2015-16 Draft Greater Sage-Grouse Annual Report
Pinedale Anticline Project Area

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Contents

OVERVIEW

The 2008 Final Supplemental Environmental Impact Statement Record of Decision (ROD) for the Pinedale Anticline Oil and Gas Exploration and Development Project (BLM 2008) includes a Wildlife Monitoring and Mitigation Matrix (WMMM) that identifies key wildlife species to be monitored and specific changes that require mitigation (Appendix A, Table 1). For Greater Sage-Grouse, the WMMM is designed to quantitatively identify changes in sage-grouse populations within the Pinedale Anticline Project Area (PAPA). Six lek complexes are monitored annually for changes specified in the WMMM (Appendix A, Figure 1). Lek attendance by male sage-grouse, number of active leks, winter concentration area use, and noise are all monitored. In 2016, monitoring results for attendance by male sage-grouse and number of active leks indicated matrix thresholds for sage-grouse were not surpassed.

MATRIX THRESHOLD CRITERIA

There are several measurements used to evaluate the matrix thresholds (or triggers) for Greater Sage-Grouse.

Active Leks Threshold

The matrix threshold of a 30% decline in total number of active leks within the development area has two comparisons that can be made with this component:

1. The total number of active leks in the three combined development area complexes is compared to the 2007 baseline for the combined development area complexes.
2. The number of active leks in a single development area complex is compared to the 2007 baseline data for that lek complex.

According to footnote 1 on page B-3 of the ROD (BLM 2008), for both of these comparisons, if the number of leks decline but the bird numbers on lek complexes do not, the mitigation threshold would not be surpassed. Therefore, the matrix threshold for a decline in the number of active leks can only be surpassed if there is a concurrent decrease in the peak number of males as explained below.

Number of Peak Males Threshold

The matrix threshold of a 30% decline in peak male numbers has two comparisons for this component:

1. A 30% decline in peak male numbers within the entire development area is compared to the entire combined reference area total. The change is derived by comparing the current year total to the prior 2-year average in annual peak male numbers within the entire combined development area. The percent change from the development area is then compared to the percent change within the entire combined reference area.
2. A 30% decline in peak male numbers within an individual development area complex compared to the entire combined reference area. The change is derived by comparing the current year total to the prior 2-year average in annual peak male numbers within each

single development area complex. The percent change from a single development area complex is then compared to the percent change within the entire combined reference area.

Winter Habitat Use Threshold

The matrix threshold for a decline in habitat area use may be met when measurements detect an average 15% per year decline in the amount of winter concentration habitat area used over 2-years as compared to the entire combined reference areas and when combined with a concurrent average of 30% decline in peak number of males over 2-years compared to the entire combined reference areas.

Noise Threshold

Noise is measured by evaluating decibel levels at development area leks. A trigger is met when noise exceeding 10 dBA above background (39 dBA, BLM 2000) when measured from the edge of the lek, is combined with a concurrent average of 30% decline in peak number of male birds over 2-years compared to the entire combined reference area numbers.

SURVEY METHODS

All monitoring follows the Wyoming Game and Fish Department (WGFD) protocols from the Handbook of Biological Techniques (Emmerich et al. 2007).

Guidelines for conducting noise monitoring (Blickley and Patricelli, 2012) were prepared for the PAPO as recommended by the Wyoming Cooperative Fish and Wildlife Research Unit (Connelly et al. 2010). Noise monitoring results are available in a separate noise monitoring report available on the PAPO website.

RESULTS

Sage-grouse monitoring included identifying the number of active leks and peak numbers of males attending leks (Appendix A, Table 2).

Total Number of Active Leks in Development Complexes Combined

In 2007, development area leks in 3 lek complexes (Mesa, Duke's Triangle and Yellowpoint) totaled 16 active leks. There were 13 total active leks within the development area in 2016 which equates to a 19% decline compared to the baseline year 2007 (Appendix B, Table 1). One new lek was found within the Mesa complex in 2016 (Luman Allotment Reservoir Lek).

Total Number of Active Leks in a Single Development Complex

For the number of active leks within a single complex, in 2007 the Mesa complex began with 6 active leks. In 2016, 6 active leks were reported for the Mesa complex resulting in no change in the number of leks compared to 2007. There were 2 active leks in the 2007 baseline year for the

Duke's Triangle complex with 1 active lek in 2016, representing a 50% decline. The Yellowpoint complex had 8 active leks in the 2007 baseline year with 6 active leks in 2016 representing a 25% decline (Appendix B, Table 2).

Peak Number of Males Attending Lek Complexes

The WMMM outlines monitoring a 2-year change in the number of males attending 3 development complexes and 3 adjacent reference area lek complexes (Appendix A, Figure 1). A decline of 30% in one of the development area complexes, when compared to the entire combined reference area, triggers mitigation. Data and calculations for these analyses can be found in Appendix B (Tables 3 thru 8).

Comparison of Entire Development Area with Combined Reference Area

In 2016, there was a 47% increase in peak males attending leks within the entire development area (Appendix B, Table 5) and a 39% increase in peak males attending leks within the combined reference area (Appendix B, Table 8). The results indicate both areas increased, with the entire development area having an 8% greater increase than the combined reference area.

Comparison of Individual Development Area Complexes with Combined Reference Area

Individual complexes within the development area were compared to the combined reference area. A decline of 30% in an individual development area complex when compared to the combined reference areas triggers mitigation. Data and calculations for these analyses can be found in Appendix B (Tables 3 thru 8).

Mesa Complex

In 2016, the Mesa complex increased 29% (Appendix B, Table 5) while the combined reference area increased 39% (Appendix B, Table 8) indicating the Mesa complex increased 10% less than the combined reference area.

Duke's Triangle

In 2016, the Duke's Triangle complex increased 131% (Appendix B, Table 5) while the combined reference area experienced a 39% increase (Appendix B, Table 8) indicating the Duke's Triangle complex had a 92% greater increase than the combined reference area.

Yellowpoint

In 2016, the Yellowpoint complex had a 67% increase (Appendix B, Table 5) while the combined reference area experienced a 39% increase (Appendix B, Table 8) indicating the Yellowpoint complex had a 28% greater increase than the combined reference area.

LEK SEARCHES

In 2016, ground searches were conducted in all complexes in the development area (Mesa, Duke's Triangle, and Yellowpoint) and all reference area complexes (Speedway, Ryegrass and East Fork). One new lek was located within the Mesa complex (Luman Allotment Reservoir) and one new lek (Chalk Butte) was found within the East Fork complex. In addition, the Sands Spring Well 2 lek located in the East Fork complex was re-occupied in 2016 after being unoccupied for several years.

WINTER CONCENTRATION AREAS

Wyoming Executive Order 2015-04 requires that identification of winter concentration areas be based on habitat features and repeated observations of winter use by a biologically significant number of Greater Sage-Grouse using a validated resource selection function (RSF) modeling approach. The Sage Grouse Implementation Team (SGIT) is currently working on standardizing the methodology and a RSF model for delineating winter concentration areas in the state of Wyoming. This RSF model could be used to better refine winter concentration areas located within the development and reference area complexes (Appendix C, Figure 1). The PAPO will continue to work on winter concentration delineation and developing monitoring protocols to assess wintering sage-grouse use.

NOISE MONITORING

The results of the 2016 noise monitoring can be found in a separate report.

LITERATURE CITED

Blickley, J. L, and G. L. Patricelli. 2013. Noise monitoring recommendations for Greater Sage Grouse habitat in Wyoming. Prepared for the PAPO, Pinedale, WY.

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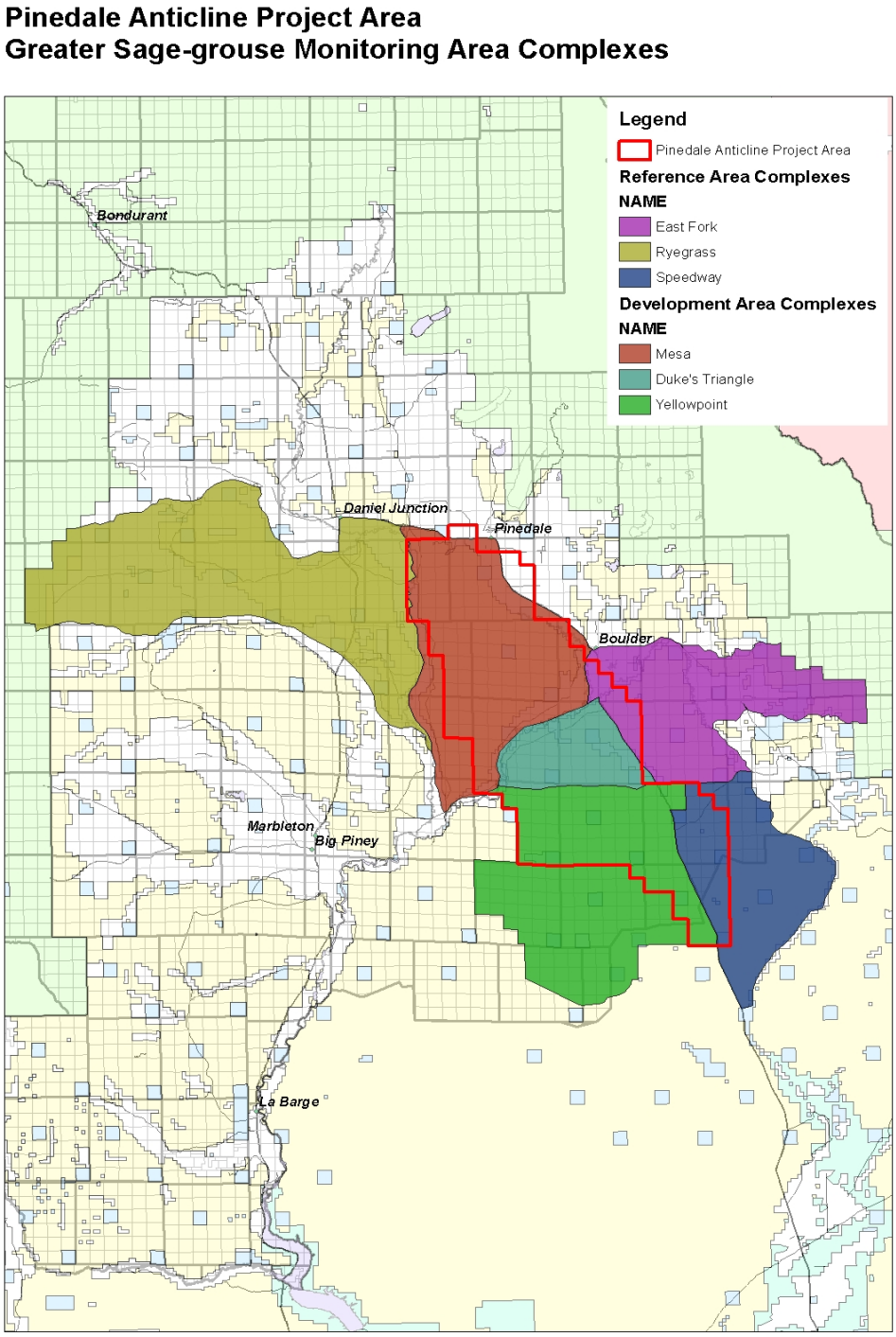
Appendix A

Table 1. Wildlife Matrix (sage-grouse) from Appendix B PAPA ROD (BLM 2008), as modified in 2011.

Criteria	Method	Changes that will be monitored	Specific Changes Requiring Mitigation	Mitigation Responses
Number of active leks in identified lek complexes	Lek counts according to protocol	Active use on 70% of total current leks; Active use on 70% of leks in each complex (the development area complexes include the Mesa, Duke's Triangle, and Yellow Point complexes) compared to 2007 data.	30% decline in total number of active leks, or 30% decline in the number of leks in a single complex.	Select mitigation response sequentially as listed below, implement most useful and feasible and monitor results over sufficiently adequate time for the level of impact described by current monitoring.
Peak numbers of males attending lek complexes	Lek counts according to protocol	Total average 2-year change in numbers of males attending development area lek complexes (the Mesa, Duke's Triangle, or Yellow Point lek complex), compared to the East Fork, Speedway, or Ryegrass reference lek complexes.	Average of 30% decline in numbers over 2 years compared to reference area.	Select mitigation response sequentially as listed below, implement most useful and feasible and monitor results over sufficiently adequate time for the level of impact described by current monitoring.
Winter concentration area use	Monitoring according to protocol	Change in winter concentration area use compared to reference area (once initial data is available), and a concurrent change in the total average 2 year numbers of males attending development area lek complexes (the Mesa, Duke's Triangle or Yellow Point lek complex), compared to the East Fork, Speedway, or Ryegrass reference lek complexes.	Average of 15% per year decline in amount of winter habitat used over 2 years compared to reference areas, and a concurrent average of 30% decline in numbers over 2 years compared to reference area.	Select mitigation response sequentially as listed below, implement most useful and feasible and monitor results over sufficiently adequate time for the level of impact described by current monitoring.
Noise levels	Decibel monitoring from March 1-May 15 at lek sites	Noise levels demonstrated to impact peak lek use by male sage-grouse and a concurrent change in the total average 2-year numbers of males attending development area lek complexes (the Mesa, Duke's Triangle, or Yellow Point lek complex), compared to the East Fork, Speedway, or Ryegrass reference lek complexes.	Decibel levels at the lek more than 10 dBA above background measured from the edge of the lek (2000 ROD, p.27), and a concurrent average of 30% decline in peak numbers of male birds over 2 years vs. reference area.	Select mitigation response sequentially as listed below, implement most useful and feasible and monitor results over sufficiently adequate time for the level of impact described by current monitoring.

Footnote 1. If the number of leks decline but the bird numbers on lek complexes do not, the mitigation threshold would not be surpassed. If the number of leks does not decline but the bird numbers on lek complexes does decline, the mitigation threshold would be surpassed. If both numbers of leks and birds decline, the mitigation threshold would obviously be surpassed

Figure 1. Greater Sage-grouse Monitoring Project Area



Wyoming Sage-Grouse Lek Definitions:

(Revised November 2012)

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

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

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

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

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

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

- Conduct lek counts at 7-10 day intervals over a 3-4 week period after the peak of mating activity. Although mating typically peaks in early April in Wyoming, the number of males counted on a lek is usually greatest in late April or early May when attendance by yearling males increases.
- Conduct lek counts only from the ground. Aerial counts are not accurate and are not comparable to ground counts.
- Conduct counts from ½ hour before sunrise to 1 hour after.
- Count attendance at each lek a minimum of three times annually during the breeding season.
- Conduct counts only when wind speeds are less than 15 kph (~10 mph) and no precipitation is falling.
- All leks within a complex should be counted on the same morning.

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

Lek Survey - A monitoring technique designed primarily to determine whether leks are active or inactive. Obtaining accurate counts of males attending is secondary. Ideally, all sage-grouse leks would be counted annually. However, some breeding habitat is inaccessible during spring because of mud and snow, or the location of a lek is so remote it cannot be routinely counted. In other situations, topography or vegetation may prevent an accurate count from any vantage point. In addition, time and budget constraints often limit the number of leks that can be visited. Where lek counts are not feasible for any of these reasons, surveys are the only reliable means to monitor population trends. Lek surveys are designed principally to determine whether leks are active or inactive, requiring as few as one visit to a lek. Obtaining accurate counts of the numbers of males attending is not essential. Lek surveys involve substantially less effort and time than lek counts. They can also be done from a fixed-wing aircraft or helicopter. Lek surveys can be conducted from the initiation of strutting in early March until early-mid May, depending on the site and spring weather. When large numbers of leks are surveyed (50+) the resulting trends of lek attendance over time mirror that of lek counts.

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

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

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

unknown – Leks for which active/inactive status has not been documented during the course of a strutting season. Excepting leks not scheduled to be checked in a particular year, the "unknown" status designation should be applied only in rare instances. Each lek should be checked enough times to determine whether it is active or not. It is preferable to conduct two good field checks every other year and confirm the lek is "inactive" rather than check it once every year and have it remain in "unknown" status.

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

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

unoccupied lek – Two classifications of unoccupied leks are "destroyed" and "abandoned" (defined below). Unoccupied leks are not protected during surface disturbing activities.

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

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

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

Table 2. Development and Reference Area Occupied Leks.

		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Development Area Complexes	**Lek Name**										
MESA	Bloom Reservoir	**123**	107	97	68	81	75	67	61	68	75
	Cat	**24**	19	2	9	3	2	3	0	0	0
	Lovatt West	**9**	25	0	0	2	0	0	0	0	0
	Luman Allotment Reservoir										46
	Mesa Road 3	**100**	97	76	40	38	32	42	38	66	79
	Oil Road Fork	**184**	154	156	105	93	72	53	43	53	67
	Mesa/Pole Creek	**0**	0	0	0	0	0	0	0	0	0
	Two Buttes	**99**	88	86	82	87	79	64	77	88	94
	Tyler Draw North			21	25	35	36	40	33	46	55
DUKE'S TRIANGLE	Big Fred	**0**	2	0	0	0	0	0	0	0	0
	Little Fred	**24**	22	0	30	9	0	0	0	0	0
	Lower Sand Springs Draw	**10**	14	13	18	18	20	20	21	37	67
YELLOW POINT	Alkali Draw	**67**	37	23	29	29	19	26	23	40	51
	Prairie Dog	**39**	41	38	23	13	29	23	18	33	53
	Sand Draw 3	**5**	0	0	0	0	0	0	0	0	0
	Sand Draw Reservoir	**38**	24	19	19	12	13	12	6	3	3
	Shelter Cabin Reservoir	**74**	51	44	27	22	40	41	34	28	36
	South Rocks	**33**	41	40	25	22	28	26	11	21	26
	Stud Horse Butte E.	**4**	2	0	0	0	0	0	0	0	0
	The Rocks	**26**	24	9	11	0	0	0	0	0	0
	Little Saddle				33	21	21	23	22	45	68
Reference Area Complexes	**Lek Name**										
RYEGRASS	Brodie Burn	**2**	0	0	6	0	1	0	0	0	1
	Brodie Draw 1	**30**	18	19	8	14	10	20	17	21	18
	Brodie Draw 2	**18**	32	18	12	7	20	43	22	19	43
	Brodie Draw 3	**0**	2	1	4	0	0	0	0	0	0
	Cut Across	**0**	19	7	0	12	0	0	0	0	0
	Fear Ditch	**41**	42	21	18	37	23	43	30	38	47
	Fear Ditch Reservoir	**30**	4	20	19	24	11	10	11	18	25
	Grindstone Butte North					9	6	9	10	24	30
	Grindstone Draw	**33**	32	38	33	35	26	22	24	59	50
	Jewett Red Flat Reservoir	**82**	33	50	31	28	NC	24	49	55	43
	Lloyd						24	27	19	35	37
	North Luman Ridge	**28**	27	7	2	4	0	0	0	0	0
	North Soapholes Creek	**16**	15	26	15	31	1	12	12	0	11
	Old Reservoir	**8**	19	60	2	6	0	0	21	0	0
	Onion Spring	**11**	2	0	0	2	7	0	0	0	1
	Onion Spring 2			38	38	21	54	50	124	86	26
	Rooster's Delight							23	16	11	23
	Ryegrass Draw	**81**	88	147	106	125	59	78	75	96	103
	Ryegrass Draw South	**NC**	69	49	35	38	41	49	62	51	87
	Ryegrass Reservoir	**7**	14	10	2	15	NC	0	4	0	2
	Ryegrass Road Fork	**42**	30	33	25	14	40	29	29	45	35
	Sommers	**37**	27	15	0	19	16	24	10	10	27
	South Luman Ridge	**44**	42	40	25	15	20	21	14	50	32
	South Soapholes Creek	**13**	21	6	0	1	0	0	0	0	0
	Upper Onion Creek	**164**	62	121	164	98	71	68	84	130	111
SPEEDWAY	Big John	**117**	96	80	73	63	56	65	53	185	187
	Darby	**104**	94	75	56	32	41	31	20	34	64
	Desert Reservoir	**226**	234	150	153	61	72	84	92	111	130
	Hole 2	**0**	0	0	18	17	25	18	12	21	43
	Mud Hole State	**235**	200	142	82	64	62	41	42	119	211
	Speedway	**132**	103	94	54	84	52	41	24	37	80
	Waterhole Draw	**120**	92	70	31	29	41	18	6	8	16
EAST FORK	Blown Out Reservoir	**216**	208	171	109	NC	87	84	89	138	119
	Chalk Butte										25
	Fremont Butte Well 2A	**31**	14	16	12	NC	34	24	46	26	18
	Fremont Butte Well 2B	**27**	29	26	21	NC	21	26	30	49	54
	Sand Springs Well 2										54

Appendix B

Data and Calculations (data is rounded to nearest whole number)

DEVELOPMENT AREA

Table 1. Number of active leks in combined development area.

Year	Combined Development Area Complexes Number of Active Leks*	Matrix Threshold: Percent change in active Leks compared to 2007
2007	16	
2008	16	0%
2009	13	-19%
2010	15	-6%
2011	15	-6%
2012	13	-19%
2013	13	-19%
2014	12	-25%
2015	12	-25%
2016	13	-19%

***Lek data provided by WGFD.**

The percent change in active leks compared to the 2007 baseline year is calculated by taking the current year's number of active leks minus the number of active leks in 2007; divide this number by the number of active leks in 2007 and multiply by 100.

Example: to calculate the percent change in active leks in 2016 compared to 2007

$$(13 - 16) / 16 \text{ X } 100 = -19\%$$

Table 2. Number of active leks per single complex in development area.

Year	Mesa Complex Number of active Leks	Matrix Threshold: Percent change in active Leks compared to 2007
2007	6	
2008	6	0%
2009	6	0%
2010	6	0%
2011	7	17%
2012	6	0%
2013	6	0%
2014	5	-17%
2015	5	-17%
2016	6	0%
Year	**Duke's Triangle Complex Number of active Leks**	**Matrix Threshold: Percent change in active Leks compared to 2007 (bold** indicates threshold has been met)
2007	2	
2008	3	50%
2009	1	**-50%**
2010	2	0%
2011	2	0%
2012	1	**-50%**
2013	1	**-50%**
2014	1	**-50%**
2015	1	-50%
2016	1	-50%
Year	**Yellowpoint Complex Number of active Leks**	**Matrix Threshold: Percent change in active Leks compared to 2007**
2007	8	
2008	7	-13%
2009	6	-25%
2010	7	-13%
2011	6	-25%
2012	6	-25%
2013	6	-25%
2014	6	-25%
2015	6	-25%
2016	6	-25%

The percent change in active leks compared to the 2007 baseline year is calculated by taking the current year's number of active leks minus the number of active leks in 2007; divide this number by the number of active leks in 2007 and multiply by 100.

Example: to calculate the percent change in active leks in the Duke's Triangle Complex in 2016 compared to 2007

$$(1 - 2) \ / \ 2 \ \ X \ \ 100 \ = \ -50\%$$

Table 3. Peak Number of Males Attending Development Area Lek Complexes.

Year	Mesa Complex	Duke's Triangle Complex	Yellowpoint Complex	Combined Development Area
2007	539	34	286	859
2008	490	38	220	748
2009	438	13	173	624
2010	329	48	167	544
2011	339	27	119	485
2012	296	20	150	466
2013	269	20	151	440
2014	252	21	114	387
2015	321	37	170	528
2016	370	67	237	674

*Lek data provided by WGFD.

Table 4. Two-year Average Number of Males Attending Development Area Lek Complexes.

Years	Mesa Complex	Duke's Triangle Complex	Yellowpoint Complex	Combined Development Area
2006-2007	558	31	261	850
2007-2008	515	36	253	804
2008-2009	464	26	197	686
2009-2010	384	31	170	584
2010-2011	334	38	143	515
2011-2012	318	24	135	476
2012-2013	283	20	151	453
2013-2014	261	21	133	414
2014-2015	287	29	142	458
2015-2016	346	52	204	601

The two-year average is calculated by adding two consecutive years of the peak number of males attending the lek complex (Table 3) and dividing by 2.

Example: 2015-2016 average for Mesa Complex

$$(321 + 370) / 2 = 346$$

Table 5. Percent Change in Number of Males Attending Development Area Lek Complexes.

Year	Mesa Complex	Duke's Triangle Complex	Yellowpoint Complex	Combined Development Area
2007	11%	0%	50%	21%
2008	-12%	23%	-16%	-12%
2009	-15%	-64%	-32%	-22%
2010	-29%	85%	-15%	-21%
2011	-12%	-13%	-30%	-17%
2012	-11%	-47%	5%	-10%
2013	-15%	-17%	12%	-8%
2014	-11%	5%	-25%	-15%
2015	23%	76%	28%	28%
2016	29%	131%	67%	47%

The percent change in number of males attending development area lek complexes is calculated using the following calculation:

> The current year annual peak male attendance for a complex (Table 3) minus the previous two-year running average for that complex (Table 4); divide this number by the previous two-year running average for that complex (Table 4) and multiply by 100.
>
> Example: to calculate the 2016 percent change in the Mesa Complex:
>
> $$(370 - 287) \ / \ 287 \ X \ 100 = 29\%$$

REFERENCE AREA

Table 6. Peak Number of Males Attending All Reference Area Lek Complexes.

Year	Ryegrass Complex	East Fork Complex	Speedway Complex	Combined Reference Area
2007	687	274	934	1895
2008	598	251	819	1668
2009	726	213	611	1550
2010	545	142	467	1154
2011	555	NA*	350	NA
2012	406	142	349	897
2013	525	134	298	957
2014	614	165	249	1028
2015	713	213	515	1441
2016	715	270	731	1716

*Lek data provided by WGFD

Table 7. Average Number of Males Attending Reference Area Lek Complexes.

Year	Ryegrass Complex	East Fork Complex	Speedway Complex	Combined Reference Area
2006-2007	572	250	908	1730
2007-2008	643	263	877	1782
2008-2009	662	232	715	1609
2009-2010	636	178	539	1352
2010-2011	550	NA	409	NA
2011-2012	481	NA	350	NA
2012-2013	466	138	324	927
2013-2014	570	150	274	993
2014-2015	664	189	382	1235
2015-2016	714	242	623	1579

*Note: the East Fork complex was not included in the 2010-2012 calculations because data was not collected in 2011. Although the running two-year average could be calculated, it would not be possible to calculate the percent change since there is not a running two-year value for the years 2011-2012.

The two-year average is calculated by adding two consecutive years of the peak number of males attending the lek complex (Table 6) and dividing by 2.

Example: 2015-2016 average for Ryegrass Complex

$$(713 + 715) / 2 = 714$$

Table 8. Percent Change in Number of Males Attending Reference Area Lek Complexes.

Year	Ryegrass Complex	East Fork Complex	Speedway Complex	Combined Reference Area
2007	66%	34%	19%	35%
2008	5%	0%	-10%	-4%
2009	13%	-19%	-30%	-13%
2010	-18%	-39%	-35%	-28%
2011	-13%	NA	-35%	-23*
2012	-26%	NA	-15%	-21*
2013	4%	NA	-15%	-4*
2014	32%	20%	-23%	11%
2015	25%	42%	88%	45%
2016	8%	43%	91%	39%

*Note: The East Fork complex was not included in the 2010-2013 calculations because data was not collected in 2011 due to heavy snow conditions. Although the running two-year average could be calculated, it would not be possible to calculate the percent change since there is not a running two-year value for the years 2011-2013.

The percent change in number of males attending reference area lek complexes is calculated using the following calculation:

> The current year annual peak male attendance for a complex (Table 6) minus the previous two-year running average for that complex (Table 7); divide this number by the previous two-year running average for that complex (Table 7) and multiply by 100.
>
> Example: to calculate the 2016 percent change in the Ryegrass Complex:
>
> $$(715 - 664) / 664 \text{ X } 100 = 8\%$$

Appendix C

Figure 1. Sage-grouse winter concentration areas.