Oregon Greater Sage-Grouse Population Monitoring: 2017 Annual Report

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Executive Summary

During the 2017 greater sage-grouse (*Centrocercus urophasianus*) breeding season, 1,580 aerial and ground lek surveys were conducted at 674 individual lek sites comprising 429 lek complexes. Surveys were conducted at 58.0% of known lek sites in the state. Survey effort during 2017 declined -17.1%, -12.2%, and 14.5% from 2016 levels, in terms of number of surveys conducted, number of leks surveyed, and number of complexes surveyed, respectively. However, even with this decline, survey effort during 2017 was the 2nd highest yet accomplished in the state. Results from these surveys indicate the sage-grouse spring breeding population in Oregon declined by -7.7% between 2016 and 2017, to 20,510 estimated individuals (±1,560 individuals). Magnitude of population trend varied by BLM district analyzed, ranging from a -17.1% decline in the Burns District, to a 1.1% increase in the Vale District.

Overview and Spring Population Monitoring Methods

Counts of male sage-grouse displaying on leks (communal breeding sites) during the spring breeding season have been used to generate indices of sage-grouse population trend since the 1940s (Patterson 1952), and remain the most widely used method to monitor sage-grouse populations range-wide (McCafferey et al. 2016). Monitoring of some sage-grouse leks in Oregon began in the 1940s, with survey efforts increasing in the state after 1980 (ODFW 2011). ODFW adopted a standardized lek survey methodology in 1996, which continues to be used, ensuring consistent data quality and allowing data comparison across the state. ODFW has generated BLM District specific spring sage-grouse population estimates since 2013, prior to 2013 yearly population estimates were conducted at the scale of ODFW Wildlife Management Units (WMUs). While WMU level estimates of fall sage-grouse populations are still developed to inform sage-grouse tag allocation, the decision to generate spring estimates at the scale of BLM Districts reflects that the BLM is the primary land manager in much of Oregon sage-grouse range, and thus the agency with the greatest ability to affect sage-grouse habitat quality and population trends. Beginning in 2015, effort has been expended to survey an increased number of leks in Priority Areas for Conservation (PACs; synonymous with ODFW Core Areas), to facilitate the implementation of PAC-level adaptive management population triggers required under the BLM Greater Sage-Grouse Approved Resource Management Plan Amendment (ARMPA). This increased survey effort is supported by a Cooperative Funding Agreement between the BLM and ODFW which supports additional seasonal lek survey positions, as well as increased aerial lek survey and telemetry effort. ODFW provides lek survey results to the BLM following the lek survey period, the BLM then generates estimates of sage-grouse population trend at the PAC level and reports on PAC level population trends and adaptive management triggers. Survey effort and trend in male lek attendance are reported at the PAC level in Appendix I, however, due to differences in trend estimation methodology, the PAC level information presented here should not be conflated with BLM-generated estimates of PAC population trend, and adaptive management trigger analysis, as required by the ARMPA. The data regarding PAC specific trends are presented here for informational purposes only.

Sage-grouse leks and lek complexes (a group of closely allied leks, within 1 mile of each other, between which a set of males may move; ODFW 2011) are monitored between 15 March and 30 April to obtain counts of breeding male sage-grouse. In a collaborative effort, biologists with ODFW, BLM, USFWS, Burns Paiute Tribe, as well as volunteers under the ODFW Adopt-a-Lek Program (Appendix II), visit leks from approximately 30 minutes before sunrise until approximately 2 hours after sunrise and count all male sage-grouse visible on a lek. Counts of all individual leks comprising a complex which occur on the same day are summed and treated as a single unit during analysis. Hereafter, lek complex will be used to refer to the sample unit in this report, whether a single lek or multiple leks compose a complex. Due to variability in male attendance at leks throughout the breeding season, a subset of lek complexes are counted up to 4 times per season, with individual counts separated by 7-10 days. Using this methodology, a subset of lek complexes are counted in each BLM district with extant sage-grouse populations, with minimum spring population estimates conducted by ODFW at the scale of BLM district (Table 1, Figure 1). In the case of the Vale District, population estimates are generated separately for the Baker Resource Area and the remainder of the District, due to the small size of the Baker Resource Area (RA) population, and its isolation from the other populations in the District.

Minimum spring population estimates are generated from maximum counts of males at each lek complex using a stratified random estimator (Krebs 1994). Lek complexes are assigned to one of five strata, based on the 8 year average of maximum male attendance: inactive (0 males), small (1-10 males), medium (11-25 males), large (26-50 Males), and XL (>50 males; ODFW 2011). To assign lek complexes not counted during the current year to the appropriate stratum, lek complex attendance is estimated by adjusting the most recent male count by the average proportional change in lek complex size for counted leks, in the relevant BLM district, between the count year and the current year (ODFW 2011). Mean lek complex attendance per stratum is then calculated based solely on actual counts, and adjusted by 0.75 to obtain an estimate of the actual mean number of males per lek complex per stratum, this adjustment is based on the assumption that only 75% of males reliably attend leks in a given year (Jenni and Hartzler 1978, Emmons and Braun 1984, Walsh et al. 2004, ODFW 2011). The adjusted estimate of mean males per lek complex per stratum is then multiplied by the 5-year average sex ratio (females per male; 2012 – 2017: 1.48 F:M), estimated from hunter harvested wings (Appendix III), to generate an estimate of the mean number of females per lek complex per stratum. The sum of females and males per lek complex per stratum is then generated and an estimate of individuals per lek complex is calculated, weighted based on the proportion of lek complexes comprising each stratum. The final spring population estimate for each BLM District/RA is calculated as the total number of known active lek complexes in a given BLM district multiplied by the weighted average lek complex size in that district (Krebs 2004). Confidence limits on these estimates are generated based on variability in counts per stratum and number of lek complexes surveyed within each stratum (Krebs 2004).

Methods for projecting sage-grouse population estimates back in time contain multiple assumptions regarding lek formation and extinction rates (ODFW 2011), for this reason no attempt is made in this report to back project estimated sage-grouse populations by BLM district to those years prior to 2013, when population estimates were conducted at the scale of WMUs. Rather, trends in population at the scale of BLM Districts between 1980 and 2017 are reported

following the methodology of Schroeder et al. (2000). An index of population trend by BLM District, between 1980 and 2017, is reported as the percentage of 2017 male attendance during Year *t*, solely at leks counted during both 2017 and Year *t*. For example, if a set of leks is counted in both 2017 and Year *t*, and the count totals are 100 males during 2017, and 120 males during Year *t*, the population index during Year *t* = 120%.

Throughout this report, change in lek size over time is depicted using the average number of males counted per active lek in a given analysis unit. While this metric is generally reliable, caution should be taken when examining these graphs during the 1980 – 1996 period. In many areas few leks were counted prior to 1996 (Figure 2), and often the leks that were counted were large. As knowledge of lek distribution across the state has increased, many relatively small leks have been identified and surveys of those leks have increased in recent years. The recent routine counting of these smaller leks has likely led to bias in the males/active lek metric, reducing the average size of counted leks, and thus potentially indicating an artificial decline in lek size in some areas.

While ODFW generates point estimates of the sage-grouse population in Oregon and confidence intervals around those estimates using the statistical method described above, caution should be used when making inference based on these estimates. Lek counts are an index of population size and the true relationship between the index and the population size is unknown (Walsh et al. 2004, ODFW 2011). Due to the high proportion of leks surveyed in a given year, and consistency in monitoring and analysis methodologies over the previous 21 years, ODFW is confident that the population trends reported here-in are accurate and scientifically supported, however the actual number of sage-grouse in a given BLM district remains unknown.

Table 1. BLM Districts/Resource Areas containing current sage-grouse populations, and the percent of the 2017 spring sage-grouse population contained in each district/RA.

BLM District/Resource Area	% Of 2017 Population
Baker Resource Area[a]	2.3
Burns District	20.4
Lakeview District	28.9
Vale District[a]	40.3
Prineville District	8.0

[a]The Baker Resource Area is analyzed separately from the remainder of the Vale BLM District, due to dissimilarity in population size and trajectory

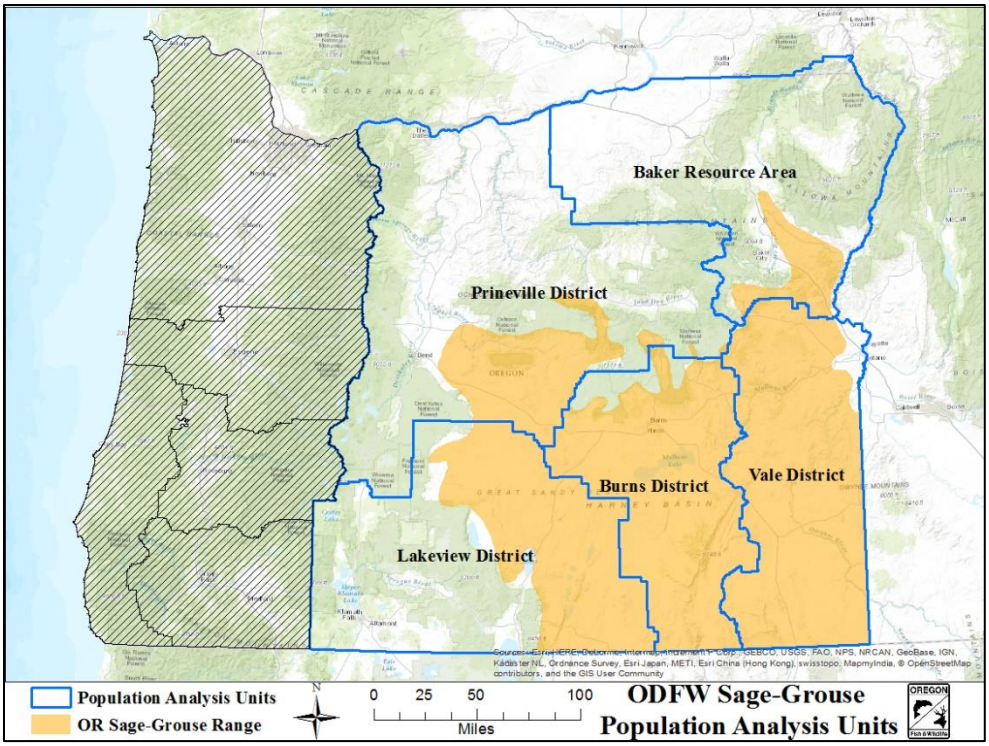


Figure 1. Oregon BLM Districts/Resource Areas containing current sage-grouse populations, and functioning as analysis units for spring population estimation in Oregon. The Baker Resource Area is analyzed separately from the remainder of the Vale BLM District, due to dissimilarity in population size and trajectory.

Lek Monitoring Effort and Population Estimates

Statewide

Statewide lek survey effort during 2017 was hampered by significant snowfall this winter, and subsequent poor road conditions, as well as continued wet weather conditions throughout the survey season. However even under these poor conditions, ODFW and partners succeeded in accomplishing all survey effort objectives, and expended the 2nd highest level of survey effort in terms of total counts conducted (Figure 2; Table 2), completing 1,527 ground counts and 53 aerial counts. Surveys were conducted at 674 leks comprising 429 lek complexes. Of the 1,162 individual leks, and 777 lek complexes known to exist or have existed in the state, 58.0% and 55.2%, respectively, were surveyed during 2017. On average each lek was surveyed 2.3 times, allowing robust conclusions to be drawn regarding the maximum male attendance at lek complexes in Oregon. Dedicated aerial surveys (Appendix IV), and incidental observations during ground surveys helped expanded knowledge of sage-grouse distribution during 2017; 23 leks, and 12 complexes were either located or surveyed for the first recorded time in 2017.

The estimated spring greater sage-grouse population in Oregon during 2017 was 20,510 individuals (95% CI: 18,950 – 22,070 individuals), a -7.7% decline from 2016 (2016 Estimate = 22,218 individuals). While this represents the first statewide population decline recorded since

the 2012 – 2013 period, estimated population size remains above 2015 levels (2015 Estimate = 19,482 individuals). The population during 2017 remained 30% below the 2003 baseline population estimate of 29,237 individuals (Figure 3). Data collected since the 2011 Oregon Greater Sage-Grouse Conservation Assessment and Strategy (hereafter: 2011 Conservation Assessment), suggests a small but significant decline in the annual average number of males counted per active complex of -0.18 birds per year since 1980 (Multiple $R^2 = 0.13$, p-value = 0.03; Figure 3).

Baker Resource Area

Lek survey effort in the Baker Resource Area decreased from 2016 levels during 2017, however the 2016 survey effort was elevated through dedicated aerial surveys of leks which ODFW and partners do not have access to on the ground. Even with the lack of aerial surveys 2017, survey effort was still the third highest in the area (Figure 4; Table 3). During 2017, 129 ground surveys, and 2 aerial surveys were conducted at 44 leks comprising 27 complexes. This constitutes 51.8% of the 85 leks, and 45.8% of the 59 complexes known to exist or have existed in the Resource Area. Survey effort per lek was high, with each lek receiving, on average, 2.98 surveys during the monitoring season. One lek, comprising 1 complex was discovered in the area in 2017.

The estimated spring sage-grouse population in the Baker Resource Area was 482 individuals (95% CI: 359 – 605 individuals), a 0.8% increase from 478 individuals in 2016. During 2017 observed male attendance at lek complexes counted during 2016 declined -2.7% from 113 to 110 observed males. While the population appeared to stabilize between 2016 and 2017, the Baker Resource Area has experienced a long-term population decline. The five-year average annual change in male lake complex attendance between 2012 and 2017 is -2.5%, and a -74.8% decline in male lek complex attendance has been observed since 2005 at complexes counted during both 2005 and 2017 ($n_{2005} = 238$, $n_{2017} = 60$; Figure 5). Male attendance at complexes monitored in both 2003 and 2017 indicates that the population in the Baker Resource Area is currently 75.0% below the 2003 baseline level ($n_{2003} = 236$, $n_{2017} = 59$). Data collected since the 2011 Conservation Assessment suggests a significant reduction in the average size of lek complexes since 1996, with average males per active complex declining by -0.63 individuals per year over this period (Multiple $R^2 = 0.56$, p-value < 0.01; Figure 5).

Table 2. **Oregon state-wide** greater sage-grouse lek complex survey effort, and trend in maximum male lek complex attendance summarized over 5-year periods, 1980 – 2017.

	1980-84		1985-89		1990-94		1995-99		2000-04		2005-09		2010-14		2015-16		2017	
Variable	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Known Complexes	141.0	6.3	218.8	20.3	322.4	15.9	479.4	21.0	599.2	13.5	682.6	8.3	724.2	5.5	760.5	4.5	777.0	-
Complexes Counted	52.0	6.3	67.0	10.6	89.8	11.9	161.8	9.0	198.6	11.3	265.0	15.9	290.8	26.1	480.5	21.5	429.0	-
Proportion Complexes Counted	0.38	0.06	0.30	0.03	0.27	0.02	0.34	0.02	0.33	0.01	0.39	0.02	0.40	0.03	0.63	0.02	0.55	-
Active Complexes Surveyed	27.2	3.4	48.2	7.3	73.0	12.7	129.2	4.1	144.6	7.7	178.8	6.9	178.6	10.3	248.0	4.0	245.0	-
Males/Complex	13.4	2.5	19.3	2.0	20.0	1.8	12.5	0.5	17.2	1.0	15.3	2.6	12.0	1.6	10.0	0.3	10.9	-
Males/Active Complex	23.4	1.8	26.6	2.3	25.3	2.4	15.6	0.6	23.8	1.8	22.4	3.6	18.9	1.7	19.3	1.2	19.1	-
Annual Proportion Change - Male Attendance	0.01	0.10	0.08	0.08	-0.08	0.07	-0.05	0.07	0.09	0.02	-0.09	0.10	0.00	0.10	0.18	0.00	-0.08	-

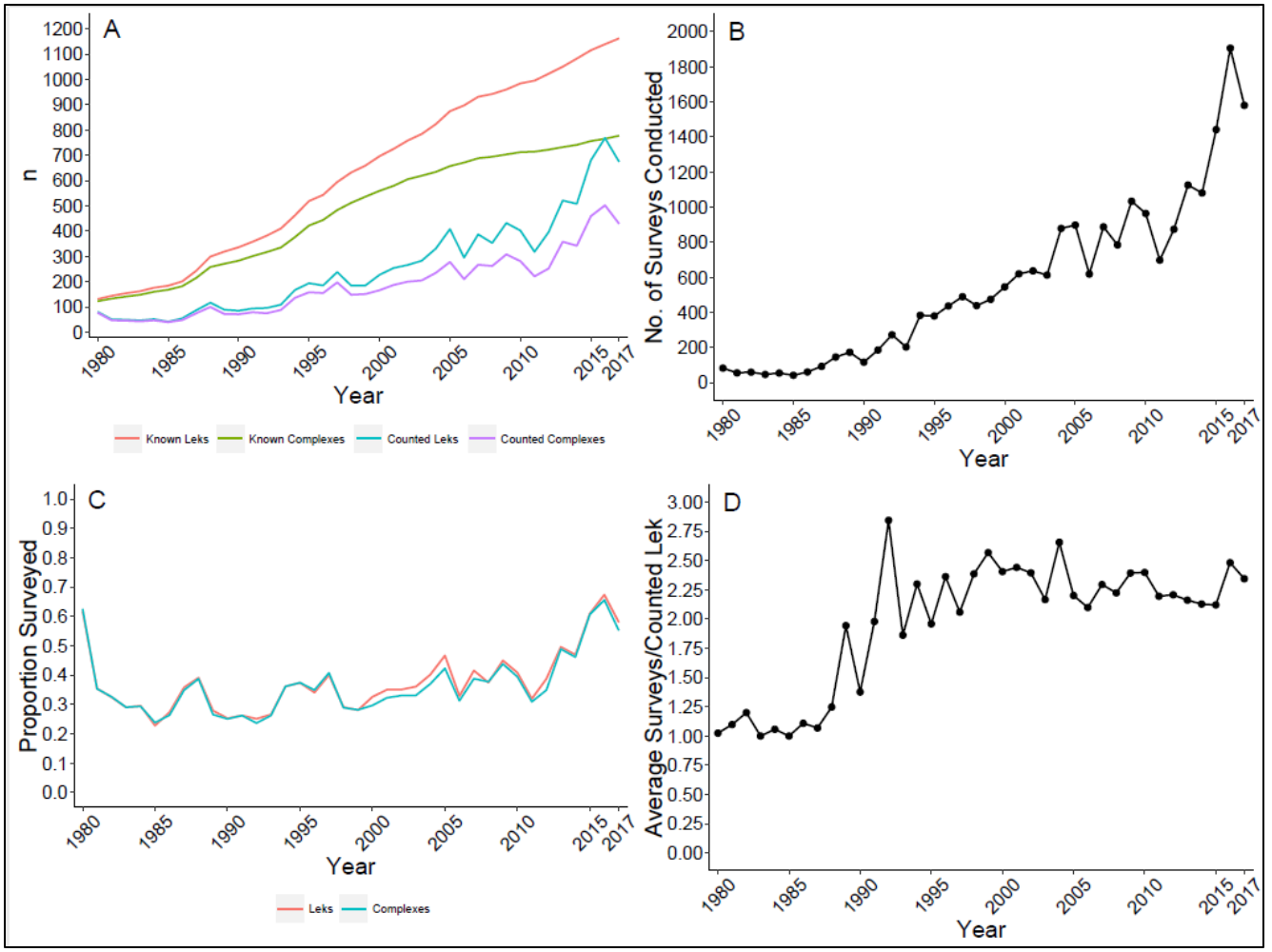


Figure 2. **Oregon state-wide** greater sage-grouse survey effort statistics, 1980 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

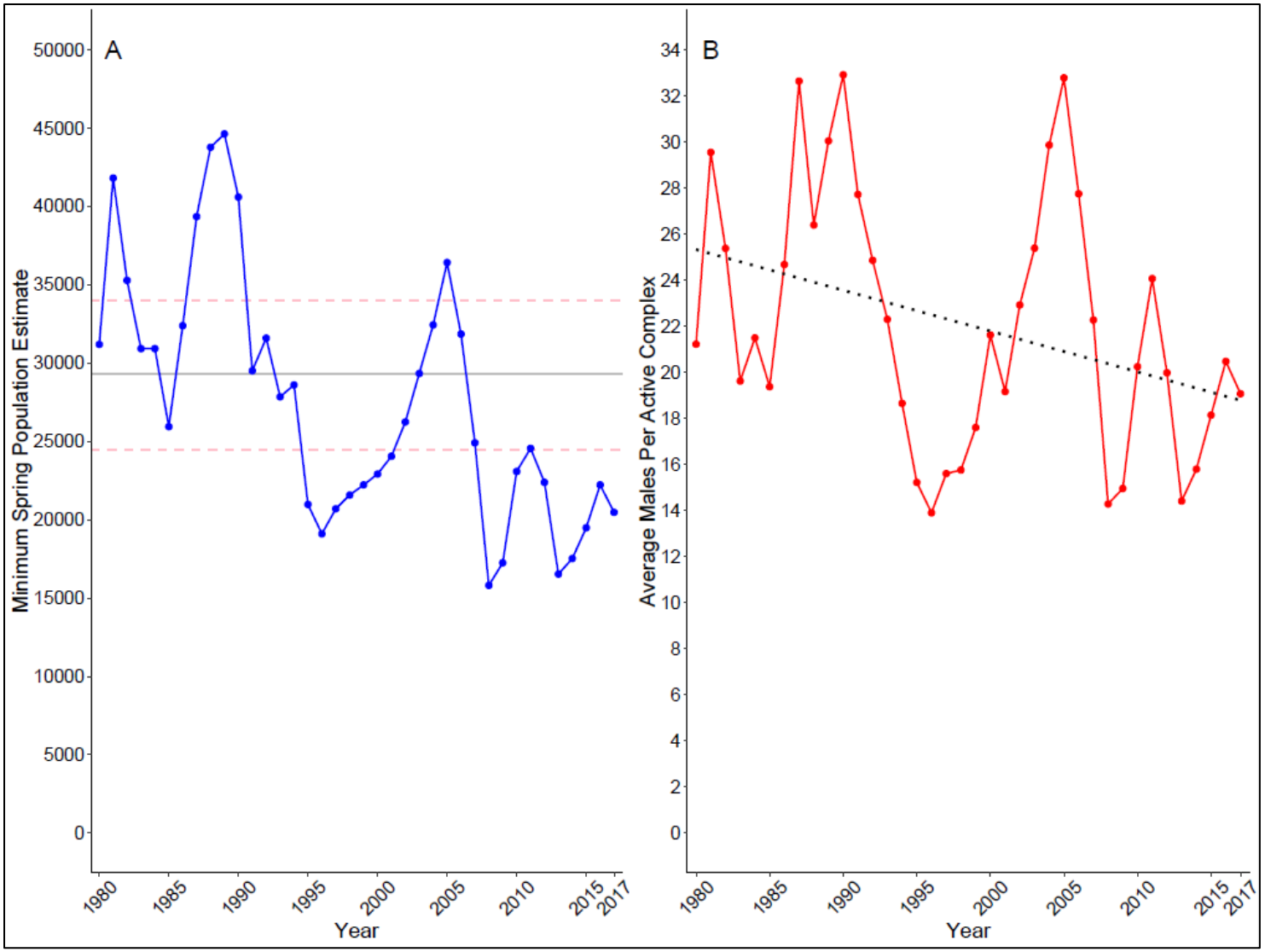


Figure 3. Greater sage-grouse population trends in **Oregon**, 1980 – 2017. A - Estimated spring breeding population of greater sage-grouse, gray line indicates 2003 baseline population level of 29,327 individuals, pink dotted lines indicate the 95% confidence interval around the 2003 baseline estimate. B - Change in average lek complex size (males per active lek complex).

Table 3. **Baker BLM Resource Area** greater sage-grouse lek complex survey effort, and trend in maximum male lek complex attendance summarized over 5-year periods, 1996 – 2017.

	1996-99		2000-04		2005-09		2010-14		2015-16		2017	
Variable	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Known Complexes	24.0	3.4	40.6	1.2	43.4	0.7	51.4	0.4	55.0	3.0	59.0	-
Complexes Counted	12.3	1.5	15.0	2.6	18.2	4.1	15.8	1.5	33.0	12.0	27.0	-
Proportion Complexes Counted	0.52	0.04	0.37	0.07	0.41	0.08	0.31	0.03	0.59	0.19	0.46	-
Complexes Active	8.0	0.8	12.4	2.7	13.4	0.7	10.4	1.2	10.0	0.0	12.0	-
Males/Complex	13.6	1.2	15.2	2.0	12.5	2.8	6.9	1.0	4.3	1.8	4.1	-
Males/Active Complex	20.5	1.1	19.0	2.4	14.6	2.5	10.3	1.0	12.0	0.7	9.3	-
Annual Proportion Change - Male Attendance	0.08	0.05	0.02	0.12	-0.16	0.05	-0.10	0.12	0.11	0.30	-0.03	-

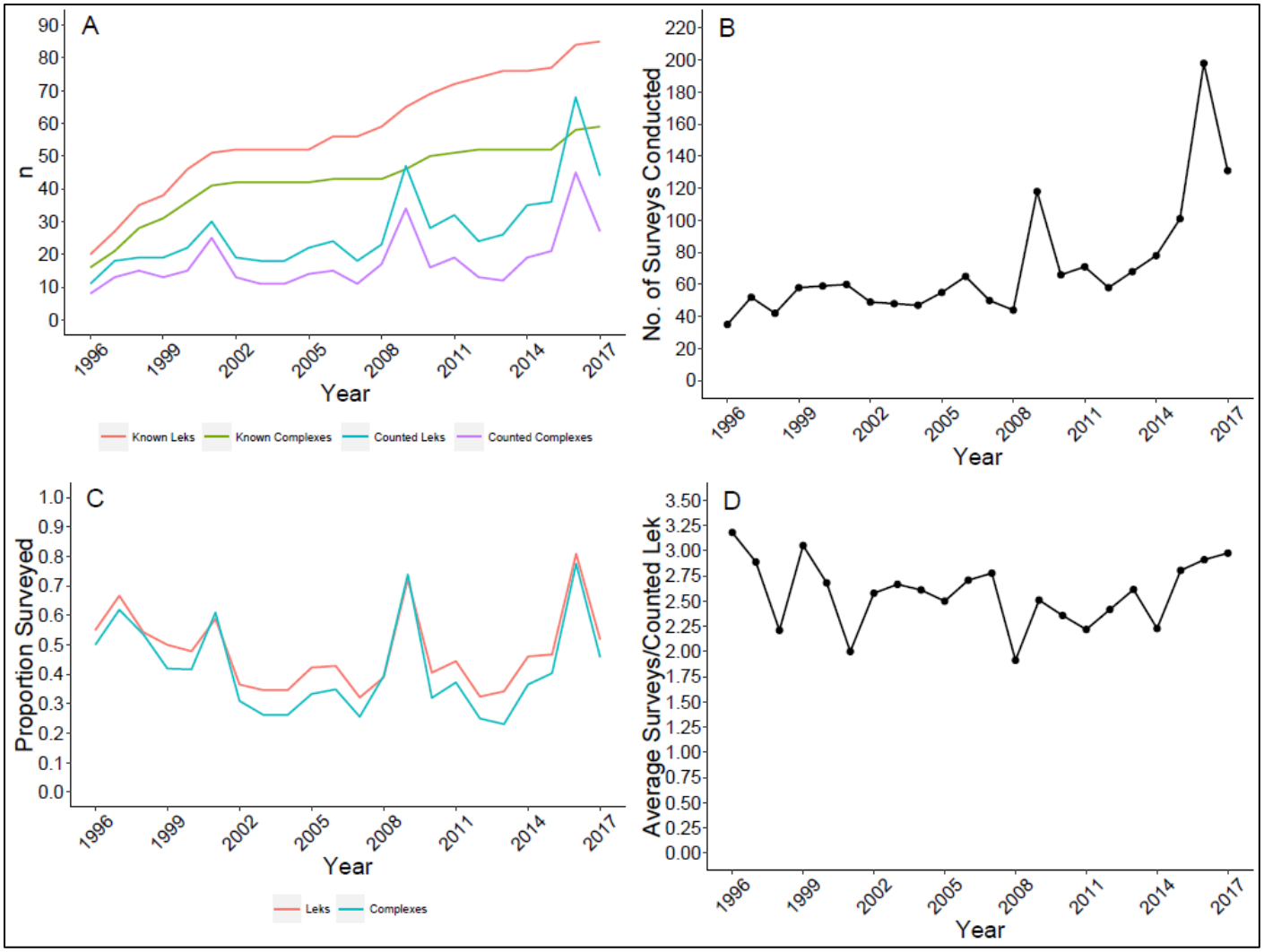


Figure 4. **Baker BLM Resource Area** greater sage-grouse survey effort statistics, 1996 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

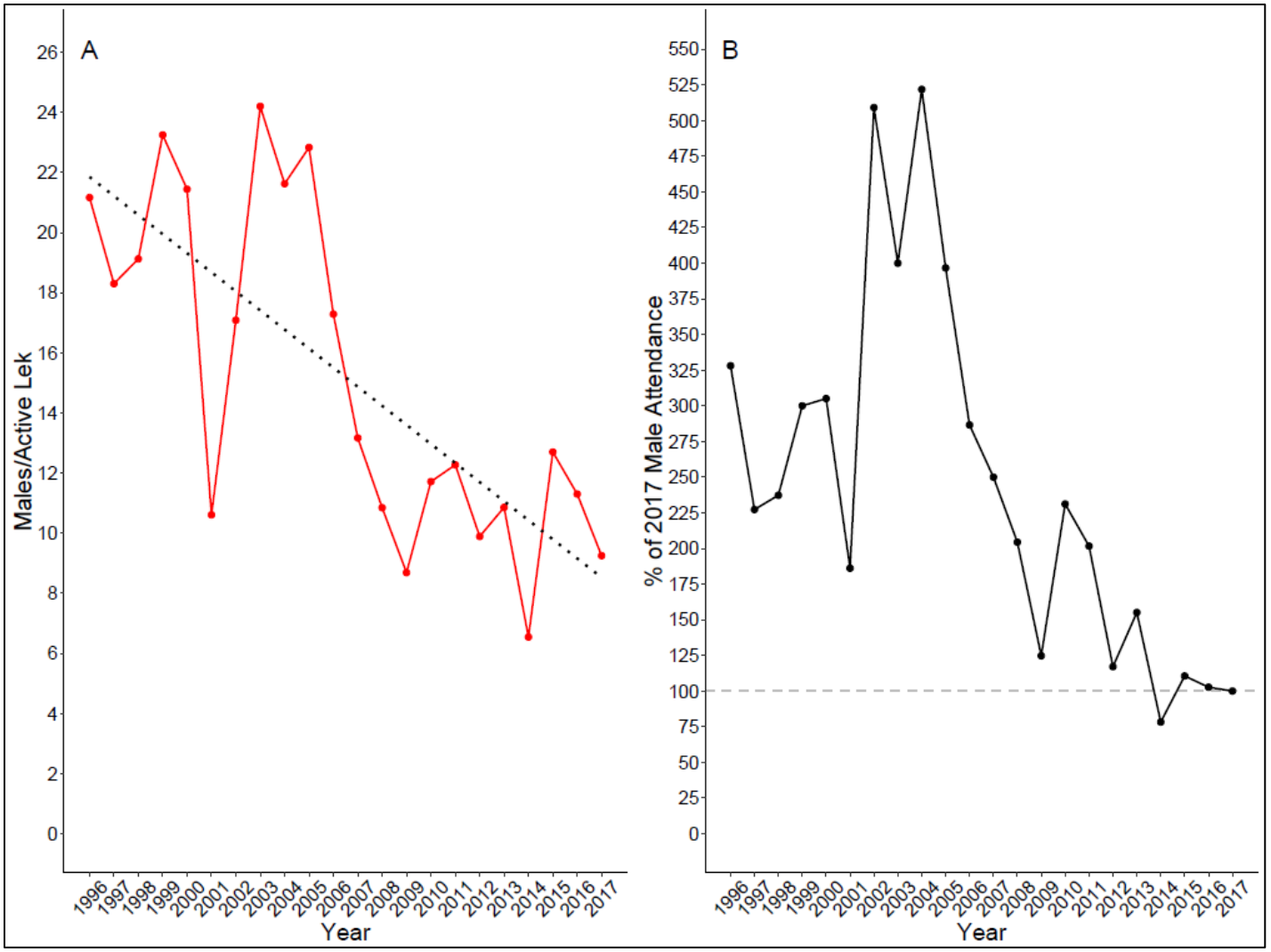


Figure 5. Greater sage-grouse population trend in the **Baker BLM Resource Area,** 1996 – 2017. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2016 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2016.

Burns District

Even with the difficult survey conditions during 2017, survey effort for the Burns District, in terms of the proportion of known complexes counted, was the highest accomplished since consistent lek monitoring on the district began (Table 4; Figure 6). During 2017, 323 ground surveys were conducted at 157 leks comprising 103 complexes. This constitutes 73.0% of the 215 leks, and 72.0% of the 143 complexes, known to exist or have existed in the District. Survey effort per lek declined slightly from 2016 levels, but remained adequate (Surveys/Lek: 2016 = 2.39, 2017 = 2.06). Three previously unknown leks, and one complex were discovered on the district by ground observers during 2017.

The estimated spring sage-grouse population in the Burns District during 2017 was 4,193 individuals (95% CI: 3,945 – 4,441 individuals), a -17.1% decline from 5,059 individuals during 2016. Observed male attendance at lek complexes counted during both 2016 and 2017 declined -15.6% from 991 to 836 observed males. The population decline between 2016 and 2017 represented an end to 3 consecutive years of population growth, and a return to 2015 population levels (Figure 7). The 5-year average population trend in the District remained negative at -3.6%. Observed male attendance during 2017 is 47.2% below the 2003 baseline level (n_{2003} = 678, n_{2017} = 358), at complexes counted during both 2003 and 2017 (Figure 7). Data collected since the 2011 Conservation Assessment suggests a significant reduction in average lek complex size since 1981, with the number of males per active complex declining by -0.51 individuals per year over this period (Multiple R^2 = 0.27, p-value <0.01; Figure 7).

Lakeview District

Survey effort in the Lakeview District during 2017 was the second highest accomplished since 1980, in terms of number of surveys conducted (Table 5; Figure 8), additionally the majority of the decline in survey effort between 2016 and 2017 can be attributed to additional aerial surveys conducted by Hart Mountain National Antelope Refuge during 2016. During 2017, 410 ground surveys, and 2 aerial surveys were conducted at 152 leks comprising 100 complexes. This constitutes 52.2% of the 291 leks, and 51.5% of the 194 complexes known to exist or have existed in the District. Survey effort per lek declined between 2016 and 2017, but remained high (Surveys per Lek: 2016 = 2.91, 2017 = 2.71). Two previously unknown leks, and 1 complex were discovered during 2017 in the District.

The estimated spring sage-grouse population in the Lakeview District was 5,921 individuals (95% CI: 5,397 – 6,444 individuals), a -12.8% decline from 6,786 individuals in 2016. During 2016, observed male attendance at complexes also counted during 2016 declined -10.1%, from 1,178 to 1,059 observed males. As was observed at the statewide level, 2017 represented a decline after 3 consecutive years of population growth, however the estimated population in the District remains above 2015 levels, and for the first time since 2006 the 5-year average population trend was positive at 0.2%. Observed male attendance remains 38.1% below the 2003 baseline level (n_{2003} = 1,355, n_{2017} = 839), at complexes counted during both 2003 and 2017 (Figure 9). Data collected since the 2011 Conservation Assessment suggests that average complex size has remained stable in the Lakeview District since 1980 (Multiple R^2 < 0.01, p-value = 0.68; Figure 9).

Table 4. **Burns BLM District** greater sage-grouse lek complex survey effort, and trend in maximum male lek complex attendance summarized over 5-year periods, 1981 – 2017.

	1981-84		1985-89		1990-94		1995-99		2000-04		2005-09		2010-14		2015-16		2017	
Variable	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Known Complexes	30.8	1.4	54.4	6.7	75.8	1.2	83.0	1.9	95.0	3.6	119.6	4.0	131.8	1.4	142.0	0.0	143.0	-
Complexes Counted	15.0	0.8	21.6	4.3	18.8	0.9	25.2	4.1	30.0	3.3	40.0	7.3	48.0	4.0	93.0	8.0	103.0	-
Proportion Complexes Counted	0.49	0.05	0.41	0.07	0.25	0.02	0.30	0.05	0.31	0.03	0.33	0.05	0.36	0.03	0.65	0.06	0.72	-
Complexes Active	11.5	1.3	14.4	0.4	16.8	0.6	20.0	1.8	24.4	2.5	29.2	3.9	31.4	1.7	56.5	1.5	62.0	-
Males/Complex	22.7	1.7	26.9	5.4	32.8	2.2	13.0	1.5	19.2	1.9	19.5	5.5	13.0	2.1	12.4	2.2	10.5	-
Males/Active Complex	30.2	2.6	36.7	5.6	36.9	3.5	15.4	0.9	23.1	1.4	24.9	5.9	19.2	2.3	20.1	2.5	17.5	-
Annual Proportion Change - Male Attendance	-0.07	0.02	0.12	0.12	-0.04	0.08	-0.06	0.13	0.12	0.10	-0.10	0.14	0.00	0.13	0.20	0.04	-0.16	-

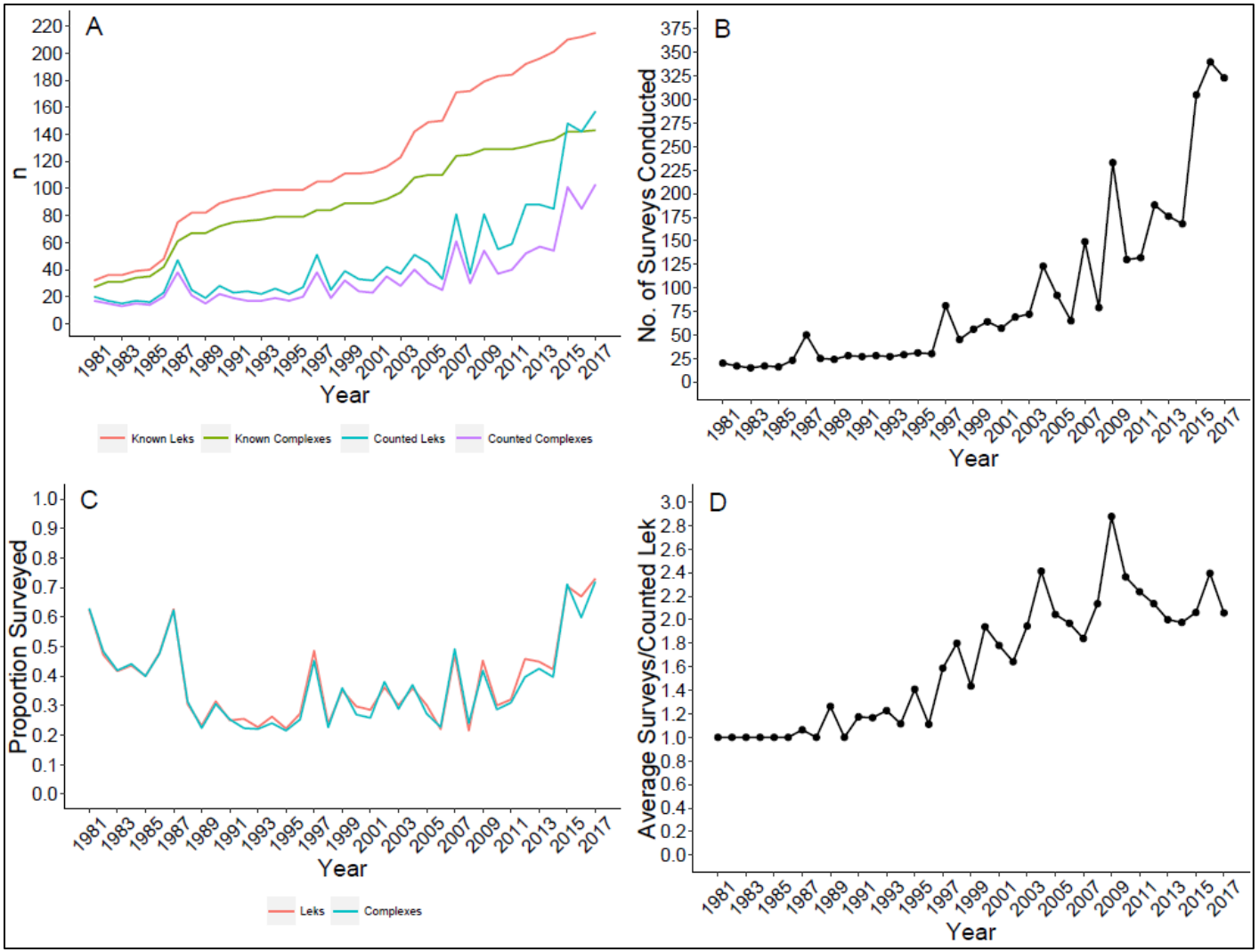


Figure 6. **Burns BLM District** greater sage-grouse survey effort statistics, 1981 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

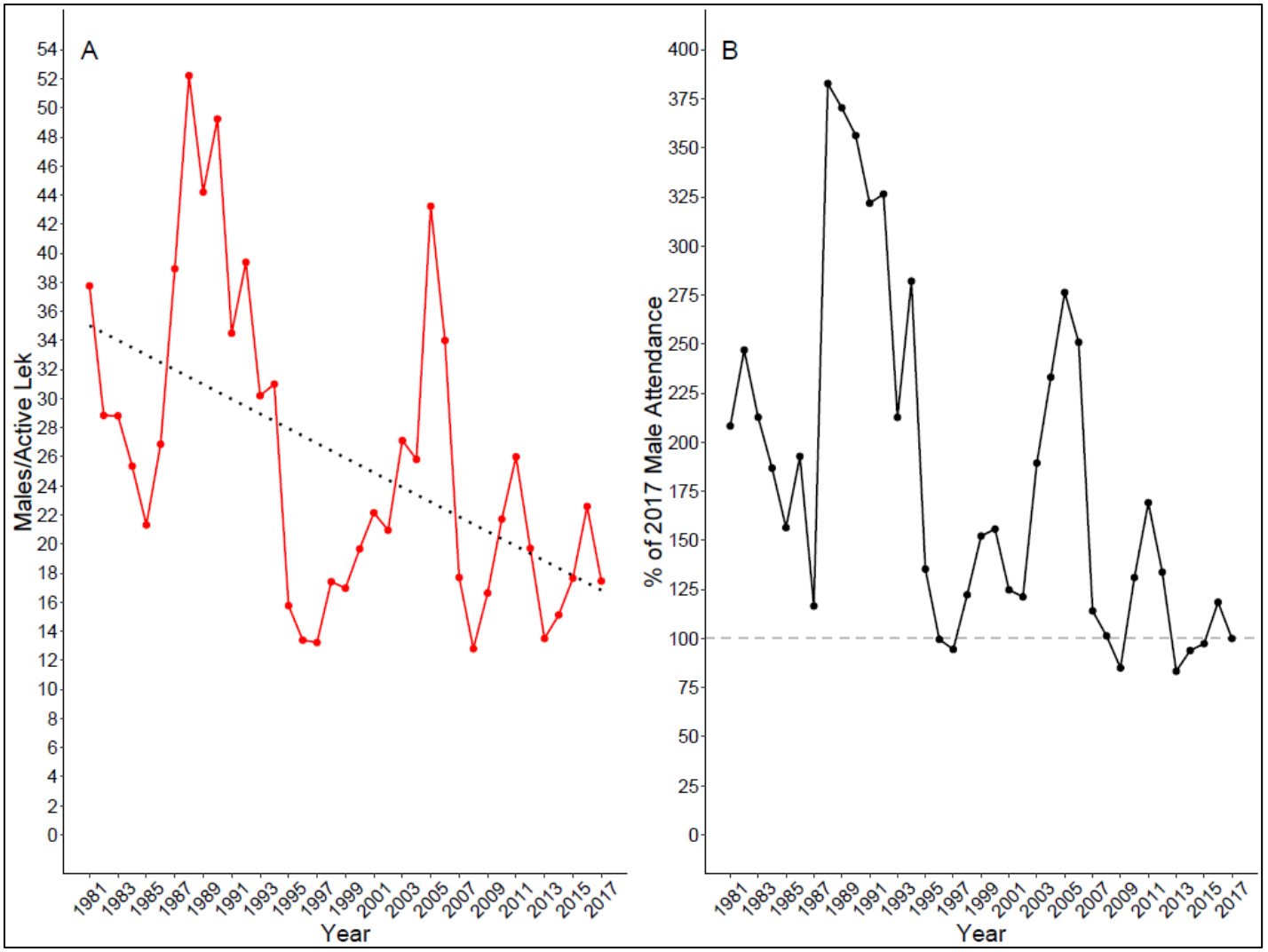


Figure 7. Greater sage-grouse population trend in the **Burns BLM District**, 1981 – 2017. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2017 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2017.

Table 5. **Lakeview BLM District** greater sage-grouse lek complex survey effort, and trend in maximum male lek complex attendance summarized over 5-year periods, 1980 – 2017.

	1980-84		1985-89		1990-94		1995-99		2000-04		2005-09		2010-14		2015-16		2017	
Variable	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Known Complexes	74.0	0.9	88.6	5.6	114.8	1.0	127.8	0.2	159.8	8.7	182.0	0.8	188.6	1.1	192.5	0.5	194.0	-
Complexes Counted	23.8	8.1	20.6	3.7	22.0	1.7	28.8	2.2	81.2	10.1	80.0	4.4	79.8	6.5	119.0	11.0	100.0	-
Proportion Complexes Counted	0.33	0.12	0.23	0.03	0.19	0.02	0.23	0.02	0.50	0.04	0.44	0.02	0.42	0.03	0.62	0.06	0.52	-
Complexes Active	10.6	1.5	14.0	1.6	16.6	2.2	23.8	2.2	53.0	6.2	48.2	2.3	48.8	3.2	60.5	6.5	56.0	-
Males/Complex	14.7	3.5	23.8	3.6	22.8	2.0	16.5	1.3	20.3	1.3	19.9	3.5	14.5	2.0	11.6	0.4	12.9	-
Males/Active Complex	22.7	2.5	33.2	3.9	31.0	2.3	20.0	1.8	31.3	3.0	33.3	6.6	23.3	2.6	22.9	0.5	23.1	-
Annual Proportion Change - Male Attendance	0.16	0.17	0.04	0.08	-0.10	0.11	-0.02	0.12	0.17	0.04	-0.12	0.09	-0.02	0.11	0.20	0.02	-0.10	-

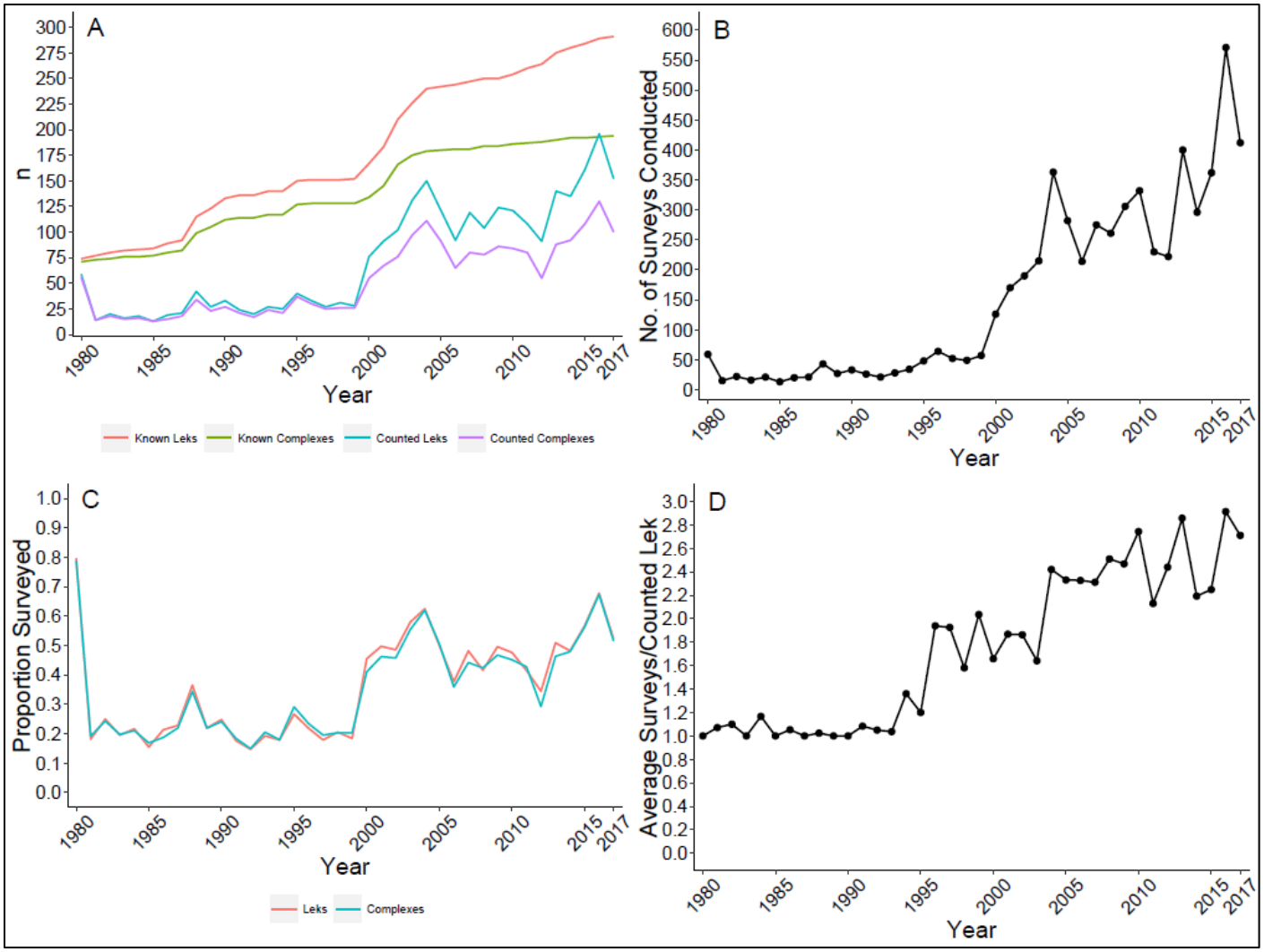


Figure 8. **Lakeview BLM District** greater sage-grouse survey effort statistics, 1980 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

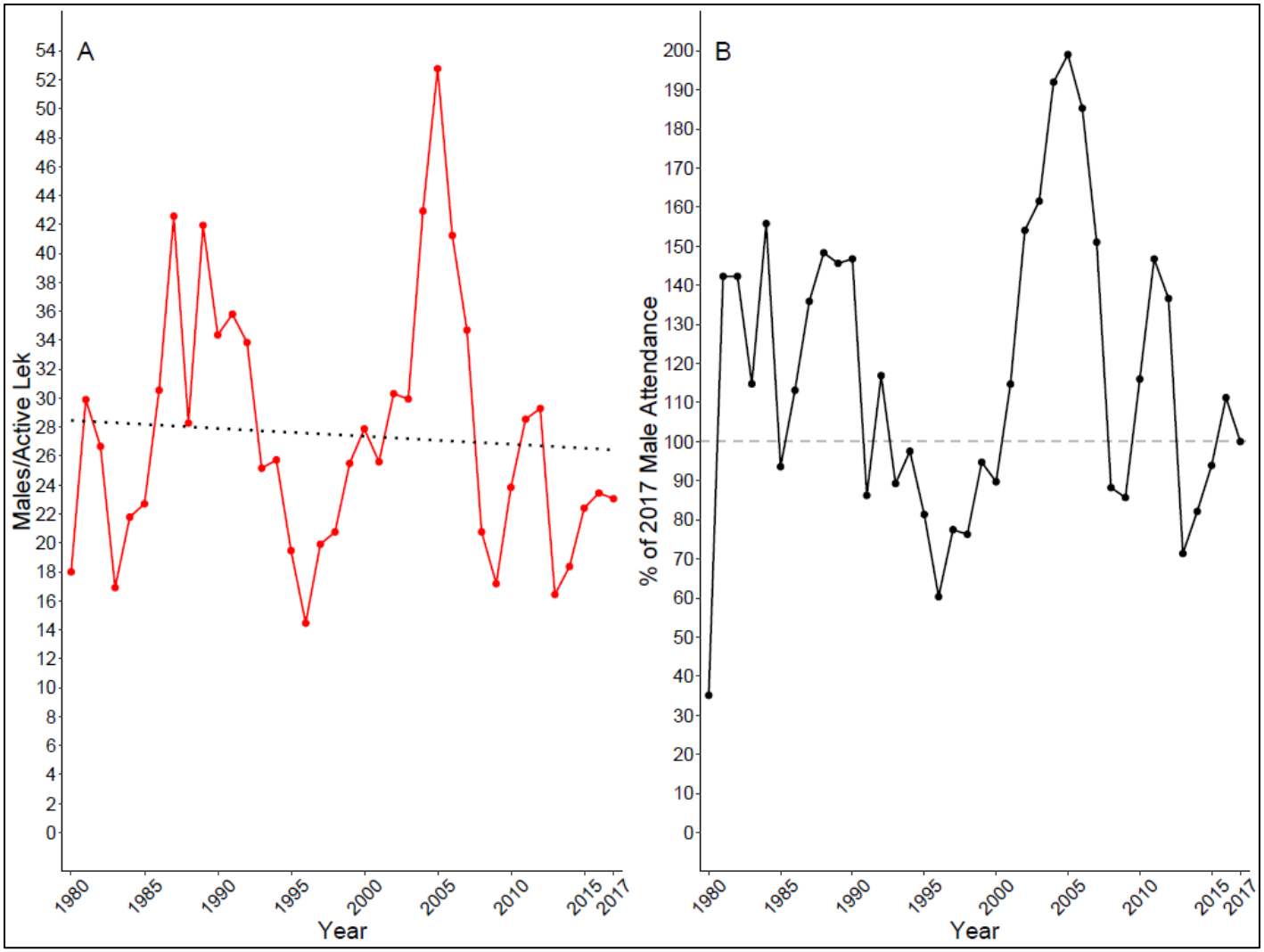


Figure 9. Greater sage-grouse population trend in the **Lakeview BLM District**, 1980 – 2017. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2017 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2017.

Prineville District

In terms of total number of leks counted and total number of surveys conducted, survey effort in the Prineville District during 2017 was the second greatest accomplished, and exceeded survey effort expended during 2016 (Table 6; Figure 10). During 2017, 237 ground surveys were conducted at 83 leks comprising 38 complexes. This constitutes 66.9% of the 124 leks, and 61.3% of the 62 complexes, known to exist or have existed in the District. Survey effort per lek was similar to 2016 levels, with each lek receiving on average 2.86 surveys during the monitoring season. No previously unknown leks were located in the District during 2017, however one lek site which was never confirmed and likely spurious, was removed from the database for the District this year.

The estimated spring sage-grouse population in the Prineville District was 1,642 individuals (95% CI: 1,540 – 1,744 individuals), a -3.9% decline from 1,709 individuals in 2016. During 2017, observed male attendance at complexes also counted during 2016 declined -3.0% from 440 to 427 observed males. Population trends in the Prineville District have been relatively stable since 2012, as the 5-year average population trend indicates at approximately 0.01%. Observed male attendance remains 13.9% below the 2003 baseline level ($n_{2003} = 488$, $n_{2017} = 420$), at complexes observed during both 2003 and 2017 (Figure 11). Data collected since the 2011 Conservation Assessment suggest a small, non-significant reduction in average lek complex size since 1980, with average males per lek complex declining by -0.05 males per year over this period (Multiple $R^2 = 0.05$, p-value = 0.22; Figure 11). However, it appears that this relationship is primarily driven by 2 years of high observed lek attendance during the early 1980s, when the number of leks counted was low.

Vale District

Survey effort in the Vale District (excluding the Baker Resource Area) during 2017 represented the third greatest survey effort achieved in the District (Table 7; Figure 12). During 2017, 428 ground surveys, and 49 aerial surveys were conducted at 238 leks comprising 161 complexes. This constitutes 53.2% of the 447, and 50.5% of the 319 complexes, known to exist or have existed in the District. Survey effort per lek was adequate, with each lek receiving on average 2.00 surveys during the monitoring season. Seventeen previously unknown leks, and 9 complexes were discovered during 2017.

The estimated spring sage-grouse population in the Vale District was 8,272 individuals (95% CI; 7,709 – 8,836 individuals), a 1.1% increase from 8,186 individuals in 2016. During 2017 observed male attendance at complexes also counted during 2016 decreased -4.5% from 1,544 to 1,475 individuals. The disparity between population estimate trend, and observed male trend can likely be attributed to the discovery of 9 previously unknown complexes in the District. Due to the likelihood that the newly discovered leks were present on the landscape during 2016, it is probable that the 2016 population estimate was biased low in comparison to the 2017 estimate. Five-year average population trend in the District was 5.2% between 2012 and 2017. However observed male attendance remains 42.2% below the 2003 baseline level ($n_{2003} = 500$, $n_{2017} = 289$), at complexes counted during both 2003 and 2017 (Figure 13). Data collected since the 2011 conservation assessment suggests small but significant growth in average complex size

since 1993, with average males per active lek complex increasing by 0.35 males per year during that period (Multiple $R^2 = 0.24$, p-value < 0.01; Figure 13).

Table 6. **Prineville BLM District** greater sage-grouse lek complex ground survey effort, and trend in maximum male lek complex attendance summarized over 5-year periods, 1980 – 2017.

	1980-84		1985-89		1990-94		1995-99		2000-04		2005-09		2010-14		2015-16		2017	
Variable	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Known Complexes	16.6	0.4	25.6	3.3	36.4	0.7	42.2	0.2	55.2	0.8	56.6	0.2	58.8	0.8	62.0	0.0	62.0	-
Complexes Counted	11.0	2.0	17.4	5.1	25.8	2.4	38.4	0.9	52.2	1.0	48.0	3.8	39.6	1.4	36.0	1.0	38.0	-
Proportion Complexes Counted	0.67	0.13	0.63	0.12	0.71	0.05	0.91	0.02	0.95	0.01	0.85	0.07	0.67	0.02	0.58	0.02	0.61	-
Complexes Active	6.8	1.4	15.2	4.9	21.4	1.7	32.8	0.9	37.2	0.7	31.2	2.5	30.0	0.9	26.0	2.0	31.0	-
Males/Complex	10.2	1.7	13.3	0.8	13.3	0.8	12.5	0.2	10.6	0.3	10.0	1.1	11.4	0.5	11.7	0.2	12.4	-
Males/Active Complex	16.7	2.5	15.8	0.7	15.9	0.7	14.7	0.4	14.8	0.5	15.3	1.8	15.0	0.4	16.2	0.5	15.2	-
Annual Proportion Change - Male Attendance	-0.24	0.13	0.11	0.17	-0.02	0.09	-0.04	0.02	-0.04	0.04	-0.07	0.09	0.10	0.13	0.03	0.02	-0.03	-

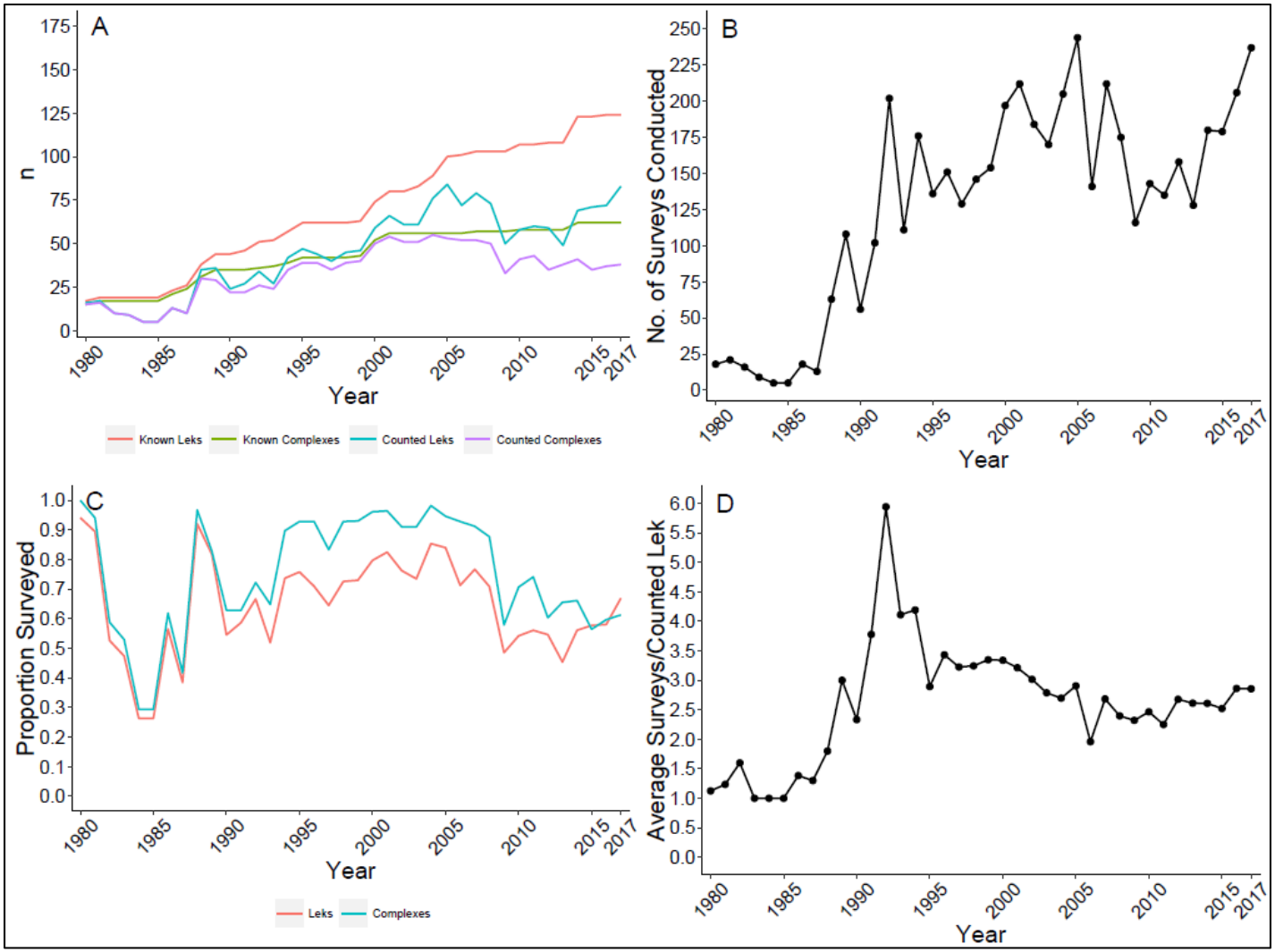


Figure 10. **Prineville BLM District** greater sage-grouse survey effort statistics, 1980 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

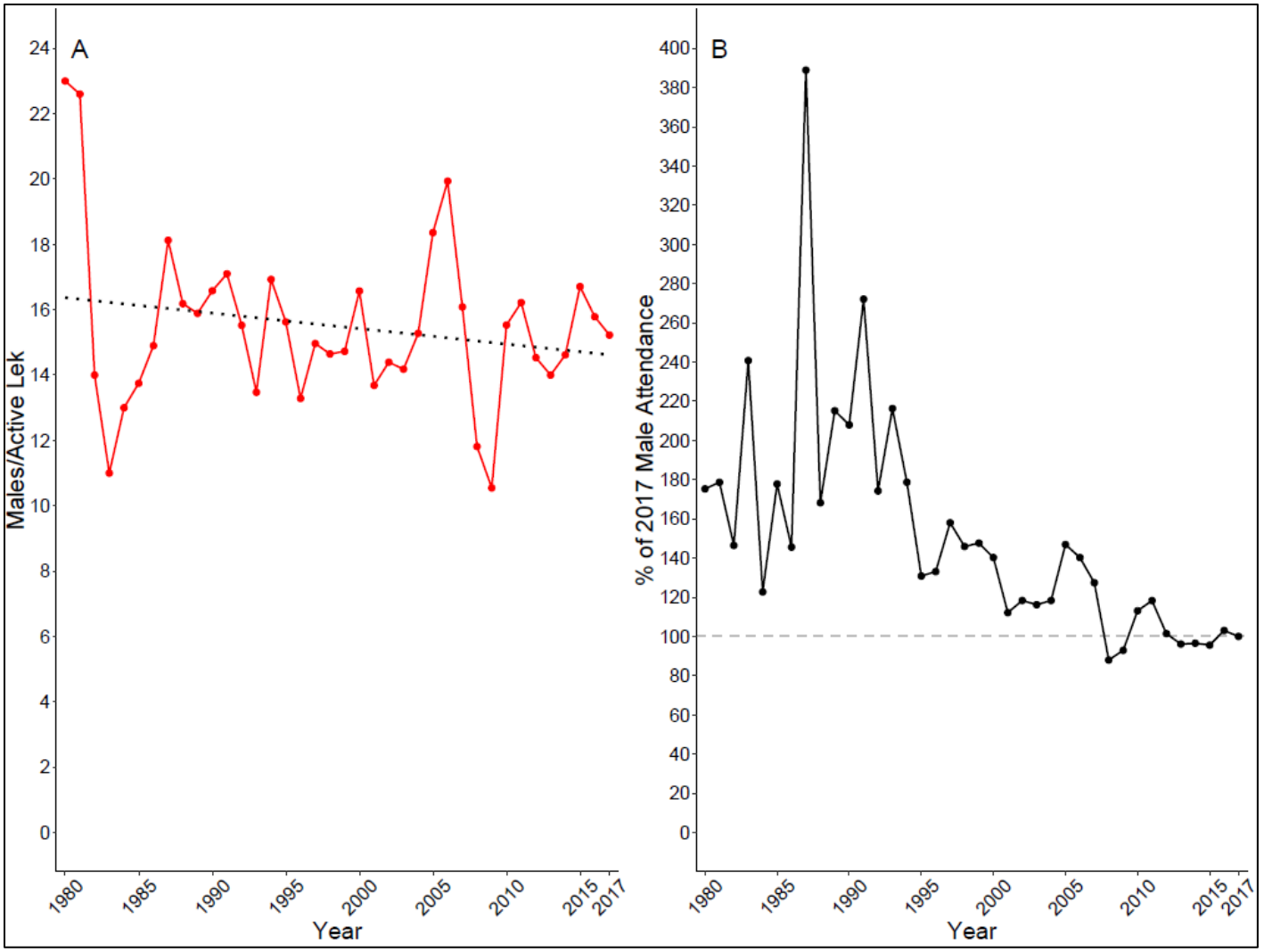


Figure 11. Greater sage-grouse population trend in the **Prineville BLM District**, 1980 – 2017. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2017 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2017.

Table 7. **Vale BLM District** (Excluding the Baker Resource Area) greater sage-grouse lek complex ground survey effort, and trend in maximum male lek complex attendance summarized over 5-year periods, 1993 – 2017.

	1993-94		1995-99		2000-04		2005-09		2010-14		2015-16		2017	
Variable	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Known Complexes	110.5	18.5	204.8	15.4	248.6	0.2	281.0	3.2	293.6	2.1	309.0	1.0	319.0	-
Complexes Counted	37.5	18.5	58.8	7.7	20.2	1.4	78.8	8.9	107.6	20.9	199.5	5.5	161.0	-
Proportion Complexes Counted	0.32	0.11	0.30	0.05	0.08	0.01	0.28	0.03	0.36	0.07	0.65	0.02	0.50	-
Complexes Active	35.0	16.0	45.8	4.5	17.6	0.7	56.8	5.0	58.0	8.8	95.0	3.0	84.0	-
Males/Complex	18.4	6.7	10.6	0.7	22.6	2.5	13.7	2.1	11.4	2.1	8.6	0.1	10.6	-
Males/Active Complex	19.0	6.1	13.4	0.7	25.6	2.4	18.4	2.2	19.7	2.7	18.2	1.2	20.4	-
Annual Proportion Change - Male Attendance	-0.54	0.20	-0.06	0.07	0.11	0.07	-0.04	0.13	-0.01	0.11	0.22	0.05	-0.04	-

Figure 12. **Vale BLM District** (excluding the Baker Resource Area) greater sage-grouse survey effort statistics, 1993 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

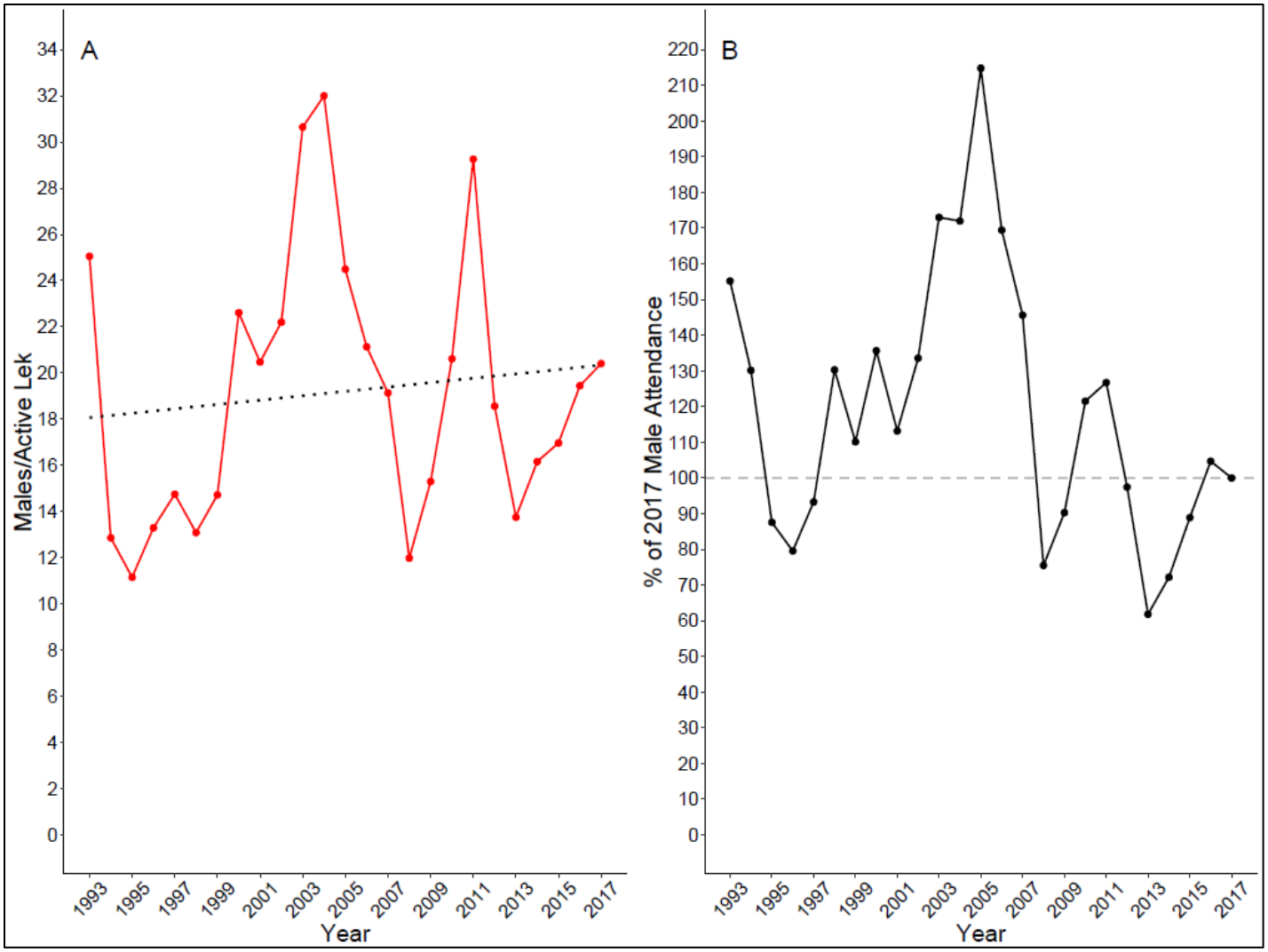


Figure 13. Greater sage-grouse population trend in the **Vale BLM District** (excluding the Baker Resource Area), 1993 – 2017. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2017 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2017.

Summary and Conclusions

The sage-grouse population in Oregon experienced a slight decline in 2017 following 3 consecutive years of population growth, decreasing by -7.7% from 2016, to an estimated 20,510 individuals. Declines occurred in the Burns, Lakeview, and Prineville BLM Districts, ranging from -3.9 to -17.1%. Populations remained near 2016 levels in the Baker Resource Area, as well as in the remainder of the Vale District, with each area exhibiting an approximately 1.0% increase in estimated population size. Population trends at the statewide level are primarily driven by the Burns, Lakeview, and Vale Districts, which contain approximately 90% of the statewide population. However further variation in population trend exists within the state at the scale of individual PACs (Appendix I).

Sage-grouse populations exhibit density dependent fluctuations over time (Garton et al. 2011), and while the population in Oregon is currently at levels similar to those observed in 2015, it still remains below the 2003 statewide baseline population of approximately 29,000 individuals. Continued monitoring of the population in Oregon will be necessary to determine whether the population is exhibiting normal cyclical behavior, or if carrying capacity in Oregon has been reduced (Garton et al. 2011). Continued conservation efforts to improve and restore sage-grouse habitat will positively affect sage-grouse populations over the long-term, allowing larger population peaks, and ameliorating troughs in the population cycle.

Estimating sage-grouse populations from lek counts is a complicated process, containing multiple assumptions (Beck and Braun 1980, Walsh et al. 2004). Standardized count procedures, in place in Oregon since 1996, have improved the reliability of sage-grouse population estimates, however multiple potential sources of uncertainty remain. These include assumptions regarding the lek attendance rate of male sage-grouse, knowledge of the distribution of leks in an area, bias in the selection of leks to be monitored in a given year, and uncertainty regarding the rate of new lek formation. Due to these sources of uncertainty all estimates of sage-grouse population size in Oregon should be considered indices only, with the relationship between these indices and the true population size remaining unknown (Walsh et al. 2004, ODFW 2011). New methods for estimating sage-grouse population are currently being developed by researchers at University of Montana in partnership with Western Association of Fish and Wildlife Agencies (WAFWA) (McCaffery et al. 2016). These methods will standardize population estimation procedures across the range of the species, as well as potentially improve the accuracy of population estimates in Oregon. In order to meet the assumptions of this new methodology, survey effort has been substantially increased in the state, improving the reliability of trend estimates, while the updated population estimation procedures are scaled up to a range-wide level. Oregon stands poised to implement these new methods as they become available, in order to further refine our understanding of sage-grouse population dynamics in the state.

References

Beck, T. D. I., and C. E. Braun. 1980. The strutting ground count: variation, traditionalism, management needs. Proceedings of the Annual Conference of the Western Association of State Game and Fish Commissioners 60:558–566.

Emmons, S. R., and C. E. Braun. 1984. Lek attendance of male sage grouse. Journal of Wildlife Management 48:1023–1028.

Garton, E. O., J. W. Connelly, J. S. Horne, C. A. Hagen, A. Moser, and M. A. Schroeder. 2011. Greater sage-grouse population dynamics and probability of persistence. Greater sage-grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology 38:293–381.

Jenni, D. A., and J. E, Hartzler. 1978. Attendance at a sage-grouse lek: implications for spring censuses. Journal of Wildlife Managment. 42:46-52.

Krebs, C. J. 1994. Ecology: the experimental analysis of distribution and abundance. 4th ed. Benjamin Cummings, San Francisco, California, USA.

McCaffery, R, J. J. Nowak, P. M. Lukacs. 2016. Improved analysis of lek count data using n-mixture models. Journal of Wildlife Management 80:1011-1021.

Oregon Department of Fish and Wildlife (ODFW). 2011. Greater sage-grouse conservation assessment and strategy for Oregon: a plan to maintain and enhance populations and habitat. Oregon Department of Fish and Wildlife, Salem, USA.

Patterson, R. L. 1952. The sage grouse in Wyoming. Sage Books Inc., Denver, Colorado, USA.

Walsh, D. P., G. C. White, T. E. Remington, and D. C. Bowden. 2004. Evaluation of the lek-count index for greater sage-grouse. Wildlife Society Bulletin 32:56–68.

Appendix I – PAC Scale Survey Effort and Population Trend

ODFW delineated the breeding habitat, based on lek size and distribution, of approximately 90% of the state's sage-grouse population, and grouped this area into 20 "Sage-Grouse Core Areas" during the 2011 – 2012 period (ODFW 2011; Figure A1.1). Since the initial delineation of these core areas, they have been incorporated into multiple assessments and regulatory documents, including the 2015 USFWS "Not-Warranted" decision (USFWS 2015), the BLM Oregon Greater Sage-Grouse Approved Resource Management Plan Amendment (ARMPA; BLM 2015), and the Oregon Sage-Grouse Action Plan (SageCon 2015). The term Priority Area of Conservation (PAC) corresponds directly with ODFW's core areas, and the term Priority Habitat Management Area (PHMA) describes the portions of each core area under BLM administration. Annual PAC scale population assessments are integral to the adaptive management approach outlined in the ARMPA. Concurrent with their adoption in various regulatory documents, information regarding population trends at the scale of individual PACs has received heightened attention; the PAC has become the de-facto scale of interest for much of the landscape-scale sage-grouse habitat assessment and conservation currently ongoing as part of sage-grouse management plan implementation. As such, it is appropriate to report sage-grouse survey effort, and population trend information at the PAC scale. Presented below is information at the scale of individual PACs regarding survey effort during the 1980 – 2017 period, as well as population trend information reported in terms of males per active lek, and proportional change in male lek attendance following the methodology used in the main body of this document (Table A1.1 – Table A1.2; Figures A1.2 – A1.43). The information presented below was derived from the same base data used to make ARMPA "trigger" determinations, however it has been analyzed using different methods than those used to make ARMPA trigger decisions. As such no effort is made to pre-project BLM trigger decisions, and all information presented below should be used for informational purposes only.

As described in the main body of this report, change in lek size over time is depicted using the average number of males counted per active lek in a given PAC. This metric may be misleading for some of the PACs presented below. In many PACs few leks were counted in the early portion of the periods analyzed and often the leks that were counted were large. As knowledge of lek distribution within PACs, and across the state, has increased, many relatively small leks have been identified and surveys of those leks have increased in recent years. The recent routine counting of these smaller leks has likely led to bias in the males/active lek metric, reducing the average size of counted leks, and thus potentially indicating an artificial decline in lek size in some areas.

References

Bureau of Land Management (BLM). 2015. Oregon greater sage-grouse approved resource management plan amendment. US Department of Interior, Bureau of Land Management, Oregon/Washington State Office, Portland, USA. BLM/OR/WA/PL-15/051+1792.

Oregon Department of Fish and Wildlife (ODFW). 2011. Greater sage-grouse conservation assessment and strategy for Oregon: a plan to maintain and enhance populations and habitat. Oregon Department of Fish and Wildlife, Salem, USA.

Sage-Grouse Conservation Partnership (SageCon). 2015. The Oregon sage-grouse action plan. Oregon Governor's Natural Resource Office, Salem, USA.

U.S. Fish and Wildlife Service (USFWS). 2015. Endangered and threatened wildlife and plants; 12-mont findings for petitions to list the greater sage-grouse (*Centrocercus urophasianus*) as threatened or endangered. Federal Register 80:59857-59942.

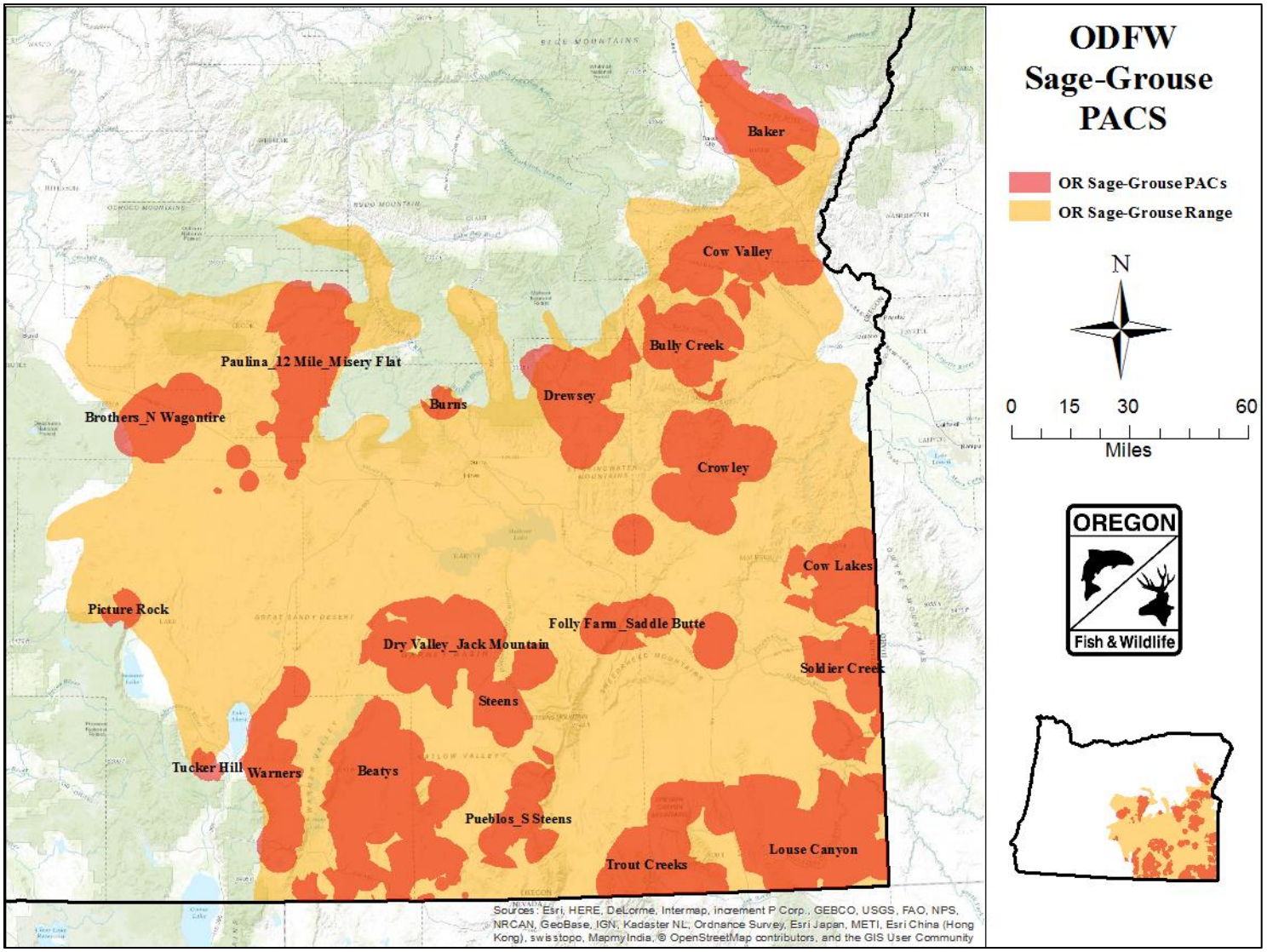


Figure A1.1. Oregon greater sage-grouse Priority Areas for Conservation (PACs).

Table A1.1. Survey effort statistics for the 20 Oregon greater sage-grouse PACs, and leks outside of PACs, 2017.

PAC	Total Known Leks	Total Known Complexes	Counts Conducted			Surveyed Sites		% Sites Surveyed		Surveys/ Lek	Previously Unknown Sites Located	
			Total	Ground	Aerial	Leks	Complexes	Leks	Complexes		Leks	Complexes
Baker	65	45	125	125	0	41	24	63.1	53.3	3.05	-	-
Beatys	154	87	181	179	2	69	42	44.8	48.3	2.62	1	1
Brothers/N. Wagontire	42	18	99	0	0	32	12	76.2	66.7	3.09	-	-
Bully Creek	42	27	47	35	12	22	11	52.4	40.7	2.14	6	-
Burns	3	2	6	6	0	3	2	100.0	100.0	2.00	-	-
Cow Lakes	55	36	100	99	1	43	28	78.2	77.8	2.33	-	-
Cow Valley	56	44	65	31	34	31	24	55.4	54.5	2.10	10	8
Crowley	50	33	57	57	0	27	17	54.0	51.5	2.10	-	-
Drewsey	43	20	75	75	0	32	16	74.4	80.0	2.34	1	1
Dry Valley/Jack Mountain	26	18	54	54	0	21	13	80.8	72.2	2.57	-	-
Folly Farm/Saddle Butte	20	15	29	29	0	14	9	70.0	60.0	2.07	-	-
Louse Canyon	60	49	46	46	0	34	27	56.7	55.1	1.35	-	-
Paulina/12-Mile/Misery Flat	60	32	125	125	0	47	23	78.3	71.9	2.66	-	-
Picture Rock	7	4	21	21	0	7	4	100.0	100.0	3.00	-	-
Pueblos/S. Steens	30	19	50	50	0	20	11	66.7	57.9	2.50	-	-
Soldier Creek	47	32	54	54	0	25	17	53.2	53.1	2.16	1	1
Steens	15	10	25	25	0	13	9	86.7	90.0	1.92	-	-
Trout Creeks	97	52	101	101	0	48	25	49.5	48.1	2.10	1	-
Tucker Hills	5	4	11	11	0	4	3	80.0	75.0	2.75	-	-
Warner	56	42	93	93	0	32	22	57.1	52.4	2.91	-	-
Non-PAC	229	188	214	210	4	109	90	47.6	47.9	1.96	3	1

Table A1.2. Population trend data for the 20 Oregon greater sage-grouse PACs, and leks outside of PACs, 2017.

PAC	Observed Males - Common Leks 2016	Observed Males - Common Leks 2017	% Change Male Attendance 2016 to 2017	2012 to 2017 - Average Annual Change in Male Lek Attendance	Observed Males - Common Leks 2003	Observed Males - Common Leks 2017	% Change Male Attendance 2003 to 2017	Lek Size Analysis Period	Annual Change in Lek Size (Males/Year)[a]
Baker	96	102	6.3	-7.7	236	59	-75.0	1996 - 2017	-0.69*
Beatys	624	626	0.3	1.8	665	507	-23.8	1980 - 2017	0.11
Brothers/N. Wagontire	104	86	-17.3	-12.1	79	74	-6.3	1980 - 2017	-0.03
Bully Creek	188	234	24.5	1.4	124	72	-41.9	1996 - 2017	-1.64*
Burns	15	13	-13.3	-22.6	NA	NA	NA	2013 - 2017	-2
Cow Lakes	231	213	-7.8	8.7	202	98	-51.5	1993 - 2017	-0.07
Cow Valley	88	77	-10.5	-1.0	61	47	-23.0	1997 - 2017	0.34
Crowley	197	205	4.1	-1.0	26	21	-19.2	1994 - 2017	0.13
Drewsey	211	216	2.4	12.1	82	76	-7.3	1997 - 2017	0.24*
Dry Valley/Jack Mountain	68	65	-4.4	-18.0	214	64	-70.1	1981 - 2017	-0.57*
Folly Farm/Saddle Butte	146	131	-10.3	9.0	12	5	-58.3	2005 - 2017	-0.13
Louse Canyon	220	184	-16.4	24.6	NA	NA	NA	2012 - 2017	2.43
Paulina/12-Mile/Misery Flat	357	362	1.4	10.1	405	367	-9.4	1988 - 2017	0.02
Picture Rock	11	7	-36.4	-28.0	39	7	-82.1	1981 - 2017	-0.19*
Pueblos/S. Steens	230	156	-32.2	7.9	185	117	-36.8	1996 - 2017	-0.07
Soldier Creek	283	264	-6.7	13.2	87	51	-41.4	1993 - 2017	0.17
Steens	191	166	-13.1	3.5	181	89	-50.8	1981 - 2017	-1.64*
Trout Creeks	231	170	-26.4	15.4	NA	NA	NA	2012 - 2017	0.68
Tucker Hills	82	63	-26.8	6.2	49	44	-10.2	1996 - 2017	0.14
Warner	258	187	-27.5	-1.7	415	193	-53.5	1993 - 2017	-0.05
Non-PAC	437	383	-12.4	2.5	195	74	-62.1	1980 - 2017	-0.12*

[a]Asterisk indicates significant change in lek size over the analyzed period at alpha value = 0.05.

Baker PAC

The Baker PAC is situated in eastern Baker County, with the north end of the PAC extending into southern Union County, and is completely contained within the Baker BLM Resource Area (Figure A1.1). Sixty five leks, comprising 45 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1941, and lek counts during the 1940s were incorporated into one of the first scientific studies of sage-grouse in W.M. Batterson and W.B. Morse's "Oregon Sage Grouse", published by the Oregon State Game Commission. Following the work conducted by Batterson and Morse, sage-grouse leks were not surveyed consistently in the Baker PAC until 1996 (Figure A1.2).

Beatys PAC

The Beatys PAC is situated in southeastern Lake County, and southwestern Harney County, and is almost entirely contained within the Lakeview BLM District (Figure A1.1). One hundred fifty-four leks, comprising 87 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1941, with consistent surveys in the PAC beginning in 1980 (Figure A1.4).

Brothers/N. Wagontire PAC

The Brothers/N. Wagontire PAC (often referred to simply as the Brothers PAC) is situated in eastern Deschutes County and southern Crook County, and is almost entirely contained within the Prineville BLM District (Figure A1.1). Forty-two leks, comprising 18 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1948; consistent survey effort has occurred almost continuously in the PAC since leks were first recorded, although knowledge of existing leks increased substantially following dedicated aerial lek searches which occurred in the late 1980s (Figure A1.6).

Bully Creek PAC

The Bully Creek PAC is situated in northeastern Malheur County, and is entirely contained within the Vale BLM District (Figure A1.1). Forty-two leks, comprising 27 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1982. Surveys did not consistently occur at a significant portion of leks within the PAC until 2009, although at least two leks have been surveyed yearly in the PAC since 1994 (Figure A1.8). Population trend information is presented for the Bully Creek PAC from 1994 – 2017 (Figure A1.9), however caution should be employed when interpreting this information due to the low proportion of leks consistently surveyed prior to 2009.

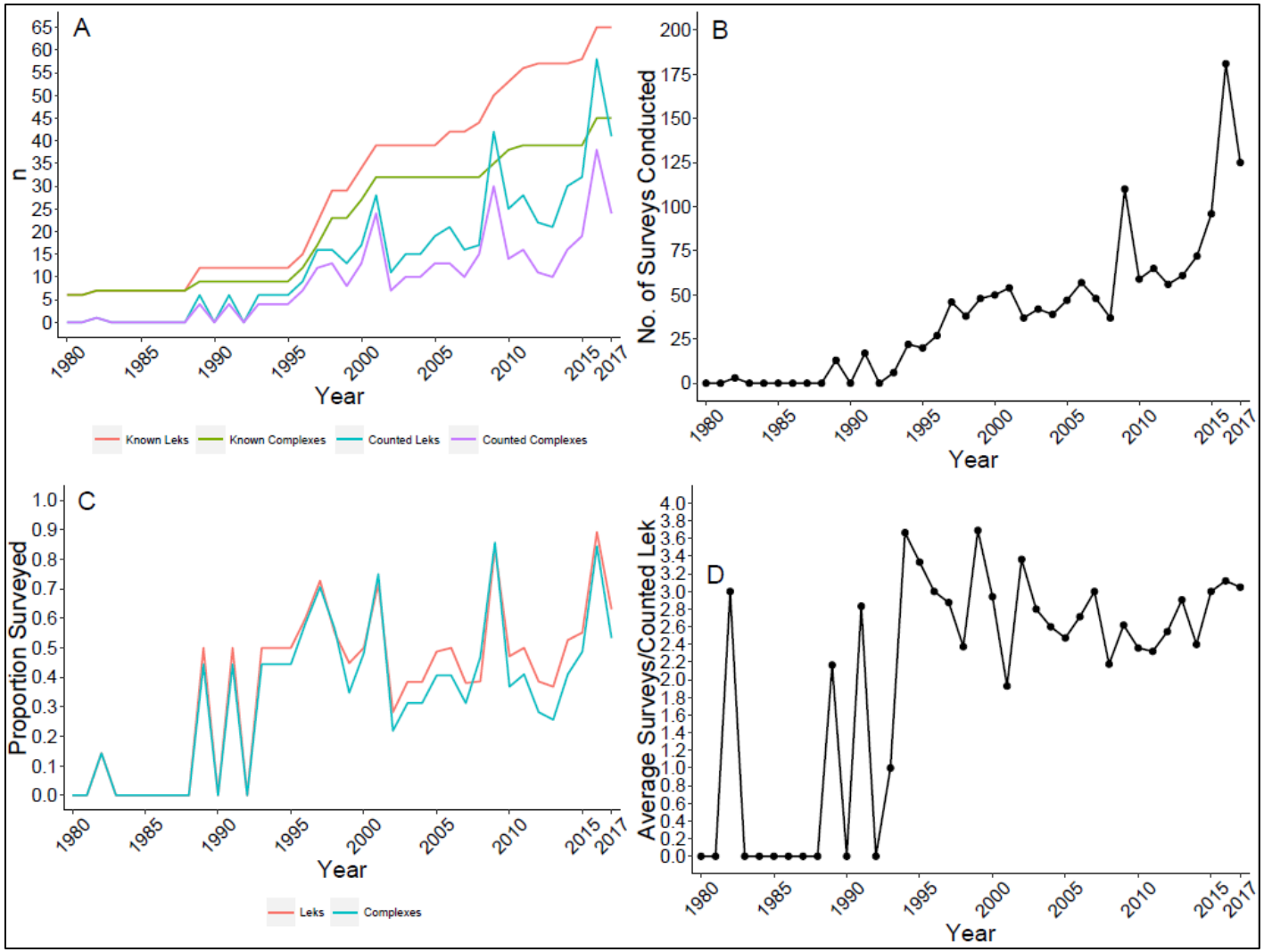


Figure A1.2. **Baker PAC** greater sage-grouse survey effort statistics, 1980 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

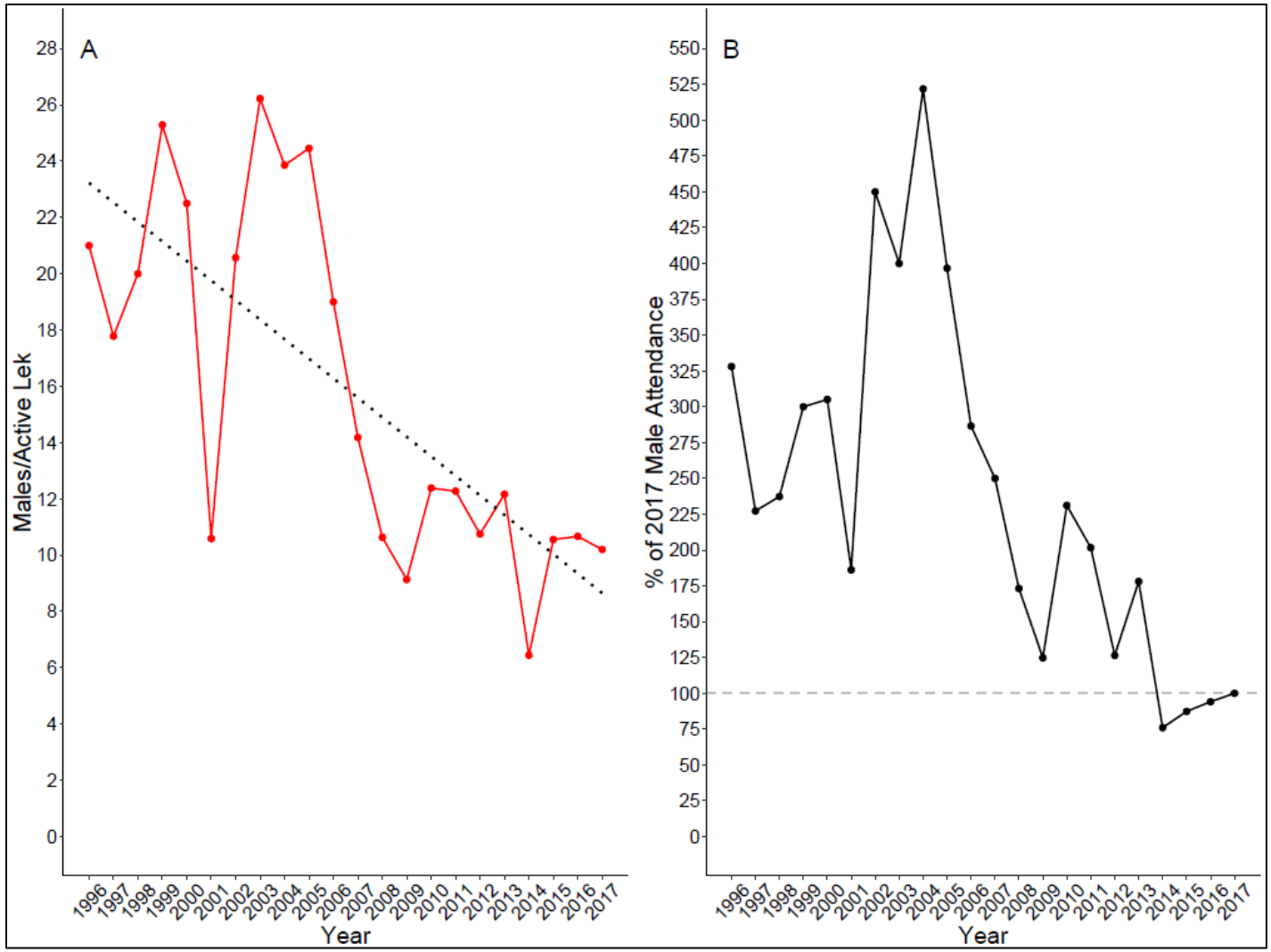


Figure A1.3. Greater sage-grouse population trend in the **Baker PAC**, 1996 – 2017. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2017 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2017.

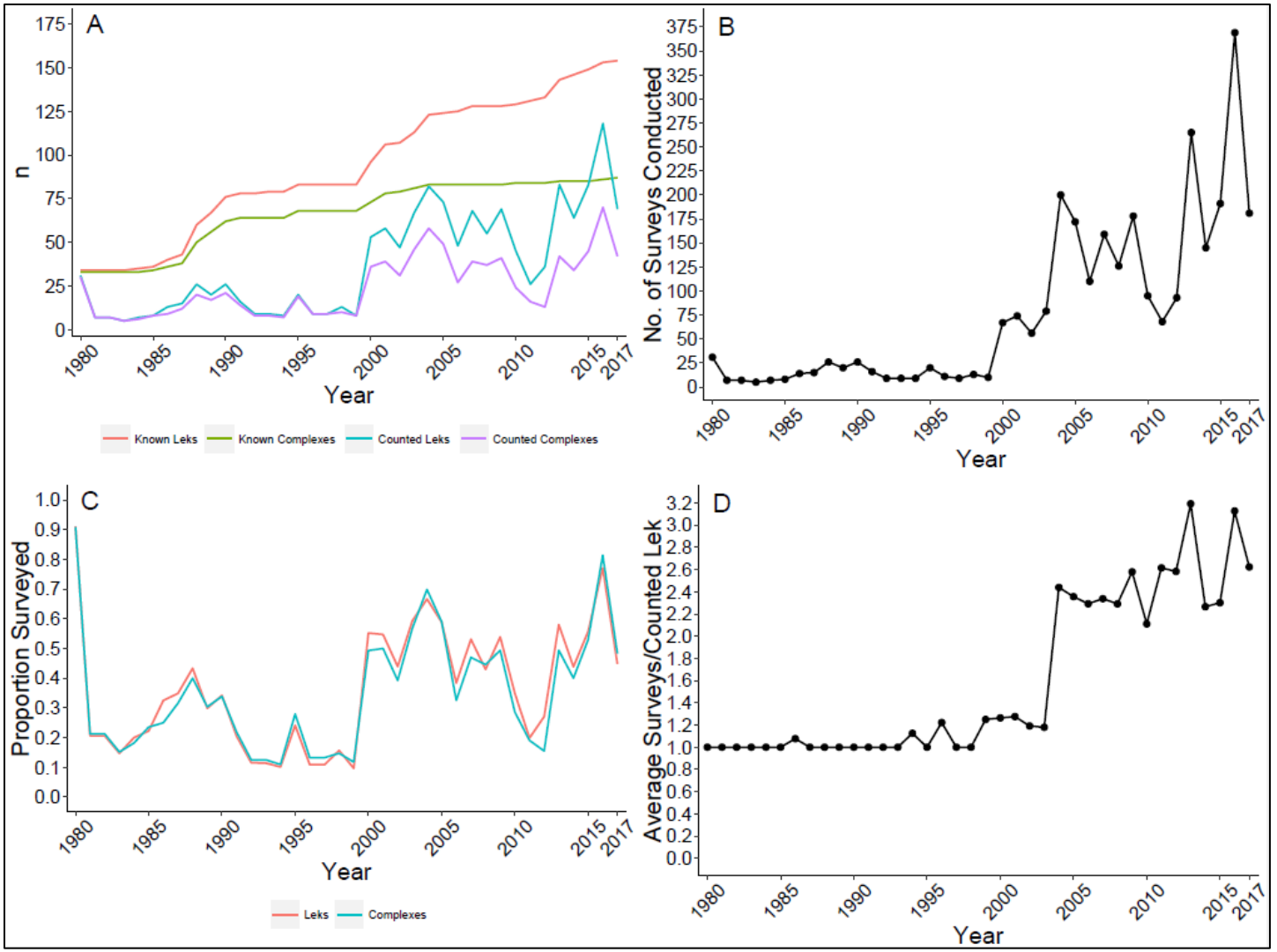


Figure A1.4. **Beatys PAC** greater sage-grouse survey effort statistics, 1980 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

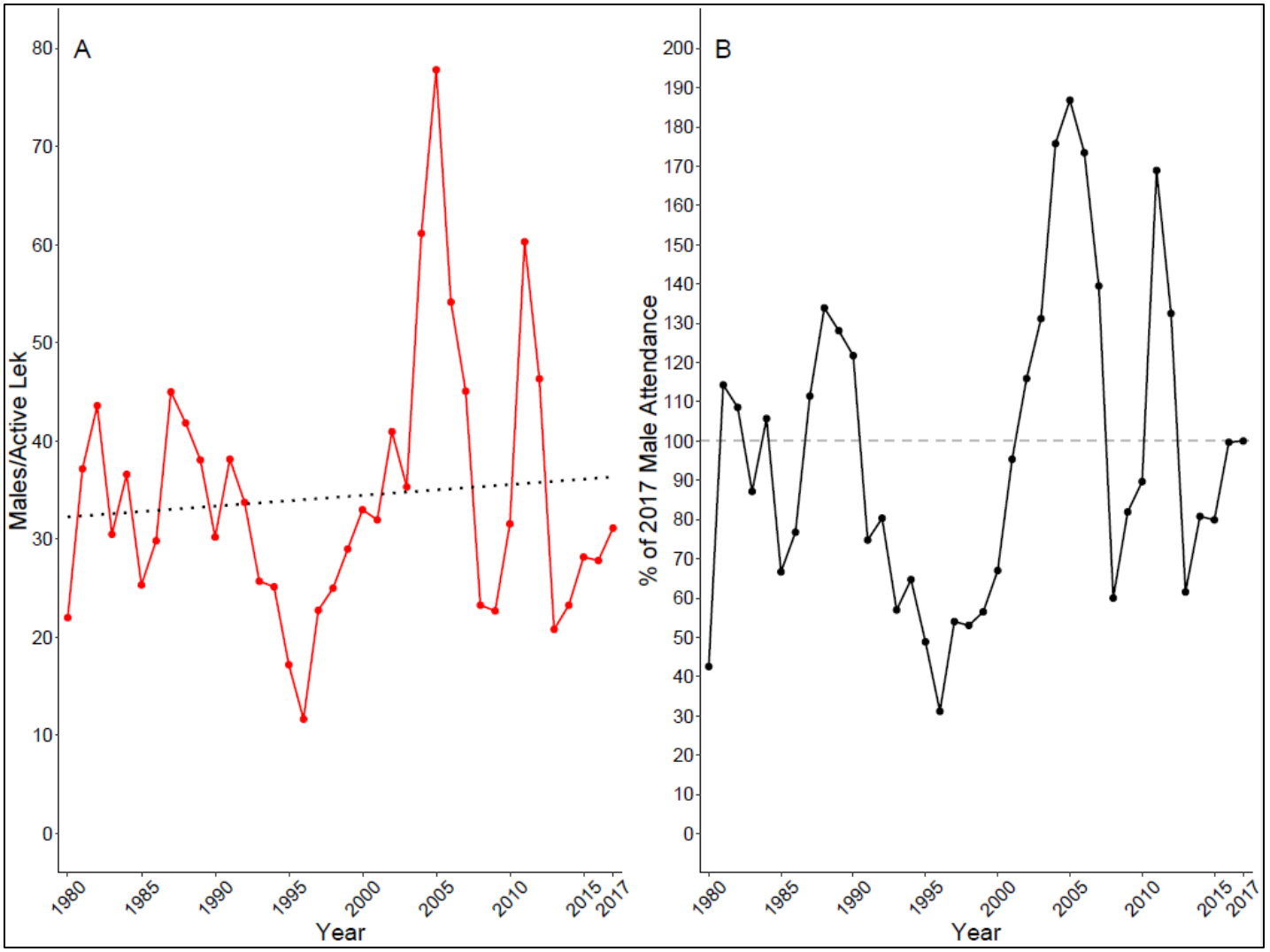


Figure A1.5. Greater sage-grouse population trend in the **Beatys PAC**, 1980 – 2017. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2017 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2017.

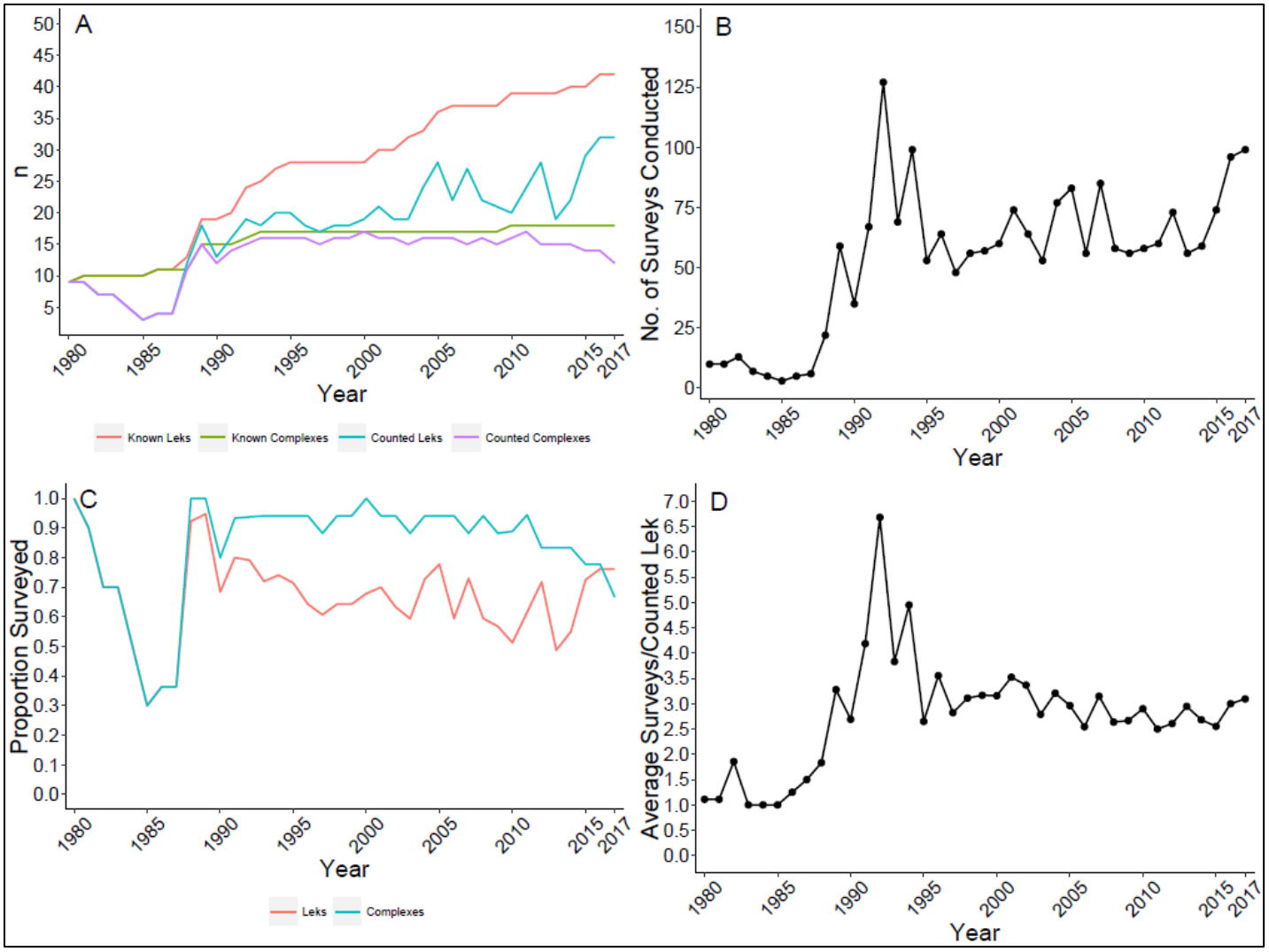


Figure A1.6. **Brothers/N. Wagontire PAC** greater sage-grouse survey effort statistics, 1980 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

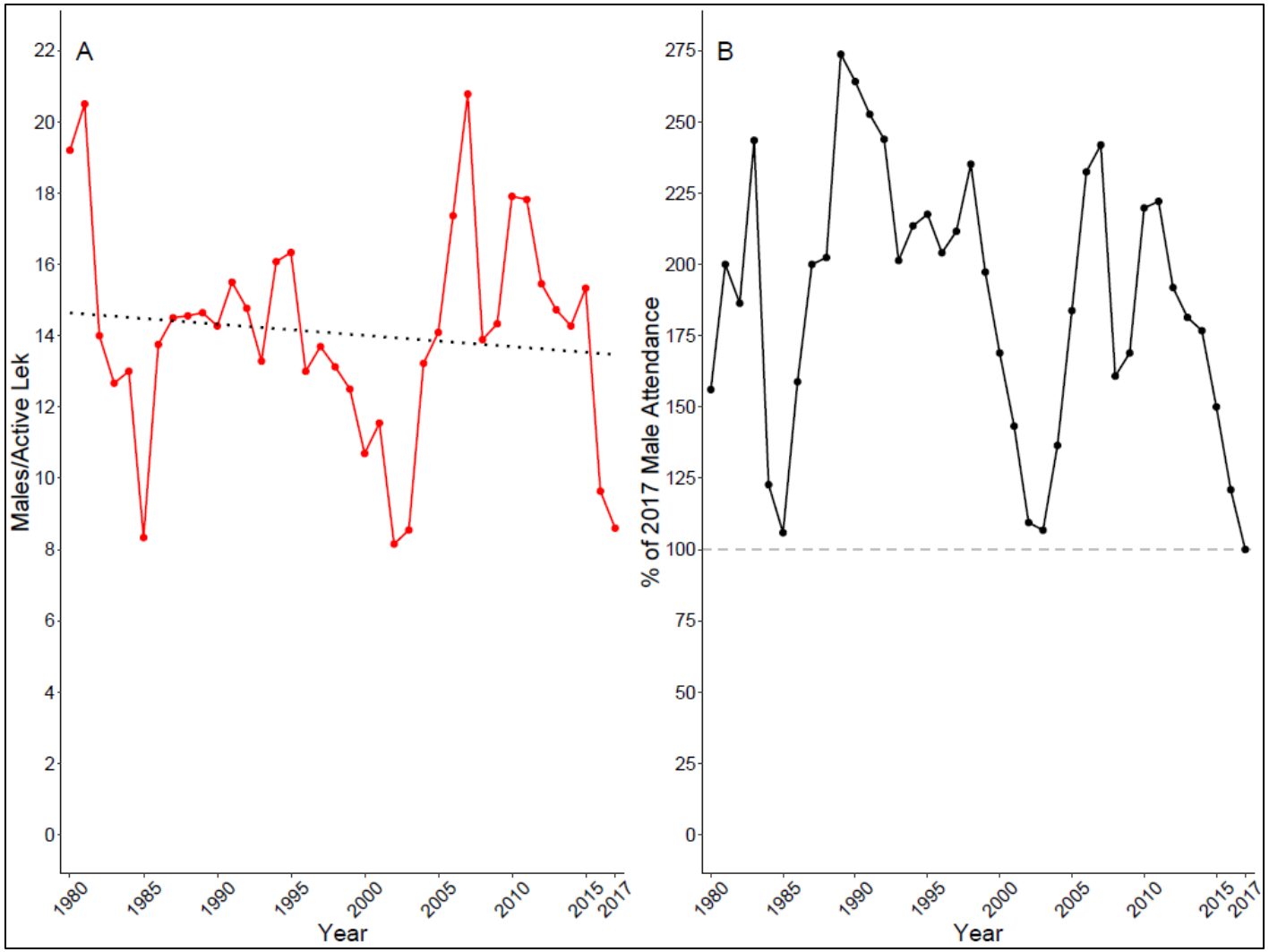


Figure A1.7. Greater sage-grouse population trend in the **Brothers/N. Wagontire PAC**, 1980 – 2017. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2017 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2017.

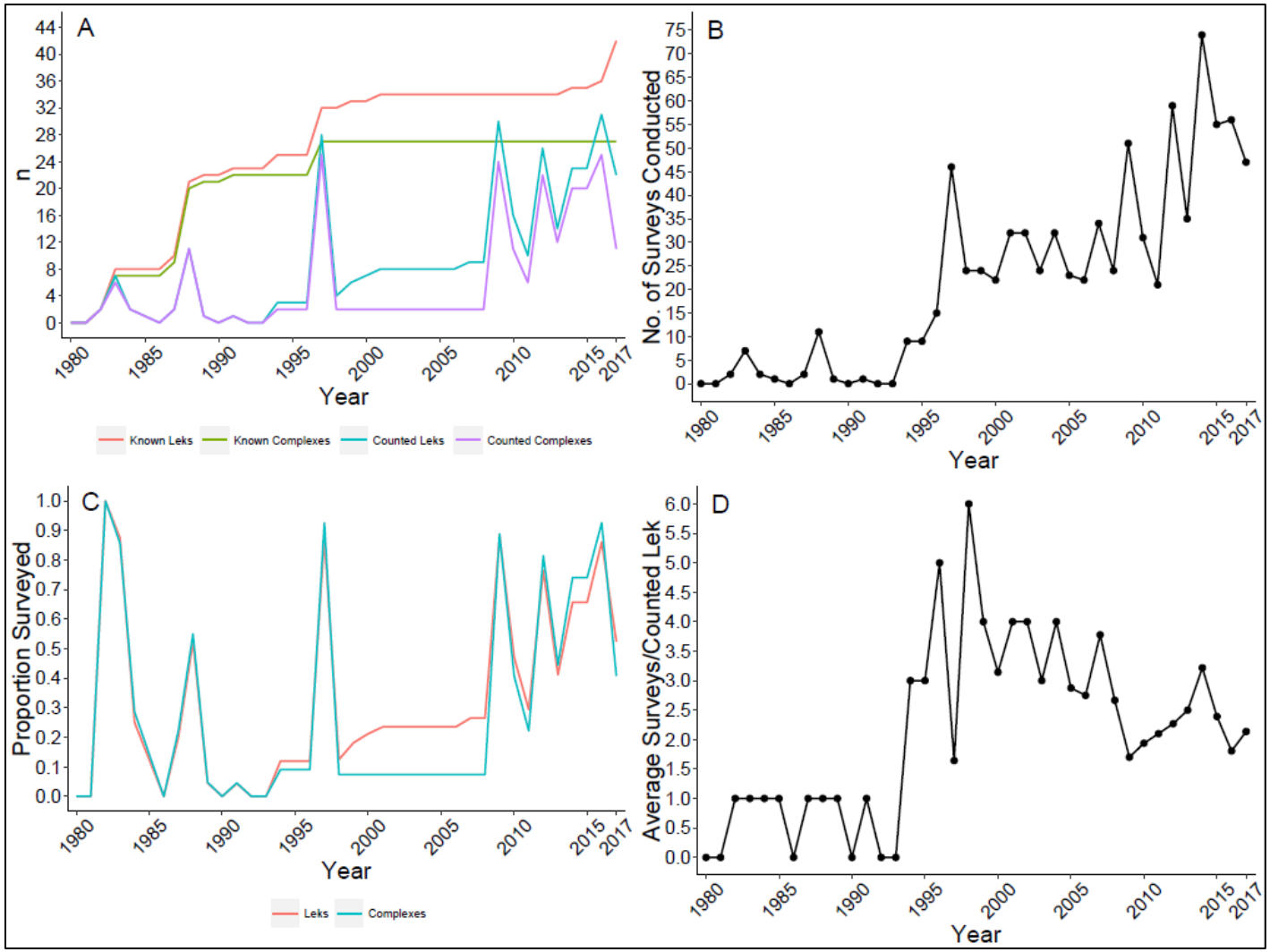


Figure A1.8. **Bully Creek PAC** greater sage-grouse survey effort statistics, 1980 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

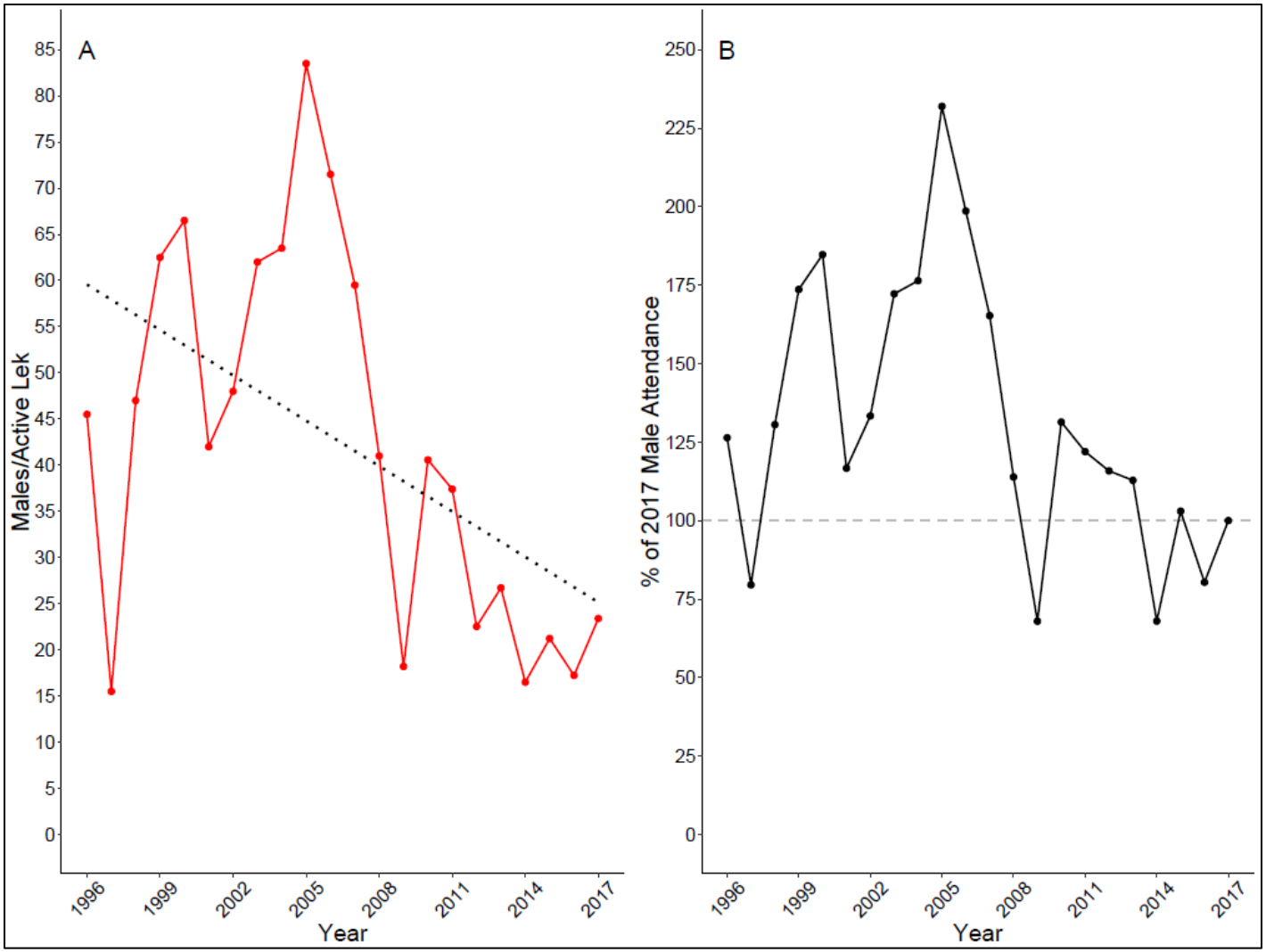


Figure A1.9. Greater sage-grouse population trend in the **Bully Creek PAC**, 1996 – 2017. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2017 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2017.

Burns PAC

The Burns PAC is situated in northern Harney County, and is entirely contained within the Burns BLM District (Figure A1.1). Only three leks, comprising two complexes are known to exist or have existed in the PAC (Table A1.1). During the delineation of core areas in Oregon, generally small polygons such as the Burns PAC were grouped with larger polygons and considered a single core area. However the Burns PAC was not in proximity to any larger core area polygons and thus maintained as a separate PAC. Surveys were first recorded for leks within the PAC in in 1981, however surveys did not consistently occur in the PAC until 2013 (Figure A1.10).

Cow Lakes PAC

The Cow Lakes PAC is situated in eastern Malheur County, and is entirely contained within the Vale BLM District (Figure A1.1). Fifty-five leks, comprising 36 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1947, however surveys did not consistently occur at a significant portion of leks within the PAC until 1993 (Figure A1.12).

Cow Valley PAC

The Cow Valley PAC is situated in northern Malheur County, and southern Baker County, and is split between the Baker BLM Resource area and the remainder of the Vale District (Figure A1.1). Fifty-six leks, comprising 44 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1941, surveys have been conducted at leks within the PAC annually since 1997, although a significant portion of leks within the PAC were only consistently surveyed beginning in 2015 (Figure A1.14). The majority of the PAC is in private holding, and thus lek survey efforts in the PAC have often been limited by land access issues. Population trend information is presented for the Cow Valley PAC from 1997 – 2017 (Figure A1.15), however caution should be employed when interpreting this information due to the low proportion of leks consistently surveyed prior to 2015.

Crowley PAC

The Crowley PAC is situated in central Malheur County, and is entirely contained within the Vale BLM District (Figure A1.1). Fifty leks, comprising 33 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1984, surveys have been conducted at leks within the PAC annually since 1991, although a significant portion of leks within the PAC were only consistently surveyed beginning in 2006 (Figure A1.16). Population trend information is presented for the Crowley PAC from 1994 – 2017 (Figure A1.17), however caution should be employed when interpreting this information due to the low proportion of leks consistently surveyed prior to 2006.

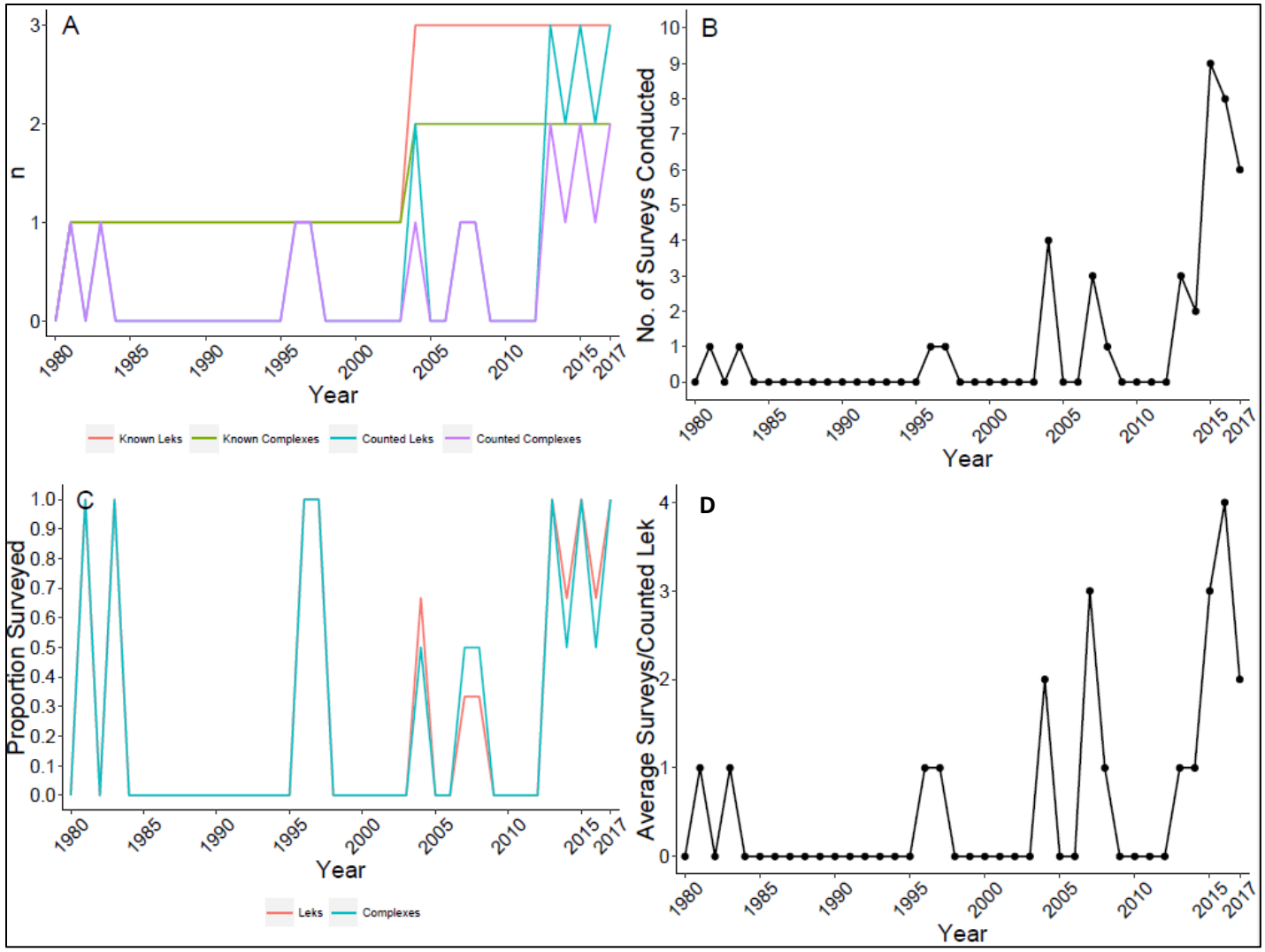


Figure A1.10. **Burns PAC** greater sage-grouse survey effort statistics, 1980 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

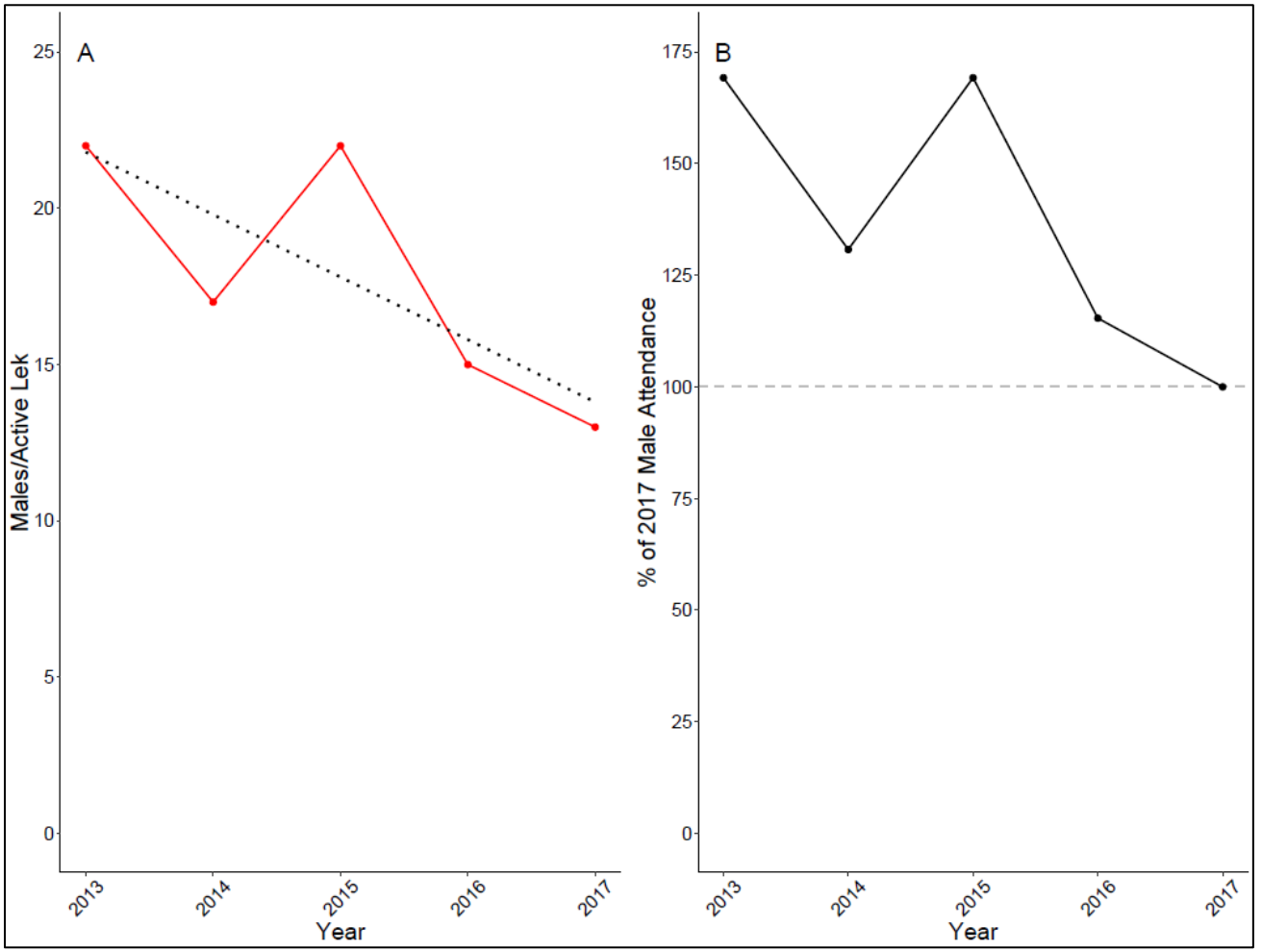


Figure A1.11. Greater sage-grouse population trend in the **Burns PAC**, 2013 – 2017. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2017 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2017.

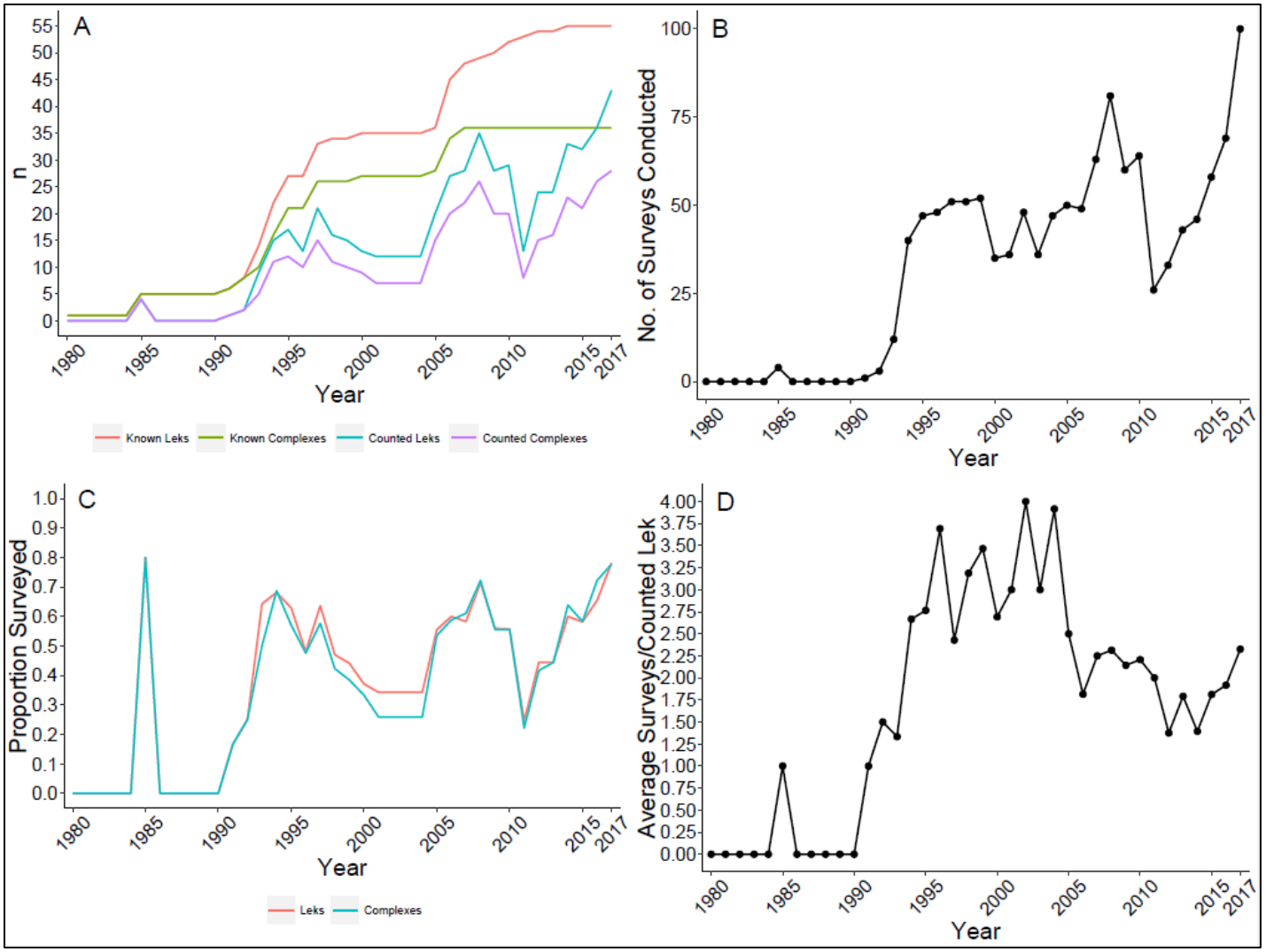


Figure A1.12. **Cow Lakes PAC** greater sage-grouse survey effort statistics, 1980 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

Figure A1.13. Greater sage-grouse population trend in the **Cow Lakes PAC**, 1993 – 2017. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2017 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2017.

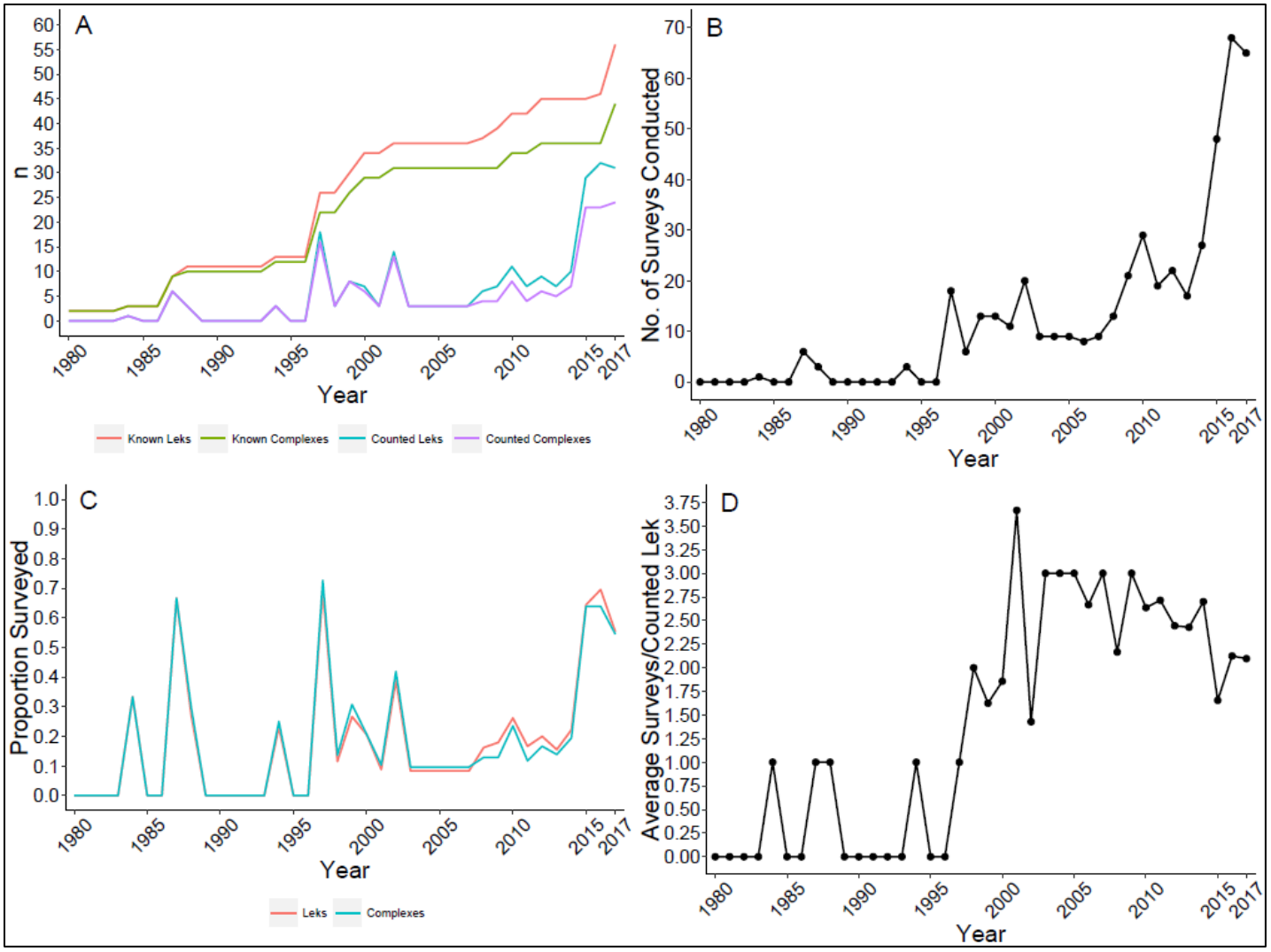


Figure A1.14. **Cow Valley PAC** greater sage-grouse survey effort statistics, 1980 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

Figure A1.15. Greater sage-grouse population trend in the **Cow Valley PAC**, 1997 – 2017. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2017 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2017.

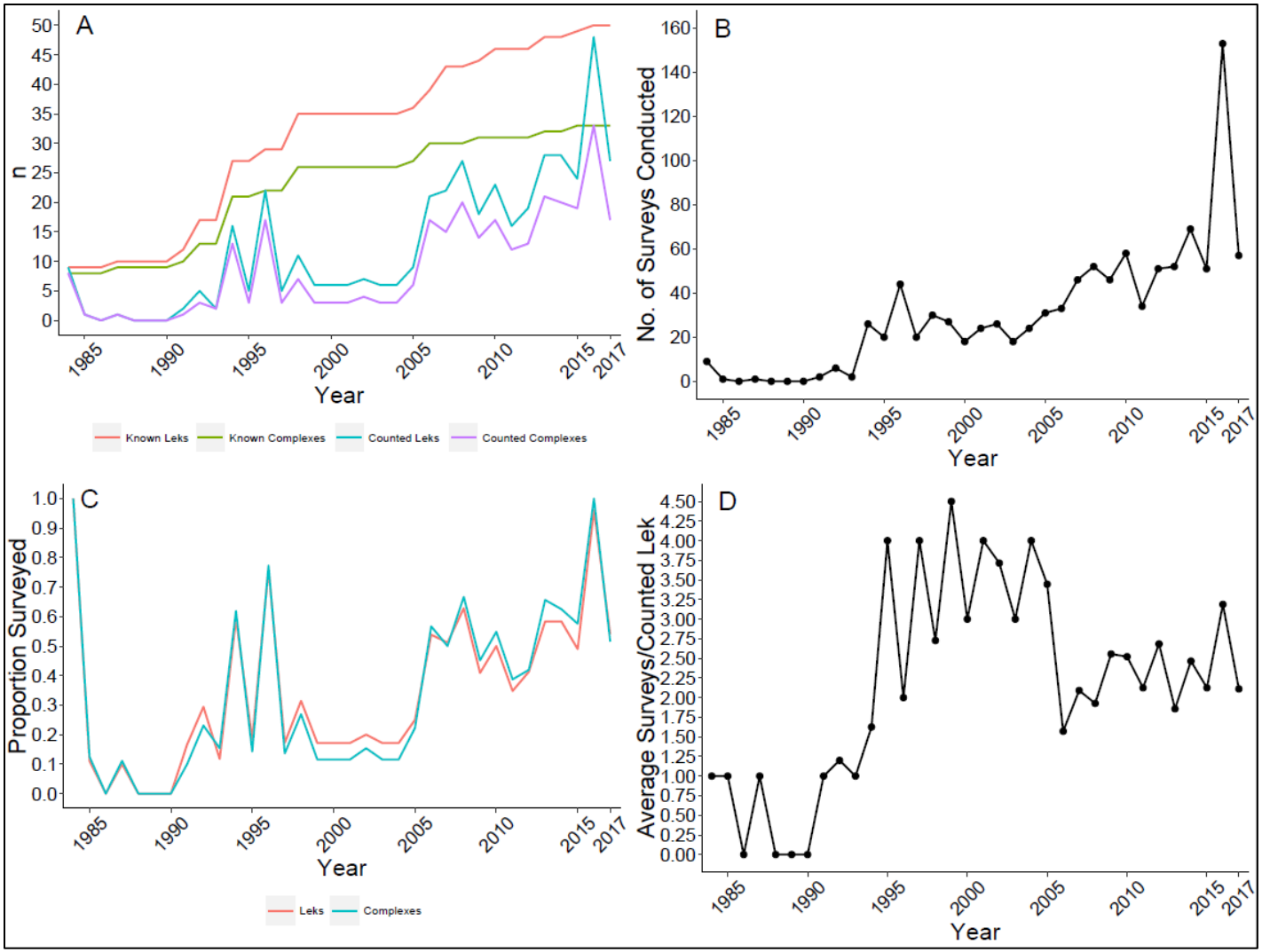


Figure A1.16. **Crowley PAC** greater sage-grouse survey effort statistics, 1980 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

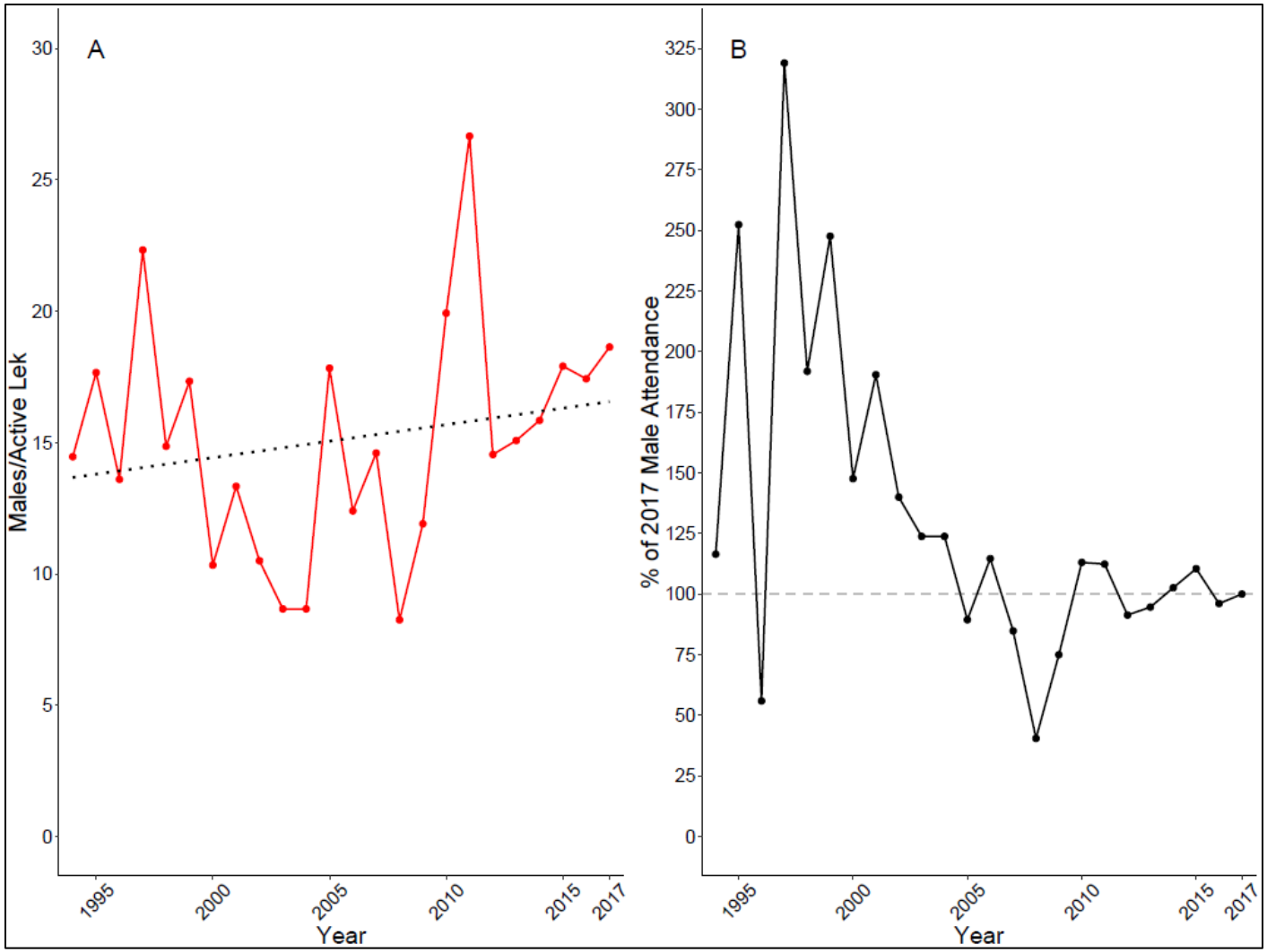


Figure A1.17. Greater sage-grouse population trend in the **Crowley PAC,** 1994 – 2017. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2017 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2017.

Drewsey PAC

The Drewsey PAC is situated in northwestern Harney County, with a small section extending into northeastern Malheur County, similarly the PAC is primarily contained within the Burns BLM District, although a small section does extend into the Vale BLM District (Figure A1.1). Forty-three leks, comprising 20 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1958, and leks have been surveyed annually in the PAC since 1981 (Figure A1.18). Population trend information is presented for the Drewsey PAC from 1997, when more than two complexes began to be surveyed annually, to 2017 (Figure A1.19), however a significant portion of leks within the PAC were only consistently surveyed beginning in 2009, thus caution should be employed when interpreting population trend information prior to 2009 for this PAC.

Dry Valley/Jack Mountain PAC

The Dry Valley/Jack Mountain PAC (often simply referred to as the Dry Valley PAC) is situated in central Harney County, and is split between the Burns and Lakeview BLM Districts (Figure A1.1). Twenty-six leks, comprising 18 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1970, and a significant portion of known leks within the PAC have been surveyed annually since 1981 (Figure A1.20), although knowledge of lek distribution in the PAC increased substantially following aerial lek searches conducted in 2003. The Dry Valley PAC was heavily impacted by the Miller Homestead Fire in 2012; many of the historically surveyed leks within the PAC burned over during that fire, likely contributing to the serious population decline observed in the PAC over time (Figure A1.21). Aerial lek searches will be conducted in the PAC in 2018, to determine whether the observed population decline is due to actual changes in the population within the PAC, shifts in lek distribution attributable to the fire, or a combination of the two factors.

Folly Farm/Saddle Butte PAC

The Folly Farm/Saddle Butte PAC (often simply referred to as the Folly Farm PAC) is situated in central Harney and Malheur Counties, and is similarly split between the Burns and Vale BLM Districts (Figure A1.1). Twenty leks, comprising 15 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1982, however until 2005 surveys were only consistently conducted at a single lek site (Figure A1.22). Survey effort in the PAC increased substantially in 2014, thus caution should be employed when interpreting population trend data for the PAC during the 2005 – 2013 period (Figure A1.23).

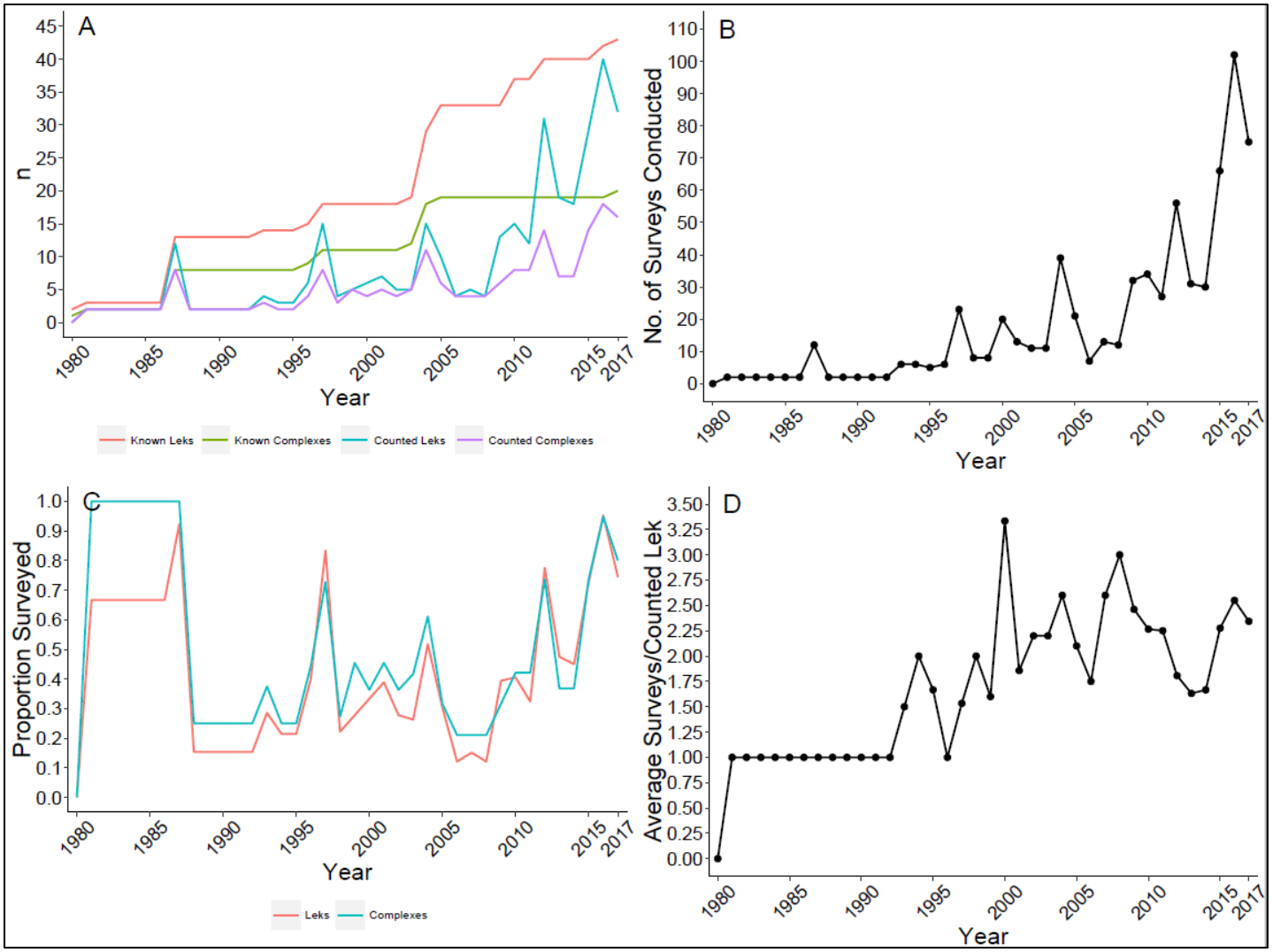


Figure A1.18. **Drewsey PAC** greater sage-grouse survey effort statistics, 1980 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

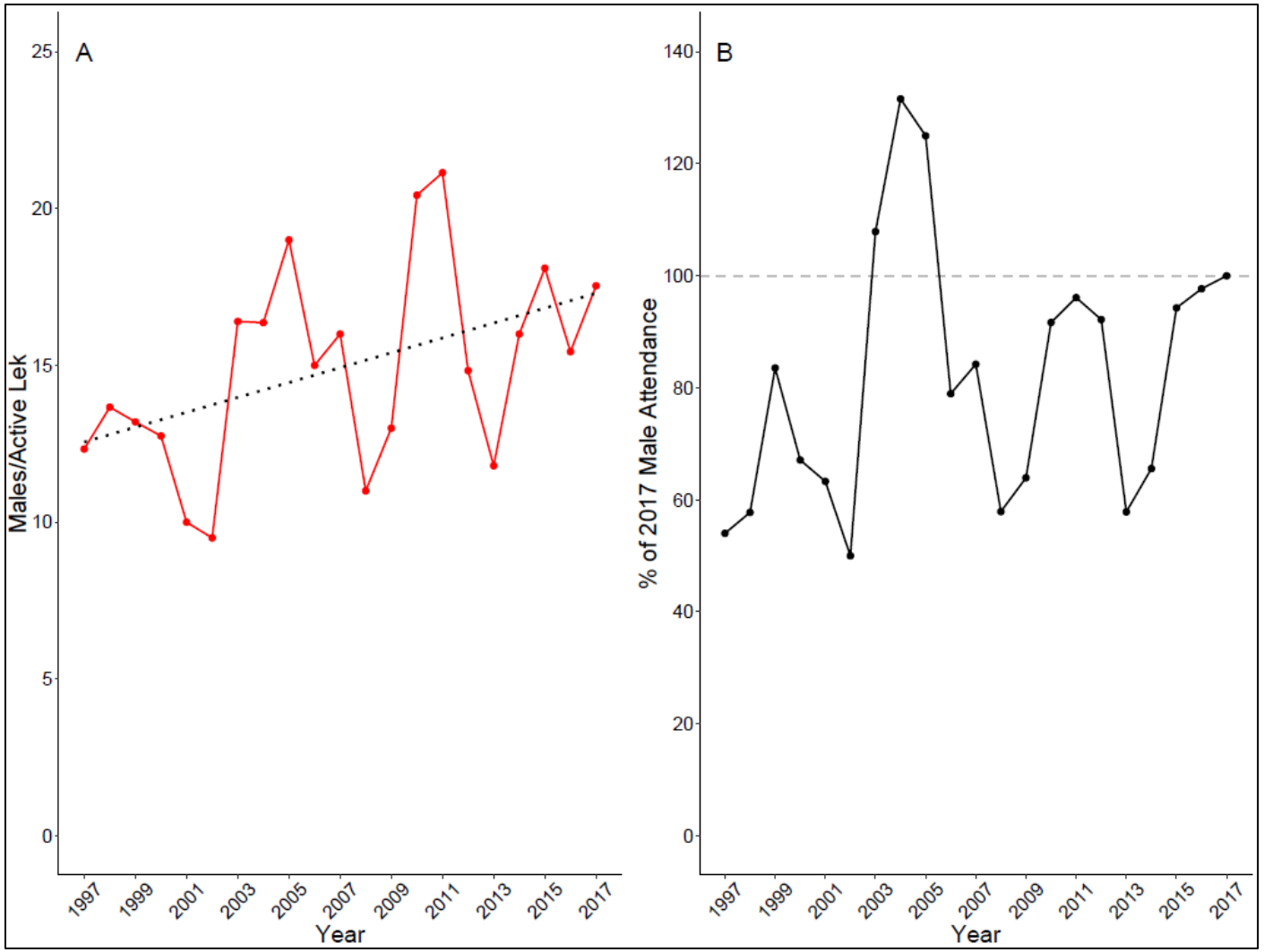


Figure A1.19. Greater sage-grouse population trend in the **Drewsey PAC**, 1997 – 2017. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2017 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2017.

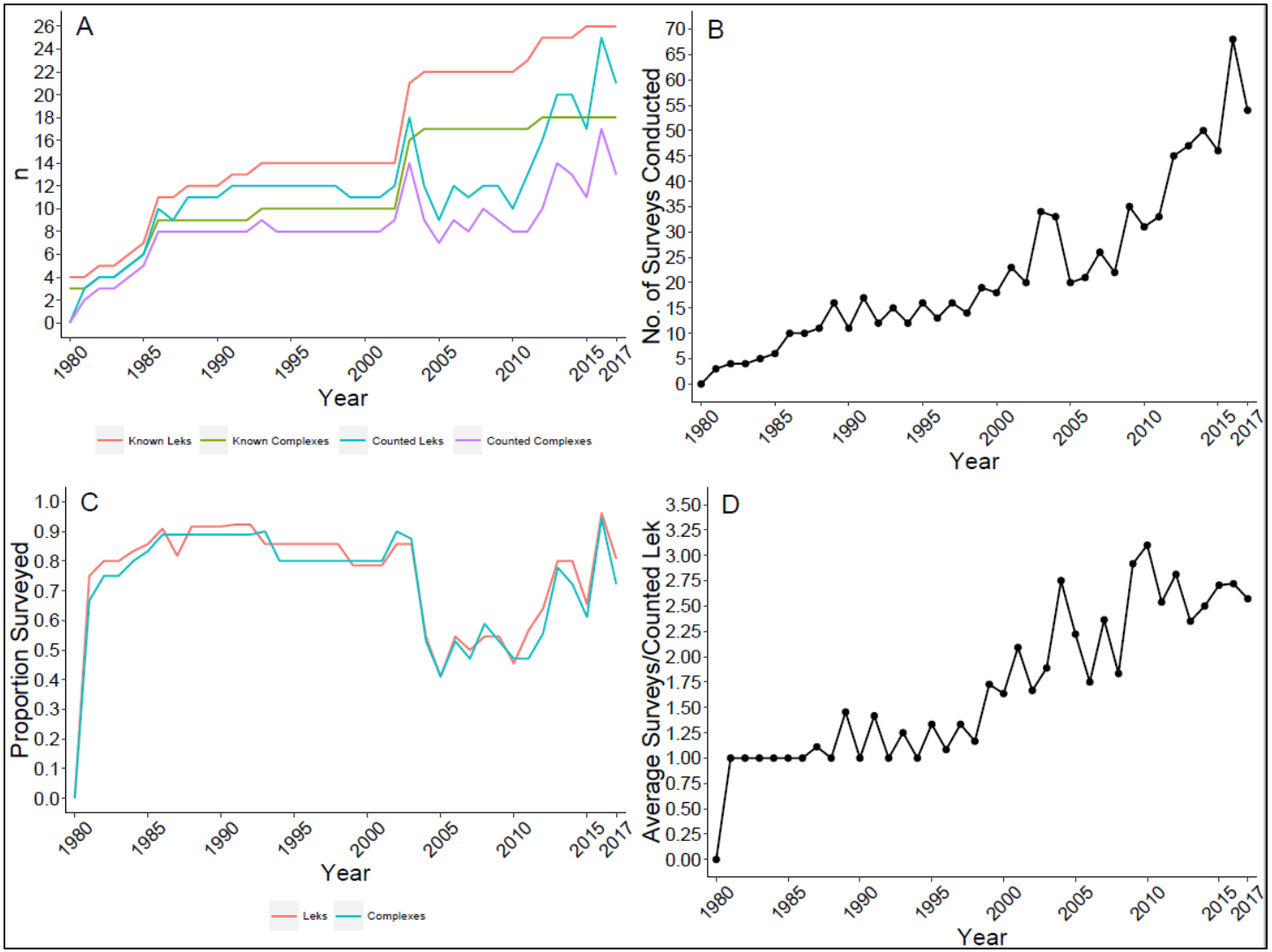


Figure A1.20. **Dry Valley/Jack Mountain PAC** greater sage-grouse survey effort statistics, 1980 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

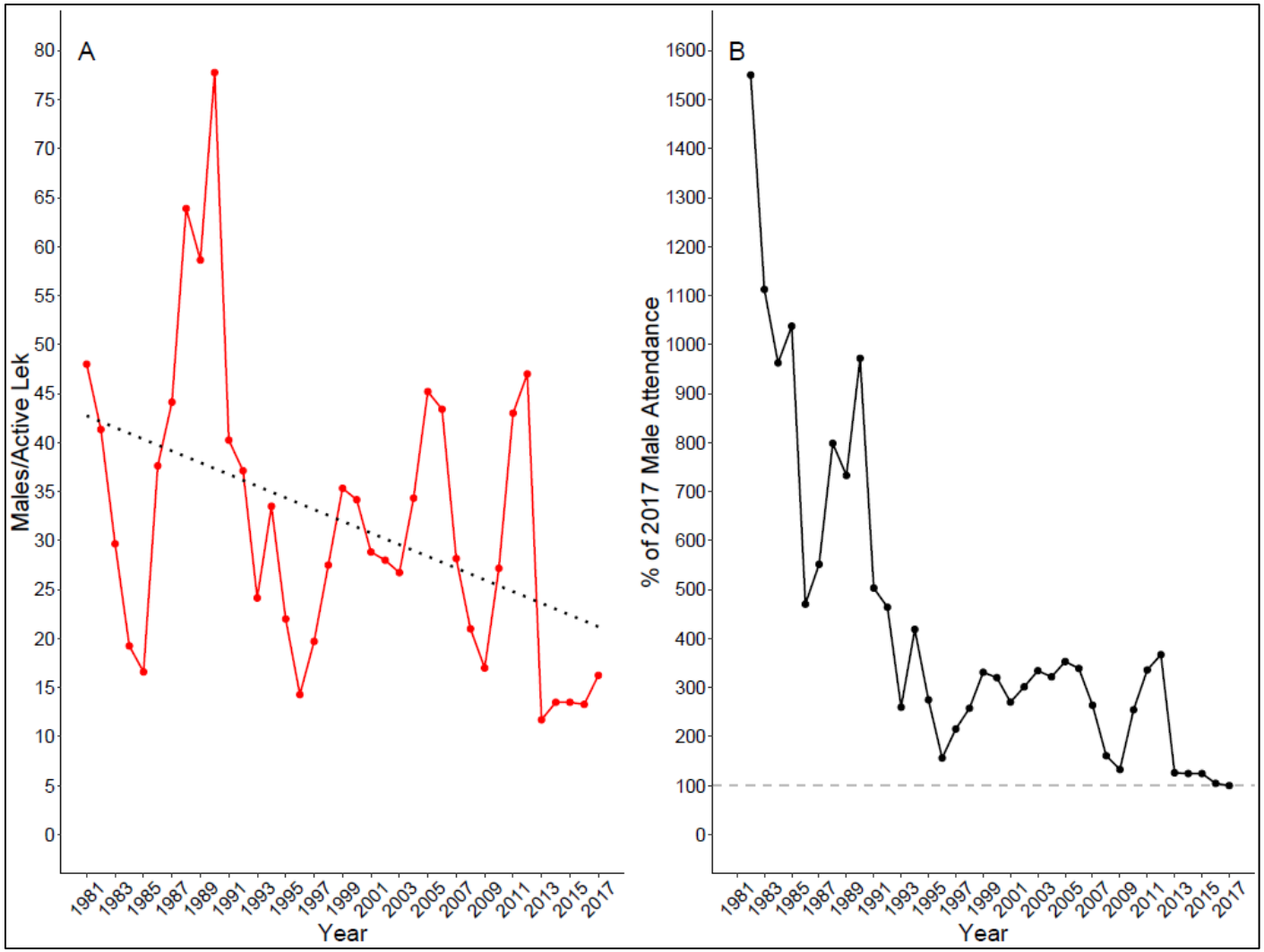


Figure A1.21. Greater sage-grouse population trend in the **Dry Valley/Jack Mountain PAC**, 1981 – 2017. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2017 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2017.

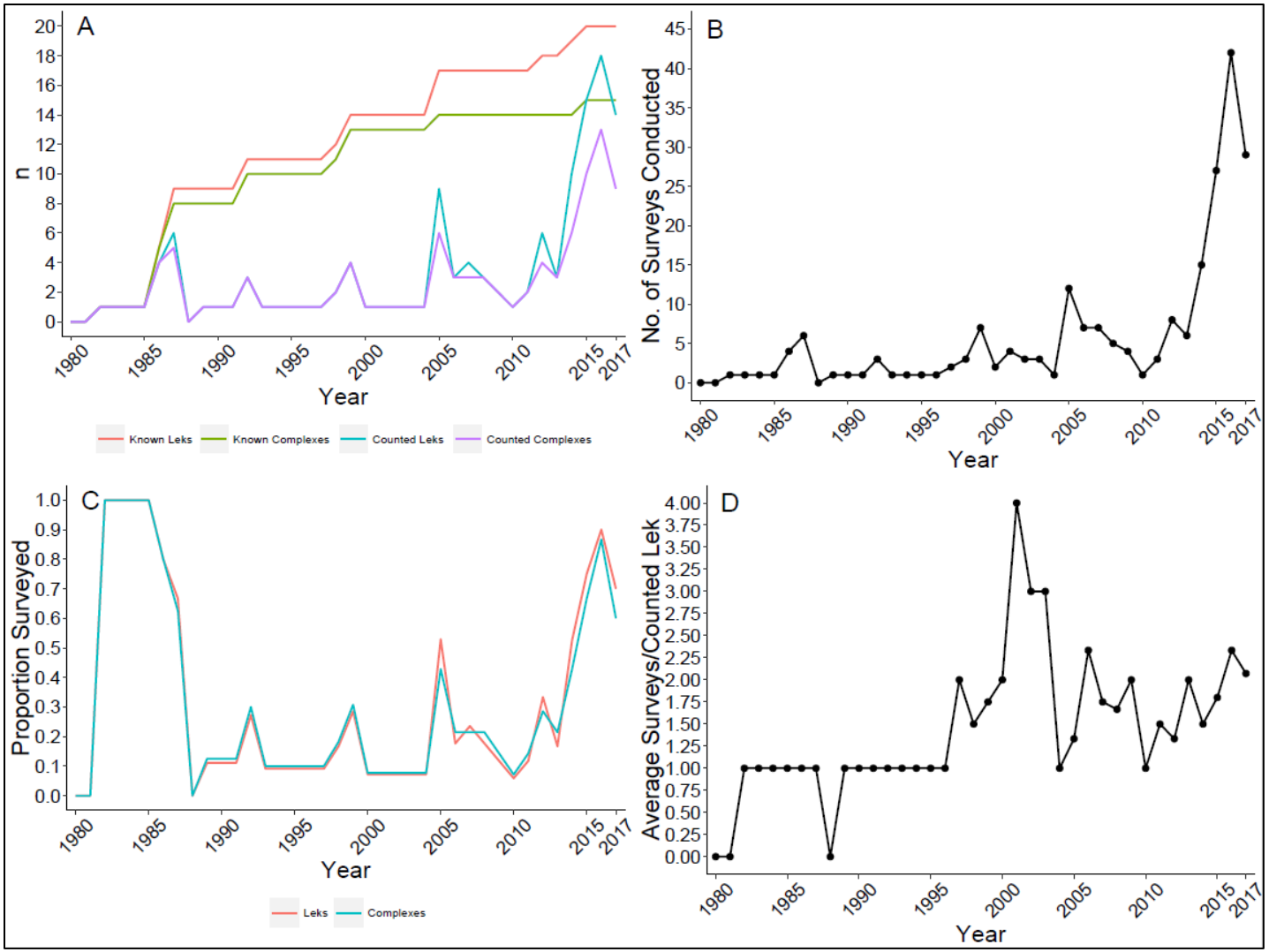


Figure A1.22. **Folly Farm/Saddle Butte PAC** greater sage-grouse survey effort statistics, 1980 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

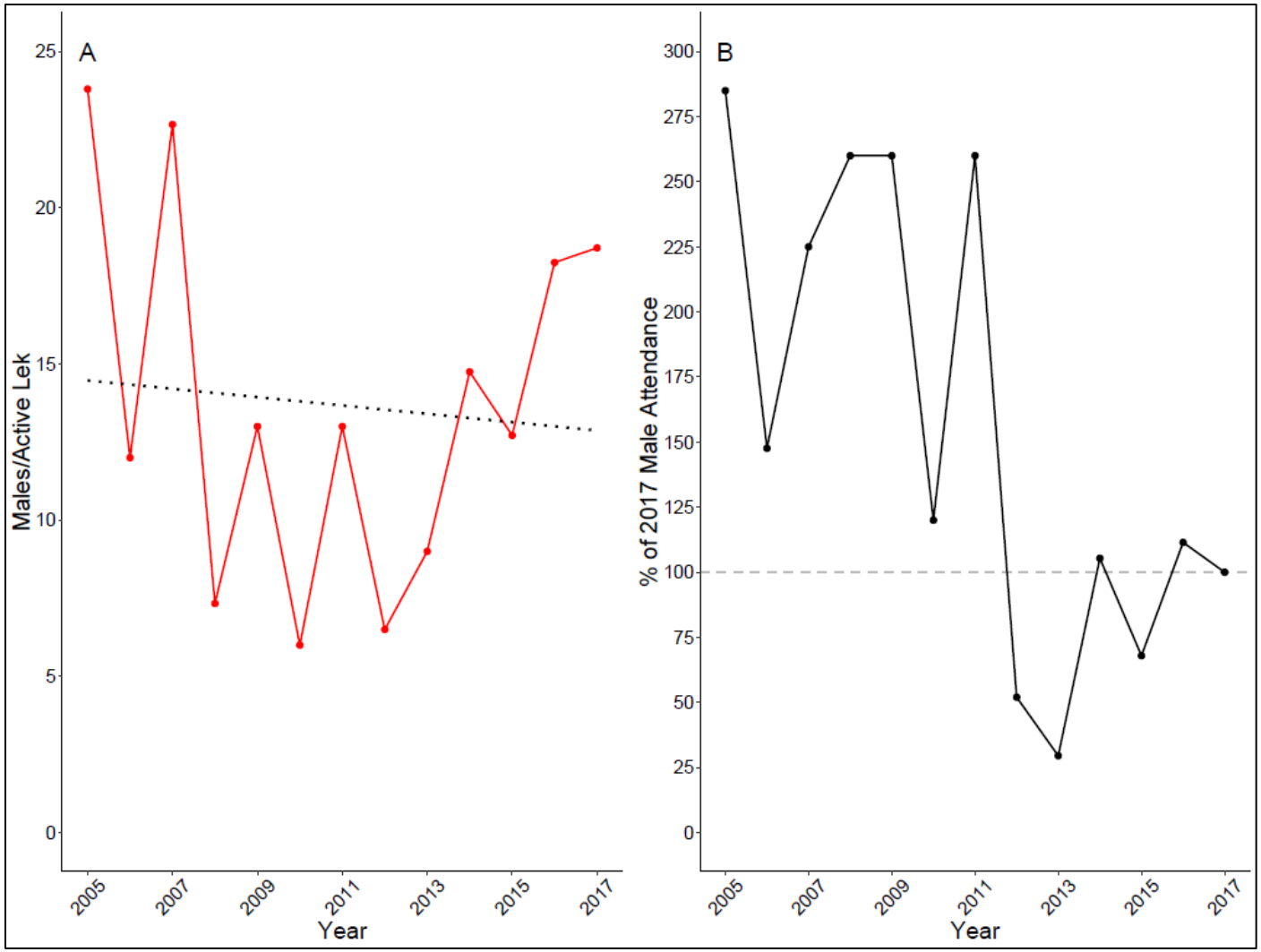


Figure A1.23. Greater sage-grouse population trend in the **Folly Farm/Saddle Butte PAC**, 2005 – 2017. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2017 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2017.

Louse Canyon PAC

The Louse Canyon PAC is situated in southeastern Malheur County, and completely contained within the Vale BLM District (Figure A1.1). Sixty leks, comprising 49 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1963, however annual surveys were not consistently conducted in the PAC until 2012 (Figure A1.24).

Paulina/12-Mile/Misery Flat PAC

The Paulina/12-Mile/Misery Flat PAC (often referred to simply as the Paulina PAC), is situated in eastern Crook County, with slivers extending into Grant, Harney, and Lake Counties; the PAC is almost entirely within the Prineville BLM District (Figure A1.1). Sixty leks, comprising 32 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1969, however surveys were not conducted consistently at a significant portion of leks within the PAC until 1988 (Figure A1.26).

Picture Rock PAC

The Picture Rock PAC is situated in central Lake County, and completely contained within the Lakeview BLM District (Figure A1.1). Seven leks, comprising 4 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1958, however annual surveys were not conducted consistently until 1981 (Figure A1.28).

Pueblo/S. Steens PAC

The Pueblo/S. Steens PAC (often referred to simply as the Pueblo PAC) is situated in southern Harney County, and is completely contained within the Burns BLM District (Figure A1.1). Thirty leks, comprising 19 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded at leks within the PAC in 1959. Surveys have been conducted annually within the PAC since 1996, however a significant portion of leks within the PAC were not surveyed consistently until 2015 (Figure A1.30). Population trend data is presented for the Pueblo PAC from 1996 – 2017 (Figure A1.31), however due to the low proportion of leks surveyed annually prior to 2015, caution should be taken when interpreting this information.

Soldier Creek PAC

The Soldier Creek PAC is situated in southeastern Malheur County, and is completely contained within the Vale BLM District (Figure A1.1). Forty-seven leks, comprising 32 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1972, and annual surveys have been conducted at leks within the PAC since 1991 (Figure A1.32). A significant proportion of known leks within the PAC were first surveyed in 1993, however from 1996 – 2005 only two complexes were consistently surveyed. Population trend data is presented for the Soldier Creek PAC from 1993 – 2017 (Figure A1.33), however due to the low proportion of leks surveyed annually prior to 2006, caution should be taken when interpreting this information.

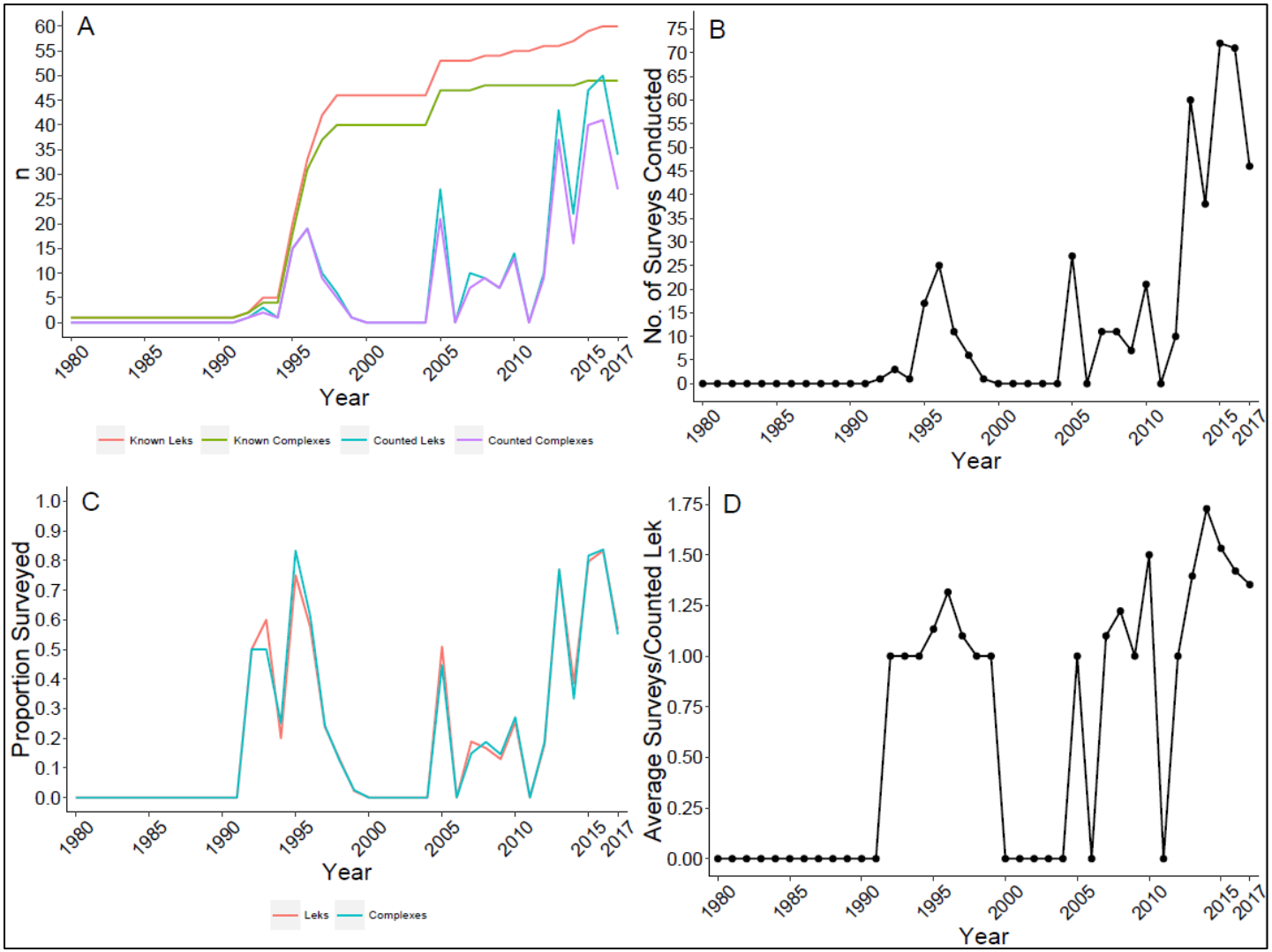


Figure A1.24. **Louse Canyon PAC** greater sage-grouse survey effort statistics, 1980 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

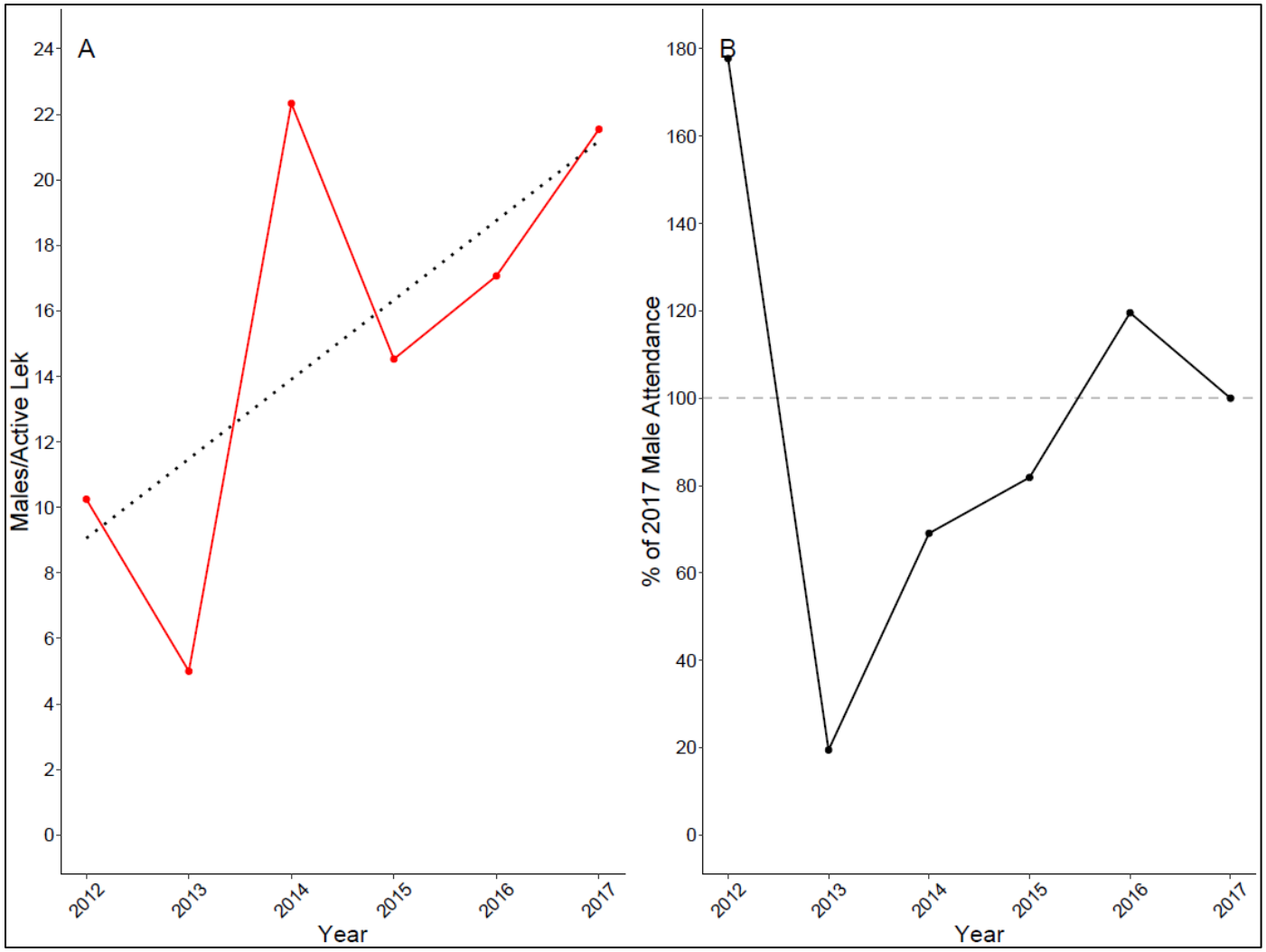


Figure A1.25. Greater sage-grouse population trend in the **Louse Canyon PAC**, 2012 – 2017. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2017 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2017.

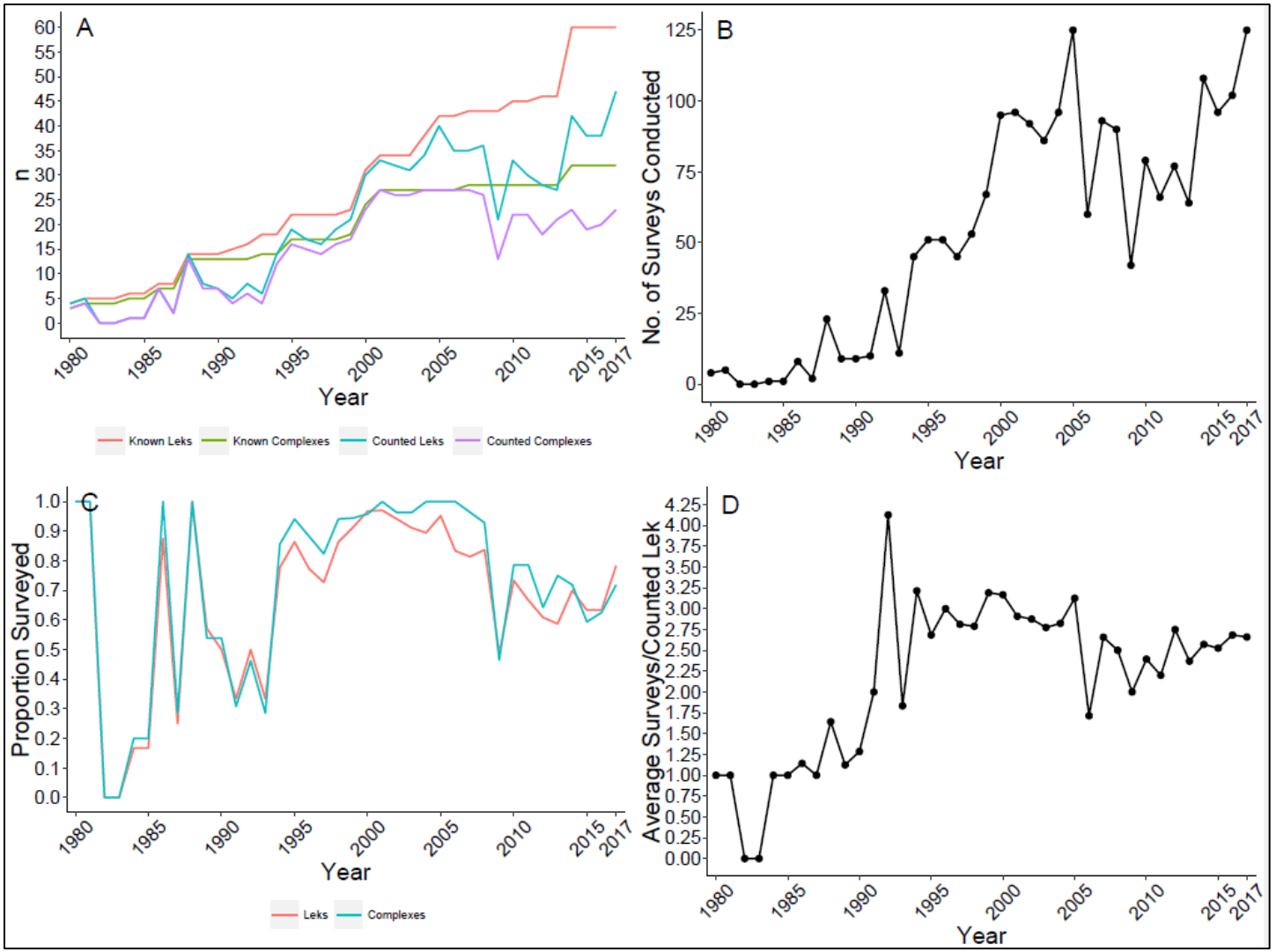


Figure A1.26. **Paulina/12-Mile/Misery Flat PAC** greater sage-grouse survey effort statistics, 1980 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

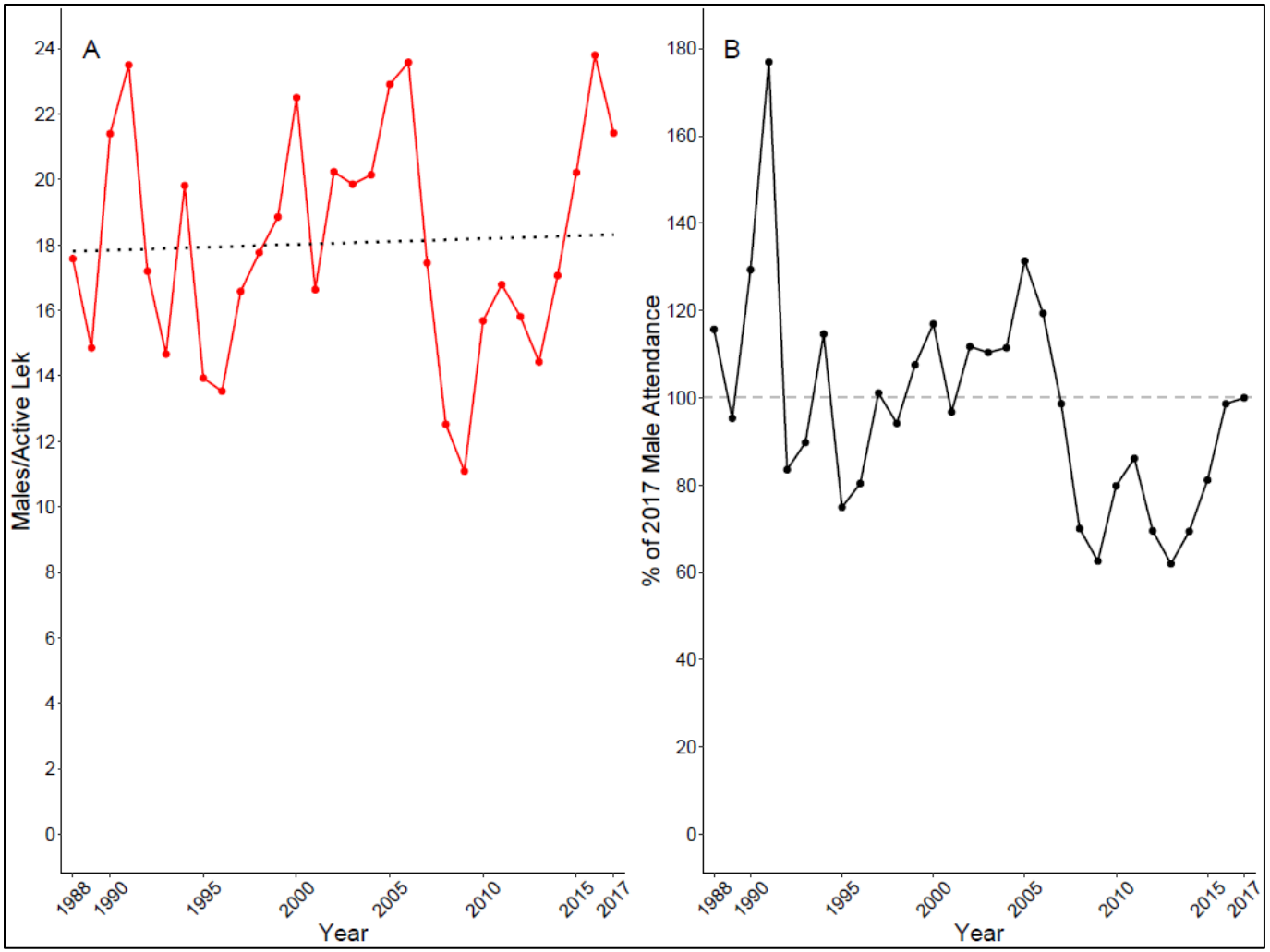


Figure A1.27. Greater sage-grouse population trend in the **Paulina/12-Mile/Misery Flat PAC**, 1988 – 2017. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2017 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2017.

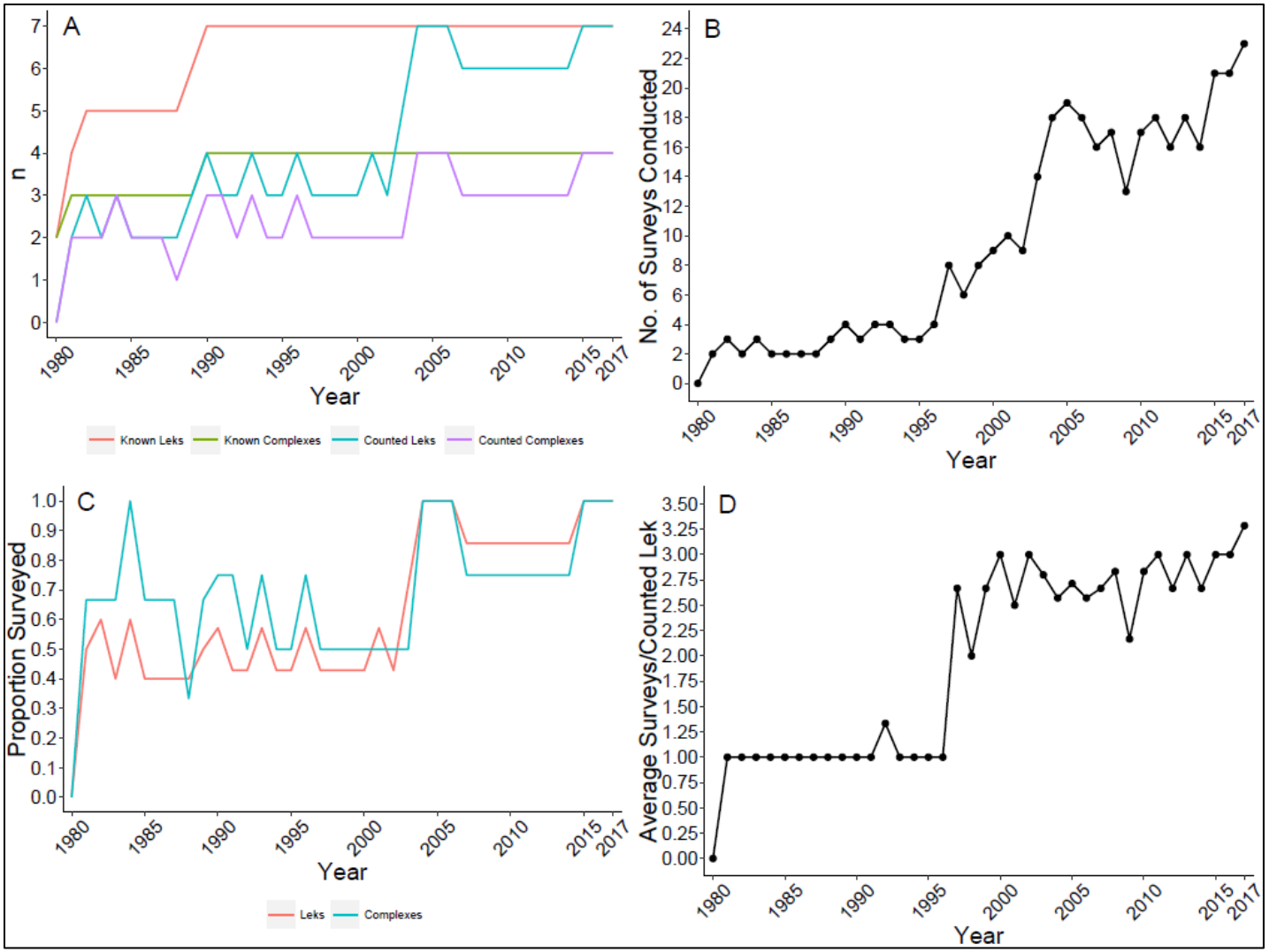


Figure A1.28. **Picture Rock PAC** greater sage-grouse survey effort statistics, 1980 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

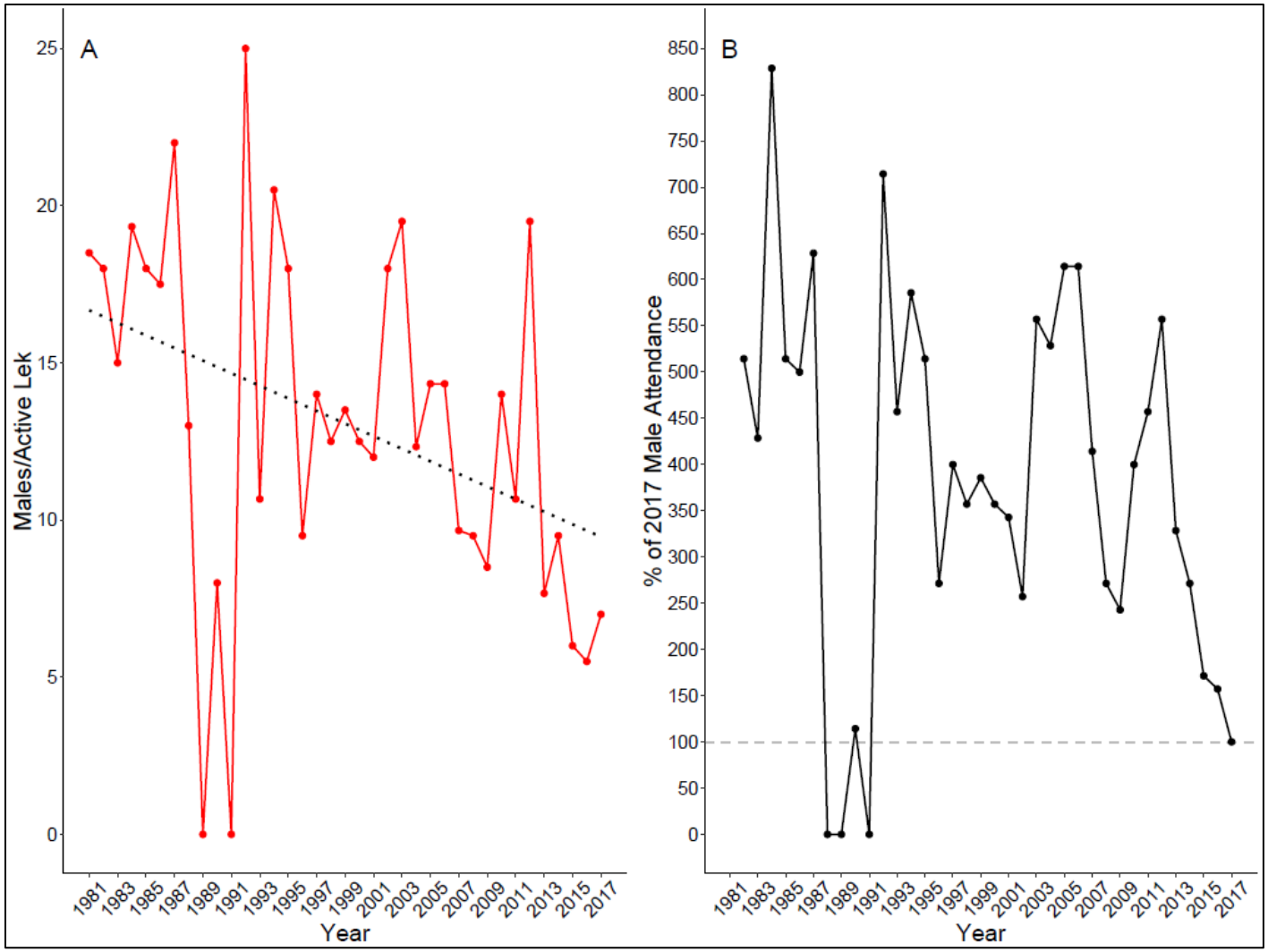


Figure A1.29. Greater sage-grouse population trend in the **Picture Rock PAC**, 1981 – 2017. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2017 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2017.

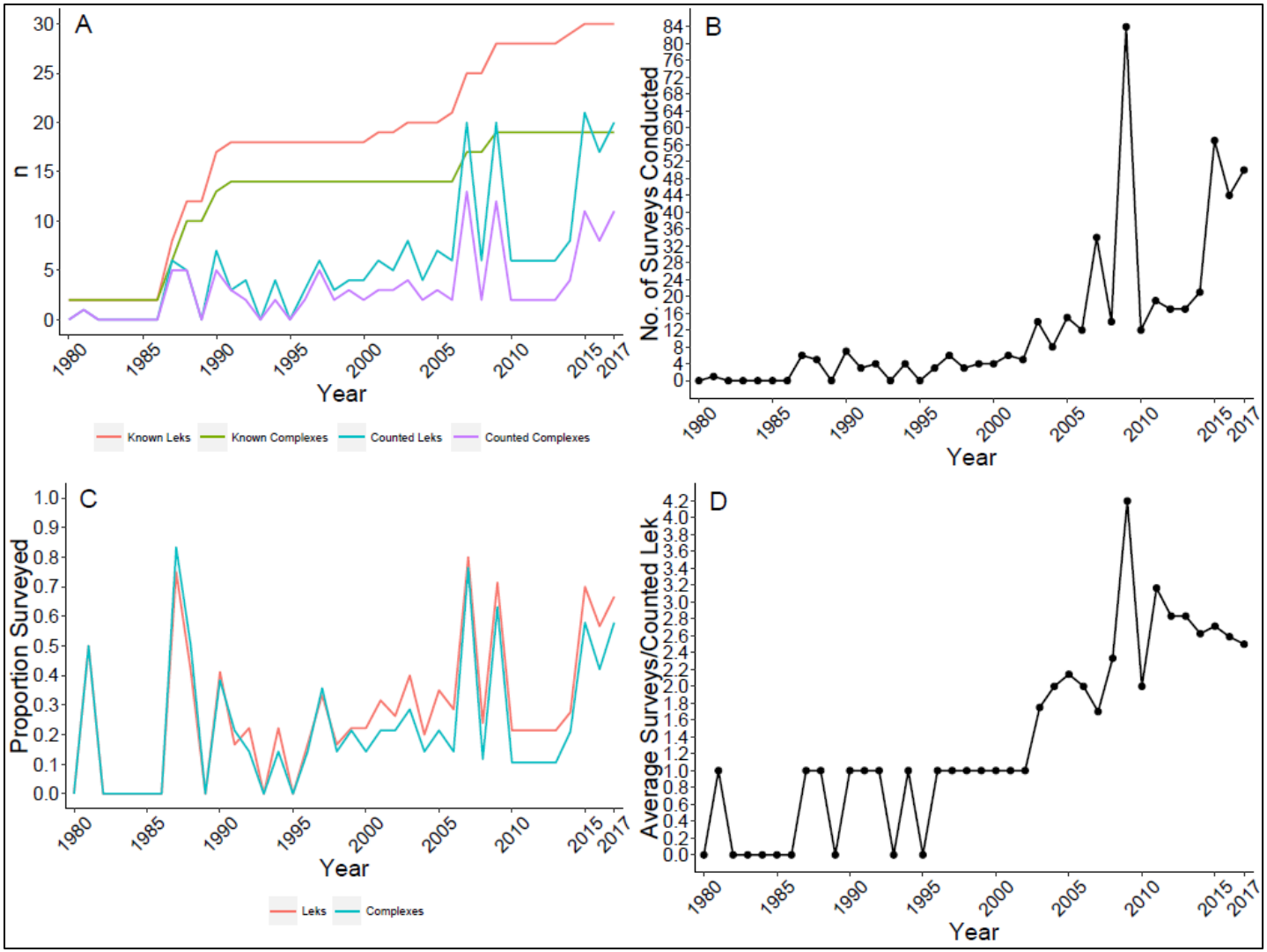


Figure A1.30. **Pueblos/S. Steens PAC** greater sage-grouse survey effort statistics, 1980 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

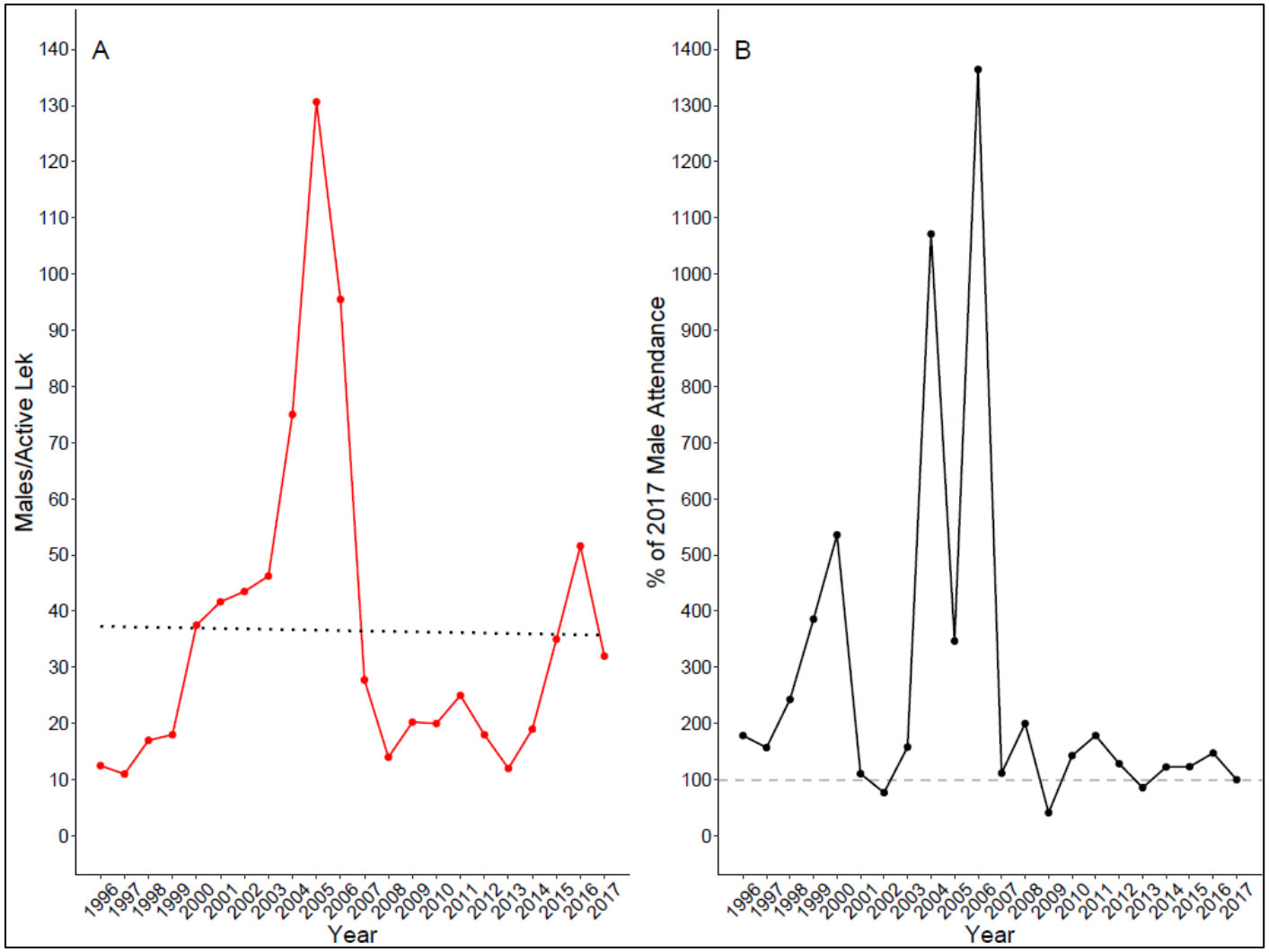


Figure A1.31. Greater sage-grouse population trend in the **Pueblos/S. Steens PAC**, 1996 – 2017. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2017 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2017.

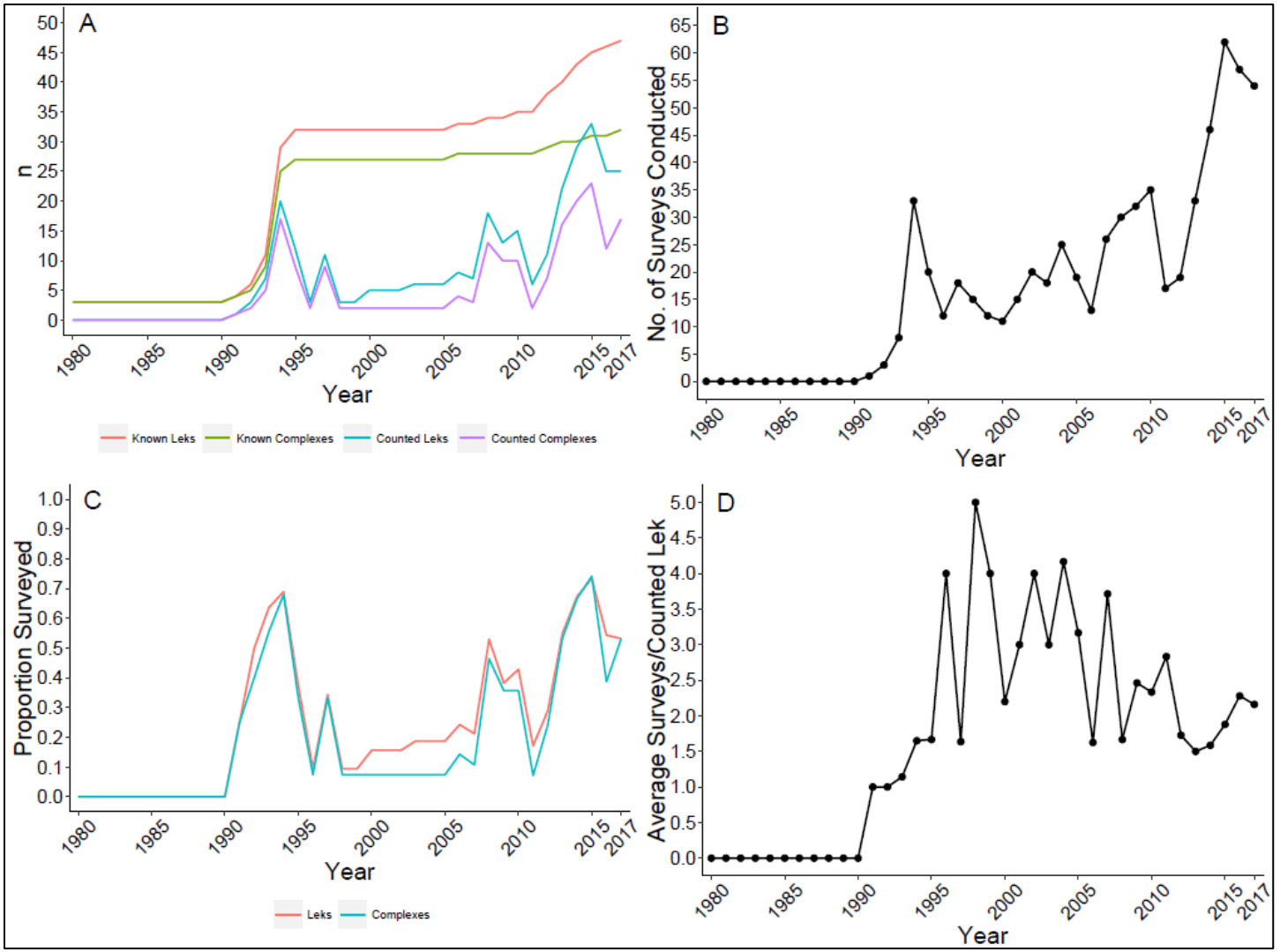


Figure A1.32. **Soldier Creek PAC** greater sage-grouse survey effort statistics, 1980 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

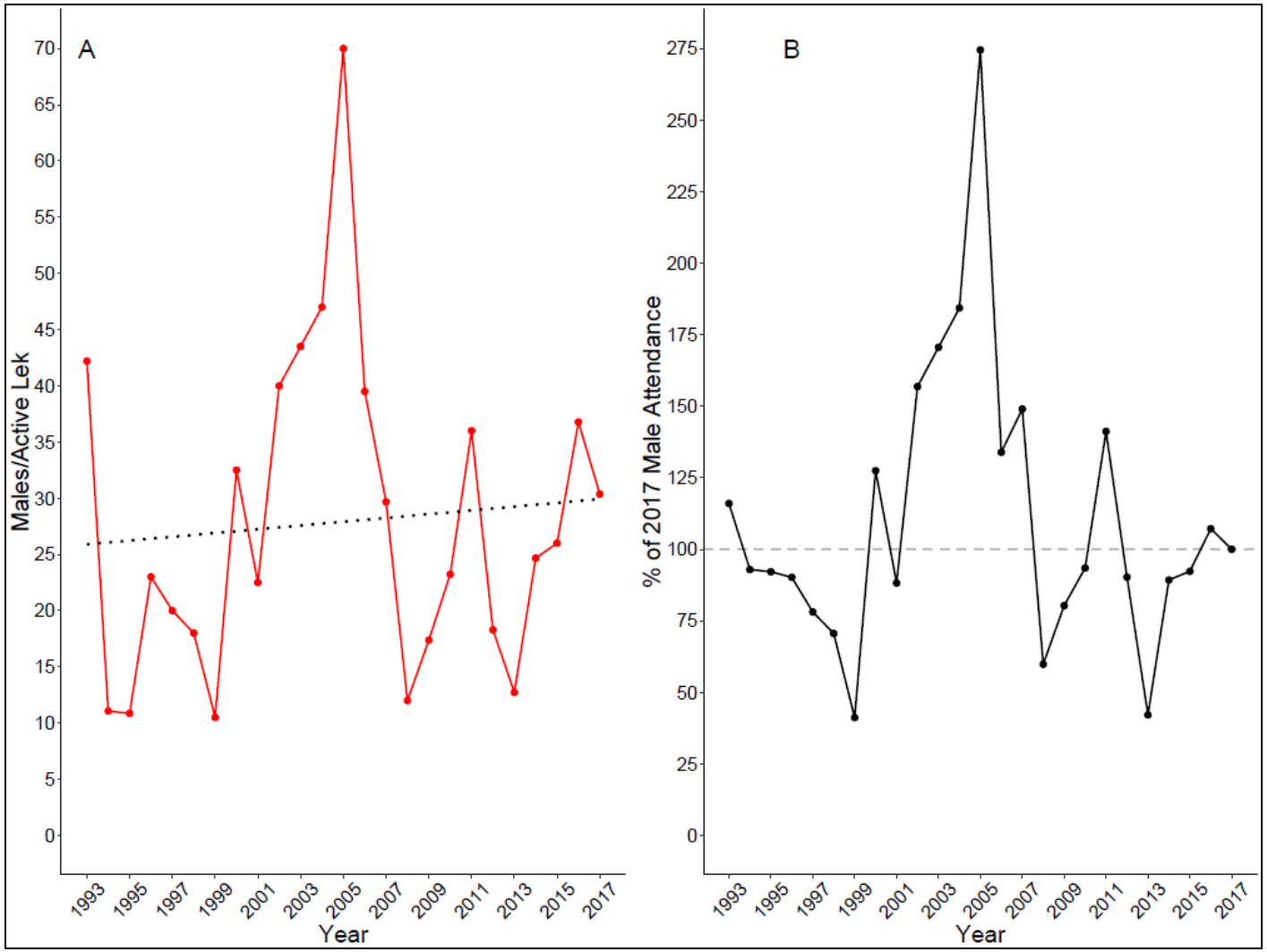


Figure A1.33. Greater sage-grouse population trend in the **Soldier Creek PAC**, 1993 – 2017. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2017 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2017.

Steens PAC

The Steens PAC is situated in central Harney County, and is entirely contained within the Burns BLM District (Figure A1.1). Fifteen leks, comprising 10 complexes are known to exist or have existed within the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1947, and annual lek surveys have been conducted in the PAC since 1981, however until 2005 only two complexes were consistently surveyed in the PAC (Figure A1.34). As such caution should be employed when interpreting population trend data in the PAC prior to 2006 (Figure A1.35).

Trout Creeks PAC

The Trout Creeks PAC is situated in southeastern Harney County, and southwestern Malheur County, and is split between the Burns and Vale BLM Districts (Figure A1.1). Ninety-seven leks, comprising 52 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1970, however annual lek surveys were not conducted consistently within the PAC until 2012 (Figure A1.36).

Tucker Hill PAC

The Tucker Hill PAC is situated in southern Lake County, and is entirely contained within the Lakeview BLM District (Figure A1.1). Five leks, comprising four complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1977, and annual surveys have been conducted in the PAC consistently since 1996 (Figure A1.38).

Warners PAC

The Warners PAC is situated in eastern Lake County, and is entirely contained within the Lakeview BLM District (Figure A1.1). Fifty-six leks, comprising 42 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1975, and annual surveys have been conducted in the PAC consistently since 1993 (Figure A1.40). The number of leks known to exist within the PAC increased substantially following aerial lek searches conducted in 2002.

Leks Outside of PACs

Leks occur outside of PACs throughout the range of sage-grouse in Oregon (Figure A1.1). Two hundred twenty-nine leks, comprising 188 complexes occur outside of mapped PACs in the state (Table A1.1). Surveys were first recorded for leks outside of mapped PACs in 1947, and surveys have been conducted annually from 1947 – 2017, survey effort and knowledge of sage-grouse distribution in habitat not mapped as a PAC increased substantially following 1980 (Figure A1.42).

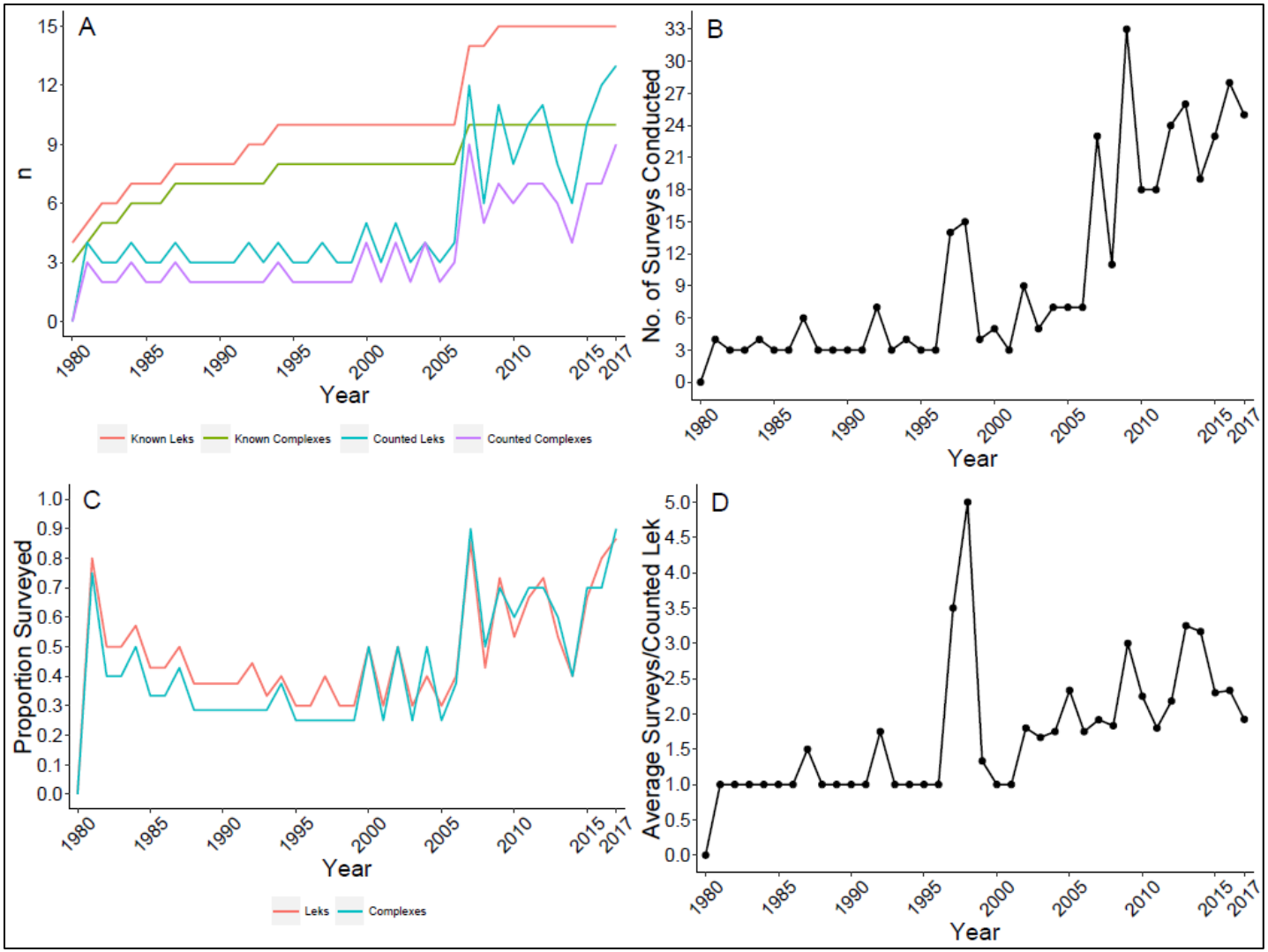


Figure A1.34. **Steens PAC** greater sage-grouse survey effort statistics, 1980 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

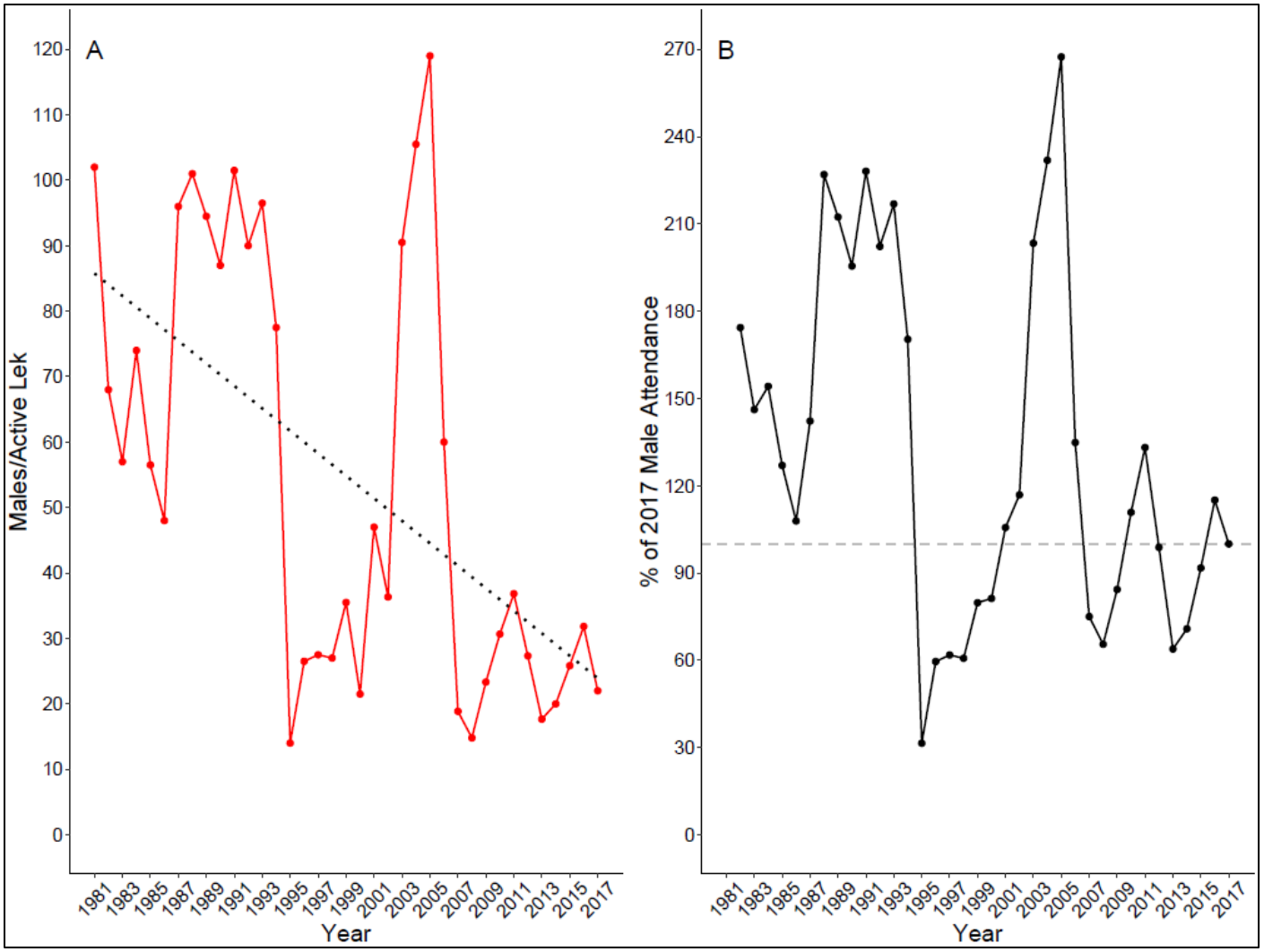


Figure A1.35. Greater sage-grouse population trend in the **Steens PAC**, 1981 – 2017. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2017 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2017.

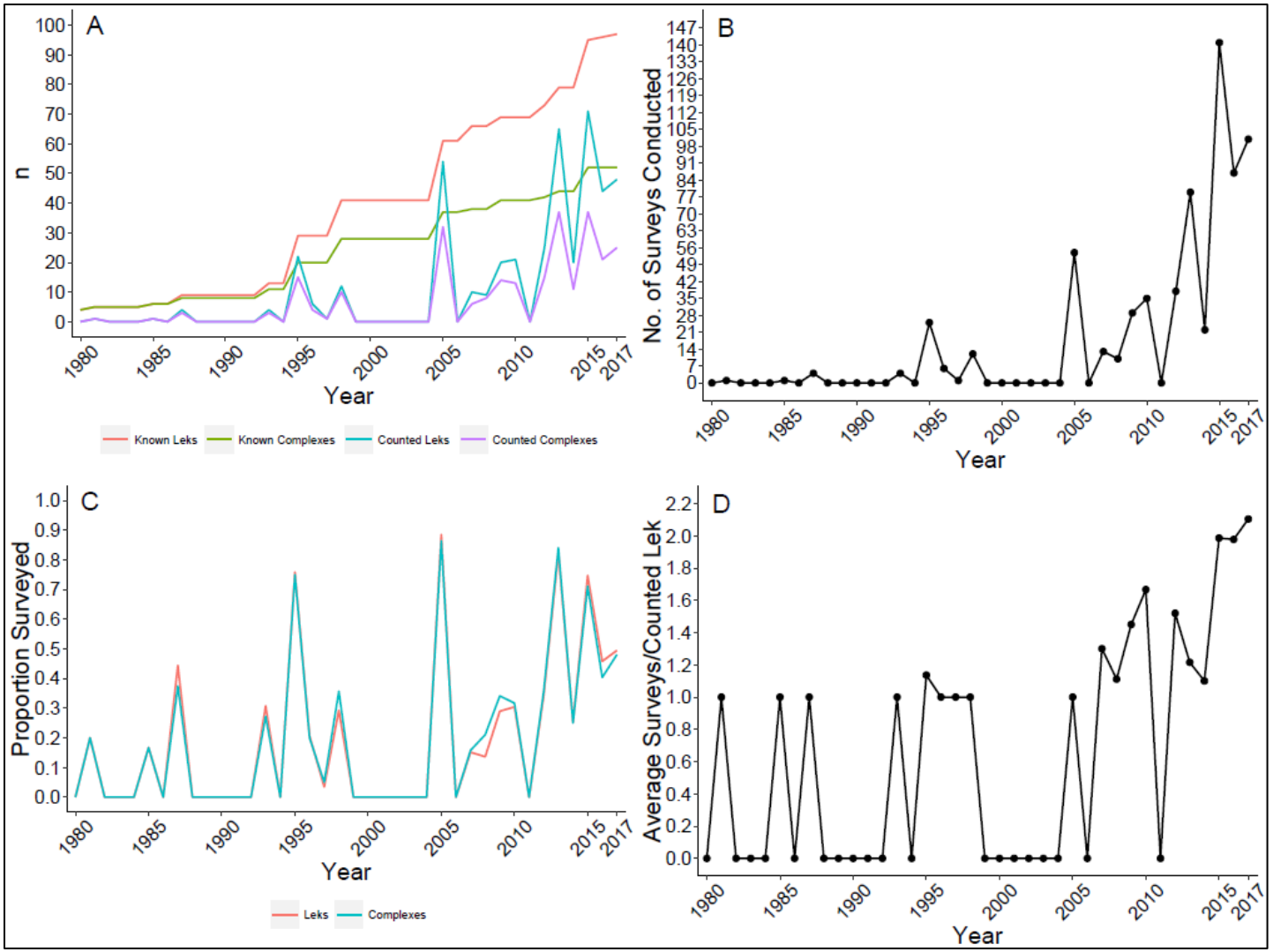


Figure A1.36. **Trout Creeks PAC** greater sage-grouse survey effort statistics, 1980 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

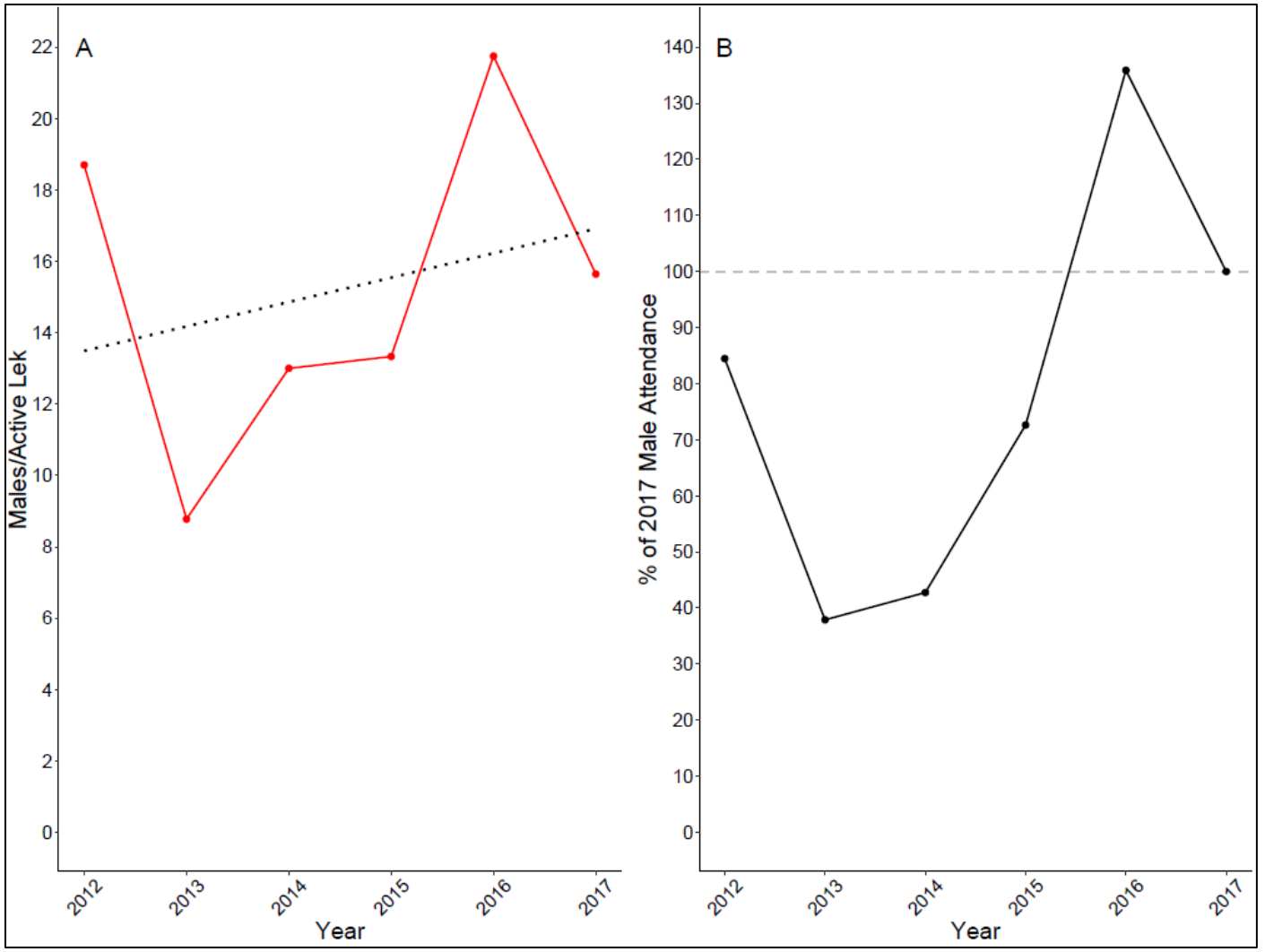


Figure A1.37. Greater sage-grouse population trend in the **Trout Creeks PAC**, 2012 – 2017. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2017 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2017.

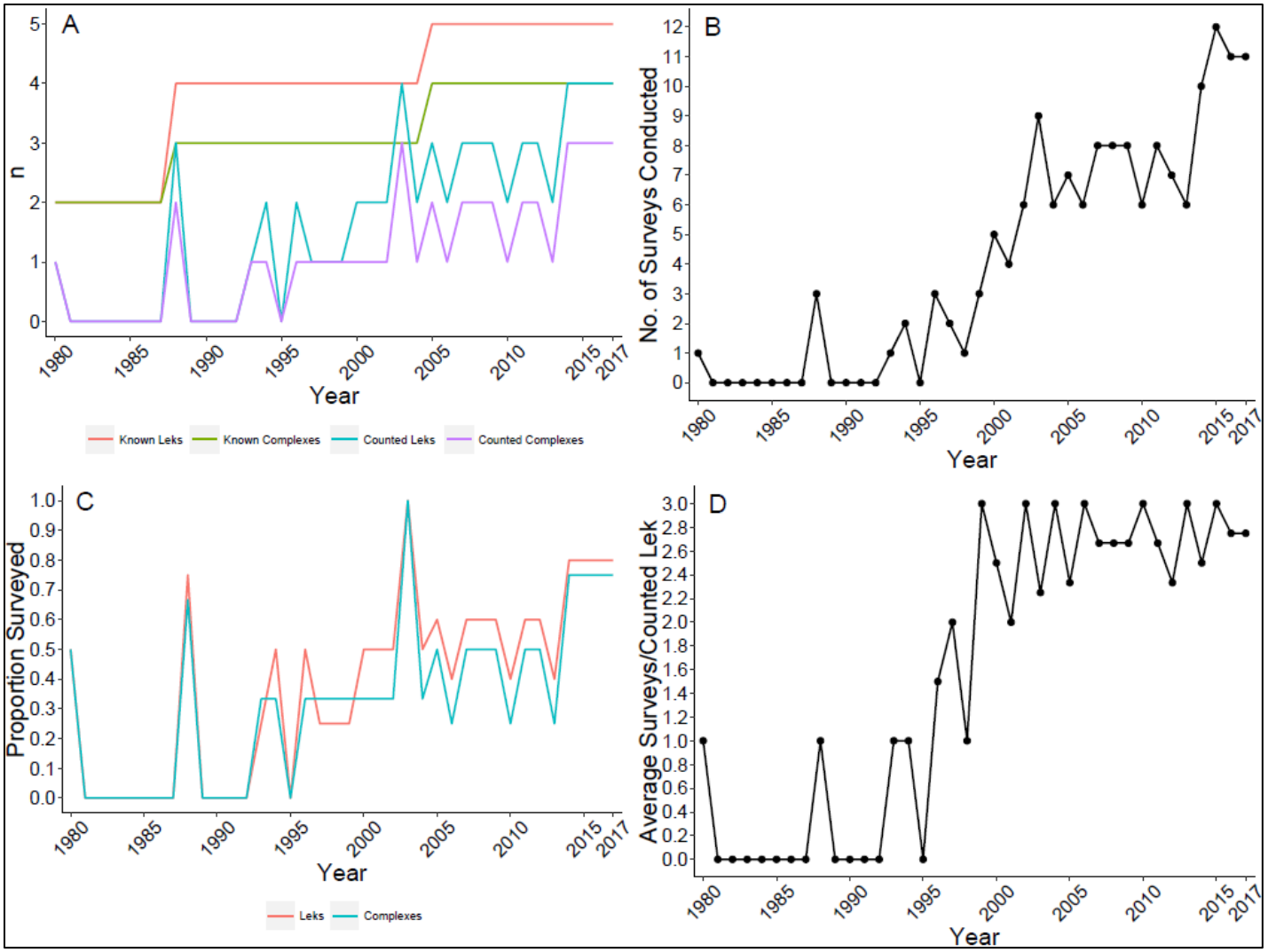


Figure A1.38. **Tucker Hill PAC** greater sage-grouse survey effort statistics, 1980 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

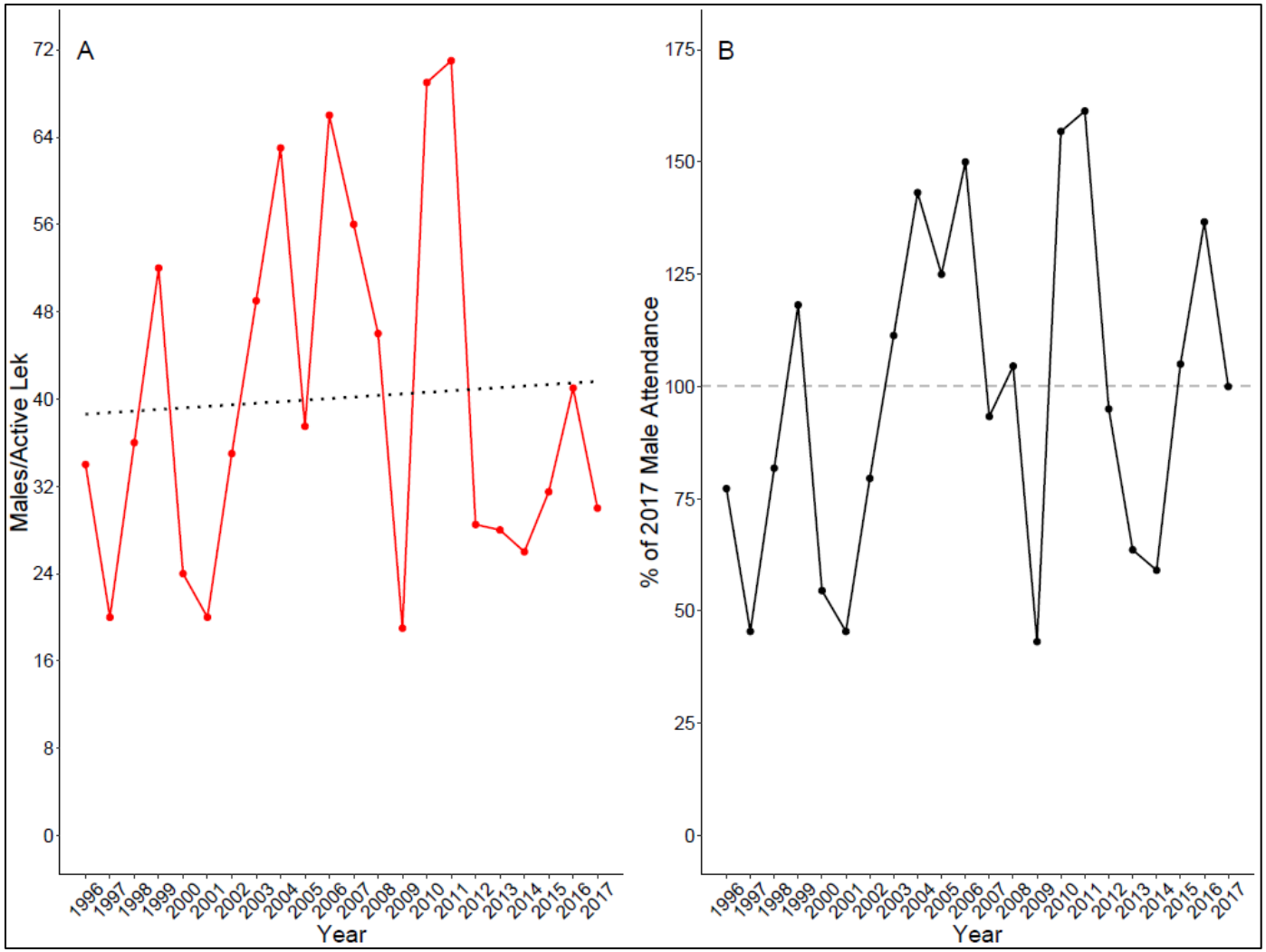


Figure A1.39. Greater sage-grouse population trend in the **Tucker Hill PAC**, 1996 – 2017. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2017 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2017.

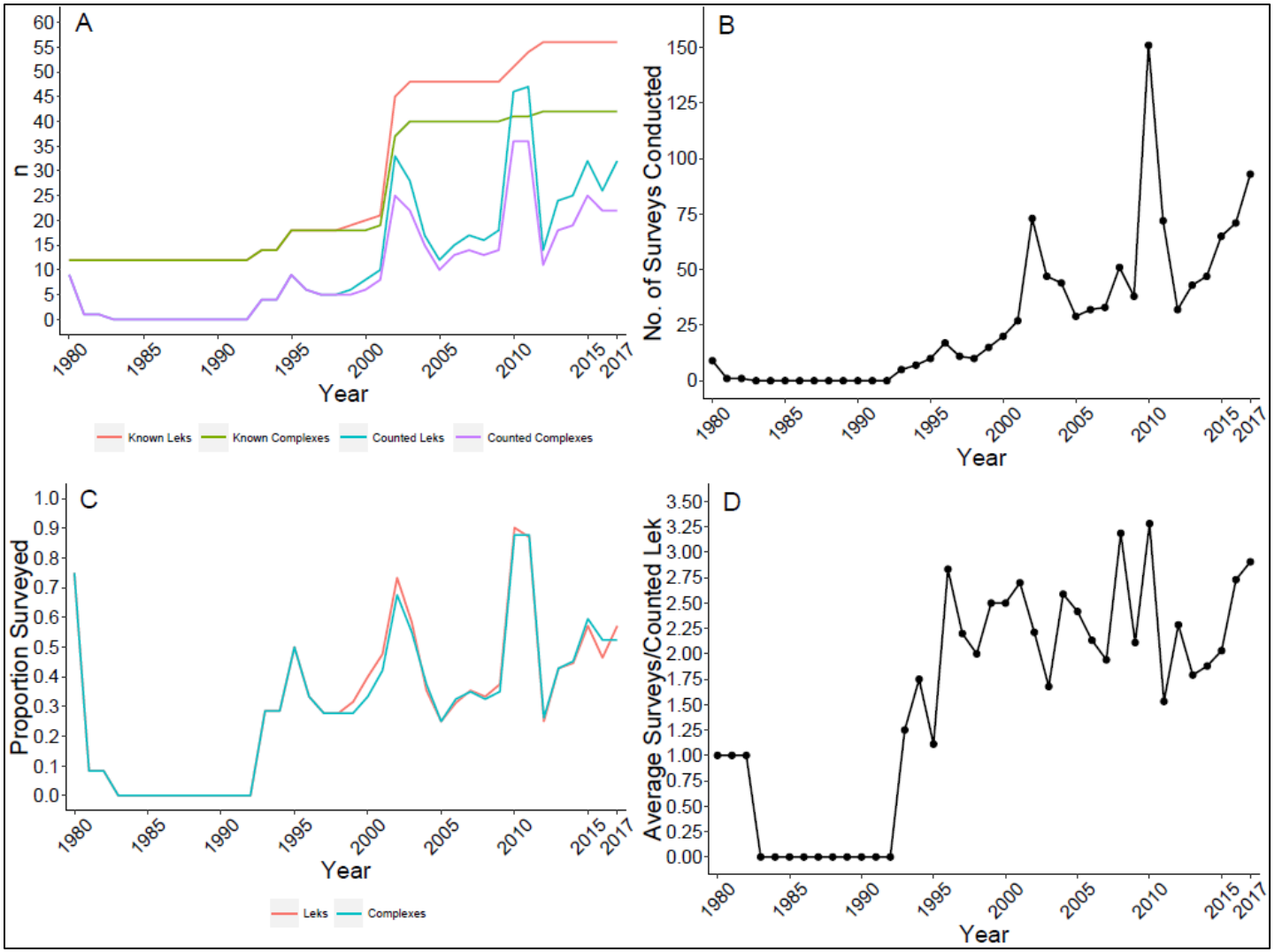


Figure A1.40. **Warners PAC** greater sage-grouse survey effort statistics, 1980 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

Figure A1.41. Greater sage-grouse population trend in the **Warners PAC**, 1993 – 2017. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2017 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2017.

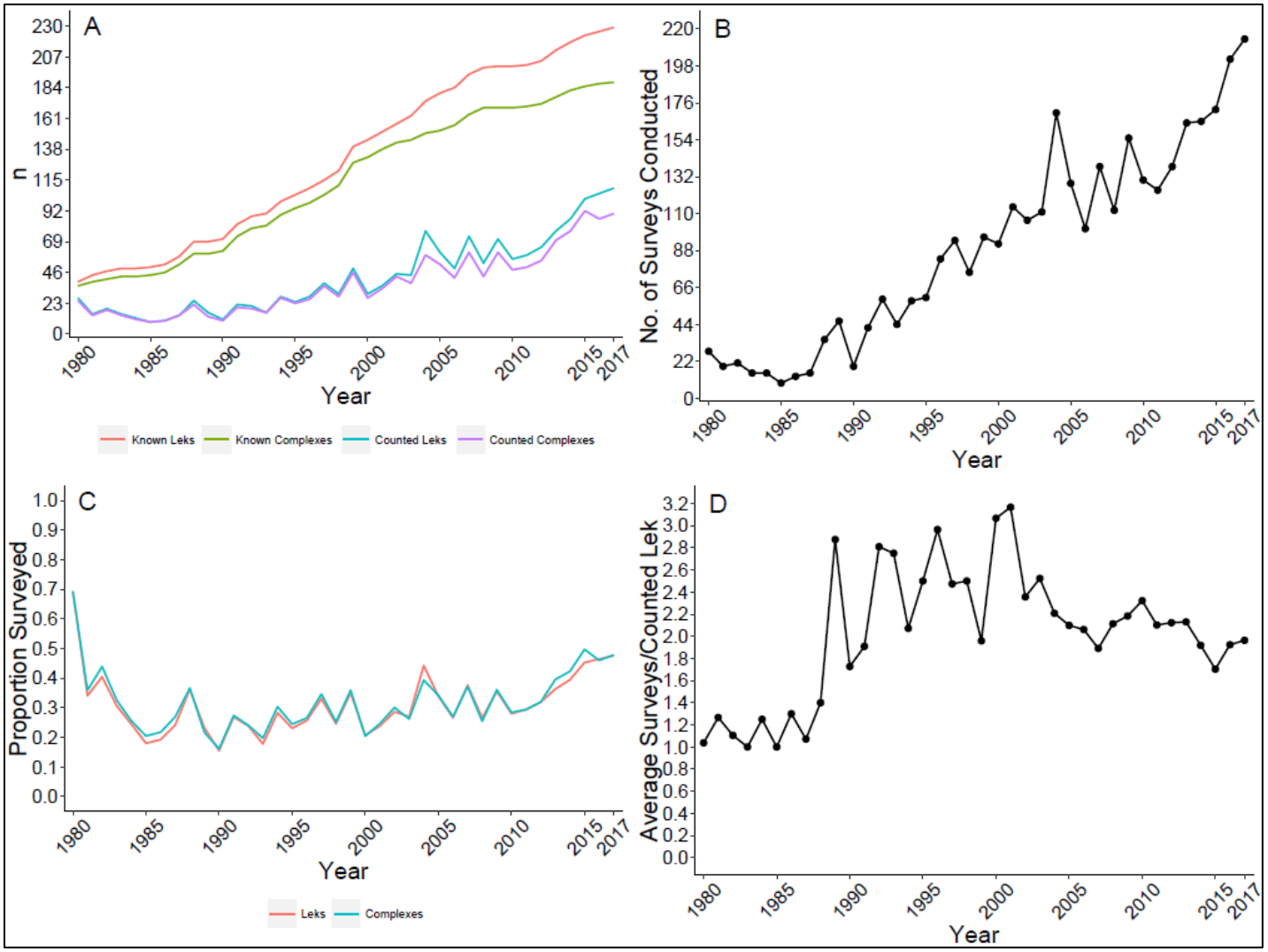


Figure A1.42. **Outside of PAC** greater sage-grouse survey effort statistics, 1980 – 2017. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

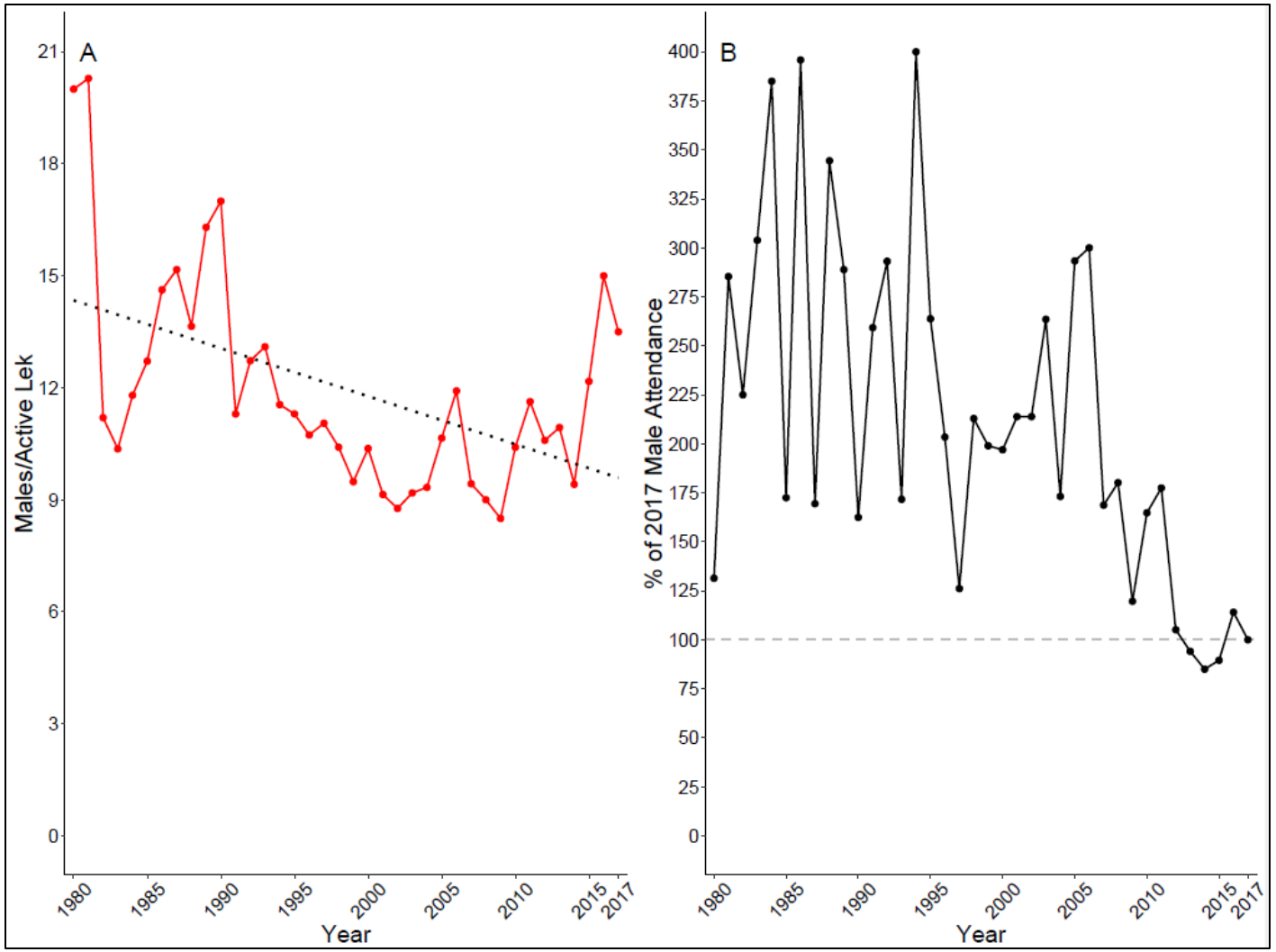


Figure A1.43. Greater sage-grouse population trend **outside of PACs**, 1980 – 2017. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2017 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2017.

Appendix II – 2017 ODFW Adopt-A-Lek Program Report

Photo by Craig Tokuda (Why We Left)

Photo by Eric Wieland (Crowley Road Washout)

2017 Volunteer Field Report

Oregon Department of Fish and Wildlife Prepared by Kelly Hazen

Southeast Oregon Sage-Grouse Adopt-A-Lek Program

2017 marks the 12th year of ODFW's Adopt-a-Lek (AAL) volunteer program. This program provides an opportunity for citizen scientists in Oregon, Washington, and Idaho to count Greater Sage-Grouse (*Centrocercus urophasianus*) leks in remote Southern Malheur County. The data collected by this program helps inform ODFW's annual population estimate for the species, and is essential to monitoring the health of the sage-grouse population in Oregon. This year, fifty nine dedicated AAL volunteers braved rain, snow, and muddy washed out roads to count male Sage-Grouse displaying on leks. We welcomed 15 new AAL volunteers to the program this year, hailing from Prineville, Redmond, and Lake Oswego in Oregon, as well as Vancouver Washington. These volunteers faced challenging road and weather conditions, as this was the wettest spring on record in Malheur County, but still maintained the high dedication and count quality typical of the program.

The 2017 lek counting effort in Oregon continued to focus on key habitat areas know as Priority Areas for Conservation (PACs). These PACs contain high priority trend leks, which need to be counted 3 times between March 15 and April 30, with 7-10 days spaced between each count morning. The AAL program volunteers were assigned to count a record total of 27 trend leks this year. In addition, the volunteers were assigned 61 non-trend leks that need to be counted at least once between March 15 and April 30. The 2017 AAL count data will be used by wildlife managers to help estimate the size of Sage-Grouse breeding populations within PACs.

This year, 76 individual sage-grouse leks were counted during 171 count mornings, and a total of 975 grouse were tallied. Even though weather and road conditions were extremely challenging, the volunteers documented and counted several important lek location shifts. Through hard work and perseverance, volunteers also pioneered and documented new observation points. Many volunteers made a special effort to write detailed comments, observations, share photos and make suggestions to improve the AAL program. Timely road conditions reporting by the volunteers helped the next volunteers as they headed into the field. A volunteer also rescued a passerby's Land Cruiser from a monster mud puddle.

AAL count data add significantly to the statewide Sage-Grouse population database, used by state biologists and federal land managers to manage this sagebrush-obligate species. As in past years, the accuracy of data gathered by the Southeast Oregon AAL volunteers has been strongly correlated the data obtained from Oregon Department of Fish and Wildlife's staff since 2006.

Oregon Department of Fish and Wildlife will continue this volunteer program in 2018 as funding becomes available. Next year's program will likely continue to focus on counting trend leks in the PACs. Let's hope for a quiet 2017 wildfire season and drier roads next spring!!

Thanks for your help AAL Volunteers!

2017 Volunteer Statistics

- **59 volunteers counted, checked, and surveyed leks.**
- **76 individual leks were counted (compared to 63 in 2016, 46 in 2015, 63 in 2014, and 81 in 2013).**
- **17 individual leks were counted 3 times (compared to 16 in 2016, 12 in 2015, 0 in 2014, and 0 in 2013).**
- **171 count mornings were conducted (compared to 116 in 2016, 89 in 2015, 67 in 2014, and 93 in 2013).**
- **53% of the leks counted were active (had birds displaying during the count morning) (compared to 52% in 2016, 72% in 2015, 56% in 2014, and 49% in 2013).**
- **36 leks were not active (no males displaying) on any count morning.**
- **40 leks were active (at least 1 male displaying) on a count morning. (compared to 33 in 2016, 33 in 2015, 35 in 2014, and 40 in 2013)**
- **975 total birds were counted (compared to 1052 in 2016, 871 in 2015, 453 in 2014, and 468 in 2013)**
- **3 leks were checked but not counted (*great job especially considering the weather*). (compared to 10 in 2016, 14 in 2015, 34 in 2014, and 35 in 2013)**

- **55% of the active leks counted had 1-10 males (compared to 42% in 2016, 48% in 2015, and 44% in 2014)**
- **18% of the active leks counted had 11-20 males (compared to 21% in 2016, 18% in 2015, and 38% in 2014)**
- **28% of the active leks counted had 21 or more males (compared to 36% in 2016, 33% in 2015, and 15% in 2014)**
- **The largest lek had 54 males, *thank you Helm Group*. (compared to 60 in 2016, 41 in 2015, and 37 in 2014)**

- **1 outreach presentation was given by Kelly Hazen about the AAL program at Winter Wings Bird Festival in Klamath Falls. An additional outreach presentation was given by Lee Foster about the AAL program during an Oregon wildlife Foundation Wildlife Talk Event in Portland, thank you volunteers for sharing your photos for this presentation.**

Funding and support for the 2017 Volunteer Program was provided by Oregon Department of Fish and Wildlife, Oregon Wildlife Heritage Foundation,
and Bureau of Land Management.

It has been MY PLEASURE to work with you again this year!!

Appendix III – 2017 Sage-Grouse Wing-Bee Report (2016 Hunting Season Data)

Annual Report – Oregon Sage-Grouse Wing Analyses, 2016

Lee Foster, Sage-Grouse Conservation Coordinator

Executive Summary: Following the 2016 hunting season, 331 greater sage-grouse (*Centrocercus urophasianus*; hereafter: sage-grouse) wings were received from hunters. Production in 2016 (as measured by percent juveniles in the harvest) was 46%, similar to the 23 year average of 47% (1993-2015). The number of chicks per hen was 1.5, which was a decline from the 2015 production value of 2.3 chicks per hen, and approximately equal to the long term (1993-2015) average of 1.5 chicks per hen. Despite average production as measured by the ratio of chicks per hen, apparent nest success in 2016 was below average based on retention of primary 9 of harvested females (P9 Nest Success: 2016 = 30%, 1993 – 2015 Average = 44%). Production data collected from hunter harvested wings in 2016 suggests that sage-grouse populations should remain stable in 2017. However, more than 80% of sage-grouse wings were collected from only four of ten Wildlife Management Units which allow hunting (WMU; Beatys Butte, Steens Mtn., Warner, and Whitehorse), and more than 30% of wings were collected from a single WMU. The preponderance of harvest occurring in these units is not unexpected, as 61% of permits are issued in these four units, however caution should be taken when extrapolating the results from this analysis outside of the area where the majority of data was collected.

Overview

In 2016, the sage-grouse hunting season in Oregon was by permit for 9 days (10-18 Sep), with a daily, and season bag limit of 2 birds. Season length in 2005-2016 was 9 days, versus 5 days from 1995-2004, and 2 days in 1993 and 1994. There have not been any changes in daily bag and season limits from 1993-2016 (Braun et al. 2015; Table A3.1).

Plumage characteristics (e.g. those associated with wings) are used to assess age and gender of multiple game bird species. By assessing plumage characteristics from hunter-harvested wings, demographic parameters (e.g. age structure, sex ratio, and nest success) can be estimated for sage-grouse populations. Sage-grouse wings have been analyzed to gather information regarding population structure and demography in Oregon since 1982. However, methods used to age and sex wings were refined in 1993. Due to this change in methodology all long-term average rates are calculated only for the 1993 – 2015 period. As in previous years, all hunters who were successful in the controlled sage-grouse hunt drawing were provided envelopes for the return of sage-grouse wings to ODFW. Sage-grouse wings collected during the 2016 hunting season were processed by personnel of Oregon Department of Fish and Wildlife, Bureau of Land Management, and Oregon State University, at an annual Wing Bee in February 2017.

Following the 2016 hunting season, 331 hunter harvested wings were received from 10 wildlife management units (WMUs; Table A3.2, Figure A3.1). This represents an increase in wing collection over the previous year (2015, 290 wings). However, wing collection remains below the 23 year (1993-2015) average of 528 wings (Table A3.3), due to a decline in the number of permits issued. More than 80% of wings (n = 242) were received from only four WMUs (Beatys Butte, Steens Mtn., Warner, and Whitehorse), and fewer than 10 wings were received from each of the Juniper, and Silvies WMUs (Table A3.4). No permits have been offered in the Sumpter or Lookout Mountain WMUs (WMUs 51 and 64 respectively) since 2014 due to concerns about decreasing population trends, and continued uncertainty about the impacts of wildfires (Kitten Complex) that occurred in the summer of 2014 (Figure A3.1). No permits were offered in that part of the Whitehorse WMU west of Highway 95 and south of the Whitehorse Ranch Road (WMU 68 Subunit 2; Figure A3.1). No permits have been offered in this area since the 2012 Holloway fire, and the number of permits in the Whitehorse WMU has been reduced in proportion to the area of the WMU closed. The closure continued, in part, to prevent hunting from confounding ongoing research investigating the impacts of the Holloway Fire on sage-grouse in the Trout Creek Mountains.

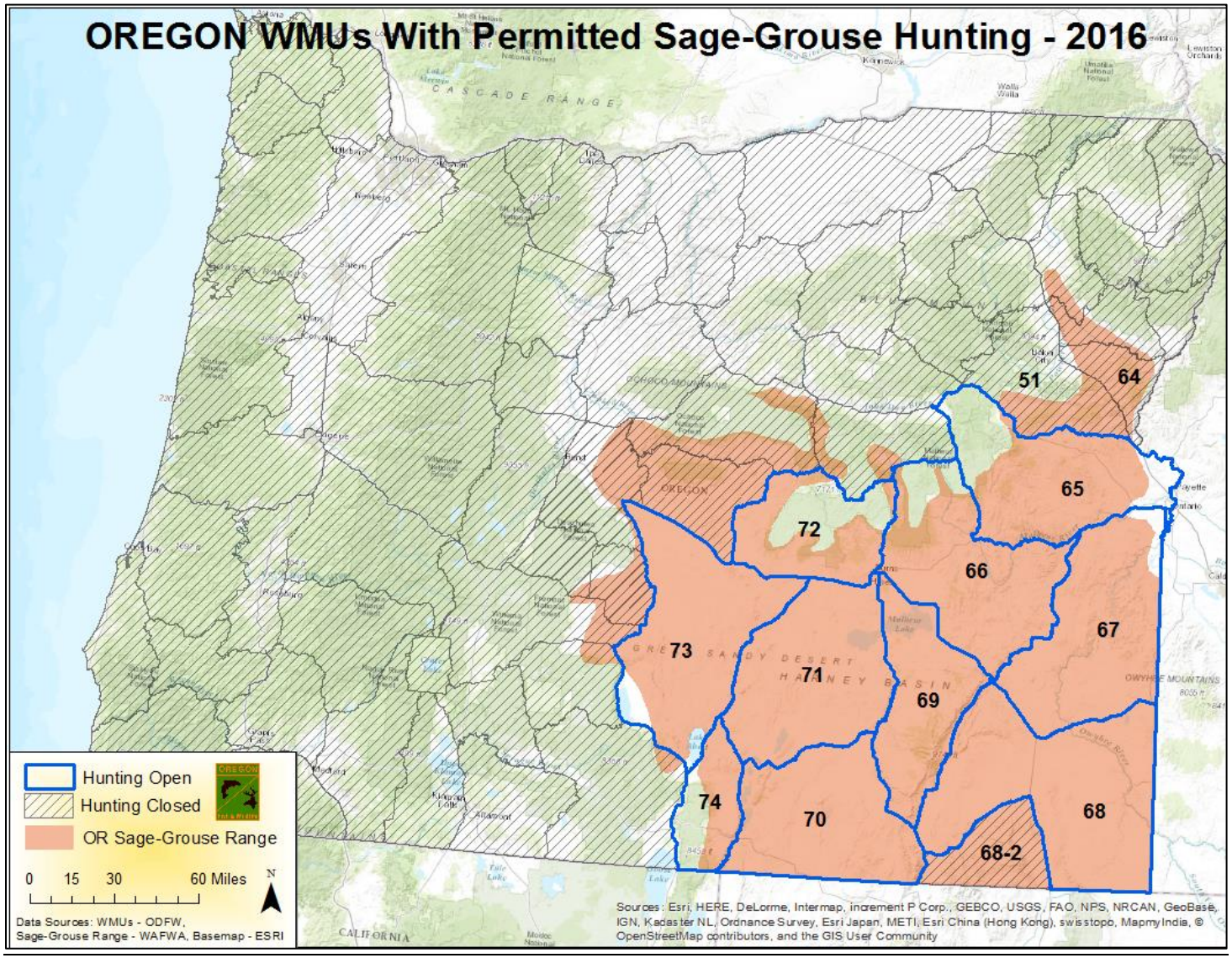
Table A3.1. Sage-grouse hunting season dates, lengths, and daily and season bag limits, Oregon, 1993-2016.

Year	Season Date	No. Days	Daily Bag	Season Limit
1993	18-19 Sep	2	2	2
1994	17-18 Sep	2	2	2
1995	9-13 Sep	5	2	2
1996	7-11 Sep	5	2	2
1997	6-10 Sep	5	2	2
1998	12-16 Sep	5	2	2
1999	11-15 Sep	5	2	2
2000	9-13 Sep	5	2	2
2001	8-12 Sep	5	2	2
2002	7-11 Sep	5	2	2
2003	6-10 Sep	5	2	2
2004	11-15 Sep	5	2	2
2005	10-18 Sep	9	2	2
2006	9-17 Sep	9	2	2
2007	8-16 Sep	9	2	2
2008	6-14 Sep	9	2	2
2009	12-20 Sep	9	2	2
2010	11-19 Sep	9	2	2
2011	10-18 Sep	9	2	2
2012	8-16 Sep	9	2	2
2013	7-15 Sep	9	2	2
2014	6-14 Sep	9	2	2
2015	12-20 Sep	9	2	2
2016	10-18 Sep	9	2	2

Table A3.2. Oregon wildlife management units with permitted sage-grouse harvest, 2016.

WMU #	WMU Name
65	Beulah
66	Malheur River
67	Owyhee
68	Whitehorse
69	Steens Mtn.
70	Beatys Butte
71	Juniper
72	Silvies
73	Wagontire
74	Warner

Figure A3.1. Oregon wildlife management units with permitted greater sage-grouse hunting, and the distribution of greater sage-grouse in Oregon, 2016.



Age and Sex Composition

Sage-grouse wings were classified by age (juvenile = hatch year; yearling = second year; adult = after hatch year), based on characteristics of the outer primaries (P10 – P7), first secondary, tertials, and wing coverts (Braun and Schroeder 2015). In areas where the majority of breeding occurs in March, such as Oregon, few yearling males will be identifiable in the harvest due to molt progression (Braun and Schroeder 2015). Additionally, if non-nesting or early nesting yearling females complete their wing molt before harvest, there is no reliable way to differentiate them from after second year adult females (Braun and Schroeder 2015). Thus, in Oregon all after hatch year birds are classified as adults, unless they can be definitively identified as yearlings, by the presence of juvenile P9 and/or P10 (Braun et al. 2015). Sex classification was assigned based on the length of primary 10 and/or primary 9 depending on the condition of the wing (Braun and Schroeder 2015). The number of wings received for individual WMUs were small (range: 2-105 wings), and only 2 of 10 WMUs had $\geq$50 wings returned (Table A3.3). Relatively few yearlings are identified in the harvest in Oregon (23 Year Average = 6% of harvest), and 2016 was no exception with 8% of the harvest classified as yearlings. However, yearling identification increased substantially between 2015 and 2016 (2015: n = 7, 2% of harvest; 2016: n = 25, 8% of harvest). Overall, the percent of juveniles in the harvest was 45%, representing a decrease from 2015 (58%). Within individual WMUs, the percent of juveniles in the harvest was variable, likely because of small sample size for many WMUs. The highest level of juveniles in the harvest was in the Malheur River WMU (58%, 11 of 19 wings), followed by the Beatys Butte WMU (56%, 59 of 105 wings; Table A3.4). The sex ratio of juveniles in the harvest was 54:46 males to females, which while not statistically different from the long term average of 46:54 at an alpha value of 0.05 (χ^2= 2.80, p = 0.09; Table A3.5), was the highest ratio of males to females ever observed in Oregon. It is unclear whether the skewing of juvenile sex ratio towards males in 2016 was an artifact of the random nature of juvenile harvest, or the result of an as yet undescribed biological mechanism.

Table A3.3. Sex composition by age class, and age composition of harvested sage-grouse, all wildlife management units open to harvest, Oregon, 1993-2016.

		Juvenile			Yearling			Adult		
Year	N	M (%)	F (%)	% Harvest	M (%)	F (%)	% Harvest	M (%)	F (%)	% Harvest
1993	439	51	49	47	26	74	4	40	60	49
1994	764	47	53	43	12	88	7	32	68	50
1995	456	42	58	36	5	95	5	32	68	60
1996	493	42	58	51	4	96	5	31	69	44
1997	586	47	53	54	16	84	4	39	61	39
1998	466	48	52	49	6	94	4	39	61	47
1999	671	46	54	56	14	86	5	41	59	39
2000	592	46	54	44	22	78	8	47	53	48
2001	670	50	50	54	10	90	7	44	56	38
2002	648	51	49	58	9	91	7	46	54	36
2003	655	46	54	48	12	88	5	47	53	47
2004	778	45	55	52	9	91	6	40	60	42
2005	829	46	54	45	5	95	5	46	54	50
2006	669	46	54	47	30	70	5	49	51	48
2007	485	44	56	28	10	90	6	38	62	66
2008	443	49	51	54	0	100	4	30	70	42
2009	493	47	53	57	0	100	5	49	51	38
2010	463	43	57	48	4	96	5	36	64	47
2011	422	43	57	42	10	90	5	48	52	53
2012	321	40	60	29	30	70	14	49	51	57
2013	254	50	50	58	11	89	7	36	64	35
2014	264	38	62	31	6	94	6	42	58	63
2015	290	43	57	58	14	86	2	40	60	40
23-yr Avg.	*528*	*46*	*54*	*47*	*12*	*88*	*6*	*41*	*59*	*47*
2016[a]	331	54	46	46	32	68	8	45	55	47

[a] Percent harvest figures in 2016 do not add to 100% due to rounding to nearest whole percentage point.

Table A3.4. Sex composition by age, and age composition of wings from harvested sage-grouse, all wildlife management units with potential sage-grouse harvest, Oregon, 2016.

		Juveniles						Yearlings						Adults					
	Sample	Male		Female		Totals		Male		Female		Totals		Male		Female		Totals	
WMU[a]	Size	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
51[b]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
64[b]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
65	19	6	67	3	33	9	47	0	0	0	0	0	0	6	60	4	40	10	53
66	19	6	55	5	45	11	58	0	0	0	0	0	0	3	38	5	63	8	42
67	15	4	80	1	20	5	33	1	100	0	0	1	7	2	22	7	78	9	60
68[c]	67	11	50	11	50	22	33	3	38	5	63	8	12	18	49	19	51	37	55
69	29	7	70	3	30	10	34	3	50	3	50	6	21	10	77	3	23	13	45
70	105	32	54	27	46	59	56	1	20	4	80	5	5	19	46	22	54	41	39
71	8	0	0	3	100	3	38	0	0	0	0	0	0	1	20	4	80	5	63
72	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	100	2	100
73	24	5	45	6	55	11	46	0	0	2	100	2	8	4	36	7	64	11	46
74	41	9	45	11	55	20	49	0	0	3	100	3	7	7	39	11	61	18	44
UNK	2	1	100	0	0	1	50	0	0	0	0	0	0	0	0	1	100	1	50
All	*331*	*81*	*54*	*70*	*46*	*151*	*46*	*8*	*32*	*17*	*68*	*25*	*8*	*70*	*45*	*84*	*55*	*154*	*47*

[a]Wildlife Management Unit: 51 - Sumpter, 64 - Lookout Mtn., 65 - Beulah, 66 - Malheur River, 67 - Owyhee, 68 - Whitehorse, 69 - Steens Mtn., 70 - Beatys Butte, 71 - Juniper, 72 - Silvies, 73 - Wagontire, 74 - Warner.
[b]WMU no hunting permits offered in 2016.
[c]WMU partially closed to hunting during 2016.

Table A3.5. Sage-grouse production data as determined from hunter harvested wings, Oregon, 1982 – 1984, 1989 – 1992, 1993 – 2015, and 2016.

Year	n	% Juvenile	Chicks/Female	Chicks M:F
1982	73	53	2.4	26:74
1983	291	38	0.9	53:47
1984	144	40	1.0	42:58
1985- 1988		Hunting Season Closed		
1989	326	41	1.1	46:54
1990	437	34	1.0	39:61
1991	295	31	0.8	37:63
1992	407	31	0.7	48:52
1982-1992 Mean	*282*	*38*	*1*	*48:58*
1993	439	47	1.4	51:49
1994	764	43	1.1	47:53
1995	456	36	0.8	42:58
1996	493	51	1.5	42:58
1997	586	54	1.8	47:53
1998	466	49	1.5	48:52
1999	671	56	2.0	46:54
2000	592	44	1.4	46:54
2001	670	54	1.9	50:50
2002	648	58	2.3	51:49
2003	655	48	1.6	46:54
2004	778	52	1.7	45:55
2005	829	45	1.4	46:54
2006	669	47	1.7	46:54
2007	485	28	0.6	44:56
2008	443	54	1.6	49:51
2009	493	57	2.3	47:53
2010	463	48	1.4	43:57
2011	422	53	1.3	43:57
2012	321	29	0.8	40:60
2013	254	58	2.0	50:50
2014	262	31	0.7	38:62
2015	290	58	2.3	43:57
1993-2015 Mean	*528*	*48*	*1.5*	*46:54*
2016	331	46	1.5	54:46

Nest Success and Production

Nest success was estimated based on wing molt patterns of adult and yearling females. Female sage-grouse replace primary feathers following completion of nesting activity (Braun and Schroeder 2015), thus hens which nest successfully initiate their molt at a later date than unsuccessful nesters. Wings from hens harvested while they were in the process of growing new primaries through P9 likely had a successful hatch (Braun and Schroeder 2015). Conversely, hens with unsuccessful nests begin molting earlier and generally have a growing primary 10, or have completed their primary molt (Braun and Schroeder 2015). The decision was made to use retention of P9 to estimate apparent nest success. Use of P9 will give a minimum estimate of nest success, but in some years may underestimate actual nest success. Overall, apparent nest success in 2016 was 30%, a slight increase in apparent nest success from 2015 (27%), but a decrease from the long-term average (44%) further indicating early nesting in 2016 and 2015 (Table A3.7). Apparent nest success was highest in the Steens Mountain WMU (67%, 4 of 6 total females), followed by the Beulah and Juniper WMUs (50%, 2 of 2 total females in each unit; Table A3.6).

Within WMUs, nest success was not correlated with either the proportion of juveniles in the harvest (Pearson's Correlation Coefficient = 0.36, $p = 0.15$; Figure A3.2), or with chicks per hen (Pearson's Correlation Coefficient = 0.41, $p = 0.12$; Figure A3.2). Connelly et al. (2000) suggested that a chick per hen ratio $\geq$ 2.25 indicates a healthy, stable or increasing, population, but this ratio may be higher than required to maintain some populations and requires further study (Braun 2012). In Oregon the long-term average chick per hen ratio is 1.5. Production in 2016 was comparable to the long term average, but declined from high production in 2015 (2015: 2.3 chicks per hen; 2016: 1.5 chicks per hen; Figure A3.3). The average production in 2016 was inconsistent with the slight increase in apparent nest success between 2015 and 2016 (apparent nest success 2015: 27%, 2016: 30%). The apparent contradiction in nest success and chicks per hen in 2016 was likely related to early nesting and hatching dates, and potentially the slightly later hunting season. Due to these factors successful hens may have already molted through primary 9 prior to harvest.

Table A3.6. Sage-grouse nesting success as indicated by retention of at least primary feather P9, and production rates, all wildlife management units with sage-grouse harvest, Oregon, 2016

	Estimated Nest Success													
	Adults			Yearling			All Hens			Harvest Age Composition			Production	
WMU	Successful Adult Females (n)	Total Adult Females (n)	Adult Nest Success (%)	Successful Yearling Females (n)	Total Yearling Females (n)	Yearling Nest Success (%)	Successful Females (n)	Total Females (n)	Nest Success (%)	Total Harvest (n)	Juveniles in Harvest (n)	Juveniles in Harvest (%)	Juveniles per Female	Juveniles per Successful Female
Beatys Butte	9	22	41	1	4	25	10	26	38	105	59	56	2.27	5.90
Beulah	2	4	50	0	0	NA	2	4	50	19	9	47	2.25	4.50
Juniper	2	4	50	0	0	NA	2	4	50	8	3	38	0.75	1.50
Malheur River	1	5	20	0	0	NA	1	5	20	19	11	58	2.20	11.00
Owyhee	2	7	29	0	0	NA	2	7	29	15	5	33	0.71	2.50
Silvies	0	2	0	0	0	NA	0	2	0	2	0	0	0.00	NA
Steens Mtn.	2	3	67	2	3	67	4	6	67	29	10	34	1.67	2.50
Wagontire	0	7	0	2	2	100	2	9	22	24	11	46	1.22	5.50
Warner	1	11	9	1	3	33	2	14	14	41	20	49	1.43	10.00
Whitehorse[a]	5	19	26	1	5	20	6	24	25	67	22	33	0.92	3.67
Unknown	0	1	0	0	0	NA	0	1	0	2	1	50	1.00	NA
All Areas (P9 Nest Success)	24	85	28	7	17	41	31	102	30	331	151	46	1.48	4.87
All Areas (P10 Nest Success)	37	85	44	17	17	100	54	102	53	331	151	46	1.48	2.80

[a]WMU partially closed to hunting during 2013 - 2016.

Table A3.7. Sage-grouse nesting success as indicated by retention of at least primary feather P9, all wildlife management units with sage-grouse harvest, Oregon, 1993 – 2016.

Year	Nest Success (P9; %)
1993	40
1994	40
1995	43
1996	51
1997	*No Data*
1998	30
1999	46
2000	45
2001	49
2002	47
2003	54
2004	35
2005	34
2006	49
2007	35
2008	48
2009	49
2010	37
2011	46
2012	63
2013	47
2014	52
2015	27
23-Year Average	*44*
2016	30

Figure A3.2. Nest success, proportion juveniles in the harvest, and chicks per hen by Oregon wildlife management unit where sage-grouse hunting occurred, 2016.

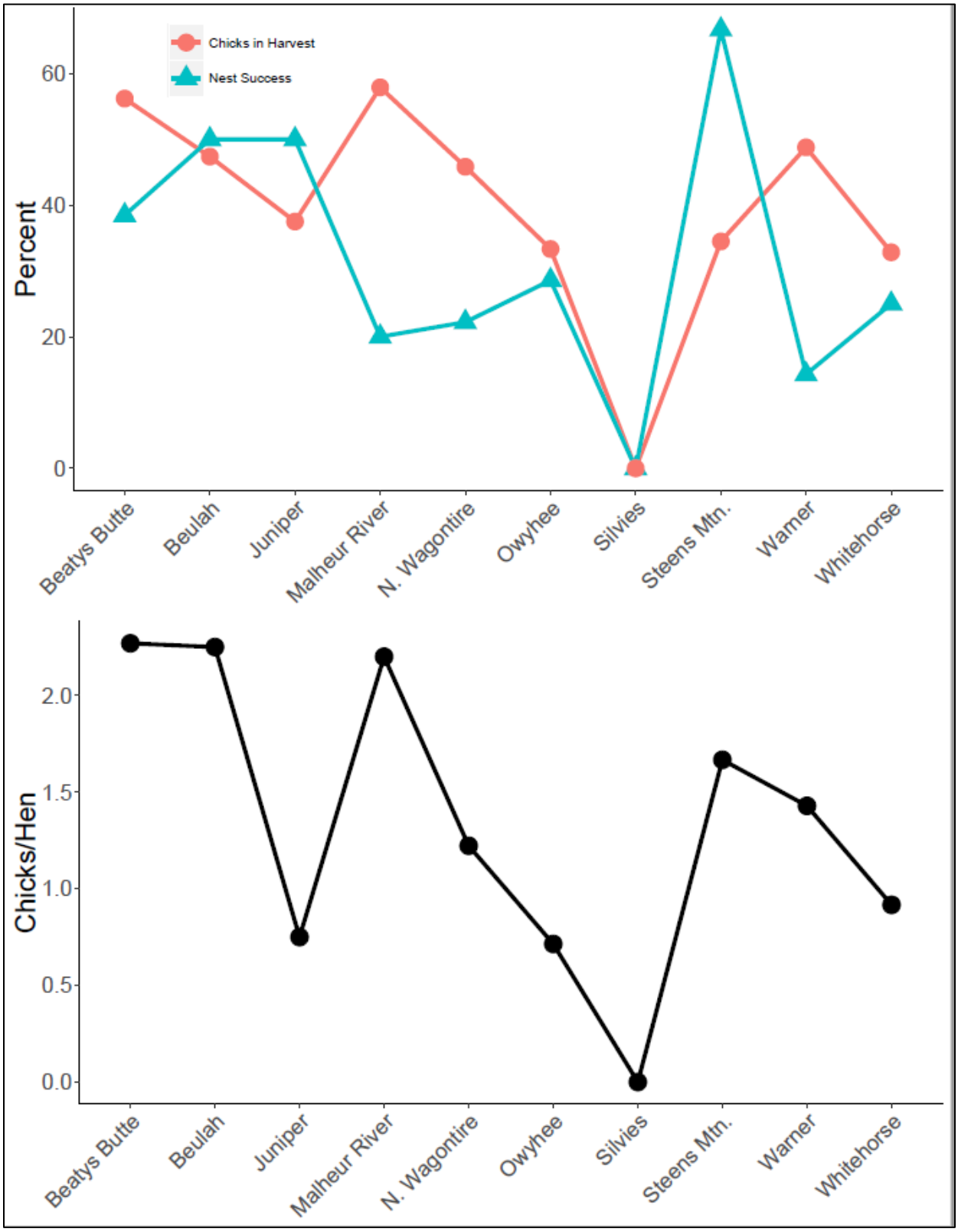
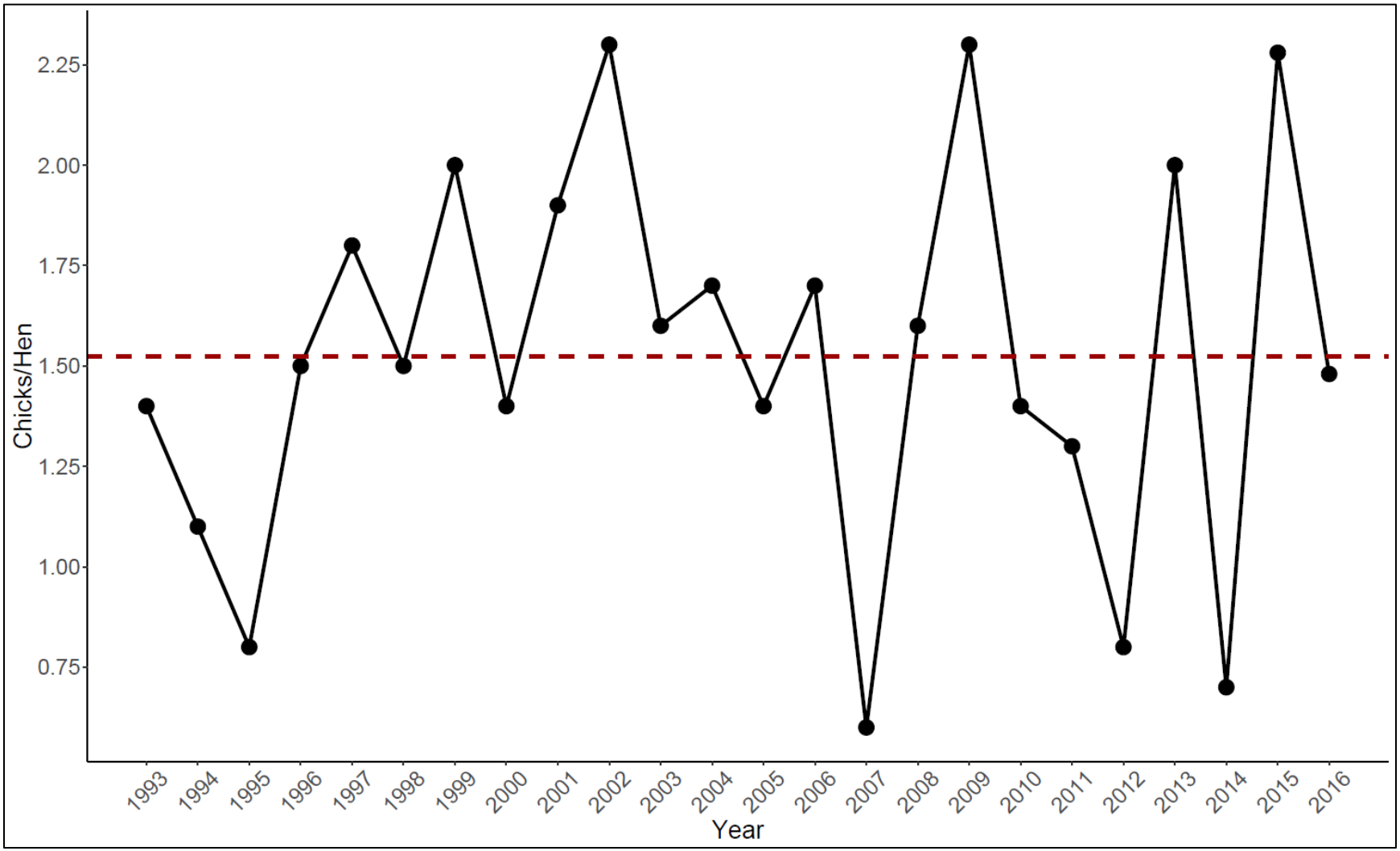


Figure A3.3. Oregon sage-grouse production values (chicks per hen) and 23-year average (dashed line; 1993 - 2015) estimated from hunter harvested wing analyses, 1993 – 2016.



Hatching Chronology

Where possible, the length of the most recently replaced actively growing adult primary (usually P8 or P7) was recorded for all juveniles. Ages of juveniles were calculated using growth data modified from captive-reared sage-grouse (Pyrah 1963). However, there is some evidence to suggest growth rates between wild and captive birds differ. Thus, the estimated hatch dates (Tables A3.8 – A3.9) may be up to seven days earlier than the actual hatch date.

Hatching began in late April and lasted through 1 July. As in 2015, during 2016 more than 80% of eggs hatched between 1 May and 4 June (Table A3.8). As in past years (excepting 2014), examination of wings indicated a difference in peak hatch between males and females. Wing analysis in 2016 indicated that peak hatch for males occurred approximately 1 week earlier than peak hatch for females (Table A3.8; Figure A3.4). This disparity in peak hatch date by sex indicates that refinement of the primary molt replacement and growth schedule, developed by Pyrah (1963), is necessary. The hatch in 2016 was slightly later than the hatch in 2015, with less than 40% of chicks hatching on or before 14 May during 2016, as compared to approximately 50% during 2015. However a larger proportion of chicks hatched in April of 2016, than in April of 2015 (chicks hatching prior to 1 May, 2015: 3%, 2016: 7%; Table A3.8).

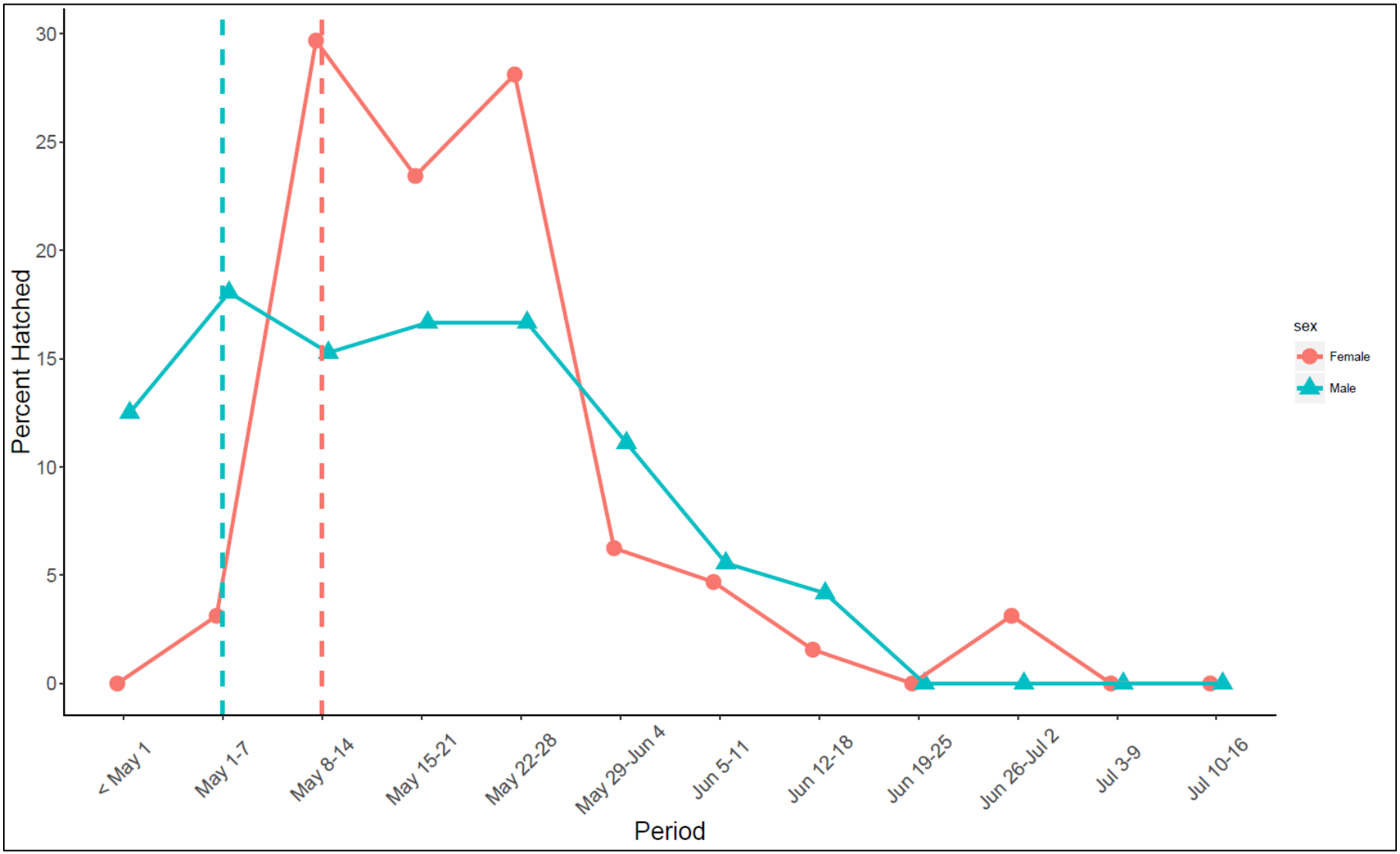
Table A3.8. Estimated hatch dates for juvenile sage-grouse (% of total) from hunter-harvested wings, Oregon 1993 – 2016.

		May					June				July		
Year	N	<1	1-7	8-14	15-21	22-28	29-4	5-11	12-18	19-25	26-2	3-9	10-16
1993	205		1	10	21	18	13	16	13	8	1	1	1
1994	327	1	9	22	18	16	11	12	8	3	1	1	-
1995	163	1	8	13	21	9	8	12	13	6	7	2	-
1996	253	2	9	15	12	14	11	17	10	4	2	3	1
1997	313	8	8	17	15	12	17	15	5	3	1	1	-
1998	229	2	10	13	15	18	14	10	3	7	2	4	1
1999	373	3	5	16	17	16	11	13	8	8	2	1	-
2000	260	7	7	17	18	16	15	14	4	2	1	-	-
2001	359	2	7	13	16	16	17	12	10	5	3	-	-
2002	373	5	6	17	13	21	13	13	4	4	3	1	-
2003	314	4	9	10	15	13	15	13	11	7	4	1	-
2004	398	3	10	24	24	14	11	8	5	2	1	-	-
2005	68	4	9	22	15	9	11	11	9	6	3	2	-
2006	323	1	3	10	12	12	18	21	15	7	1	1	-
2007	135	3	7	16	16	21	15	14	5	2	0	1	-
2008	241	3	7	10	12	15	15	15	8	8	7	-	-
2009	279	3	12	17	21	13	13	11	5	3	1	<1	-
2010	221	<2	6	9	18	13	15	14	13	4	4	<2	-
2011	178		<1	6	10	16	13	17	10	13	8	5	3
2012	94	3	5	25	14	16	11	10	11	5	-	-	-
2013	138	4	17	17	20	14	9	9	8	2	<1	-	-
2014	71	8	21	24	14	11	8	6	7	-	-	-	-
2015	152	3	17	28	15	9	14	8	6	1	1	-	-
2016	136	7	11	22	20	22	9	5	3	-	1	-	-

Table A3.9. Estimated hatch dates, from hunter-harvested wings, for juvenile sage-grouse in Oregon, 2016.

	Males			Females			All Chicks		
Period	n	%	Cumulative %	n	%	Cumulative %	n	%	Cumulative %
< 1 May	9	13	13	0	0	0	9	7	7
1-7 May	13	18	31	2	3	3	15	11	18
8-14 May	11	15	46	19	30	33	30	22	40
15-21 May	12	17	63	15	23	56	27	20	60
22-28 May	12	17	79	18	28	84	30	22	82
29 May - 4 Jun	8	11	90	4	6	91	12	9	90
5-11 Jun	4	6	96	3	5	95	7	5	96
12-18 Jun	3	4	100	1	2	97	4	3	99
19-25 Jun	0	0	100	0	0	97	0	0	99
26 Jun - 2 Jul	0	0	100	2	3	100	2	1	100
3-9 Jul	0	0	100	0	0	100	0	0	100
10-16 Jul	0	0	100	0	0	100	0	0	100

Figure A3.4. Estimated hatch dates of male and female juvenile sage-grouse (% hatched during period), from hunter-harvested wings, Oregon, 2016. Vertical lines depict peak hatching periods for males and females respectively.



Annual Turnover

The data for annual turnover, when based on the proportion of yearlings in the fall harvest, were too marginal for analysis. Few yearlings were identifiable in 2016 (N = 25; 8 male, 17 female), likely due to typically early nesting in Oregon, and a correspondingly early start to the primary molt. Generally, the timing of breeding and nesting in Oregon is earlier than in populations which occur in the eastern portion of the sage-grouse distribution, and at higher elevations (Connelly et al. 2011), leading to an advanced molt in Oregon compared to these other populations. Thus, the proportion of juveniles in the fall harvest of each sex was compared to the proportion of adults and yearlings (combined) of each sex to examine annual turnover (Table A3.10). This method is valid if one assumes the proportion of juveniles equals the annual loss of yearlings and adults. If the population was stable, annual mortality of adult and yearling males, and adult and yearling females would be 52%, and 44%, respectively (based on the 23 year average; Table A3.10).

Table A3.10. Estimated annual turnover (%) of adult sage-grouse, assuming population stability, Oregon, 1993-2016.

	Males		Females	
Year	Young	Adults/Yearling	Young	Adults/Yearling
1993	54	46	41	59
1994	54	46	36	64
1995	44	56	31	69
1996	60	40	46	54
1997	61	39	49	51
1998	56	44	44	56
1999	60	40	52	48
2000	45	55	43	57
2001	61	39	49	51
2002	64	36	52	48
2003	50	50	47	53
2004	57	43	47	52
2005	47	53	43	57
2006	47	53	48	52
2007	33	67	25	75
2008	68	32	46	54
2009	58	42	55	45
2010	55	45	44	46
2011	42	58	43	57
2012	27	73	31	69
2013	69	31	50	50
2014	31	69	31	69
2015	61	39	56	44
23-yr Avg	*52*	*48*	*44*	*56*
2016	51	49	41	59

Conclusions

Oregon's sage-grouse hunting seasons are based on a long history of population monitoring, and research. The current permit system allows ODFW to closely control legal harvest of sage-grouse. Each year, ODFW projects the fall population of sage-grouse based on lek counts and summer production inventories. In 2016, ODFW estimated there were 19,951 sage-grouse in the fall population in the 10 WMUs where sage-grouse hunting is permitted, and offered 845 permits, of which 487 were issued (Table A3.11). ODFW has a self-imposed policy not to harvest more than 5% of the fall population, with harvest usually estimated at around 3% of the fall population. This harvest strategy is well within the guidelines suggested by the Western Association of Fish and wildlife Agencies (Connelly et al. 2000). In addition, it is well below the <11% harvest rate unlikely to influence sage-grouse populations in Nevada and Colorado (Sedinger et al. 2010).

Compared to other states that offer a sage-grouse hunting season, Oregon's hunting season is likely the most conservative:

- Oregon's sage-grouse season is limited-entry for each WMU;
- Sage-grouse are not hunted range-wide in Oregon. Hunting is permitted in only 10 of 21 WMUs where sage-grouse occur (Figure A3.1);
- Permit numbers are allocated to take no more than 5% of the fall population (3% or less in practice);
- Each permit holder is allowed only 2 sage-grouse per season;
- In 2016, estimated harvest of sage-grouse was 537 birds, 2.7% of the estimated 19,951 sage-grouse in potential hunt areas.

Through the collection of hunter harvested wings, Oregon's sage-grouse hunting season provides crucial demographic data regarding the structure of sage-grouse populations in Oregon. This data would be costly or unfeasible to collect through other means. However caution should be applied when extrapolating the results from this analysis to populations outside the primary area of harvest in the Beatys Butte, Steens Mtn., Warner, and Whitehorse WMUs, due to the preponderance of wings which are received from those units. In 2016 more than 60% of issued permits, and more than 80% of returned wings, occurred in WMUs which contain only an estimated 28% of the fall population occurring in potential hunt areas (Table A3.11). It should be assumed that variation in population structure and demographic rates exists between those WMUs which receive the majority of harvest in Oregon, and other areas which are lightly, or not hunted.

Table A3.11. Estimated fall sage-grouse population, maximum allowable harvest, hunter statistics, and permit allocation in Oregon wildlife management units where sage-grouse harvest is permitted, 2016.

WMU	Estimated Fall Population	Harvest Limit (5%)	Birds/Hunter[a]	Hunter Participation Rate[a]	2016 Permits
Juniper	612	31	0.73	0.54	70
Silvies	1140	57	0.73	0.54	20
Wagontire	1028	51	0.73	0.54	55
Beatys Butte	3952	198	1.13	0.70	150
Steens Mtn.	1442	72	1.13	0.70	75
Warner	2308	115	1.13	0.70	80
Beulah	2166	108	0.59	0.29	150
Malheur River	2251	113	0.59	0.29	100
Owyhee	1286	64	1.19	0.54	75
Whitehorse	3326	166	1.19	0.54	70
Total	19951	998	-	-	845

[a]Hunter statistics based on average from hunter harvest survey by Data Analysis Unit (DAU) for years 2010 – 2015.

References

Braun, C. E. 2012. Oregon sage-grouse wing analysis, 1993-2012. Unpubl. Report for OR Dept. of Fish and Wildlife. 40 p.

Braun, C. E., D. A. Budeau, and M. A. Schroeder. 2015. Fall population structures of sage-grouse in Colorado and Oregon. Oregon Department of Fish and Wildlife Technical Report 005-2015. 72 p.

Braun, C. E., and M. A. Schroeder. 2015. Age and sex identification from wings of hunter-harvested sage-grouse. Wildlife Society Bulletin 39:182-187.

Connelly, J. W., C. A. Hagen, M. A. Schroeder. 2011. Characteristics and dynamics of greater sage-grouse populations. Studies in Avian Biology 38:53-67.

Connelly, J. W., M. A. Schroeder, A. R. Sands, and C. E. Braun. 2000. Guidelines to manage sage grouse populations and their habitats. Wildlife Society Bulletin 28:967-985.

Pyrah, D. B. 1963. Sage grouse investigations. Idaho Fish and Game Department. Wildlife Restoration Division Job Completion Report Project W-125-R-2. 71 p.

Sedinger, J. S., G. C. White, S. Espinoza, E. T. Partee, and C. E. Braun. 2010. Assessing compensatory versus additive mortality: an example using greater sage-grouse. Journal of Wildlife Management 74:3

Appendix IV – 2017 Aerial Lek Search Summary

ODFW conducts annual helicopter lek searches, currently made possible through funding support by the Oregon/Washington BLM, in order to locate previously undocumented leks, document shifts in sage-grouse breeding distribution, and check activity of leks which are inaccessible from the ground. Lek searches are conducted from ½ hour before to 2 hours after sunrise, following fixed transects separated by ¼ - ½ mile. During searches the helicopter maintains an altitude of 50 – 150 feet above ground level, and a speed of approximately 60 mph. Helicopter searches and surveys are primarily directed towards the assessment of lek occupancy, as lekking sage-grouse are sensitive to aerial predators, and thus often limit display behavior in presence of a helicopter. For this reason, following the discovery of previously unknown leks, ground observation of a site is required to confirm lek occupancy and attendance. Counts conducted from a helicopter are generally not used to estimate population trend in an analysis area, but rather act as presence-only assessments of lek activity, and are also used to assign leks to size strata. The exception to this rule is when male counts conducted from a helicopter are greater than follow up counts conducted by a ground observer, in these cases the aerial counts are used to both assess population trend and assign leks to size strata.

During 2017, ODFW conducted 75 hours of helicopter lek searches in the Bully Creek and Cow Valley PACs. Approximately 2,500 miles of transects were flown (Figure A4.1) over the course of 10 days utilizing 2 helicopters. In the Bully Creek PAC, 6 previously unknown lek sites were located, and confirmed to be active through follow up survey. All 6 sites were associated with pre-existing lek complexes. Maximum male attendance at these 6 leks was 108 males, or 46.2% of the 234 maximum males observed in the PAC. Average size of previously unknown sites observed in the PAC was 18 males. An additional 17 potential lek sites were located in the Bully Creek PAC during helicopter surveys, however these were not positively confirmed through ground surveys, and thus will require resurvey during 2018 prior to being entered into the ODFW lek database and considered confirmed lek sites.

In the Cow Valley PAC, 10 previously unknown lek sites, and 8 previously unknown complexes were located. Ground confirmation of these sites was not feasible during 2017, due to private land access issues. Efforts will be made to gain access to these sites during 2018, however due to uncertainty regarding future access, all located sites in the Cow Valley PAC were entered into the ODFW lek database, and considered confirmed lek sites. Two of these new lek sites were associated with pre-existing complexes, with the remaining 8 sites comprising new complexes. Maximum male attendance at these 10 leks was 76 males, or 40.9% of the 186 maximum males observed in the PAC. Average size of previously unknown sites observed in the PAC was 7.6 males. However, aerial counts conducted at these sites contained many flushed individuals which could not be identified to sex, as such the estimates of lek size presented above should be considered minimums.

One additional lek, and complex were identified in the Beatys PAC. This lek was found opportunistically during a bighorn sheep survey flight.

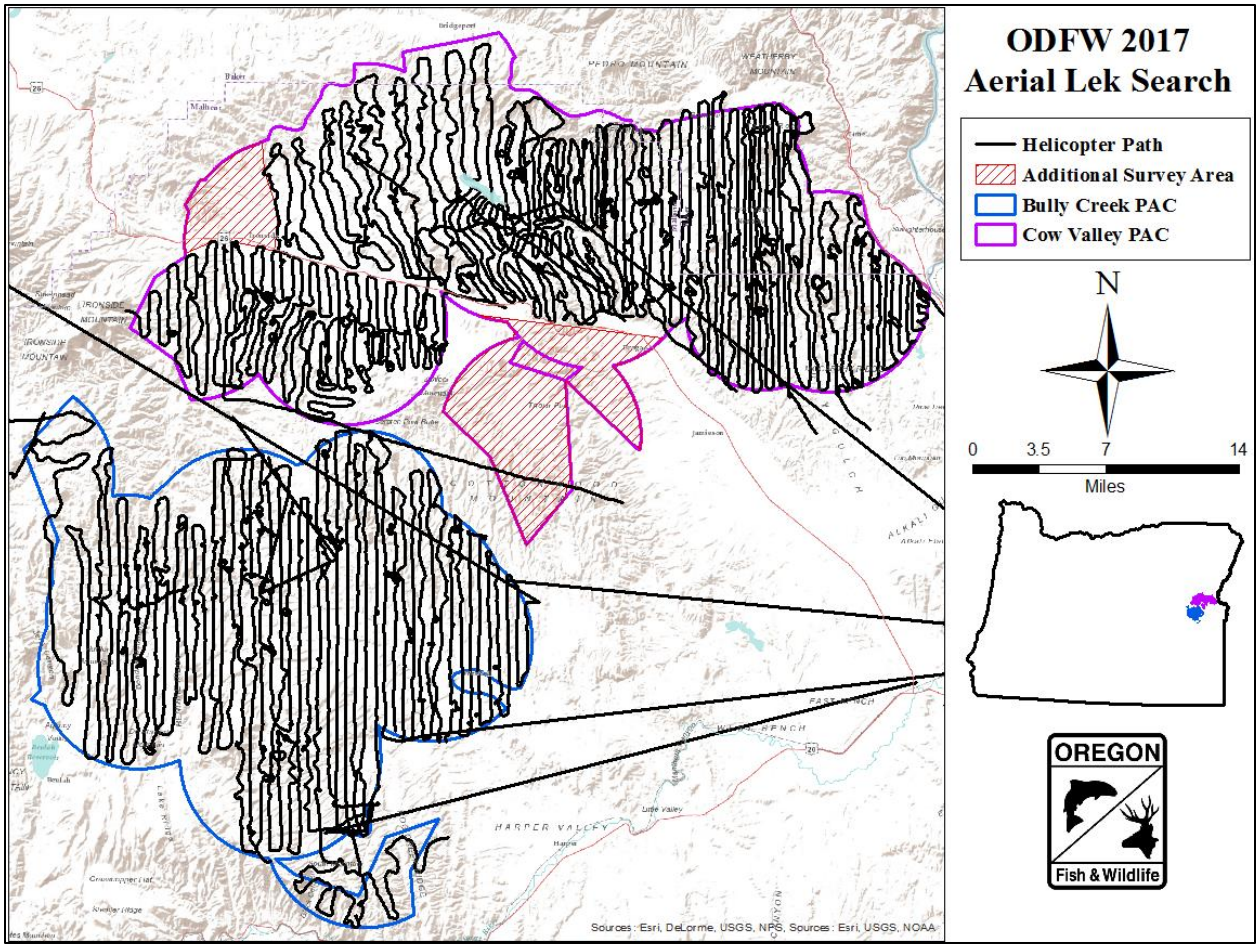


Figure A4.1. Greater sage-grouse aerial lek search transects, and additional areas surveyed where transect data was not recorded, in the Bully Creek and Cow Valley PACs, 2017.