2015 Sage-grouse Population Triggers Analysis

Ann Moser
Don Kemner
Idaho Department of Fish and Game

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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 within Idaho: West Owyhee, Southern, Desert, and Mountain Valleys. Within those are areas identified as Core, Important, and General management zones for sage-grouse.

Within the Governor's alternative, hard population triggers are 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 are 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 incorporates the Governor's population triggers, but the Habitat Management Areas (HMAs) were refined and modified during the plan development. Furthermore, the term "Core" was changed to "Priority."

Methods

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 April, 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 management zones. Because the data for a route cannot be split, we assigned a lek route to the management zone which had the higher proportion of its leks within it.

The lek route trigger compares the current 3-year average of males in each conservation area/management zone 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, 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% than a hard population trigger has been tripped.
If % change is ≤ -10% than 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 around the lambda calculated from the 1st year to the 3rd year (e.g., lambda from 2013 to 2015; 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 must occur in at least 2 successive years.

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 can also be included.

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 “new” leks to validate whether or not they are really a lek.

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 2012 to 2014 data for Core and Important within each Conservation Area (i.e., management zone). Using these values, we used the sample size estimation formula for ratios from Schaeffer et al. (1986, page 139) to estimate the number of leks that need to be counted in both 2013 to 2015, using a bound of 0.01.

Rather than sampling from only leks that were counted in 2013, we opted to increase our count efforts to assure broader coverage statewide. We also did not want to get stuck in a monitoring schedule that included the same leks every other year. Since lek route leks will automatically be included in leks counted both years, we wanted to assure that a proportion of other leks (i.e., leks not on lek routes) are included in the lambda calculations. First, we calculated the proportion of other leks in each management zone. We multiplied the sample size estimate by the proportion of other leks to get the number of these leks should be sampled in 2015. After assigning 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 (2013 and 2015) in each management zone. 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 1,117 leks statewide in 2015. This process resulted in an oversampling of leks in Desert Core and Mountain Valleys Core, however, we maintained the over sample so as not to bias lambda too heavily towards lek route leks. It may be impossible to count enough leks in Southern Core in 2015 to obtain sufficient power to be able to detect a significant $\lambda<1$. Only 77 leks were counted in 2013, and the sample size estimate of leks needed to count in 2013 and 2015 is 103 leks. After the random selection and adjustment of other leks to count in Southern Core, we then added the remaining 17 leks that were counted in 2013 to the priority list of leks to count in 2015.

Because sample size requirements were calculated in spring 2015 prior to the September 2015 Record of Decision on the land use plan amendments (BLM 2015), the sample size analysis and results follow the Governor's Plan map and terminology. Following the 2015 Record of Decision, we recalculated the lek route and lambda triggers. These results are presented in Appendix A.

Results

We counted 1,245 leks in 2015. Of these 540 were on lek routes. Of all leks counted, 597 were active in 2015, 511 were inactive, and 115 had an unknown status. Leks with an unknown status were either surveyed only once by helicopter with no birds detected or a survey was conducted during inclement weather (i.e., 1 survey was insufficient to determine status). We also discovered 22 new leks in 2015.

We compared the actual number of leks counted by management zone to the 2015 lek prioritization scheme (Table 1). Similarly, we evaluated whether we met our sample size target for lambda estimation. We did not meet our sample size target for the number of leks counted in both 2013 and 2015 in Desert Important, Mountain Valleys Important, Southern Core, or Southern Important.

No hard population triggers were tripped in 2015. There were 4 management zones where the percent change in males at lek routes from 2011 was between -10% and -20% (Table 2). These were Desert Core, Desert Important, Mountain Valleys Core, and Southern Important. None of these had a corresponding significant $\lambda<1.0$, although Desert Important and Southern Important likely did not have a sufficient sample of leks counted both years.

In addition to statistical sample issues, we also investigated apparent discrepancies between lek route and lambda results. Specifically, there was a discrepancy between a negative lek route change and a $\lambda>1.0$ in Desert Important and Southern Important; i.e., trends for each metric were opposing.

In Desert Important, there was a -14% decline in total males on routes from the current 3-year average compared to the 2011 baseline. In contrast, lambda for 2013 to 2015 was 1.213, although this number was not significantly >1.0. This discrepancy is likely due to the small sample size for lek routes in this zone. There are only 3 lek routes encompassing 12 leks and 1 of these routes (Blair Trial) is currently unoccupied. Sample size was improved for the lambda analysis with 42 and 56 leks in the sample for lambda in 2013 and 2015 respectively. However, this sample size still had insufficient statistical power to detect a significant lambda ratio.

Southern Important had a -16% decline in total males on routes, compared to a significant λ>1.0. There are 11 lek routes in this zone. Most of the decline can be attributed to the 4 lek routes in the Greater Curlew Valley, while the remaining routes are stable to increasing. The Curlew declines were offset with the larger sample size for the lambda analysis.

Table 1. Estimate of number of leks to count by management zone in Idaho in 2015, statistical sample needed of leks counted in 2013 and 2015 for lambda estimation, and actual 2015 results.

Management Zones	Total leks to count 2015	Actual # leks counted 2015	Sample size estimate of leks counted both years	Actual # of leks counted both years	Statistical power reached
Desert Core	225	235	62	184	Yes
Desert Important	74	56	53	34	No
Mountain Valleys Core	181	215	52	153	Yes
Mountain Valleys Important	126	95	78	58	No
Southern Core	178	155	103	67	No
Southern Important	135	127	77	64	No
West Owyhee Core	113	146	73	90	Yes
West Owyhee Important	25	46	11	30	Yes
Desert General	NA	49	NA	NA	NA
Mountain Valleys General	NA	31	NA	NA	NA
Southern General	NA	58	NA	NA	NA
West Owyhee General	NA	3	NA	NA	NA
Not categorized or non-habitat	NA	29	NA	NA	NA

Table 2. Lek triggers evaluation for lek routes and lambda (λ) by management zone in Idaho, 2015.

	Total males on lek routes								Lambda (λ)		
Management Zone	2011	2012	2013	2014	2015	3-year avg[a]	% change from 2011[b]	Route trigger tripped[c]	λ 2013 to 2015	90% confidence interval	λ trigger tripped[c]
Desert Core	1697	1424	1451	1394	1275	1373	-19%	Soft	0.986	0.838 - 1.133	No
Desert Important	106	91	79	91	102	91	-14%	Soft	1.213	0.879 - 1.547	No
Mountain Valleys Core	1778	1684	1454	1558	1528	1513	-15%	Soft	0.976	0.848 - 1.104	No
Mountain Valleys Important	348	322	319	352	399	357	2%	No	1.474	1.074 - 1.874	No
Southern Core	352	334	311	449	500	420	19%	No	1.592	1.255 - 1.928	No
Southern Important	524	426	426	361	527	438	-16%	Soft	1.398	1.194 - 1.601	No
West Owyhee Core	505	415	368	419	617	468	-7%	No	1.365	1.156 - 1.574	No
West Owyhee Important	188	185	159	147	220	175	-7%	No	1.276	0.990 - 1.562	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.

Discussion and Management Recommendations

Statewide, sage-grouse populations were up 3% in 2015 compared to 2014. The current 3-year average (2013-2015) is still down 12% from the 2011 baseline. However, no population triggers were tripped within any management zone. Four zones had a percent change in males at lek routes that was between -10% and -20% from 2011 but the corresponding lambda was not significantly <1.0.

A comparison of lek routes and lambda within management zones revealed that some zones have sample size issues. Furthermore, 115 leks are not in classified habitat; 31 of these leks are currently occupied. This issue is addressed in Appendix A.

Despite the prioritization scheme for lek monitoring in 2015, we did not meet our sample size target for lambda for the number of leks counted in both 2013 and 2015 in Desert Important, Mountain Valleys Important, Southern Core, or Southern Important. This may be due to logistics, access issues, and/or regional staffing. Emphasizing the importance of the lek priorities to regional staff will be critical to improve the confidence and reliability of our triggers analysis. The sampling strategy will be re-run for 2016, with new sampling priorities assigned. The sage-grouse data coordinator will be responsible for assuring the regions have the funds, staff, equipment, and technical assistance needed to accomplish surveys for priority leks.

Another issue of concern is when one area or population demonstrates a different trend than other populations in the same management zone. For example, declines in the Greater Curlew Valley are negatively influencing the lek route results in the Southern Important zone. 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.

Finally, based on recent advances in sage-grouse trend monitoring (M. Hurley, personal communication) we recommend that the sage-grouse data coordinator work with the Department's research staff to review the ecological applicability and accuracy of the population triggers. Because these population trend models are not yet available, this review will occur after the 2016 lek season.

Literature Cited

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Appendix A. Population triggers analysis using Habitat Management Areas.

In October 2015, we received the GIS layer for the Habitat Management Areas (HMAs) approved in the Record of Decision (BLM 2015). Because the map had been refined and revised since the Governor's Plan, we re-mapped and re-assigned leks and lek routes to the new habitat areas. This resulted in some changes in some management areas (see Appendix B). Significant changes included the re-assignment of the South Big Desert lek route from General to Important habitat. This change should help the sample size concern discussed above. In contrast, all lek routes in West Owyhee are now classified in Priority habitat; therefore, there is no full triggers analysis available for West Owyhee Important.

We also addressed the 115 leks that are 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 "Priority HMA by buffer," etc., to maintain their unique identity, but are included in the analyses for their assigned HMA.

We reanalyzed the population triggers for 2015 with the updated habitat assignments. Regardless of the route assignment changes, there was no change in the results for 2015 and no population triggers were tripped (Table A1).

Table A1. Lek triggers evaluation for lek routes and lambda (λ) by management zone in Idaho, 2015.

	Total males on lek routes								Lambda (λ)		
Management Zone	2011	2012	2013	2014	2015	3-yr avg[a]	% change from 2011[b]	Route trigger tripped	λ 2013 to 2015	90% confidence interval	λ trigger tripped[c]
Desert Priority	1697	1424	1451	1394	1275	1373	-19%	Soft	0.973	0.829-1.117	No
Desert Important	233	186	194	194	190	193	-17%	Soft	1.172	0.917-1.427	No
Mountain Valleys Priority	1790	1716	1456	1576	1537	1523	-15%	Soft	1.015	0.863-1.166	No
Mountain Valleys Important	336	290	317	334	390	347	3%	No	1.469	1.151-1.787	No
Southern Priority	276	252	249	323	403	325	18%	No	1.770	1.369-2.170	No
Southern Important	600	508	488	487	624	533	-11%	Soft	1.287	1.105-1.469	No
West Owyhee Priority	693	600	527	566	837	643	-7%	No	1.324	1.150-1.498	No
West Owyhee Important	0	0	0	0	0	0	NA	NA	1.929	1.037-2.820	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 B. 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.