US Department of Agriculture Forest Service
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Tyee Spotted Owl Demography Study
2016 Annual Report
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1. Title

Demographic characteristics of northern spotted owls (*Strix occidentalis*) on the Tyee Density Study Area, Roseburg, Oregon: 1985–2016.

2. Principal Investigator and Research Team

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3. Introduction

Background

Banding was initiated on the study area in 1983 by Oregon State University Graduate Student, Gary Miller while pursuing his Master's Degree on dispersal of juvenile spotted owls (Miller, 1989). In 1985, Eric Forsman, an independent wildlife contractor, was hired to band and uniquely mark owls on the Roseburg District of the BLM. Forsman used cloth "jess" material until a plastic auxiliary marker was fabricated for use starting in 1986 and continues to be the only form of color marking presently used on spotted owls (Forsman et al, 1996). Surveys on the study area increased in 1987 to include the lower 2/3 of the present study area and in 1989, the study area was expanded to include the upper third portion of the present area (Fig. 1). In 1990, we initiated the density study area (DSA) method in which we survey the entire study area each year, regardless of habitat type. The study area was named for the BLM Resource Area (Drain), but in 1993 the Roseburg BLM District restructured their 4 resource areas into 3 and renamed the resource area "Tyee." The study area was renamed the Tyee Density Study Area. By 1997, the Roseburg District restructured into 2 resource areas and renamed the resource area "Swiftwater." Rather than continue to rename the study area after administrative restructuring, the study area remains as the Tyee Density Study Area.

Management of forest lands by the BLM and private landowners within the boundaries of the DSA has led to a reduction of suitable owl habitat during the last 40–50 years (Thomas et al. 1993). Although rates of harvest on BLM lands have declined substantially since the adoption of the Northwest Forest Plan (USDA and USDI, 1994), there has been an increased emphasis on thinning stands on federal lands, and harvest of old forests on non-federal lands has continued. The effects of thinning within close proximity to owl sites is uncertain, but there is evidence that thinning in young stands causes reductions in the density of northern flying

squirrels (Wilson, 2010, Wilson and Forsman 2013), which are an important prey of spotted owls in the Tyee DSA (Forsman et al. 2004). Although habitat is still an important factor contributing to population stability of spotted owls, other factors such as climate change, increasing numbers of barred owls, and disease and pathogens such as West Nile Virus may also affect the numbers of spotted owls in the study area (Franklin et al, 2000, Courtney et al, 2004, Glenn et al. 2011, Wiens et al, 2014, Diller et al, 2016). While the data collected during this study cannot be used to predict future conditions, they can be used to assess predictive models that examine population projections under varying landscape conditions or management regimes (Forsman et al. 2011).

Potential Benefit or Utility of the Study

The Tyee DSA on the Roseburg District of the Bureau of Land Management was designed to monitor age-specific birth and death rates of northern spotted owls, thereby allowing estimates of population trend over time. We also test a variety of ecological covariates such as the amount of owl habitat and the proportion of territories occupied by barred owls in order to determine if those covariates influence trends in spotted owl population. This study is one of eight long-term demographic studies funded through the federal monitoring program for the northern spotted owl (Lint et al. 1999, Anthony et al. 2006, Forsman et al. 2011, Dugger et al. 2016). We have attempted to band all known fledglings produced in the study area since 1985. As a result, we know the origin and age of most individuals that have been recruited into the population, and we have detailed information on population age structure and internal and external recruitment in the study area.

Study Objectives

1. Elucidate the population ecology of the spotted owls including estimates of population age structure, reproductive rates, survival rates, and population trends.

2. Quantify trends in numbers of spotted owls in the study area.

3. Document social integration of juveniles into the territorial population to include age at pair formation and age at first breeding.

4. Document trends in barred owl numbers and interactions with spotted owls.

4. Study Area

The Tyee DSA northwest of Roseburg, Oregon includes a mixture of federal lands administered by the Bureau of Land Management (BLM) interspersed in a checkerboard pattern with intervening sections of private land (Fig. 1). Total size of the study area is 1,025 km^2 (253,280 acres). We also have monitored known spotted owl territories within a 6-mile buffer area outside the eastern and western boundaries of the DSA to reduce the amount of unknown emigration from the DSA (Reid et al. 1996). The study area includes all or part of 4 Late-Successional Reserves (LSR's) as identified in the Northwest Forest Plan land-use allocations (USDA and USDI, 1994).

5. Methods

Survey design

Banding was initiated on the study area in 1983 and increased substantially in 1985. Surveys increased in 1987 to include all suitable spotted owl habitat. In 1989, the study area was expanded to include the upper third portion of the present area (Fig. 1). In 1990, we initiated the density study method in which we survey the entire study area each year. Based on these surveys we estimate the number of territorial owls. The number of survey polygons within the DSA (n = 160) has remained relatively constant among years and was determined by the location of historical spotted owl site centers (Table 1). The size of each survey polygon varies, depending on topography and land ownership, but is roughly equal to the area of a spotted owl territory. Areas between known spotted owl territories were delineated for survey depending on topography, road access, and distance from other known spotted owl sites. In all surveys we document spotted owls as well as all other owls that are seen or heard.

Field methods

Methods used in this study and other demographic studies of spotted owls have been described in a variety of published sources (e.g., Forsman 1983, Franklin et al. 1990, Franklin 1992, Franklin et al. 1999, Lint et al. 1999). Seemingly unoccupied areas are surveyed with a minimum of 3 complete night visits spaced throughout the survey season (1 March-31 August; Reid et al. 1999). Resightings and recaptures of previously banded owls are used to estimate survival rates (Forsman et al. 2011, Dugger et al. 2016).

Analytical methods

As part of the Effectiveness Monitoring Plan of the Northern Spotted Owl, a meta-analysis workshop is held every 5 years to analyze monitoring data for demographic study areas identified in the Northwest Forest Plan. This meta-analysis includes mark –recapture, fecundity, and occupancy data from the 8 federally funded study areas, plus three additional study areas funded through other sources within the range of the Northern Spotted Owl. We used an information-theoretic approach (Burnham and Anderson 2002) to determine the best models for each analysis. The meta-analysis includes Cormack-Jolly-Seber open population modeling of mark-recapture data (Lebreton et al. 1992), a reparameterization of the Jolly-Seber capture-recapture model to estimate annual population change and recruitment (Pradel 1996), a mixed effects linear model of reproductive data, and a two-species territory occupancy model (MacKenzie et al. 2004, 2006, Miller et al. 2012, Yackulic et al. 2014). Program MARK (White and Burnham 1999) was used to estimate occupancy parameters and model selection results. The results of the most recent workshop can be found in Dugger et al. (2016). The previous workshop occurred in 2009, and the results from that analysis were published in Forsman et al. (2011)

6. Results

Population trends

Key findings of the 2014 meta-analysis of Spotted Owl demography data (Dugger et al. 2016) were: 1) there was strong evidence of population declines in Spotted Owls on most study areas examined (including the Tyee Study Area); and 2) Barred Owl presence had a generally negative effect on demographic rates of Spotted Owls. The estimate of mean annual rate of population change (λ) for the Tyee Study Area was 0.976 (95% CI 0.944–1.008), indicating an annual population decline of 2.4%. The number of spotted owls detected on the Tyee DSA

continued to decline in 2016 (Table 1).

Numbers of owls detected on the DSA

Between 1983 and 2016, we banded 990 spotted owls on the DSA, including 709 juveniles, 96 subadults, and 185 adults. The sex ratio of adults in the banded sample was slightly skewed towards males. By comparison, the sex ratio of subadults was skewed toward females (Table 2). The disproportionate number of males in the adult sample was most likely because males, especially unpaired males, were more detectable than females (Reid et al. 1999).

In 2016, we documented 47 non-juvenile spotted owls in the DSA, including 19 pairs and 9 unpaired individuals (Table 3). This represents approximately 32% of the number of individuals that were located during the first year of the study in 1990 and was the lowest number of owls detected since inception of the study (Fig. 2). It also represents the third consecutive year that the population of spotted owls has dipped below 50% of the original 1990 population level.

Number of sites with spotted owls

We defined a site as an area where a pair of spotted owls was documented in at least one year in the study and defined a pair as 2 individuals of opposite sex that clearly associated during the survey year. The number of sites with pairs declined rapidly after 2005 and had not recovered by 2016 (Tables 1, 3). In 2016, the number of pairs and the total number of non-juvenile spotted owls detected was the lowest recorded for the 27 year survey period (Table 3). In addition, the number of sites where spotted owls were detected was at its lowest on record with only 21% of sites having spotted owls (Table 1). In 2016, approximately 95% of the pairs (n = 19) and 94% of the nesting pairs (n = 17) in the DSA were located on federal land and 6% were on private land.

Age Distribution

Population age structure can be an indication of the future trends in population numbers (Tanner, 1978). The non-juvenile spotted owl population in the Tyee DSA has completely turned over since 1996 (Fig. 3). One male that was a juvenile in 1996 was found paired in 2016 but did not nest. The majority of birds confirmed in 2016 remain in the 8 to 20 age range, with only five of the 47 non juvenile birds detected under 8 (Fig. 3).

Barred Owls

Although we survey exclusively using spotted owl acoustic lure techniques, we often detect other owl species during our surveys. We have kept records for these other owl detections on the DSA since 1990, including the increasing trend in barred owl numbers. In 2016, the number of survey areas where we detected barred owls continued to exceed the number of survey areas where we detected spotted owls, 130 (81%) and 37 (21%) sites respectively. The number of sites occupied by only spotted owls declined to only 9 sites or 5.6% of sites surveyed (Fig. 4).

Reproduction

The proportion of females nesting in 2016 was the second lowest recorded for the study

area, (0.118, 95% CI = 0.00-0.28, Table 4). Although the success rate was 100% in 2016, only 2 pairs nested. The number of pairs has severely declined in the last 7 years and the number of young produced in 2016 was one of the lowest on record (Fig. 5). For all years combined, the annual percentage of females that nested averaged 47.6% (n = 27 years, Table 4). The average number of young produced per female in 2016 was 0.143, which was considerably lower than the average of 0.473 for all years (Table 7). The data continued to indicate that most measures of reproductive performance of spotted owls were lowest for 1-yr-old owls, intermediate for 2-yr-old owls, and highest for adults (Tables 5–6). Sample size of 1-yr-old females was too small to estimate some parameters (Table 5–6). The number of spotted owl territories with offspring has declined in the past 10 years, while the number of territories with barred owls detected has increased dramatically during the time of low spotted owl reproduction (Fig. 6).

Nest tree characterization

We documented two nesting pairs of spotted owls within the Tyee in 2016. One of the nests was first documented in 2013 and is a side cavity entrance. The second nest was a previously undocumented nest. It was a 155cm, 45m tall Douglas-fir and the nest was in the very top. Both nests were successful in fledging young (Table 7).

Diet

Collection of diet information is often dependent on the concentration of roosting events. As a result, most of our information on diet is associated with the nesting pairs, and especially nesting pairs where young have fledged. We collected diet information from 17 different roosting events in 2016. The most and largest collection of information on diet was from sites were nesting was documented. Nine of the 17 different roosting events were from the 2 documented nests in the study area. Whereas, 8 of the 17 collections of diet material were from 5 sites were non-nesting was documented.

7. Discussion

Trends

Spotted owls continued to decline on the Tyee DSA in 2016 and the proportion of females that attempted to nest was well below average. All but one of the non-juvenile spotted owls in the study area in 2016 were previously banded indicating that recruitment of younger owls into the territorial population continues to remain very low (Table 3). The spotted owl population is aging and with low recruitment of young owls, the prospect for a stable or increasing population of spotted owls is doubtful. Fluctuations in reproduction are typical of spotted owl populations but prolonged below average reproduction for the last 7 years is concerning (Fig. 3). Total reproductive output will likely not increase if the continued number of pairs and occupied territories continues to decrease. The typical healthy population age structure with higher numbers of younger owls in the population and a gradual decline in older individuals can be depicted by a pyramid shaped figure (Tanner, 1978). This type of age structure is not currently present in the Tyee DSA (Fig. 3). This could be useful in predicting future reproductive output. As the older owls die off and there are fewer owls in the high reproductive age classes, the population will decline. The low rates of reproduction in 2016 will do little to add young individuals to the population (Tanner, 1978).

Summary

We continued to document fewer pairs of spotted owls in the study area which could be related to the increased presence of barred owls within Tyee DSA territories as well as habitat degradation that continues to occur. Although the rate of harvest of older forest on Federal land has decreased, spotted owl habitat availability throughout the Tyee DSA continues to decline due to thinning and clear-cut harvesting.

The estimate of sites occupied by barred owls was considered conservative because we did not survey specifically for barred owls, and it was likely that some barred owls were not detected (Wiens et al. 2011). The increasing trend in barred owl detections suggests that barred owls are colonizing sites historically occupied by spotted owls and excluding spotted owls from those sites (Yackulic et al. 2014). Barred owl numbers seem to be slowing and could be reaching saturation levels in the study area (Rossman et al, 2016). Barred owls almost certainly compete with spotted owls for both food and space (Hamer et al. 2007, 2001, Wiens et al. 2014). Our surveys continue to document increasing numbers of barred owls. Combined auditory and visual detections were up 41% from 2015 (though each detection cannot be considered a distinct individual), and it appears that this may be correlated with increased social instability, lower overall reproductive output, apparent abandonment of territories, and possibly lower detection rates of spotted owls (Bailey et al. 2009, Yackulic, et al. 2014). As habitat remains the same or decreases and barred owl numbers remain the same or increase, the spotted owl population will likely continue to experience declines (Dugger et al. 2015).

8. Acknowledgments

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10. Tables

Table 1. Number of northern spotted owl polygons (polys) surveyed to protocol (Forsman 1995) and the number of these polygons where spotted owls were detected on Tyee Demography Study Area, Oregon, 1990-2016.

Year	# of Polys Surveyed	# of Polys w/ Pairs	# of Polys w/ Single Owls	# of Polys w/ Social Status Unknown	Total # Polys Occupied	# Polys Unoccupied	% Polys Occupied
1990	161	59	11	20	90	71	56%
1991	160	61	12	10	83	77	52%
1992	160	62	11	13	86	74	54%
1993	163	56	8	26	90	73	55%
1994	161	60	6	16	82	79	51%
1995	152	57	7	16	80	72	53%
1996	160	52	10	15	77	83	48%
1997	162	56	16	17	89	73	55%
1998	161	60	14	15	89	72	55%
1999	161	51	16	17	84	77	52%
2000	160	53	11	11	75	85	47%
2001	160	58	16	12	86	74	54%
2002	163	62	11	12	85	78	52%
2003	162	63	15	9	87	75	54%
2004	162	67	12	4	83	79	51%
2005	159	66	13	4	83	76	52%
2006	159	51	18	12	81	78	51%
2007	158	46	21	15	82	76	52%
2008	158	49	26	13	88	70	56%
2009	159	44	28	5	77	82	48%
2010	159	46	18	5	69	90	43%
2011	159	32	18	12	62	97	39%
2012	159	29	12	14	55	104	35%
2013	160	29	14	9	52	108	33%
2014	160	27	7	5	39	121	24%
2015	160	23	24	0	47	113	29%
2016	160	19	4	10	33	127	21%

Table 2. Number of previously unbanded spotted owls banded, Tyee Density Study Area, Roseburg, Oregon: 1990–2016.

	Adults		Subadults		Fledglings
Year	**Male**	**Female**	**Male**	**Female**	
<1990[1]	67	49	12	13	58
1990	14	7	4	7	31
1991	4	5	5	3	23
1992	3	6	2	3	44
1993	1	2	0	1	11
1994	0	2	2	2	28
1995	1	1	0	0	16
1996	1	0	0	0	53
1997	0	0	2	0	26
1998	1	0	1	2	34
1999	0	2	2	1	26
2000	1	1	1	0	28
2001	2	0	0	2	67
2002	2	1	1	4	40
2003	0	1	1	2	18
2004	1	2	0	1	37
2005	0	1	0	1	45
2006	2	0	2	0	10
2007	1	0	1	2	20
2008	1	1	2	2	27
2009	0	0	3	3	11
2010	0	0	1	1	15
2011	1	0	1	1	2
2012	0	0	0	1	4
2013	0	0	0	0	7
2014	0	0	0	1	5
2015	0	0	0	0	20
2016	0	1	0	0	3
Total	103	82	43	53	709

[1]Includes those owls banded 1983-1989. The analysis for the DSA focuses on 1990-2016.

Table 3. Number of spotted owls detected within the Tyee Density Study Area (DSA), Roseburg, Oregon: 1990–2016.

		Adults*		1– 2-year-old		Age Unknown**		
Year	**Pairs***	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Non-Juv**
1990	59	62	50	8	10	7	8	145
1991	61	60	51	12	6	7	6	142
1992	62	59	52	10	8	4	5	138
1993	56	55	45	8	8	4	4	124
1994	60	58	49	10	10	1	2	130
1995	57	63	54	1	3	2	6	129
1996	52	56	51	5	5	4	2	123
1997	56	57	51	16	5	4	1	134
1998	60	54	46	19	14	5	4	142
1999	51	57	50	9	5	9	3	133
2000	53	56	52	5	2	5	3	123
2001	58	63	50	10	10	1	3	137
2002	62	60	48	17	17	3	1	146
2003	63	67	52	13	15	1	2	150
2004	67	73	62	4	5	1	2	147
2005	66	73	59	6	7	1	0	146
2006	51	58	49	11	8	2	0	128
2007	46	59	43	4	6	5	2	119
2008	49	64	43	8	8	2	2	127
2009	44	55	36	10	9	3	4	117
2010	46	48	43	14	5	1	0	111
2011	32	44	35	4	2	5	1	91
2012	29	42	30	0	1	1	3	77
2013	29	38	31	0	0	4	1	74
2014	27	34	27	0	2	2	0	65
2015	23	32	24	0	1	4	1	61
2016	19	21	19	0	2	2	3	47
AVG	49.5	54.4	44.5	7.6	6.4	3.3	2.6	118.7

*Numbers may be different from previous years reported due to changes in definitions of social status, age class, and in modeling methodology.

** Counts of Age unknown includes auditory detections and unconfirmed individuals that we believe represent different individuals from those already identified for the year.

Table 4. Annual reproductive statistics for female northern spotted owls on the Tyee Density Study Area, Roseburg, Oregon: 1990–2016.

	Proportion nesting [1]			Proportion fledging young [2]			Proportion nesting that fledged young [3]		
Year	N	Prop.	95% C.I.	N	Prop.	95% C.I.	N	Prop.	95% C.I.
1990	53	0.736	0.62–0.86	61	0.475	0.35–0.60	39	0.692	0.55–0.84
1991	56	0.446	0.32–0.58	59	0.237	0.13–0.35	25	0.560	0.36–0.76
1992	58	0.603	0.47–0.73	62	0.484	0.36–0.61	35	0.800	0.67–0.93
1993	47	0.255	0.13–0.38	54	0.130	0.04–0.22	12	0.500	0.20–0.80
1994	58	0.569	0.45–0.71	60	0.383	0.26–0.51	33	0.667	0.50–0.83
1995	53	0.415	0.28–0.55	60	0.200	0.10–0.30	22	0.500	0.29–0.71
1996	48	0.813	0.70–0.93	56	0.607	0.48–0.74	39	0.769	0.64–0.90
1997	51	0.588	0.45–0.72	55	0.327	0.20–0.46	30	0.600	0.42-0.78
1998	61	0.557	0.43–0.68	63	0.429	0.30–0.55	34	0.794	0.66–0.93
1999	45	0.556	0.41–0.70	55	0.327	0.20–0.46	25	0.680	0.49–0.87
2000	50	0.500	0.36–0.64	54	0.315	0.19–0.44	25	0.600	0.40–0.80
2001	54	0.796	0.69–0.90	61	0.639	0.52–0.76	43	0.837	0.73–0.95
2002	56	0.571	0.44–0.71	65	0.385	0.26–0.51	32	0.688	0.52–0.85
2003	57	0.386	0.26–0.51	66	0.197	0.10–0.29	22	0.545	0.33–0.76
2004	63	0.540	0.42–0.66	66	0.424	0.30–0.55	34	0.765	0.62–0.91
2005	61	0.639	0.52–0.76	65	0.446	0.32–0.56	39	0.744	0.60–0.88
2006	54	0.222	0.11-0.33	57	0.140	0.05-0.23	12	0.667	0.39-0.95
2007	44	0.432	0.28-0.58	48	0.292	0.16-0.43	19	0.737	0.53-0.94
2008	41	0.707	0.57-0.85	50	0.320	0.18-0.45	29	0.483	0.30-0.67
2009	41	0.317	0.17-0.46	45	0.178	0.06-0.29	13	0.538	0.26-0.82
2010	43	0.674	0.53-0.84	46	0.261	0.12-0.38	28	0.429	0.24-0.62
2011	30	0.100	0.00-0.21	37	0.027	0.00-0.08	3	0.333	0.00-0.99
2012	28	0.143	0.01-0.27	31	0.097	0.06-0.13	4	0.750	0.26-1.00
2013	26	0.192	0.04-0.35	29	0.138	0.01-0.27	5	0.800	0.41-1.00
2014	25	0.400	0.20-0.60	29	0.103	0.00-0.22	10	0.200	0.00-0.46
2015	24	0.583	0.39-0.78	24	0.542	0.34-0.74	14	0.929	0.79-1.00
2016	17	0.118	0.00-0.28	20	0.100	0.00-0.24	2	1	0
Mean	N=27 years	0.476		N=27 years	0.304		N=27 years	0.652	

[1] Estimates were calculated for females whose nesting status was determined by protocol.
[2] Estimates were calculated for females whose reproductive status was determined by 31 August.
[3] Estimates were calculated for females whose nesting status was determined to protocol and reproductive status by 31 August.

Table 5. Average age-specific reproductive parameters of female northern spotted owls on the Tyee Density Study Area, Roseburg, Oregon: 1990–2016.

	Proportion nesting [1]			Proportion fledging young [2]			Proportion nesting that fledged young [3]		
Age	**N**	**Prop.**	**95% C.I.**	**N**	**Prop.**	**95% C.I.**	**N**	**Prop.**	**95% C.I.**
1 year old	55	0.127	0.03–0.22	71	0.028	0.00–0.07	7	0.286	0.00–0.65
2 year old	89	0.448	0.34–0.55	102	0.245	0.16–0.33	40	0.625	0.47–0.78
Adult	1091	0.530	0.50–0.56	1188	0.350	0.32–0.38	594	0.702	0.67–0.74
Unknown	11	0.545	0.24–0.85	21	0.238	0.05–0.43	10	0.500	0.17–0.83

[1] Estimates were calculated for females whose nesting status was determined to protocol.
[2] Estimates were calculated for females whose reproductive status was determined by 31 August.
[3] Estimates were calculated for females whose reproductive status was determined to protocol and reproductive status by 31 August.

Table 6. Average age-specific number of young fledged and brood size of female northern spotted owls on the Tyee Density Study Area, Roseburg, Oregon: 1990–2016.

	Fecundity[1]			Brood size[2]		
Age	**N**	**Mean**	**SE**	**N**	**Mean**	**SE**
1 year old	71	0.028	0.020	2	2.000	0.000
2 years old	102	0.206	0.038	25	1.680	0.095
Adults	1188	0.272	0.012	415	1.554	0.025
Unknown	21	0.167	0.072	5	1.400	0.245

[1]Fecundity was defined as number of female young produced per female. We assumed a 1:1 sex ratio for fledglings

[2] Brood size was based on the number of young seen outside the nest tree, regardless of whether they were dead or alive.

Table 7. Estimated number of young fledged and mean brood size of female spotted owls on the Tyee Density Study Area: 1990–2016.

	Number of young fledged[1]			Brood size[2]		
Year	**Females**	**Young**	**Mean**	**Broods**	**Mean**	**SE**
1990	61	35	0.574	29	1.207	0.077
1991	59	24	0.407	14	1.714	0.125
1992	62	48	0.774	30	1.600	0.091
1993	54	11	0.204	7	1.571	0.202
1994	60	33	0.550	23	1.435	0.106
1995	60	18	0.300	12	1.500	0.151
1996	56	60	1.071	34	1.765	0.074
1997	55	29	0.527	18	1.611	0.118
1998	63	38	0.603	27	1.444	0.097
1999	55	26	0.473	18	1.444	0.121
2000	54	28	0.519	17	1.647	0.119
2001	61	70	1.148	39	1.795	0.075
2002	65	41	0.631	25	1.640	0.098
2003	66	17	0.258	13	1.308	0.133
2004	66	44	0.667	28	1.571	0.095
2005	65	47	0.723	29	1.621	0.092
2006	57	11	0.193	8	1.375	0.183
2007	48	20	0.417	14	1.429	0.137
2008	50	26	0.520	16	1.625	0.125
2009	45	13	0.289	8	1.625	0.183
2010	46	18	0.391	12	1.500	0.151
2011	37	2	0.054	1	2.000	N/A
2012	30	4	0.129	3	1.333	0.333
2013	29	6	0.207	4	1.500	0.289
2014	29	5	0.172	3	1.667	0.272
2015	24	20	0.833	12	1.667	0.136
2016	21	3	0.143	2	1.500	0.500
Mean	N=27 years	25.8	0.473	N=27 years	1.542	0.028

[1] Documented by 31 August

[2] Both number of young fledged and brood size were based on the number of young seen outside the nest tree, regardless of whether they were dead or alive.

11. Figures

Figure 1. The hatched area represents the Tyee Density Study Area (DSA), Roseburg, Oregon.

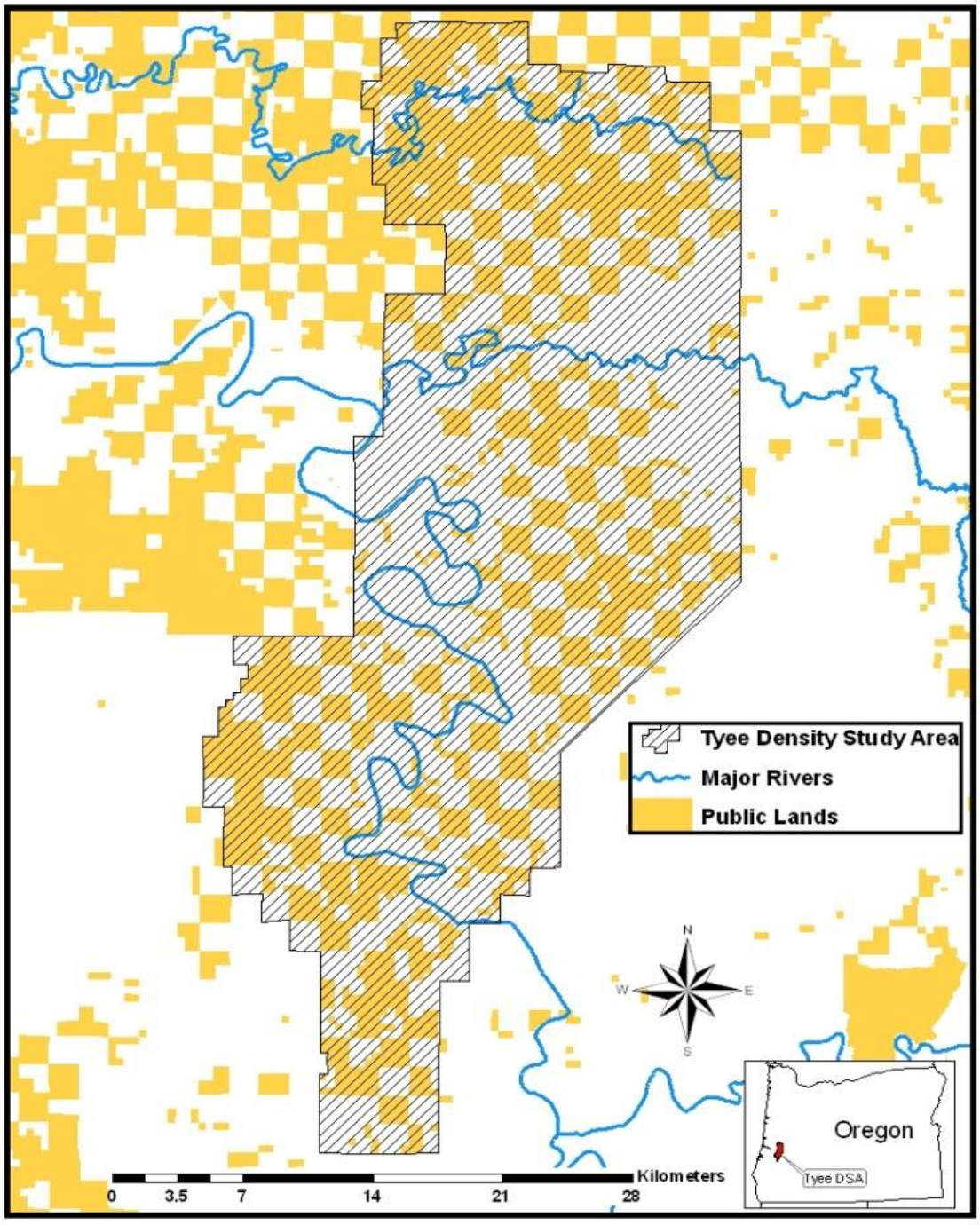


Figure 2. Yearly proportion of non-juvenile spotted owls detected relative to the first year of study, Tyee Density Study Area (DSA), Roseburg, Oregon, 1990-2016.

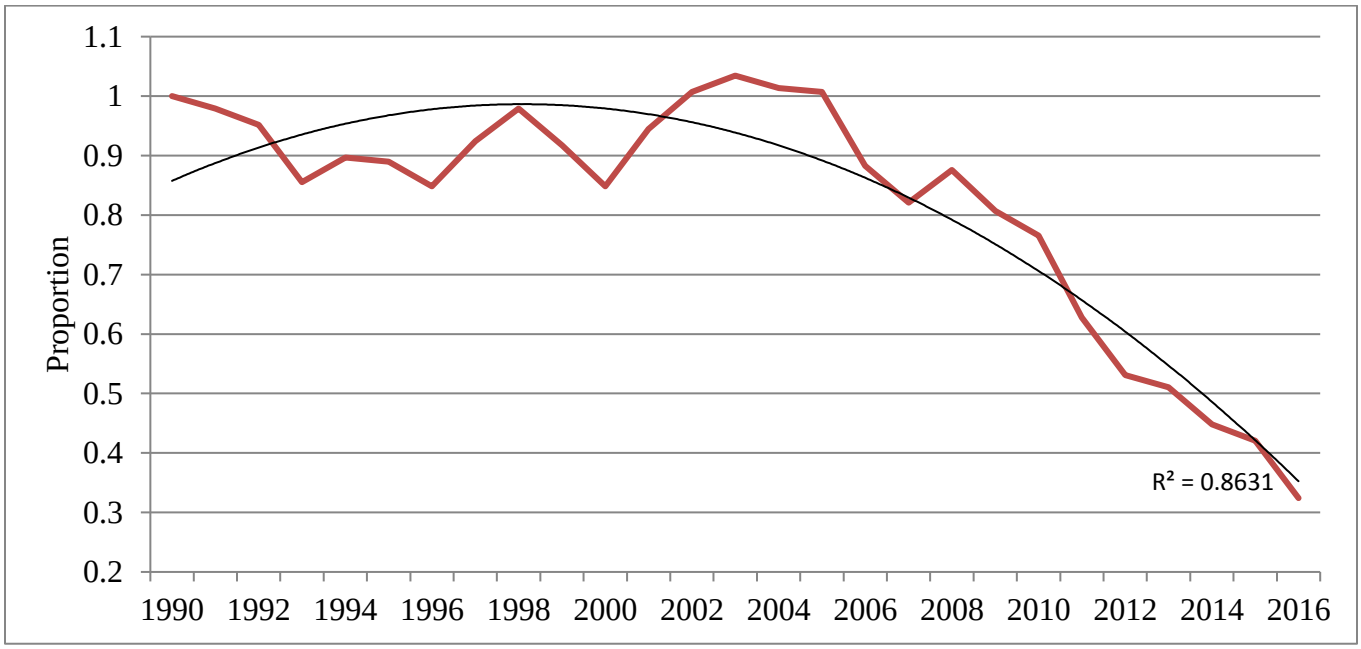


Figure 3. Age class distribution for known age, non-juvenile spotted owls detected in the Tyee DSA in 1996 (left), 2006 (middle), and 2016 (right). Blue lines with arrows indicate where the age class would be represented in the next graph, 10 years later.

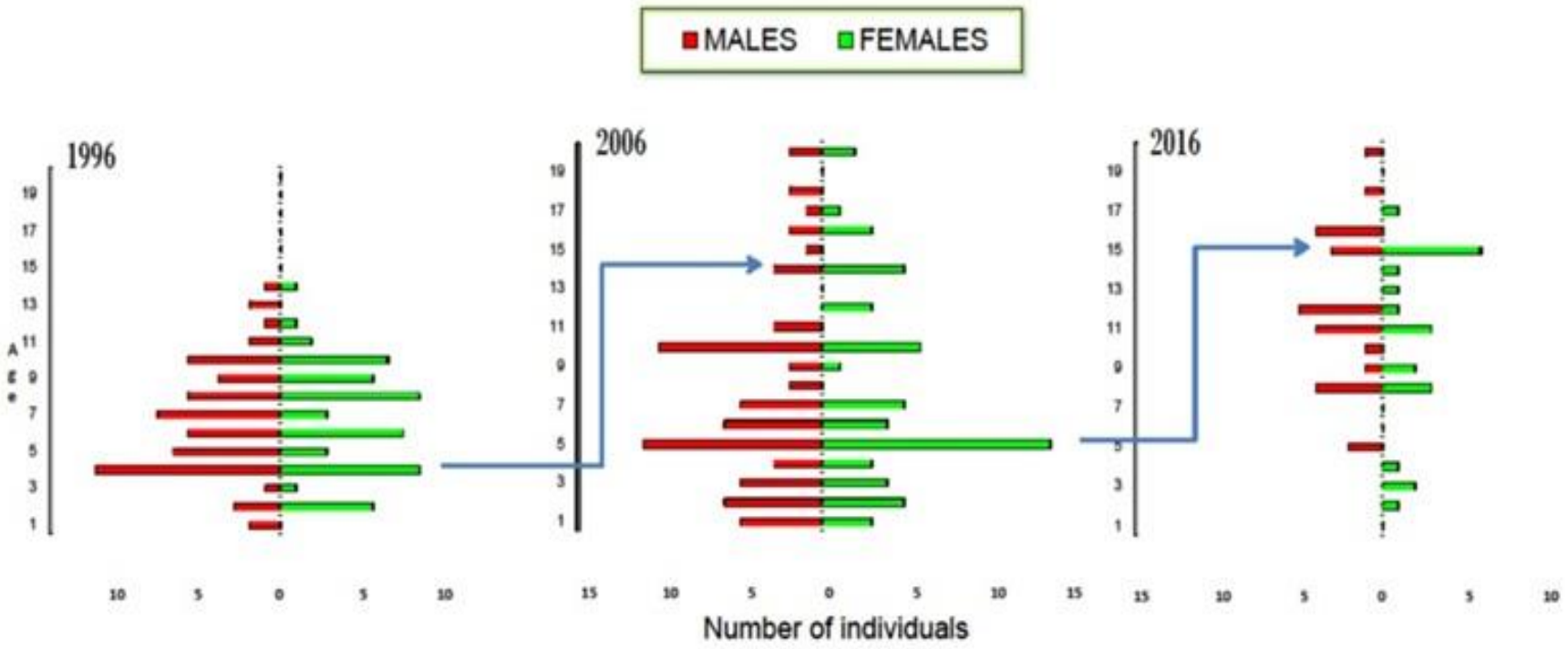


Figure 4. Percent of sites occupied by spotted owls and/or barred owls, Tyee DSA, Roseburg, Oregon: 1990-2016.

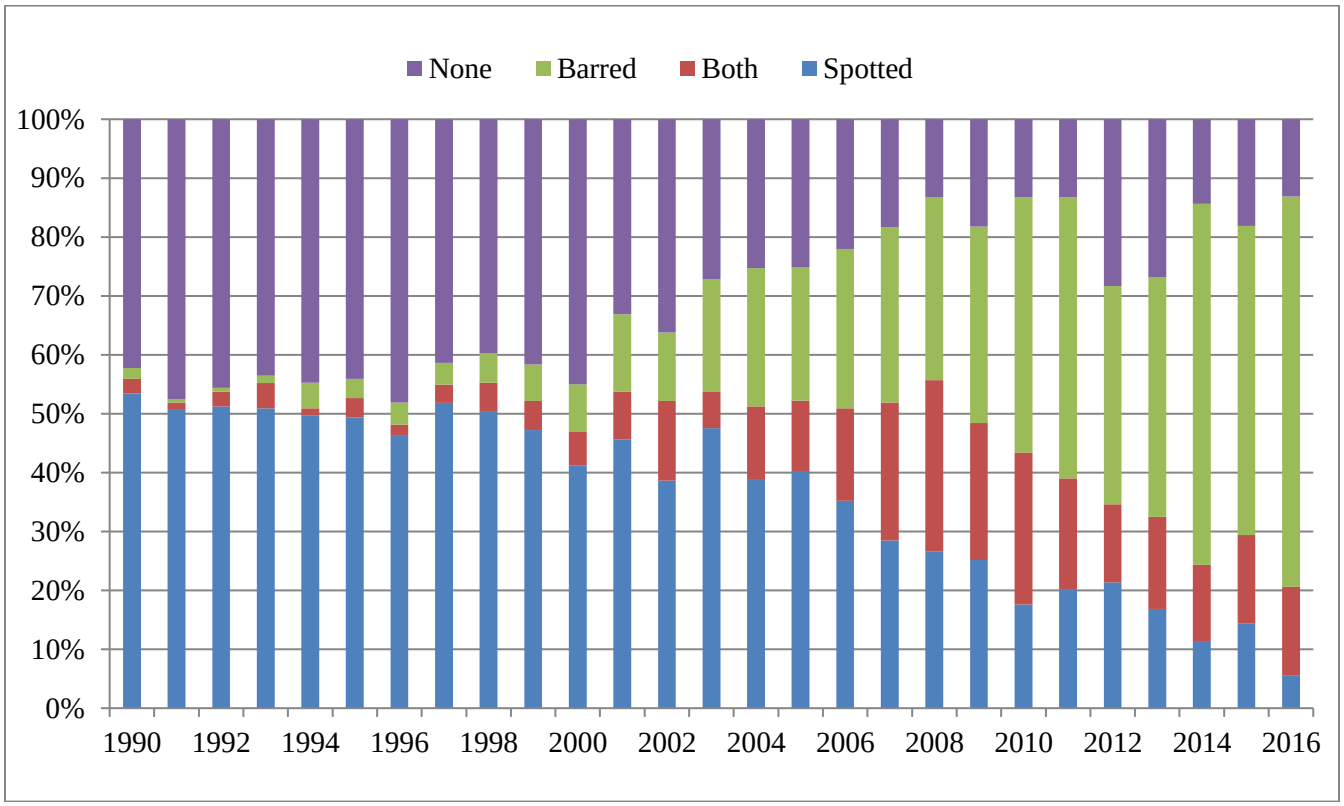


Figure 5. Annual number of spotted owl pairs detected and fledglings produced, Tyee DSA, Roseburg, Oregon: 1990-2016. Horizontal lines indicate means for the entire period.

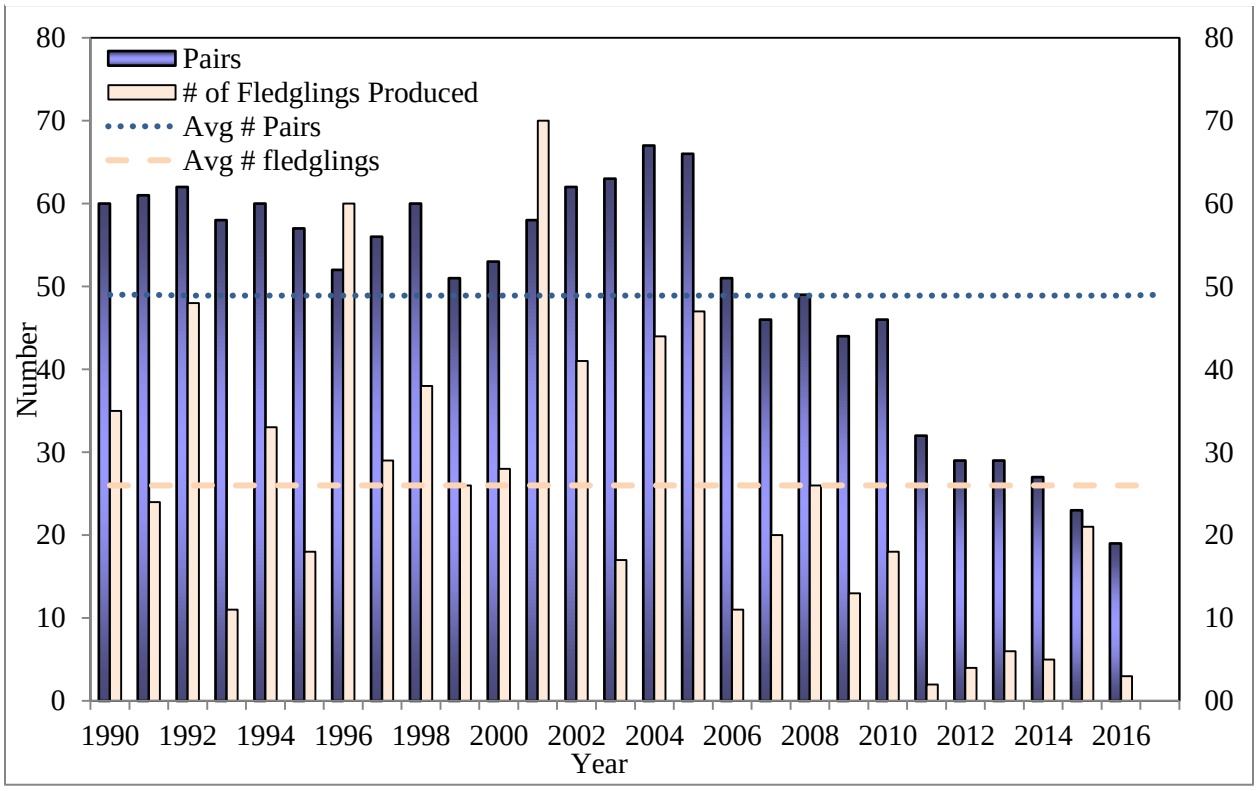
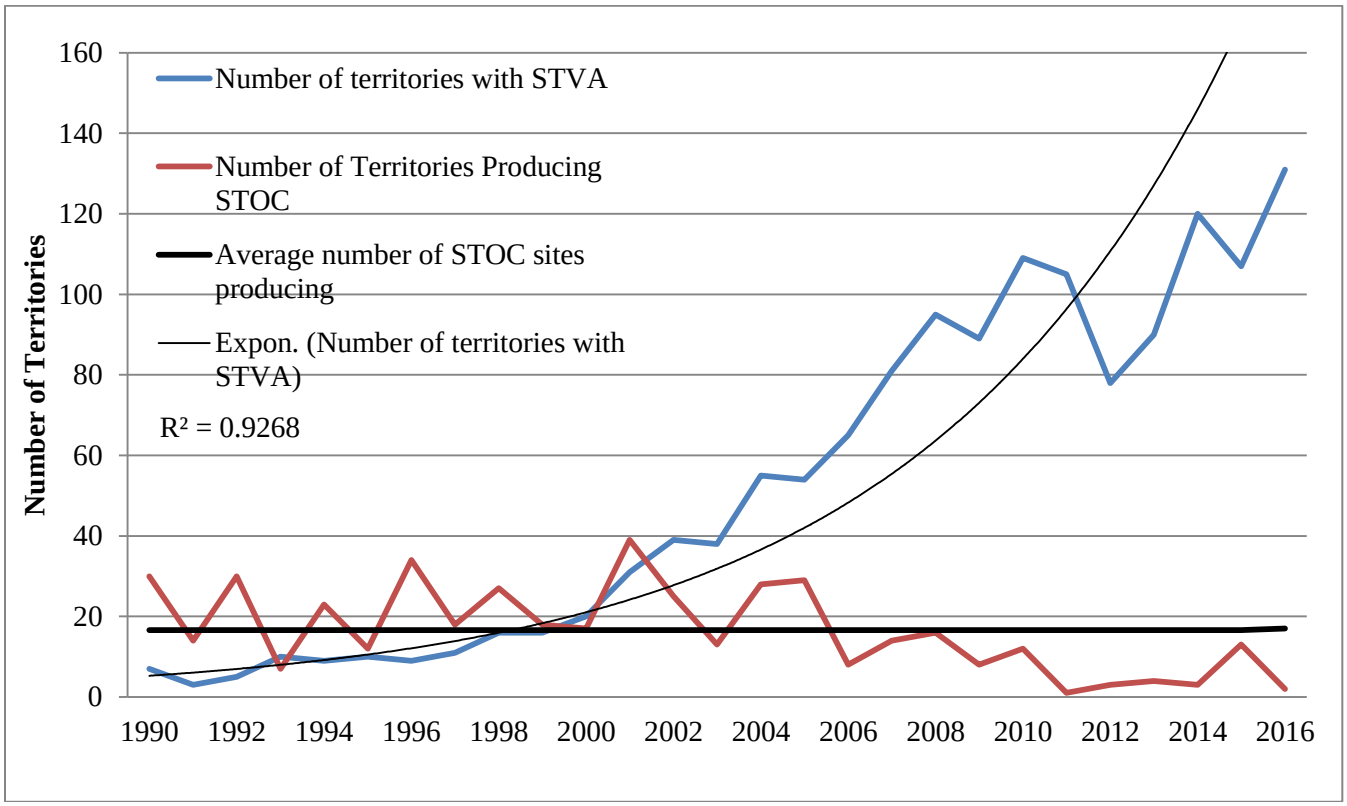


Figure 6. Yearly number of survey polygons (maximum of 160) on the Tyee DSA where barred owls were detected and where spotted owl reproduction was documented, Tyee DSA, Roseburg, Oregon: 1990-2016.



12. Publications, Presentations, and Data Transfers

1. We provided information to Ron Gaines, Environmental Services Northwest, and biological consultant for Lone Rock Timber Company.

2. We provided survey information to Roseburg, and Coos Bay Districts of the BLM for the sites that we surveyed in their districts.

3. We provided spotted owl survey information to Oregon Department of Forestry.

4. We provided survey information to several landowners including Weyerhaeuser Company, Roseburg Resources, Elkton Reserve, Seneca Jones Timber Company, and several other smaller landowners that granted us access to conduct surveys.

5. We provided feather samples for genetic analysis and datasets for pedigree analysis to the USGS genetics lab in Corvallis.

6. J. Reid led a field outing for the Oregon Youth Conservation Corps to demonstrate the field techniques associated with spotted owl demography studies.

7. J. Reid led a field outing for the Oregon Birders Association to demonstrate our field techniques and discuss the history and objectives of the study.

8. J. Reid presentations entitled "*Spotted Owl Demographic Study Design and Population Trends from Range-wide Analysis*" to Wildlife Biology Classes at Umpqua Community College.

9. J. Reid participated in the Youth in Wilderness outing where spotted owl biology was presented.

10. J. Reid presented Spotted Owl Study Design and Field Collection Techniques to the Umpqua Birders, a local community group.

11. J. Reid, and J. Burgher participated in the Science & Environmental Education Discovery Seminar (SEEDS) at Umpqua Community College where students majoring in Natural Resources were in attendance.

12. J. Burgher led a field outing for the Neighborworks Umpqua Residential Summer Camp to demonstrate field biology techniques and the importance of habitat conservation.

13. K. Dugger presented for the OSU Fish and Wildlife Department Seminar Series on 10/21/2015. "*The effects of habitat, climate and Barred Owls on the long-term demography of Northern Spotted Owls*"

14. Publication of : Dugger, Katie M., Eric D. Forsman, Alan B. Franklin, Raymond J. Davis, Gary C. White, Carl J. Schwarz, Kenneth P. Burnham, James D. Nichols, James E. Hines, Charles B. Yackulic, Paul F. Doherty, Jr., Larissa Bailey, Darren A. Clark, Steven H. Ackers, Lawrence S. Andrews, Benjamin Augustine, Brian L. Biswell, Jennifer Blakesley, Peter C. Carlson, Matthew J. Clement, Lowell V. Diller, Elizabeth M. Glenn, Adam Green, Scott A.

Gremel, Dale R. Herter, J. Mark Higley, Jeremy Hobson, Rob B. Horn, Kathryn P. Huyvaert, Christopher McCafferty, Trent McDonald, Kevin McDonnell, Gail S. Olson, Janice A. Reid, Jeremy Rockweit, Viviana Ruiz, Jessica Saenz, Stan G. Sovern. 2016. The effects of habitat, climate and Barred Owls on the long-term population demographics of Northern Spotted Owls. The Condor 118(1):57-116.

15. Publication of: Rossman, S., Yackulic, C. B., Saunders, S. P., Reid, J., Davis, R. and Zipkin, E. F. 2016. Dynamic N-occupancy models: estimating demographic rates and local abundance from detection-nondetection data. Ecology, 97: 3300–3307.

13. Interesting Observations and Problems Encountered

Interesting observations and unusual events documented in 2016

We encountered two adult males and one adult female occupying a single territory during the nesting season on May 5th 2016. Both adult males were observed roosting in the same tree with no physical or auditory aggressive behavior. Additionally, three different birds, two adult males and one adult female, were observed between March and May within a single territory of another site, though not at the same time, so no inferences on aggression can be made.
We also documented four instances of spotted owl barred owl interaction. All interactions were between adult male owls and three of the four interactions involved single male spotted owls and barred owls of unknown pair status. The three instances of single spotted owls were of auditory interactions only. A single physical interaction occurred between a paired male spotted owl and a single male barred owl. This interaction almost certainly interrupted a nesting attempt by the pair of spotted owls.

Problems Encountered

We continue to experience problems with deteriorating roads and blocked access on both federal and private lands. New gates, inoperable gates (some because of vandalism), and denial of access are a particular problem. One small woodland owner in the study area has refused access to the site on his land to verify identification of the owls on his property. Extra effort and thought have gone into formulating ways to continue to gather the necessary information.
Noise from logging traffic has also increased in recent years and results in extra effort to reschedule visits to avoid the problem. All of this leads to decreased survey efficiency and a greater workload.

We also note increased difficulty in visual detections on daytime follow ups. Many sites received multiple pre-dawn owl responses with immediate sun-rise follow up hikes with no visual confirmation or additional auditory responses. This led to multiple sites without confirmed reproduction status even though auditory detection of a pair existed. Extra sampling effort was given to these sites often involving multiple researchers.

14. No Appendices