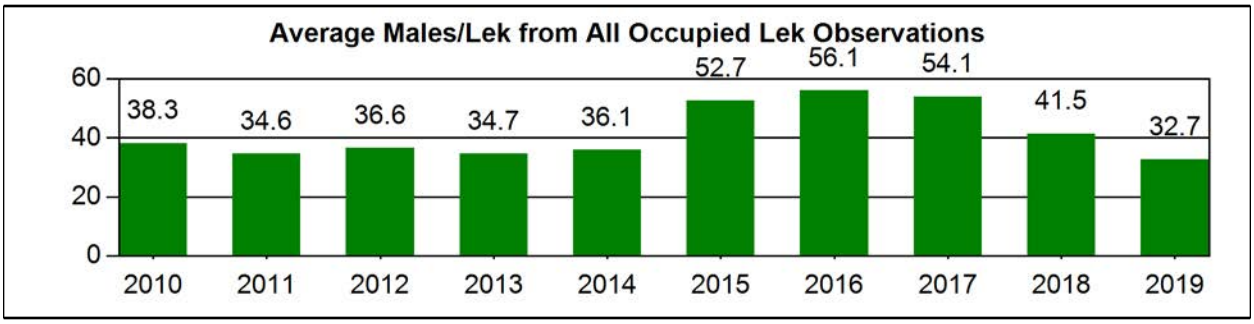
3) Inactive - Confirmed no birds/sign present (see official definitions)

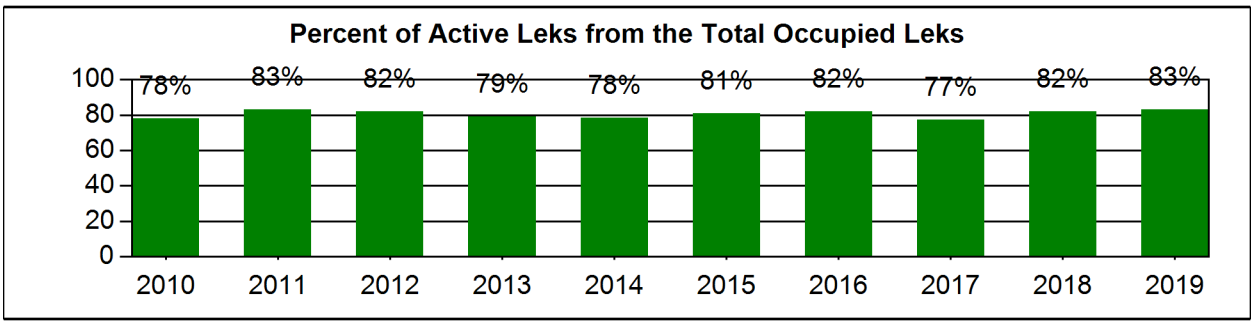
Sage Grouse Occupied Lek Attendance Summary

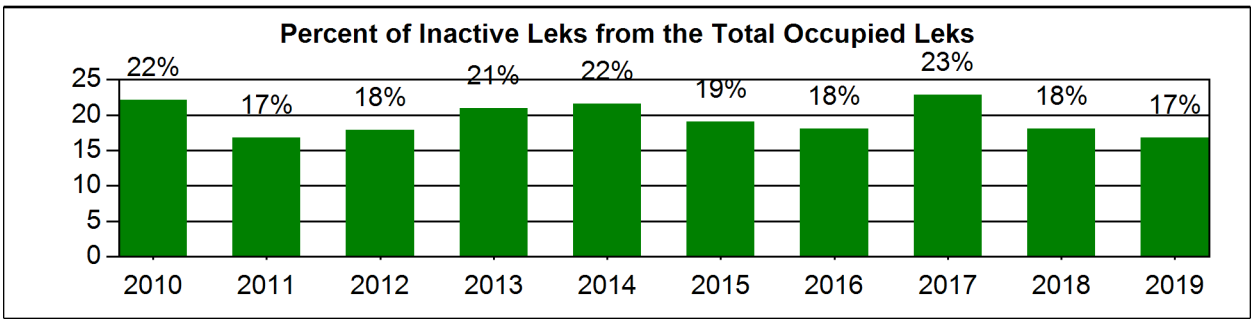
Year: 2010 - 2019, Management Area: D, Working Group: Upper Green River











Sage Grouse Job Completion Report

Year: 2009 - 2018, Management Area: D, Working Group: Upper Green River

3. Sage Grouse Hunting Seasons and Harvest Data

a. Season

Year	Season Start	Season End	Length	Bag/Possesion Limit
2009	Sep-19	Sep-30	12	2/4
2010	Sep-18	Sep-30	13	2/4
2011	Sep-17	Sep-30	14	2/4
2012	Sep-15	Sep-30	16	2/4
2013	Sep-21	Sep-30	10	2/4
2014	Sep-20	Sep-30	11	2/4
2015	Sep-19	Sep-30	12	2/4
2016	Sep-17	Sep-30	14	2/4
2017	Sep-16	Sep-30	15	2/4
2018	Sep-15	Sep-30	16	2/4

b. Harvest

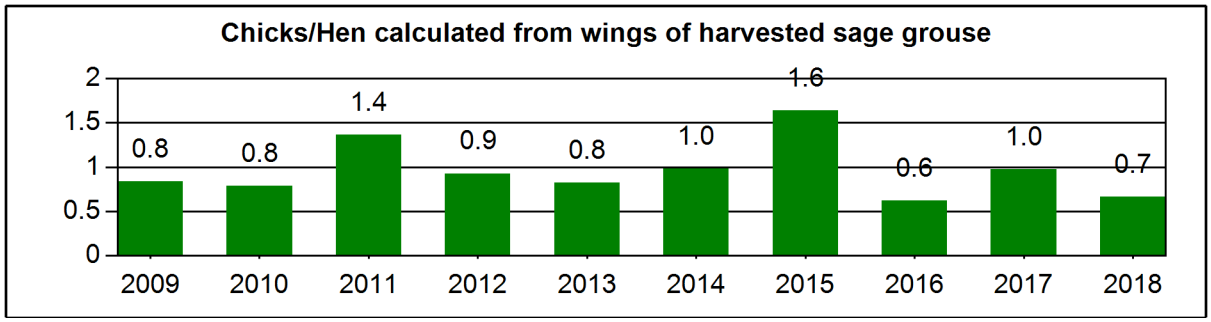
Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2009	1203	460	1177	1.0	2.6	2.6
2010	1510	526	1497	1.0	2.9	2.8
2011	1720	565	1605	1.1	3.0	2.8
2012	1320	476	1296	1.0	2.8	2.7
2013	628	387	848	0.7	1.6	2.2
2014	1056	406	1266	0.8	2.6	3.1
2015	1205	500	1129	1.1	2.4	2.3
2016	1990	706	2012	1.0	2.8	2.8
2017	988	402	921	1.1	2.5	2.3
2018	2161	853	2632	0.8	2.5	3.1
Avg	1,378	528	1,438	1.0	2.6	2.7

Sage Grouse Job Completion Report

Year: 2009 - 2018, Management Area: D, Working Group: Upper Green River

4. Composition of Harvest by Wing Analysis

Year	Sample Size	Percent Adult		Percent Yearling		Percent Young		Chicks/ Hens
		Male	Female	Male	Female	Male	Female	
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
2011	547	8.6	32.5	4.0	4.4	24.1	26.3	1.4
2012	544	12.1	34.2	3.5	9.6	17.1	23.5	0.9
2013	372	12.1	40.9	3.2	5.6	17.2	21.0	0.8
2014	337	13.4	33.8	3.0	8.3	18.1	23.4	1.0
2015	482	12.4	27.0	2.1	5.4	24.7	28.4	1.6
2016	450	17.6	43.1	3.1	5.8	12.4	18.0	0.6
2017	573	15.0	35.1	3.3	6.3	18.8	21.5	1.0
2018	466	11.8	38.8	5.8	10.7	11.8	21.0	0.7



Lek Monitoring

A total of 165 leks are currently documented in the Upper Green River Basin Working Group Area (UGRBWGA). These leks are classified as follows; 137 occupied, 28 unoccupied, and 0 undetermined. During 2019, a total of 131 occupied leks (96%) were checked (survey or count). Lek monitoring efforts in 2019 resulted in the proportion of counts (50%) and surveys (45%) being similar, although past emphasis has been on counts. The reduction in count (increase in survey) leks during 2019 was due to limited access due to persistent snow during the month of April. Compared to 2018, the proportion of overall leks monitored in 2019 was similar. Results from the counts and surveys showed that 83% of the leks were active and 17% were inactive. The average number of males/lek for all active leks decreased to 33 in 2019, compared to the past three years of 42 in 2018, 54 in 2017, and 56 in 2016. This results in a 21% decrease compared to 2018 and a 40% decrease since 2017 (Figure 1).

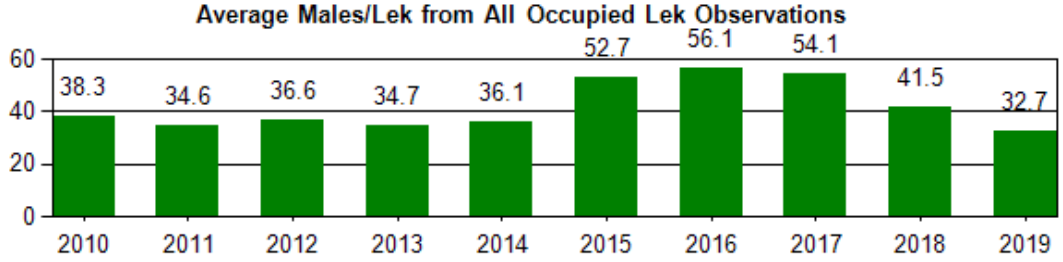


Figure 1. Average Peak Male Sage-grouse Lek Attendance 20010-2019, UGRBWG Area.

The highest documented average peak male attendance occurred in 2007 at 69 for this UGRBWGA. Since 2007, the observed average peak males has declined through 2010, stabilized from 2011-2014, and increased in 2015, stabilized in 2016-2017, and declined in 2018-2019 (Figure 3). The 2019 male lek attendance is 52% lower compared to the peak in 2007 using all occupied leks within the UGRBWGA. This trend is likely a combination of the cyclic nature of sage-grouse populations (Fedy and Doherty 2010) and drought combined with documented influences from habitat fragmentation in the Upper Green River Basin. Caution is warranted when analyzing long-range data sets (20+ years) within the UGRBWG area as the number of known (documented) leks have more than doubled during the past 17 years. Since many of these newly documented leks probably existed but were not monitored, there is some speculation in regards to what the average number of males/lek actually was prior to the mid 1990's.

The proportion of leks checked that are confirmed "active" has stayed relatively stable during the past 10 years, ranging from 77% to 83%. 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 (64 new leks since 2004) mathematically negating the downward trend in the proportion of active leks in the UGRBWGA.

Peak male lek attendance from 1997-2008, using only leks known in 1997, reveals a trend similar to all known leks within the UGRBWGA (Figures 2 & 3). Since 1997, the discovery and monitoring of leks has more than doubled, explaining the variation in the

average number peak males between the two data trends (known leks from 1997 verses all known leks).

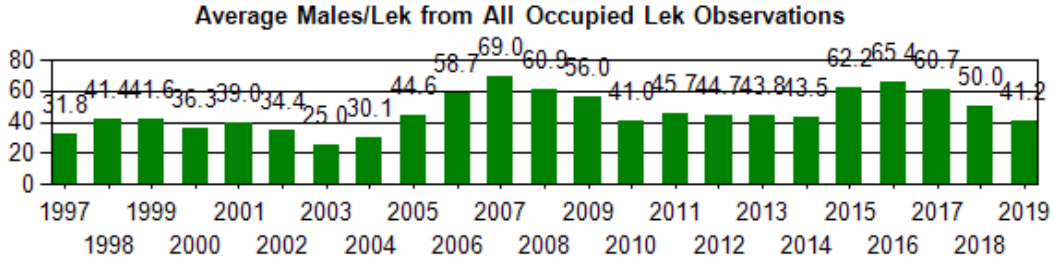


Figure 2. Average Peak Male Sage-grouse Lek Attendance 1997-2019 using only leks known in 1997, UGRBWG Area.

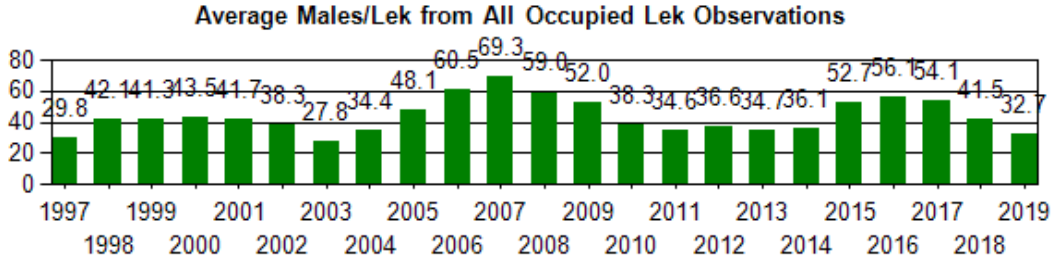


Figure 3. Average Peak Male Sage-grouse Lek Attendance 1997-2019 using all known leks, UGRBWG Area.

An analysis to assess natural gas development impacts to sage grouse leks in the Pinedale area shows lower male attendance, reduced occupancy and reduced activity on those leks within or near gas field development. The most recent analysis can be found in the 2017 (6/1/2017-5/31/2018) UGRBWGA Job Completion Report found on the WGFD website at https://wgfd.wyo.gov/ , with an updated analysis reported in the 2019 JCR.

Harvest

The 2018 sage-grouse season was September 15 through September 30, a 16-day hunting season, similar seasons since 2004. Hunting seasons since 2002 have allowed the season to remain open through two consecutive weekends. From 1995 – 2001 hunting seasons were shortened to a 15-16 day season that typically opened during the third week of September and closed in early October. Prior to 1995, the sage-grouse seasons opened on September 1 with a 30 day season. Seasons have been shortened with later opening dates to increase survival of successful nesting hens (as they are usually more dispersed later in the fall) and to reduce overall harvest.

Bag limits from 2003 to 2018 have been 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, where SGMA D covers all of the UGRBWGA and has been reported that way since 2010.

The 2018 harvest survey estimated that 853 hunters bagged 2161 sage grouse and spent 2632 days hunting, a significant increase from 2017 and the highest during the last 10-year period. The average number of birds per day was 0.8, the average number of birds per hunter was 2.5, and the number of days spent hunting per hunter was 3.1 during 2018. The increased hunter participation in 2018 can't be fully explained, except for the longer season length and favorable weather. Harvest rates (# birds/day, # birds/hunter, and # days/hunter) have remained somewhat similar since 2010, with the exception of lower harvest rates during 2013 (Figure 4). From 1995 to 2002, overall harvest and harvest rates significantly declined following altered seasons (shortened and moved to a later date). Since 2010, hunter participation has varied from 387 to 853 hunters per year.

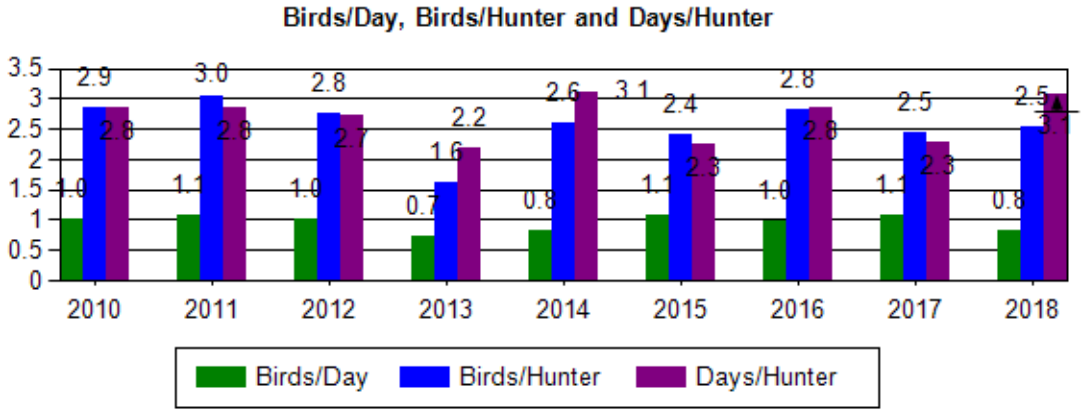


Figure 4. Sage grouse harvest rates 2010-2018 in SGMA D.

Wing Collections

Eighteen sage-grouse wing barrels were distributed throughout Sublette County in 2018 within SGMA D. 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. The wings are used to determine age and sex based on molting patterns and feather characteristics.

A total of 466 sage-grouse wings were collected from barrels in the UGRBWGA during 2018, lower than 573 in 2017, and similar to the wings collected during 2015 and 2016. The number of wings collected during the past 10-year period ranged from 337 to 573. Of the 466 wings collected in 2018, 33% were juvenile birds and 50% were adult and yearling hens. The overall composition of wings in 2018 indicated a ratio of 0.7 chicks/hen (adult and yearling females), which results in lower lek counts the following spring. The 2016 wing collections showed a 0.6 chicks/hen ratio, representing the lowest production during the past 10-year period. Conversely, wing collections during 2015 showed 1.6 chicks/hen, resulting in the highest production during the past 10-year period (Figure 5). The combination of low chick production during the past three years explains the decline (-41%) in the 2019 spring lek counts. This chick/hen ratio derived from wing collections has been a relatively good indicator to predict future population trends, as male lek attendance trends have broadly correlated with chick production in the UGRBWGA.

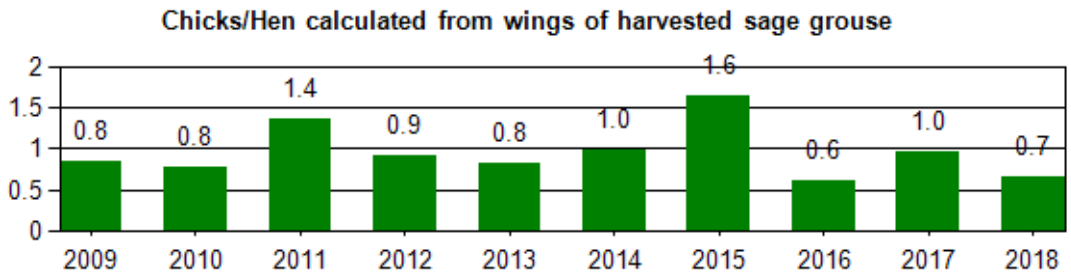


Figure 5. Sage grouse chick/hen ratios derived from wing collections 2009-2018, UGRBWGA.

Winter Distribution Surveys

No specific winter sage grouse surveys were conducted during the 2017-2018 winter within the UGRBWG Area. Winter surveys were initially conducted in 2004 and continued through 2013 within portions of the Upper Green River Basin. This winter data has been used to develop winter concentrations area maps (first map developed in 2008). Additional analysis methods such as Resource Selection Function (RSF) models have recently been utilized with winter survey data to help refine previously identified winter concentration areas (WCA). Although, WCA have been identified throughout the UGRBWG Area, the Sage Grouse Implementation Team has only recognized one area located in the Alkali Draw & Alkali Creek Area as of 2019. Efforts to re-delineate WCA's throughout the UGRBWGA are planned for completion in 2020.

Sage-grouse Research Projects

From 1998-2009 there were several research projects initiated and completed that have provided information on sage-grouse demographics and effects of natural gas development on sage-grouse populations. See UGRBWGA 2010 JCR for a summary of past sage-grouse research in the Pinedale area.

Significance of Geophagy:

There is an on-going study (initiated in 2013) looking into the significance of geophagy by sage grouse within the UGRBWGA. Sage-grouse geophagy, or intentional ingestion of soil, was documented in Sublette County Wyoming during the winter of 2012 – 2013. While it is well-known for a variety of other birds and mammals, it represents a behavior that has not been described for sage-grouse. The goal of this project is to assess the importance of "soil-eating" areas in describing winter habitat selection by sage-grouse. Currently, within the Upper Green River Basin researchers have identified 24 confirmed locations of geophagy behavior. An additional 20+ potential locations have also been identified. Past collaborators on the project have been the BLM, Teton Raptor Center, Wyoming Wildlife Consultants, and Sublette County Conservation District. Soil has been collected and tested at each confirmed location and compared to soil at random locations in order to identify the potential target mineral or compound responsible for the behavior. Soil tests indicate higher sodium, pH, and clay content at the documented geophagy sites.

A Utah State University graduate student is currently assessing habitat selection for wintering sage-grouse in the presence of geophagy sites. This resource selection analysis will not only help determine how geophagy sites influence winter habitat selection, but also help predict areas of importance to wintering sage-grouse in these areas. A second graduate student from Utah State University is continuing research and data collection efforts for this geophagy project specifically to evaluate how geophagy behavior may influence reproduction during the breeding season.

Ecology of Greater Sage-grouse in Alkali Creek and the Upper Green River Basin:
There are additional questions that would aid managers about the ecology of sage-grouse in the new 140,000 acre Normally Pressured Lance (NPL) Gas Field with a potential for up to 3,500 wells. Although there are large winter flocks and documentation of sage-grouse movement to the NPL in winter, it is unknown what proportion of birds survive while using the area. It is possible to have a great deal of human use or development of an area, without any impacts to survival. Instead, animals can be displaced or avoid an area, which might not result in any population-level impacts, but would reduce the carrying capacity. However, if survival is compromised, it becomes necessary to understand the timing and causes of bird mortality. Therefore, it is necessary to assess survival rates of sage-grouse in the region to better understand the utility of the area in sage-grouse conservation. In addition to the importance of movements, resource selection, and survival, it has been documented that sage-grouse in the area are geophagic. If geophagy plays an important role in winter resource selection, resulting in high use of the NPL site during winter, we might be missing a key parameter in RSF models and WCA delineations on the site, because we have not considered geophagy. Last, we know very little about the mobility of these flocks, their fidelity to certain areas, and the stability of group membership within Alkali Creek and Alkali Draw. The intensive aerial flights that were conducted on the site capture sage-grouse distributions in late January and February but key areas during November, December and March (i.e., current timing restriction for the WCA are in effect from November 15 to March 15), could go unknown if we rely solely on flight data. Because delineation of a WCA requires 50 birds, it becomes important to understand how flock numbers change over time.

Collectively, these issues require a comprehensive research project which will provide information to help manage sage-grouse populations in the NPL region. Specifically, this study will provide movements, resource selection, survival, and sites selected by sage-grouse for geophagic behavior. Because these questions require fine-scale observations of sage-grouse, global positioning systems transmitters combined with solar-powered Argos platform transmitter terminals (GPS-PTTs) are being used which have been shown to effectively monitor activities of sage-grouse in other parts of Wyoming (J. Millspaugh, unpublished data). Our study is focused within the Alkali Creek and Alkali Draw regions of the NPL for 3 years (initiated in 2019).

Sage-Grouse Working Group
The UGRBWG 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 UGRBWG 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. The Upper Green River Basin Sage-Grouse Conservation Plan was finalized in May of 2007 and can be found on the WGFD website (https://wgfd.wyo.gov/Habitat/Sage-Grouse-Management). This plan identified past, proposed, and ongoing projects; recommended management activities; funding sources; and other relevant sage-grouse information within the UGRBWGA intended to maintain and/or increase sage-grouse populations. The Working Group completed an addendum to this 2007 plan (Upper Green River Basin Sage-Grouse Conservation Plan Addendum – 2014) that provides updated information on activities, projects, and management strategies within the UGRBWGA. Appropriation of State monies approved for sage grouse projects during past years have been allocated to the UGRBWG for local conservation measures that benefit sage grouse. Raven control, water windmill to solar pump conversion, and cheatgrass inventory/control projects continue to account for the majority of allocated funds granted to the UGRBWG in recent years.

Management Summary

Data collected and reported in this 2018 Sage-Grouse Job Completion Report (June 2018 thru May 2019) gives insight to population trends. Analysis of lek trend data indicates that the sage-grouse populations steadily increased from 2003 to 2007, dropped slightly in 2008, continued to decline through 2011, stabilized through 2014, increased significantly in 2015, followed by a relatively stable population in 2016 and 2017, and population decline in 2018 and 2019. Lek trend data suggest grouse populations were at the lowest level in 2003 and highest level in 2007.

Lek monitoring in the UGRBWGA showed a 146% increase in the peak number of males per lek from 2003 to 2007 as males increased from 28 males/lek to 69 males/lek. This trend reversed after 2007, as the number of males/lek declined by 48% dropping to 36 males/lek by spring of 2014. During 2015, lek counts showed a 47% (53 males/lek) increase followed by an 8% increase in 2016, 4% decrease in 2017, 23% decrease in 2018, and 21% decrease in 2019. Sage-grouse leks within developing gas fields continue to show declines and lek abandonment regardless of lek trends outside of gas development, indicating negative impacts to sage grouse in and near natural gas fields. Existing leks within non-core habitats and within gas development fields will be subject to further impacts.

Sage-grouse hunting season dates, season length, and bag limits have remained similar since 2002, running from mid to late September for 9-15 days with a daily bag limit of 2 birds and a possession limit of 4 birds. Although season length and bag limits have remained similar since 2002, overall harvest and hunter participation has varied somewhat, while harvest rates (# birds taken/day, #birds taken/hunter, and # days/hunter) have remained similar on most years. With grouse numbers steadily increasing from 2003-2007, declining from 2007-2014, increasing in 2015-2016, and decreasing in 2017-2018, the progression of hunter participation was expected to show similar trends.

Variation in hunter participation can be affected by hunting season structure, weather conditions (especially during the current short seasons), and hunter perceptions of sage-grouse populations.

Wing collection from barrels (drop locations) continues to provide good sample sizes to determine overall chick survival trends within the UGRBWGA. During 2008-2018 wing collections ranged from 22% to 58% of the reported harvest. The sample size of 466 wings in 2018 accounted for 22% of the reported harvest, the lowest proportion in the last 10-years. These annual wing samples can vary significantly based on weather conditions affecting hunter participation, especially during the weekend days of hunting season. Overall, some correlation exists between trends in wing sample sizes and harvest, and provides managers the most reliable data for determining annual reproductive rates and population trends in the UGRBWGA.

Trends in chicks/hen derived from wing collections continue to show a correlation with following year lek trends. An increase (or decrease) in the number of chicks/hen in the harvest typically results in similar trends documented on leks the following year(s). In general, a chick/hen ratio below 1.1 has shown declines in overall male lek attendance the following spring, 1.1 to 1.3 chicks/hen has shown stable attendance, and a chick/hen ratio greater than 1.3 has shown increases in lek attendance in the UGRBWGA. During the past 5 years (2014-2018) the chicks/hen ratio has varied from 0.6 to 1.6 and averaging 1.0 chicks/hen.

Above normal precipitation during 2004 and 2005 during key periods (specifically in the spring and early summer) contributed to increased sage-grouse numbers due to enhanced production and juvenile survival in the Upper Green River Basin. Declining chick survival was documented in 2006 and 2007 caused by spring and summer drought conditions in the Upper Green River Basin. Male sage-grouse lek numbers declined from 2007-2011 and remained stable from 2012-2014. Good to above average spring precipitation during 2008-2011 led to good herbaceous production, which should have helped turn around the recent declining trends in the UGRBWGA. It appears the cold temperatures during the spring of 2009 and 2010 impacted reproduction resulting in further declines in lek numbers in 2010. Spring moisture in 2011 resulted in very good habitat production, and most likely contributing to the slight increase in bird numbers documented during the spring of 2012. Drought conditions in 2012 and 2013 most likely attributed to poor chick survival as spring temperatures were near normal, resulting in little change on spring lek counts in 2014. In 2014, good forage production was the result of increased precipitation during the fall of 2013 and spring of 2014 which likely contributed to increased male lek counts in 2015. Although the winter of 2014-15 was mild with low precipitation, the spring of 2015 had above average precipitation, primarily attributed to a very wet May, apparently resulting in very good chick production. The 2015-2016 winter and 2016 spring conditions were very similar to the previous year with dry winter and wet spring conditions, but resulted in poor chick production and similar lek counts. The 2016-17 winter conditions were severe with heavy snow loads and cold temperatures followed by a dry spring, yet lek counts in 2017 were similar to those recorded in 2016. The 2017-18 winter was mild with low snow accumulations and

above average temperatures followed by a relatively wet spring, and a decline in 2018 lek counts. The 2018-19 winter resulted in late persistent snow and cold temperatures through the spring of 2019, and a decline in 2019 lek counts. The predictability of factors that determine nest success and chick survival remains complex and is likely more dynamic than just climate conditions such as precipitation and temperature trends.

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 localized populations. Lek monitoring data has shown lower male attendance and in several cases total abandonment of leks within and adjacent to developing gas fields. Sage-grouse studies and research in the UGRBWGA has also documented impacts to grouse from gas development. Direct, indirect, and cumulative impacts to sage-grouse from gas and residential development will continue to challenge managers to maintain current grouse numbers.

Recommendations

1. Continue to monitor sage-grouse leks and look for new and previously undocumented ones.
2. Continue to monitor and provide input on natural gas development/sage-grouse projects being conducted.
3. Continue to place wing barrels in enough locations to obtain an adequate and representative sample to derive sex/age and harvest trend information.
4. Continue existing efforts and encourage new efforts to document and identify important sage-grouse areas (breeding, brood rearing, and winter).
5. Continue to work with GIS personnel and land managers to create and update seasonal range maps (breeding, summer/fall, and winter) to aid land managers in protecting and maintaining important sage-grouse habitats. Delineation of winter concentration areas will be a priority.
6. Continue to identify needed sage-grouse research, data collection efforts, project proposals, development mitigation, and funding.
7. Implement proposals and management recommendations identified in the Upper Green River Basin Sage-Grouse Working Group Conservation Plan and Plan Addendum where possible.

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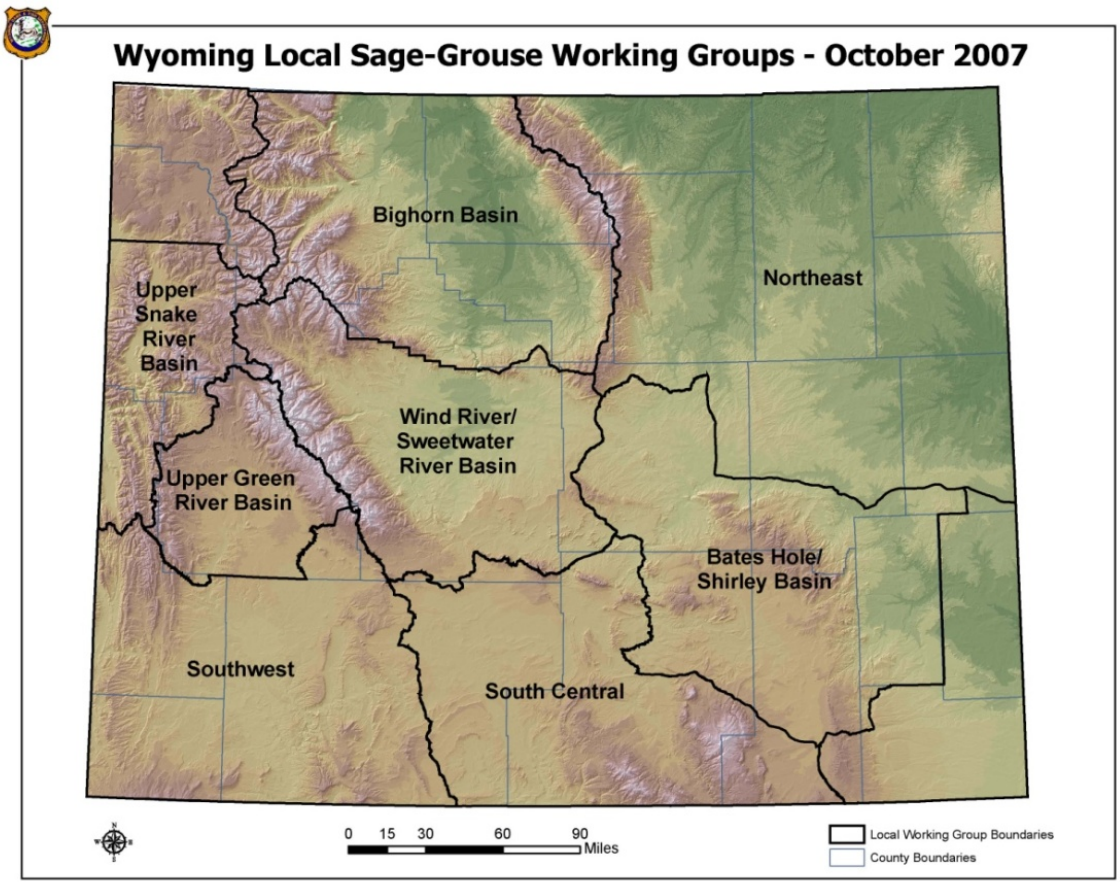
Upper Snake River Basin Conservation Area
Job Completion Report

Species: Greater Sage-Grouse
Period Covered: June 1, 2018 – May 31, 2019
Management Areas: A; Upper Snake River Basin
Prepared by: Alyson Courtemanch, North Jackson Wildlife Biologist



Sage Grouse Lek Characteristics

Management Area: A

Region	Number	Percent
Jackson	17	89.5
Pinedale	2	10.5

Working Group	Number	Percent
Upper Snake River Basin	19	100.0

Classification	Number	Percent
Occupied	15	78.9
Undetermined	1	5.3
Unoccupied	3	15.8

BLM Office	Number	Percent
Pinedale	19	100.0

Biologist	Number	Percent
Jackson	17	89.5
Thayne	2	10.5

Warden	Number	Percent
Big Piney	2	10.5
North Jackson	15	78.9
South Jackson	2	10.5

County	Number	Percent
Sublette	2	10.5
Teton	17	89.5

Land Status	Number	Percent
National Park	12	63.2
USFS	4	21.1
USFWS	3	15.8

Management Area	Number	Percent
A	19	100.0

Lek Status	Number	Percent
Active	8	42.1
Inactive	10	52.6
Unknown	1	5.3

Year: 2010 - 2019, Management Area: A

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

a. Leks Counted

Year	Occupied	Counted	Percent Counted	Peak Males	Avg Males / Active Lek (2)
2010	14	14	100	164	16.4
2011	14	14	100	112	14.0
2012	16	15	94	142	14.2
2013	16	13	81	149	16.6
2014	16	13	81	163	16.3
2015	16	14	88	227	25.2
2016	15	15	100	227	20.6
2017	15	15	100	176	16.0
2018	15	15	100	108	10.8
2019	15	15	100	62	5.6

b. Leks Surveyed

Year	Occupied	Surveyed	Percent Surveyed	Peak Males	Avg Males / Active Lek (2)
2010	14	0	0		#Error
2011	14	0	0		#Error
2012	16	0	0		#Error
2013	16	0	0		#Error
2014	16	0	0		#Error
2015	16	0	0		#Error
2016	15	0	0		#Error
2017	15	0	0		#Error
2018	15	0	0		#Error
2019	15	0	0		#Error

c. Leks Checked

Year	Occupied	Checked	Percent Checked	Peak Males	Avg Males / Active Lek (2)
2010	14	14	100	164	16.4
2011	14	14	100	112	14.0
2012	16	15	94	142	14.2
2013	16	13	81	149	16.6
2014	16	13	81	163	16.3
2015	16	14	88	227	25.2
2016	15	15	100	227	20.6
2017	15	15	100	176	16.0
2018	15	15	100	108	10.8
2019	15	15	100	62	5.6

d. Lek Status

Year	Active	Inactive (3)	Unknown	Known Status	Percent Active	Percent Inactive
2010	10	3	1	13	76.9	23.1
2011	8	3	3	11	72.7	27.3
2012	11	3	1	14	78.6	21.4
2013	9	4	0	13	69.2	30.8
2014	10	3	0	13	76.9	23.1
2015	9	5	0	14	64.3	35.7
2016	11	4	0	15	73.3	26.7
2017	11	4	0	15	73.3	26.7
2018	11	4	0	15	73.3	26.7
2019	11	4	0	15	73.3	26.7

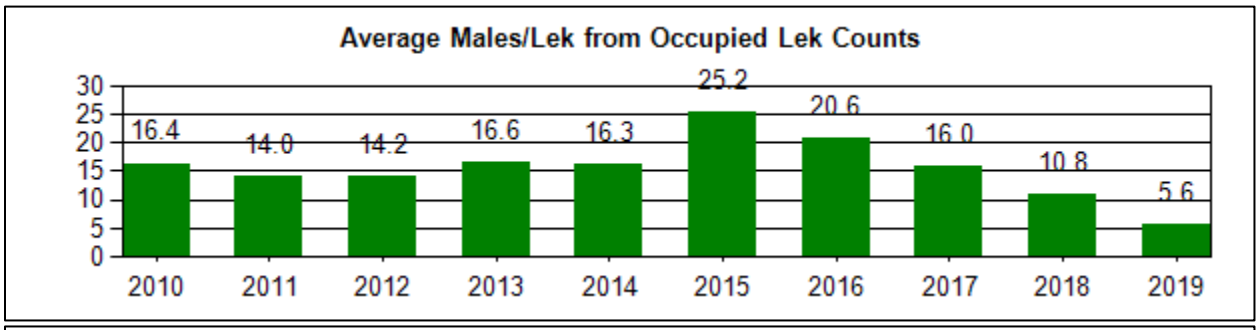
1) Occupied - Active during previous 10 years (see official definitions)

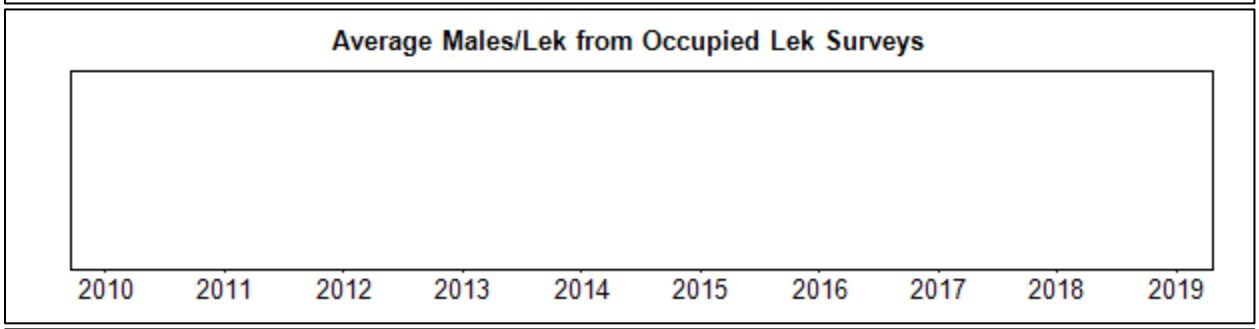
2) Avg Males/Active Lek - Includes only those leks where one or more strutting males were observed. Does not include "Active" leks where only sign was documented.

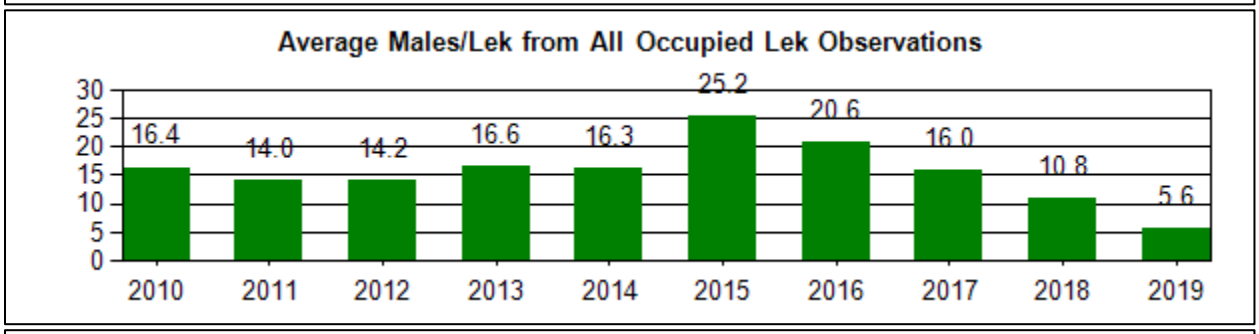
3) Inactive - Confirmed no birds/sign present (see official definitions)

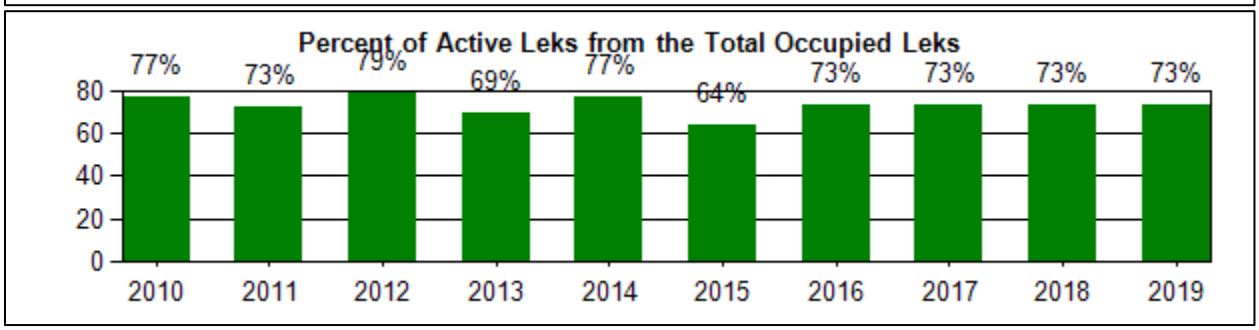
Sage Grouse Occupied Lek Attendance Summary

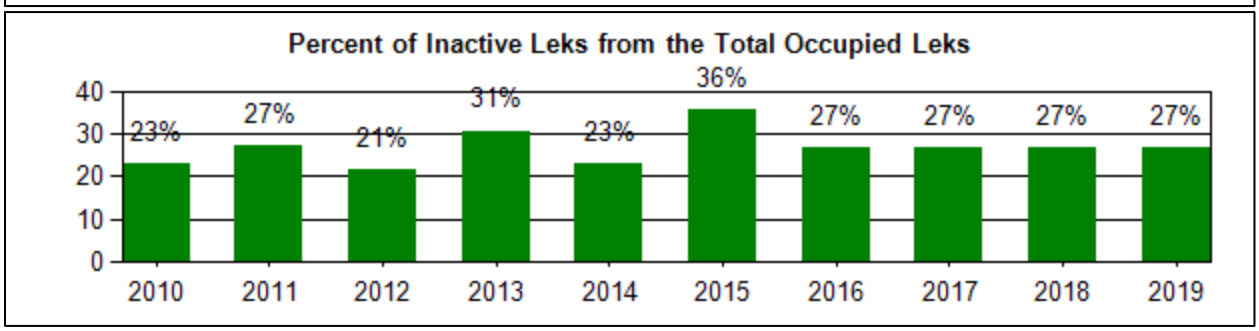
Year: 2010 - 2019, Management Area: A











Lek Monitoring

Sage-grouse data collection within the Upper Snake River Basin Conservation Area (USRBCA) focuses on lek surveys. Prior to 1994, relatively few leks were monitored and since 2000, efforts have been made to increase data collection on leks and standardize data collection methods. Starting in 2005, lek counts in GTNP, and to some extent on the NER, were coordinated to occur on the same days when it was logistically possible. This presumes that all leks in Jackson Hole constitute a sub-population and the leks in the Gros Ventre drainage constitute a second sub-population. No marked birds from the Gros Ventre leks have appeared on the Jackson Hole leks (Holloran and Anderson 2004, Bryan Bedrosian *pers. comm.*) and there is no evidence of genetic flow from the Gros Ventre to Jackson Hole (Schulwitz et al. 2014).

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 USRBCA are summarized in Table 1 from 1990 through 2019. There are a total of 19 leks in the USRBCA: 15 occupied (11 of these were active this year) and 4 unoccupied (Table 1). Unoccupied leks have not had birds observed for at least 10 years; these include 3 Bar H Road, Antelope Flats, McBride, and Beacon leks. The Beacon lek switched to unoccupied in 2016 since no birds were observed since 2006. In recent years the Simpson lek, formerly called Poverty Flats lek on the NER was considered to be unoccupied but 3 males were sighted there in 2012. The occupied leks that were inactive this year include Airport Pit, Bark Corral East, Dry Cottonwood, and Simpson.

There is some movement of males between leks, particularly from the North Gap lek on the NER to leks in GTNP and between leks in the lower valley with leks in the upper valley as the spring progresses and snow melt occurs. 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.

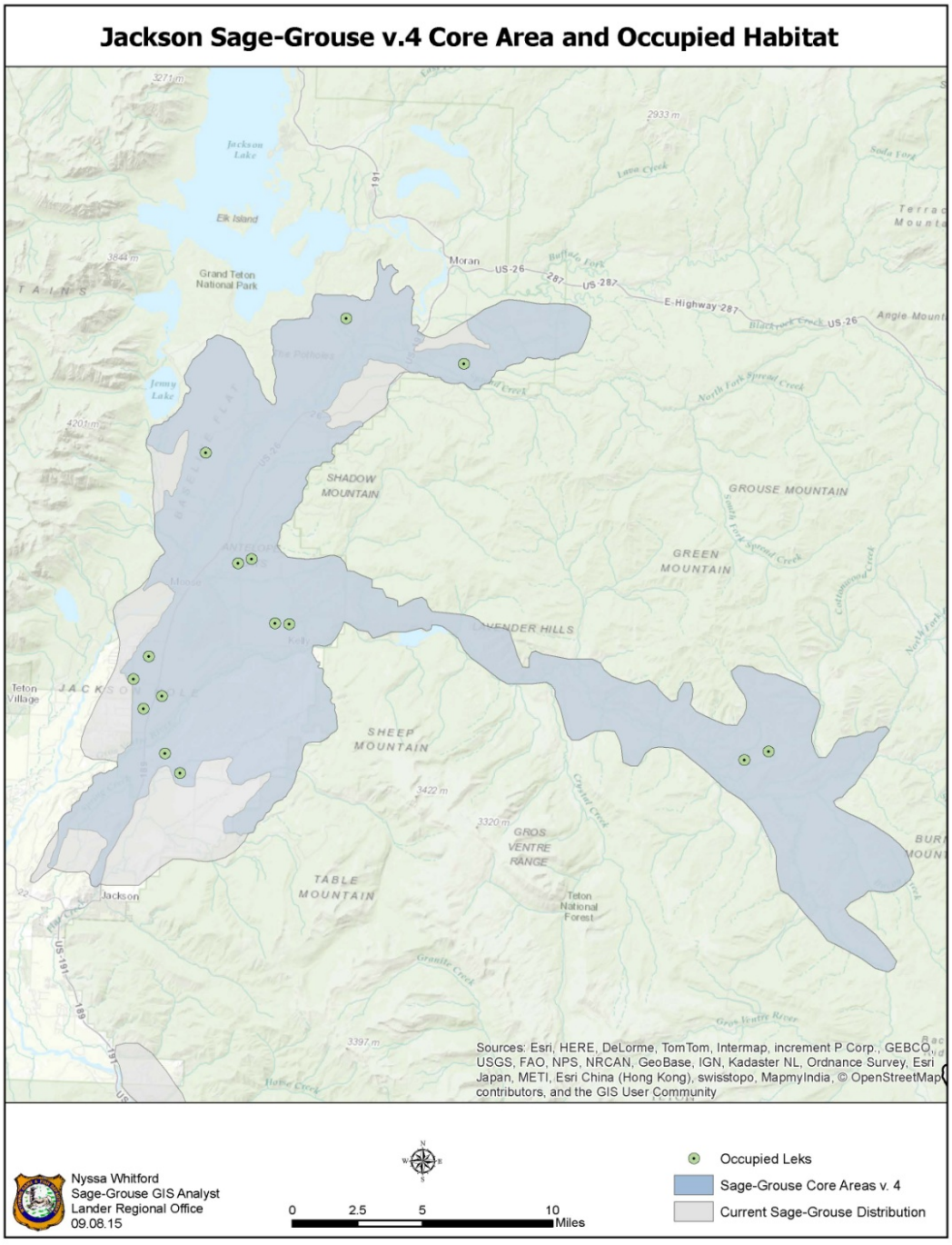


Figure 1. Sage-grouse core area, occupied habitat, and occupied leks in the Upper Snake River Basin Area (does not show Clark's Draw and Ollie's Draw leks).

Table 1. Maximum male counts at sage-grouse leks in the Upper Snake River Basin Conservation Area, 1990-2019. Blank cells denote years when the lek was inactive or it was not checked.

Year	3 Bar H Road	Airport	Airport Pit	Antelope Flats	Bark Corral East	Bark Corral West	Beacon	Breakneck Flats	Clark Draw	Dry Cottonwood	McBride	Moulton East	Moulton West	NER-North Gap	NER-Simpson	Ollie's Draw	RKO	Spread Creek	Timbered Island	Average # males/active lek
1990		52		10	8						10	49	63	22						30.6
1991		63		10	16						15	26	48	29						29.6
1992		51		8	16						12	58	37	21						29.0
1993		37		5	8		21				16	23	24	9	54					21.9
1994											27	50		7						28.0
1995		18		4	10		15				6	59	4	6						15.3
1996		18		2	8		8				4	32	1	19						11.5
1997		15			1		1				6		48	10						13.5
1998		14									4	29		7						13.5
1999		17										21		9						15.7
2000		18						21				28		5						18.0
2001		15						19				30		6						17.5
2002		19					24	9				28		4						16.8
2003		25						7				35		3					8	15.6
2004		17			2			14				54		4					15	17.7
2005		17						16		6		49		18					17	20.5
2006		23	6				4	21		9		44		30					20	19.6
2007		23			1			30		4	1	41		9				4	20	14.8
2008		16			2	8		22		13		38		23			12	5	26	16.5
2009		10	2		5			21		1		33		11			15	4	22	12.4
2010		10			24			24	13	4		40		13			13	5	18	16.4
2011		11				10		5	13			27		21			10	15		14.0
2012		17			3			14	14			44	14	18	3		8		7	14.2
2013		17						14	13	5		46		8			6	24	16	16.6
2014		11	3		10			18	7			61		21			8	8	16	16.3
2015		12				11		27	17			103		10			21	15	11	25.2
2016		7				13		34	12	8		21	53	7			48	6	18	20.6
2017		10				4		22	13			36	46	4		5	15	5	16	16.0
2018		13				7		8	5			28		6		8	16	5	12	10.8
2019		8				1		7	6			14	5	1		4	8	1	7	5.6
Max		63	6	10	24	13	24	34	17	13	27	103	63	30	54	8	48	24	26	

Population Trends and Estimates

The peak number of males and average number of males per lek are used as the main measures of population trend over time in the USRBCA. These provide a reasonable index of abundance of sage-grouse populations over time in response to environmental conditions. Average peak number of males per active lek declined in the early 1990's (Figure 2). Counts from 2009 - 2016 years showed a generally increasing trend, however there has been a sharp decrease from 2017 – present (Figure 2). The average peak males per lek in 2015 and 2016 were the highest recorded since 1994 at 25.2 and 20.6, respectively. However, the average peak males per lek dropped to 16.0 in 2017, 10.8 in 2018, and 5.6 in 2019. The 2018 and 2019 counts are the lowest on record for this population.

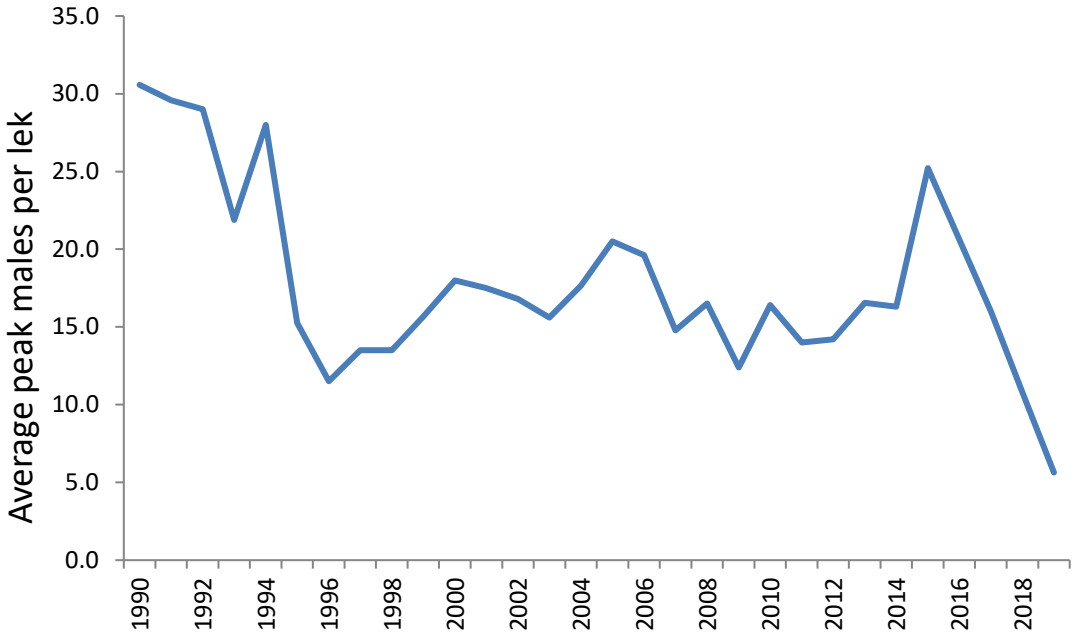


Figure 2. Average peak male counts for active leks in the Upper Snake River Basin Conservation Area, 1990-2019.

Data from the most recent 10 year period suggests that the population experienced a peak in 2015 and then declined sharply from 2017 - 2019. The population decline over the past 3 years is very concerning. The drop is largely driven by a significant reduction in counts at the Moulton East and Moulton West leks, which had a peak of 103 males in 2015 and only peaked at 19 males in 2019. Declines at other leks such as Breakneck Flats in the Gros Ventre drainage (from 34 males in 2016 to 7 in 2019) and RKO lek (48 in 2016 to 8 in 2019) reflect this trend. The long term persistence of this population continues to be of paramount concern to the local working group and resource managers.

Winter 2019 aerial and ground survey

Teton Conservation District provided funding for approximately 2 hours of helicopter flight time to the WGFD to survey sage-grouse in February 2019. In order to reduce flight costs, we conducted this survey in conjunction with our annual big game helicopter classification. The goal was to fly over previously identified sage-grouse winter habitat areas and obtain counts on groups of sage-grouse. These areas needed to be surveyed at a lower altitude and slower speed than the big game survey portions.

Overall, we found very few sage-grouse during the survey (69 total). We observed 54 sage-grouse in the Elk Ranch area in Grand Teton National Park, including a large flock of approximately 40 birds on the southeast side of Uhl Hill (Figure 3). We observed 14 sage grouse in the Gros Ventre drainage and 1 sage grouse on the National Elk Refuge (Figure 3). Staff from Teton Raptor Center and Teton Conservation District also conducted concurrent ground surveys at the same time as the helicopter flight, but did not find additional groups of sage-grouse. The low number of sage-grouse observed during this winter survey is in line with the low lek counts observed in spring 2019.

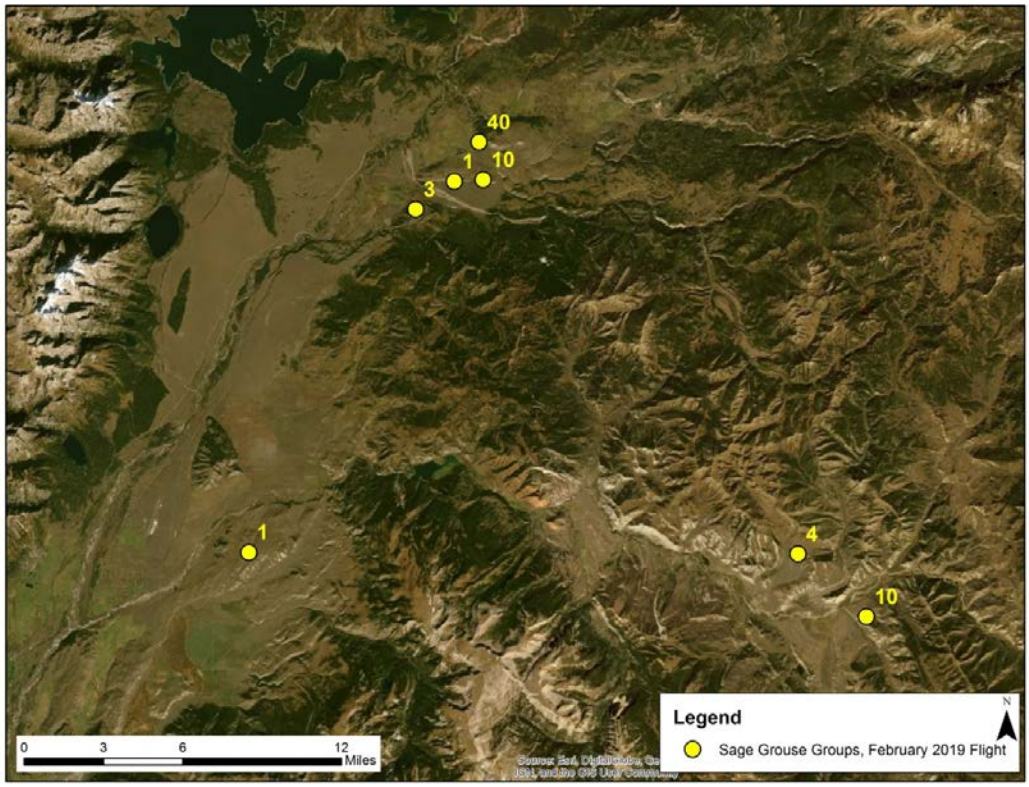


Figure 3. Sage-grouse observations (yellow points) and group sizes (yellow numbers) during February 2019 flight survey.

Productivity

No productivity data were collected on this population this year.

Harvest

Most of the USRBCA has been closed to hunting since the establishment of GTNP in 1929. No sage-grouse hunting has been allowed on lands under the jurisdiction of GTNP or the NER. In 2000, the hunting season was closed in the entire USRBCA and remains so today.

Habitat

Management of greater sage-grouse habitat in Wyoming is based on a "core area" strategy of limiting human disturbance in the most important sage-grouse habitats. This strategy is codified by a Governor's executive order. The current Executive Order (2019-3) was signed by Governor Mark Gordon in August 2019. The Executive Order and Core Area Policy can be found on the WGFD website and attached to the Statewide JCR.

The majority of sage-grouse habitat in the USRBCA is located within GTNP. There is also habitat in the Gros Ventre drainage on Bridger-Teton National Forest and the NER. Little habitat occurs on private lands.

No wildfires or prescribed burns occurred in significant areas of sagebrush habitat in sage-grouse core areas within the USRBCA during the reporting period. Grand Teton National Park finished building a traffic circle at Gros Ventre Junction on Highway 89, which permanently removed a relatively small area of sagebrush near the road. The Kelly Hayfields restoration project continued this year in GTNP, which is a project to remove smooth brome hayfields and reestablish a sagebrush community. There were no other significant human developments or surface disturbances in the core area during this reporting period.

Summer 2018 had average precipitation and moisture conditions. Winter 2018/2019 conditions were average in early winter but then shifted rapidly due to several large snowstorms in early February. Most sage-grouse winter habitat areas were covered in deep snow that persisted late into the winter and early spring. These very deep snow conditions likely impacted over-winter sage-grouse survival and contributed to the low lek counts observed in spring 2019.

Conservation Planning

The Upper Snake River Basin Sage-Grouse Conservation Plan was updated in March 2014 and can be found on the WGFD website at:
https://wgfd.wyo.gov/WGFD/media/content/PDF/Habitat/Sage%20Grouse/SG_USR_CONSERVPLAN.pdf
The Upper Snake River Basin Sage-Grouse Working Group met several times during the reporting period to plan lek monitoring schedules, review lek survey data, discuss and fund special projects, and review other issues affecting sage-grouse in the area. The local working group is particularly concerned about the low lek counts in 2018 and 2019 and met several times to discuss potential courses of action to reverse this decline. Discussions have been ongoing and will be detailed in next year's Job Completion Report. Continued coordination between agencies and the local working group to monitor this population is essential.

Special Projects

Sage-Grouse Movements, Productivity, and Habitat Use in the Spread Creek Area

Bryan Bedrosian, Teton Raptor Center
John Stephenson, Grand Teton National Park
Jason Wilmot, Bridger-Teton National Forest

SUMMARY
Spread Creek is an important area in Grand Teton National Park for sage-grouse leking and nesting. There is also an active gravel extraction facility in the area (on Bridger-Teton National Forest) that operates at differing levels of use annually. There is potential for disturbance from the gravel pit operations to sage-grouse movements and demography in the area. The gravel pit is expected to have low levels of activity in 2016 and 2017, but increase operations in 2018 and 2019. The project will investigate the movements, habitat use, and nesting demography of sage-grouse from 2016-2019 to evaluate the effects of differing levels of disturbance. Sage-grouse will be captured and fitted with solar-powered, rump-mounted GPS transmitters. Transmitters will gather a minimum of hourly locations during daylight and an additional roost location. Any suspected nesting attempts or mortality events will be investigated. Home range sizes, distances to gravel pit, and other movement metrics will be compared in a pre/post design framework. Also, nest locations, clutch sizes, success, and brood sizes among years will be assessed. This project applied for and received funding from the Upper Snake River Basin Sage-Grouse Working Group for 2017-2018.

Sagebrush Restoration in an Abandoned Hayfield in the Upper Gros Ventre Watershed

Jason Wilmot, Bridger-Teton National Forest

SUMMARY
The project area is located on the Dew Place Ranch in the Upper Gros Ventre watershed, which was homesteaded 1899 and brought into the National Forest System through a land exchange in 1997. The Forest Service and partners have identified the ranch for several habitat improvement projects in wetland, riparian, and upland areas. Located near the confluence of Fish Creek and the Gros Ventre River—and within 3 miles of the Breakneck Flat sage grouse lek—the property is uniquely situated to provide critical, high value habitat for upland and riparian-dependent wildlife, including sage-grouse. The area is within core sage-grouse habitat identified under the Wyoming Executive Order. Telemetry data collected during the last two decades suggest that sage grouse use the ranch and vicinity throughout the year (Holloran and Anderson 2004, Bedrosian 2010). However, sage-grouse apparently make little use of the abandoned agricultural field.

This project proposes to establish the methodology needed to re-establish sagebrush steppe on an abandoned hayfield on the Dew Place Ranch, with the net effect of increasing the availability of winter, nesting, and late brooding rearing habitats for sage grouse in the upper Gros Ventre watershed. About 88 acres on the south end of the Dew Place Ranch currently stands as an abandoned hayfield and irrigation ditches located on a terrace above the Gros Ventre River. The hayfield is dominated by non-native, smooth brome (*Bromus inermis*) interspersed with patches of Kentucky bluegrass (*Poa pratensis*), and supports few noxious weeds. Our treatment methods will generally follow currently in use by Grand Teton National Park Science and Resource Management personnel to restore the Kelly

Hayfields, a successful and ongoing 4,500-acre effort in a similar ecological setting. Methodology developed from the test plots will be subsequently applied to the entire hayfield, and likely to similar Forest Service lands in the area. This project applied for and received funding from the Upper Snake River Basin Sage-Grouse Working Group for 2017-2018.

Sage steppe plant community restoration in abandoned smooth brome dominated hayfields in Grand Teton National Park

Grand Teton National Park

SUMMARY

The sagebrush steppe vegetation within 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 Beringia 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. These abandoned hayfields are within 4 miles of the Moulton lek. 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.

For the benefit of sage-grouse and many other species, the park has begun to restore these hayfields to native sagebrush-steppe vegetation. This work has been initiated with funds from the Wyoming Sage-Grouse Conservation Fund and the National Park Service. During 2015 and 2016, Grand Teton National Park staff have treated additional acres for smooth brome removal, continued to monitor and conduct noxious weed treatments as necessary, collected native seeds, and seeded treated areas with native seeds. Fencing was also constructed on some treatment units to reduce native ungulate grazing pressure. In total, there are 1,263 acres in various stages of restoration treatment. The goal is to restore 4,500 acres to ecological function, which will require many more years of work.

Invasive species control in occupied sage-grouse habitat

Mark Daluge, Teton County Weed and Pest District
Jason Wilmot, Bridger-Teton National Forest

SUMMARY

This project is designed to address the issue of noxious weeds out-competing the natural habitat in such a way that sage-grouse suffer from lack of cover and inadequate forage. By employing Early Detection/Rapid Response tactics we will be more efficiently managing our resources. Over time this method can greatly conserve cost because it targets small problems while they are still manageable before they become too expensive and extensive to treat. Our project would benefit the grouse in preserving their natural habitat and keeping their habitat free of large noxious weed infestations. Well established noxious weed infestations will be controlled so they do not continue their spread.

Sage-grouse in the Upper Gros Ventre watershed have very limited winter range and are vulnerable to loss of habitat due to noxious weed infestations. The core winter ranges (Breakneck Flats and the

Cottonwood-Fish Creek) on Bridger-Teton National Forest support a large percentage (> 60%) of the high quality foraging and thermal cover in the entire watershed. Thus, little other habitat is available to displaced birds. This is an ongoing project that has received financial support numerous times by the Upper Snake River Basin Sage-Grouse Working Group. In 2016, crews treated noxious weeds on approximately 81.5 acres and surveyed and mapped 765 acres in the Gros Ventre watershed. This project applied for and received funding from the Upper Snake River Basin Sage-Grouse Working Group for 2017-2018.

Management Summary

It appears that following a population rebound in 2015 and 2016, the population has undergone a significant decline during the past 3 years. Lek counts in spring 2019 were the lowest on record for this population. As a result of this population decline, the local working group met several times in spring 2019 to discuss potential courses of action. Discussions have been ongoing and will be detailed in next year's Job Completion Report. Continued coordination between agencies and the local working group to monitor this population is essential.

Lek data suggest the population has declined over the long term (1989-present) (Table 1, Figure 2). The long-term viability of this population probably can be assured only if mortality factors currently affecting adult and juvenile hens do not increase. Reinstituting the hunting season in Management Area A (formerly Areas 1 and 2) is not warranted at this time.

Limited winter habitat is considered to be a primary issue for this population. Therefore, monitoring sagebrush habitats used by sage-grouse is a priority. Additional documentation of sage-grouse distribution would be helpful to confirm seasonal distribution, movements, and habitat use. Key areas on public lands used by sage-grouse should be protected from management actions which could have adverse impacts on that habitat, including recreation access. Wildfire suppression should be considered in occupied sage-grouse habitat in Jackson Hole and the Gros Ventre drainage. Restoration of native sagebrush habitats on lands formerly hayed in GTNP and the Gros Ventre drainage appears to have the greatest potential to expand and enhance habitat used by sage-grouse in the USRBCA. Protecting sagebrush habitat on private lands from future residential development is also important. Sagebrush restoration on private lands may also be an option in the future.

The impact of the Jackson Hole Airport on the sage-grouse population is an ongoing challenge. Management options that do not adversely affect the 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.

Past and current sage-grouse research by local researchers provides essential information to manage this sage-grouse population and its habitat in Jackson Hole. Managers should continue to prioritize funding and in-kind support to these research efforts.

Recommendations

1**.** Continue to help coordinate lek surveys across jurisdictional boundaries using the lek survey protocols adopted by the WGFD.

2. Continue coordinating with other agencies to ensure periodic monitoring of historic, unoccupied or inactive leks. Continue to coordinate with other agencies to search for new leks.

3. Continue to document sage-grouse observations to improve occupied habitat mapping.

4. Cooperate with the National Park Service and Jackson Hole Airport to complete the hazard plan and environmental assessment, and assist with designing projects to minimize risks of sage-grouse strikes to aircraft.

5. Support GTNP's sagebrush habitat restoration projects in the Mormon Row and Hayfields areas which could be used as winter, nesting, and brood-rearing habitats for sage-grouse.

6. Continue to work with land management agencies during the implementation of habitat improvement projects to minimize impacts to sage-grouse occupied habitats.

7. Implement the USRBWG Sage-Grouse Conservation Plan (2014). Work to implement the strategies and projects identified in the plan.

8. Support implementation of the most current version of the Governor's Executive Order for Greater Sage-Grouse Core Area Protection.

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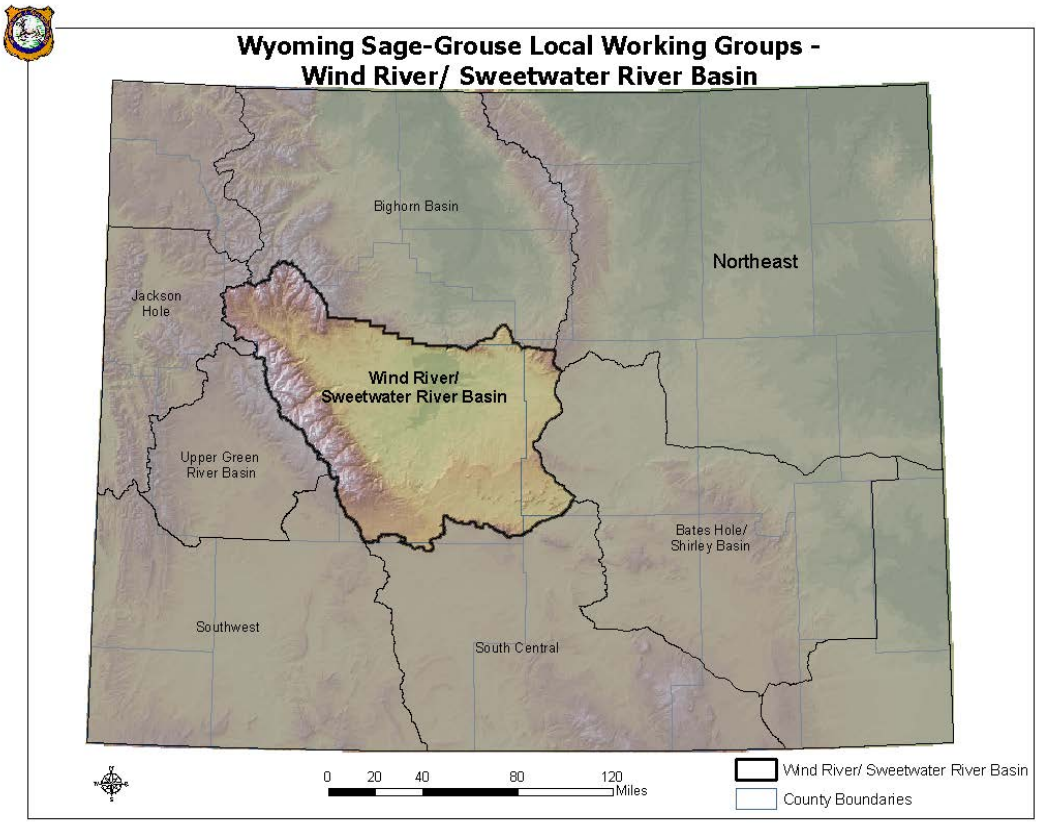
Wind River/Sweetwater River Conservation Area
Job Completion Report

Species: Greater Sage Grouse
Mgmt. Areas: E & WR, Lander Region
Period Covered: June 1, 2018 – May 31, 2019
Prepared by: Stan Harter, South Lander Wildlife Biologist



Sage Grouse Lek Characteristics (2019)

Working Group: Wind River/Sweetwater River

Region	Number	Percent
Casper	2	0.8
Lander	194	75.5
WRIR	61	23.7

Working Group	Number	Percent
Wind River/Sweetwater River	257	100.0

Classification	Number	Percent
Occupied	200	77.8
Undetermined	18	7.0
Unoccupied	39	15.2

BLM Office	Number	Percent
Lander-WRR	61	23.7
Casper	12	4.7
Lander	175	68.1
Rock Springs	7	2.7
Worland	2	0.8

Biologist	Number	Percent
WRR-USFWS	61	23.7
Casper	2	0.8
North Lander	69	26.8
Sinclair	1	0.4
South Lander	123	47.9
Worland	1	0.4

Warden	Number	Percent
Shoshone-Arapahoe Tribal	61	23.7
Dubois	1	0.4
Lander	72	28.0
North Riverton	27	10.5
South Riverton	61	23.7
West Casper	2	0.8
West Rawlins	33	12.8

County	Number	Percent
Carbon	1	0.4
Fremont	227	88.3
Hot Springs	4	1.6
Natrona	24	9.3
Sweetwater	1	0.4

Land Status	Number	Percent
BLM	147	57.2
BOR	4	1.6
Private	30	11.7
Reservation	60	23.3
State	16	6.2

Management Area	Number	Percent
E	196	76.3
WR	61	23.7

Lek Status	Number	Percent
Active	149	58.0
Inactive	36	14.0
Unknown	72	28.0

Sage Grouse Job Completion Report

Year: 2010 - 2019, Working Group: Wind River/Sweetwater River

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

a. Leks Counted

Year	Occupied	Counted	Percent Counted	Peak Males	Avg Males / Active Lek (2)
2010	179	54	30	1621	36.0
2011	187	70	37	1668	26.9
2012	193	78	40	1899	28.8
2013	196	81	41	1543	22.4
2014	199	101	51	1860	21.6
2015	215	116	54	4589	44.1
2016	212	95	45	4694	55.2
2017	207	87	42	3499	44.3
2018	208	109	52	3618	38.5
2019	205	96	47	2364	31.1

b. Leks Surveyed

Year	Occupied	Surveyed	Percent Surveyed	Peak Males	Avg Males / Active Lek (2)
2010	179	90	50	1660	23.4
2011	187	86	46	1311	22.6
2012	193	89	46	1358	21.2
2013	196	90	46	1056	15.3
2014	199	87	44	976	17.7
2015	215	85	40	1595	25.3
2016	212	104	49	2744	34.3
2017	207	103	50	2542	33.4
2018	208	87	42	1402	22.3
2019	205	99	48	1187	17.2

Sage Grouse Job Completion Report

Year: 2010 - 2019, Working Group: Wind River/Sweetwater River

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

c. Leks Checked

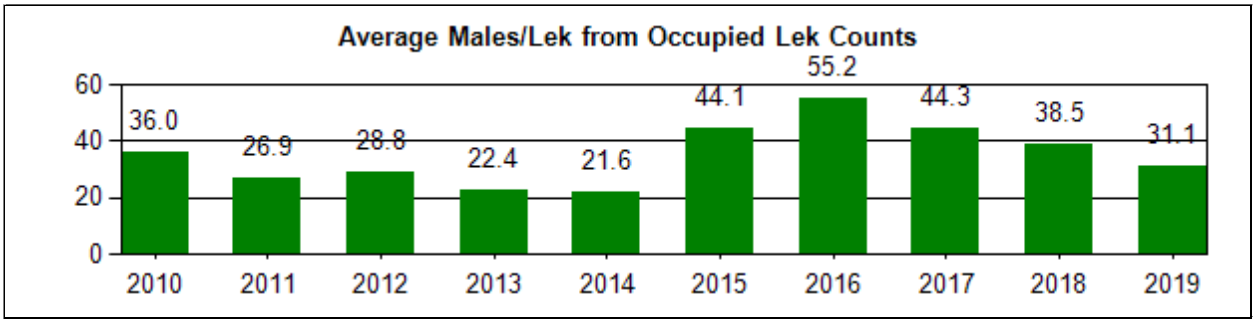
Year	Occupied	Checked	Percent Checked	Peak Males	Avg Males / Active Lek (2)
2010	179	144	80	3281	28.3
2011	187	156	83	2979	24.8
2012	193	167	87	3257	25.1
2013	196	171	87	2599	18.8
2014	199	188	94	2836	20.1
2015	215	201	93	6184	37.0
2016	212	199	94	7438	45.1
2017	207	190	92	6041	39.0
2018	208	196	94	5020	32.0
2019	205	195	95	3551	24.5

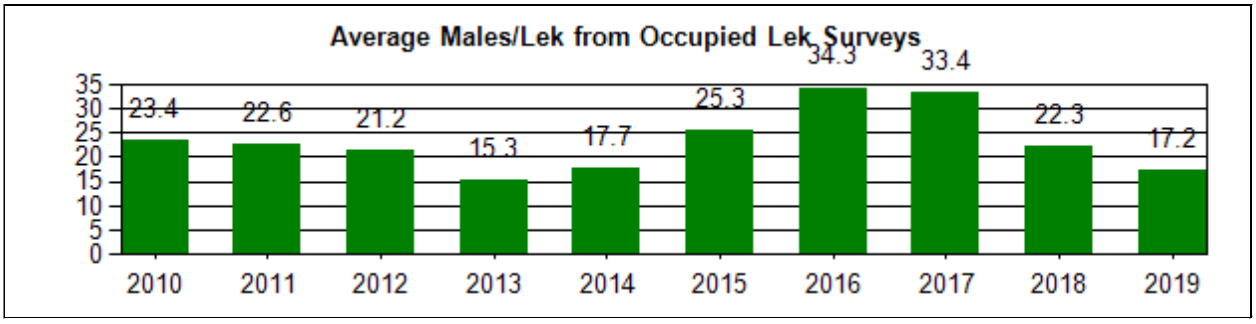
d. Lek Status

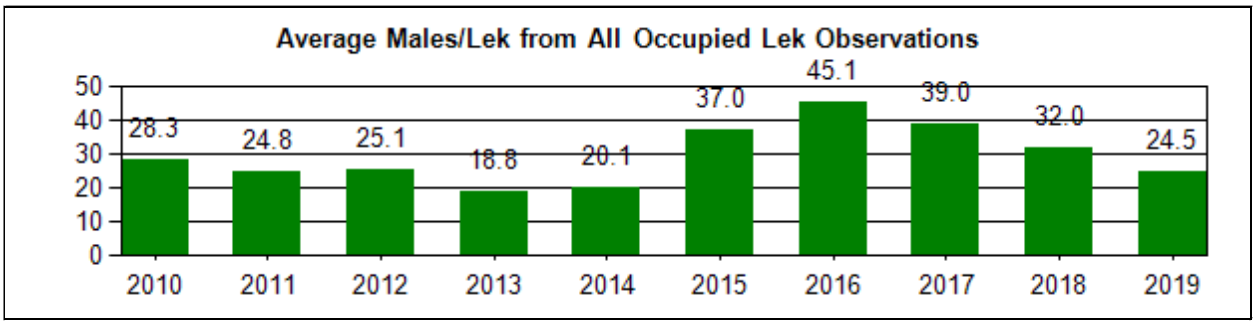
Year	Active	Inactive (3)	Unknown	Known Status	Percent Active	Percent Inactive
2010	119	9	16	128	93.0	7.0
2011	121	10	25	131	92.4	7.6
2012	131	16	20	147	89.1	10.9
2013	139	14	18	153	90.8	9.2
2014	142	22	24	164	86.6	13.4
2015	167	17	17	184	90.8	9.2
2016	167	11	21	178	93.8	6.2
2017	156	8	26	164	95.1	4.9
2018	157	14	25	171	91.8	8.2
2019	146	20	29	166	88.0	12.0

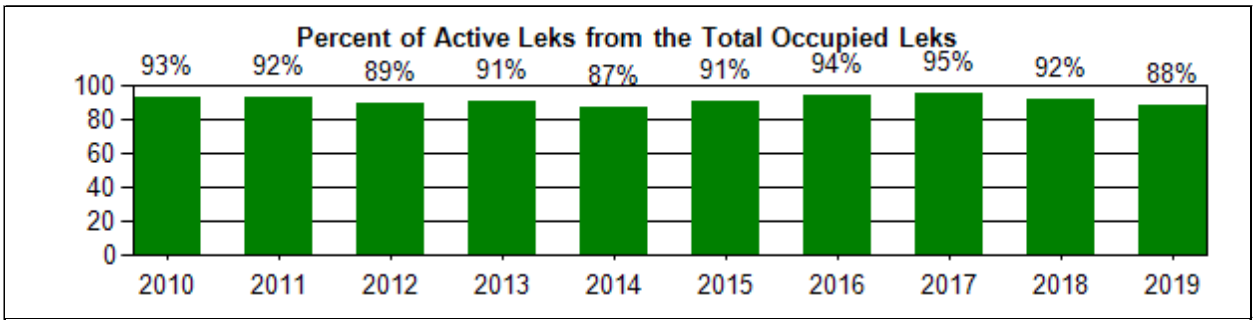
Sage Grouse Occupied Lek Attendance Summary

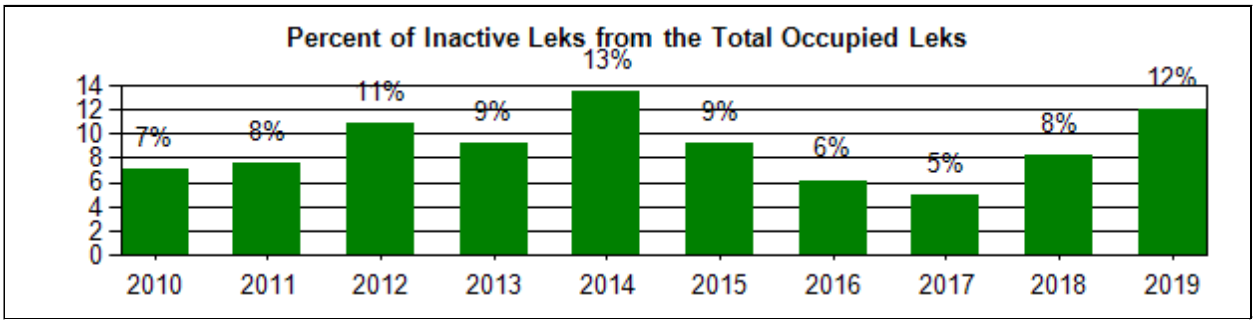
Year: 2010 - 2019, Working Group: Wind River/Sweetwater River











Sage Grouse Job Completion Report

Year: 2009 - 2018, Working Group: Wind River/Sweetwater River

3. Sage Grouse Hunting Seasons and Harvest Data

a. Season

Year	Season Start	Season End	Length	Bag/Possesion Limit
2009	Sep-19	Sep-30	12	2/4
2010	Sep-18	Sep-30	13	2/4
2011	Sep-17	Sep-30	14	2/4
2012	Sep-15	Sep-30	16	2/4
2013	Sep-21	Sep-30	10	2/4
2014	Sep-20	Sep-30	11	2/4
2015	Sep-19	Sep-30	12	2/4
2016	Sep-17	Sep-30	14	2/4
2017	Sep-16	Sep-30	15	2/4
2018	Sep-15	Sep-30	16	2/4

b. Harvest

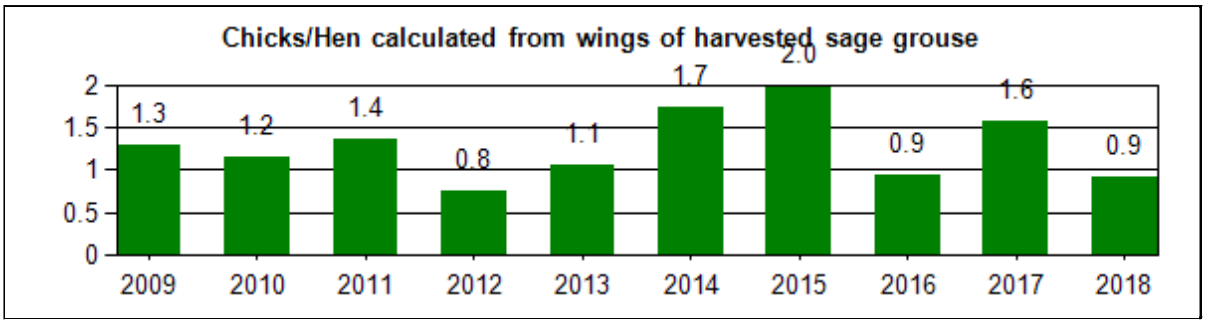
Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2009	2295	875	2114	1.1	2.6	2.4
2010	2495	1056	2866	0.9	2.4	2.7
2011	1779	771	1801	1.0	2.3	2.3
2012	2068	890	2296	0.9	2.3	2.6
2013	1240	565	1325	0.9	2.2	2.3
2014	1546	772	1853	0.8	2.0	2.4
2015	2158	737	1846	1.2	2.9	2.5
2016	1910	922	2264	0.8	2.1	2.5
2017	1364	630	1427	1.0	2.2	2.3
2018	2250	970	2519	0.9	2.3	2.6
Avg	1,911	819	2,031	0.9	2.3	2.5

Sage Grouse Job Completion Report

Year: 2009 - 2018, Working Group: Wind River/Sweetwater River

4. Composition of Harvest by Wing Analysis

Year	Sample Size	Percent Adult		Percent Yearling		Percent Young		Chicks/ Hens
		Male	Female	Male	Female	Male	Female	
2009	598	16.7	24.6	6.9	8.9	14.7	28.3	1.3
2010	476	16.0	30.3	4.4	6.7	15.1	27.5	1.2
2011	376	9.0	27.1	6.9	8.5	14.4	34.0	1.4
2012	443	18.5	36.1	6.3	6.8	11.1	21.2	0.8
2013	202	18.8	29.7	0.5	9.4	14.9	26.7	1.1
2014	343	10.5	23.3	2.3	8.5	30.3	25.1	1.7
2015	513	11.3	21.2	5.3	6.6	21.4	34.1	2.0
2016	307	16.9	29.6	3.9	11.1	16.9	21.5	0.9
2017	393	18.8	28.5	2.8	2.0	20.9	27.0	1.6
2018	520	17.9	29.0	6.5	10.4	13.7	22.5	0.9



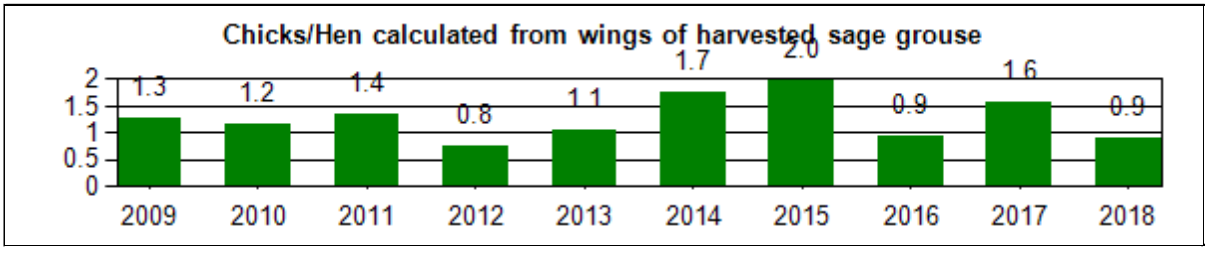
Sage Grouse Wing Analysis Summary

Year: 2018, Working Group: Wind River/Sweetwater River

Adult Males:	93	% of All Wings:	17.9
Adult Females:	151	% of All Wings:	29.0
Adult Unknown:	0	% of All Wings:	0.0
Total Adults:	244		
Yearling Males:	34	% of All Wings:	6.5
Yearling Females:	54	% of All Wings:	10.4
Yearling Unknown:	0	% of All Wings:	0.0
Total Yearlings:	88		
Chick Males:	71	% of All Wings:	13.7
Chick Females:	117	% of All Wings:	22.5
Chick Unknown:	0	% of All Wings:	0.0
Total Chicks:	188		
Unknown Sex/Age:	0		
Total for all Sex/Age Groups:	**520**		

Chick Males:	71	% of All Chicks	37.8
Yearling Males:	34	% of Adult and Yearling Males	26.8
Adult Males:	93	% of Adult and Yearling Males	73.2
Adult and Yearling Males:	127	% of Adults and Yearlings	38.3
Total Males:	198	% of All Sex/Age Groups	38.1
Chick Females:	117	% of All Chicks	62.2
Yearling Females:	54	% of Adult and Yearling Females	26.3
Adult Females:	151	% of Adult and Yearling Females	73.7
Adult and Yearling Females:	205	% of Adults and Yearlings	61.7
Total Females:	322	% of All Sex/Age Groups	61.9

Chicks:	188	% of All Wings:	36.2
Yearlings:	88	% of All Wings:	16.9
Adults:	244	% of All Wings:	46.9
Chicks/Hen	0.9		



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 abundance data currently available for sage-grouse. Known leks indicate sage-grouse distribution within the WRSRCA as represented below in Figure 1.

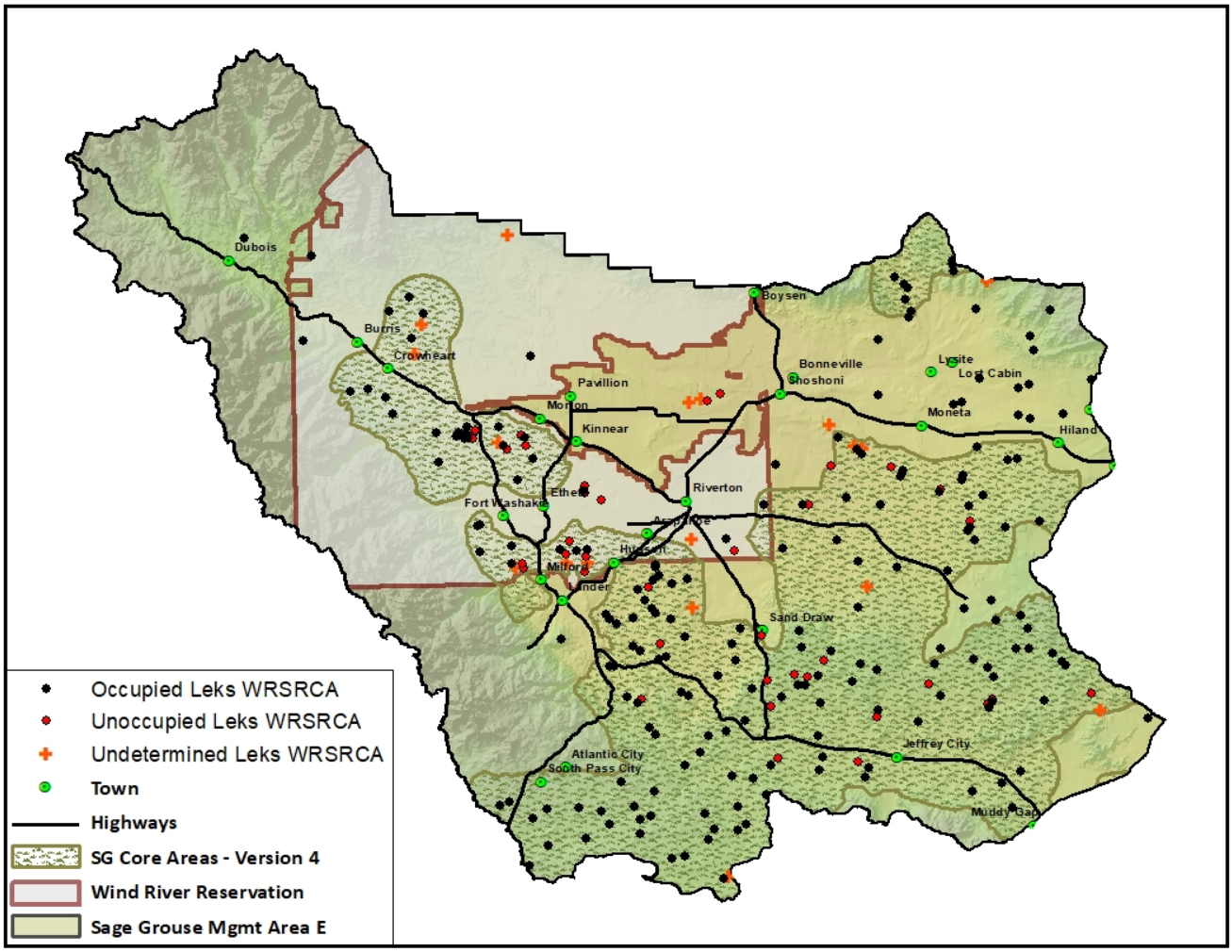


Figure 1. Known sage-grouse lek and core area distribution (2019) in the Wind River/Sweetwater River Conservation area.

Lek Attendance - 2019

Sage-grouse are generally found throughout the WRSRCA, except in heavily forested, agriculturally developed, or urbanized areas. Sage-grouse leks in the WRSRCA are located within the Lander WGFD Region, 4 BLM Resource Areas, 5 Wyoming counties, and the WRR. There were 200 known occupied leks within the conservation area in 2019, along with 39 unoccupied and 18 undetermined leks. As seen above in Figure 1, a good majority of leks of all 3 classification levels occur within the 3 core areas that are partially or entirely within the WRSRCA (Crowheart, Greater South Pass, and Washakie). It is highly probable there are leks within the WRSRCA that have not yet been documented, as evidenced by at least 131 (average 6 per year) new or newly discovered leks being documented in the WRSRCA through

intensive monitoring and search efforts since 1995. Similarly, there are leks that have been abandoned or destroyed that are undocumented. Lek attendance generally increased between 1995 and 2006, declined until 2013, increased again for 3 years, only to decline in 2017 through 2019, mimicking Wyoming's statewide trends, but with generally higher numbers than the Wyoming average (Figures 2 and 3).

Personnel from WGFD, BLM, USFWS, and Shoshone-Arapahoe Tribal Fish and Game (SATFG), assisted by several researchers, consultants, and volunteers checked 196 of the 208 known occupied leks in the WRSRCA in 2019. Of those checked, 96 were counted and 99 were surveyed. Of the 166 leks where status was confirmed, 146 (88.0%) were active and 20 (12.0%) were inactive, with a lower proportion in active status than the average since 2010.

Average male lek attendance for all leks checked dropped from 32.0 in 2018 to 24.5 in 2019. Average maximum male attendance at count leks also dropped from 38.5 in 2018 to 31.1 in 2019, dipping below the count lek average since 2010 (34.9), and 59% below the peak in 2006 (76.0).

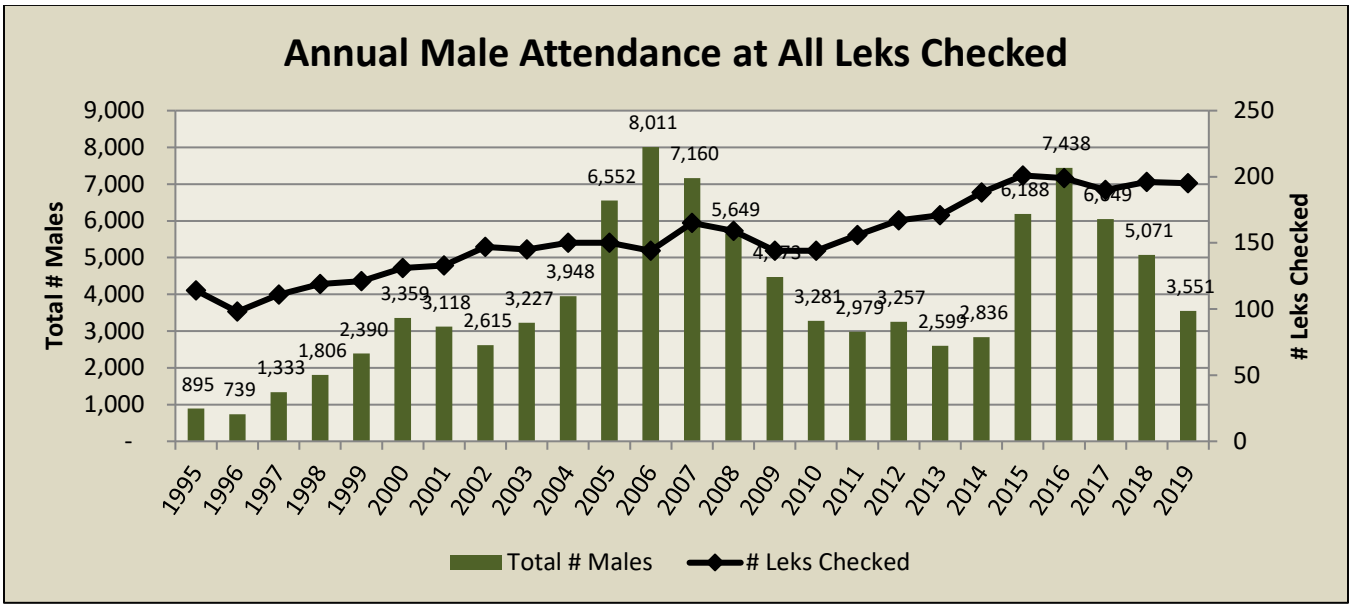


Figure 2. Total male attendance at all leks within the Wind River/Sweetwater River Conservation Area, 1995–2019.

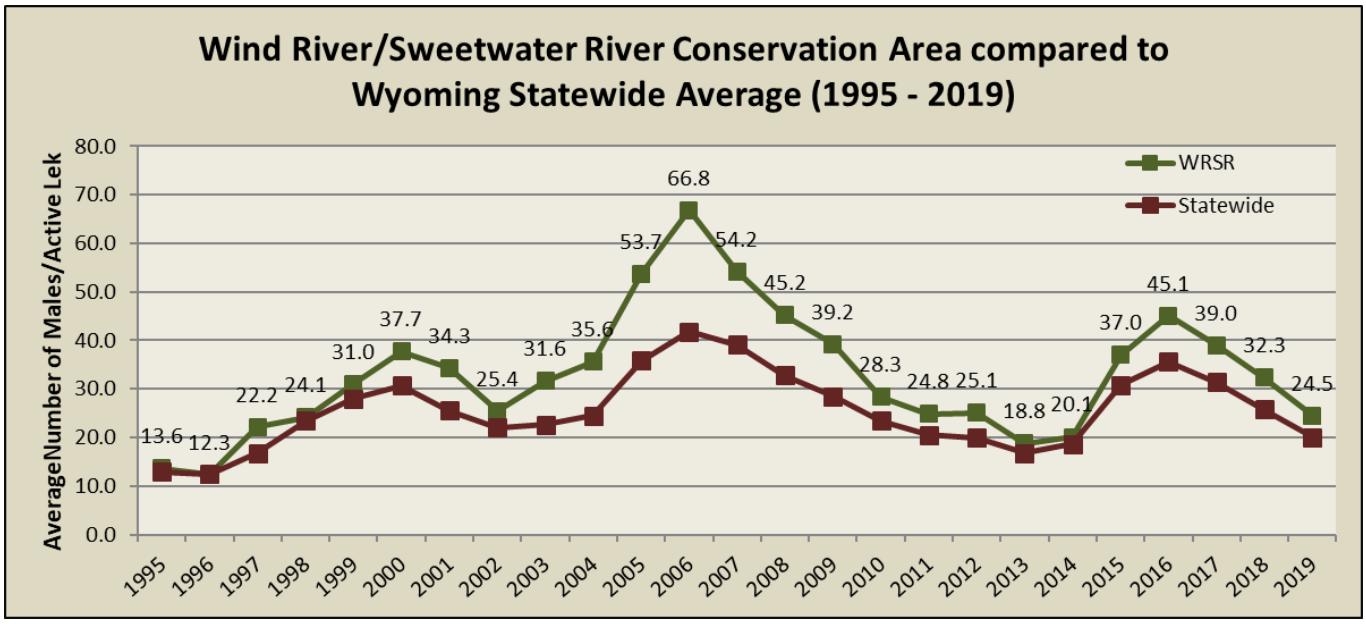


Figure 3. Average male lek attendance (all leks checked) in WRSRCA relative to Wyoming statewide trends, 1995 –2019.

Lek Perimeter Mapping

Nearly all leks in the WRSRCA have perimeters mapped, as of 2019.

Productivity

Since summer brood data are very limited in the WRSRCA, wing data collected from harvested birds provide a more reliable indicator of recruitment than do brood survey data. Harvested wings are collected from hunters at 7 wing barrels placed annually along major hunting area exit roads in Sage Grouse Management Area E and at the Lander Game Check Station, and typically provide significant wing data, due to a relatively high number of sage-grouse hunters in the area. Wing data are summarized for the WRSRCA for hunting seasons 2009 – 2018, and reported in detail for 2018 (pages 7 and 8). Wings collected from harvested birds during the 2018 hunting season yielded an average brood size of 0.9 chicks per hen, 31% below the average of 1.3 chicks per hen over the last 10 years. This was tied for the second lowest average brood size since 2009, and was 44% less than in 2017. Population growth typically requires 1.7 chicks/hen or more based on historic statewide averages. With chick survival in 2018 being well below that threshold, male lek attendance in 2019 was 23% below that of 2018.

Hunting Season and Harvest

Regulated hunting is the cornerstone of the North American Model of Wildlife Conservation, a system that keeps wildlife a public and sustainable resource, and scientifically managed by professionals. Many greater sage-grouse populations can, and do, support hunting under this model (WGFD - Hunting and Sage Grouse, 2010). The Wind River/Sweetwater River Conservation Area has some of the most robust habitats in the entire sage grouse range. As outlined in the hunting season tables on page 6, bag limits, season lengths, and harvest levels area within acceptable levels for the "population" of sage grouse within the WRSRCA. Wings are collected annually from harvested birds in barrels placed at major exits from hunting spots within the WRSRCA. Data gathered from these wings are used to calculate age and sex ratios, and chick survival. Sage-grouse hunting on tribal lands within the Wind River Reservation is minimal and data are not included in this report.

Sage-grouse hunting season in Management Area E lies entirely within Wyoming Hunt Area 1, which has been "standardized" since 2009, keeping opening day on the 3rd Saturday in September. The 2018 sage-grouse hunting season was 16 days long (Sept. 15 – 30). Hunter numbers rose 54% and sage grouse harvest was 65% higher in 2018, compared with the 2017 hunting season. Hunter effort (days/bird) and (birds/hunter) statistics remained near the 10-year average (Page 6).

Habitat (Current and Historic)

Long-term sage-grouse habitat conditions have 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 WRSRCA 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/Inventory

Habitat monitoring is discussed in past WRSRCA JCRs, and in the 2007 WRSRCA Local Sage Grouse Conservation Plan and 2014 Addendum. No habitat monitoring transects were measured in 2018, except for vegetation monitoring in association with research in the Jeffrey City area by the University of Wyoming (Leonard, et al., ongoing). However, implementation of Rapid Habitat Assessments (RHAs) began as part of the South Wind River/Sweetwater Mule Deer Initiative, to develop a baseline from which to gauge overall habitat condition. A minimum of 19 RHAs covering shrub/rangeland habitats were completed within the WRSRCA in 2018, and offer insight as to the condition of sage-grouse habitats within the South Wind River and Sweetwater Mule Deer herd units that overlap the WRSRCA.

Winter Habitat Use Survey

Limited winter observations were collected in 2018-19, mostly as opportunistic observations during deer, elk, and moose classifications flights or random ground surveys.

Habitat Treatments

Since adoption of the WRSR LWG plan in 2007, a number of vegetation treatments have been implemented with the intention of improving habitats for sage grouse, mule deer, and other wildlife. Summaries of these treatments are reported in past JCRs and in the 2007 WRSRCA Local Sage Grouse Conservation Plan and 2014 Addendum. No new treatments in sage grouse habitats occurred during 2018.

Conservation Easements

Within the WRSRCA, several privately owned properties have been placed under conservation easements with deed restrictions ranging from minimal to no new construction of houses, barns, or other buildings. Conservation easements are mostly located in the Lander Foothills, Sweetwater River, Twin Creek, Dubois, and Ervay Basin areas. Two new conservation easements in sage grouse habitats were completed in 2018 within the WRSRCA. Presently, over 32,000 acres of private lands are permanently protected by conservation easements within the WRSRCA, and provide protection of crucial wildlife habitat, water quality, maintain migration routes, and continue traditional agricultural land uses.

Research

A number of research projects have been conducted in the WRSRCA since 2000. Studies conducted prior to 2019 were reported in past JCRs and in the 2007 WRSRCA Local Sage Grouse Conservation Plan and 2014 Addendum, which contains the most complete bibliography of sage grouse research for the WRSRCA through March 2014. A collection of current sage-grouse research being conducted in Wyoming is compiled annually by Dr. Jeff Beck at the University of Wyoming and is included in the annual statewide sage-grouse JCR. Citations for ongoing research and published works from the WRSRCA are included at the end of this report.

Diseases

No new cases of West Nile Virus (WNv) or other avian diseases are known to have occurred in sage grouse in the WRSRCA in 2018.

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 2014 Addendum and work to incorporate recommended management practices.

3. Continue to collect age and sex composition of the harvest via wing collection and analyses.
4. Continue intensive lek counts in the Government Draw area south of Hudson.
5. Continue ground checks of all non-intensively monitored leks.
6. Continue to search for new or undiscovered leks in remote areas of WRSRCA.
7. Continue to cooperate with private landowners and Federal/State land managers to reduce negative impacts to crucial sage-grouse habitats.
8. Continue to coordinate research projects with University of Wyoming, University of California-Davis, and others within or applicable to the WRSRCA.

Literature Cited

Ongoing Research within the Wind River/Sweetwater River Sage-grouse Conservation Area

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