Wyoming

Sage-Grouse Job Completion Report 2021

June 2021-May2022

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Wyoming Game and Fish Department

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Sage-Grouse Job Completion Report

Management Area: Statewide Summary
Period Covered: 6/1/2021– 5/31/2022
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Lek Monitoring

Approximately 37% of the range wide greater sage-grouse (*Centrocercus urophasianus*; hereafter, sage-grouse) population lives in Wyoming and 90% of estimated historic habitat in Wyoming is still occupied by the bird. There are just over 1,700 known, occupied sage-grouse leks in Wyoming. Wyoming Game and Fish Department (WGFD) personnel and sage-grouse stakeholders surveyed 87% of these leks in the spring of 2022. Results of the survey indicate 995 leks were confirmed active, 319 confirmed inactive, and 196 were unknown or unchecked. The average number of males observed was 17.9 per active lek, a 6% increase from the 16.8 males per active lek observed in the spring of 2021, suggesting an overall population increase and a stabilization of recent trends (Figure 1). In 2022, 16,835 male sage-grouse were observed on leks compared to 16,274 males observed on leks in 2021 (Table 1a). Methods for collecting sage-grouse data are described in the sage-grouse chapter of the WGFD Handbook of Biological Techniques (Whitford and Bish 2022), which is largely based on Connelly et al. 2003.

Lek monitoring data for the 2022 breeding season are summarized in Tables 1a-b and Figures 1-4. For the 10-year period (2013-2022), average male lek attendance ranged from 16.8 males/lek in 2013 and 2021, the lowest average males per lek since 1997, to a high of 35.6 males/lek in 2016 (Table 1a). The proportion of active, occupied leks decreased slightly from 76.1% in 2021 to 75.8% in 2022 (Table 1b). In 2022, average lek size was 17.9 males/active lek which is 24% lower than the 10-year (2013-2022) average of 23.5 males/active lek (Table 1a). This indicates a population decline over a 10 year period. Short-term trends in statewide populations are believed to be largely weather related. In the late 1990s, 2004-05, and again in 2014-15, timely precipitation resulted in improved habitat conditions allowing greater numbers of sage-grouse to successfully reproduce. Drought conditions throughout this decade are believed to have caused lower grouse survival leading to population declines. These trends are valid at the statewide scale but trends are more varied at the local scale. Sub-populations more heavily influenced by anthropogenic impacts (residential development, intensive energy development, large-scale conversion of habitat from sagebrush to grassland or agriculture, interstate highways, etc.) have experienced declining populations or localized extirpation.

It is important to note that not all leks were checked from year to year over the last 10 years. However, leks that were checked consistently over the same period demonstrated the same trends except in some local areas as described in the Regional 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 observation effort and the number of leks visited has varied over time, 2) not all leks have been located, 3) sage-grouse populations cycle, 4) the effects of yet to be located 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.

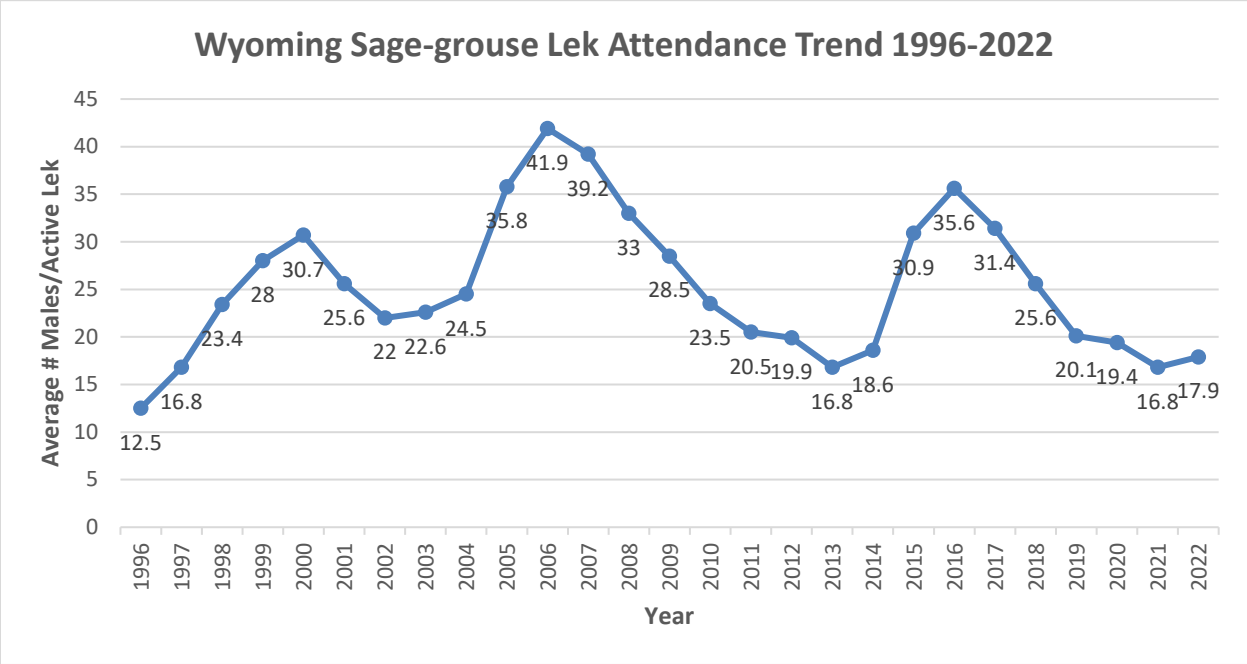

Figure 1. Average number of males per lek counted in Wyoming from 1996-2022.

Table 1a.
Leks Checked

Year	Occupied	Checked	Percent Checked	Peak Males	Avg Males / Active Lek (2)
2013	1791	1573	88	18274	16.8
2014	1794	1610	90	20070	18.6
2015	1824	1622	89	36534	30.9
2016	1839	1680	91	43271	35.6
2017	1828	1649	90	36594	31.4
2018	1817	1608	88	29521	25.6
2019	1794	1569	87	21442	20.1
2020	1765	1455	82	19139	19.5
2021	1751	1514	86	16274	16.9
2022	1733	1523	88	16835	17.9

Table 1b.
Lek Status

Year	Active	Inactive (3)	Unknown	Known Status	% Active	% Inactive
2013	1114	285	174	1399	79.6	20.4
2014	1105	353	149	1458	75.8	24.2
2015	1215	275	132	1490	81.5	18.5
2016	1258	275	147	1533	82.1	17.9
2017	1204	304	141	1508	79.8	20.2
2018	1179	300	129	1479	79.7	20.3
2019	1134	298	137	1432	79.2	20.8
2020	1027	338	90	1365	75.2	24.8
2021	1020	320	174	1340	76.1	23.9
2022	1005	321	197	1326	75.8	24.2

1) Occupied: Active during previous 10 years (see Attachment A for 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 Attachment A for definitions)

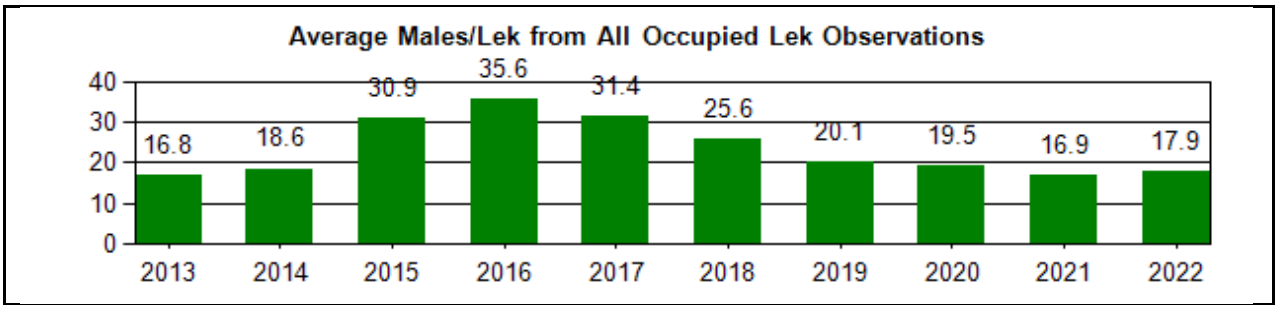

Figure 2. Average males/lek from all occupied leks checked (counts+surveys).

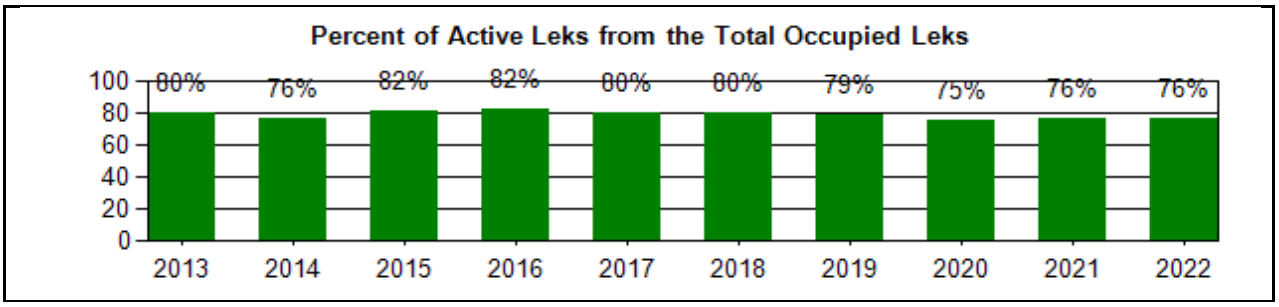

Figure 3. Percent active leks from the occupied leks checked with known status.

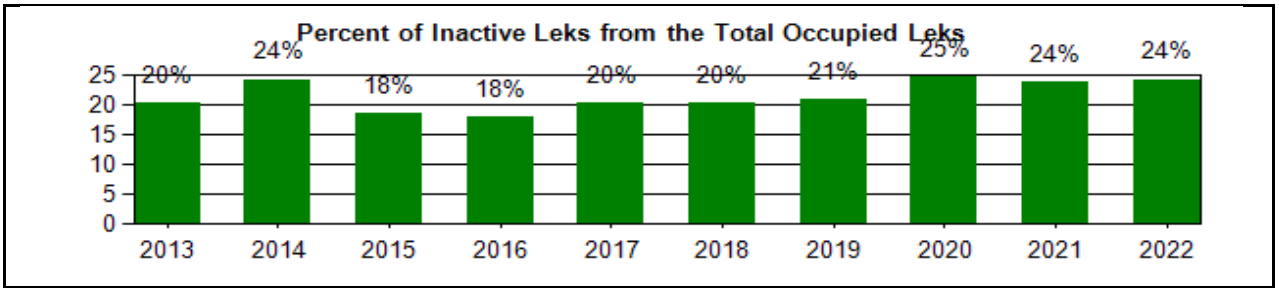

Figure 4. Percent inactive leks from the occupied leks checked with known status.

Hunting Season and Harvest

The 2021 hunting season (Figure 5 and Table 2) for most of the state (Area 1) was 1 day longer than 2020 due to the calendar effect of opening the season on the third Saturday of September. In 2020, the third Saturday was September 19, but in 2021, it was September 18.

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 (Area 2) and the Snake River Drainage in northwest Wyoming (Area 3), are closed to sage-grouse hunting (Figure 5 and Table 2). The data presented in Table 3b and Figures 6-9 are estimated from a voluntary hunter survey.

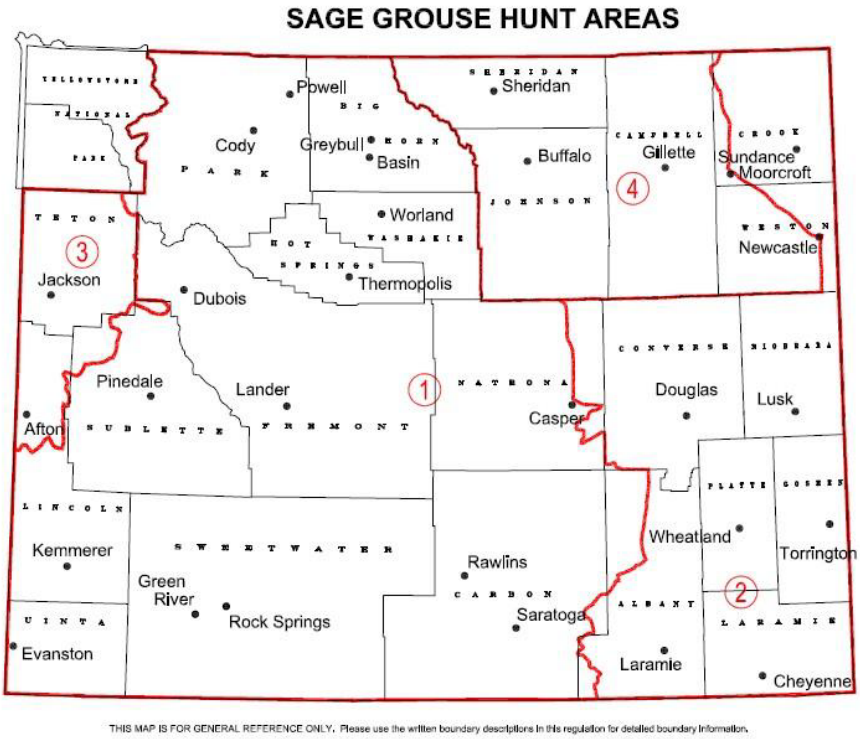

Figure 5. Sage-Grouse Hunt Areas

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

Table 2. 2021 sage-grouse hunting season map and regulations.

Year	Season Start	Season End	Length	Bag/Possession Limit
2012-1	Sep-15	Sep-17	3	2/4
2012-4	Sep-15	Sep-30	16	2/4
2013-1	Sep-21	Sep-23	3	2/4

2013-4	Sep-21	Sep-30	10	2/4
2014-1	Sep-20	Sep-22	3	2/4
2014-4	Sep-20	Sep-30	11	2/4
2015-1	Sep-19	Sep-21	3	2/4
2015-4	Sep-19	Sep-30	12	2/4
2016-1	Sep-17	Sep-19	3	2/4
2016-4	Sep-17	Sep-30	14	2/4
2017-1	Sep-16	Sep-18	3	2/4
2017-4	Sep-16	Sep-30	15	2/4
2018-1	Sep-15	Sep-17	3	2/4
2018-4	Sep-15	Sep-30	16	2/4
2019-1	Sep-21	Sep-23	3	2/4
2019-4	Sep-21	Sep-30	10	2/4
2020-1	Sep-19	Sep-21	3	2/4
2020-4	Sep-19	Sep-30	12	2/4
2021-1	Sep-18	Sep-20	3	2/4
2021-4	Sep-18	Sep-30	13	2/4

Year	Harvest	Hunters	Days	Birds/Day	Birds/ Hunter	Days/ Hunter
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
2019	7615	4229	9473	0.8	1.8	2.2
2020*	6544	3227	9705	0.7	2.0	3.0
2021	8457	5107	14465	0.6	1.7	2.8
Average	8,300	4,117	10,378	0.8	2.0	2.5

*****The 2020 sage-grouse harvest estimates should be interpreted with caution, because that particular year's survey under-sampled potential sage-grouse hunters from certain license fee types, resulting in poor quality harvest estimates. Making comparisons between previous years' estimates and the 2020 estimates should be avoided, because the results from the voluntary survey were unreliable due to sampling issues.

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

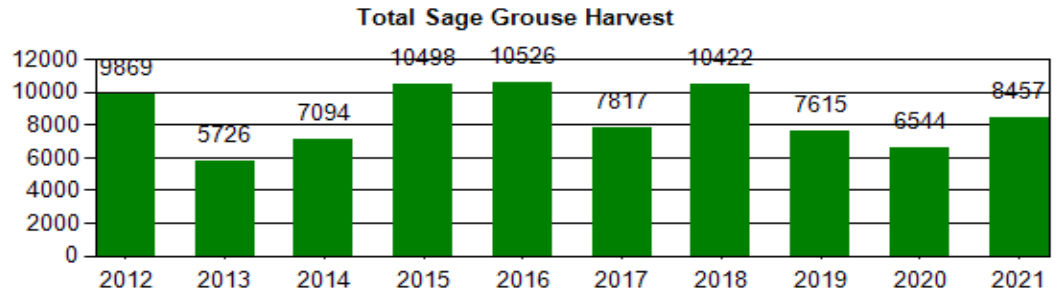

Figure 6. Wyoming statewide sage-grouse harvest 2013-2021.

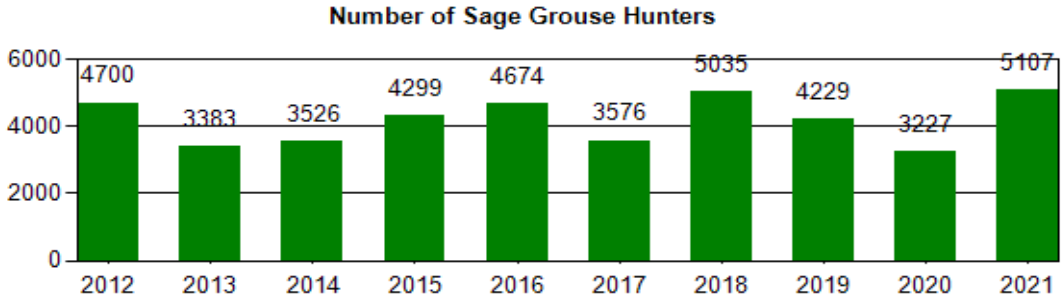

Figure 7. Wyoming statewide sage-grouse hunter numbers 2013-2020.

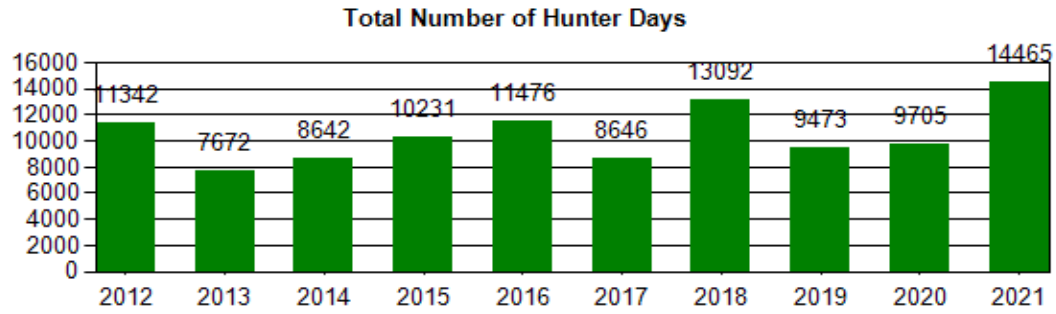

Figure 8. Wyoming statewide number of hunter days 2011-2020.

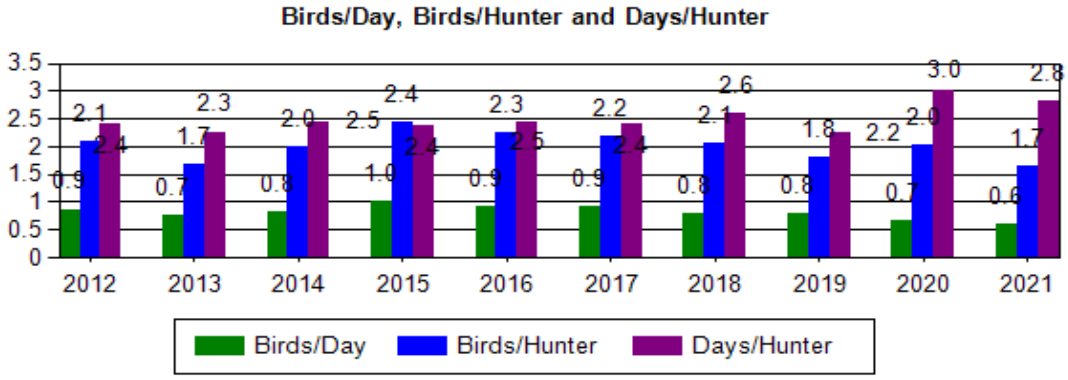

Figure 9. Wyoming statewide birds/day, birds/hunter and days/hunter 2011-2020.

Hunters voluntarily submit sage-grouse wings, separately from the harvest survey, at wing barrels throughout much of the state. The 2021 wing data indicate a chick:hen ratio of 0.8 chicks per hen (Table 4 and Figure 12). This level of productivity is typically associated with a declining population. The 2022 lek data (all leks checked) indicated a 6% increase in the average numbers of males on leks (Table 5). Considering the opportunistic sampling of hunter harvested wings and that wings are not collected statewide, due to shorter seasons or closed hunting areas, this inconsistency is not unexpected. When 1998-2021 data are pooled, average male lek attendance declined an average of 11% when chick:hen ratios the previous fall were less than 1.4:1, were closer to 0% change (-5%) 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.

Year	Sample	Percent Adult		Percent Yearling		Percent Young		Chicks/
	Size	Male	Female	Male	Female	Male	Female	Hens
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
2019	1631	10.4	31.5	3.2	9.7	14.9	30.3	1.1
2020	2171	9.8	31.5	4.1	9.1	17.4	28.1	1.1
2021	1542	10.2	39.8	2.8	8.0	16.0	23.0	0.8

Table 4. Composition of harvest by wing analysis 2012-2021.

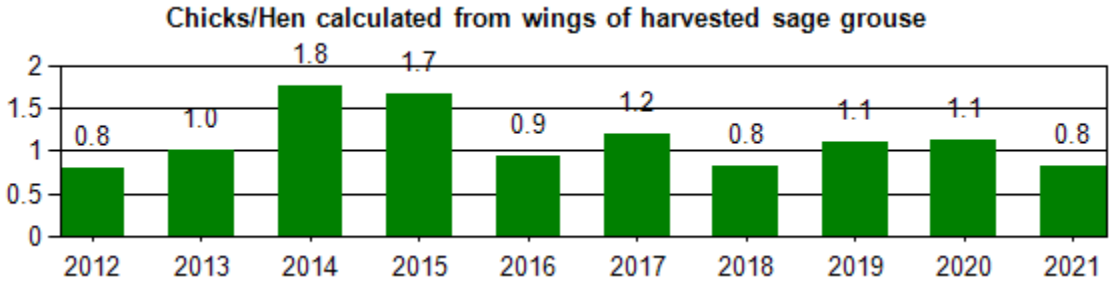

Figure 10. Average number of chicks per hen 2012-2021 based on wings from harvested sage-grouse.

Year	Chicks:Hen (based on wings from harvested birds)	Change in male lek attendance the following spring
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%
2019	1.1	-2.5%
2020	1.1	-13%
2021	0.8	+6%

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

Weather and Habitat

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 stream courses. Wyoming also experienced significant drought in the spring of 2021. As of May 2021, 80% of Wyoming was in at least a moderate to extreme drought. For the biological year considered, conditions improved slightly in the Big Horn Basin and Northeast Wyoming, Figure 13, but degraded in the western portion of the state, Figure 14. In general, spring precipitation is positively linked to summer chick survival, autumn chick:hen ratios, which are in turn, linked to the next year's lek counts of males. However, periods of prolonged cold, wet weather may have adverse effects on hatching success, chick survival, and plant and insect phenology and production. 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 predictable fashion over meaningful scales have largely failed.

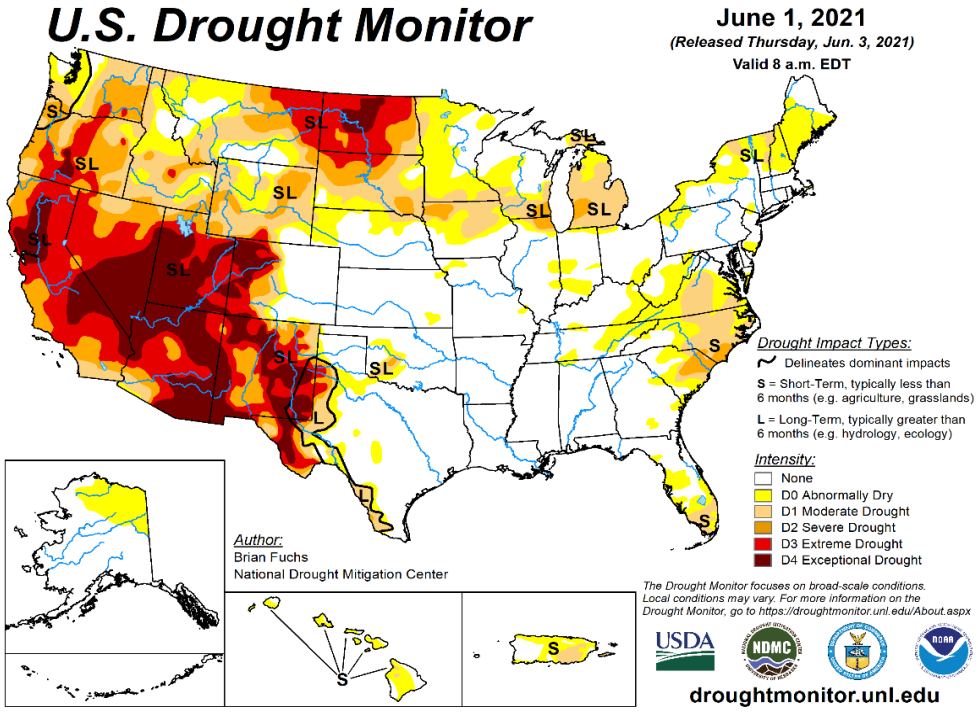

Figure 11. Drought Monitor Map from June 1, 2021. (National Drought Mitigation Center)

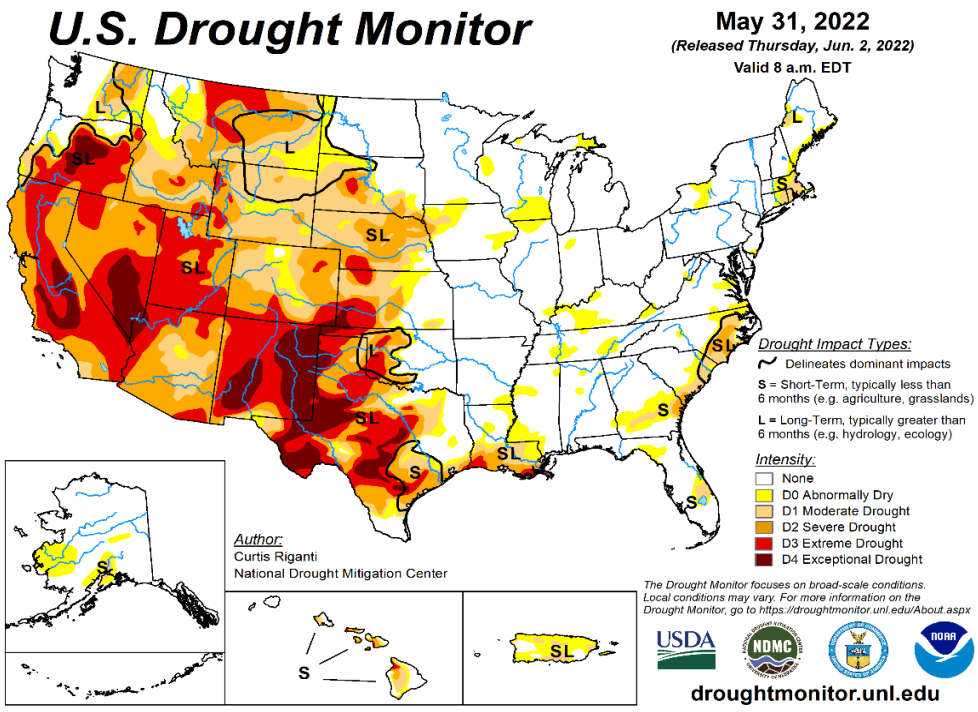

Figure 12. Drought Monitor Map from May 31, 2022 (National Drought Mitigation Center)

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, WGFD, the Wyoming Geographic Information Science Center (WYGISC) of the University of Wyoming and others.

Conservation Planning

The Wyoming Game and Fish Commission typically allocates $548,000 annually to fund Sage-Grouse local working group (Figure 13) projects. During Fiscal Year 2022, twenty (20) projects (Attachment B) were funded. Most of the projects are supported by multiple cost-sharing partners. Cumulatively, three-hundred and fourteen (314) projects have been approved since the Local Working Groups inception in 2005. Projects include habitat treatments/restoration, improved range management infrastructure and grazing management plans, applied research, inventories, monitoring, and public outreach.

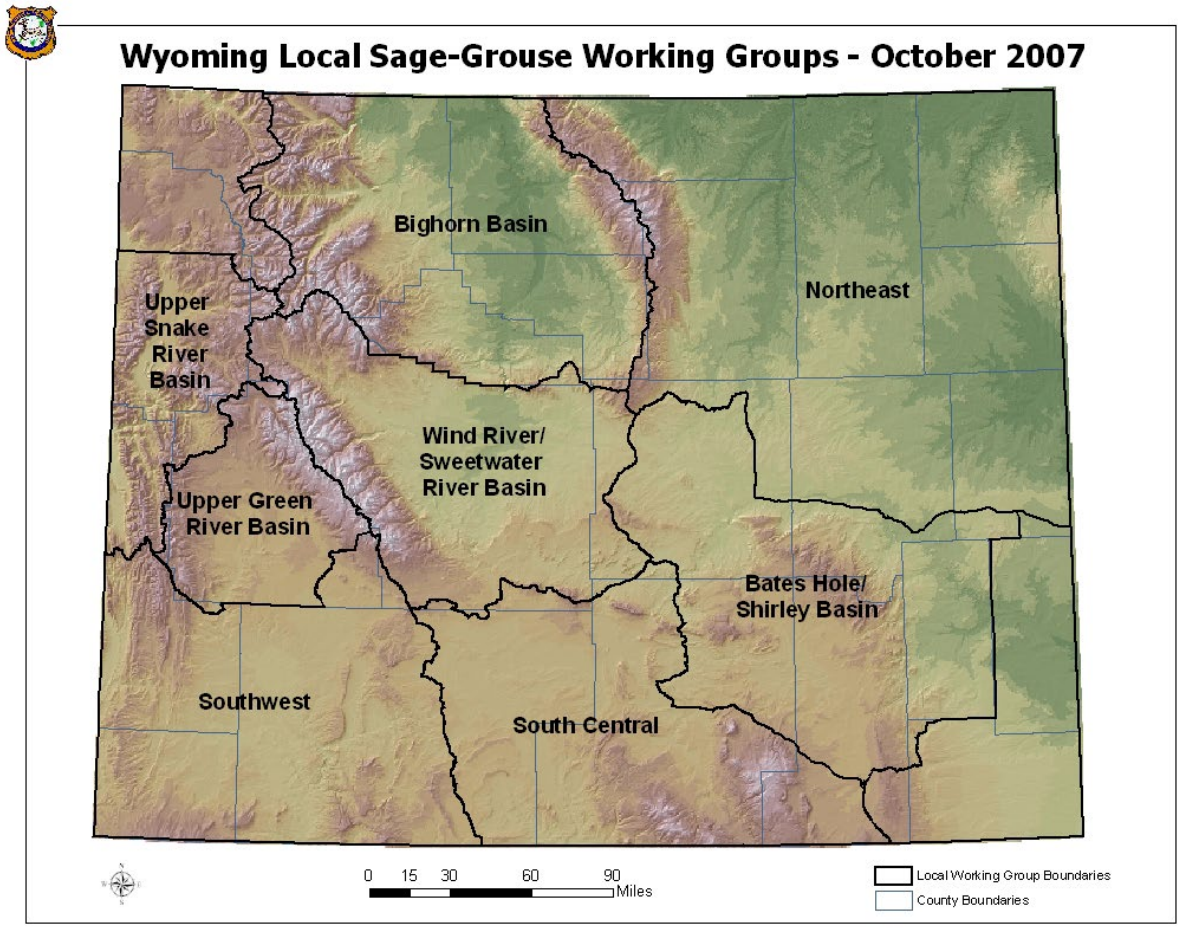

Figure 13. Wyoming Local Sage-grouse Working Group boundaries.

Governor's Core Area Strategy 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 (Figure 14). 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

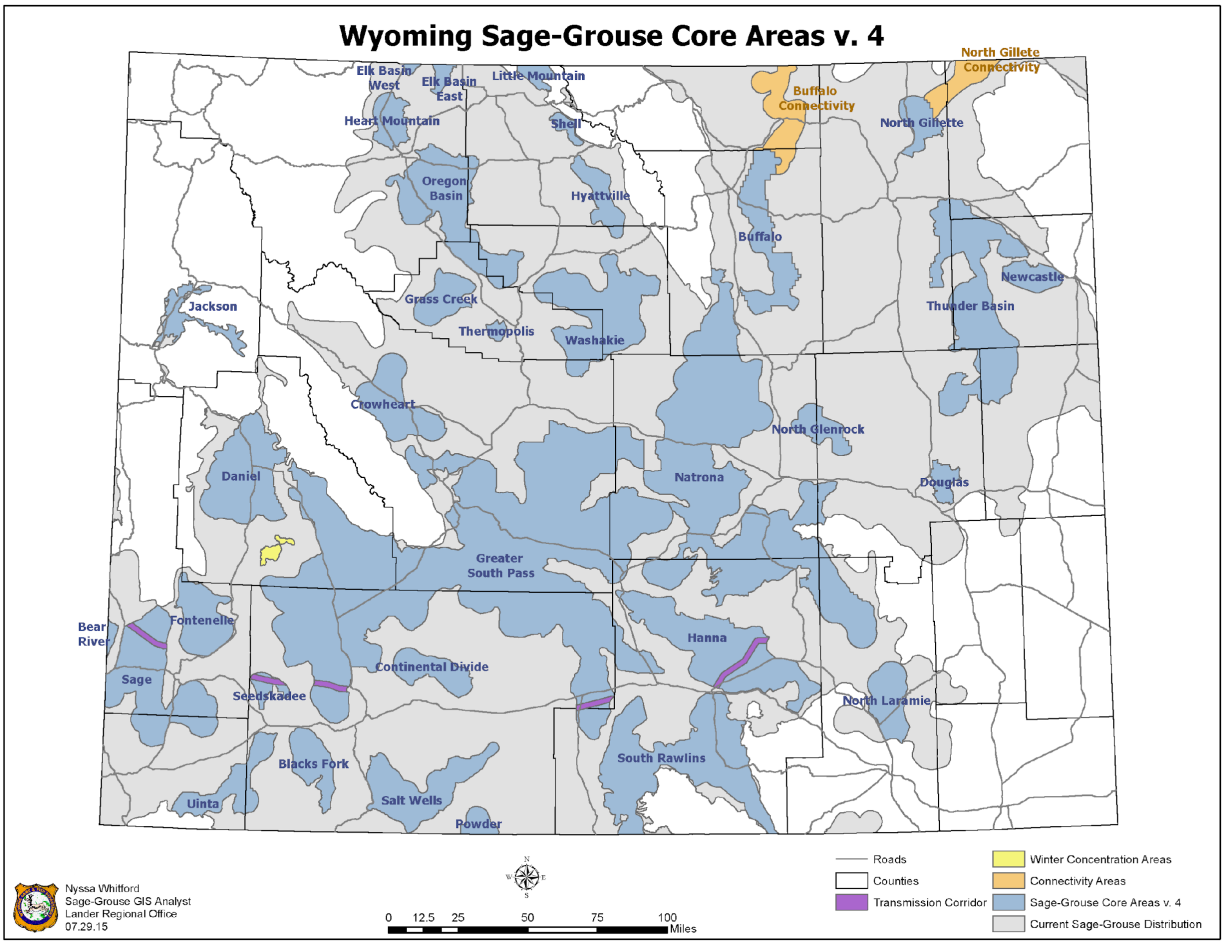

Figure 14. Sage-Grouse Core Areas, version 4.

The Core Area Strategy is being implemented across the state under the guidance of a state/federal interagency team of specialists (Sage-grouse Implementation Team; SGIT) who meet 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. Until early 2022, this tool was provided by the University of Wyoming's Geographic Information and Science Center. Currently, the Wyoming Game and Fish maintains and manages the application.

In accordance with Appendix I of the State of Wyoming 2019-3 Executive Order, the State Adaptive Management Working Group (SAMWG) requested information and recommendations

from each Local Working Group (LWG) as well as WGFD biologists in early 2022 regarding 2021 trends and current conditions of sage-grouse populations and sagebrush habitat. The LWGs reviewed data and, in conjunction with input from WGFD, provided recommendations on areas of concern to the SAMWG. This resulted in the SAMWG's determination, either in part or in whole, that the following 16 core areas were deemed areas of concern: Blacks Fork, Buffalo, Douglas, Greater South Pass, Hanna, Heart Mountain, Hyattville, Jackson, Natrona, Newcastle, North Glenrock, North Laramie, Oregon Basin, Sage, South Rawlins, and Washakie. In many instances a request was made by the LWGs to establish a technical team to evaluate these issues further. On August 8, 2022, a Strike Team was officially convened by the SAMWG to begin the process of a more rigorous evaluation of potential causal factors related to areas of concern within a subsample of the aforementioned core areas. The six core areas selected for this exercise were Blacks Fork, Hanna, Natrona, Sage, South Rawlins, and Washakie. These six core areas occurred within five different LWG areas: Bates Hole/Shirley Basin, Southwest, South Central, Wind River/Sweetwater, and the Bighorn Basin. The Strike Team was tasked with taking a deeper look at information and recommendations from the LWGs following their initial assessments of casual factors as well as considering other sources of information and data with the end goal of producing a revised report to the SAMWG. A report was delivered to the SAMWG by the end of 2022. A response is forthcoming. This process has yet to begin for lek monitoring data collected during the spring of 2022.

Wyoming to North Dakota Translocation Project

Utah State University researchers, in conjunction with North Dakota Game and Fish and WGFD, translocated sage-grouse from the Stewart Creek area of Wyoming to Bowman County, North Dakota starting in 2017 and ending in 2020. In 2017, adult males and females were translocated with males and complete broods translocated in the latter years. The results of this study are detailed in four published research papers: Lazenby et al. 2020, Meyerpeter et al. 2021, Picardi et al. 2021a, Picardi et al. 2021b.

Over the 4 years of this translocation project, initial thoughts by field managers were 1) translocations have had a positive impact for ND and little, if any, impacts to WY, but 2) translocations would need to occur on a longer time scale to ensure that translocations coincide with a rare "good" year, climate-wise and 3) brood translocations were the best hope and had the shortest dispersals and shortest time spent exploring the new habitat before settling into a localized behavior state; however 4) since hens did not explore when translocated with a brood, choosing a high-quality brood-rearing site is critical. These initial thoughts were supported by the published research.

Western Association of Fish and Wildlife Agencies Conservation Assessment Report

The Western Association of Fish and Wildlife Agencies planned to re-examine the 2015 "not warranted" listing decision in 2020 to ensure planned conservation efforts were implemented and the status of the species remains unwarranted for listing. WAFWA's examination is not yet complete but should be released in 2023.

Sage-Grouse Bird Farm Legislation

The 2017 state 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. One permit was issued to the same facility in 2019, 2020, 2021, and January 2022. In April and May 2021, 133 eggs were collected from the wild for this purpose. The eggs were incubated at the facility and chicks hatched in the summer of 2021. As of July 2021, 94 live sage-grouse resided in the pens of the facility. In spring of 2022, 203 eggs were collected inside the facility, of those 172 were viable. Of those viable eggs, 117 birds survived the hatch and brooding process. The 2022 Legislature passed a bill extending the sunset date of this legislation for another 5 years to continue the allowance of private bird farm operations to collect sage-grouse eggs from the wild for purposes of establishing a captive flock. In spring 2022, Chapter 60 was amended to limit certifications of facilities to one.

Research and Publications

Attachment B 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) Continue to refine and enhance the sage-grouse database and Job Completion Report intranet program.

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

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

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

7) Monitor 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.

8) Continue to manage and maintain the OneSteppe site which includes the Density Disturbance Application Tool (DDCT) and the Wyoming Conservation Efforts Database (WyCED)

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Project #	Project Name	Fiscal Year	Local Working Group	Total Cost of Project	Sage-grouse Funds	Partners
295	Sanchez Creek Riparian Restoration and Conifer Removal	2022	Bates Hole	$529,525	$20,000	WGFD
296	Cellers Loop Fire Treatment	2022	Northeast	$95,750	$37,500	WGFD, WWNRT
297	Shirley Basin Infrared Survey Flights	2022	Bates Hole	$40,000	$20,000	WGFD
298	Grizzly Wildlife Habitat Management Area Shade Balls	2022	South Central	$3,200	$3,200	WGFD, BLM, SERCD
299	Bear Creek Riparian enhancement Phase II	2022	Bighorn Basin	$67,500	$19,300	WGFD, Rocky Mountain Elk Foundation
300	Adaptive Management of the NPL Gas Field for Sage-grouse	2022	South Central/Southwest/Upper Green	$631,225	$70,000	WGFD, BLM, Jonah Energy, UW
301	Southwest Wyoming Local Sage Grouse Project Monitoring and Maintenance Phase 2	2022	Southwest	$10,500	$10,500	BLM, WGFD
302	Live Sagebrush Streams & Virtual Classroom Content	2022	Bates Hole	$44,000	$15,000	Audubon Rockies
303	Interactive Effects of Predators, Habitat, and Livestock Presence on Sage-Grouse	2022	Bighorn Basin	$519,287	$55,700	BLM, WGFD
304	Saratoga Elementary School Outdoor Classroom Phase 1	2022	South Central	$69,336	$10,000	Saratoga Elementary School
305	Barrett Ridge Conifer Encroachment	2022	South Central	$160,000	$10,000	BLM
306	Influence of Annual Climatic Variability on Sage-grouse Brood-rearing Ecology	2022	Bates Hole, Big Horn Basin, Northeast, South Central, Southwest, Upper Green, Upper Snake, Wind River, Sweetwater		$55,525	UW
307	Antelope Flats Sagebrush Habitat Restoration Project	2022	Upper Snake	$350,000	$23,000	Grand Teton National Park
308	Boyd Hollow Spring Protection and Development	2022	Southwest	$27,000	$7,500	Water for Wildlife, USFWS PFW, Teichert Bros
309	Lowham Ranch Yellow Creek and Spring Exclosure	2022	Southwest	$58,500	$14,275	Wyoming Wildlife Federation, WGFD
310	Cheatgrass Management in Greater Sage Grouse Core Areas, Sublette County	2022	Upper Green	$1,000,000	$30,000	Sublette County Weed and Pest
311	Pacific Butte Sheep Protection	2022	Southwest	$22,650	$4,000	BOW, RMEF, MFF, WFW, JAIO-PAPO, MDI, BLM
312	UAS Invasive Treatment Program	2022	Wind River	$91,160	$10,000	Fremont County Weed and Pest, WGFD, BLM
313	Roadside Invasive Annual Grass Control and Prevention	2022	Wind River	$100,000	$40,000	BLM, Fremont County Weed and Pest, SAC
314	Split Rock Ranch riparian and Springhead Restoration	2022	Wind River	$186,600	$25,000	BLM, WGFD, PACd

Attachment B:
Wyoming Sage-Grouse Research Reports (through May 31, 2022)

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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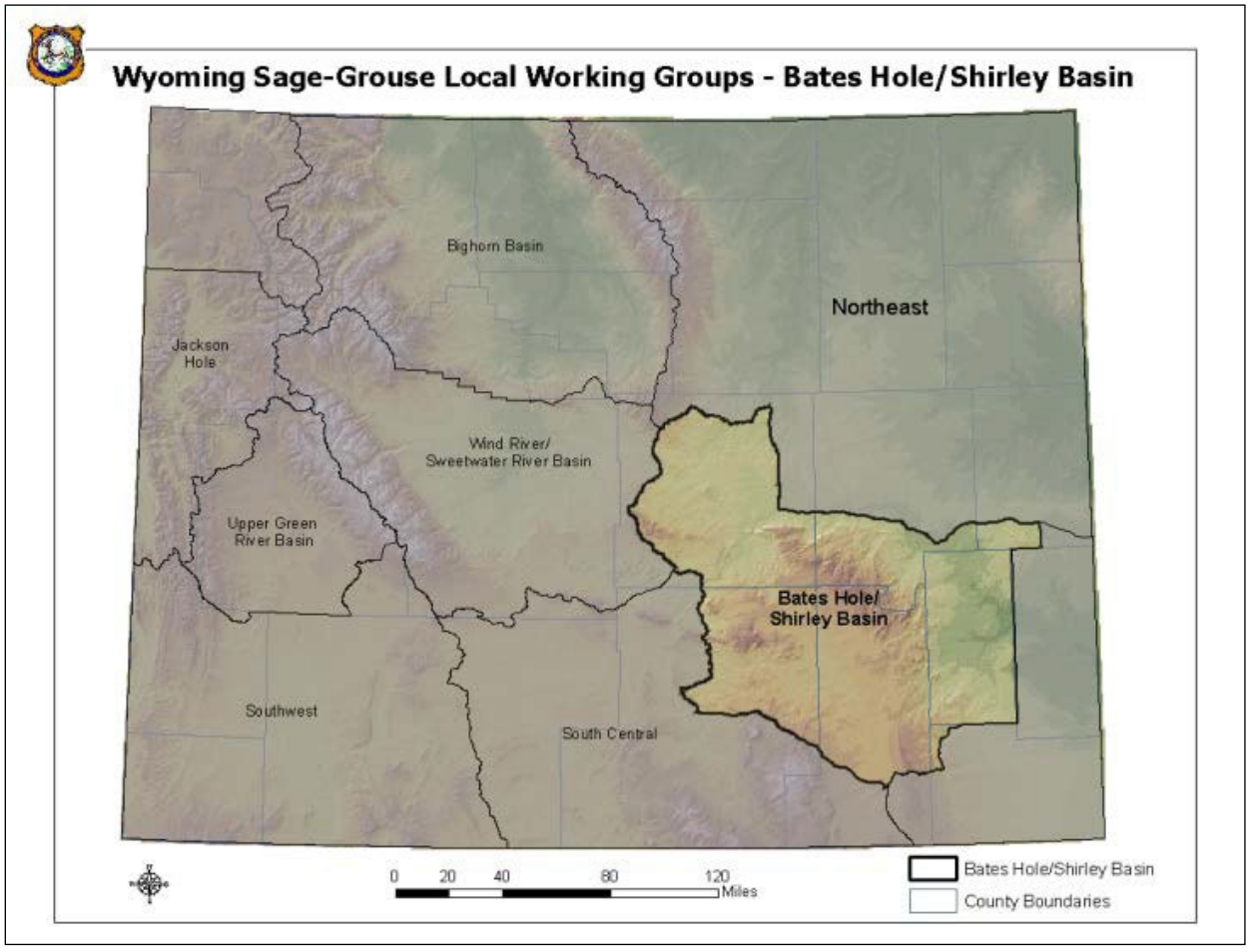
Bates Hole – Shirley Basin Conservation Area
Job Completion Report

Management Area: **F – (portions of Casper and Laramie Regions)**
Period Covered: **6/1/2021-5/31/2022**
Prepared By**: Willow Bish, Casper Region Habitat Biologist**



Sage Grouse Lek Characteristics

Management Area: F

Region	Number	Percent
Casper	128	40.3
Lander	2	0.6
Laramie	188	59.1

Working Group	Number	Percent
Bates Hole	318	100.0

Classification	Number	Percent
Occupied	204	64.2
Undetermined	21	6.6
Unoccupied	93	29.2

BLM Office	Number	Percent
Casper	129	40.6
Lander	2	0.6
Newcastle	1	0.3
Rawlins	186	58.5

Biologist	Number	Percent
Casper	117	36.8
Douglas	11	3.5
Laramie	109	34.3
Saratoga	72	22.6
Sinclair	2	0.6
Wheatland	7	2.2

Warden	Number	Percent
Douglas	3	0.9
East Casper	37	11.6
East Rawlins	2	0.6
Elk Mountain	69	21.7
Glenrock	9	2.8
Lusk	1	0.3
Medicine Bow	71	22.3
North Laramie	40	12.6
West Casper	78	24.5
West Cheyenne	2	0.6
Wheatland	6	1.9

County	Number	Percent
Albany	77	24.2
Carbon	107	33.6
Converse	12	3.8
Laramie	2	0.6
Natrona	113	35.5
Niobrara	1	0.3
Platte	6	1.9

Land Status	Number	Percent
BLM	106	33.3
BOR	1	0.3
Private	183	57.5
State	28	8.8

Management Area	Number	Percent
F	318	100.0

Lek Status	Number	Percent
Active	135	42.5
Inactive	119	37.4
Unknown	64	20.1

Sage Grouse Job Completion Report

Year: 2013 - 2022, Management Area: F

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

a. Leks Counted

Year	Occupied	Counted	Percent	Peak Males	Avg Males / Active Lek (2)
2013	220	77	35	969	16.4
2014	221	86	39	1261	19.4
2015	222	102	46	2869	33.0
2016	223	86	39	2893	40.2
2017	224	79	35	2213	35.7
2018	219	109	50	1944	24.0
2019	217	89	41	1474	21.1
2020	213	116	54	1513	18.2
2021	212	105	50	1260	16.6
2022	208	107	51	1514	19.9

b. Leks Surveyed

Year	Occupied	Surveyed	Percent	Peak Males	Avg Males / Active Lek (2)
2013	220	98	45	814	14.0
2014	221	120	54	928	13.4
2015	222	94	42	1677	26.6
2016	223	103	46	2298	31.9
2017	224	124	55	2143	29.0
2018	219	80	37	1105	20.5
2019	217	99	46	1060	20.4
2020	213	58	27	648	18.5
2021	212	74	35	659	16.5
2022	208	80	38	675	17.8

c. Leks Checked

Year	Occupied	Checked	Percent Checked	Peak Males	Avg Males / Active Lek (2)
2013	220	175	80	1783	15.2
2014	221	206	93	2189	16.3
2015	222	196	88	4546	30.3
2016	223	189	85	5191	36.0
2017	224	203	91	4356	32.0
2018	219	189	86	3049	22.6
2019	217	188	87	2534	20.8
2020	213	174	82	2161	18.3
2021	212	179	84	1919	16.5
2022	208	187	90	2189	19.2

d. Lek Status

Year	Active	Inactive (3)	Unknown	Known Status	% Active	% Inactive
2013	123	39	13	162	75.9	24.1
2014	138	48	20	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	138	43	8	181	76.2	23.8

Sage Grouse Job Completion Report

Year: 2013 - 2022, Management Area: F

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

Continued

2019	133	37	18	170	78.2	21.8
2020	125	38	11	163	76.7	23.3
2021	121	36	22	157	77.1	22.9
2022	126	38	23	164	76.8	23.2

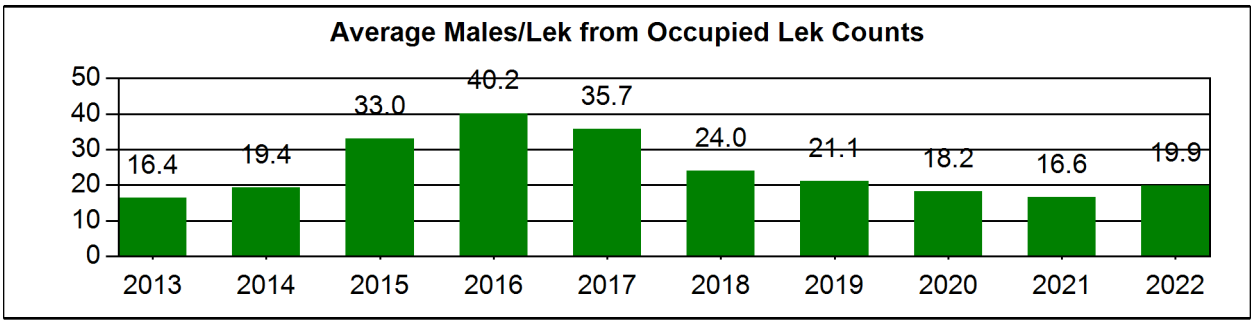
1) Occupied - must have been active once during previous 10 years, calculated based on the official definitions

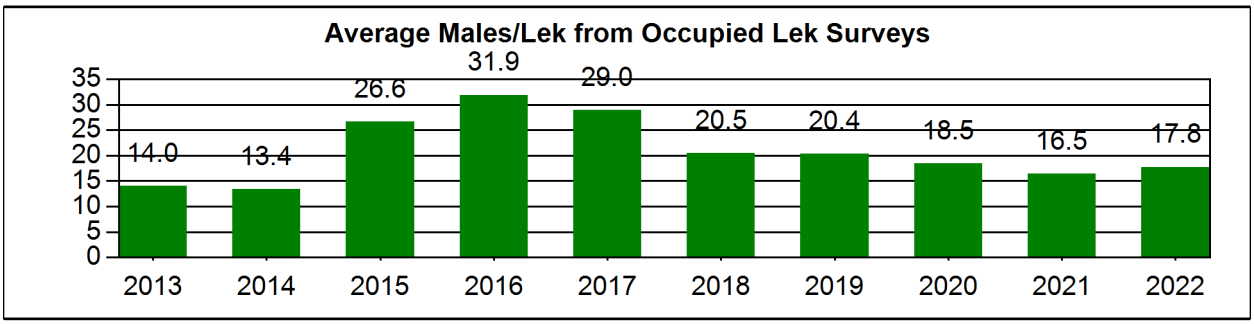
2) Avg Males/Active Lek - Includes only those leks where one or more strutting males were observed. Does not include "Active" leks where only sign was documented.

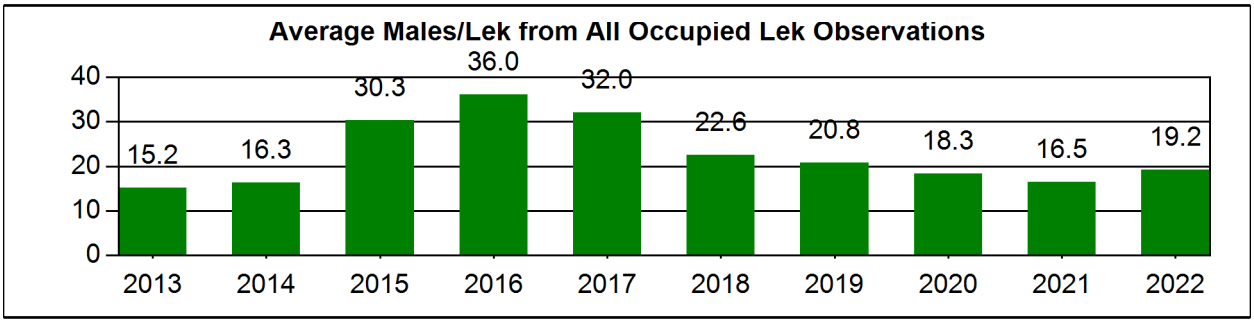
3) Inactive - Confirmed no birds/sign present (see official definitions)

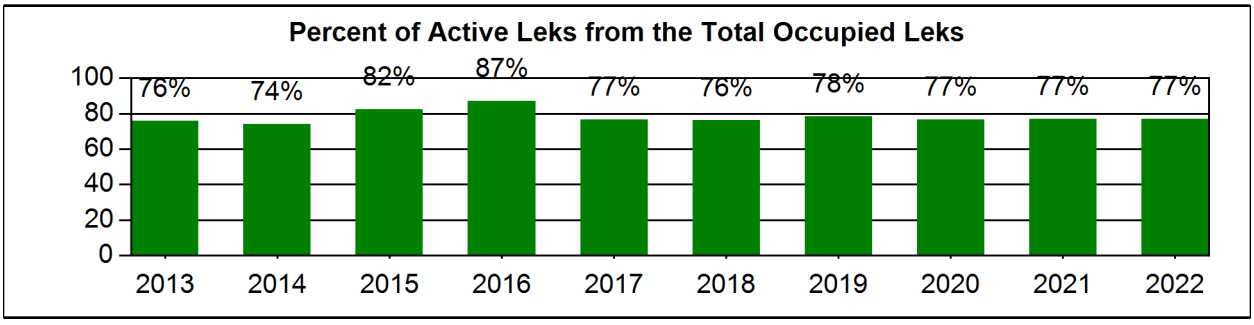
Sage Grouse Occupied Lek Attendance Summary (1)

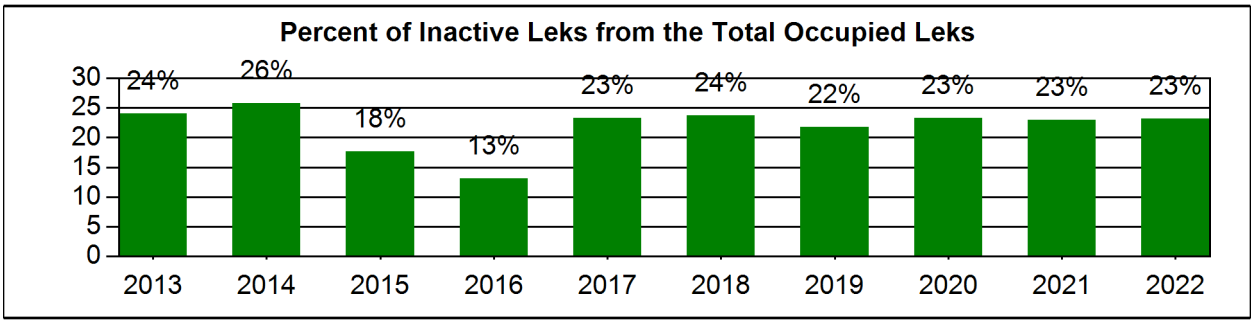
Year: 2013 - 2022, Management Area: F











1) Occupied - must have been active once during previous 10 years, calculated based on the official definitions

Sage Grouse Job Completion Report

Year: 2012 - 2021, Working Group: Bates Hole

3. Sage Grouse Hunting Seasons and Harvest Data

a. Season

Year	Season Start	Season End	Length	Bag/Possesion Limit
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
2019	Sep-21	Sep-30	10	2/4
2020	Sep-19	Sep-30	12	2/4
2021	Sep-18	Sep-30	13	2/4

b. Harvest

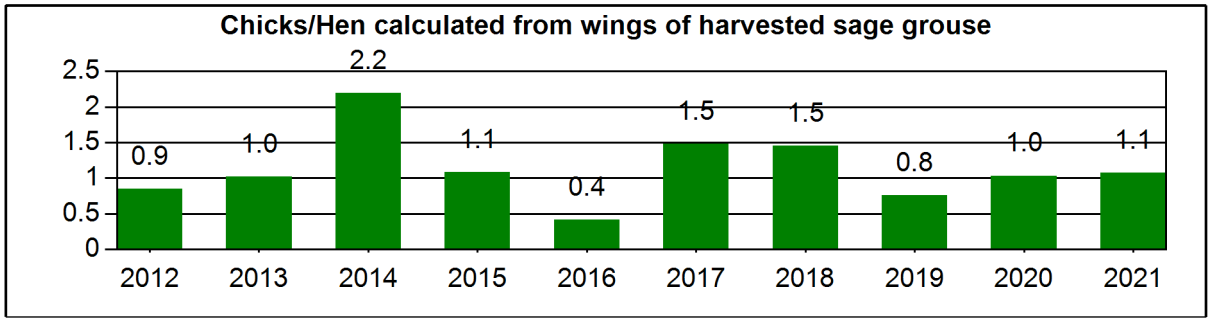
Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2012	688	415	852	0.8	1.7	2.1
2013	488	399	670	0.7	1.2	1.7
2014	588	352	804	0.7	1.7	2.3
2015	837	380	889	0.9	2.2	2.3
2016	869	466	869	1.0	1.9	1.9
2017	621	315	688	0.9	2.0	2.2
2018	805	464	993	0.8	1.7	2.1
2019	723	403	736	1.0	1.8	1.8
2020	252	212	595	0.4	1.2	2.8
2021	1071	513	1195	0.9	2.1	2.3
Avg	694	392	829	0.8	1.7	2.2

Sage Grouse Job Completion Report

Year: 2012 - 2021, 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	
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
2019	212	13.2	32.5	3.8	14.6	12.3	23.6	0.8
2020	273	8.8	30.8	4.8	11.7	10.6	33.3	1.0
2021	195	8.7	31.8	3.1	10.8	21.0	24.6	1.1



Report Date: January 4, 2023

Lek Monitoring

As of spring 2022, there are 208 known occupied leks, 93 unoccupied leks, and 21 leks of an undetermined classification within the Bates Hole/ Shirley Basin Local Working Group (BHSBLWG) area. In 2022, WGFD personnel, BLM personnel, volunteers and consultants combined efforts to check 90% of known occupied leks in the BHSBLWG area. A total of 107 occupied leks were counted while 80 were surveyed, with annual status being confirmed on 164 occupied leks in 2021. Of these, 126 (77%) were active and 38 (23%) were inactive.

Population Trend

Sage-grouse populations exhibit cyclical patterns. The 2021 average males/lek (16.5) from all occupied lek observations (counts and surveys) was similar to the average males/lek in 2013 and 2014 (15.2 and 16.3, respectively). Average male lek attendance from 2013-14 and 2021 mark the lowest averages recorded since intensive lek monitoring began in 2000. Although male lek attendance increased significantly through 2016, which marked a cyclical peak with a mean maximum number of males per counted lek increasing to 36, male lek attendance then declined sharply from 2016-2021. In 2022, there were 19.2 males/lek from all occupied lek observations, which marked an increase from last year and may indicate sage-grouse will continue to increase as they enter this phase of their population cycle. See “Sage Grouse Occupied Lek Attendance Summary for graph.

Productivity

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. 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. Based on wing data within the BHSBLWG area, moderate to poor sage-grouse juvenile recruitment over the past five years has resulted in continued population decline as evidenced by declining male lek attendance. In 2021, the chick/hen ratio was 1.1, based on wing-barrel data. The chick to hen value was calculated using a sample of 195 wings, which represents 18% of the estimated harvest based on hunter surveys. Despite the 2021 chick/hen ratio being below what is normally considered necessary for subsequent population increase, male lek attendance increased in 2022. This may be a function of improved annual survival of sage-grouse over the past year or the true proportion of chicks to hens was underrepresented in the wing barrels.

Harvest

Hunter harvest has declined in recent years, with estimates from 2013 (N=488) marking an historic low. Following a period of steadily increasing harvest from 2013-2016, sage-grouse harvest has since remained relatively static in the BHSBLWG area from 2017-2019, averaging 716. Total harvest in 2020 was estimated to be 252 birds, however, due to sampling errors, harvest data from 2020 is unreliable. Estimated harvest was 1,071 in 2021. There were 513 sage-grouse hunters in the BHSBLWG area in 2021, which is the highest number of hunters since 2011. Birds harvested per day in 2021 (0.9) and days/hunter (2.3) are similar to the 10-year

average (0.8 and 2.2, respectively). Thus increased harvest is likely a result of the higher number of hunters in 2021.

Habitat

The BHSBLWG area has many of the same habitat quality concerns that occur throughout sage-grouse range including habitat alteration, development and fragmentation, drought, noxious and invasive weed, especially annual invasive grasses, declines in mesic habitat, and improper livestock grazing. In recent years, managers are most concerned about on-going and potential expansion of large-scale industrial wind development projects within Shirley Basin. Transmission lines within the BHSBLWG area have also been a recent and on-going large scale disturbance within prime sage-grouse habitat.

Sagebrush condition throughout some portions of the area may also be of concern. In spring of 2021, sagebrush condition was assessed across the northern portion of the LWG area in Natrona County by WGFD personnel. While browse levels averaged 23%, which is not excessive, 30% of the plants were in poor to extremely condition (defined as having 30% or more of an individual plant appearing dead), likely from previous years of drought. In addition, only 24% of the plants were classified as being lightly hedged, with 40% and 36% of the plants being moderately or severely hedged, respectively. Hedging is a result of previous and potentially long-term over-browse, likely from pronghorn and domestic sheep, where they occur. Sagebrush plants in this area may take a very long time to recover, if they ever do. This decline in sagebrush quality may negatively impact sage-grouse. Managers in southern portions of the LWG area have noticed similar concerns with sagebrush quality.

The RR316 wildfire burned 14,200 acres outside of Hanna, Wyoming in late summer 2020. High fire severity resulted in substantial loss of sagebrush cover in sage-grouse core area. Over ten miles of woven wire/barbed combination fence were replaced with four-wire wildlife friendly fence in 2021 and marked with reflective markers in spring 2022. At least two tire tanks with associated pipes and wildlife access modifications will be constructed in 2023. In portions of the burned area, livestock grazing was deferred in 2021, which resulted in good recovery of native, perennial herbaceous vegetation. Additionally, in fall 2021, BLM planted approximately 3,000 sagebrush seedlings north of US 30 on BLM and private lands to aid in sagebrush recovery and reduce wind erosion. Thus far, cheatgrass has not invaded the burn scar.

The Pedro Mountain Fire burned about 19,000 acres in 2019. However, very little of the fire was in suitable sage-grouse habitat. The very southern portion of the burn is of most concern to sage-grouse managers. Sagebrush restoration efforts have not occurred, however, the area has been sprayed for cheatgrass and plans are in place to re-spray in the future.

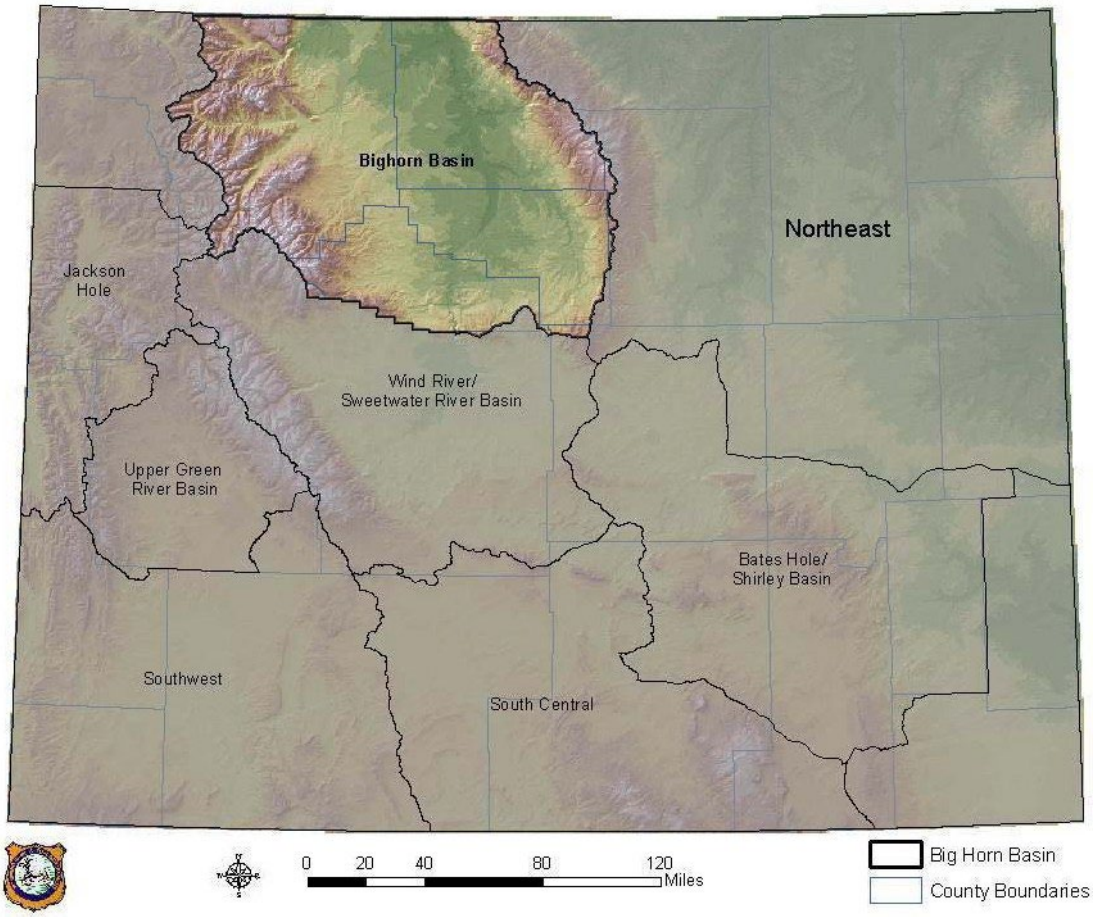
Disease

There were no confirmed cases of West Nile virus (WNv) in sage-grouse within the BHSBLWG area during this reporting period. While WGFD field personnel, other agency personnel and the public are requested to recover and submit carcasses of dead birds to the Wyoming State Vet Lab for necropsy, very few, if any birds are submitted. Sage-grouse carcasses typically do not persist

in the field for very long, making it difficult for timely discovery and submission. 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.

Bighorn Basin Local Working Group
Job Completion Report

Management Area: B – (Cody Region)
Period Covered: 6/1/2021 – 5/31/2022
Prepared by: Sam Stephens, Greybull Wildlife Biologist



Lek Monitoring

In spring 2022, 79 occupied leks were counted in the Basin, resulting in an average of 15.7 males per lek (Table 1a). We surveyed 121 leks for a total of 200 leks checked during the 2022 season (2013-22 average=200; Table 1b). 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 males observed on leks

The average number of male sage-grouse on all occupied leks showed an increase from the 2021 count of 11.9 to 12.6 in 2022 (Table 2c). Sage-grouse populations cycle on approximate 7 to 10-year intervals (Fedy and Doherty 2010; Figure 2). The number of inactive leks increased significantly in 2020 (58). In 2022 the number of inactive leks showed a slight increase from 53 (2021) to 60.

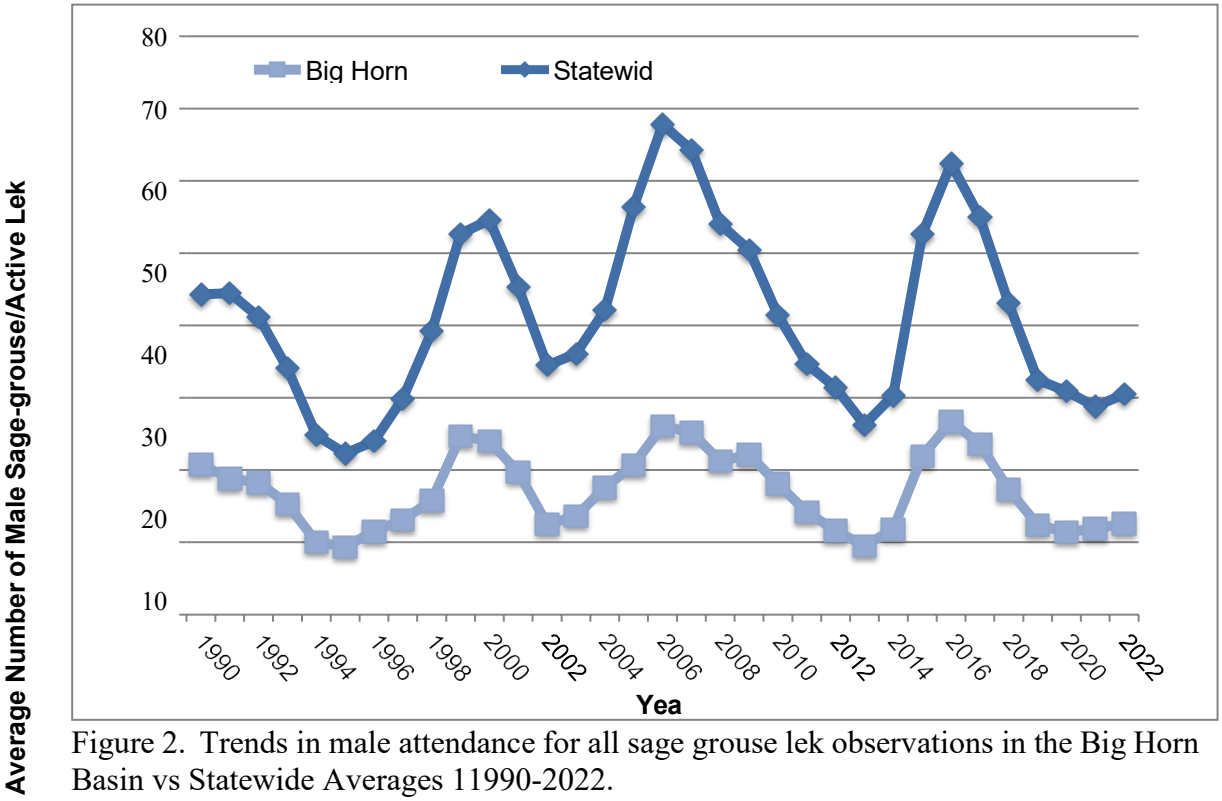


Figure 2. Trends in male attendance for all sage grouse lek observations in the Big Horn Basin vs Statewide Averages 11990-2022.

Table 1a. Leks Counted

Year	Occupied	Counted	Percent Counted	Peak Males	Avg Males / Active Lek (2)
2013	237	42	18	501	12.5
2014	234	67	29	823	14.4
2015	244	53	22	1108	26.4
2016	250	86	34	2258	30.5
2017	252	56	22	1636	34.8
2018	243	60	25	1115	24.2
2019	242	58	24	873	17.1
2020	233	69	30	863	16.6
2021	232	113	49	1082	14.2
2022	229	79	34	815	15.7

Table 1b. Leks Surveyed

Year	Occupied	Surveyed	Percent Surveyed	Peak Males	Avg Males / Active Lek (2)
2013	237	148	62	749	8.2
2014	234	91	39	517	9.2
2015	244	141	58	2297	20.3
2016	250	140	56	2053	23.3
2017	252	175	69	2286	19.2
2018	243	153	63	1434	14.2
2019	242	139	57	835	9.6
2020	233	127	55	617	7.9
2021	232	81	35	292	7.5
2022	229	121	53	609	10.0

Table 1c. Leks Checked

Year	Occupied	Checked	Percent Checked	Peak Males	Avg Males / Active Lek (2)
2013	237	190	80	1250	9.5
2014	234	158	68	1340	11.9
2015	244	194	80	3405	22.0
2016	250	226	90	4311	26.6
2017	252	231	92	3922	23.6
2018	243	213	88	2549	17.3
2019	242	197	81	1708	12.4
2020	233	196	84	1480	11.4
2021	232	194	84	1374	11.9
2022	229	200	87	1424	12.6

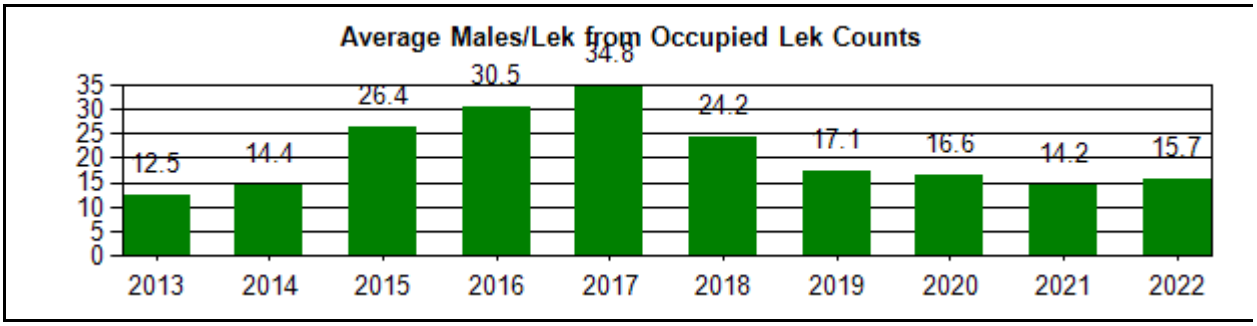
Table 1d. Lek Status

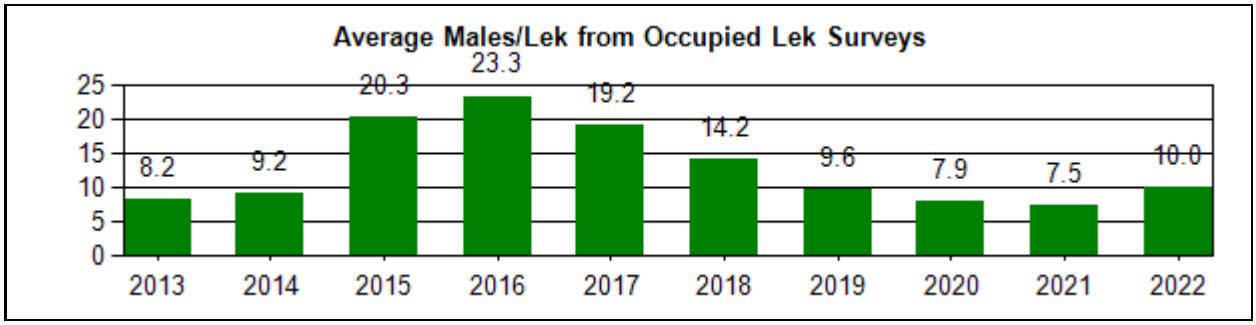
Year	Active	Inactive (3)	Unknown	Known Status	% Active	% Inactive
2013	132	9	49	141	93.6	6.4
2014	115	23	20	138	83.3	16.7
2015	156	27	11	183	85.2	14.8
2016	173	26	27	199	86.9	13.1
2017	171	35	25	206	83.0	17.0
2018	152	34	27	186	81.7	18.3
2019	148	42	7	190	77.9	22.1
2020	136	58	2	194	70.1	29.9
2021	124	53	17	177	70.1	29.9
2022	116	60	24	176	65.9	34.1

1) Occupied - must have been active once during previous 10 years, calculated based on the 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)


Average Males/Lek from Occupied Lek Counts
35
30
25
20
15
10
5
0
12.5
14.4
26.4
30.5
34.8
24.2
17.1
16.6
14.2
15.7
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022


Average Males/Lek from Occupied Lek Surveys
25
20
15
10
5
0
8.2
9.2
20.3
23.3
19.2
14.2
9.6
7.9
7.5
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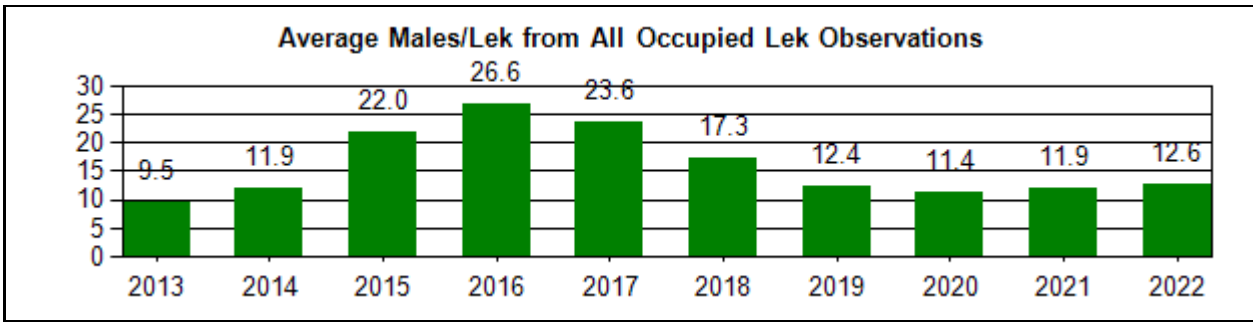
2022


Average Males/Lek from All Occupied Lek Observations
30
25
20
15
10
5
0
9.5
11.9
22.0
26.6
23.6
17.3
12.4
11.4
11.9
12.6
2013
2014
2015
2016
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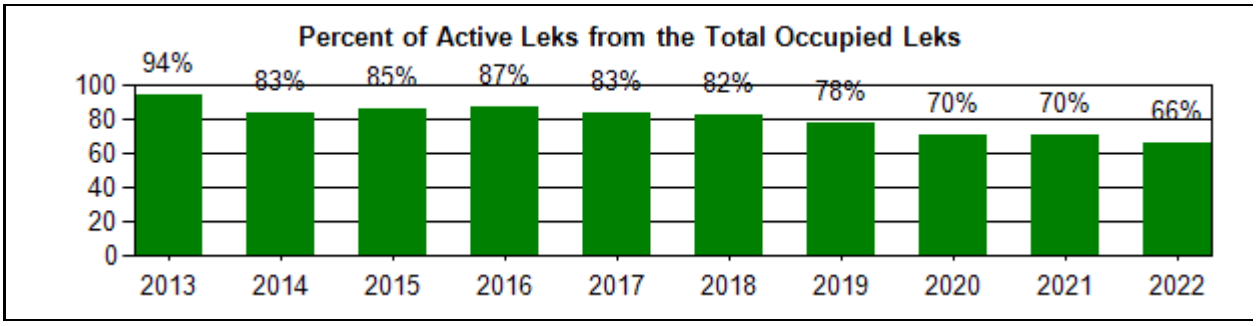
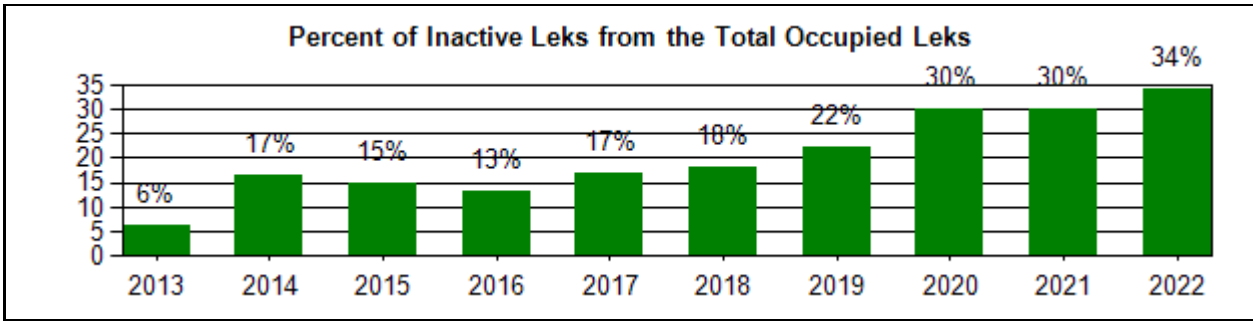
2018
2019
2020
2021
2022


Percent of Active Leks from the Total Occupied Leks
100
80
60
40
20
0
94%
83%
85%
87%
83%
82%
78%
70%
70%
66%
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022


Percent of Inactive Leks from the Total Occupied Leks
35
30
25
20
15
10
5
0
6%
17%
15%
13%
17%
18%
22%
30%
30%
34%
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

Lek Characteristics
Working Group: Big Horn Basin

Region	Number	Percent
Cody	310	100.0

Working Group	Number	Percent
Big Horn Basin	310	100.0

Classification	Number	Percent
Occupied	219	70.6
Undetermined	43	13.9
Unoccupied	48	15.5

BLM Office	Number	Percent
Cody	115	37.1
Worland	195	62.9

Biologist	Number	Percent
Cody	86	27.7
Greybull	52	16.8
Worland	172	55.5

Warden	Number	Percent
Greybull	23	7.4
Lovell	31	10.0
Meeteetse	32	10.3
North Cody	25	8.1
Powell	13	4.2
South Cody	28	9.0
Ten Sleep	52	16.8
Thermopolis	48	15.5
Worland	58	18.7

County	Number	Percent
Big Horn	48	15.5
Hot Springs	61	19.7
Park	105	33.9
Washakie	96	31.0

Land Status	Number	Percent
BLM	205	66.1
BOR	3	1.0
Private	83	26.8
State	19	6.1

Management Area	Number	Percent
B	310	100.0

Lek Status	Number	Percent
Active	129	41.6
Inactive	124	40.0
Unknown	57	18.4

Production Surveys

Eleven sage-grouse broods were documented in 2022 (Table 4). 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, August and Early September. 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, 2012-21.

Year Observed	Broods	Chicks	Hens	Chicks/brood	Chicks/hen
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
2020	4	22	4	5.5	5.5
2021	4	22	4	5.5	5.5
2022	11	56	13	5.0	4.3
2013-22 average	**6.8**	**32**	**10.3**	**4.8**	**3.9**

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 (2013-2021), hunters averaged 1.7 birds/hunter and 2.6 days/hunter. In 2021, 493 hunters in the Big Horn Basin harvested 586 sage-grouse (1.2 birds/hunter); spending 1290 hunter-days afield (2.6 days/hunter) during the 13-day hunting season (Table 3). The significant decrease in sage grouse harvest from 2020 to 2021 (767 to 586) is likely due to the cumulative impact of decreased sage grouse abundance and poor weather conditions. Hunters who visited with regional staff expressed a desire to harvest sage grouse while the opportunity still exists relative to other states where harvest has been more restricted. This likely contributed to the record high number of sage grouse hunters in 2021(493).

Table 3. Sage Grouse Hunting Seasons and Harvest Data

a. Season

Year	Season Start	Season End	Length	Bag/Possession Limit
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
2019	Sep-21	Sep-30	10	2/4
2020	Sep-19	Sep-30	12	2/4
2021	Sep-18	Sep-30	13	2/4

b. Harvest

Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
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
2019	312	244	463	0.7	1.3	1.9
2020	767	331	1037	0.7	2.3	3.1
2021	586	493	1290	0.5	1.2	2.6
Avg	556	334	880	0.6	1.7	2.6

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 2022, 310 sage-grouse leks are known to occur in the conservation area with 219 leks known to be occupied and 48 leks known to be unoccupied (Table 1). Undetermined leks (n=43) 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 potentially other leks in the Basin not yet discovered.

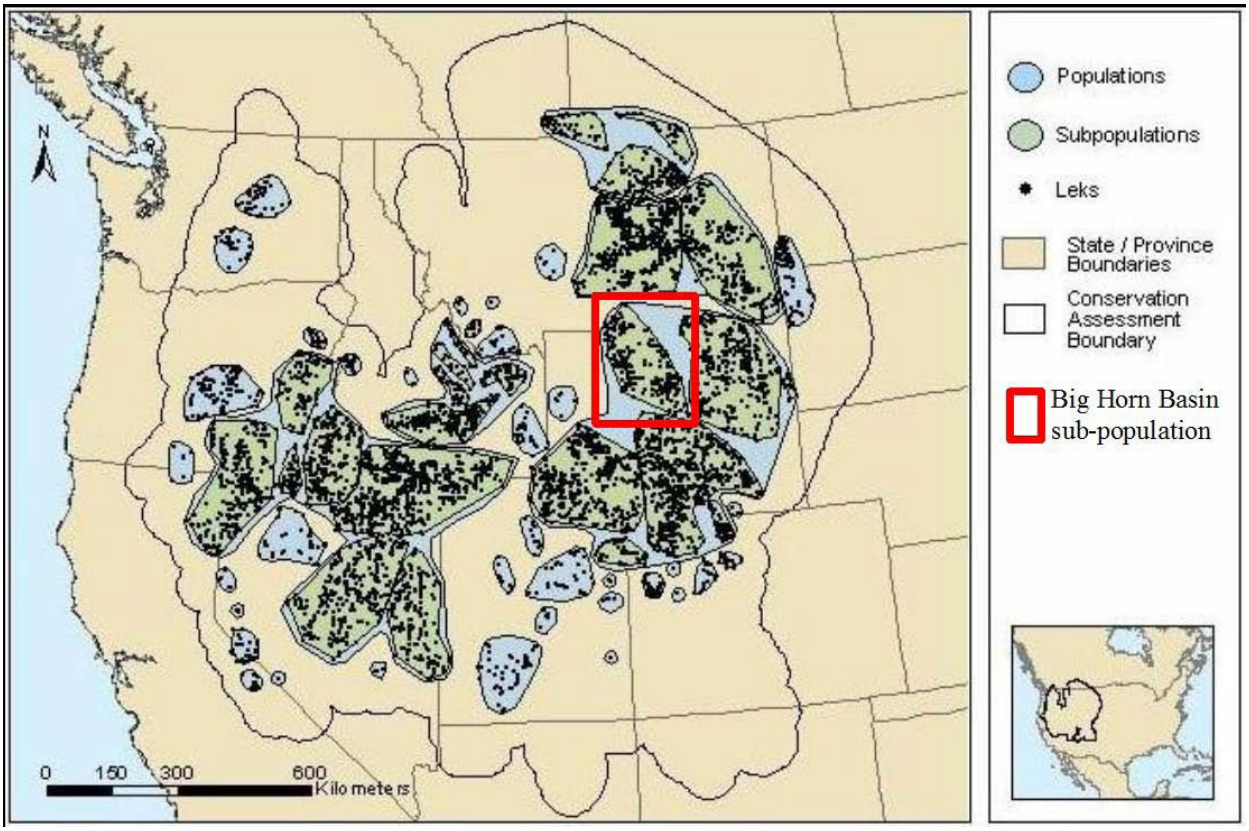


Figure 3. Discrete populations and subpopulations of sage-grouse in western North America, with the Big Horn Basin sub-population surrounded by the red rectangle. (Adapted from Connelly et. al. 2004).

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 2022 to discuss project funding allocation to sage grouse research and habitat improvement projects. The group agreed to grant $55,700 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. Additionally $10,000 was granted to fund wet meadow restoration through the application of Beaver Dam Analogs on Enos Creek.

Conclusions and Recommendations

For the 2021 biological year sage grouse populations in the Bighorn Basin appear to be on an upward trend from the previous two years. Peak male attendance in 2022 indicates a reversal of negative trends in the population. Although the sample size is limited the 2022 brood count survey data suggest that for the 2022 biological year, sage grouse populations in the Bighorn Basin will likely continue along the same increasing trend. 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.

- Formalize winter use area mapping in coordination with Worland and Cody BLM offices
- Serve an advisory role to the Bighorn Basin Sage Grouse Local Working Group in their annual efforts to follow the Adaptive Management practices outlined in the Wyoming State Executive Order 2019-3.
- 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 Shoshone National Forest, 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

Management Area: C – (Sheridan & Casper Regions)
Period Covered: 6/1/2021 – 5/31/2022
Prepared by: Erika Peckham, Gillette Wildlife Biologist

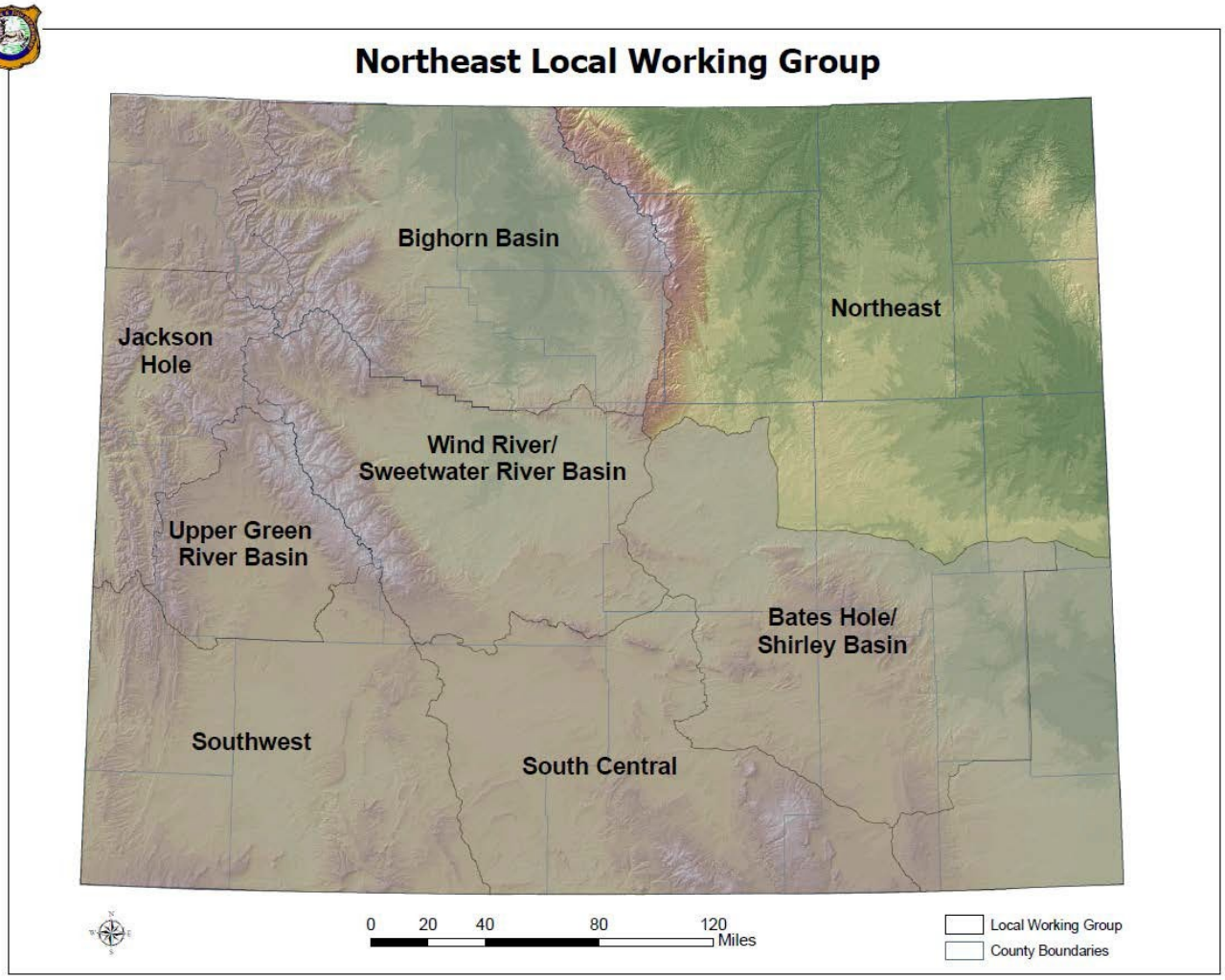


Figure 1: Northeast Local Working Group

Sage Grouse Lek Characteristics

Region	Number	Percent
Casper	157	26.3
Sheridan	439	73.7

Working Group	Number	Percent
Northeast	596	100.0

Classification	Number	Percent
Occupied	335	56.2
Undetermined	84	14.1
Unoccupied	177	29.7

BLM Office	Number	Percent
Buffalo	392	65.8
Casper	73	12.2
Newcastle	131	22.0

Biologist	Number	Percent
Buffalo	76	12.8
Casper	14	2.3
Douglas	65	10.9
Gillette	272	45.6
Newcastle	78	13.1
Sheridan	91	15.3

Warden	Number	Percent
Buffalo	77	12.9
Dayton	24	4.0
Douglas	27	4.5
East Casper	5	0.8
Glenrock	30	5.0
Kaycee	61	10.2
Lusk	25	4.2
Moorcroft	78	13.1
Newcastle	63	10.6
North Gillette	68	11.4
Sheridan	12	2.0
South Gillette	119	20.0
Sundance	6	1.0
West Casper	1	0.2

County	Number	Percent
Big Horn, MT	1	0.2
Campbell	211	35.4
Carter, MT	1	0.2
Converse	58	9.7
Crook	27	4.5
Johnson	145	24.3
Natrona	15	2.5
Niobrara	25	4.2
Powder River, MT	1	0.2
Sheridan	34	5.7
Weston	78	13.1

Land Status	Number	Percent
BLM	54	9.1
Private	463	77.7
State	42	7.0
USFS	37	6.2

Management Area	Number	Percent
C	596	100.0

Lek Status	Number	Percent
Active	170	28.5
Inactive	242	40.6
Unknown	184	30.9

Table 1a. Leks Counted

Year	Occupied	Counted	Percent Counted	Peak Males	Avg Males / Active Lek (2)
2013	406	107	26	713	10.5
2014	403	197	49	932	9.7
2015	395	188	48	1933	16.2
2016	390	166	43	1961	20.4
2017	373	162	43	1845	20.1
2018	368	175	48	1376	13.8
2019	360	151	42	1112	12.5
2020	356	159	45	1516	15.5
2021	349	145	42	1040	14.1
2022	346	130	38	991	14.0

Table 1b. Leks Surveyed

Year	Occupied	Surveyed	Percent Surveyed	Peak Males	Avg Males / Active Lek (2)
2013	406	249	61	940	8.5
2014	403	161	40	700	10.0
2015	395	146	37	1057	16.3
2016	390	179	46	1708	19.2
2017	373	163	44	1375	16.4
2018	368	107	29	654	12.3
2019	360	144	40	833	11.3
2020	356	80	22	491	13.6
2021	349	140	40	845	13.2
2022	346	151	44	609	9.4

Table 1c. Leks Checked

Year	Occupied	Checked	Percent Checked	Peak Males	Avg Males / Active Lek (2)
2013	406	356	88	1653	9.3
2014	403	358	89	1632	9.8
2015	395	334	85	2990	16.3
2016	390	345	88	3669	19.8
2017	373	325	87	3220	18.3
2018	368	282	77	2030	13.3
2019	360	295	82	1945	11.9
2020	356	239	67	2007	15.0
2021	349	285	82	1885	13.7
2022	346	281	81	1600	11.8

Table 1d. Lek Status

Year	Active	Inactive (3)	Unknown	Known Status	% Active	% Inactive
2013	180	120	56	300	60.0	40.0
2014	168	135	55	303	55.4	44.6
2015	187	94	53	281	66.5	33.5
2016	191	108	46	299	63.9	36.1
2017	179	98	48	277	64.6	35.4
2018	157	97	28	254	61.8	38.2
2019	165	79	51	244	67.6	32.4
2020	136	87	16	223	61.0	39.0
2021	143	84	58	227	63.0	37.0
2022	139	88	54	227	61.2	38.8

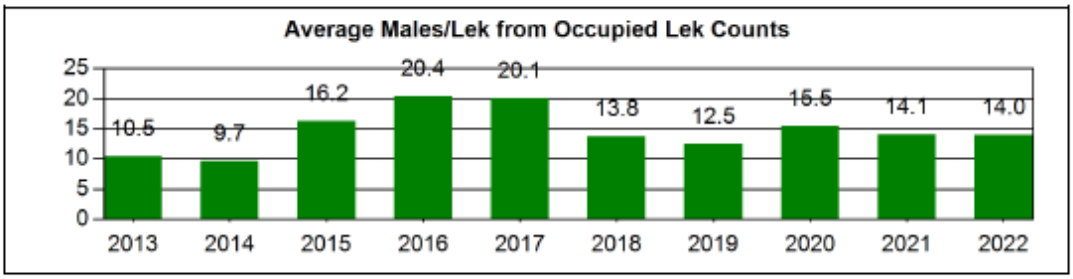
1) Occupied - must have been active once during previous 10 years, calculated based on the official definitions

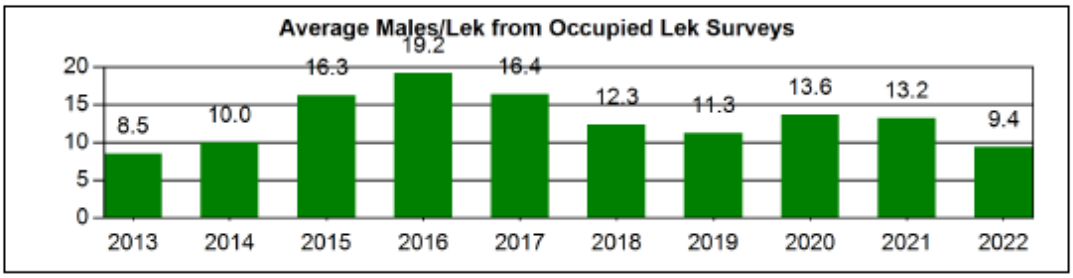
2) Avg Males/Active Lek - Includes only those leks where one or more strutting males were observed. Does not include "Active" leks where only sign was documented.

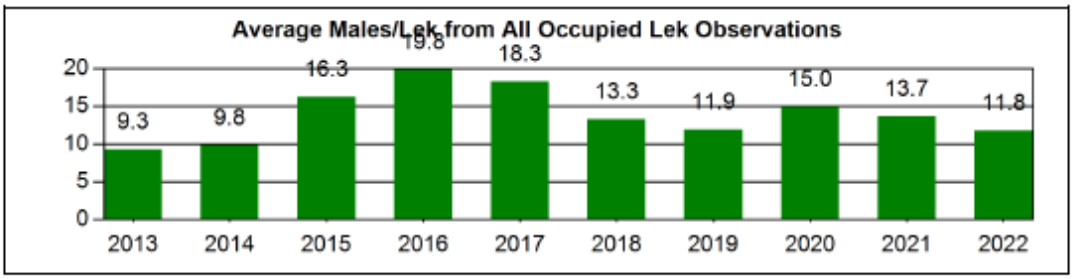
3) Inactive - Confirmed no birds/sign present (see official definitions)

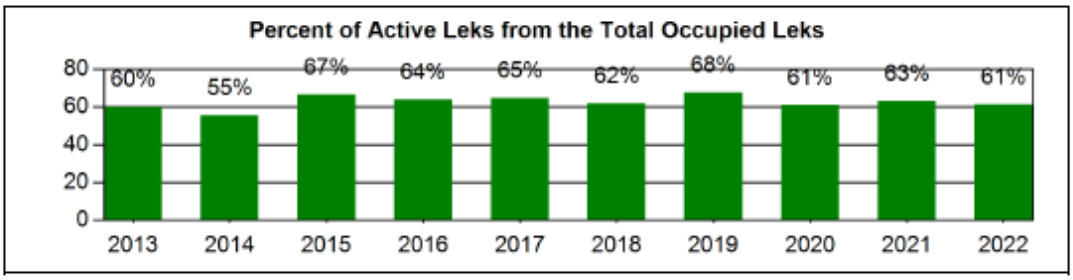
Sage Grouse Occupied Lek Attendance Summary

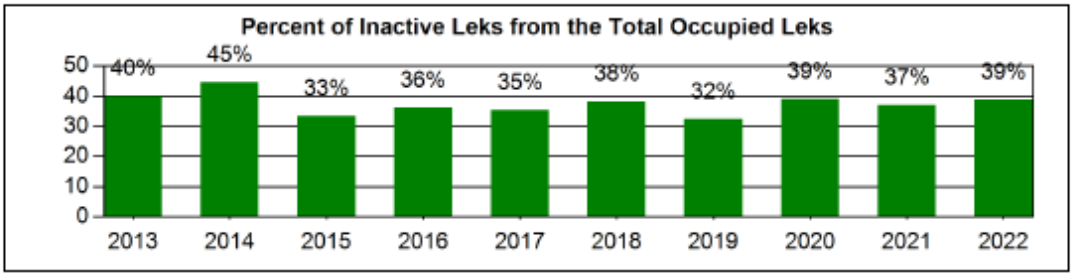
Year: 2013 - 2022, Working Group: Northeast











1) Occupied - must have been active once during previous 10 years, calculated based on the official definitions

Sage Grouse Job Completion Report

Year: 2013 - 2022, 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
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
2019	Sep-21	Sep-30	10	2/4
2020	Sep-19	Sep-30	12	2/4
2021	Sep-18	Sep-30	13	2/4

b. Harvest

Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
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
2019	129	122	203	0.6	1.1	1.7
2020	126	168	798	0.2	0.8	4.8
2021	404	205	755	0.5	2.0	3.7
Avg	175	157	415	0.4	1.0	2.6

Lek Monitoring – Background

The number of males per active lek provides a reasonable index of abundance of the sage-grouse population over time, particularly given the rigorous methods and long-term nature of the dataset in Wyoming. However, it should 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.

In the Northeast Working Group Area, lek monitoring efforts increased substantially since 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 annual lek monitoring. A significant portion of leks in Northeast Wyoming are checked using a helicopter or fixed-wing plane and many leks are on private land where access might be difficult to attain. In recent years, CBNG development has slowed, resulting in a continued reduction of lek survey work being completed by private consultants. In response, WGFD personnel have re-examined our annual coordination efforts with the goals of increasing consistency with the leks that are monitored each year as well as targeting undetermined and long-term inactive occupied leks to update management status to unoccupied as appropriate based on our lek monitoring protocols and definitions.

Lek Monitoring – Results

Following the 2022 lek monitoring period, there are 596 documented leks in the Northeast Wyoming Working Group area. Of this total, 335 (56%) are occupied and of those, 170 (29%) were active during the 2022 breeding season. There are 84 (14%) undetermined leks and 177 (30%) unoccupied leks.

The number of known occupied leks checked by lek counts and lek surveys combined was 281 leks, or 81% of the known occupied leks, and meets the objective of 80% of occupied leks checked (Table 1c). The number of occupied leks counted peaked at 239 in 2012 and has steadily declined since. In 2022, 130 occupied leks were counted. The percent of occupied leks counted has remained between 40% and 50% since 2010, with the exception of 2012 (58%) and 2013 (26%); prior to 2010 less than 40% of occupied leks were counted each year. In 2022, 38% of occupied leks were counted.

Northeast Wyoming has one of the lowest average male lek attendance rates in the state, averaging 14 males per active lek in 2022 compared to the statewide average of 20 males per active lek. Most leks in northeast Wyoming are small, with less than 20 males. In years when grouse are at the peak of their population cycle less than 10% of the active leks have greater than 50 males at peak count. Two leks exceeded 50 males in 2022. No lek has exceeded 100 males since 2007. This is important because regular population stochastisity presents small leks with a greater risk of becoming inactive in poor years and greater difficulty rebounding in productive years.

Average male lek attendance in northeast Wyoming has decreased significantly over time and decreased by more than half over the last 30 years. 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. This concern is confounded by the decreasing number of occupied leks, despite new leks still being discovered.

The 2022 lek count suggests the sage-grouse population decreased after peaking in 2016 at 20 males per active lek. The previous cycle peaked at 28 males per active lek in 2006. With 14 males per active lek in 2022, lek attendance was the same as last year.

Annual lek status was confirmed for 254 leks in 2022. Where status was determined, 157 (62%) were active and 97 (38%) were inactive. There are 28 leks with an unknown activity status in 2022. The annual lek status determination follows the statewide JCR and the Biological Techniques Manual (Whitford 2022). Many leks are checked each year that do not meet the standards to confirm inactivity of a lek. Ground checks for sign (droppings/feathers), for example, can be a challenge due to inaccurate locations based on legal descriptions.

The number of inactive leks is on a decreasing ten-year trend, which is likely a reflection of inactive leks being re-designated as not occupied over that time. The number of active leks is also on a decreasing trend, which is not reflected in the percent inactive due to the decrease in known status leks. With WGFD efforts to re-examine annual coordination efforts, we expect to see an increase in the number of known-status leks. Continued efforts at determining the exact location and status of these leks are needed.

Production

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. 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. In most years the sample was too small to allow for reliable results. No wings were collected during the 2022 hunting season.

Harvest

The Northeast Working Group area is comprised of Hunt Area 4 and portions of Hunt Areas 1 and 2 (Figure 2). Hunt Area 2 is closed to hunting. In Hunt Area 4 has a very conservative hunting season and has been in place since 2010 due to continuing concerns of decreasing lek attendance trends.

In total, there were 1,600 males were observed during 2022 lek monitoring efforts, with most of these birds in Hunt Area 4 (Figure 2). The 2021 harvest survey estimated 404 sage-grouse were harvested by 205 hunters, which are similar to the ten-year averages. There are challenges with obtaining statistically valid harvest survey data with a very small sample size of hunters. Given current survey methods and license structures it is difficult to target sage-grouse hunters specifically.

Figure 2. Northeast Wyoming Sage-grouse Hunt Areas.

Habitat

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 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.

Following two years of drought conditions, 2022 experienced moderate moisture levels throughout much of the Northeast Wyoming Working group area. Cheatgrass continues to thrive in the Powder River Basin, competing with native grasses and forbs in sagebrush understory. The increased wildfire risk due to cheatgrass invasion is being realized. In 2020, the Reno Fire burned through the middle of the Buffalo Core Area, splitting the north half from the south half. In 2021, the Cellars, Wild Horse Creek, and Dry Fork wildfires cumulatively burned almost 7,500 acres in and around the Thunder Basin Core Area. Sagebrush restoration and invasive species management following fires like these is still experimental and will take decades for the sagebrush to recover.

Vast coal reserves continue to be 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. 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. 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 broadly accepted by some and this has contributed to uncertainty in the public and political arenas as to the effects of energy development. Furthermore, many continue to fault predation or harvest for sage-grouse population declines, which have much lower population impacts than habitat fragmentation, direct loss, and indirect loss.

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.

Disease

No West Nile virus (WNv) mortality was reported for northeast Wyoming in 2022 and no major mortality events have been documented since 2003 when WNv was first documented in sage- grouse in the Powder River Basin. 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. As of 20 October 2021, the Wyoming Department of Health reported two positive mosquito pools of 14 tested in Natrona County, of which a small area is within the Northeast Working Group area. One animal tested positive in both Campbell and Converse Counties. Conversely, zero mosquito pools, humans, or animals tested positive for WNv in 2020 (Wyoming Department of Health 2021).

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 one outbreak year could result in the extirpation of some local populations due to the small lek sizes in the area.

In the spring of 2022 a highly pathogenic form of Avian Influenza occurred through large portions of the sage-grouse range. Although no sage-grouse were documented having contracted this disease, several other avian species were lab verified in the northeast corner of the state. It is unknown how this disease may effect sage-grouse, but it is of concern and should continue to be closely monitored as this strain of Avian Influenza continues to surface.

Conservation Planning - Northeast Local Working Group

In 2021, the Northeast Working Group (hereafter, working group) was asked to review multiple 2020 datasets to assess if adaptive management triggers had been tripped and the group identified multiple soft triggers and one hard trigger. The working group also highlighted concerns

with the process, particularly related to the lack of response to the working group and Technical Team's work related to the 2018 soft trigger.

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 Northeast Wyoming Working Group identified and ranked those factors believed to be most influencing the northeast Wyoming sage-grouse population, as well as actions that might provide the greatest benefit for sage-grouse conservation in northeast Wyoming. 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. As a follow-up, in 2021 the Working Group initiated a GIS mapping exercise to spatially overlay these key factors influencing sage-grouse populations under their area of responsibility. The goal is to have a tool to solicit more funding applications that address the most pressing needs for regional sage-grouse populations as well as create project ranking priorities.

Conservation Planning – Northeast Technical Team

In April 2021, the Northeast Wyoming Sage-grouse Technical Team (hereafter technical team) submitted recommendations to address the soft trigger identified in 2018. The group met over 11 months and 11 meetings. One key finding was that recent genetic connectivity research demonstrates that the current core and connectivity boundaries are not acting as intended; some protected areas are not as important to range wide populations as initially thought while other areas that are not currently protected have critical conservation value. The technical team recommended that the Statewide Adaptive Management Team determine if this meets the definition of new, substantive, and compelling information to qualify for an interim core area review, pursuant to Executive Order 2019-3. The technical team identified the most immediate and pressing concerns relating to the long-term viability of sage-grouse populations in Northeast Wyoming as 1) maintaining and/or enhancing genetic connectivity and 2) the potential for long- term loss of substantial acreage of sagebrush habitats due to wildfire. The technical team provided six recommendations.

Special Reports - Douglas Core Area

Sage-grouse peak lek attendance within the Douglas Core Area (DCA) totaled 19 males at one active lek in 2022 (Figure 3). Three of the four leks were inactive, which increases long-term concerns about the viability of this core area population. 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 Wyoming Governor's Sage-grouse Executive Order. 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.

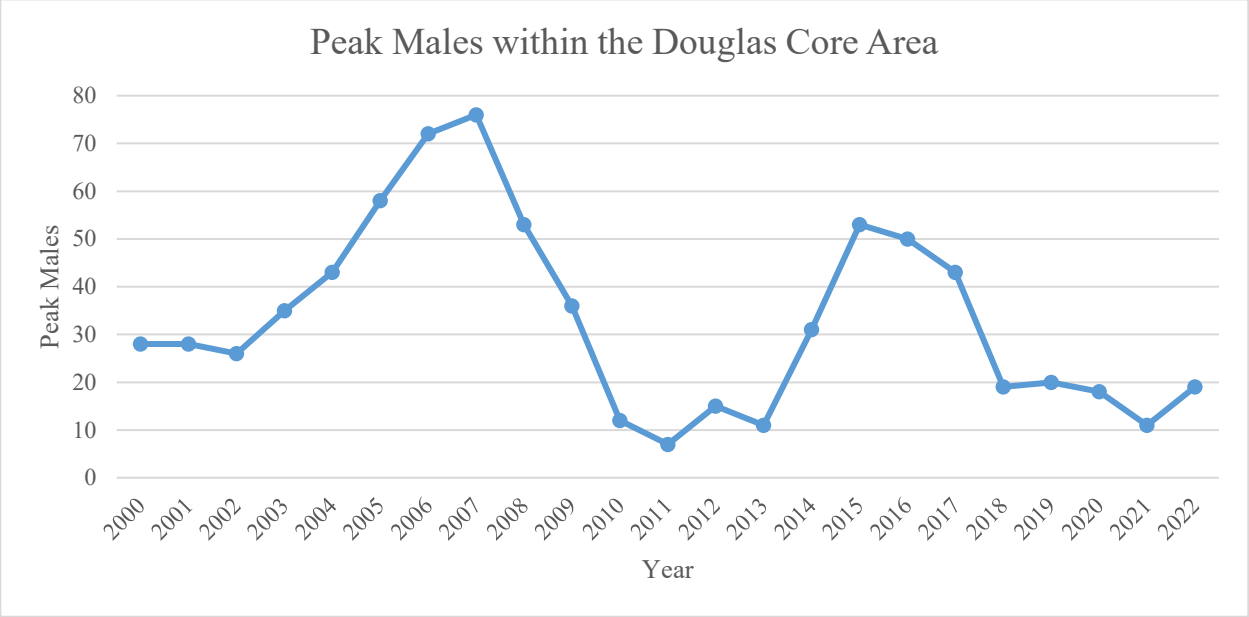


Figure 3: Peak males from all leks in the Douglas Core Area 2000-2022.

Recommendations – Time Sensitive Needs

Habitat management

The concern of invasive annual grasses and wildfire frequencies in sagebrush habitats is an immediate threat to the long-term viability of sage-grouse habitats in Northeast Wyoming. We need to figure out how to treat cheatgrass in viable sagebrush habitats at a large scale. This is vital for the long-term viability of sagebrush habitats in Northeast Wyoming. This will require managers to find ways to engage with landowners on a massive scale. Additionally, work to increase brood-rearing habitats would help address low chick recruitment rates reported (Kirol 2021).

Prepare for core area review

Core areas were designated with the objective of identifying habitats that supported most of Wyoming's sage-grouse. Statewide, core areas encompass leks with 78% of the 2012-2014 peak males. However, in the Northeast Wyoming Working Group area, 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. Recent genetic connectivity research as well as work completed by the Northeast Working Group and Technical Teams confirm that the core area in Northeast Wyoming do not accurately reflect the areas of greatest conservation need. All relevant groups, stakeholders, and managers should be prepared to propose revisions to the currently delineated core and connectivity areas in 2024, if not sooner, pursuant to Executive Order 2019-3.

Lek monitoring coordination

In recent years, CBNG development has slowed, resulting in a reduction of lek survey work being completed by private consultants. In response, WGFD personnel are spearheading efforts to re-examine the annual coordination efforts with the goals of increasing consistency with the leks that are counted each year and the number of leks that are counted each year, as well as targeting undetermined and long-term inactive occupied leks to update management status to unoccupied as appropriate based on our lek monitoring protocols and definitions. This project should be conducted with the cooperation of the BLM and the Northeast Working Group. This effort was commenced in 2021 and will re-evaluation will occur on an annual basis to ensure maximization of personnel time and minimization of duplicated efforts.

Recommendations – Continue Long-Term Work

- 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).
- Annually monitor 80% of the occupied leks in the local working group area.
- WNv monitoring.
- Assist the BLM with coordinating sage-grouse population monitoring efforts with the private consultants doing work for energy development companies.
- Use any additional flight money for lek searches and surveys. Check all leks at least once every three years. All leks should be recorded in UTMs (NAD 83) using GPS.
- Review the sage-grouse database to eliminate leks without adequate documentation to support a lek designation.
- The Working Group should continue to solicit habitat projects on private lands that will have benefit for sage-grouse.
- The WGFD Regions should continue to recommend protection of occupied sage-grouse leks during environmental commenting and promote their protection on private land projects.
- Additional effort is needed to document the status of undetermined leks. Encourage reporting of lek activity from the public and landowners.
- Better document wintering sage-grouse locations and develop a seasonal range map for sage-grouse for the Working Group Area.
- Continue to map lek perimeters to ensure adequate buffer distance in protecting leks.

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.

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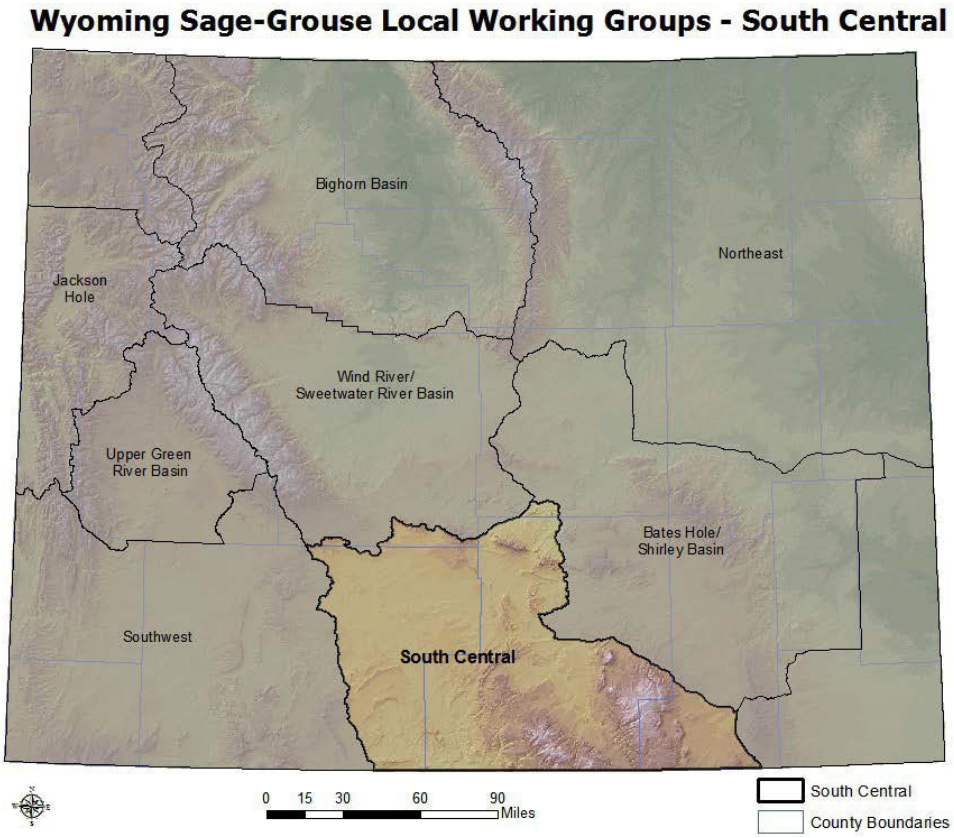
South-Central Conservation Area
Job Completion Report

Management Area: H – (Lander & Laramie Regions)
Period Covered: 6/1/2021-5/31/2022
Prepared by: Teal Cufaude, Saratoga Wildlife Biologist



Sage Grouse Lek Characteristics

Management Area: H, Working Group: South Central

Region	Number	Percent
Green River	139	34.1
Lander	210	51.5
Laramie	59	14.5

Working Group	Number	Percent
South Central	408	100.0

Classification	Number	Percent
Occupied	257	63.0
Undetermined	47	11.5
Unoccupied	104	25.5

BLM Office	Number	Percent
Casper	2	0.5
Lander	26	6.4
Rawlins	363	89.0
Rock Springs	17	4.2

Biologist	Number	Percent
Baggs	126	30.9
Green River	14	3.4
Lander	15	3.7
Laramie	5	1.2
Saratoga	54	13.2
Sinclair	194	47.5

Warden	Number	Percent
Baggs	125	30.6
East Rawlins	105	25.7
Elk Mountain	6	1.5
Lander	2	0.5
Rock Springs	14	3.4
Saratoga	48	11.8
South Laramie	5	1.2
West Rawlins	103	25.2

County	Number	Percent
Albany	5	1.2
Carbon	270	66.2
Fremont	13	3.2
Natrona	2	0.5
Sweetwater	118	28.9

Land Status	Number	Percent
BLM	228	55.9
LocalGov	1	0.2
Private	148	36.3
State	30	7.4
USFWS	1	0.2

Management Area	Number	Percent
H	408	100.0

Lek Status	Number	Percent
Active	172	42.2
Inactive	181	44.4
Unknown	55	13.5

Sage Grouse Job Completion Report

Year: 2013 - 2022, Management Area: H, Working Group: South Central

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

a. Leks Counted

Year	Occupied	Counted	Percent	Peak Males	Avg Males / Active Lek (2)
2013	278	94	34	1662	21.9
2014	281	101	36	1607	21.4
2015	282	90	32	1915	32.5
2016	286	73	26	2381	39.0
2017	286	96	34	2176	29.4
2018	285	113	40	2210	24.6
2019	278	131	47	2419	22.0
2020	272	146	54	2584	22.7
2021	272	91	33	1604	21.7
2022	267	82	31	1470	23.0

b. Leks Surveyed

Year	Occupied	Surveyed	Percent	Peak Males	Avg Males / Active Lek (2)
2013	278	159	57	1564	14.9
2014	281	175	62	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	1961	20.9
2019	278	126	45	1078	16.8
2020	272	101	37	875	18.6
2021	272	160	59	1285	15.7
2022	267	150	56	1668	19.6

c. Leks Checked

Year	Occupied	Checked	Percent Checked	Peak Males	Avg Males / Active Lek (2)
2013	278	253	91	3226	17.8
2014	281	276	98	3623	19.3
2015	282	260	92	5139	29.4
2016	286	265	93	6088	31.5
2017	286	258	90	4641	25.4
2018	285	266	93	4171	22.7
2019	278	257	92	3497	20.1
2020	272	247	91	3459	21.5
2021	272	251	92	2889	18.5
2022	267	232	87	3138	21.1

d. Lek Status

Year	Active	Inactive (3)	Unknown	Known Status	% Active	% Inactive
2013	192	45	16	237	81.0	19.0
2014	198	71	7	269	73.6	26.4
2015	185	54	21	239	77.4	22.6
2016	198	54	13	252	78.6	21.4
2017	188	55	15	243	77.4	22.6
2018	192	53	21	245	78.4	21.6

Sage Grouse Job Completion Report

Year: 2013 - 2022, Management Area: H, Working Group: South Central

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

Continued

2019	189	48	20	237	79.7	20.3
2020	172	68	7	240	71.7	28.3
2021	172	64	15	236	72.9	27.1
2022	163	45	24	208	78.4	21.6

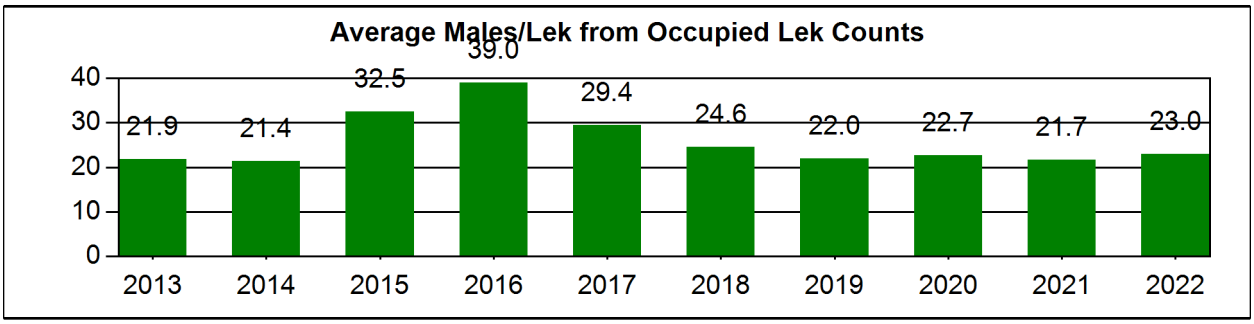
1) Occupied - must have been active once during previous 10 years, calculated based on the official definitions

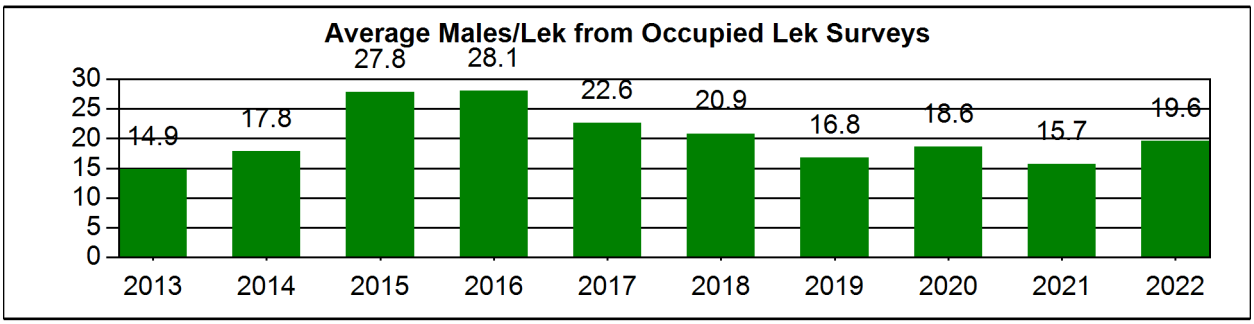
2) Avg Males/Active Lek - Includes only those leks where one or more strutting males were observed. Does not include "Active" leks where only sign was documented.

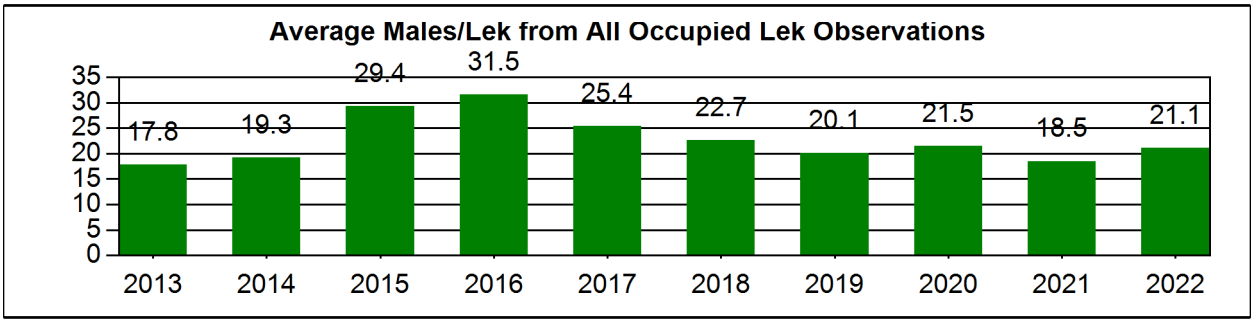
3) Inactive - Confirmed no birds/sign present (see official definitions)

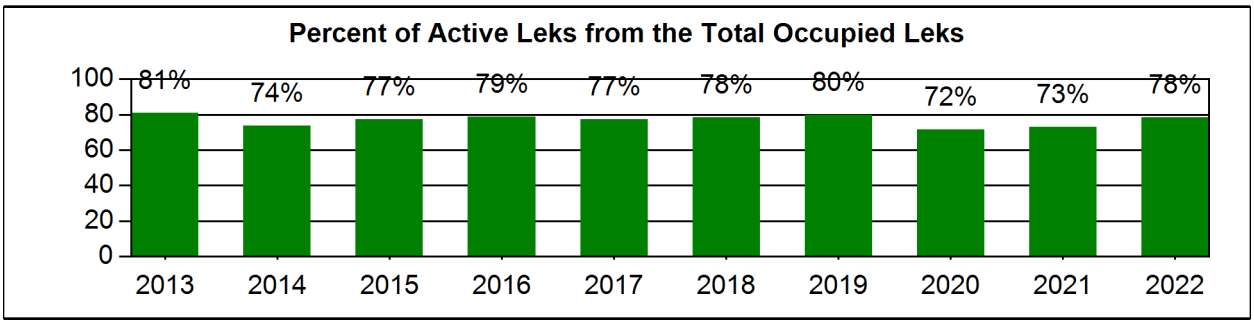
Sage Grouse Occupied Lek Attendance Summary (1)

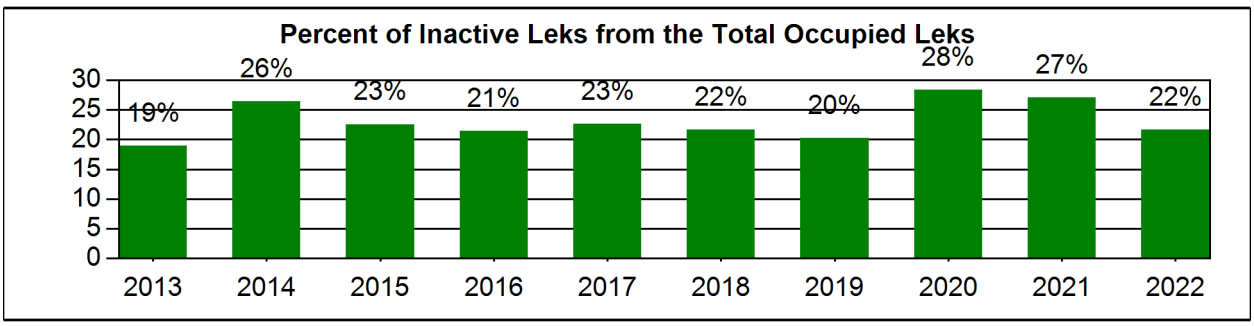
Year: 2013 - 2022, Management Area: H, Working Group: South Central











1) Occupied - must have been active once during previous 10 years, calculated based on the official definitions

Sage Grouse Job Completion Report

Year: 2012 - 2021, 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
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
2019	Sep-21	Sep-30	10	2/4
2020	Sep-19	Sep-30	12	2/4
2021	Sep-18	Sep-30	13	2/4

b. Harvest

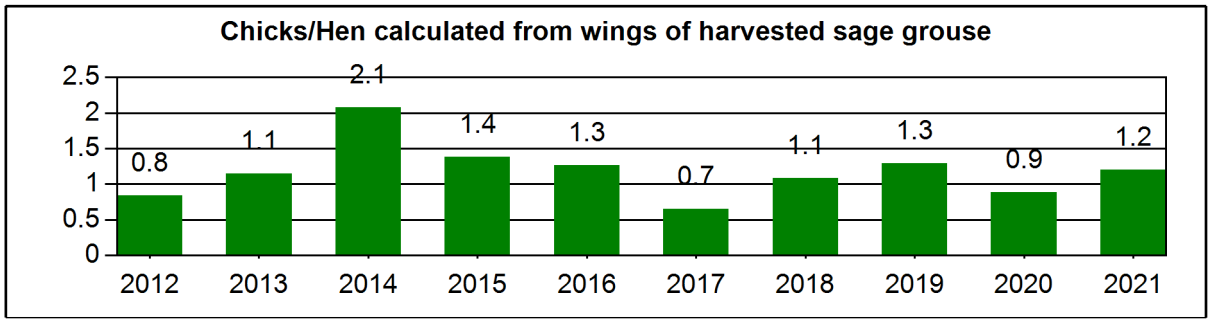
Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2012	1194	636	1382	0.9	1.9	2.2
2013	624	437	928	0.7	1.4	2.1
2014	612	391	934	0.7	1.6	2.4
2015	776	457	963	0.8	1.7	2.1
2016	911	477	1162	0.8	1.9	2.4
2017	501	363	846	0.6	1.4	2.3
2018	903	500	1245	0.7	1.8	2.5
2019	1052	584	1186	0.9	1.8	2.0
2020	1023	465	1250	0.8	2.2	2.7
2021	1080	691	2178	0.5	1.6	3.2
Avg	868	500	1,207	0.7	1.7	2.4

Sage Grouse Job Completion Report

Year: 2012 - 2021, 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	
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
2019	196	13.8	25.0	6.6	9.7	13.8	31.1	1.3
2020	258	11.6	27.1	5.8	16.7	13.2	25.6	0.9
2021	201	10.0	26.4	4.5	12.4	23.9	22.9	1.2



Lek Monitoring

For biological year 2021, 408 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 (Fig. 1).

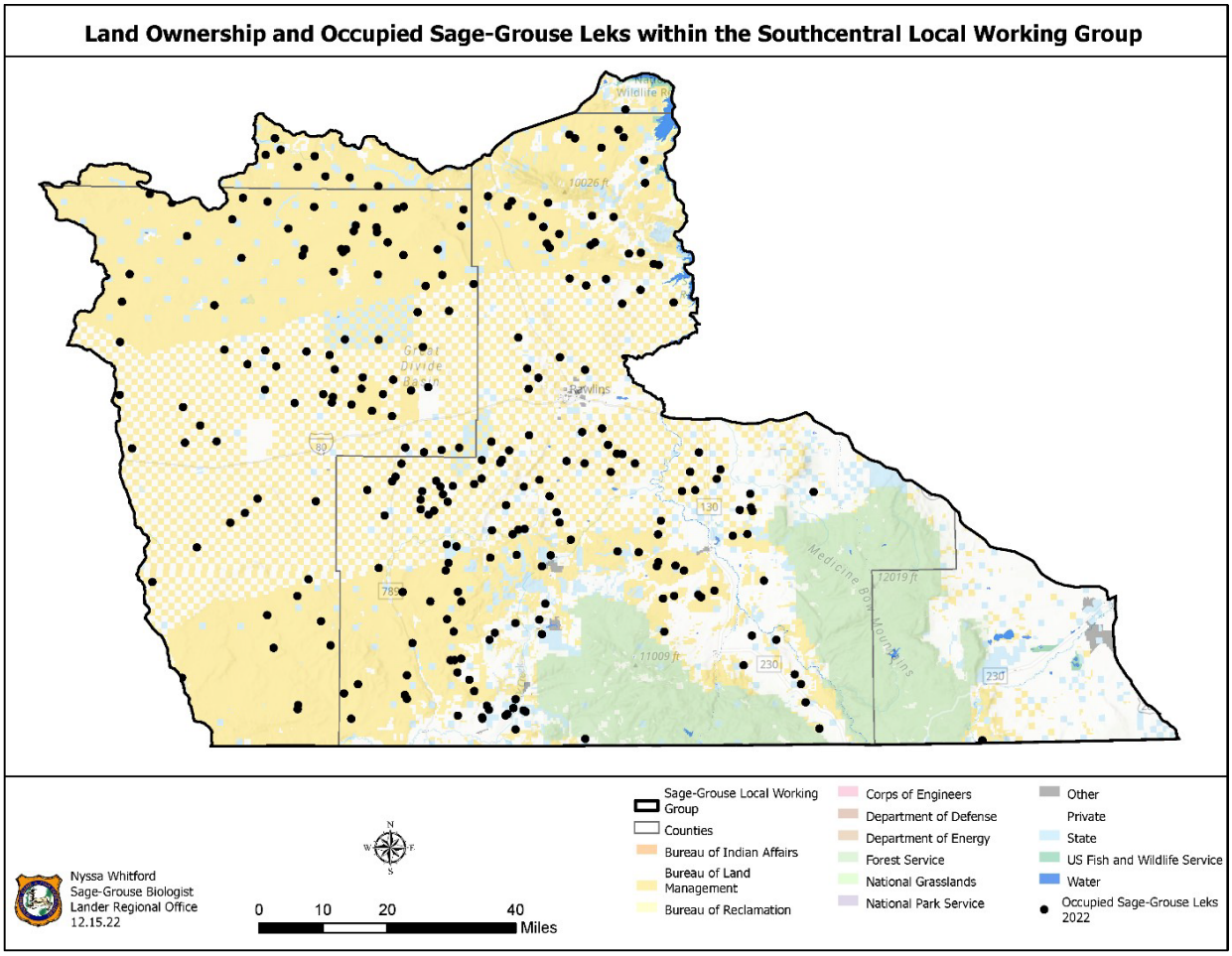


Figure 1. Landownership and sage-grouse lek locations within the SCCA, Wyoming.

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 Whitford (20). During the 2022 lekking season, 232 leks were monitored. This represented checking 87% of the occupied status leks in the SCCA. This rate of effort was 5% less than in 2021; and was slightly below the 10-year average rate of effort (Table 1c)[1].

A total of 82 leks were *counted* in the SCCA, resulting in an average of 23 males per lek. A total of 150 leks were *surveyed* resulting in an average of 19.6 males per lek. Across the SCCA, more leks were monitored with *survey* protocol and fewer were monitored with *count* protocol. To

[1] Table 1c does not include "Unknown" lek observations.

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 2022, the peak male lek attendance with the SCCA totaled 3,138 males. This was an 8.6% decrease from 2021. The average number of male sage-grouse on both *counted* and *surveyed* leks increased from 21.7 and 15.7 in 2021 to 23 and 19.6 in 2022. 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). The proportion of occupied leks which were considered inactive decreased from 27.1% in 2021 to 21.6% in 2022. During an upswing in the sage-grouse population, we would expect a decrease in the number of inactive leks. In 2022, the management status for 24 leks (10%) was unknown because they were not monitored or monitoring protocol requirements were not met (Table 1a-d).

No reliable method for estimating the sage-grouse population for the SCCA exists at this time, however the number of male per lek provides a reasonable index of abundance of the population over time. The increase in the male per lek average, increase in peak male lek attendance, along with the observed chick per hen ratios in hunter submitted wings indicated a stable to slightly increasing sage-grouse population across the SCCA during biological year 2021.

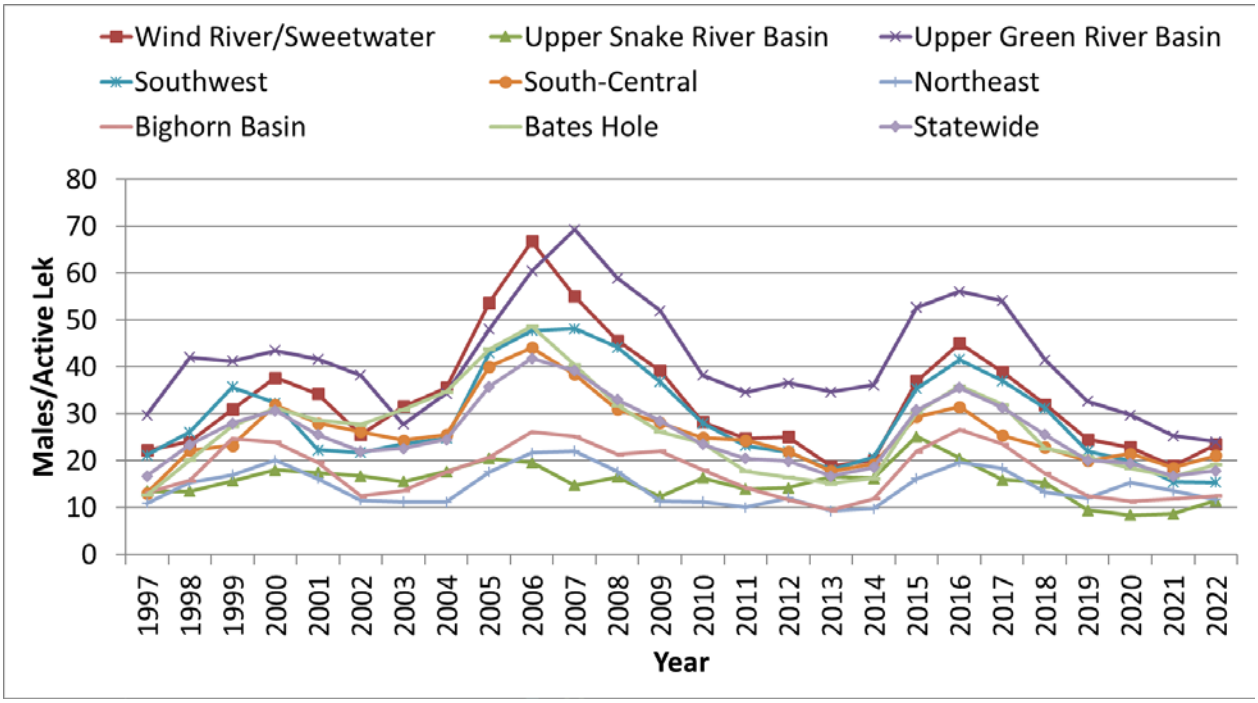


Figure 2. 1997-2022 Average peak male sage-grouse lek attendance, by Conservation Area and Statewide, Wyoming.

Harvest

The 2021 sage-grouse hunting season in the SCCA, was from 18 September to 30 September (13 days), and allowed for the harvest of 2 sage-grouse per day and 4 in possession (Table 3a). The 2021 upland harvest survey estimated 691 hunters spent 2,178 days to harvest 1,080 sage- grouse

in the SCCA. The average number of birds harvested per hunter day was 0.5. The average number of sage-grouse harvested per hunter was 1.6 and the average number of days hunted was 3.2 (Table3b). Compared to the last 10 years, when hunting regulations were similar with the exception small changes to hunting season length; 2021 hunter numbers were 38% higher than the 10-year average number of hunters, the 2021 birds/day was 29% lower than the 10-year average, and the days/hunter was 33% higher than the 10-year average indicating hunters were less successful and harvesting required more hunter effort than previous years. Generally, during the past 10 years, overall harvest appeared to be correlated to both hunter numbers and sage- grouse abundance. Based on check station observations and hunter success appeared to vary across the SCCA, with lower success in the northern portions (Red Desert/ Ferris) and higher success in the southern portions (Saratoga, south Rawlins, Baggs).

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 2021 hunting season, WGFD collected 201 wings from wing barrels within the SCCA, which was 19% of the estimated harvest of 1,080 birds. This was a 22% decrease in the total number of wings when compared to the 258 wings collected in 2020. Age and sex composition of the wings indicated the proportion of chicks per hen increased from 0.9 in 2020 to 1.2 in 2021 (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.

Habitat

Sage-grouse habitat within the SCCA is comprised of relatively intact sagebrush communities. The health of these communities is predominately dependent on the type, amount, and timing of annual precipitation. Spring precipitation is an important factor in the quantity and quality of grass and forb production, which have been linked to sage-grouse nest success and chick survival. Much of the sagebrush habitat in the SSCA is trending towards older, decadent age classes. While mature sagebrush stands are important to sage-grouse for both forage and cover, a monoculture of older and decadent stands may lead to lower nutrient content of this key forage. 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 habitat.

Primary land use in the SCCA is livestock grazing and energy development. 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. Sheep numbers have since declined and cattle have become the primary species of livestock grazing in 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 obligate species. Feral horses continue inhabit the western and northern portions of the SCCA.

Energy development and mineral extraction continue to be a primary use of sage-grouse habitat within the SCCA, with a majority of the energy development focused on producing natural gas from both deep gas and coalbed methane sources. 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. Development for the Chokecherry/Sierra Madre Wind Energy Project, including access roads and turbine pads, continued through 2020 and 2021. Past and present uranium mining has also contributed to reducing sage-grouse habitat in the SCCA. Construction of the Energy Gateway West Aeolus-Jim Bridger powerline, which coincides with the EO 2019-3 Transmission Corridor, was completed in 2020. Energy development has directly and indirectly reduced the functionality of sage-grouse habitat in portions of the SCCA. The Interstate 80/Union Pacific Railroad transportation corridor bisects the SCCA east to west and is a major cause of habitat fragmentation. Continued urban/rural development within sagebrush communities also continues to fragment sage-grouse habitat.

The Mullen wildfire started in September 2020 and burned approximately 176,800 acres. While the Mullen fire was predominately on forested lands, firefighting efforts resulted in back burning of transitional shrub communities outside the forest. Over 10,300 acres were aerially treated with indaziflam (Rejuvra) on USFS to control cheatgrass on the western side of the Snowy Range. The USFS, WGFD, USGS, and BLM continue to extensively monitor the burn scar and treated areas for cheatgrass. In the fall of 2021 and 2022, USFS and volunteers planted several thousand sagebrush seedlings west of the North Platte River to aid in sagebrush recovery.

The 2021 growing season precipitation (April –July) within the SCCA was below normal. Precipitation events throughout the spring and summer were sporadic and covered small geographic areas. Temperatures were very high in early June, resulting in earlier senescence of grasses and forbs. 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 2021 could have impacts to sage-grouse nutrition and survival.

We continue to plan and implement habitat projects including cheatgrass control, sagebrush mowing, juniper removal, and wet meadow restoration within the SCCA to improve sage-grouse habitat. Spring 2022 cheatgrass germination and growing conditions were excellent, leading to an "explosion" of cheatgrass along the entire west slope of the Sierra Madres and into the desert- type foothills. In an effort to mitigate habitat issues related to cheatgrass in sage-grouse habitats, aerial herbicide treatments continue to be conducted throughout the SCCA. Over the past five years, the BLM, Carbon County Weed and Pest (CCWP), WGFD, and local conservation districts have treated over 60,000 acres of cheatgrass on public and private land.

Sagebrush thinning projects were planned around High Savery Reservoir in higher elevation nesting and brood-rearing mountain big sagebrush stands that exceeded 50% cover. These projects should improve conditions for these sage grouse uses, and implementation is scheduled to begin in biological year 2022.

In the northwest portion of the SCCA, the BLM removed approximately 2,000 wild horses in late fall/winter 2021. Wild horse removals in the desert and prime sage-grouse habitats were

successfully near target levels.

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 2021.

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 three meetings during this reporting period. During these meetings, the SCLWG allocated their $75,000 Fiscal Year 2022 funds. Projects that received support from SCLWG during this reporting period included:

1. Saratoga Elementary School Outdoor Classroom
2. Influence of Annual Climatic Variability in Sage-Grouse Brood Rearing Ecology
3. Adaptive Management of the NPL Gas Field for Sage-Grouse
4. Barrett Ridge Conifer Encroachment
5. Stewart Creek Water Development Exclosure Fencing
6. Red Rim - Grizzly Wildlife Habitat Management Shade Balls

Local Working Group Adaptive Management Trigger Identification

Executive Order 2019-3 Appendix I called for sage-grouse local working groups to evaluate sage-grouse lek data annually to determine if anything unexpected is happening which may be cause for a suspected soft or hard trigger. In June 2021, the SCLWG met to evaluate sage-grouse core areas within the SCCA using several tools to identify possible triggers. SCLWG identified a soft trigger had been tripped during biological year 2020 in the SCCA portion of Hanna Core Area. The SCLWG deferred to the Bates Hole/Shirley Basin Local Working Group to evaluate a possible trigger from the 2020 316 Fire. The SCLWG determined that South Rawlins Core needed to be watched, but did not meet the group's criteria for a trigger during this evaluation period. This decision was based on Executive Order calculations not indicating a soft or hard trigger, borderline habitat triggers that needed further investigation, and the USGS clusters only being representative of 2019 lek data. The Greater South Pass Core Area did not meet the SCLWG's criteria for tripping a trigger based on the Executive Order calculations not indicating a trigger. The SCLWG agreed that both the South Rawlins and Greater South Pass Core Areas should be evaluated closely next year. The Statewide Adaptive Management Working Group (SAMWG) met multiple times to consider the suspected triggers identified by all the local working groups. The SAMWG group will work on drafting a new Appendix I that will focus on the process, clarifying roles and responsibilities, and defining triggers. The SAMWG did not declare any triggers during this

reporting period.

In February 2022, the SCLWG met to review areas of concern that were brought forward by WGFD biologists. The SAMWG had developed a series of questions for the SCLWG to answer in regards to the areas of concern identified by WGFD biologists. SCLWG agreed with biologists that the western portion of Hanna Core Area (Sinclair Biologist District) and southeastern portion Greater South Pass Core Area (Sinclair Biologist District) were areas of concern based on the downward population trends (decrease in peak male counts for past 23 years, record low counts in recent years, and long-term downward trend of male lek attendance). Although the SCLWG agreed these were areas of concern and should be watched in subsequent years, the formation of a technical team was not recommended. SCLWG agreed that a portion of non-core area west from SR789 to Delaney Rim, south to Colorado border, north to I-80 (Baggs Biologist District) was an area of concern due to downward population trends (peak male attendance declines and/or leks becoming unoccupied status over the last several years). This area of concern was almost entirely within non-core, but the SCLWG recommended the formation of a technical team to further evaluate causal factors of declining sage-grouse in this area. SCLWG similarly agreed that the South Rawlins Core and non-core area east from SR789 to Cow Butte, south to Wild Horse Butte, north to Muddy Creek (Baggs Biologist District) was an area of concern and warranted further investigation into causal factors by a technical team. The SCLWG would meet in the next reporting period to further evaluate causal factors in the South Rawlins and Hanna Core Areas with a Strike Team (technical team) that was put together by the SAMWG.

Special Projects

The North Dakota Greater Sage-Grouse Translocation Project was completed in June 2020. This translocation effort was done in an effort to supplement North Dakota's remnant sage-grouse population. Researchers at Utah State University and U.S. Geological Survey found that as of biological year 2021, the North Dakota sage-grouse population is still struggling. The translocation efforts were successful at stabilizing the North Dakota sage-grouse population for a short time, but ultimately more translocation efforts would likely need to occur for the population to stabilize or increase long-term. Research also indicated that the relative change in the source population (Stewart Creek) was neutral and data suggests no negative impacts on the source population post-translocation. This work was used in developing detailed a description of sage-grouse translocation protocols.

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. Seek out opportunities to increase flight money for lek searches and surveys in hard to access portions of the SCCA.
5. Support WGFD and BLM efforts to address mitigation and reclamation issues.
6. Support research efforts to identify seasonal habitats, especially winter concentration habitat.

7. Coordinate with BLM and USFS to ensure development and habitat treatments in Sage- Grouse Core Area comply with WY-EO-2019-3.
8. Continue to build partnerships with private landowners to maintain or improve sage-grouse habitat on private lands through mutually beneficial habitat projects.

Research

University of Wyoming sage-grouse-feral horse study examining the potential impacts of feral horses on sage grouse was completed in 2021. The objectives of this research included evaluating: 1) the potential impact of free-roaming horses on greater sage-grouse nest and brood-rearing site selection, as well as nest and brood survival measured from marked female sage-grouse, and 2) the relative degree in which horse utilization, modeled from horse fecal transects, compared to free-roaming horse resource selection modeled from locations acquired from GPS-equipped free-roaming mares. The results of this work indicated a strong overlap between horses and sage-grouse during the summer. This work highlighted the importance of managers recognizing the potential for horses to influence habitat quality of sage-grouse.

In April 2021, the University of Wyoming, began the second of two consecutive field seasons to re-evaluate source and sink dynamics for greater sage-grouse in the Atlantic Rim Project Area (ARPA). The objectives of this study are to: 1) collect appropriate habitat and population data in spring and summer to develop new source and sink models and in winter to develop new winter occurrence and survival risk models and maps for the ARPA, 2) compare and contrast new models based on 2020–2022 data with those generated from 2008 and 2009 for breeding habitat and winters 2007–2008, 2008–2009, and 2009–2010 for wintering habitat within the ARPA and surrounding public lands, and 3) determine juvenile survival from the end of summer throughout the winter months.

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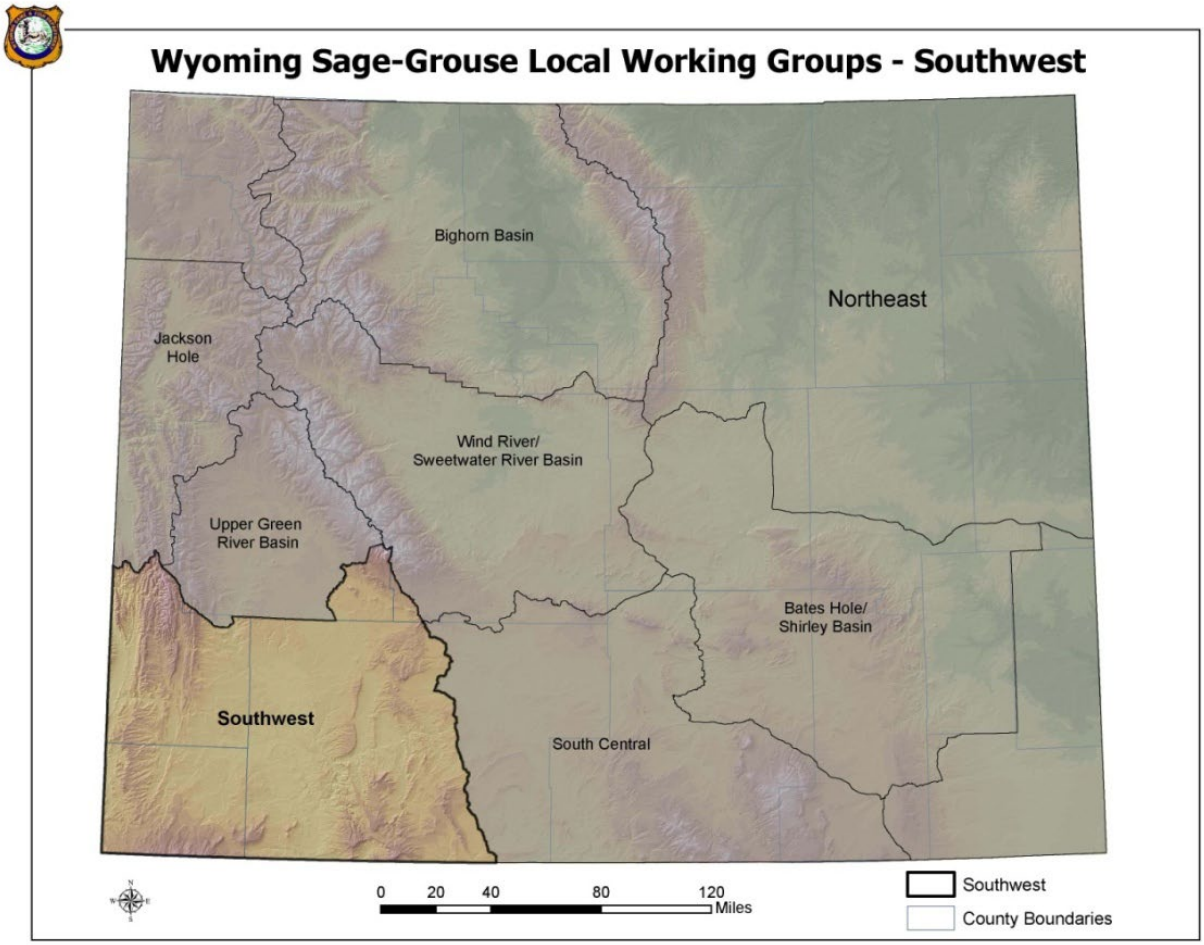
Whitford, N. W. Bish. 2022. Chapter 12: Sage Grouse (*Centrocercus urophasianus*). Pages 12-1 to 12-43 in Handbook of Biological Techniques: third edition. Wyoming Game and Fish Department. Cheyenne, WY.

Wyoming Game and Fish Department (WGFD). 2007. South Central Sage-Grouse Conservation Plan. 74pp.

Southwest Conservation Area
Job Completion Report

Management Area: G - (Green River & Pinedale Regions)
Biological Year: 6/1/2021-5/31/2022
Prepared By: Patrick Burke, Green River Wildlife Biologist



Sage Grouse Lek Characteristics

Working Group: Southwest

Region	Number	Percent
Green River	400	88.1
Pinedale	54	11.9

Working Group	Number	Percent
Southwest	454	100.0

Classification	Number	Percent
Occupied	329	72.5
Undetermined	10	2.2
Unoccupied	115	25.3

BLM Office	Number	Percent
Kemmerer	198	43.6
Pinedale	14	3.1
Rawlins	4	0.9
Rock Springs	238	52.4

Biologist	Number	Percent
Green River	170	37.4
Lander	1	0.2
Mountain View	229	50.4
Pinedale	54	11.9

Warden	Number	Percent
Cokeville	55	12.1
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	54	11.9

County	Number	Percent
Fremont	4	0.9
Lincoln	136	30.0
Sublette	35	7.7
Sweetwater	212	46.7
Uinta	67	14.8

Land Status	Number	Percent
BLM	315	69.4
BOR	15	3.3
National Park	2	0.4
Private	106	23.3
State	15	3.3
USFS	1	0.2

Management Area	Number	Percent
G	454	100.0

Lek Status	Number	Percent
Active	252	55.5
Inactive	67	14.8
Unknown	135	29.7

Sage Grouse Job Completion Report

Year: 2013 - 2022, 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)
2013	308	116	38	1966	19.5
2014	310	96	31	1613	19.9
2015	316	70	22	2197	34.9
2016	325	94	29	3744	44.0
2017	334	97	29	2950	34.3
2018	338	102	30	2654	30.2
2019	337	87	26	1433	19.4
2020	336	73	22	1224	20.4
2021	337	90	27	1207	17.2
2022	335	80	24	800	14.3

b. Leks Surveyed

Year	Occupied	Surveyed	Percent Surveyed	Peak Males	Avg Males / Active Lek (2)
2013	308	175	57	2243	17.0
2014	310	190	61	3177	21.2
2015	316	222	70	6256	35.7
2016	325	211	65	6488	40.6
2017	334	203	61	5991	38.9
2018	338	210	62	5357	32.1
2019	337	201	60	3068	23.6
2020	336	212	63	3003	20.0
2021	337	183	54	1933	14.6
2022	335	206	61	2242	16.0

c. Leks Checked

Year	Occupied	Checked	Percent Checked	Peak Males	Avg Males / Active Lek (2)
2013	308	291	94	4209	18.1
2014	310	286	92	4790	20.7
2015	316	292	92	8453	35.5
2016	325	305	94	10232	41.8
2017	334	300	90	8941	37.3
2018	338	312	92	8011	31.4
2019	337	288	85	4501	22.1
2020	336	285	85	4227	20.1
2021	337	273	81	3140	15.5
2022	335	286	85	3042	15.5

d. Lek Status

Year	Active	Inactive (3)	Unknown	Known Status	% Active	% Inactive
2013	241	28	22	269	89.6	10.4
2014	236	24	23	260	90.8	9.2
2015	251	20	21	271	92.6	7.4
2016	263	26	16	289	91.0	9.0
2017	253	30	17	283	89.4	10.6
2018	262	31	19	293	89.4	10.6
2019	230	46	12	276	83.3	16.7
2020	225	31	29	256	87.9	12.1
2021	219	33	21	252	86.9	13.1
2022	223	28	35	251	88.8	11.2

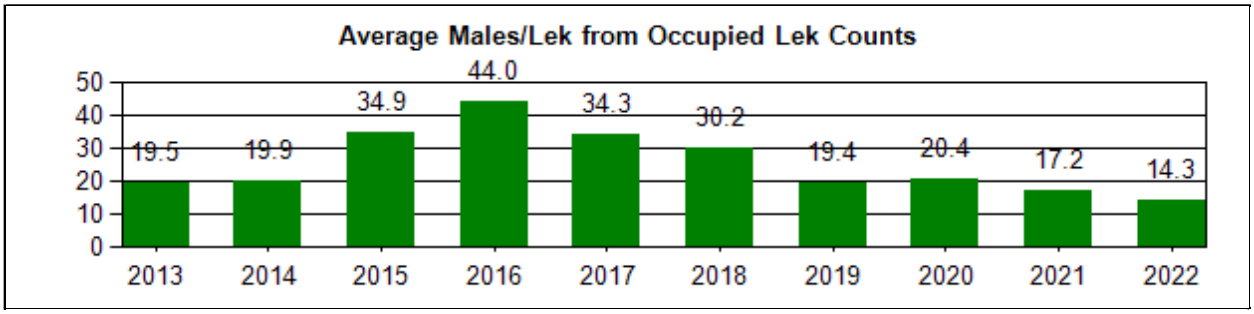
1) Occupied - must have been active once during previous 10 years, calculated based on the official definitions

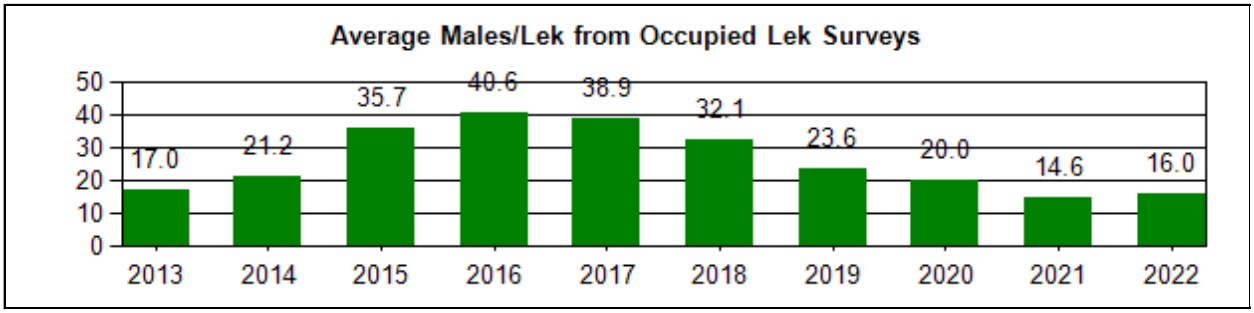
2) Avg Males/Active Lek - Includes only those leks where one or more strutting males were observed. Does not include "Active" leks where only sign was documented.

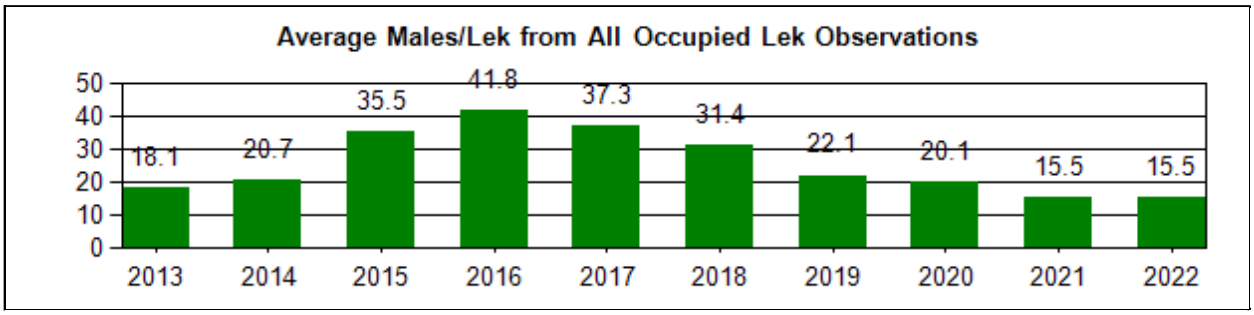
3) Inactive - Confirmed no birds/sign present (see official definitions)

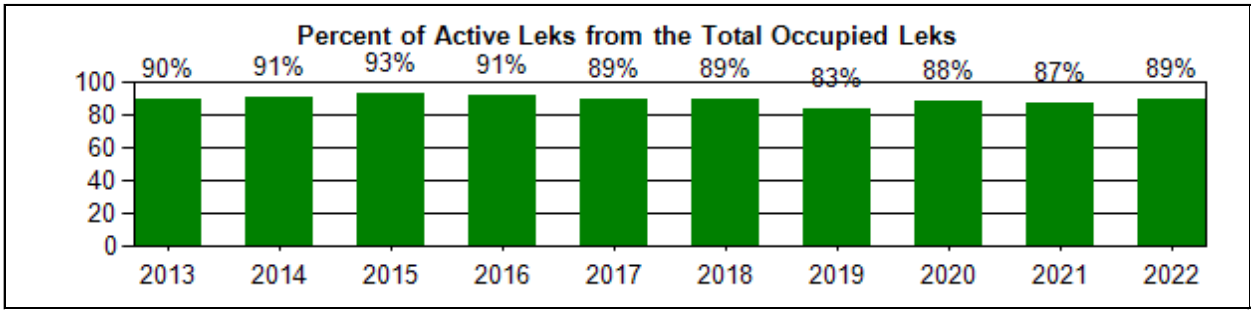
Sage Grouse Occupied Lek Attendance Summary (1)

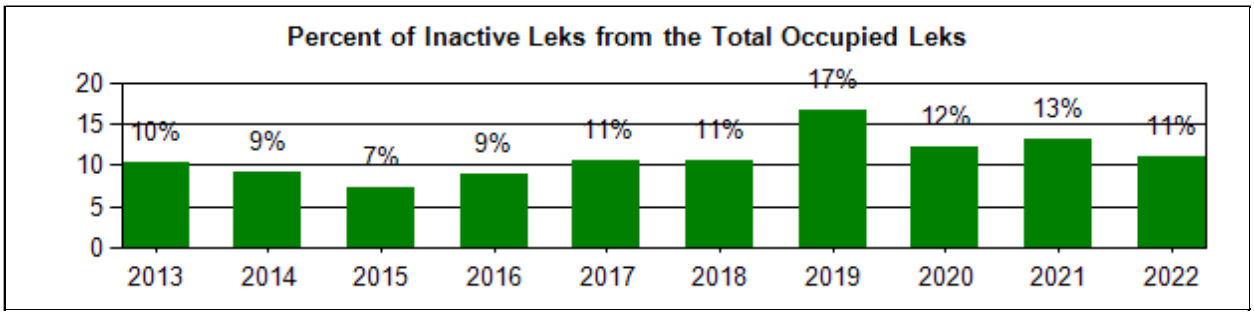
Year: 2013 - 2022, Working Group: Southwest











Sage Grouse Job Completion Report

Year: 2012 - 2021, Working Group: Southwest

3. Sage Grouse Hunting Seasons and Harvest Data

a. Season

Year	Season Start	Season End	Length	Bag/Possesion Limit
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
2019	Sep-21	Sep-30	10	2/4
2020	Sep-19	Sep-30	12	2/4
2021	Sep-18	Sep-30	13	2/4

b. Harvest

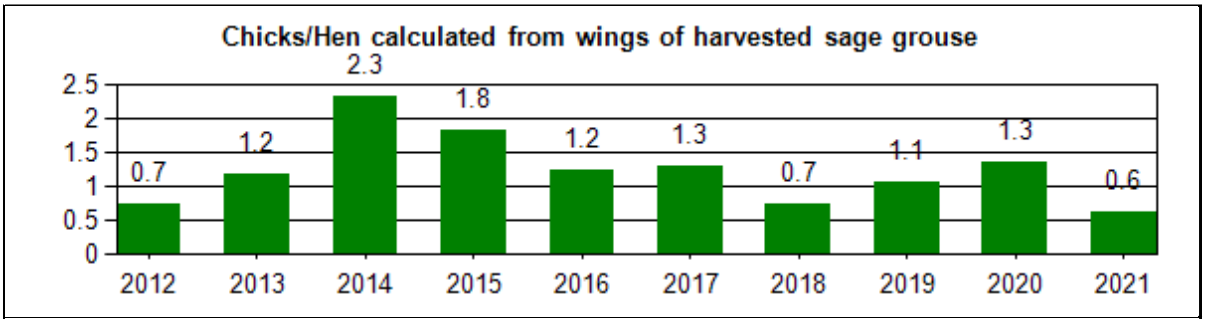
Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2012	3737	1775	4503	0.8	2.1	2.5
2013	2513	1307	3139	0.8	1.9	2.4
2014	2645	1165	2835	0.9	2.3	2.4
2015	4479	1586	4057	1.1	2.8	2.6
2016	4163	1672	4036	1.0	2.5	2.4
2017	3590	1421	3675	1.0	2.5	2.6
2018	3410	1630	3873	0.9	2.1	2.4
2019	2821	1514	3746	0.8	1.9	2.5
2020	1491	737	2336	0.6	2.0	3.2
2021	2937	1650	5022	0.6	1.8	3.0
Avg	3,179	1,446	3,722	0.9	2.2	2.6

Sage Grouse Job Completion Report

Year: 2012 - 2021, 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	
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
2019	570	7.9	37.5	2.1	6.3	14.4	31.8	1.1
2020	779	7.8	31.3	3.6	6.4	20.5	30.3	1.3
2021	447	12.8	46.1	1.6	6.9	15.0	17.7	0.6



Lek Monitoring

A total of 335 occupied leks were known to exist in the Southwest Wyoming Sage-grouse Conservation Area (SWSGCA) during the 2022 lekking season. Of these 335 occupied leks, 286 of them were checked, with 80 of those checks being lek counts with three or more visits during the breeding season, with the remaining 206 checks consisting of lek surveys where less than three lek visits were made during the breeding season. The percentage of the known sage-grouse leks that were checked during the 2022 lekking season was 85%; typically over 90% of the known leks in the SWSGCA are checked annually, however personnel turnover and vacant positions in both state and federal agencies during the last several years as well and changes in land ownership and access has resulted in a lower percentage of leks being checked in the western part of the SWSGCA in the last four years.

Of the 454 known lek sites in the SWSGCA in 2022, 255 of them were classified as being active, 69 were classified as being inactive, 35 leks were of unknown status and 112 are unoccupied. All lek monitoring data from 2022, along with data from the past ten years for comparison are summarized in Tables 1 a-d.

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 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 83-93% active. The proportion of active leks for the 2022 lekking season, was in line with typical values having 88.8% of the occupied leks being active.

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, 5) lek sites may shift over time, and 6) new leks may be created. 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 2022 lekking season was 15.5 males per active lek. This is down from the high observations of 35 to 41 males per active lek observed from 2016 to 2018, and below the average from the previous 10 years of 26.5 males per active lek. The average number of males in attendance on the 80 count leks in 2022 was 14.3 males per lek. This number is below the 10 year average of 26.3 males per lek, and is the lowest number observed since the mid 1990's. For the 206 leks that were surveyed in 2022, the average lek had 16.0 males in attendance; which is below the 10 year

average of 26.4 males per lek, and down substantially from 2016's and 2017's observed values of 40.3 and 38.7 males per survey lek. It is however a slight increase from the 14.6 males per lek observed in 2021.

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 2021 hunting season for sage-grouse in the SWSGCA ran from September 18 to September 30 and allowed for a daily take of 2 birds with a limit of 4 grouse in possession (Table 3a). The 2021 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 2012 through 2021 hunting seasons in this report (Table 3b). Based on harvest survey estimates, 1,650 hunters harvested 2,937 sage-grouse during the 2021 hunting season. This number is down from the 4,479 birds reported harvested in 2015, but is generally in line with recent harvest estimates for the SWSGCA. 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 447 grouse wings from the 2021 hunting season (Table 4). This represents just over 15% of the estimated total harvest for 2021, which is slightly below the average submission rate of around 18%-19% of reported harvest.

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 2021 hunting season was 0.6 chicks/hen (Table 4). This ratio suggests a decreasing grouse population, which corresponds well with the lower male lek attendance seen in the spring of 2022.

Weather

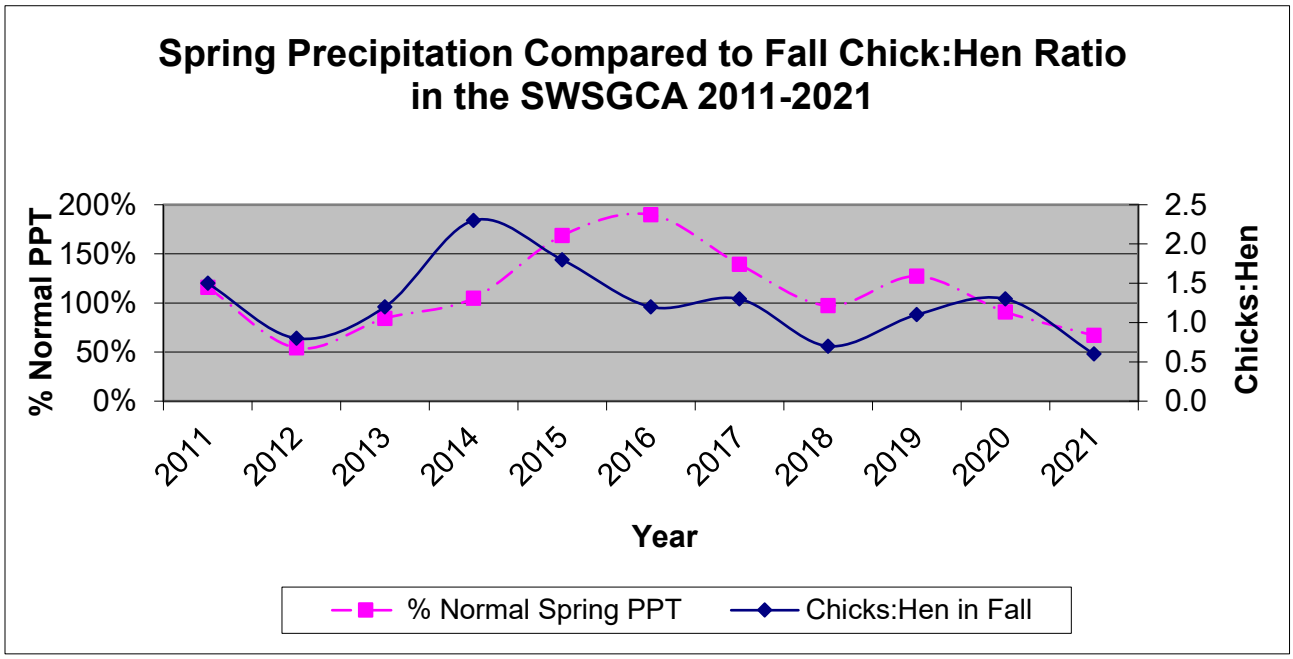
Spring habitat conditions are one of the most important factors in determining nesting success and chick survival for sage-grouse. Specifically, shrub height and cover, live and residual grass height and cover, and forb production, all have a large impact on sage-grouse nesting and brood rearing success. 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 or poorly timed 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 2010-2019. 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
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
2019	125%	1.1
2020	91%	1.3
2021	67%	0.6



Diseases

No cases of West Nile Virus (WNv) or other avian diseases are known to have occurred in sage-grouse in the SWSGCA in 2021.

Habitat and Seasonal Range Mapping

While new leks are still being located in the SWSGCA, the majority of the currently occupied leks have likely been documented, however important other seasonal habitats such as winter concentration areas and especially nesting/early brood-rearing areas could still be identified and further delineated.

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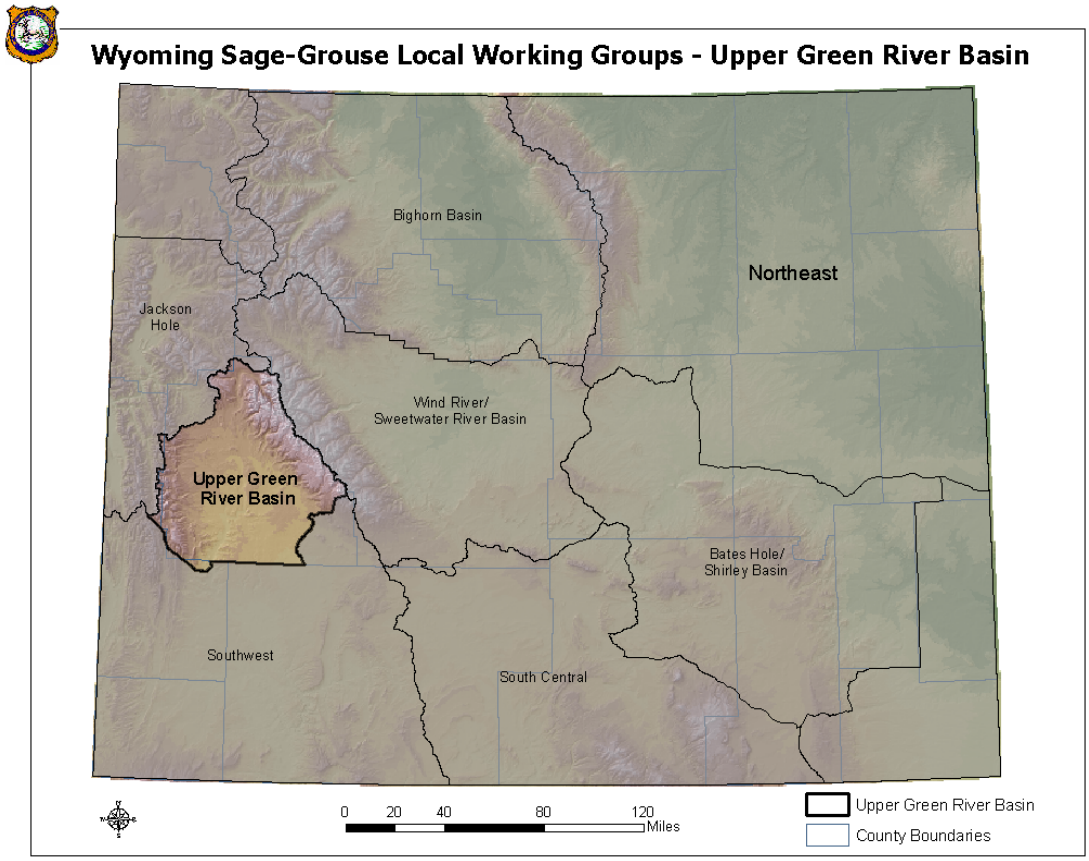
Upper Green River Basin Working Group Area
Job Completion Report

Management Area: D – (Pinedale Region)
Period Covered: 6/1/2021 – 5/31/2022
Prepared by: Dean Clause, Pinedale Wildlife Biologist



Lek Monitoring

A total of 166 leks are currently documented in the Upper Green River Basin Working Group Area (UGRBWGA). These leks are classified as follows; 128 occupied, 38 unoccupied, and 0 undetermined. During 2022, a total of 125 occupied leks (97%) were checked (survey or count). Lek monitoring efforts in 2022 resulted in a high proportion of counts (80%) verses surveys (17%), similar to most years. Results from lek monitoring in 2022 showed 78% were active and 22% inactive of those leks classified as occupied. The average number of males/lek for all active leks decreased to 24 in 2022, compared to the past three years of 25 in 2021, 30 in 2020, and 33 in 2019. This results in a 5% decrease compared to 2021 and a 57% decrease since the last peak in 2016 (Figure 1).

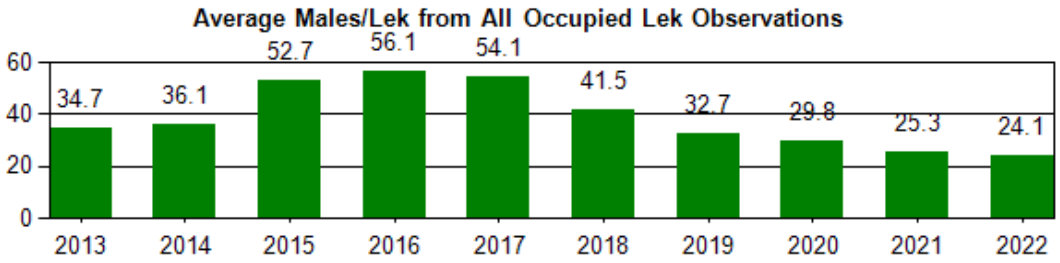


Figure 1. Average Peak Male Sage-grouse Lek Attendance 2013-2022, UGRBWG Area.

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 2018-2022 (Figure 3). The 2022 male lek attendance is 65% 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), drought, and 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 20 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 76% 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 (65 new leks since 2004) mathematically negating the downward trend in the proportion of active leks in the UGRBWGA.

Peak male lek attendance from 1997-2021, 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).

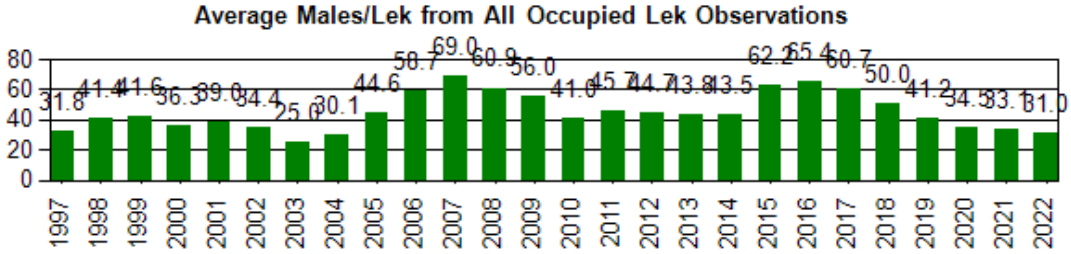


Figure 2. Average Peak Male Sage-grouse Lek Attendance 1997-2022 using only leks known in 1997, UGRBWG Area.

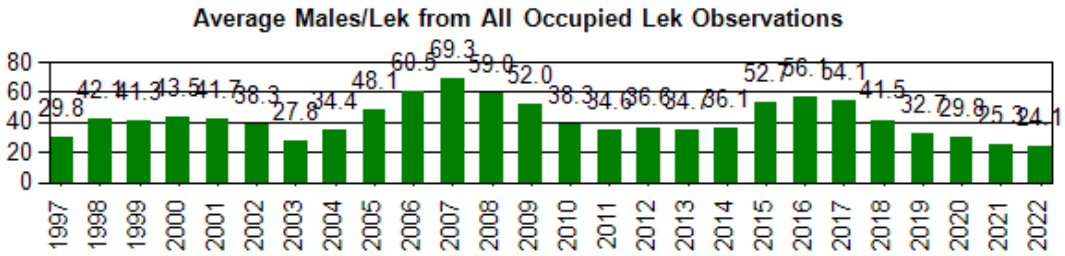


Figure 3. Average Peak Male Sage-grouse Lek Attendance 1997-2022 using all known leks, UGRBWG Area.

An analysis to assess natural gas development impacts to sage grouse leks in the UGRBWGA shows lower male attendance, reduced occupancy, and reduced activity on those leks within or near gas field development. Using the latest aerial imagery, leks located within or less than one mile of gas field activity in the Pinedale Anticline Project Area (PAPA), Jonah Gas Fields, and Normally Pressured Lance (NPL) Gas Field were grouped for comparison. The group of leks referred to as "Disturbed Leks" (n=23) were those leks within or near (roughly within one mile) active gas field development within the PAPA, Jonah, and NPL. The other group of leks referred to as "Undisturbed Leks" (n=143) were the remaining leks in the UGRBWGA used as a control for comparison. The range of data used in this comparison was from 1997 – 2022 for the same reasons mention earlier (lack of lek monitoring and standardized monitoring protocol). In comparing Disturbed Leks vs. Undisturbed Leks, the average number of peak males/ active lek for occupied leks reveal general trends (increasing verses decreasing) that are similar. Although, the long-term peak number of males in the Disturbed Leks has declined by 61% while the Undisturbed Leks have decreased by 16% (Figures 4 & 5) when comparing the average peak males/active lek from 1997 to 2022.

Another difference documented between the two data sets is associated with the lek occupancy, occupied verses unoccupied leks. A much higher proportion of leks are currently unoccupied (abandoned or destroyed – no male attendance during the past 10 year period) within or near the PAPA, Jonah, and NPL gas fields (Disturbed Leks) at 70% compared to only 15% of all leks outside these three gas fields (Undisturbed Leks) being unoccupied. Of the 7 remaining occupied leks within the Disturbed Lek set (23 total leks), five (71%) were active in 2022, while 92 (78%) of the occupied leks in the Undisturbed Lek set were active in 2022. Lek activity (documented yearly male attendance) has been variable within the in the Disturbed Leks ranging from 38% to 93% since 1997, due to changes in lek occupancy (occupied to unoccupied) along with a smaller sample size of leks. Lek activity has been relatively stable in the Undisturbed Leks ranging from 74% to 89% since 1997.

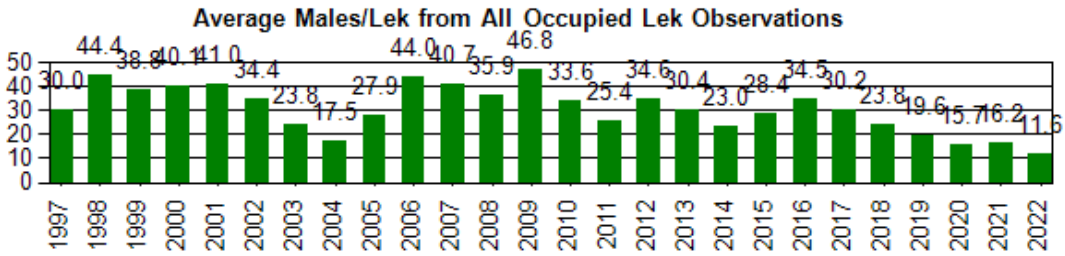


Figure 4. Average Peak Male Sage-grouse Lek Attendance 1997-2022, Disturbed Leks.

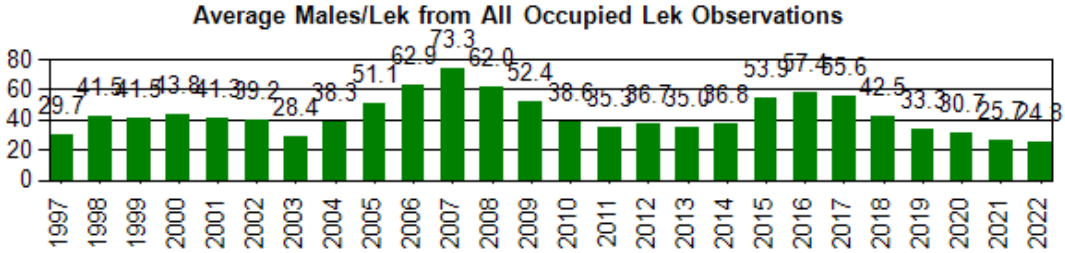


Figure 5. Average Peak Male Sage-grouse Lek Attendance 1997-2022, Undisturbed Leks.

Harvest

The 2021 sage-grouse season was September 18 through September 30, a 13-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 2021 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 2021 harvest survey estimated that 772 hunters bagged 1238 sage grouse and spent 1998 days hunting. The average number of birds per day was 0.6, the average number of birds per hunter was 1.6, and the number of days spent hunting per hunter was 2.6 during 2021. During the past 10 year period, hunter participation and harvest metrics have varied somewhat, probably attributed to a combination of population trends, yearly bird recruitment, weather conditions, and season length. Overall, hunter participation and harvest was lowest during 2013 (387 hunters and 628 birds harvested) and highest in 2018 (853 hunters and 2161 birds harvested) during the past 10-year period. Birds/day and

days/hunter appears to be the most stable harvest statistic averaging 0.9 birds/day and 2.6 days/hunter in the UGRBWGA (Figure 4). From 1995 to 2002, overall harvest and harvest rates significantly declined following altered seasons (shortened and moved to a later date).

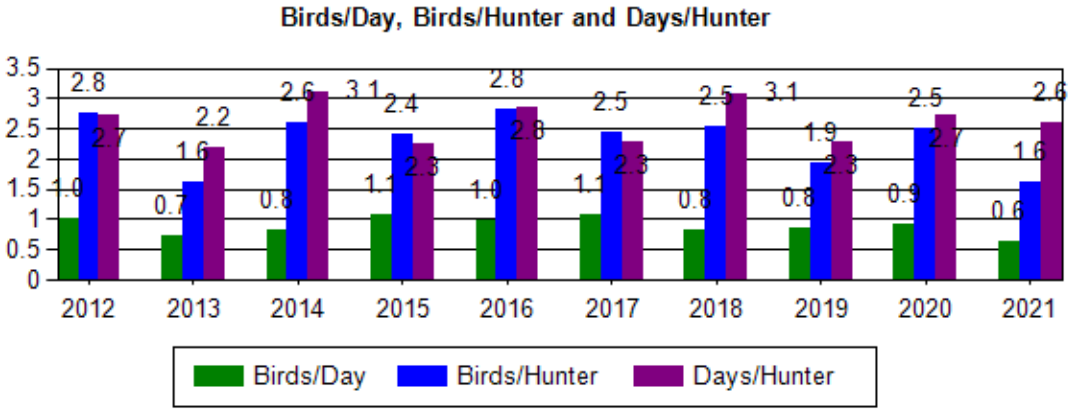


Figure 4. Sage grouse harvest rates 2012-2021 in SGMA D.

Wing Collections

Eighteen sage-grouse wing barrels were distributed throughout Sublette County in 2021 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 410 sage-grouse wings were collected from barrels in the UGRBWGA during 2021, compared to 471 in 2020 and 342 in 2019. The number of wings collected during the past 10-year period ranged from 337 to 573. Of the 410 wings collected in 2021, 33% were juvenile birds and 53% were adult and yearling hens. The overall composition of wings in 2021 indicated a ratio of 0.6 chicks/hen (adult and yearling females), which typically results in lower lek counts the following spring. The 2016 and 2021 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 several years explains the recent declines male lek attendance. 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.

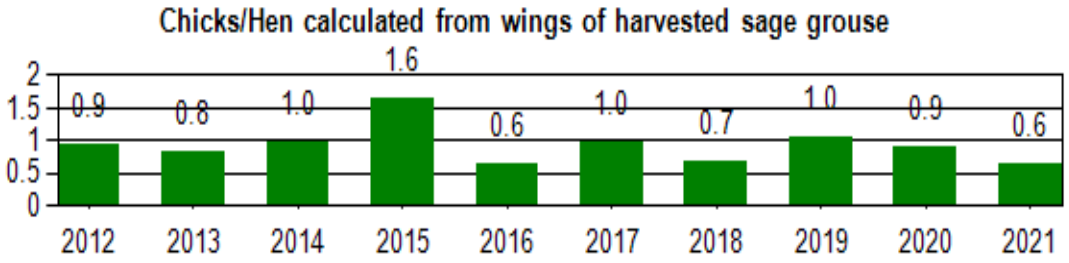


Figure 5. Sage grouse chick/hen ratios derived from wing collections 2012-2021, UGRBWGA.

Winter Distribution Surveys

No specific winter sage grouse surveys were conducted during the 2021-2022 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 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 2023.

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 has been on-going study (initiated in 2013) looking into the significance of geophagy by sage grouse within the UGRBWGA. The field work was completed in the fall of 2021 with a summary report anticipated in 2023.

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), along with infrared flights are being used which have been shown to effectively monitor activities of sage-grouse in other parts of Wyoming (J. Millspaugh, unpublished data). This study is focused within the Alkali Creek and Alkali Draw regions of the NPL that was initiated in 2019, portions of the study were put on hold during 2020-2022, except deployment of transmitter in control and treatment areas, due to lack of funding. Following the 2022-2023 winter, a summary report will be available summarizing data from transmittered birds.

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 2021 Sage-Grouse Job Completion Report (June 2021 thru May 2022) 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 2018-2022. Lek trend data suggest grouse populations are currently at the lowest level with the highest level occurring 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, 21% decrease in 2019 a decrease of 9% in 2020 (30 males/lek), a continued decrease of 15% in 2021(25 males/lek), and a slight decline of 5% in 2022 (24 males/lek). 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 2017-2021, the progression of hunter participation was expected to show similar trends. Variation in hunter participation can be affected by hunting season structure, weather conditions, population trends, 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 2008-2021 wing collections ranged from 22% to 58% of the reported harvest. The sample size of 410 wings in 2021 accounted for 33% of the reported harvest. These annual wing samples can vary significantly based on weather conditions affecting hunter participation, especially during the weekend days of hunting season. Overall, some correlation exists between trends in wing sample sizes and harvest, and provides managers the most reliable data for determining annual reproductive rates 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 (2017-2021) the chicks/hen ratio has varied from 0.6 to 1.0 and averaging 0.8 chicks/hen, correlating to the persistent decline in male lek attendance.

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 2019-20 winter had average snow and cold temperatures with a slight decline in 2020 lek counts. The 2020-2021 winter had very low snow and average temperatures with a decline in 2021

lek counts. The 2021-2022 winter had below average snow and average temperatures followed by dry spring conditions and a slight decline in 2022 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, although cold and wet weather events around nest hatch appears to influence chick production and survival in the UGRBWGA located at relatively higher elevation than most other breeding habitat range-wide.

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 a high rate of lek abandonment within and adjacent to developing gas fields. Sage-grouse studies and research conducted in the UGRBWGA has also documented impacts to grouse from gas development (Doherty el al. 2008, Green et al. 2016, Holloran et al. 2006, Holloran et al. 2007, Kaiser 2006, Kirol et al. 2020, Walker et al. 2007). 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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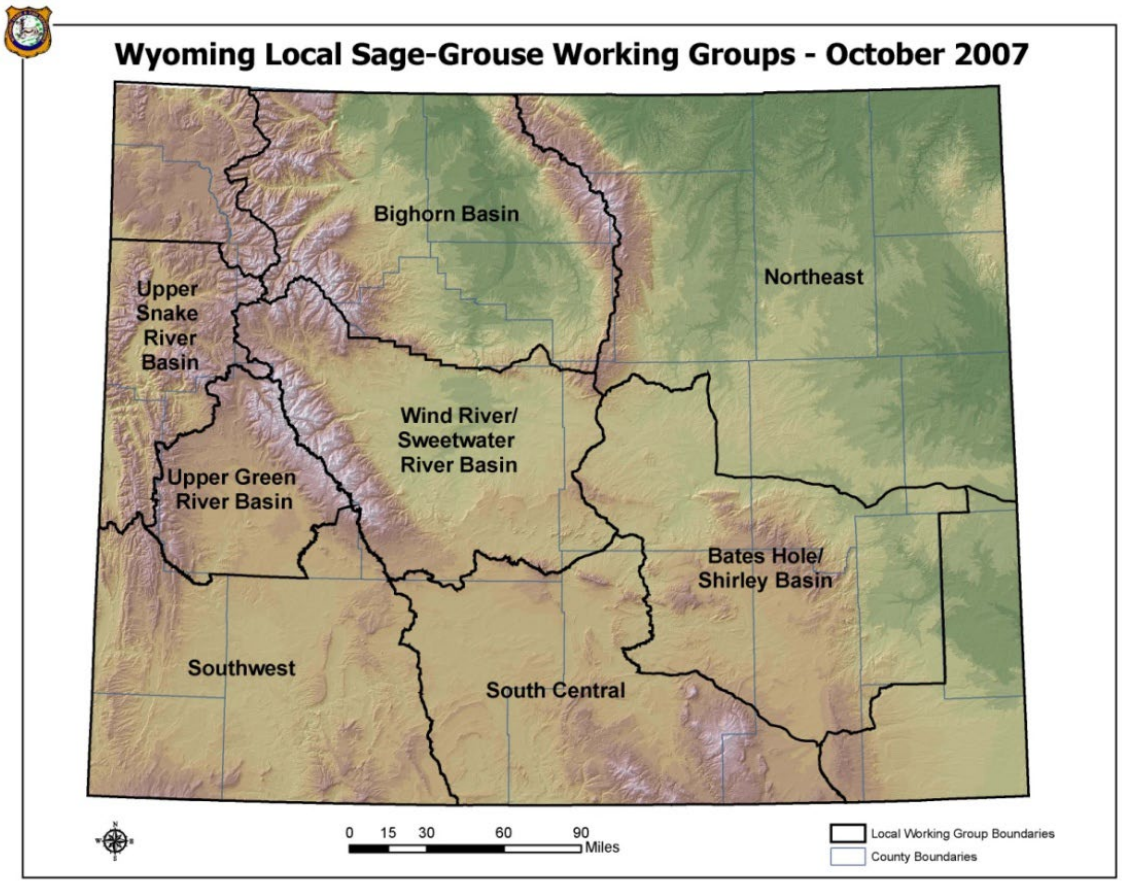
Upper Snake River Basin Conservation Area
Job Completion Report

Management Area: A – (Jackson Region)
Period Covered: 6/1/2021 – 5/31/2022
Prepared by: Alyson Courtemanch, North Jackson Wildlife Biologist



Sage Grouse Lek Characteristics

Working Group: Upper Snake River Basin

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	14	73.7
Undetermined	1	5.3
Unoccupied	4	21.1

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	7	36.8
Inactive	11	57.9
Unknown	1	5.3

Year: 2013 - 2022, Working Group: Upper Snake River Basin

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

a. Leks Counted

Year	Occupied	Counted	Percent Counted	Peak Males	Avg Males / Active Lek (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
2020	15	12	80	67	8.4
2021	15	15	100	61	8.7
2022	14	14	100	92	11.5

b. Leks Surveyed

Year	Occupied	Surveyed	Percent Surveyed	Peak Males	Avg Males / Active Lek (2)
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
2020	15	0	0		#Error
2021	15	0	0		#Error
2022	14	0	0		#Error

c. Leks Checked

Year	Occupied	Checked	Percent Checked	Peak Males	Avg Males / Active Lek (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
2020	15	12	80	67	8.4
2021	15	15	100	61	8.7
2022	14	14	100	92	11.5

d. Lek Status

Year	Active	Inactive (3)	Unknown	Known Status	% Active	% Inactive
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
2020	8	4	0	12	66.7	33.3
2021	7	8	0	15	46.7	53.3
2022	9	5	0	14	64.3	35.7

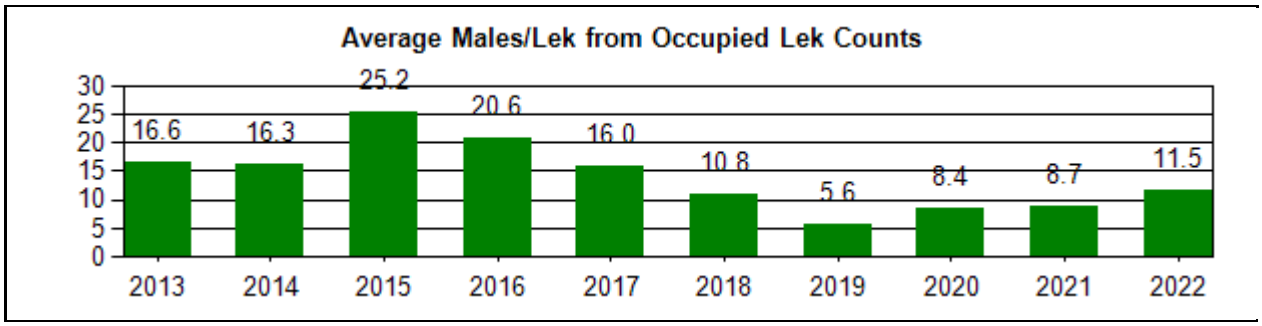
1) Occupied - must have been active once during previous 10 years, calculated based on the official definitions

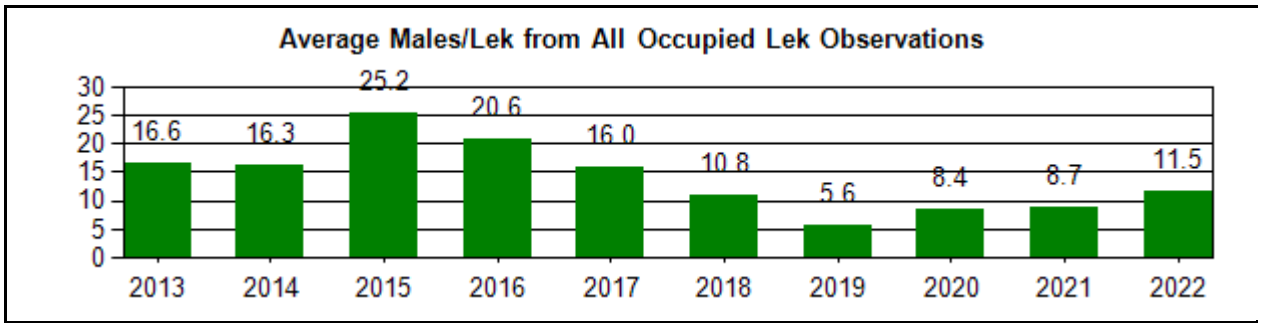
2) Avg Males/Active Lek - Includes only those leks where one or more strutting males were observed. Does not include "Active" leks where only sign was documented.

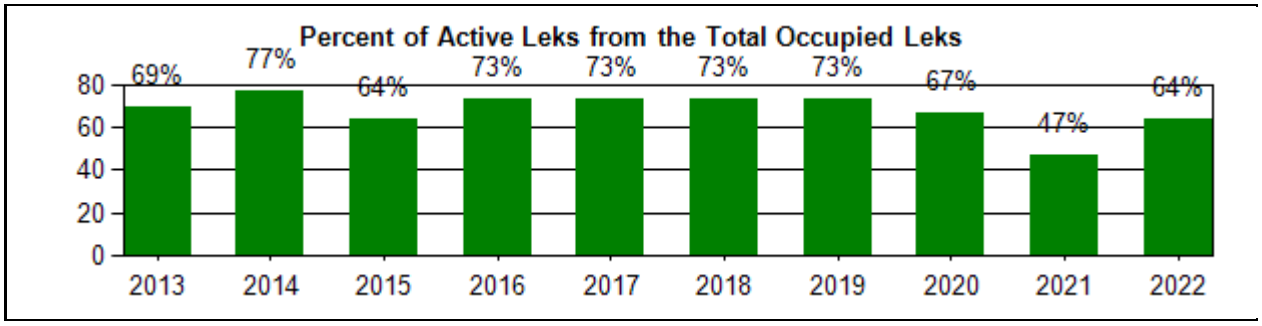
3) Inactive - Confirmed no birds/sign present (see official definitions)

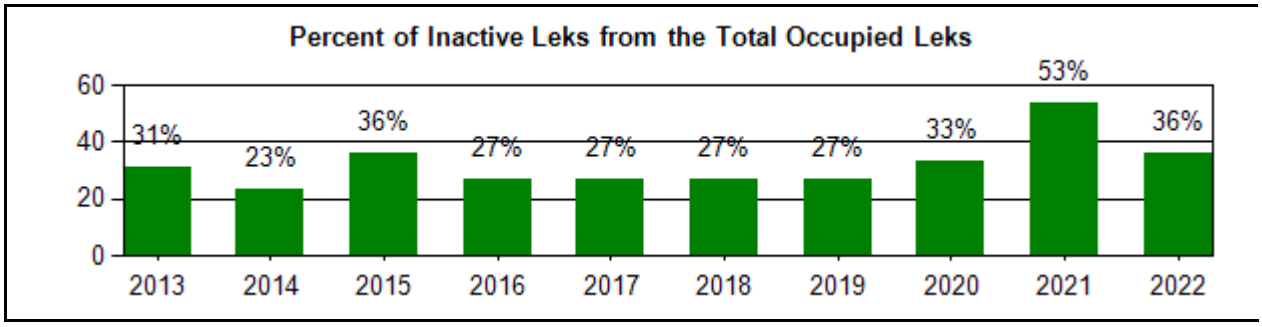
Sage Grouse Occupied Lek Attendance Summary (1)

Year: 2013 - 2022, Working Group: Upper Snake River Basin









1) Occupied - must have been active once during previous 10 years, calculated based on the official definitions

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 current 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 2022. There are a total of 19 leks in the USRBCA: 14 occupied (8 of these were active this year), 4 unoccupied, and 1 undetermined.

Helicopter Survey

Lek counts at the two sites in the Gros Ventre drainage have been very low in recent years (Breakneck Flats and Dry Cottonwood leks). These leks are challenging to survey due to time-consuming and difficult access conditions as well as topography and sagebrush that birds often hide in. In order to improve lek counts and search for additional leks, managers conducted two mornings of helicopter surveys in spring 2022. We conducted helicopter surveys on the mornings of April 18 and 19, 2022, which coincides with the traditional time period of peak male counts at these leks. We flew for approximately 3 hours each morning and surveyed the two known leks as well as all other known sage grouse spring habitat in the Gros Ventre drainage. We counted 4 males on the Breakneck lek and 0 birds at the Dry Cottonwood lek. We flushed one male from Bacon Ridge but could not locate additional birds. The male was approximately 1/2 mile northwest of where we flushed a hen in 2021 during a helicopter survey. This area is over 3 miles away from the Breakneck and Dry Cottonwood leks, which suggests there could be another lek in this area. We plan to fly another survey in spring 2023 and will concentrate search efforts on the Bacon Ridge area again.

During these flights, the Spread Creek lek and several historical leks in southern GTNP (McBride, 3 Bar H Road, and Airport Pit) were also checked. We did not observe any birds at the three historical leks. We observed 2 males on Wolff Ridge at one of the known Spread Creek lek sites and an additional 18 males at an alternate lek site strutting on the sagebrush flats between Wolff Ridge and Spread Creek. Both of these are known areas that birds shift between on a regular basis during the breeding season. Spread Creek can be a difficult area to observe birds from the ground due to time consuming access, topography, and other wildlife activity such as bison that can displace birds. Periodic aerial surveys may be a tool that managers could consider implementing in the future for monitoring this lek.

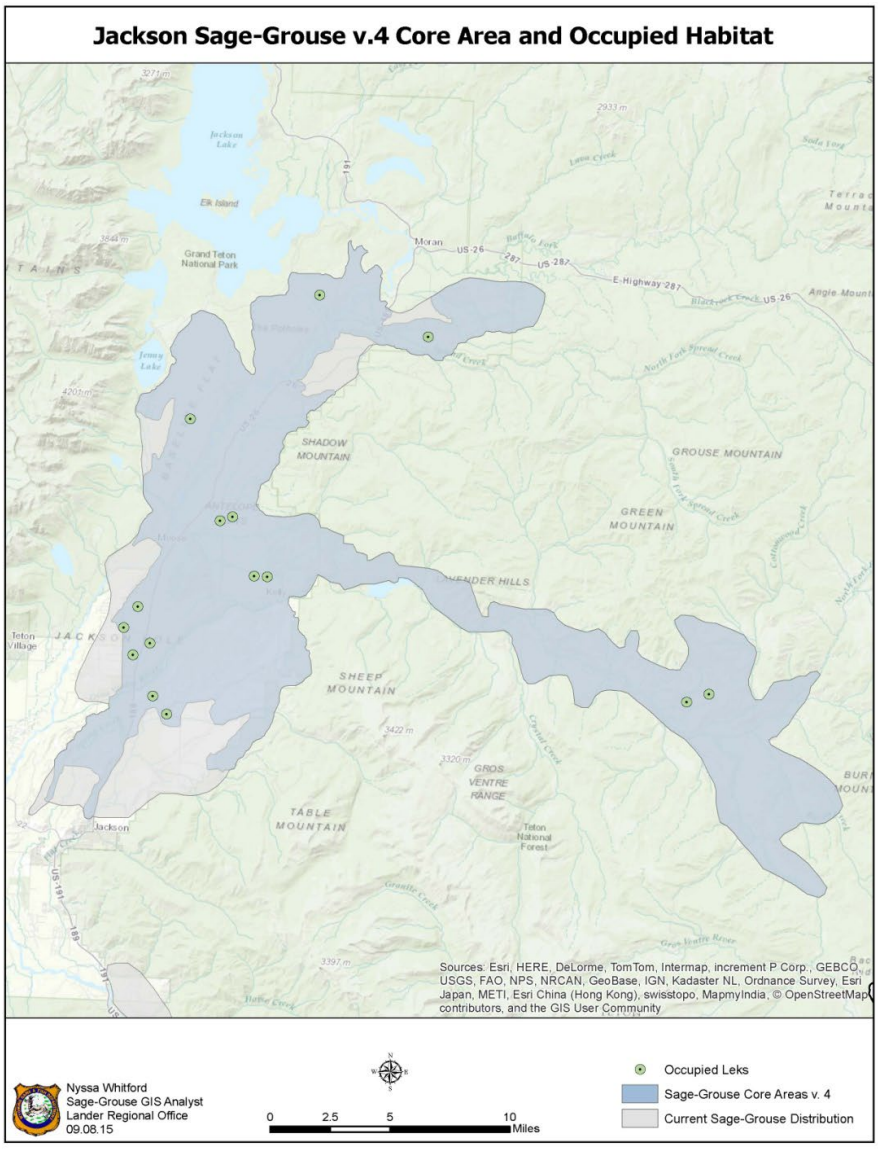


Figure 1. Sage-grouse core area, occupied habitat, and occupied leks in the Upper Snake River Basin Area (does not show Clark's Draw and Ollie's Draw leks).

Table 1. Maximum male counts at sage-grouse leks in the Upper Snake River Basin Conservation Area, 1990-2022. "NC" denotes the lek was not checked that year, "0" denotes the lek was checked but no birds were seen, and grey cells denote the lek had not been discovered yet.

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	**Total Peak Males**	**Average # males/ active lek**
1990	NC	52		10	8		NC				10	49	63	22	NC					214	30.6
1991	NC	63		10	16		NC				15	26	48	29	NC					207	29.6
1992	NC	51		8	16		NC				12	58	37	21	NC					203	29.0
1993	NC	37		5	8		21				16	23	24	9	54					197	21.9
1994	NC	NC		NC	NC		NC				27	50	NC	7	NC					84	28.0
1995	NC	18		4	10		15				6	59	4	6	NC					122	15.3
1996	NC	18		2	8		8				4	32	1	19	NC					92	11.5
1997	NC	15		0	1		1				6	0	48	10	NC					81	13.5
1998	NC	14		0	0		0				4	29	0	7	NC					54	13.5
1999	NC	17		0	0		0				0	21	0	9	NC					47	15.7
2000	NC	18		0	NC		NC	21			0	28	0	5	NC					72	18.0
2001	NC	15		0	NC		NC	19			0	30	0	6	NC					70	17.5
2002	NC	19		0	NC		24	9			0	28	0	4	NC					84	16.8
2003	NC	25		0	NC		0	7			0	35	0	3	NC				8	78	15.6
2004	NC	17		0	2		0	14			0	54	0	4	NC				15	106	17.7
2005	NC	17		0	NC		0	16		6	NC	49	0	18	NC				17	123	20.5
2006	NC	23	6	0	0		4	21		9	0	44	0	30	0				20	157	19.6
2007	0	23	0	NC	1		NC	30		4	1	41	0	9	0			4	20	133	14.8
2008	0	16	0	NC	2	8	0	22		13	0	38	0	23	NC		12	5	26	165	16.5
2009	NC	10	2	0	5	NC	0	21		1	0	33	0	11	0		15	4	22	124	12.4
2010	NC	10	0	0	24	0	0	24	13	4	0	40	0	13	0		13	5	18	164	16.4
2011	0	11	0	0	0	10	0	5	13	0	0	27	0	21	0		10	15	0	112	14.0
2012	0	17	0	0	3	NC	0	14	14	0	0	44	14	18	3		8	0	7	142	14.2
2013	NC	17	0	0	0	0	NC	14	13	5	NC	46	NC	8	0		6	24	16	149	16.6
2014	NC	11	3	NC	10	0	NC	18	7	0	NC	61	NC	21	0		8	8	16	163	16.3
2015	NC	12	0	NC	0	11	NC	27	17	0	0	103	NC	10	0	NC	21	15	11	227	25.2
2016	NC	7	0	0	0	13	0	34	12	8	0	21	53	7	0	NC	48	6	18	227	20.6
2017	NC	10	0	NC	0	4	NC	22	13	0	0	36	46	4	0	5	15	5	16	176	16.0
2018	NC	13	0	NC	0	7	NC	8	5	0	NC	28	0	6	0	8	16	5	12	108	10.8
2019	NC	8	0	NC	0	1	NC	7	6	0	NC	14	5	1	0	4	8	1	7	62	5.6
2020	NC	7	0	NC	0	6	NC	3	NC	0	NC	24	0	12	0	NC	4	4	7	67	8.4
2021	NC	3	0	NC	0	0	NC	7	8	0	NC	22	0	1	0	0	10	0	10	61	8.7
2022	NC	2	0	NC	0	0	NC	4	16	0	0	23	0	0	0	6	20	6	15	92	11.5
Max		63	6	10	24	13	24	34	17	13	27	103	63	30	54	8	48	24	26	227	30.6

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 showed a generally increasing trend, however there was a sharp decrease from 2017 – 2019 (Figure 2). Numbers have slowly improved from 2020-2022 but they remain the lowest we have recorded in this population. 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 5.6 in 2019, 8.4 in 2020, 8.7 in 2021, and climbed to 11.5 in 2022.

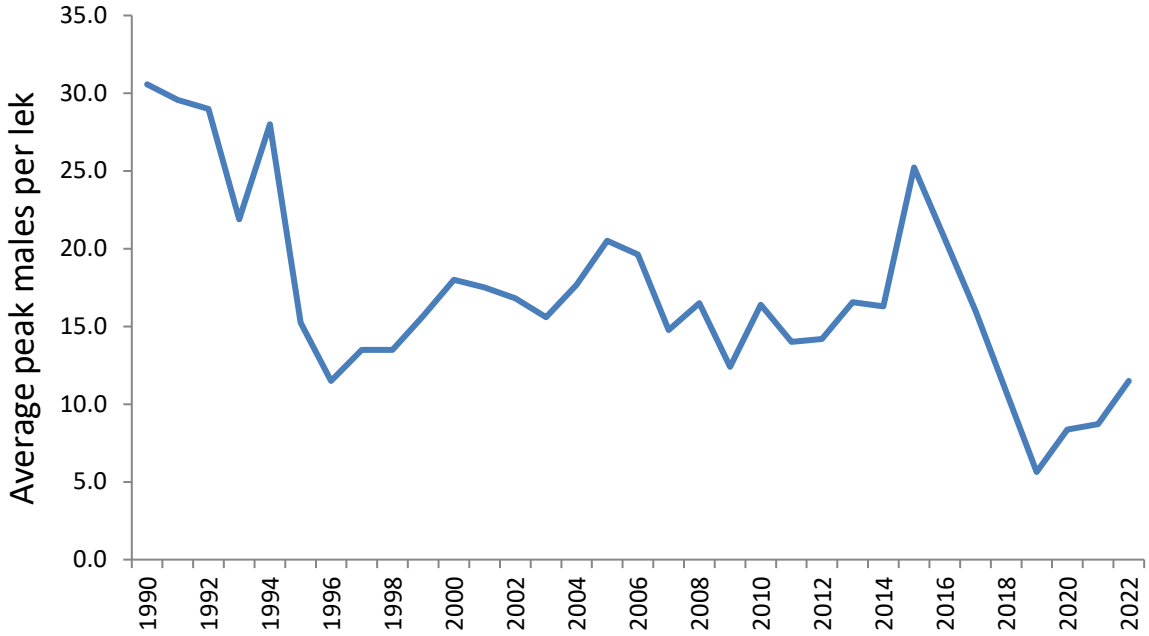


Figure 2. Average peak male counts for active leks in the Upper Snake River Basin Conservation Area, 1990-2022.

The population decline and low numbers during the past 6 years is very concerning. The drop has largely been 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 between 19-24 males from 2019-2022. Declines at other leks such as Breakneck Flats in the Gros Ventre drainage (from 34 males in 2016 to 7 in 2019, 3 in 2020, 7 in 2021, and 4 in 2022) and RKO lek (48 in 2016 to 8 in 2019, 4 in 2020, and 10 in 2021) reflect this trend. It should be noted that the slight increase seen in 2022 is partially driven by improved counts at the Clark's Draw and Ollie's Draw leks in the Hoback Basin (Table 1), which are disconnected from the rest of the Jackson population. Timbered Island, Spread Creek, and RKO leks also improved slightly in 2022. Although the small increase in 2022 is promising, the long term persistence of this population continues to be of paramount concern to the local working group and Wyoming Game and Fish managers.

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

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 northern NER. Little habitat occurs on private lands. The majority of habitat on private lands is located on East and West Gros Ventre Buttes, the Spring Gulch area, and west of the Jackson Hole Airport.

No wildfires or prescribed burns occurred in significant areas of sagebrush habitat in sage-grouse core areas within the USRBCA during the reporting period. 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.

Winter 2021/2022 conditions were average. However, several severe rain and snowstorms in spring 2022 could have affected late winter survival and nesting.

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 from 2018-2022 and met several times to discuss potential courses of action to reverse this decline. Following Appendix I of the Executive Order, the working group prepared a document in 2019 notifying the Statewide Adaptive Management Working Group of this concern. In response, the Jackson Sage-Grouse Technical Team was assembled in 2019 to review the situation and make recommendations of ways to address the population decline. The Technical Team submitted a report outlining its findings and recommendations in April 2020. At this time, the Statewide Adaptive Management Working Group and Sage Grouse Implementation Team (SGIT) have decided not to move forward with recommending any

management actions. Therefore, the USRBWG has focused on continuing to monitor the population.

Special Projects

Inventorying Fences in Sage-Grouse Habitat
Jackson Hole Wildlife Foundation

SUMMARY
The goal of this project is to determine where and how many problematic fences occur on the landscape in sage-grouse core habitat on Grand Teton National Park and the Gros Ventre drainage on Bridger-Teton National Forest lands. The objectives are to create maps and update shapefiles that are clear in definition of problematic fences for sage-grouse in core habitat so that they can be mitigated. Jackson Hole Wildlife Foundation will use their records of fence removals and modifications from 2012 – present to compare with 1) an existing Grand Teton National Park fence shapefile, 2) shapefiles of allotment and pasture perimeters from the Bridger-Teton National Forest, and 3) shapefiles from the University of Wyoming (1992) and the Office of State Lands and Investment (2012). These shapefiles will be merged and updated to include information regarding past fence modifications that have occurred. If modifications have not occurred, then these fences will be targeted for manual inspection on the ground and the GIS layer updated. Fences that are deemed problematic in sage-grouse core habitat will be slated for future modifications or removals, as deemed appropriate and approved by the land managing agency.

Assessment of Cheatgrass Treatments and Restoration for Sage-Grouse Habitat
The Nature Conservancy

SUMMARY
In 2019, a wildfire ignited on the sagebrush hillside behind the National Museum of Wildlife Art in Jackson and within a year the hillside became heavily infested with cheatgrass. Although unfortunate, this presented The Nature Conservancy and our partners an opportunity to better understand the dynamics between wildfire, invasive species, and native plant restoration in the sagebrush steppe of the Upper Snake River Basin. Our research aims to better understand the effect of two commonly used herbicides, Imazapic and Indaziflam, specifically on forbs in the sage-grouse diet for up to three years post-treatment. Additionally, we are testing the effectiveness of reseeding with three different native seed mixes (commercial, locally sourced, and regional mixture) one year and two years post treatment to replenish the seedbank. Our ultimate goals are to deliver best-practices to land managers in the Upper Snake River Basin for cheatgrass mitigation and native plant restoration to directly improve sage-grouse and other wildlife habitat.

Genetics Assessment of the Jackson Core Area Sage-grouse Population
Teton Raptor Center and U.S. Geological Survey

SUMMARY
The goal of this project is to assess the genetic health and genetic diversity of the Jackson Core Area sub-populations in relation to each other and other small, isolated sage-grouse populations. This builds on earlier genetic work conducted by Sarah Oyler-McCance from USGS on these

populations. This project will collect and submit genetic samples (fecal and feathers) from the Jackson Hole and Gros Ventre sub-populations for genetic analysis. Knowledge of the degree of connectivity between populations and sub-populations is crucial for better management of small populations in this changing landscape.

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
Teton County Weed and Pest District

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 sage-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.

Management Summary

It appears that following a population rebound in 2015 and 2016, the population has undergone a significant decline during the past 6 years. Lek counts in spring 2019 were the lowest on record for this population, and spring 2020, 2021, and 2022 only improved slightly. Data collection, monitoring, and discussions are continuing regarding which potential actions may or may not be implemented by the respective land management agencies and WGFD.

Limited winter habitat continues 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 and habitat condition 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 disturbance. 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.

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. 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.
5. Continue to work with land management agencies during the implementation of habitat improvement projects to minimize impacts to sage-grouse occupied habitats.
6. Implement the USRBWG Sage-Grouse Conservation Plan (2014). Work to implement the strategies and projects identified in the plan.

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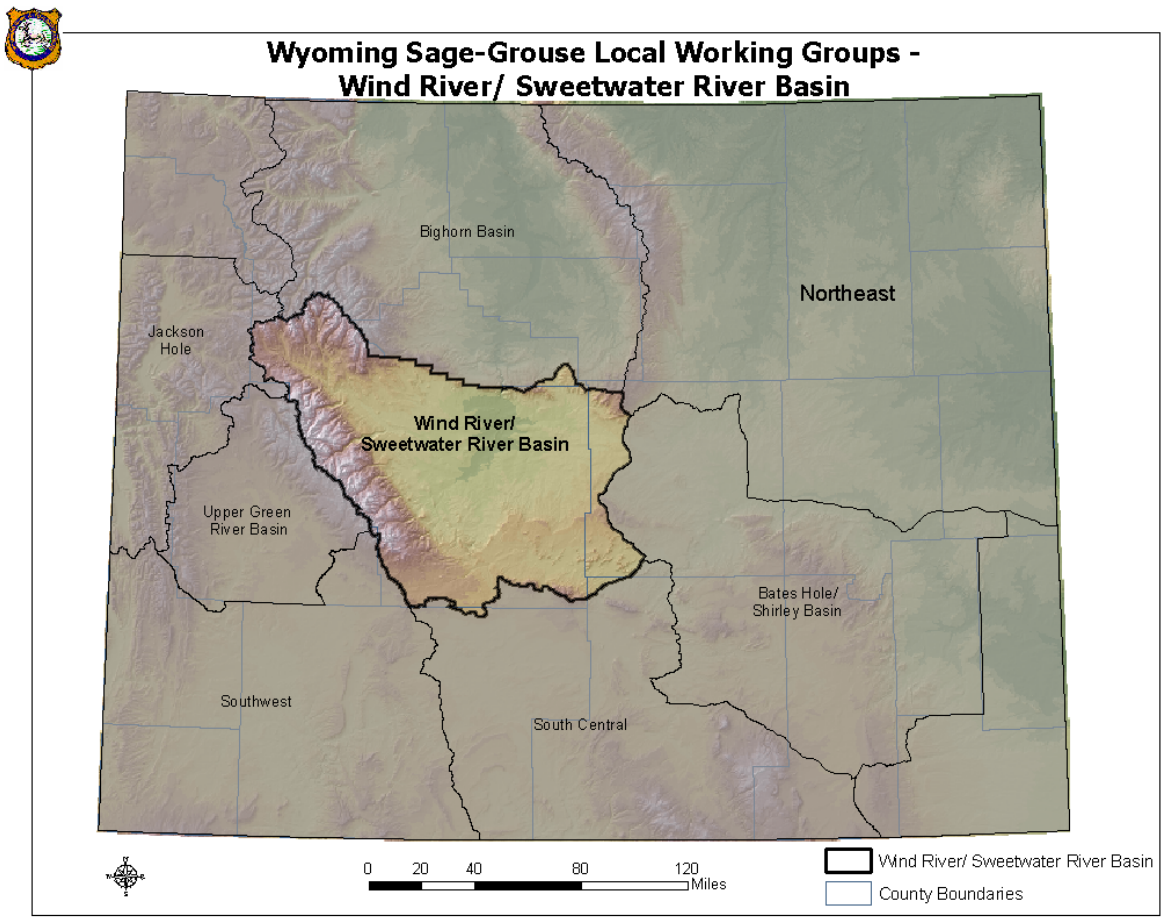
Wind River/Sweetwater River Conservation Area
Job Completion Report

Management Areas: E & WR – (Lander Region)
Period Covered: 6/1/2021 – 5/31/2022
Prepared by: Stan Harter, Lander Wildlife Biologist



Sage Grouse Lek Characteristics (2022)

Working Group: Wind River/Sweetwater River

Region	Number	Percent
Casper	2	0.8
Lander	196	75.7
WRR	61	23.6

Working Group	Number	Percent
Wind River/Sweetwater River	259	100.0

Classification	Number	Percent
Occupied	195	75.3
Undetermined	18	6.9
Unoccupied	46	17.8

BLM Office	Number	Percent
Lander (WRR)	61	23.6
Casper	12	4.6
Lander	177	68.3
Rock Springs	7	2.7
Worland	2	0.8

Biologist	Number	Percent
WRR-USFWS	61	23.6
Casper	2	0.8
Dubois	69	26.6
Lander	125	48.3
Sinclair	1	0.4
Worland	1	0.4

Warden	Number	Percent
Shoshone-Arapahoe Tribal	61	23.6
Dubois	1	0.4
Lander	73	28.2
North Riverton	27	10.4
South Riverton	62	23.9
West Casper	2	0.8
West Rawlins	33	12.7

County	Number	Percent
Carbon	1	0.4
Fremont	229	88.4
Hot Springs	4	1.5
Natrona	24	9.3
Sweetwater	1	0.4

Land Status	Number	Percent
BLM	149	57.5
BOR	4	1.5
Private	30	11.6
Reservation	60	23.2
State	16	6.2

Management Area	Number	Percent
E	198	76.4
WR	61	23.6

Lek Status	Number	Percent
Active	136	52.5
Inactive	43	16.6
Unknown	80	30.9

Sage Grouse Job Completion Report

Year: 2013 - 2022, 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)
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	209	110	53	3678	38.7
2019	206	97	47	2416	31.4
2020	204	104	51	2181	26.3
2021	202	85	42	1503	23.1
2022	203	110	54	2264	28.7

b. Leks Surveyed

Year	Occupied	Surveyed	Percent Surveyed	Peak Males	Avg Males / Active Lek (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	209	87	42	1402	22.3
2019	206	100	49	1195	17.1
2020	204	68	33	605	15.1
2021	202	105	52	874	14.3
2022	203	85	42	715	14.9

Sage Grouse Job Completion Report

Year: 2013 - 2022, 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)
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	209	197	94	5080	32.2
2019	206	197	96	3611	24.6
2020	204	172	84	2786	22.7
2021	202	190	94	2377	18.9
2022	203	195	96	2979	23.5

d. Lek Status

Year	Active	Inactive (3)	Unknown	Known Status	% Active	% Inactive
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	158	14	25	172	91.9	8.1
2019	148	20	29	168	88.1	11.9
2020	126	21	25	147	85.7	14.3
2021	128	21	41	149	85.9	14.1
2022	130	29	36	159	81.8	18.2

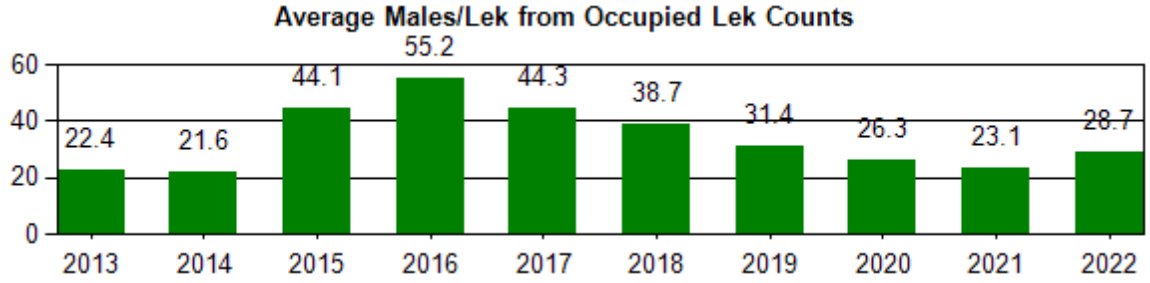
1) Occupied - must have been active once during previous 10 years, calculated based on the official definitions

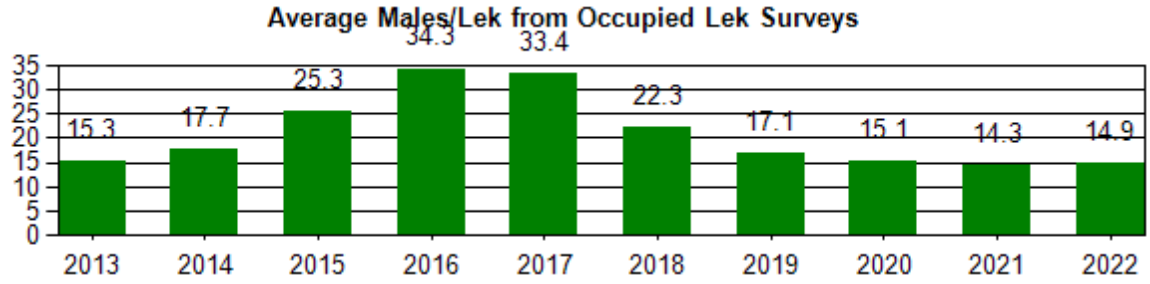
2) Avg Males/Active Lek - Includes only those leks where one or more strutting males were observed. Does not include "Active" leks where only sign was documented.

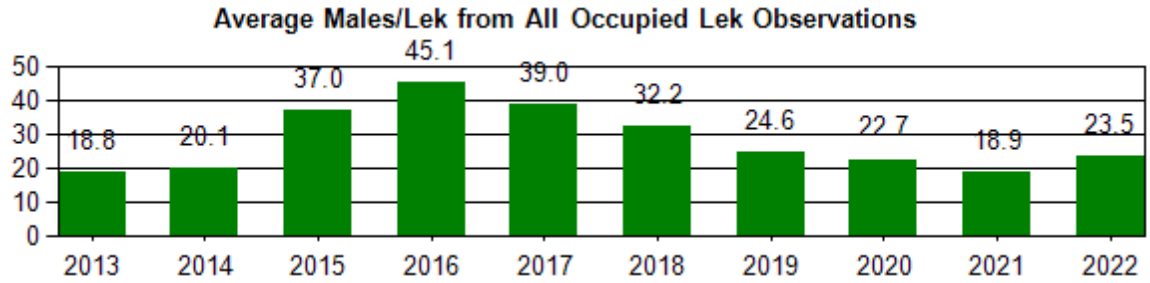
3) Inactive - Confirmed no birds/sign present (see official definitions)

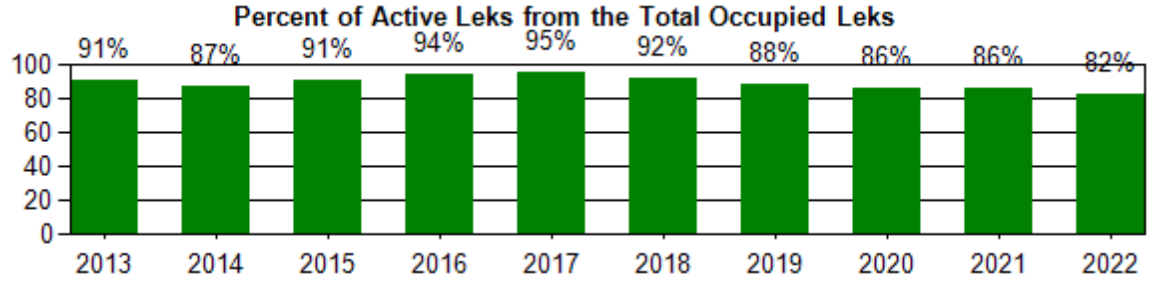
Sage Grouse Occupied Lek Attendance Summary

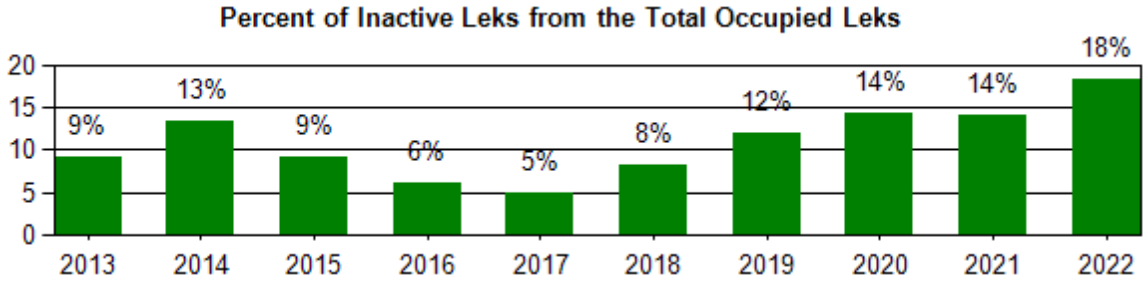
Year: 2013 - 2022, Working Group: Wind River/Sweetwater River











Sage Grouse Job Completion Report

Year: 2012 - 2021, Working Group: Wind River/Sweetwater River

3. Sage Grouse Hunting Seasons and Harvest Data

a. Season

Year	Season Start	Season End	Length	Bag/Possession Limit
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
2019	Sep-21	Sep-30	10	2/4
2020	Sep-19	Sep-30	12	2/4
2021	Sep-18	Sep-30	13	2/4

b. Harvest

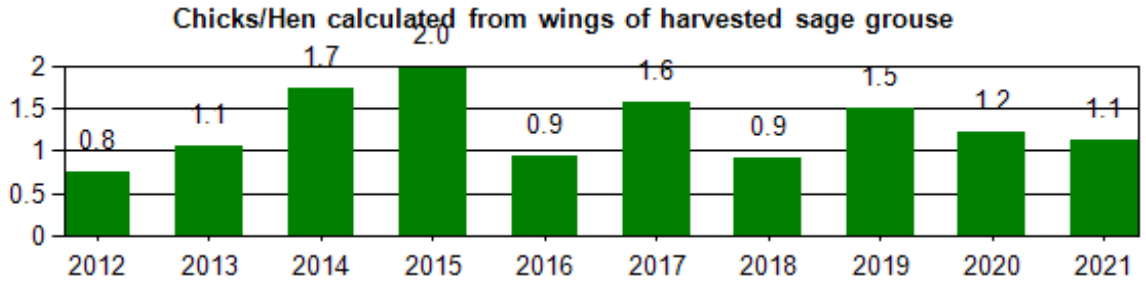
Year	Harvest	Hunters	Days	Birds/ Day	Birds/ Hunter	Days/ Hunter
2012	2068	890	2296	0.9	2.3	2.6
2013	1240	565	1325	0.9	2.2	2.3
2014	1546	772	1853	0.8	2.0	2.4
2015	2158	737	1846	1.2	2.9	2.5
2016	1910	922	2264	0.8	2.1	2.5
2017	1364	630	1427	1.0	2.2	2.3
2018	2250	970	2519	0.9	2.3	2.6
2019	1525	814	1891	0.8	1.9	2.3
2020	1115	610	1767	0.6	1.8	2.9
2021	1141	783	2027	0.6	1.5	2.6
Avg	1,632	769	1,922	0.9	2.1	2.5

Sage Grouse Job Completion Report

Year: 2012 - 2021, 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	
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
2019	311	14.5	22.5	4.2	10.0	19.0	29.9	1.5
2020	390	12.8	27.9	5.1	9.0	17.4	27.7	1.2
2021	289	6.2	34.6	3.1	8.0	14.2	33.9	1.1



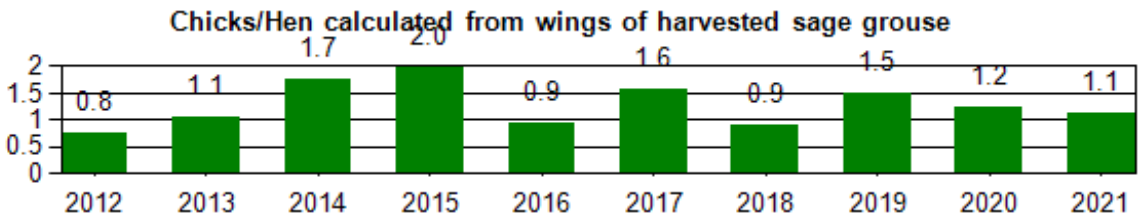
Sage Grouse Wing Analysis Summary

Year: 2021, Working Group: Wind River/Sweetwater River

Adult Males:	18	% of All Wings:	6.2
Adult Females:	100	% of All Wings:	34.6
Adult Unknown:	0	% of All Wings:	0.0
Total Adults:	118		
Yearling Males:	9	% of All Wings:	3.1
Yearling Females:	23	% of All Wings:	8.0
Yearling Unknown:	0	% of All Wings:	0.0
Total Yearlings:	32		
Chick Males:	41	% of All Wings:	14.2
Chick Females:	98	% of All Wings:	33.9
Chick Unknown:	0	% of All Wings:	0.0
Total Chicks:	139		
Unknown Sex/Age:	0		
Total for all Sex/Age Groups:	**289**		

Chick Males:	41	% of All Chicks	29.5
Yearling Males:	9	% of Adult and Yearling Males	33.3
Adult Males:	18	% of Adult and Yearling Males	66.7
Adult and Yearling Males:	27	% of Adults and Yearlings	18.0
Total Males:	68	% of All Sex/Age Groups	23.5
Chick Females:	98	% of All Chicks	70.5
Yearling Females:	23	% of Adult and Yearling Females	18.7
Adult Females:	100	% of Adult and Yearling Females	81.3
Adult and Yearling Females:	123	% of Adults and Yearlings	82.0
Total Females:	221	% of All Sex/Age Groups	76.5

Chicks:	139	% of All Wings:	48.1
Yearlings:	32	% of All Wings:	11.1
Adults:	118	% of All Wings:	40.8
Chicks/Hen	1.1		



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. Sage-grouse distribution is visualized via a map of known leks within the WRSRCA (Figure 1).

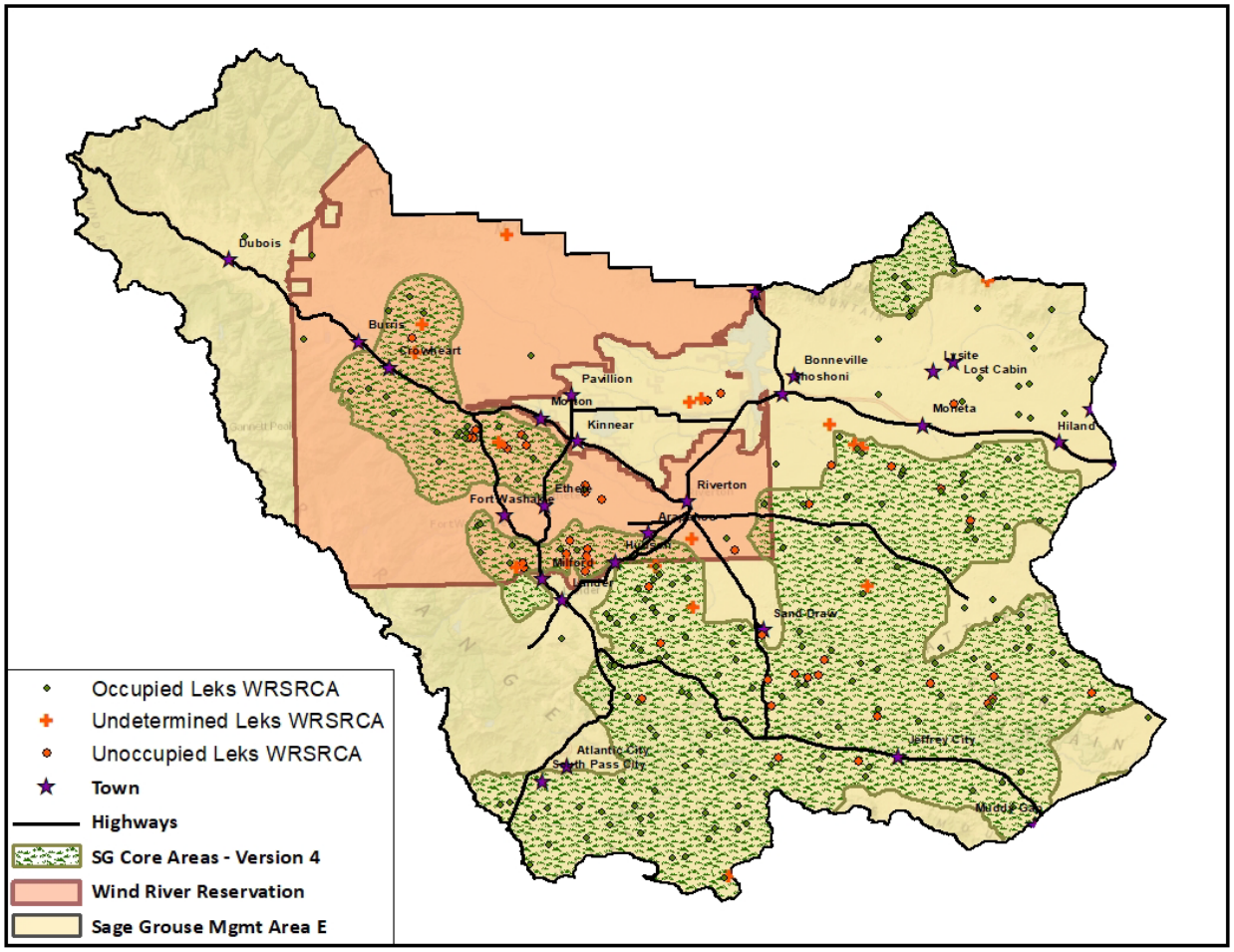


Figure 1. Known sage-grouse lek (2022) and core area distribution in the Wind River/Sweetwater River Conservation area.

Lek Attendance - 2022

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. According to the lek characteristics report on page 2, there were 195 known occupied leks within the conservation area in 2022, along with 46 unoccupied and 18 undetermined leks. As seen above in Figure 1, a 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 133 (average 6 per year) new or newly discovered leks being documented in

the WRSRCA through intensive monitoring and search efforts since 1995. Similarly, there likely are leks that have been abandoned or destroyed that are undocumented. Lek attendance at all leks checked generally increased between 1995 and 2006, declined until 2013, increased again for 3 years, only to decline in 2017 through 2021, with a 24% uptick in 2022. These lek attendance figures mimic Wyoming's statewide trends, but with generally higher numbers than the Wyoming average (Figures 2 and 3). While a 24% increase in 2022 is encouraging, it should be noted the 2021 level was the 4th lowest level since 1995 in the WRSRCA.

Personnel from WGFD, BLM, USFWS, and Shoshone-Arapahoe Tribal Fish and Game (SATFG), assisted by several researchers, consultants, and volunteers checked 195 (96%) of the 203 known occupied leks in the WRSRCA in 2022. Of those leks checked, 110 were counted and 85 were surveyed. Of the 159 leks where status was confirmed in 2022, 130 (81.8%) were active and 29 (18.2%) were inactive, marking the lowest proportion in active status since 1995.

Average male attendance for all leks checked improved from 18.9 males per active lek checked in 2021 to 23.5 in 2022. Average maximum male attendance at count leks also increased from 23.1 males per active lek in 2021 to 28.7 in 2022, remaining below the count lek average since 2013 (33.6), and 62% below the long-term peak observed in 2006 (76.0).

A subset of 17 leks (16 long-term, with one lek that moved in 2018, but since the distance was over 1 mile and birds still attend the old lek, we are considering the new location as a new lek) in the Government Draw area east of Lander which have been counted since 1995 also had a lek attendance increase in 2022, with a 20% increase in male attendance from 31.9 males per active lek in 2021 to 38.3 males per active lek in 2022. This area has outperformed the attendance averages for the entire WRSRCA, over the last few years, with the 2022 being the 3rd best since 2013, while the WRSRCA average lek attendance in 2022 was the 6th best in the same period. Of concern though, the number of inactive leks in this subset has gone from 1 in 2017 to 5 each year since 2020. (perhaps a function of a much lower visitation rate since the last year of UC-Davis research in this area (2017), which provided nearly daily visits to most of the leks to a much less rigorous rate of 3-4 visits per breeding season since then)

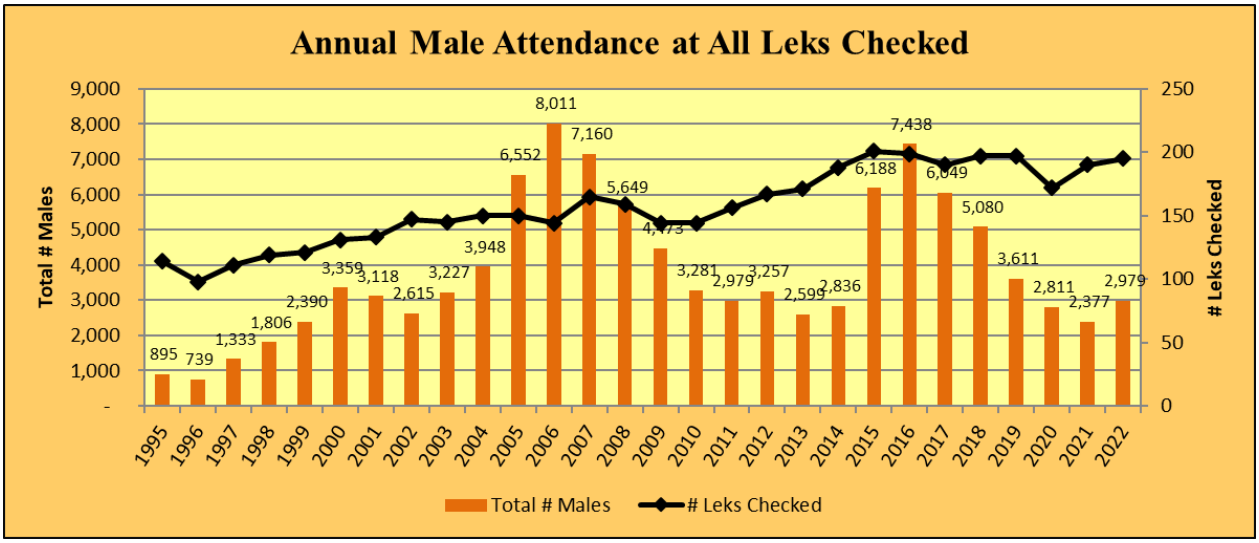


Figure 2. Total male attendance at all leks checked within the Wind River/Sweetwater River Conservation Area, 1995–2022.

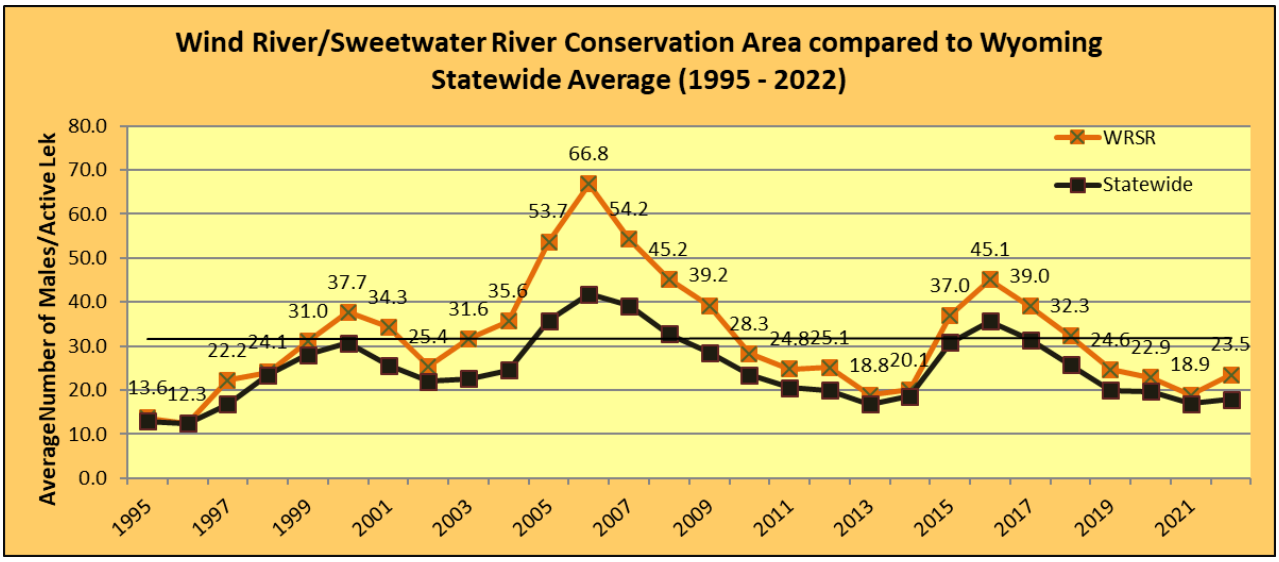


Figure 3. Average male lek attendance (all leks checked) in WRSRCA relative to Wyoming statewide trends, 1995 –2022.

Lek Perimeter Mapping

As of 2022, nearly all leks in the WRSRCA have perimeters mapped.

Productivity

Since summer brood data are very limited in the WRSRCA, wing data collected from harvested sage grouse provide a more reliable indicator of recruitment than do brood survey data. Wings are collected from hunters at 7 wing barrels placed annually at exit roads from major hunting destinations in Sage Grouse Management Area E and at the Lander Game Check Station. These wings typically provide significant data, due to a relatively high number of sage-grouse hunters in the area, yet the number of wings collected in recent years has declined, with the 2021 sample being the 2nd lowest in the last 10 years (mimicking lek attendance trends). Wing data are summarized for the WRSRCA for hunting seasons 2012 – 2021, and reported in detail for 2021 (pages 7 and 8). Wings collected from harvested birds during the 2021 hunting season yielded an average brood size of 1.1 chicks per hen, below the average of 1.3 chicks per hen observed over the last 10 years. Population growth typically requires 1.7 chicks/hen or more based on historic statewide averages. However, with chick survival in 2020 being below that threshold, male lek attendance still increased 24% in 2022 in the WRSRCA.

Hunting Season and Harvest

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 and ending on September 30. The 2021 sage-grouse hunting season was 13 days long (Sept. 18 – 30). In 2021, a total of 1,141 sage grouse were harvested in Management Area E, an increase of 26 from the 2020 harvest and the 2nd lowest since 2012, with annual harvest levels generally following lek attendance trends. Hunter numbers were 28% higher and hunter days were 15% higher, compared with the 2020 hunting season. Hunter effort (days/hunter) was just above average

and success (birds/hunter and birds/day) statistics were the lowest in the last 10-year period (Page 6).

Sage-grouse hunting on tribal lands within the Wind River Reservation is minimal and data are not included in this report.

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 2021 specifically for sage grouse. However, implementation of Rapid Habitat Assessments (RHAs) continued as part of the South Wind River and Sweetwater Mule Deer Initiatives, to develop a baseline from which to gauge overall habitat condition. Several RHAs covering shrub/rangeland habitats were completed within the WRSRCA in 2021, and offer insight as to the condition of sage-grouse habitats within the South Wind River and Sweetwater Mule Deer herd units that overlap a portion of the WRSRCA.

Winter Habitat Use Survey
Limited winter observations were collected in 2021-22, mostly as opportunistic observations during deer, elk, and moose classification 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 2021, however Fremont County Weed & Pest conducts annual herbicide applications to curtail the spread of noxious weeds, including cheatgrass in many parts of the WRSRCA.

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. 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 2020 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 2021.

Management Recommendations

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

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

Response of Greater Sage-grouse to Treatments in Wyoming Big Sagebrush –
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Comparison of Avian and Mammalian Predators in Sage-Grouse Core and Non-Core Areas: Assessing Predator Abundance and Responses to Anthropogenic Features –
Claire L. Revekant[1] and Jonathan B. Dinkins[1] [1]Department of Animal and Rangeland Sciences, Oregon State University, Corvallis, OR 97331 – Master of Science Thesis June 2021

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