2017 Sage-grouse Population Triggers Analysis

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Introduction

The *Federal Alternative of Governor C.L. "Butch" Otter for Greater Sage-grouse Management in Idaho* (Governor's Sage-Grouse Task Force 2012) proposed 2 metrics for monitoring sage-grouse populations and developed corresponding population triggers that would result in land management changes within a Conservation Area. The metrics are maximum number of males and lambda (λ), or the finite rate of change. There are 4 Conservation Areas (CAs) within Idaho: Desert, Mountain Valleys, Southern, and West Owyhee. Within those are areas identified as Core, Important, and General management zones for sage-grouse.

Within the Governor's alternative, hard population triggers were defined as:

- A 20 percent decline in the current 3-year average of total maximum number of males counted on lek routes compared to the 2011 maximum male baseline **and** an average finite rate of change (λ) significantly below 1.0 within Core or Important habitat within a Conservation Area over the same 3-year period.

Soft population triggers were defined as:

- A 10 percent decline in the current 3-year average of total maximum number of males counted on lek routes compared to the 2011 maximum male baseline **and** an average finite rate of change (λ) significantly below 1.0 within Core or Important habitat within a Conservation Area over the same 3-year period.

In September 2015, a Record of Decision was signed for the *Idaho and Southwestern Montana Sub-regional Greater Sage-grouse Proposed Land Use Plan Amendment and Final Environmental Impact Statement* (BLM 2015). This approved document incorporated the Governor's population triggers, but the management zone boundaries were refined and modified during the plan development. In addition, the term "Core" was changed to "Priority." In this document we follow the "G2" map for Priority, Important, and General Habitat Management Areas (i.e., PHMA, IHMA, and GHMA), as documented in the Environmental Impact Statement (BLM 2014).

Methods

We intersected all Idaho leks with the G2 sage-grouse habitat map and leks were assigned to a Conservation Area and Habitat Management Area (PHMA, IHMA, and GHMA). One-hundred fifteen leks were not in classified habitat. Some of these leks are in agricultural areas on private land, but the birds likely nest and winter in adjacent sagebrush habitats. We used the 10-km nesting buffer identified in Appendix B of the Governor's Plan (Governor's Sage-grouse Task Force 2012), to assign each lek to the appropriate HMA. These leks are attributed as "PHMA by buffer," etc., to maintain their unique identity, but are included in the analyses for their assigned HMA. Six leks were >10 km from any mapped Priority, Important, or General habitat.

Lek Routes

Idaho Department of Fish and Game utilizes lek routes to monitor population trend. A lek route, as defined by Connelly et al. (2003), is a "census of a group of leks that are relatively close and represent part or all of a single breeding population." These leks must be close enough to allow all leks on the route to be counted from 0.5 hours before official sunrise to 1.5 hours after sunrise. Lek routes are counted 3-4 times each spring, typically from late March to early May, depending on elevation. Counts are not conducted during inclement weather (e.g., rain or snow, or winds >15 kph). Observers record the number of males at each lek on each survey day. The maximum number of males on a lek route is the highest number of males counted on one survey day.

Some lek routes are split between different HMAs. Because the data for a route cannot be split, we assigned a lek route to the HMA which had the higher proportion of its leks within it (Appendix A).

The lek route analysis compares the current 3-year average of males in each CA and HMA to the maximum number of males in 2011 (i.e., 2011 baseline). In 2011, we had 76 lek routes that qualified for inclusion in this analysis (Figure 1), which included 412 leks. This represents about 25% of the leks in the Idaho lek database.

$$\%\ change = \left(\frac{Current\ 3year\ average - 2011\ total\ males}{2011\ total\ males}\right) * 100$$

If % change is ≤ –20% then a hard population trigger has been tripped.
If % change is –10% to –20% then a soft population trigger has been tripped.

Lambda

Lambda is simply the population size in time t+1 divided by the population size in time t. A stable population is represented by a λ (lambda) value of 1.0. If λ<1.0 the population is decreasing and if λ>1.0 the population is increasing.

Because significance for lambda was not defined in the Governor's Alternative, we consulted with statisticians to determine a valid statistical approach that also made sense biologically. Based on these discussions, we defined significance for lambda by the 90% confidence interval (Scheaffer et al. 1996) around the lambda calculated from the 1st year to the 3rd year (e.g., lambda from 2014 to 2016; E.O. Garton, personal communication). We concluded that a population decline from year 1 to year 3 would be more important biologically than a 3-year average. If the 90% confidence interval is less than, and does not include 1.0, then the finite rate of change is considered significant. The finite rate of change and variance will be calculated following Garton et al. (2011). Garton et al. (2011) used a population reconstruction model to calculate lambda and estimate the minimum population of sage-grouse back through time. The main requirement of the model estimate is that counts on a lek must occur in at least 2 successive years or in this case every other year (i.e., 2015 and 2017).

Ratio estimation under classic probability sampling designs—simple random, stratified, cluster, and probability proportional to size—assumes the sample units (leks counted in alternate successive years in this case) are drawn according to some random process but the strict requirement to obtain unbiased

estimates is that the ratios measured represent an unbiased sample of the ratios (i.e., finite rates of change) from the population or other area sampled.

Any count data can go into this analysis, as long as it meets the time of day and weather requirements for counting leks. Because the model uses ratios of counts cumulated within a larger area, lek counts may be included for leks that were visited 1 or more times within the season (we are currently recommending 2 visits). Aerial survey data that has been carefully reviewed (e.g., meets time and weather requirements and conducted by experienced pilots and observers) can also be included.

Database and other lek monitoring priorities

In addition to lek trend monitoring, there are other reasons for surveying particular leks within a given year. Lek database maintenance priorities are:

1. Visiting undetermined leks that need 1 more visit to be reclassified as unoccupied (5 consecutive surveys with zero birds results in an unoccupied status).

2. Visiting unoccupied leks that haven't been visited in >5 years (unoccupied leks need to be visited every 5-10 years to maintain that status).

3. Maintaining updated occupancy status by visiting occupied leks at least once every 5 years.

4. Re-visiting newly discovered leks to validate whether the observation is of a true lek and not a random occurrence.

Other priorities for surveying leks might be to evaluate response to infrastructure projects, wildfire, or habitat improvements. Although lek surveys for database or other priorities are biased (i.e., they are not a statistical sample of the population), they are important nonetheless.

Sample size estimation for lambda

We calculated lambda and the variance based on the 2014 to 2016 data for PHMA and IHMA in each CA. Using these values, we used the sample size estimation formula for ratios from Scheaffer et al. (1986, page 139) to estimate the number of leks that need to have counts in both 2015 and 2017 to produce an estimate of lambda ± 0.20.

Rather than sampling from only leks that were counted in 2015, we opted to increase our count efforts to assure broader coverage statewide. Since lek route leks will automatically be included in leks counted both years, we wanted to assure that an unbiased proportion of other leks (i.e., leks not on lek routes) were included in the lambda calculations. We multiplied the sample size estimate by the proportion of other leks to get the number of these leks that should be sampled in 2017. After assigning database priorities 1-4 above, we randomly selected the remaining leks to reach the target number. We then counted the total number of leks that would be counted both years (2015 and 2017) in each CA/HMA. We adjusted the target number upwards if we were still not meeting the estimated sample size. Using this sample size estimation process, we needed to count a minimum of 1,043 leks statewide in 2017; of these, 556 were on lek routes, 419 were randomly assigned leks, and 68 were database or other priorities. Database priorities included 19 leks for priority 1, none for priority 2, 8 for priority 3,

and 35 for priority 4. We also targeted to survey 6 additional leks that were within the 2015 Soda Fire in the West Owyhee Conservation Area.

Results and Discussion

We counted 1,288 leks in 2017. Of all leks counted, 642 were active in 2017, 595 were inactive, 47 had an unknown status, and 4 were new. Surveyed leks with an unknown status were either surveyed only once by air (helicopter or fixed wing using infrared videography) with no birds detected or a survey was conducted during inclement weather (i.e., 1 survey was insufficient to determine status). Of the 19 new leks that were discovered in 2016, 12 were confirmed as occupied leks in 2017.

Statewide, male attendance at lek routes was down 18% in 2017 compared to 2016 (this includes routes mapped in General habitat). For lek routes in Priority and Important habitats, the current 3-year average (2015-2017) was down 1% from the 2011 baseline.

No soft or hard population triggers were tripped in 2017, with a caution for results for West Owyhee IHMA. We met our sample size requirements for the lambda analysis for all areas except West Owyhee IHMA (Table 1).

The West Owyhee IHMA will be problematic for the triggers analysis into the future. There are no lek routes mapped in IHMA in this Conservation Area, so the triggers analysis can only be based on lambda. Furthermore, there are only 34 leks in this area (2 new leks were found in 2016, but only 1 was active in 2017). Our power analysis determined that 33 leks needed to be counted in 2017. However, a time lag in our analysis will not be rectified until 2018 because only 20 leks were surveyed in 2015. Therefore, only 20 leks were surveyed in 2015 and 2017 and we are unlikely to have confidence in the resulting lambda. Our lack of a sufficient analysis for West Owyhee IMHA is problematic because this area is operating under a hard habitat trigger due to the 2015 Soda Fire. In other words, >20% of the key habitat in West Owyhee IHMA was lost in the fire, resulting in all PHMA management actions being applied to the IHMA (BLM 2015).

There were 3 HMAs where the percent change in males at lek routes from 2011 was between -10% and -20%, but did not have a corresponding significant $\lambda<1.0$ (Table 2). These were Desert PHMA, Desert IHMA, and Mountain Valleys PHMA.

Lek routes in the Desert PHMA are down 13% from the 2011 baseline, while lambda is not significantly <1.0. The 2011 baseline for Desert PHMA may be higher than expected and requires further investigation.

For Desert IHMA, there was a discrepancy between a negative lek route change and a $\lambda>1.0$; i.e., trends for each metric were opposing. In Desert IHMA, part of the discrepancy may be explained by the fact that only 23% of the leks in that HMA are on routes. In other words, the number of leks on routes is small compared to the number of leks in the HMA and those lek routes may not be representative of the entire HMA. The South Big Desert route is contributing most to the observed decline.

The Mountain Valleys PHMA had a 16% decline in males on lek routes compared to the 2011 baseline. Lambda was <1.0 but not significantly so. The negative change in males on lek routes compared to the 2011 baseline is largely driven by the Lidy and Table Butte routes. Conversations with IDFG regional staff indicated that sage-grouse on the Table Butte and Lidy routes are likely impacted by long-term landscape changes, including agricultural conversion and fire. Table Butte, a documented wintering area, burned in 2002. These issues emphasize the importance of utilizing both route and lambda triggers and fully examining the data that goes into the analysis, while also understanding the complexities and variations in sage-grouse populations.

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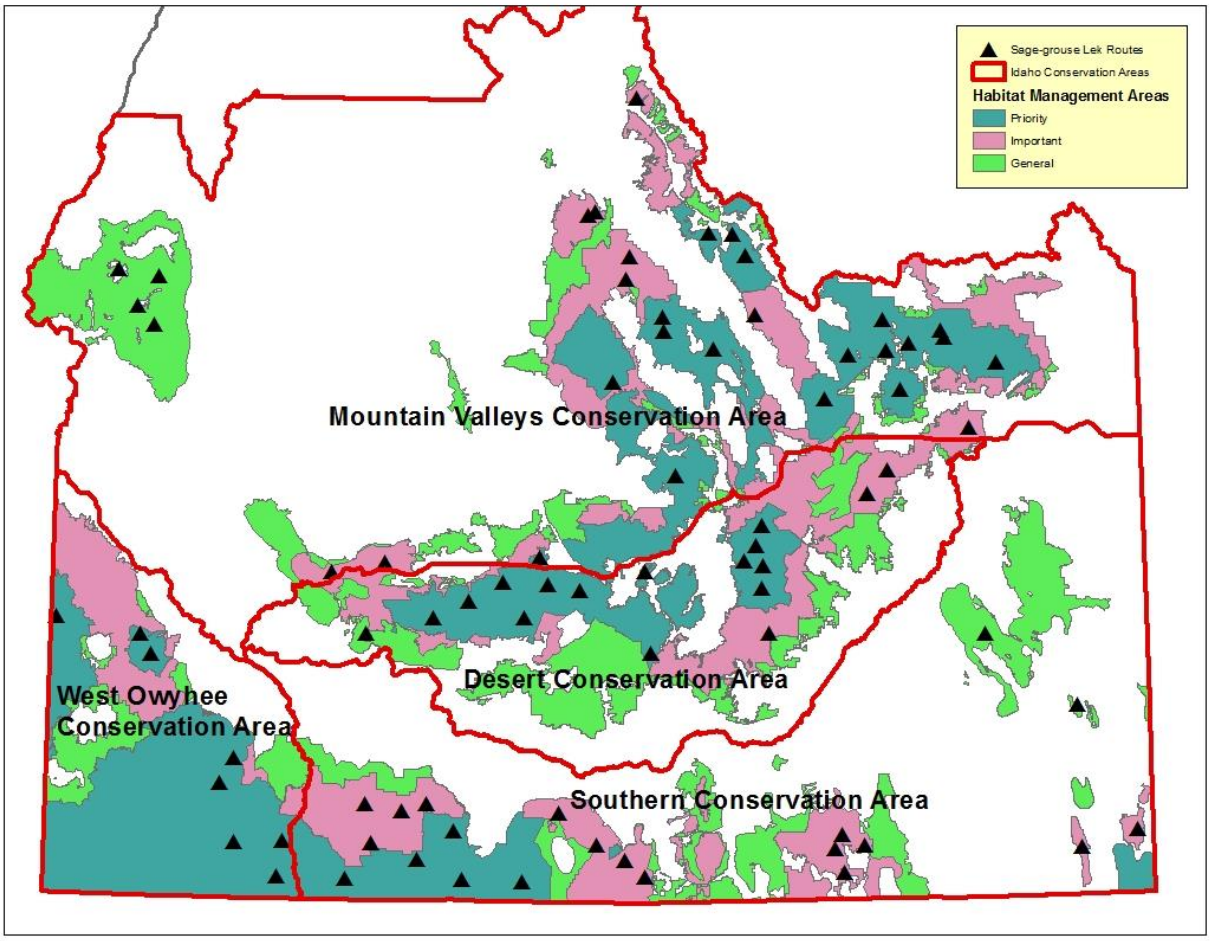

Figure 1. Location of sage-grouse lek routes in each Conservation Area and Habitat Management Area.

Table 1. Estimate of number of leks to count by Conservation Area and Habitat Management Area (HMA) in Idaho in 2017, statistical sample needed of leks counted in 2015 and 2017 for lambda estimation, and actual 2017 results.

Conservation Area/HMA	Total leks[a]	# of leks on lek routes[b]	Total leks to count 2017[c]	Actual # leks counted 2017[d]	Sample size needed of leks counted 2015 & 2017[e]	Actual # leks counted 2015 & 2017	Statistical power reached
Desert Priority	465	154	204	255	47	188	Yes
Desert Important	127	29	114	102	57	76	Yes
Mountain Valleys Priority	385	142	178	225	47	187	Yes
Mountain Valleys Important	109	41	109	98	57	74	Yes
Southern Priority	240	46	142	141	71	89	Yes
Southern Important	279	65	133	163	83	132	Yes
West Owyhee Priority	298	39	80	169	35	154	Yes
West Owyhee Important	35	1	35	34	33	20	No
Desert General	42	4	6	8	NA	NA	NA
Mountain Valleys General	77	18	22	36	NA	NA	NA
Southern General	110	16	19	54	NA	NA	NA
West Owyhee General	3	0	0	0	NA	NA	NA
Not categorized or non-habitat	6	1	1	3	NA	NA	NA
Statewide	2176	556	1043	1288	430	920	--

[a] Leks in 2016 database.

[b] When ran in lambda analysis, lek route leks are separated from their lek route and assigned to the HMA they plot in (See Appendix A)

[c] Includes lek route leks, random leks, and database priorities.

[d] Includes 4 new leks.

[e] Number of leks that needed to be counted in both 2015 and 2017 to produce an estimate of lambda ± 0.20 (Scheaffer et al. 1986).

Table 2. Lek triggers evaluation for lek routes and lambda (λ) by Conservation Area/Habitat Management Area in Idaho, 2017.

	Total males on lek routes										Lambda (λ)		
Conservation Area/HMA	2011	2012	2013	2014	2015	2016	2017	Current 3-year avg[a]	% change from 2011[b]	Route trigger tripped[c]	λ 2015 to 2017	90% confidence interval	λ trigger tripped[c]
Desert Priority	1697	1424	1451	1394	1275	1580	1580	1478	-13%	Soft	0.931	0.812 - 1.051	No
Desert Important	233	186	194	194	190	241	164	198	-15%	Soft	1.066	0.907 - 1.226	No
Mountain Valleys Priority	1790	1716	1456	1576	1537	1549	1408	1498	-16%	Soft	0.878	0.739 - 1.018	No
Mountain Valleys Important	336	290	317	334	390	439	370	400	19%	No	0.925	0.781 - 1.068	No
Southern Priority	276	252	249	323	403	436	378	406	47%	No	1.061	0.825 - 1.297	No
Southern Important	600	508	488	487	624	664	664	651	8%	No	0.862	0.705 - 1.019	No
West Owyhee Priority	693	600	527	566	837	1108	935	960	39%	No	1.153	1.034 - 1.272	No
West Owyhee Important	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.762	0.504 - 1.021	No?

[a] Current 3-year average.

[b] % change in current 3-year average from 2011 total.

[c] For a population trigger to trip, both lek route and lambda must meet the trigger requirements.

Appendix A. Lek Routes.

Lek routes used in the population triggers analysis[a], assigned Habitat Management Zone and Habitat Management Area and notes on assignments.

Lek Route	Conservation Area	Governor's Alt Management Zone	BLM Habitat Management Area	Notes
Antelope Creek	Mountain Valleys	Core	Priority	
Antelope Pocket	Southern	Core	Priority	Most of route in Priority
Big Desert #1	Desert	Core	Priority	
Big Desert #3	Desert	Core	Priority	Most of route in Priority
Big Desert #5	Desert	Core	Priority	
Big Jack's Creek	West Owyhee	Core	Priority	
Birch Creek	Southern	Important	Important	
Blair Trail	Desert	Important	Important	
Bliss-Hill City Road	Desert	Core	Priority	
Bloomington	Southern	Important	Important	
Brown's Bench	Southern	Core	Priority	
Brown's Creek	West Owyhee	Important	Priority	
Carlson Cabin	Mountain Valleys	Core	Priority	
Cottonwood Ridge	Southern	Important	Important	4 leks in Important, 3 in Priority; small pocket of Priority here
Cow Creek	West Owyhee	Core	Priority	
Crane Creek	Mountain Valleys	General	General	
Crooked Creek	Mountain Valleys	Core	Priority	
Crow's Nest-Clover	Southern	Important	Important	Only occupied lek is in Important, others in Important, 1 in general, 3 not in mapped habitat
Curlew East	Southern	Important	Important	1 lek in non-habitat
Curlew North	Southern	Important	Important	1 lek in non-habitat
Curlew South	Southern	Important	Important	2 leks in non-habitat
Curlew West	Southern	Important	Important	
Dishpan	Southern	Core	Priority	
Dry Creek	Southern	Core	Important	
Dry Gulch	Mountain Valleys	Important	Important	

Lek Route	Conservation Area	Governor's Alt Management Zone	BLM Habitat Management Area	Notes
EIU Sheep Creek (2B032 only)	Southern	Important	Important	2B032 was only lek counted in 2011, it is in Important
Fingers Butte	Desert	Core	Priority	Most of route in Priority
Fir Grove	Desert	Core	Priority	
Grassy Hills	Southern	Core	Priority	
INL/Tractor Flat	Desert	Important	Important	1 lek in General
Jacoby	Mountain Valleys	Core	Priority	
Kinyon	Southern	Important	Important	
Leadore East	Mountain Valleys	Core	Priority	
Leadore West	Mountain Valleys	Core	Priority	1 lek in non-habitat
Lidy	Mountain Valleys	Core	Priority	3 leks in non-habitat
Lincoln/Minidoka	Desert	Core	Priority	1 lek in General
Little Hat Creek	Mountain Valleys	Important	Important	
Little Lost	Mountain Valleys	Core	Priority	
Little Sagehen Flat	Mountain Valleys	Important	Important	
Lower Birch Creek	Mountain Valleys	Core	Priority	
Lower Lemhi	Mountain Valleys	Important	Important	
Lower Pahsimeroi East	Mountain Valleys	Important	Important	
Lower Pahsimeroi West	Mountain Valleys	Important	Important	
Macon Flat	Desert	Core	Priority	
Medicine Lodge	Mountain Valleys	Core	Priority	2 leks in non-habitat
Middle Mountain	Southern	Important	Important	
Midvale Hill	Mountain Valleys	General	General	
Monday Gulch	Mountain Valleys	General	General	
Moores Flat	Mountain Valleys	Important	Important	
North Shoshone	Desert	Core	Priority	
Oreana	West Owyhee	Important	Priority	1 lek in Important
Paddelford Flat	Desert	Core	Priority	1 lek in non-habitat
Picabo	Desert	Core	Priority	1 lek in non-habitat
Plano	Mountain Valleys	Important	Important	
Red Road	Mountain Valleys	Core	Priority	4 leks in Important, 6 in Priority
Rock Creek	Mountain Valleys	Important	Priority	Most of route in Priority
Rocky Knoll	West Owyhee	Core	Priority	
Roland Road	West Owyhee	Core	Priority	

Lek Route	Conservation Area	Governor's Alt Management Zone	BLM Habitat Management Area	Notes
Roseworth	Southern	Important	Important	5 leks in Important, 2 in Priority
RWMC/INL	Desert	Core	Priority	5 leks in Priority, 3 in Important
Sheep Creek	West Owyhee	Core	Priority	
Sheep Station	Mountain Valleys	Core	Priority	
Shoshone Basin	Southern	Core	Priority	
Slug Creek	Southern	General	General	
Soulen Center	Mountain Valleys	General	General	
South Big Desert	Desert	General	Important	
Stible Road	Desert	Important	Important	
Sunday Creek	Southern	General	General	
Table Butte	Mountain Valleys	Core	Priority	
Timmerman	Desert	Core	Priority	
Upper Big Lost	Mountain Valleys	Core	Priority	
Upper Birch Creek	Mountain Valleys	Core	Important	
Upper Lemhi	Mountain Valleys	Core	Priority	
Upper Pahsimeroi	Mountain Valleys	Core	Priority	
Wickahoney	West Owyhee	Important	Priority	
Yellow Sign Road	Southern	Core	Important	

[a] Two lek routes, Spring Gulch and Winter Camp, are not included because they were not surveyed in 2011.