NORTHERN SPOTTED OWL MONITORING ANNUAL REPORT, FY 2014

1. Title:

Demographic characteristics of northern spotted owls (*Strix occidentalis caurina*) in the Klamath Mountain Province of Oregon, 1990-2014.

2. Principal Investigators and Organizations:

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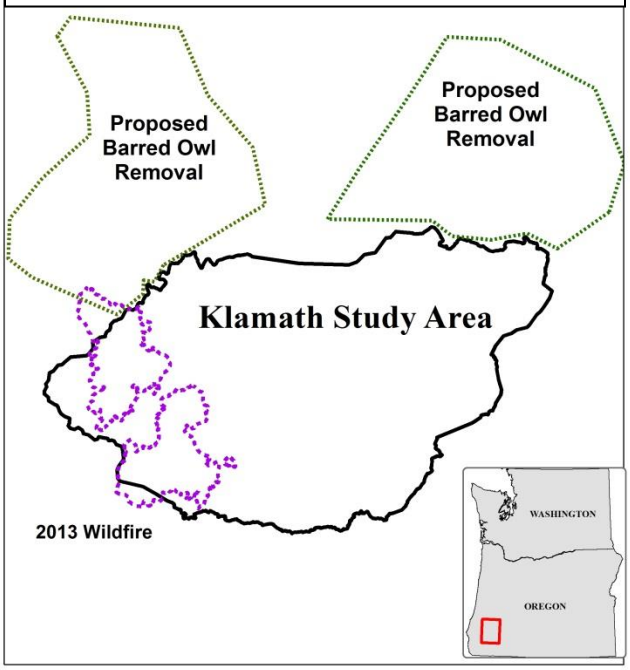
3. Study Objectives:

The study objectives are to estimate the population parameters of northern spotted owls on the Klamath Study Area (KSA) within the Klamath Mountain Province. These parameters include occupancy, survival and reproductive success. The lands are administered by the USDI Bureau of Land Management (BLM), Glendale Field Office of the Medford District and South River Field Office of the Roseburg District.

4. Potential Benefit or Utility of the Study:

Figure 1. Klamath Study Area boundary. Approximate boundaries of the 2013 wildfire and the proposed experimental removal of barred owls.



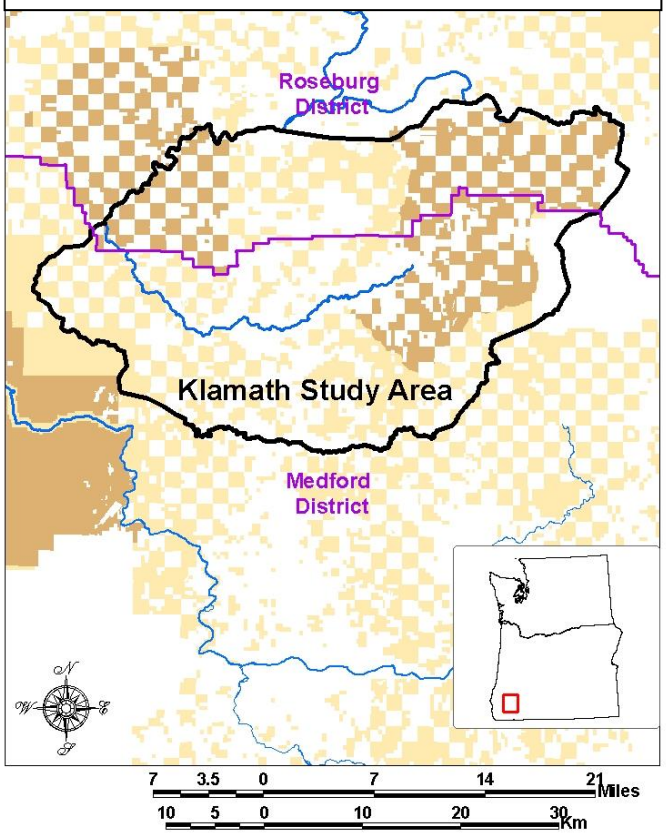
The KSA is one of eight long-term northern spotted owl study areas designed to assess the status and trends in northern spotted owl populations and habitat as directed under the Northwest Forest Plan (USDA and USDI 1994). The data from these studies are analyzed every 5 years as part of a range-wide meta-analysis workshop, and were most recently analyzed using data through 2013 (Dugger et al, *in prep*). An Environmental Impact Statement (EIS) has proposed experimental removal of barred owls in four areas (USDI, 2013) (Figure 1). The Union Myrtle Study Area (UMSA) is one of the four proposed long-term northern spotted owl study areas designed to assess the effects of barred owl removal on the status and trends in northern spotted owl populations as directed under

Recovery Action 29 in the Revised Recovery Plan (USDI 2011). The KSA is considered the control area for this proposal. The survival and reproductive data has and will be used in population modeling to assess the long-term stability of the population (Franklin et al. 1999). Data from several study areas has also been used in the development of habitat suitability models and maps for the spotted owl (Lint et al. 1999, Anthony et al. 2000, Lint 2005, Davis et al. 2011, USFWS 2011).

5. Study Area Description and Survey Design:

The KSA was located within the Klamath Mountains Physiographic Province in Southwestern Oregon and was approximately 1422 km^2 (351,334 ac) in size (Figure 2). This province was characterized by mixed conifer forests dominated by Douglas-fir (*Pseudotsuga menziesii*) and incense cedar (*Calocedrus decurrens*). Other common species included pine (*Pinus* spp.), grand fir (*Abies grandis*), pacific madrone (*Arbutus menziesii*), golden chinquapin (*Castanopsis chrysophylla*), and oak (*Quercus* spp.) (Franklin and Dyrness 1973). Owl sites within the current boundaries of the KSA were systematically surveyed from 1997 to present. A smaller study area (about 466 km^2; 115,138 ac) was systematically surveyed from 1990-1994 and was within the current study area boundary.

Figure 2. Klamath Study Area boundary. Yellow and brown represent federally administered lands, brown represents Late Successional Reserves.



The KSA included portions of two BLM Districts in Western Oregon (Medford and Roseburg) and much of the intervening areas of private and state lands (Figure 2). The federal lands were primarily in an alternating "checkerboard" pattern of ownership with private lands. Of the eight long-term studies, two (Klamath and Tyee) were composed almost entirely of this checkerboard pattern of ownership. Two types of study areas were included in the eight long-term studies: (1) density study areas, where all of the area within the boundary was surveyed each year, and (2) territorial study areas, where all known past and present owl territories were surveyed each year. The KSA was a territory based study area.

The Northwest Forest Plan (NWFP) designated forestland into several land use allocations

(LUA's). One such LUA, Late Successional Reserves (LSR), were designed to maintain a functional, interacting, late-successional and old growth forest ecosystem across the range of the northern spotted owl (USDA and USDI, 1994). The KSA includes part or all of two LSR's designated under the NWFP.

The checkerboard pattern made analysis by ownership or LUA difficult since virtually all sites within an LSR designation also encompass non-LSR within their home range. For the purpose of this analysis, a boundary was drawn around each of the two LSR's in the study. If sites were located within these boundaries they were considered in LSR, even though the private land within these boundaries was not actually designated as LSR.

The study monitored demographic parameters including survival rates, reproductive rates, and annual rate of population change. The protocol used to determine site occupancy, nesting, and reproductive status for this study follows the guidelines specified by the Northern Spotted Owl Effectiveness Monitoring Plan for the Northwest Forest Plan (Lint et al. 1999). An attempt was made to uniquely color band all newly detected owls and re-observe all previously banded individuals within the study. The re-observation of banded owls was used for the calculation of survival rates and population trends (Franklin et al. 1999, Burnham et al. 1996, Anthony et al. 2006, Forsman et al. 2011a).

6. Results for FY 2014:

Survey Effort

There are currently 158 known spotted owl sites within the KSA (Appendix A). During the period of study, it was determined that four sites previously considered separate sites, were different use areas of another site and have since been combined with other sites. Of the 158 sites surveyed during 2014; 38 were occupied by a pair, 9 by a single, and 14 were occupied by one or two owls with unknown status (Appendix A). At least one spotted owl was detected at 61 (38.6 %) of the sites (Appendix A).

Spotted Owl Occupancy

We identified 102 individual, non-juvenile, spotted owls (54 males and 48 females) in 2014, resulting in a male:female ratio of 1.13:1 (Appendix B). Of the 87 non-juvenile owls where age was determined, 87 (100.0%) were adults and 0 (0.0%) were subadults (Appendix B). The oldest known owl within the KSA was a male at 20 years old. The oldest known female was at least 17 years old. A total of 30 owls were newly banded during 2014; 28 (93.3%) were fledglings, two (6.7%) were adults, and none were subadults. During July 2013, a large wildfire with a perimeter of more than 16,000 ha (40,000 ac) impacted the western edge of the study area (Figure 1). The burn severity varied; approximately 25 demographic sites were within the perimeter, approximately 5 of those sites had a substantial amount of suitable habitat severely burned. The small number of sites with major impacts and the short time frame means any conclusions regarding occupancy or reproduction would be inappropriate.

Spotted Owl Reproduction

Yearly reproductive data (Appendix C, D) includes nesting attempts, nesting success, fecundity rate, and mean brood size. The proportion of nesting attempts is defined as the number of females that attempted to nest versus the number where nesting status was determined. Nesting success is defined as the proportion of nesting females that fledged young. The fecundity rate is defined as the number of female young produced per female versus the number of sites where the number of young produced was determined. The mean brood size is defined as the average number of young produced per successfully reproducing pair.

Where appropriate, the data were split into four female age classes; 1-year old, 2-year old, adult, and unknown age. The reproductive data were summarized two ways: (1) the entire KSA and (2) by LUA (LSR and non-LSR) (Appendix E).

There were a total of 35 sites where nesting status was determined in 2014, 20 territories nested (57.1%) and 15 territories did not nest (42.9%). Sixteen nesting attempts resulted in successfully fledged young and four failed, resulting in a nesting success rate of 80.0% (Appendix D).

The fecundity rate for all age classes in the KSA during 2014 was 0.366 (Appendix C). The fecundity rate for all sites during the years 1990-2014 was split into four female age classes. The rate for 1-year olds (0.064) was much lower than 2-year olds (0.304), adults (0.330), and unknown age class (0.266) (Table 1).

In 2014, the mean brood size was 1.67. The mean brood size for the years 1990-2014 was split into four female age classes, all known age classes resulted in similar values (Table 1).

Table 1. Fecundity rate and mean brood size by age class of female within the KSA (1990-2014). [a]

Age class	**Mean fecundity (N), 1990-2014**	**95% CI for fecundity**	**Mean brood size (N), 1990-2014**	**95% CI for brood size**
1-yr	0.064 (94)	0.016-0.111	1.71 (7)	1.35-2.08
2-yr	0.304 (138)	0.237-0.372	1.50 (56)	1.37-1.63
Adult	0.330 (1468)	0.309-0.352	1.59 (610)	1.55-1.63
Unk	0.266 (48)	0.164-0.367	1.32 (19)	1.10-1.53
Total	0.312		1.57	

[a] Preliminary data, values may change.

Spotted Owl Dispersal

Two owls originally banded as juveniles within the KSA were recaptured for the first time during 2014 (Appendix F).

Figure 3. The annual average distance of non-juvenile movements within the KSA (1990-2014). Only movements within the KSA are included. A polynomial trend line is plotted (r^2 = 0.379).

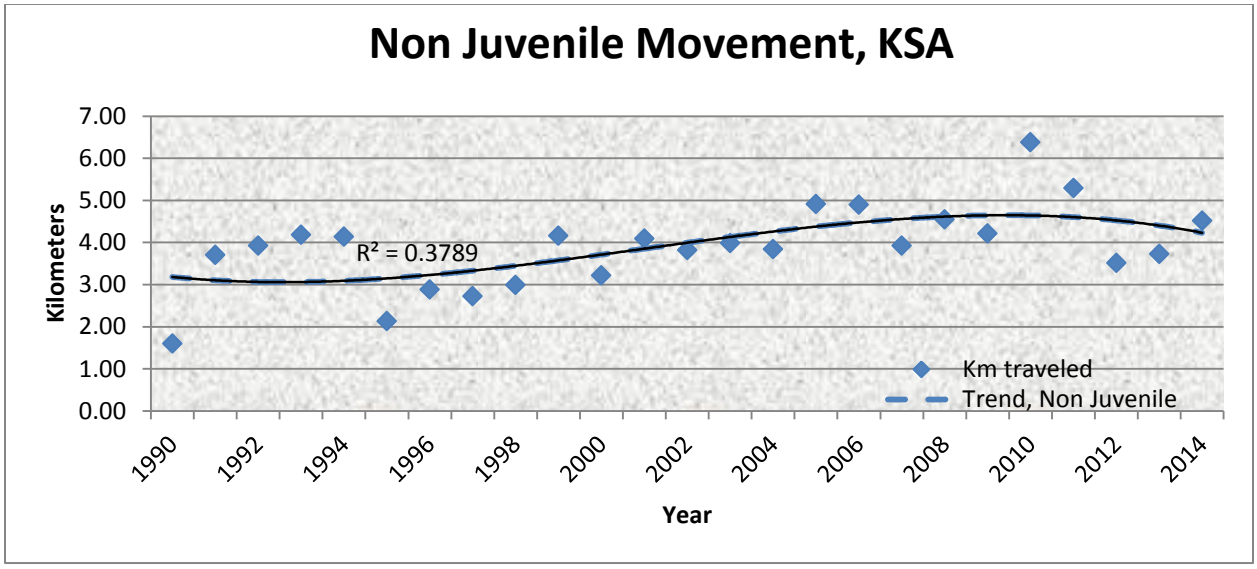
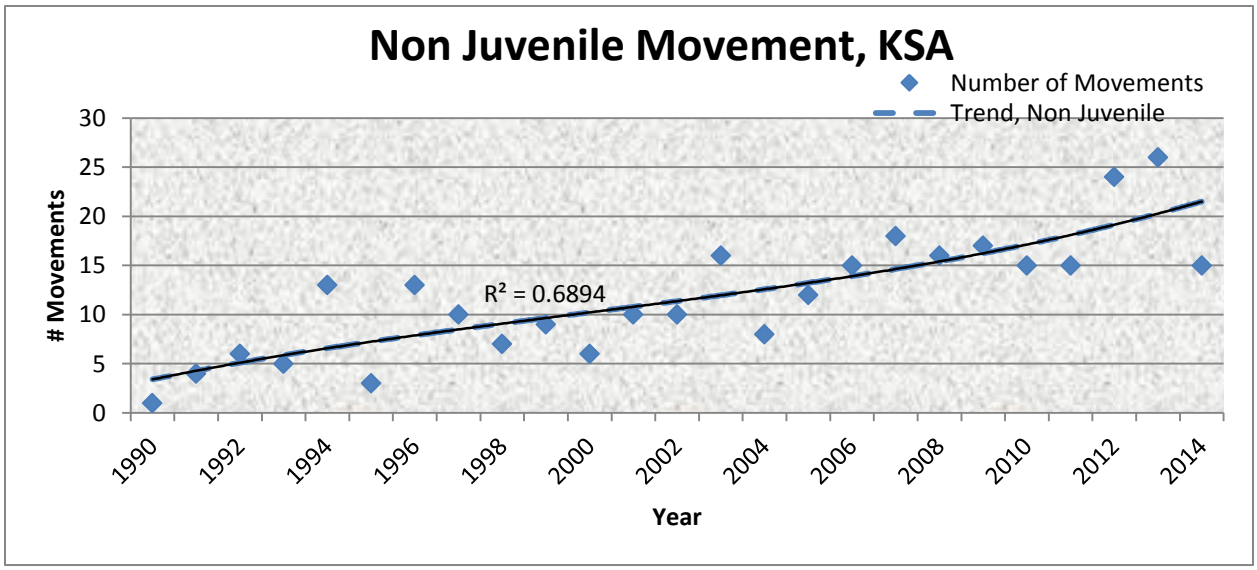


Figure 4. The annual number of non-juvenile movements within the KSA (1990-2014). Only movements within the KSA are included. A polynomial trend line is plotted (r^2 = 0.689).



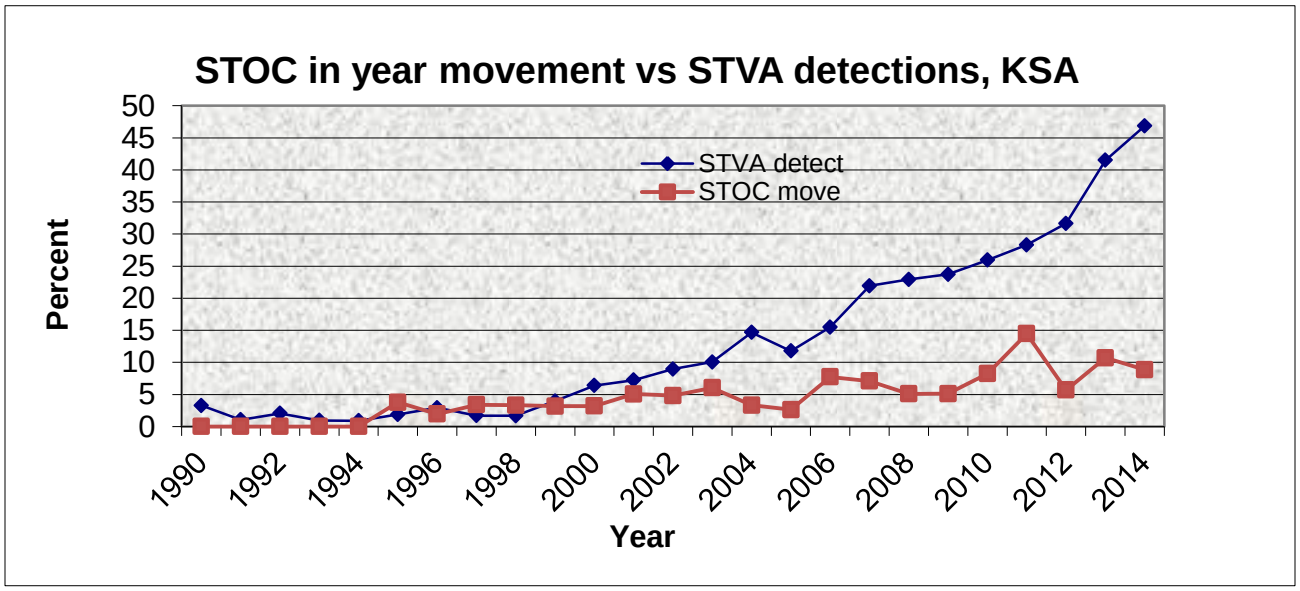
The average distance of between year movements for non-juveniles within the KSA, during 2014, was 4.5 km (2.8 mi); 5.1 km (3.2 mi) (N=6) for males and 4.1 km (2.6 mi) (N=9) for females (Figure 3). The number of between year movements has been steadily increasing

and the trend line fits the data quite well (r^2 = 0.689) (Figure 4). Within year movement of non-juveniles is documented when owls are positively identified at more than one site during the same year. The percent of within year movement is calculated as the number of owls identified at each different site versus the total number owls uniquely identified on the study (Appendix B and F). Within year movements of spotted owls have tended to increase (Figure 5) as the percent of barred owl detections increases within the study area (r^2 = 0.625).

Barred Owl

There were at least 126 non-juvenile barred owls (*Strix varia*) detected at 74 sites on the KSA during 2014. We detected a pair of barred owls at 39 sites and a single at 35 sites. Fledglings were detected at 13 of the sites during 2014. Two hybrids were detected in 2014, 1 of the hybrids paired with a female spotted owl and produced 1 fledgling. We compared the percentage of sites that were surveyed where at least one spotted owl was detected versus at least one barred owl detected (Figure 6). This comparison includes the Union Myrtle Study Area (UMSA) north of the KSA where an Environmental Impact Statement (EIS) has proposed experimental removal of barred owls (USDI, 2013) (Figure 1). The barred owl detections were incidental to spotted owl surveys; therefore the number of sites with at least one barred owl detection is probably underestimated. The percentage of spotted owl sites with barred owl detections is steadily increasing, from less than 10% in all years previous to 2003, to greater than 10% in all years beginning with 2003 (Appendix A).

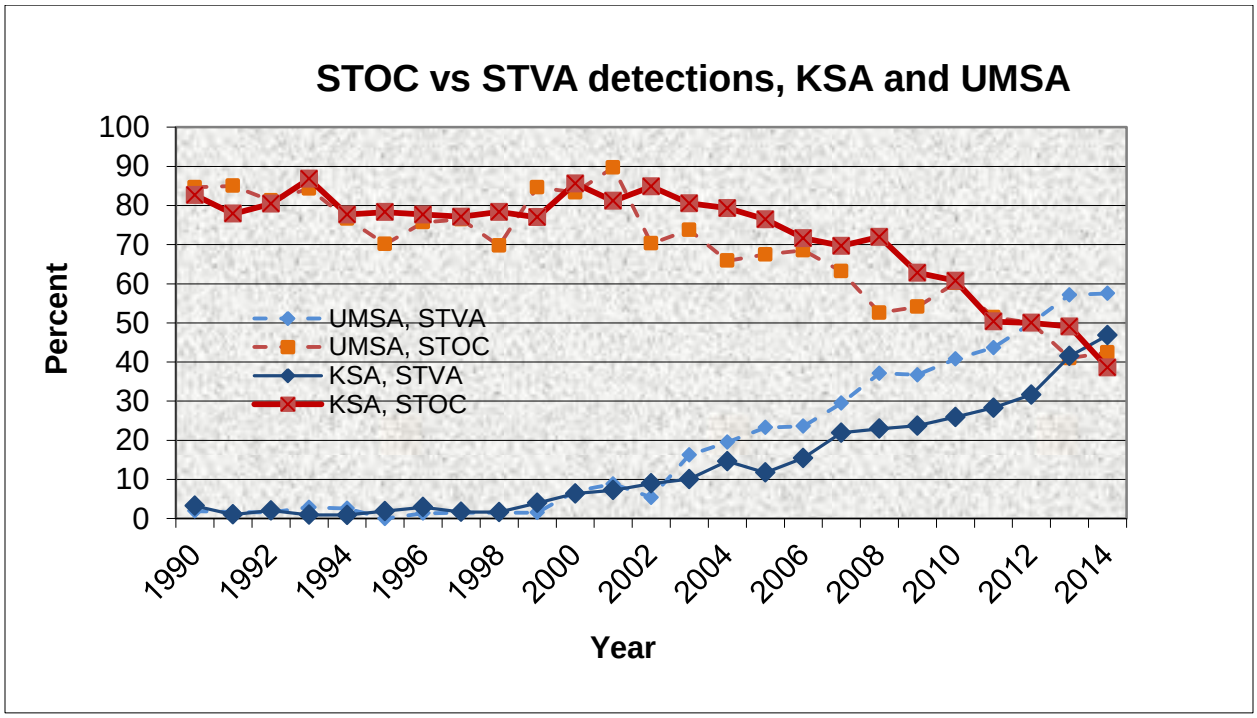
Figure 5. Percentage of within year spotted owl movements versus sites with at least one barred owl detection. Klamath Study Area, 1990-2014.



We compared the fecundity rate of spotted owls at sites with barred owl detections and sites without known barred owl detections (Figure 7). The fecundity rate during 2014 was 0.200

(N=5) at sites with barred owl presence, and 0.371 (N=35) at sites without known barred owl presence. The average spotted owl fecundity rate from 1999-2014 was 0.178 (N=86) at sites with barred owl presence, and 0.286 (N=1130) at sites without known barred owl presence. The beginning year of 1999 was chosen since it was the first year any barred owls were detected at a site where spotted owl reproductive status was determined. Before barred owl detections at all the sites within the study area exceeded 10% (1990-2002), the fecundity rate for all sites was 0.393. The fecundity rate was 0.228 after barred owl detections at all the sites within the study area exceeded 10% (2003-2014). The 10% threshold was chosen to estimate a low level of barred owl presence, below which there would be limited effect on spotted owl territories and population.

Figure 6. Percentage of sites surveyed with at least one spotted owl detection versus sites with at least one barred owl detection. Klamath Study Area (KSA) and proposed experimental barred owl removal area (UMSA), 1990-2014.

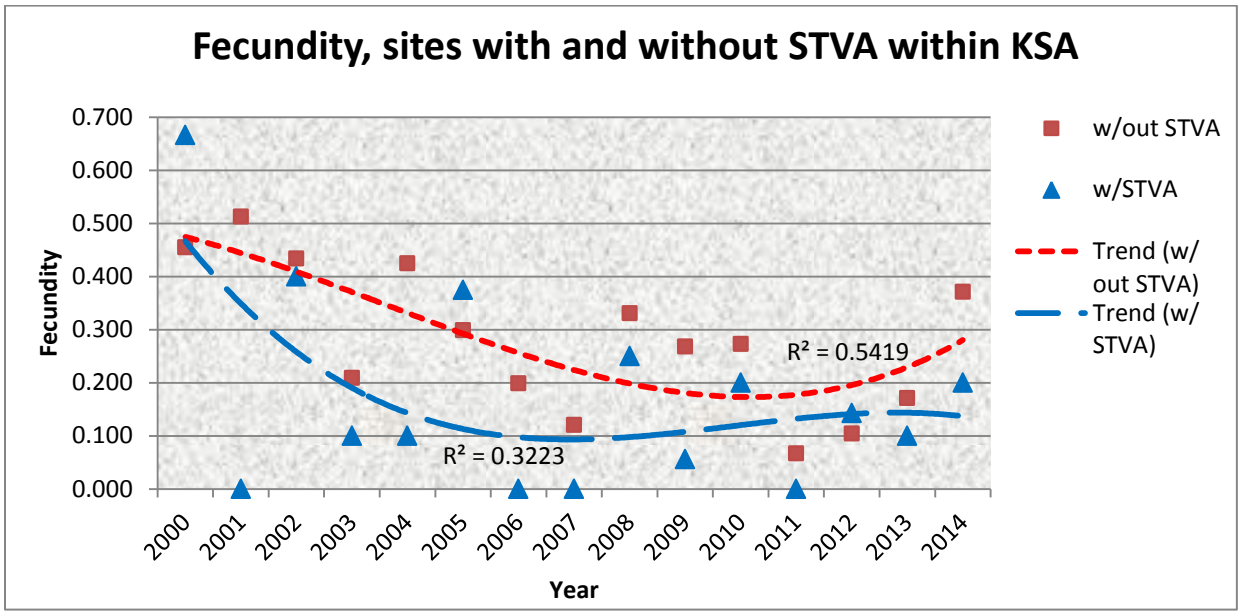


7. <u>Discussion for FY 2014</u>:

Survey Effort

The survey effort within the KSA has varied over time, however the general trend has been an increase in the number of sites located and surveyed (Appendix A). The KSA boundaries were established in 1997 and the survey effort increased significantly until about 2003, and has remained relatively steady since. Although most of the area within this boundary is covered by territorial surveys, it is not a density study and some area may not be surveyed.

Figure 7. Spotted owl fecundity rate at sites with and without known STVA detections (1999-2014). Polynomial trend lines are plotted.



Spotted Owl Occupancy

In recent years there has been a steady decline in the number of non-juveniles detected (Appendix B) and an even larger decrease in the number of pairs detected (Appendix A). The number of non-juveniles detected in 2014 (102) was the lowest ever documented on the study area (Appendix B). The number of individual spotted owls during 2014 was 54.3% fewer than the high of 223 during 2002. The sex ratio of male:female was closer to the average, 1.13:1, compared to the highly skewed ratio towards males during 2013. The decline in the number of pairs was even more sizeable than the decline of individuals, with 61.2% fewer detected in 2014 than the high of 98 during 2005. The number of pairs detected on the study area has declined every year since 2005. The 38 pairs detected during 2014 was the lowest number documented during the study period. Although the number of sites surveyed during this period has remained relatively constant, the number of pairs detected at sites has declined and the number of unoccupied sites has increased (Appendix A). While the recent meta-analysis (Forsman et al, 2011a) indicated that survival on the KSA was stable through 2006, the most recent data regarding occupancy has shown a steady and rapid decline, which suggests the stability of the population may be in question.

The decrease in the number of subadults is even more pronounced than the decrease within all non-juvenile age classes. The highest proportion of subadults ever documented in the KSA (25.1%) occurred during 2003 and has declined to under 10% during each of the past eight years (Appendix B). The proportion (0.0%) during 2014 was the first year that no subadults were documented on the study area. Some of this decline may be explained by an extended period of very low fecundity corresponding to subsequent years of fewer subadults

recruited into the population. Another indicator of recruitment is the number of juveniles banded on the KSA that survive and are subsequently recaptured within the KSA. Using only internal recruitments helps reduce the bias from varied survey effort at sites off the study area. The number of internal recruits remained fairly high from 2000 through 2007 and has been much lower the past seven years. Two juveniles previously banded within the KSA were recaptured within the KSA during 2014, one of the lowest numbers ever documented (Appendix F).

Spotted Owl Reproduction

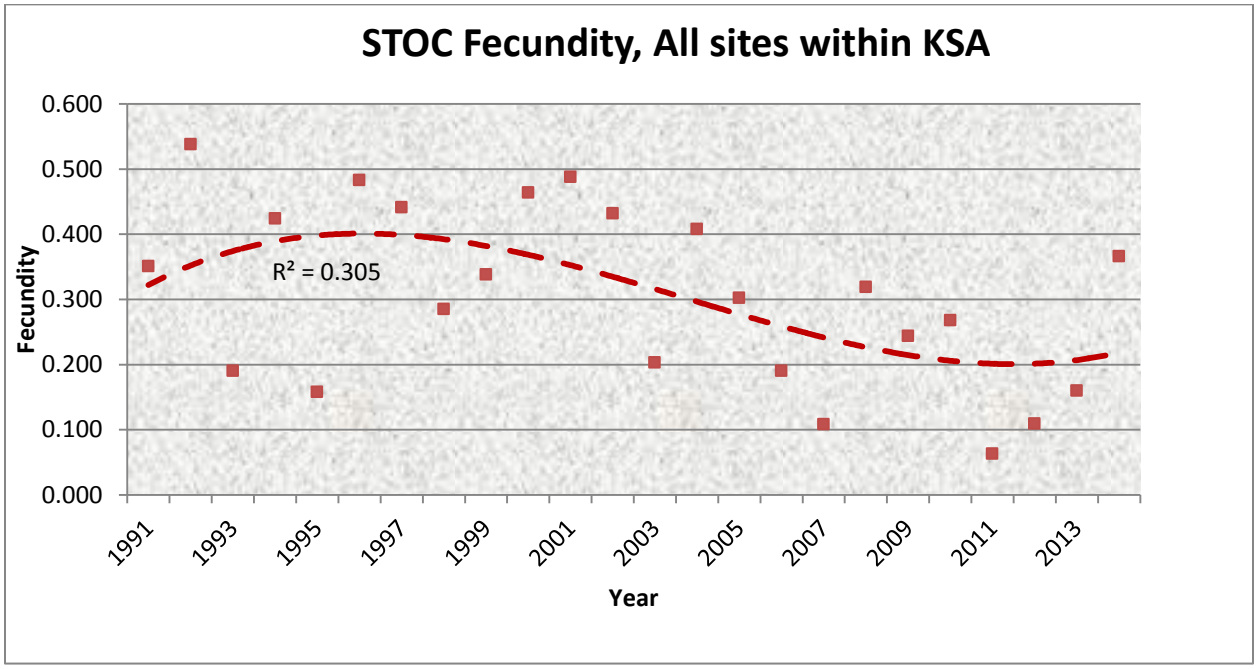
Nesting status was determined at 35 of the 38 sites where reproductive status was eventually determined during 2014. This high level of nest status determination results in a more accurate calculation of nest success and a more accurate count of the number of young fledged. The number of sites where nest status was determined has decreased every year since 2005 (N-90), and appears directly related to the decrease in pair occupancy.

The nest success rate for 2014 (80.0%) was higher than the 1990-2014 average of 74.4%. Nesting success during the previous 2 years (2012-2013) was also above the 24 year average (Appendix D), however this is offset by the declining number of pairs available for reproductive output during those years. Mean brood size was 1.67 in 2014, slightly higher than the average for all years (1.56, Appendix C). Although the nest attempt rate, nest success rate and mean brood size during 2014 were all above average, the continuing decline in pair occupancy results in fewer fledglings produced than during earlier years when reproductive rates were lower but pair occupancy was much higher (Appendix B, C, D).

Fecundity increases from 1-year old to adult age classes on the KSA. Our most recent analysis shows a very low fecundity rate of 0.064 for 1-year olds, while the rate for 2-year olds was very similar to the adult rate (0.304 and 0.330, respectively) (Table 1). This follows the trend that Loschl (2008) reported for data from the Oregon Coast Range, where the mean annual number of young fledged increased at a constant rate from 1-year old through 4-year olds, then remained constant. The mean brood size varied by age class, with the 1-year old age class actually having the highest rate (1.71), however the sample size was very small.

The fecundity rate for 2014 was 0.366, which was higher than the average for the years 1990-2014 (0.314) (Appendix C). While the fecundity rate for spotted owls is known to fluctuate, we documented only 2 years (including 2014) during the most recent 10 years where the fecundity rate was above the overall average, and the rate appears to be in a downward trend (Figure 8). Forsman et al. (2011a) noted that the fecundity rate on the KSA was declining and the most recent data agrees with this conclusion. The number of fledglings detected within the KSA during 2014 (31) was lower than the overall mean (44) and the most recent 6 years all had a lower number of fledglings detected on the study area than the overall mean (Appendix B). Although the fecundity rate during 2014 was above average, a combination of the downward trend in fecundity rates, the downward trend in number of pairs, and the declining number of non-juveniles may indicate problems with maintaining a stable population.

Figure 8. Spotted owl fecundity at all sites surveyed, KSA 1990-2014. A polynomial trend line is plotted (r^2 = 0.305).



The yearly fecundity rates for sites within an LSR compared to sites outside the LSR boundary are given in Appendix E. The NWFP became effective in the spring of 1994. Data presented here are for the combined years before and after the effective date. Fecundity rates for LSR sites compared to non-LSR sites, both before and after the NWFP implementation, indicate similar trends. There was a decrease in average fecundity rates after the NWFP implementation for both LSR (0.411 versus 0.287) and non-LSR (0.399 versus 0.295) sites. The fecundity rate during 1990-2014 was virtually identical for LSR sites and for non-LSR sites. After the NWFP implementation, the timber harvest level on federal land decreased significantly. This resulted in less difference in habitat loss between LSR and non-LSR, which may partially explain the similar fecundity rates.

Barred Owl Influence on Spotted Owl Occupancy

It is clear that the barred owl population is increasing across the range of the northern spotted owl. The most recent meta-analysis (Forsman et al., 2011a) indicates that the spotted owl populations have declined across most of the range, with the most significant declines occurring in Washington where the barred owl has been present the longest. Analysis of all three of the study areas in Washington indicated declining spotted owl populations. Although analysis within the KSA indicated a stable spotted owl population during the study period (1992-2006) (Forsman et al. 2011a), the recent data may indicate a change towards a declining population. The numbers of barred owls continued to increase, while spotted owl occupancy and fecundity continued to decrease.

The number of individual barred owl detections was increasing during recent years and

2014 was the highest number ever detected. In addition, many of these detections appear to comprise more than one pair of barred owls within a single spotted owl site. Multiple detections at a site are estimated using a home range distance separating detections during a season or simultaneous responses. There were at least 126 non-juvenile barred owls detected on the KSA during 2014 compared to 104 during 2013. The numbers may be underestimated since barred owl detections were incidental during surveys where spotted owl calls were used, and Wiens (2011) noted that barred owls were more likely to respond to a conspecific call versus a spotted owl call (0.66/visit vs. 0.48/visit). However, as the numbers of spotted owl pairs decline, any underestimation may become lower since Bailey et al. (2009) noted that barred owls are often twice as likely to be detected if spotted owls are not present.

Using simple presence of at least one owl at a site, there was a proportional increase in the number of sites with barred owl detections during the last few years. This increase agrees with the increase in the number of individual detections noted above. Beginning in 2004, the number of barred owls detected has increased in each subsequent year (Figure 6). Barred owls were detected on the highest percentage of sites during 2014, and the percentage of sites where spotted owls were detected was the lowest of any year.

There has been a rapid increase in barred owl detections on the Tyee Density study area north of the KSA (Forsman et al. 2011b). On the Tyee Density study, the number of sites where barred owls were detected exceeded the number of sites where spotted owls were detected for the first time in 2009, and has remained above since. On the KSA, the number of sites where barred owls were detected exceeded the number of sites where spotted owls were detected for the first time in 2014 (Figure 6). The trends on the KSA seem to be similar to the trends on the Tyee Density study with a 3-5 year lag period. It is probable that barred owls will continue their expansion south affecting spotted owl detections and population trends (Kelly 2001).

Bailey et al. (2009) and Crozier et al. (2006) determined that the presence of barred owls negatively affected the detection probabilities of spotted owls. Olson et al. (2005) determined that barred owl presence positively affected local-extinction probabilities or negatively affected colonization probabilities of spotted owls. They concluded that a further decline in the proportion of sites occupied by spotted owls is expected. The steady decline in the number of pairs and the number of non-juveniles on the KSA since 2002 (Appendix A, B) seems to indicate that the KSA population may be experiencing these effects.

It has been postulated that the spotted owl population will experience internal movements in reaction to barred owl disruption of territories. The numbers of non-juvenile movements, between years and within years, were consistently higher within the study during recent years (2003-2014) (Appendix F, Figure 4, Figure 5) compared to pre-2003 data. Data on the distance of non-juvenile movements indicated a slight upward trend in distance moved since 2003 (Figure 3). Forsman et al (2011b) noted an increase of non-juvenile movements as well as an increase in the number of individuals located at multiple sites during the same year on the Tyee Density study area. There appears to be a trend of increasing numbers of between year movements and within year movements of spotted owls within the KSA

(Figure 5) that seems to agree with Forsman et al. (2011b). Since fewer sites were surveyed in the earlier years, the numbers are not directly comparable but the trend is towards increasing numbers of movements. While some of the increase of within year movements may be due to crew experience and an increased ability to identify within year movements, the increase is large enough that it is likely real and possibly associated with barred owl presence. These data indicate that a disruption of territorial fidelity within the KSA may be occurring.

Barred Owl Influence on Spotted Owl Reproduction

We compared fecundity rates at sites with and without barred owl influences using two methods. One method was a site specific rate that compares fecundity at sites with barred owl presence to sites where barred owls have not been detected. The second method is a coarse scale rate that compares the study wide fecundity during years with low barred owl presence (1990-2002) to years with higher barred owl presence (detections at >10% of sites) (2003-2014). Because barred owl detections were incidental, the results from sites where spotted owl reproduction was determined may be biased low. However, any survey bias comparing reproductive versus non reproductive sites should be somewhat similar since most visits to occupied sites occur diurnally. The site specific fecundity rate from 1999-2014 at sites with known barred owl presence was 0.178 compared to 0.286 at sites where barred owls were not detected. The average fecundity at a coarse scale was 0.393 (1990-2002) compared to 0.228 (2003-2014) (Figure 8). The site specific analysis and coarse scale analysis give similar results. In both cases, barred owl presence appears to reduce spotted owl fecundity rates. These individual and cumulative year data indicate barred owl presence may be having a negative impact on spotted owl reproduction and is consistent with findings from Forsman et al. (2011a) which included analysis of the KSA through 2008. Glenn (2009) and Olson et al. (2004) also noted that there was a negative association with barred owl presence and reproduction in their respective analysis.

There is mounting evidence that barred owls may be negatively impacting the spotted owl population within the KSA. This is illustrated by several apparent population trends: (1) spotted owl detections have been steadily decreasing (Figure 6) and reached the lowest point in 2014, when barred owl detections reached their highest level; (2) fecundity rates appear to be declining (Figure 8) and in only 2 of the previous 10 years was the rate above the 25 year average; and (3) the fecundity rate for sites with known barred owl presence was lower than at other sites and is continuing to decline. Forsman et al. (2011a) noted that the consistency of the negative associations between spotted owl demographic rates and the presence of barred owls supports the conclusion that barred owls are having a negative effect on spotted owl populations. The recent KSA data, with the combination of decreasing occupancy and reduced fecundity, appears to reinforce this conclusion.

8. Acknowledgments:

Many people and organizations contributed to the success of this project. Without the dozens of dedicated people collecting the field data, none of this could have been accomplished. In addition, biologists from surrounding areas have contributed information regarding owl movements. Several private timber companies have been gracious enough to

allow access to sites on their property. Funding for range wide demographic studies comes from BLM, USDA Forest Service, and the National Park Service.

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Appendix A. Territories surveyed and occupancy results by year within the KSA (1990-2014). [a]

Year	Total Sites[b]	Sites w/ STVA[c]	Total STVA ind[d]	Sites w/ Pair[e]	Sites w/ single	Sites w/ undetermined status[f]	Total occupied sites	Sites w/ no occ[g]	Sites w/ incomplete survey[h]
1990	92	3	4	56	10	10	76	14	7
1991	95	1	1	59	11	4	74	18	11
1992*	97	2	2	57	12	9	78	17	11
1993*	106	1	1	64	15	13	92	13	9
1994*	112	1	1	71	4	12	87	22	9
1995*	106	2	2	61	11	11	83	18	16
1996	103	3	4	60	7	13	80	21	19
1997	118	2	2	61	13	17	91	25	9
1998*	120	2	3	76	11	7	94	22	11
1999*	126	5	6	74	9	14	97	26	6
2000*	125	8	10	71	16	20	107	14	8
2001*	138	10	15	86	12	14	112	21	1
2002	145	13	16	96	10	17	123	18	1
2003	149	15	23	96	11	13	120	21	0
2004	150	22	28	97	10	12	119	27	0
2005	153	18	27	98	12	7	117	32	1
2006	155	24	31	90	11	10	111	34	1
2007	155	34	52	82	15	11	108	38	1
2008	157	36	52	80	12	21	113	36	0
2009	156	37	60	76	8	14	98	52	2
2010	158	41	63	69	12	15	96	51	0
2011	159	45	62	52	13	15	80	58	0
2012	158	50	86	51	11	17	79	71	1
2013	159	66	104	48	13	17	78	70	0
2014	158	74	126	38	9	14	61	81	1

[a] Preliminary data, values may change.
[b] Sites surveyed to protocol.
[c] STVA occupancy is opportunistic and is defined as any detection at the site.
[d] Total STVA individuals is an estimate based biologist opinion if multiples occupy the same site.
[e] Pair as defined in Lint et al 1999.
[f] Undetermined status may include one or 2 owls, does not qualify as a pair or resident single.
[g] No occupancy determined with at least 3 survey visits. The sum of this column and the total occupied sites column may not equal the total sites number since sites with the same individual located at 2 sites during the same year are not considered as occupied at one of the sites.
[h] Incomplete survey is 2 visits or less (usually no visits, only includes sites surveyed in previous years).
* represents years with a site where the pair was comprised of a spotted owl and a barred owl which was included as a "site with single".

Appendix B. Sex and age composition of spotted owls located within the KSA (1990-2014). Non-juvenile owls where the sex could not be determined are not included. [a]

Year	Adult (M,F)	Subadult (M,F)	Percent Subadult	Age unk (M,F) [b]	Total non-juvenile (M,F)	Juvenile
1990	102 (58,44)	16 (10,6)	13.6	22 (11,11)	140 (79,61)	52
1991	111 (60,51)	18 (9,9)	14.0	13 (6,7)	142 (75,67)	40
1992	106 (61,45)	18 (8,10)	14.5	18 (11,7)	142 (80,62)	59
1993	113 (61,52)	24 (13,11)	17.5	28 (17,11)	165 (91,74)	22
1994	122 (67,55)	27 (12,15)	18.1	18 (9,9)	167 (88,79)	55
1995	118 (66,52)	9 (1,8)	7.1	19 (14,5)	146 (81,65)	18
1996	110 (60,50)	8 (4,4)	6.8	29 (15,14)	147 (79,68)	56
1997	112 (57,55)	22 (15,7)	16.4	26 (11,15)	160 (83,77)	52
1998	127 (69,58)	28 (15,13)	18.1	20 (9,11)	175 (93,82)	41
1999	133 (74,59)	17 (6,11)	11.3	29 (14,15)	179 (94,85)	44
2000	136 (74,62)	19 (10,9)	12.3	28 (18,10)	183 (102,81)	65
2001	151 (80,71)	35 (20,15)	18.8	19 (14,5)	205 (114,91)	82
2002	154 (85,69)	48 (21,27)	23.8	21 (14,7)	223 (120,103)	83
2003	152 (85,67)	51 (23,28)	25.1	14 (10,4)	217 (118,99)	38
2004	171 (93,78)	29 (11,18)	14.5	19 (14,5)	219 (118,101)	75
2005	191 (106,85)	19 (3,16)	9.0	8 (7,1)	218 (116,102)	61
2006	170 (91,79)	19 (5,14)	10.1	14 (11,3)	203 (107,96)	35
2007	162 (85,77)	16 (7,9)	9.0	12 (8,4)	190 (100,90)	19
2008	161 (82,79)	9 (4,5)	6.3	21 (13,8)	191 (99,92)	53
2009	150 (76,74)	10 (5,5)	5.2	15 (12,3)	175 (93,82)	38
2010	137 (71,66)	12 (7,5)	8.1	20 (12,8)	169 (90,79)	38
2011	111 (58,53)	8 (5,3)	6.7	17 (14,3)	136 (77,59)	7
2012	110 (54,56)	9 (7,2)	7.6	15 (10,5)	134 (71,63)	12
2013	105 (58,47)	2 (0,2)	1.9	26 (21,5)	133 (79,54)	15
2014	87 (44,43)	0 (0,0)	0.0	15 (10,5)	102 (54,48)	31

[a] Preliminary data, values may change.
[b] It is possible some of the unknown are auditory responses and the same individuals as included in another category.

Appendix C. Fecundity rate and mean brood size by year within the KSA (1990-2014). Years with an * represent years when backpack transmitters were attached to females during the nesting season, these sites are excluded from the calculation. [a]

Year	Mean fecundity (N)	95% CI for fecundity	Mean brood size (N)	95% CI for brood size
1990*	0.521 (48)	0.397-0.644	1.61 (31)	1.44-1.79
1991*	0.351 (57)	0.233-0.468	1.67 (24)	1.44-1.89
1992*	0.538 (53)	0.423-0.652	1.50 (38)	1.31-1.69
1993	0.190 (58)	0.100-0.279	1.47 (15)	1.21-1.73
1994	0.424 (66)	0.308-0.541	1.81 (31)	1.64-1.97
1995	0.158 (57)	0.076-0.240	1.38 (13)	1.11-1.66
1996	0.483 (58)	0.378-0.588	1.47 (38)	1.34-1.61
1997	0.441 (59)	0.322-0.559	1.73 (30)	1.57-1.89
1998	0.285 (72)	0.198-0.371	1.37 (30)	1.19-1.54
1999	0.338 (65)	0.231-0.446	1.69 (26)	1.51-1.87
2000	0.464 (70)	0.366-0.563	1.51 (43)	1.36-1.66
2001	0.488 (84)	0.387-0.589	1.78 (46)	1.66-1.90
2002	0.432 (96)	0.344-0.520	1.60 (52)	1.49-1.70
2003	0.203 (96)	0.136-0.271	1.34 (29)	1.17-1.52
2004	0.408 (92)	0.319-0.496	1.56 (48)	1.42-1.70
2005	0.302 (101)	0.220-0.384	1.61 (38)	1.45-1.76
2006	0.190 (92)	0.116-0.264	1.59 (22)	1.38-1.80
2007	0.108 (88)	0.046-0.170	1.73 (11)	1.45-2.00
2008	0.319 (83)	0.234-0.404	1.43 (37)	1.27-1.59
2009	0.244 (78)	0.153-0.334	1.73 (22)	1.54-1.92
2010	0.268 (72)	0.181-0.355	1.41 (27)	1.22-1.60
2011	0.063 (56)	0.006-0.119	1.40 (5)	0.92-1.88
2012	0.109 (57)	0.035-0.183	1.50 (8)	1.13-1.87
2013	0.160 (49)	0.067-0.252	1.50 (10)	1.17-1.83
2014	0.366 (41)	0.229-0.503	1.67 (18)	1.44-1.89
1990-2014	**0.314**		**1.56**	

[a] Preliminary data, values may change.

Appendix D. Proportion of nesting attempts at sites with nest status determined, and proportion of nest success by year within the KSA (1990-2014). Years with an * represent years when backpack transmitters were attached to females during the nesting season, these sites are excluded from the calculation. [a]

Year	Nest Attempt Proportion (N)	95% CI for Nest Attempts	Nest Success Proportion (N)	95% CI for Nest Success
1990*	0.842 (38)	0.725-0.960	0.750 (32)	0.598-0.902
1991*	0.696 (46)	0.561-0.830	0.688 (32)	0.524-0.851
1992*	0.783 (46)	0.662-0.903	0.889 (36)	0.785-0.993
1993	0.391 (46)	0.249-0.534	0.722 (18)	0.509-0.935
1994	0.600 (55)	0.469-0.731	0.818 (33)	0.685-0.952
1995	0.462 (39)	0.303-0.620	0.667 (18)	0.443-0.891
1996	0.872 (39)	0.765-0.978	0.853 (34)	0.732-0.974
1997	0.540 (50)	0.400-0.680	0.963 (27)	0.890-1.036
1998	0.660 (53)	0.532-0.789	0.618 (34)	0.452-0.783
1999	0.472 (53)	0.336-0.607	0.880 (25)	0.750-1.010
2000	0.776 (58)	0.668-0.884	0.844 (45)	0.737-0.952
2001	0.716 (74)	0.613-0.820	0.849 (53)	0.752-0.946
2002	0.667 (90)	0.569-0.765	0.850 (60)	0.759-0.941
2003	0.506 (83)	0.398-0.614	0.595 (42)	0.445-0.745
2004	0.614 (88)	0.511-0.716	0.852 (54)	0.756-0.947
2005	0.600 (90)	0.498-0.702	0.611 (54)	0.480-0.742
2006	0.375 (88)	0.273-0.477	0.606 (33)	0.437-0.775
2007	0.224 (76)	0.129-0.318	0.647 (17)	0.413-0.881
2008	0.613 (75)	0.502-0.724	0.783 (46)	0.662-0.903
2009	0.449 (69)	0.331-0.568	0.677 (31)	0.510-0.845
2010	0.787 (61)	0.683-0.891	0.500 (48)	0.357-0.643
2011	0.208 (48)	0.092-0.324	0.500 (10)	0.173-0.827
2012	0.208 (48)	0.092-0.324	0.800 (10)	0.539-1.061
2013	0.267 (45)	0.136-0.397	0.833 (12)	0.613-1.054
2014	0.571 (35)	0.405-0.738	0.800 (20)	0.620-0.980
1990-2014	**0.556**		**0.744**	

[a] Preliminary data, values may change.

Appendix E. Fecundity rate and mean brood size by Land Use Allocation and year within the KSA. Years with an * represent years when backpack transmitters were attached to females during the nesting season, these sites are excluded from the calculation. [a]

Year	LSR, Mean fecundity (N)	LSR, 95% CI for fecundity	Non-LSR, Mean fecundity (N)	Non-LSR, 95% CI for fecundity
1990*	0.500 (26)	0.328-0.672	0.545 (22)	0.364-0.727
1991*	0.397 (29)	0.232-0.561	0.304 (28)	0.134-0.473
1992*	0.589 (28)	0.422-0.757	0.480 (25)	0.325-0.635
1993	0.214 (28)	0.077-0.352	0.167 (30)	0.048-0.285
1994	0.357 (35)	0.194-0.521	0.500 (31)	0.336-0.664
1995	0.145 (31)	0.032-0.258	0.173 (26)	0.052-0.294
1996	0.485 (33)	0.347-0.623	0.480 (25)	0.315-0.645
1997	0.533 (30)	0.371-0.696	0.345 (29)	0.176-0.514
1998	0.294 (34)	0.176-0.412	0.276 (38)	0.150-0.403
1999	0.333 (33)	0.176-0.491	0.344 (32)	0.195-0.493
2000	0.444 (36)	0.305-0.584	0.485 (34)	0.345-0.626
2001	0.500 (43)	0.362-0.638	0.476 (41)	0.327-0.625
2002	0.489 (46)	0.358-0.620	0.380 (50)	0.263-0.497
2003	0.191 (47)	0.090-0.293	0.214 (49)	0.124-0.305
2004	0.409 (44)	0.273-0.545	0.406 (48)	0.291-0.522
2005	0.202 (47)	0.100-0.304	0.389 (54)	0.268-0.509
2006	0.113 (40)	0.023-0.202	0.250 (52)	0.141-0.359
2007	0.051 (39)	0.000-0.121	0.153 (49)	0.057-0.249
2008	0.319(36)	0.195-0.444	0.319 (47)	0.202-0.436
2009	0.181 (36)	0.056-0.305	0.298 (42)	0.168-0.427
2010	0.317 (30)	0.165-0.469	0.232 (42)	0.130-0.334
2011	0.075 (20)	0.000-0.155	0.056 (36)	0.000-0.131
2012	0.158 (19)	0.007-0.309	0.083 (38)	0.003-0.164
2013	0.029 (17)	0.000-0.087	0.233 (32)	0.099-0.368
2014	0.467 (15)	0.223-0.710	0.309 (26)	0.144-0.471
1990-1994	**0.411**		**0.399**	
1995-2014	**0.287**		**0.295**	
1990-2014	**0.312**		**0.316**	

[a] Preliminary data, values may change.

Appendix F. Internal recruitment and internal movement within the KSA (1990-2014). [a]

Year	Juvenile recruitment	Total non-juv movement, between years	Total non-juv movement, within year
1990	5	1	0
1991	8	3	0
1992	3	6	0
1993	4	5	0
1994	6	13	0
1995	1	3	4
1996	4	11	2
1997	11	10	4
1998	10	7	4
1999	8	9	4
2000	10	6	4
2001	17	10	7
2002	14	10	7
2003	18	16	9
2004	10	8	5
2005	11	12	4
2006	8	15	12
2007	17	18	11
2008	5	16	8
2009	9	17	8
2010	5	15	13
2011	3	15	23
2012	1	24	9
2013	5	25	17
2014	2	15	14

[a] Preliminary data, values may change.