

**ANNUAL RESEARCH REPORT**  
**FY 2013**  
**January 2014**

**1. Title:**

Demographic Characteristics and Ecology of Northern Spotted Owls (*Strix occidentalis caurina*) in the Southern Oregon Cascades.

**2. Principal Investigators and Organizations:**

Dr. Katie Dugger (PI), OR Cooperative Wildlife Research Unit, Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon; Biologists: S. Andrews (Project Leader), E. Fleigel, L. Friar, T. Phillips, A. Stormberg, and T. Tippin. Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon.

**3. Study Objectives:**

- a. Estimate population parameters (proportion of territories where owls were detected, fecundity, survival rates, and annual rates of population change) and occupancy dynamics of northern spotted owls on the Rogue River-Siskiyou and Fremont-Winema National Forests.
- b. Examine northern spotted owl diets, nesting habitat, and interspecific interactions with barred owls.
- c. Communicate results to other researchers examining northern spotted owl ecology.

**4. Potential Benefit or Utility of the Study:**

Studying the population dynamics, diet and habitat characteristics associated with breeding spotted owls will increase our understanding of factors affecting spotted owl populations. This study offers insights into spotted owl ecology while concurrently addressing the validation and effectiveness monitoring requirements of the Northwest Forest Plan (USDA and USDI 1994). The Southern Oregon Cascades Study Area (CAS) is one of eight Federally-sponsored study areas that represent the Effectiveness Monitoring Program for Spotted Owls under the Northwest Forest Plan (Lint *et al.* 1999). Demography data from this study area has been included in five meta-analyses of spotted owl vital rates across the species range (Burnham *et al.* 1996, Franklin *et al.* 1999, Anthony *et al.* 2006, Forsman *et al.* 2011). These data were important for the 2004 review of the species' threatened status (USFWS 2004), the Revised Recovery Plan for the Northern Spotted Owl, and the Experimental Removal of Barred Owls to Benefit Threatened Northern Spotted Owls Final Environmental Impact Statement (USDI 2008, 2011, 2013).

**5. Study Description and Survey Design:**

The design of this project follows the framework of a demographic study that monitors a collection of known owl sites within a bounded area. To meet the objectives of this study, we gathered annual data that allowed us to estimate survival, reproductive rates, and annual rate of

population change (Forsman *et al.* 2011), as well as occupancy dynamics (Dugger *et al.* 2011). This study utilized a sample of northern spotted owls within Late-Successional Reserve (LSR), Matrix Land-use Allocations (LUA) (USDA and USDI 1994) and Wilderness Areas. We followed survey protocol and data collection procedures as outlined in Forsman (1995).

## 6. Study Area

The CAS incorporates approximately 2,400 km<sup>2</sup> of primarily Federal forest land. The area is geographically situated on lands administered by the Rogue River-Siskiyou National Forest (High Cascades Ranger District), the Fremont-Winema National Forest (Klamath Ranger District), and the Umpqua National Forest (Diamond Lake Ranger District) (Figure 1). The study area occupies the southern terminus of the Oregon Cascades including portions of both the western and eastern provinces. Landforms are primarily volcanic in origin and consist of plateaus and moderately dissected terrain (USDA and USDI 1994). The study area lies within the Mixed-Conifer, *Abies concolor*, *Abies magnifica* var. *shastensis*, and *Tsuga mertensiana* zones at elevations ranging from 900-2000 meters (Franklin and Dyrness 1973).

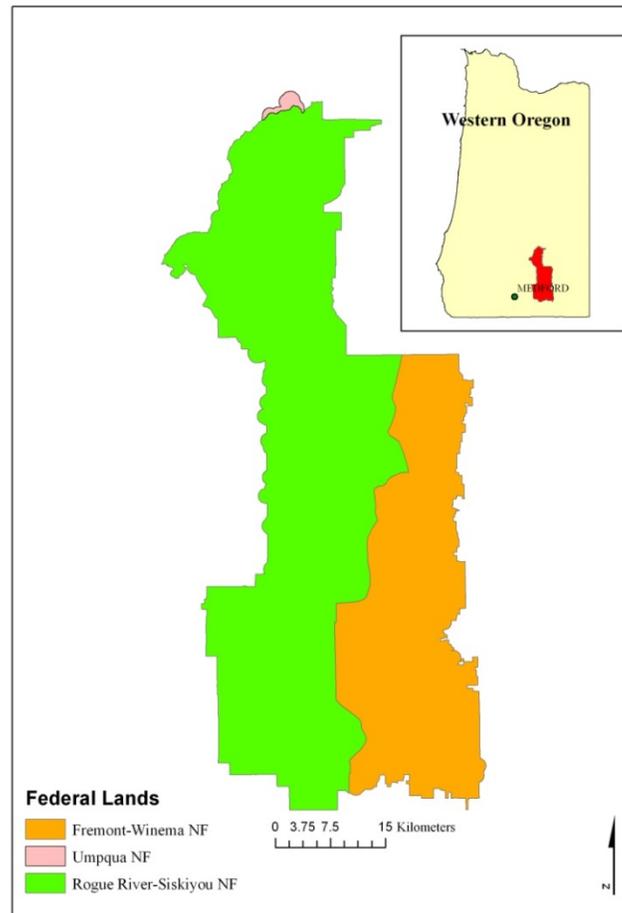


Figure 1. The Southern Cascades Study Area, Rogue River-Siskiyou and Fremont-Winema National Forests, Oregon, 1990-2013.

The CAS was established in 1990 and is one of the eight long-term monitoring sites in the Effectiveness Monitoring Program for Northern Spotted Owls under the auspices of the Northwest Forest Plan (Lint *et al.* 1999). The total number of surveyed spotted owl sites has increased over time, as new sites were added when previously unmonitored owls are detected and a total of 171 sites were surveyed in 2013 (Figure 2).

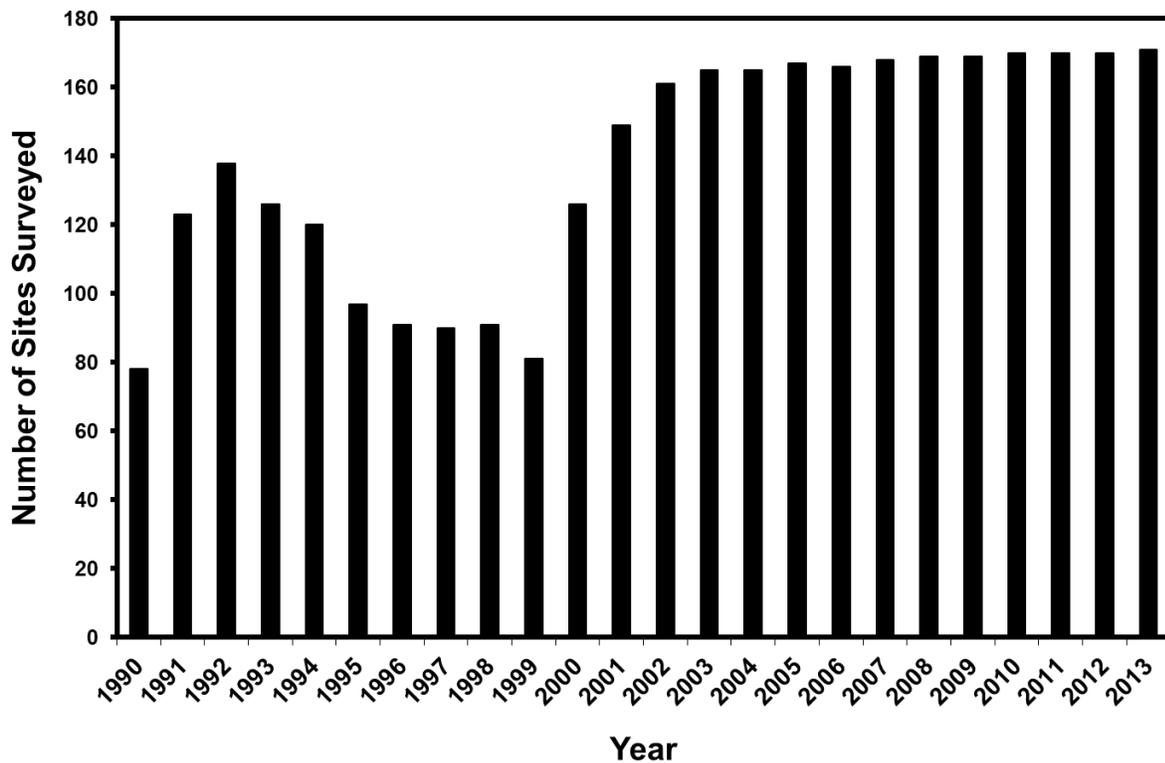


Figure 2. The number of historic spotted owl territories surveyed annually on the Southern Cascades Study Area, Rogue River-Siskiyou and Fremont-Winema National Forests, Oregon, 1990-2013.

There are 89 sites within the boundaries of the study that have been surveyed continuously from 1992 to 2013 and this subset of owl territories were among those used to estimate the annual rate of population change in the last two meta-analyses (Anthony *et al.* 2006, Forsman *et al.* 2011).

An important component of the CAS area is the Late-successional Reserves: Rogue-Umpqua Divide (LSR 225), Middle Fork (LSR 226), Dead Indian (LSR 227), Clover Creek (LSR 228), and Sevenmile Creek (LSR 229). Of these, Rogue-Umpqua Divide, Middle Fork, and Dead Indian are large encompassing 16,050, 20,080, and 41,310 ha, respectively, and projected to support 15-20 pairs of owls (USDA 1998). Clover Creek and Sevenmile Creek LSRs are smaller, incorporating 1,130 and 3,710 ha (USDA 1997). The LSRs are situated entirely within the study area. Dead Indian LSR spans the crest of the southern Oregon Cascades and is jointly administered by the Rogue River-Siskiyou and Fremont-Winema National Forests. Three Congressionally Reserved Wilderness Areas are also located within the study area. Owl territories were found in the Sky Lakes (45,800 ha), Mountain Lakes (9,300 ha) and a portion of the Rogue-Umpqua Divide Wilderness Areas (2,064 ha) (Figure 3).

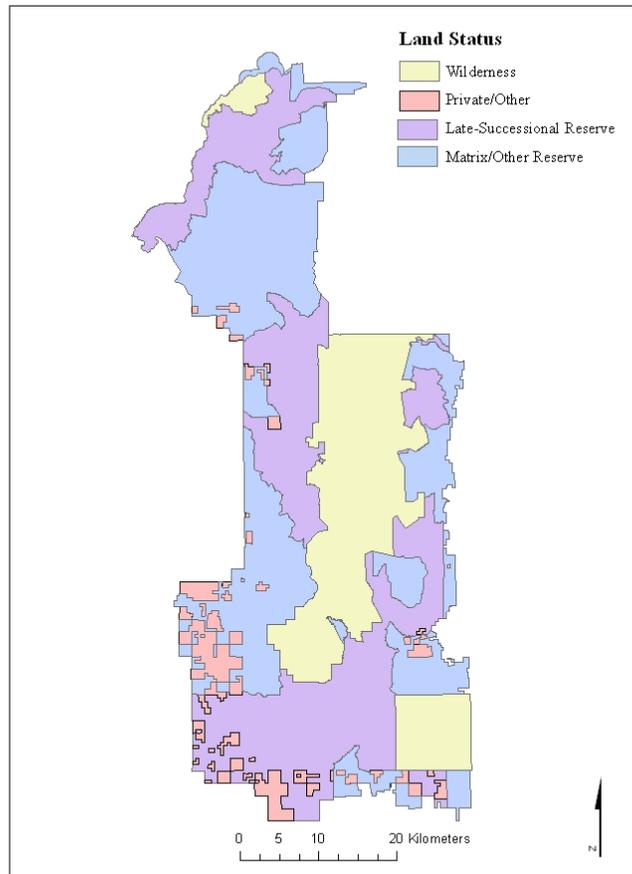


Figure 3. Land-use Allocations within the Southern Cascades Study Area, Rogue River-Siskiyou and Fremont-Winema National Forests, Oregon, 1990-2013.

## 7. Research Accomplishments:

### **Proportion of territories where spotted owls were detected**

Spotted owls were detected at 60 of the 171 sites we visited in 2013 (Figure 4). Among the sites that were surveyed to protocol, pairs were detected at 36 sites, single owls were detected at 4 sites, and owls of unknown social status were detected at 20 sites (Appendix 1). The percentage of sites where spotted owls were detected on the study area (35%) represented a 7.0% decrease from 2012 ( $\bar{x} = 67.4\%$ ,  $SE = 3.75$ ,  $n = 24$  years), and of the percent of pairs located (21%) was the lowest recorded during the study ( $\bar{x} = 52.2\%$ ,  $SE = 3.43$ ,  $n = 24$  years). There were 89 sites with continuous survey effort between 1992 and 2013, and banded spotted owls were detected at 30% of these sites in 2013 ( $\bar{x} = 53.6\%$ ,  $SE = 2.93$ ,  $n = 22$  years).

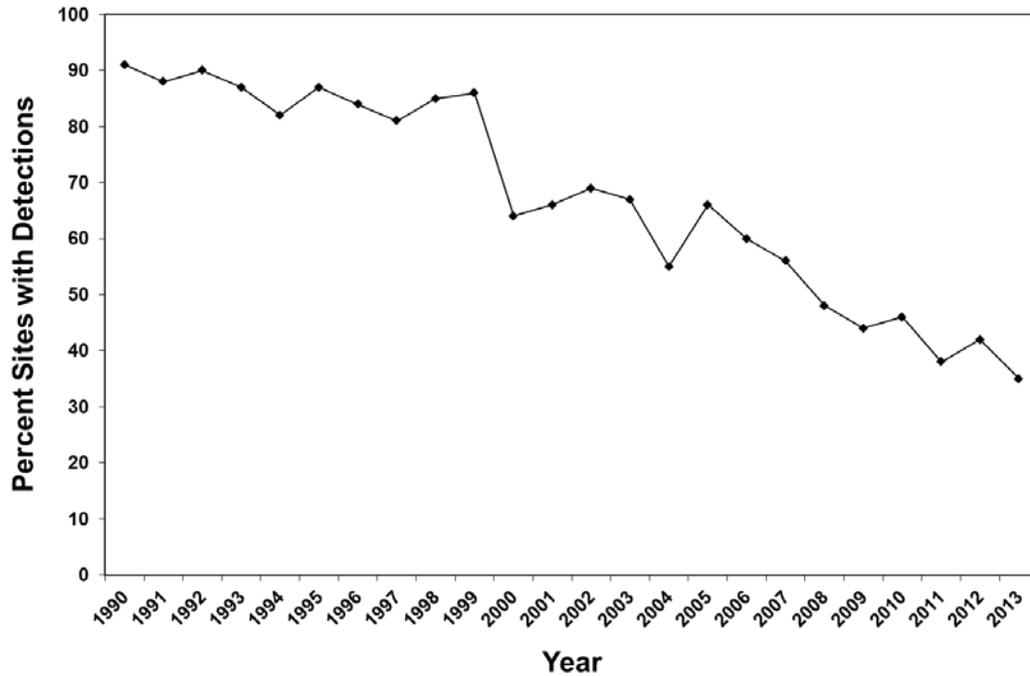


Figure 4. Percentage of all sites surveyed annually with  $\geq 1$  spotted owl detected on the Southern Cascades Study Area, Rogue River-Siskiyou and Fremont-Winema National Forests, Oregon, 1990-2013.

Spotted owls were detected at 6 Wilderness, 34 LSR, and 20 Matrix sites in 2013 (Appendix 2). The percentage of sites where spotted owls were detected (either single or paired) in Wilderness decreased from 39% in 2012 to 33% ( $\bar{x} = 57.1.0\%$ ,  $SE = 5.00$ ,  $n = 17$  years), and the percentage of sites where pairs were located was 22% ( $\bar{x} = 45.3\%$ ,  $SE = 4.80$ ,  $n = 17$  years). In the LSRs, the percentage of sites where owls were detected equaled 34% ( $\bar{x} = 60.9\%$ ,  $SE = 3.70$ ,  $n = 17$  years), while the percentage of sites where owl pairs were detected declined from 26% in 2012 to 19% ( $\bar{x} = 46.1\%$ ,  $SE = 3.70$ ,  $n = 17$  years). Owls were detected on 37% of Matrix owl territories ( $\bar{x} = 58.0\%$ ,  $SE = 4.30$ ,  $n = 17$  years), with pairs located at 24% of Matrix sites in 2013 ( $\bar{x} = 45.7\%$ ,  $SE = 4.30$ ,  $n = 17$  years). Overall, the mean percentage of sites with owls detected and the mean percentage of sites with pairs is similar for the three land management categories and continues to decline over time but with some annual variation (Appendix 2).

### Nest Success

Thirty-one owl pairs were surveyed to the nesting protocol to determine nesting status (Forsman 1995), and 8 of these pairs exhibited nesting behavior (26%). On average, 53% ( $SE = 5.10$ ,  $n = 24$  years; min. = 3%; max = 86%) of pairs detected each year attempted to nest. All owl pairs which exhibited nesting behavior early in the breeding season fledged young in 2013. The mean rate of nest failure for all years (1990-2013) was 16% ( $SE = 1.90$ ; min. = 0.0, max. = 26.9).

## Productivity

Of the sites where owls were detected in 2013, 31 pairs were located and 8 of these successfully reproduced as determined by the productivity protocol ( $\bar{x} = 39.6$ ,  $SE = 4.30$ ,  $n = 24$  years;  $min. = 1$ ;  $max. = 56$ ; Forsman 1995). The average number of young fledged per pair (0.42) was less in 2013 than the mean for all years ( $\bar{x} = 0.66$ ,  $SE = 0.082$ ,  $n = 24$  years) (Figure 5). The number of young produced per successful pair (1.62) in 2013 was similar to the average during the study ( $\bar{x} = 1.60$ ,  $SE = 0.044$ ,  $n = 24$  years) (Appendix 3).

In 2013, the average number of fledglings per pair in the LSRs was 0.67, and 0.25 in the Matrix; no pairs fledged young in the Wilderness. Between 1997 and 2013 the average number of young produced per pair in Matrix ( $\bar{x} = 0.64$ ,  $SE = 0.092$ ,  $n = 17$  years;  $min. = 0.00$ ,  $max. = 1.46$ ) and LSRs ( $\bar{x} = 0.64$ ,  $SE = 0.106$ ,  $n = 17$  years;  $min. = 0.04$ ,  $max. = 1.40$ ) have been similar and slightly better than in Wilderness areas ( $\bar{x} = 0.47$ ,  $SE = 0.139$ ,  $n = 17$  years;  $min. = 0.0$ ,  $max. = 1.67$ ) (Appendix 4).

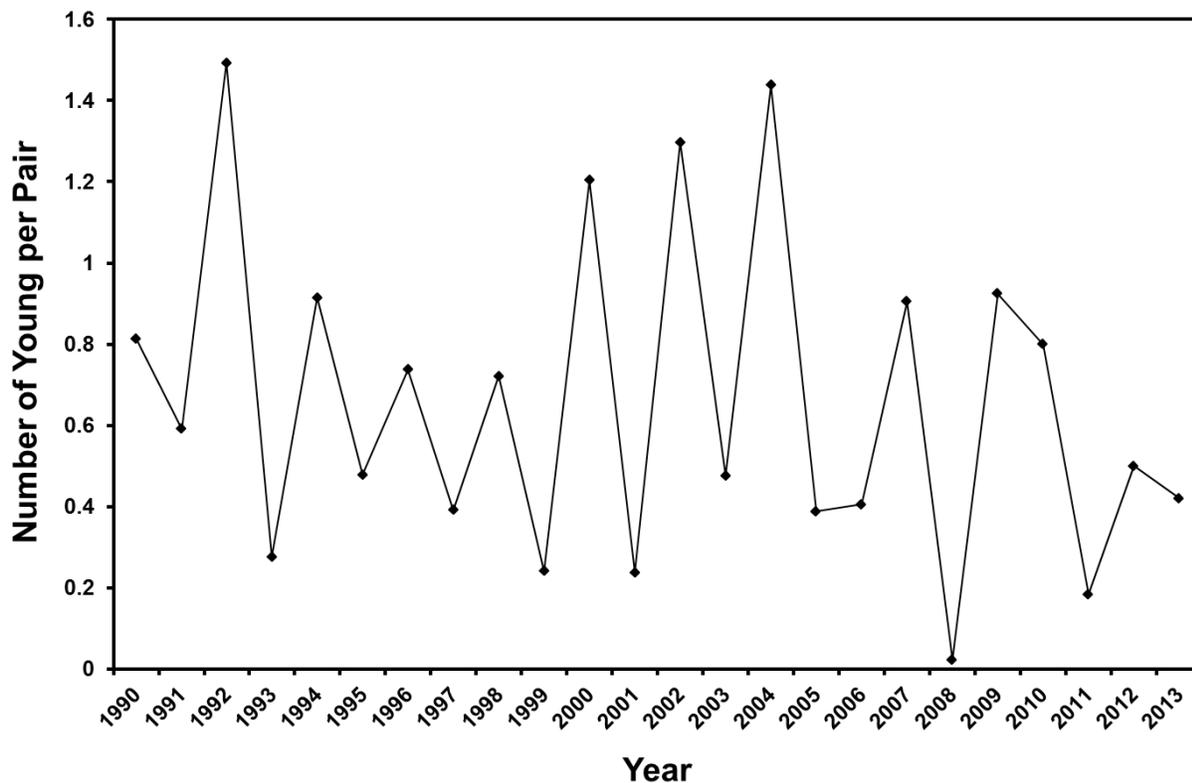


Figure 5. The number of young produced per total number of sites where spotted owl pairs were detected when surveyed to protocol for reproduction on the Southern Cascades Study Area, Rogue River-Siskiyou and Fremont-Winema National Forests, Oregon, 1990-2013.

We calculated fecundity as the mean number of young fledged per female checked for reproductive success divided by 2, assuming a 1:1 sex ratio of young at birth for 2013 (i.e., mean number of female young fledged per female). The mean fecundity for pairs we located in 2013 (age classes combined) was 0.31 ( $\bar{x} = 0.31$ ,  $SE = 0.052$ ,  $n = 17$  years,  $min. = 0.02$ ,  $max. = 0.67$ )

for territories in the LSR, and 0.13 ( $\bar{x} = 0.31$ , SE = 0.040, n = 17 years, min. = 0.00, max. = 0.66) for territories in the Matrix. No young were located in the Wilderness ( $\bar{x} = 0.20$ , SE = 0.070, n = 17 years, min. = 0.00, max. = 0.67) (Appendix 4). Over the course of the study, annual mean fecundity for spotted owl territories in the LSR and Matrix tended to be greater than for Wilderness sites. Overall, average fecundity was 0.20 (SE = 0.067, n = 32) for adult and subadult females in 2013 ( $\bar{x} = 0.34$ , SE = 0.046, n = 24 years; min. = 0.01, max. = 0.74) (Figure 6).

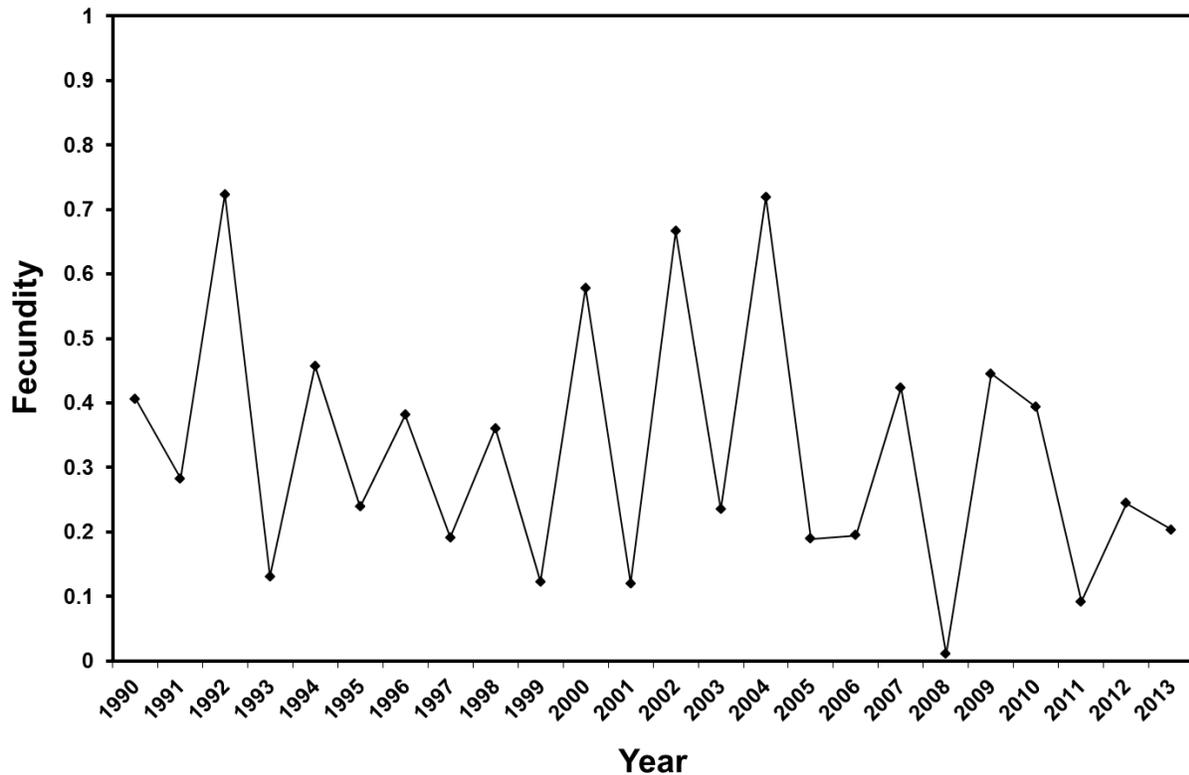


Figure 6. Mean annual fecundity (number of female fledglings per female) on the Southern Cascades Study Area, Rogue River-Siskiyou and Fremont-Winema National Forests, Oregon, 1990-2013.

### Age and Sex Composition

In 2013, 74 non-juvenile owls were detected, which is less than in most years of the study (Appendix 5). Of the owls we could assign to an age class, 91.9% were adults ( $\geq 3$  years old) and 8.1% were subadults (Appendix 5). We could not ascertain the age of 27% of the study population, the largest percentage owls of unknown age across all years ( $\bar{x} = 18.7\%$ , SE = 2.60, n = 24 years). The majority of unknown aged owls represented auditory detections usually during nighttime surveys without visual observation. On average 54% of the owls detected each year on the study area population are males, and males constituted a majority of the owls detected (53%) in 2013 (Appendix 5).

A total of 101 female and male owls were detected in 2013 ( $\bar{x} = 163.9$ , SE = 7.0, n = 24 years), and this was a large decrease of nearly 18% relative to 2012 (Appendix 5). The relative

proportions of female to male owls and age-class representation has been fairly constant in past years and this distribution appears to be unchanged through 2013 (Dugger *et al.* 2010).

### **Banding and Resighting**

In 2013, we banded 8 owls (3 fledglings, one subadult and 4 adults) on the study area and a total of 57 banded non-juvenile owls of known identity (including newly banded owls) were seen at least once during the season, a decline of nearly 38% from 2012 (Appendix 6). The minimum average age for all males was 7.3 years (SE = 0.79, n = 39) and 7.5 years (SE = 0.70, n = 35) for all females. The oldest owl in the sample, a male banded as a juvenile, was 18 years of age.

There were 12 documented inter-territory movements of banded owls in 2013 in the demographic study. One owl banded as a first year subadult in 2011 was reobserved as an emigrant outside of the study area. Two owls banded as juveniles (2009 and 2011) were located at non-natal sites within the study area. Nine owls banded as adults were relocated as internal emigrants in 2013.

A total of 293 movements have been recorded from 1990-2013 and the mean movement distance was 23.5 km for females (SE = 1.83, n = 133; min. = 0.9, max. = 95.4) and 15.0 km (SE = 1.48, n = 151; min. = 0.8, max. = 128.6) for males.

### **Barred Owls**

The range of northern barred owls (*Strix varia*) has expanded during the last century and now overlaps that of the northern spotted owl (Livezey 2009). Barred owls were first detected within the boundaries of the CAS in 1981 (*Pers. comm.* Rick Hardy, Wildlife Biologist (Ret.), U.S. Forest Service). This study was not designed to systematically follow trends in barred owl occupancy but it has gathered a significant number of incidental detections of barred owls during the course of spotted owl surveys. The annual percentage of barred owl detections at the 171 historic spotted owl territories on the study has increased from a low of 4.1% to a high of 30% in 2012 and 2013 (Figure 7). Cumulatively, barred owls have been detected at 71% of the spotted owl territories during at least one breeding season over the course of this study. The annual proportion of surveyed areas with spotted owl detections exhibits a strong negative association with the cumulative proportion of surveyed areas with barred owl detections ( $r = -0.928$ ,  $p \leq 0.001$ ). This proportion is likely still an underestimate of the number of spotted owl territories being influenced by barred owls, as some barred owls are probably missed during surveys for spotted owls. However, a study in the Oregon Coast range suggests that over the course of a season, spotted owl surveys to protocol ( $\geq 3$  visits) allow ~85% of the barred owls present in the area to be detected (Wiens *et al.* 2011). In addition, we have been able to document the strong negative effects of barred owl detections on spotted owl detection rates, as well as extinction and colonization rates on this study area (Dugger *et al.* 2011).

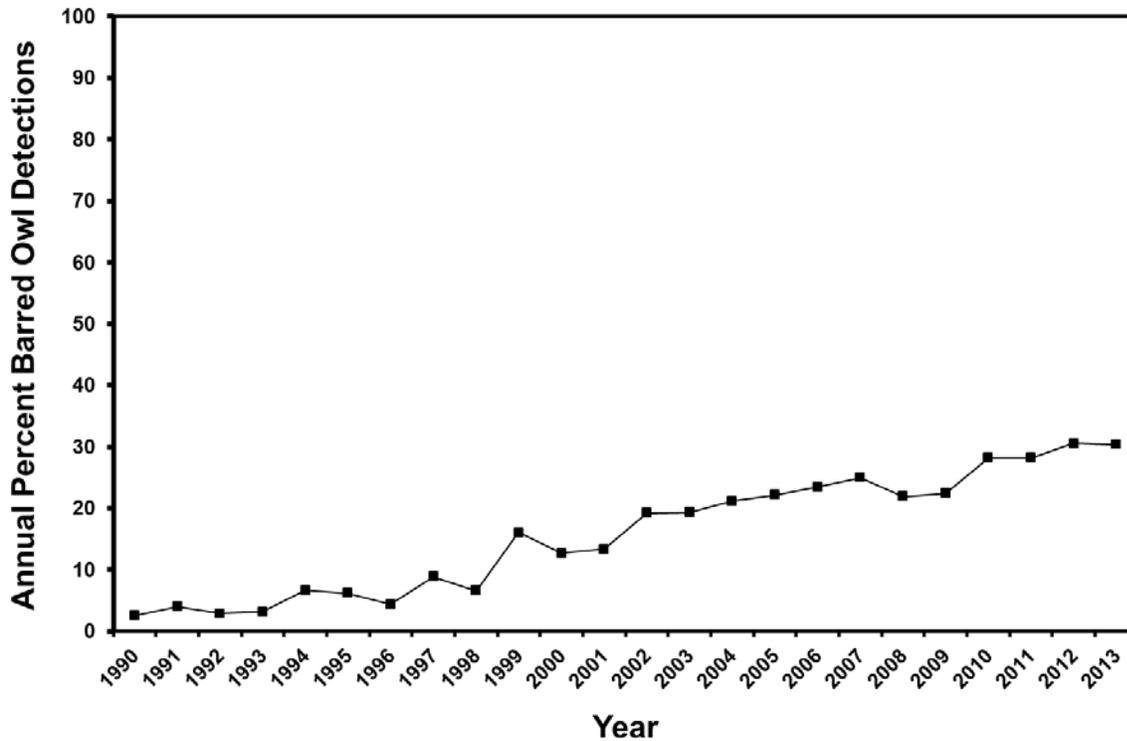


Figure 7. The annual percentages of historic spotted owl territories surveyed where barred owls were detected on the Southern Cascades Study Area, Rogue River-Siskiyou and Fremont-Winema National Forests, Oregon, 1990-2013.

### Spotted Owl Diets

A total of 6,109 prey specimens from 130 owl sites in regurgitated pellets were collected and identified between 2000-2010. Samples were collected opportunistically at spotted owl nesting or roosting sites with most pellets collected from breeding spotted owls. The sample consists primarily of northern flying squirrels (*Glaucomys sabrinus*), woodrat species (*Neotoma cinerea* and *N. fuscipes*) and Lagomorphs (Figure 8).

Pocket gophers (*Thomomys mazama* and *T. talpoides*), red-backed voles (*Clethrionomys californicus*) and moles (*Scapanus orarius* and *S. latimus*) in pellets were low in biomass but higher in absolute numbers (Figure 9).

Updated summaries on owl diets through 2013 are pending.

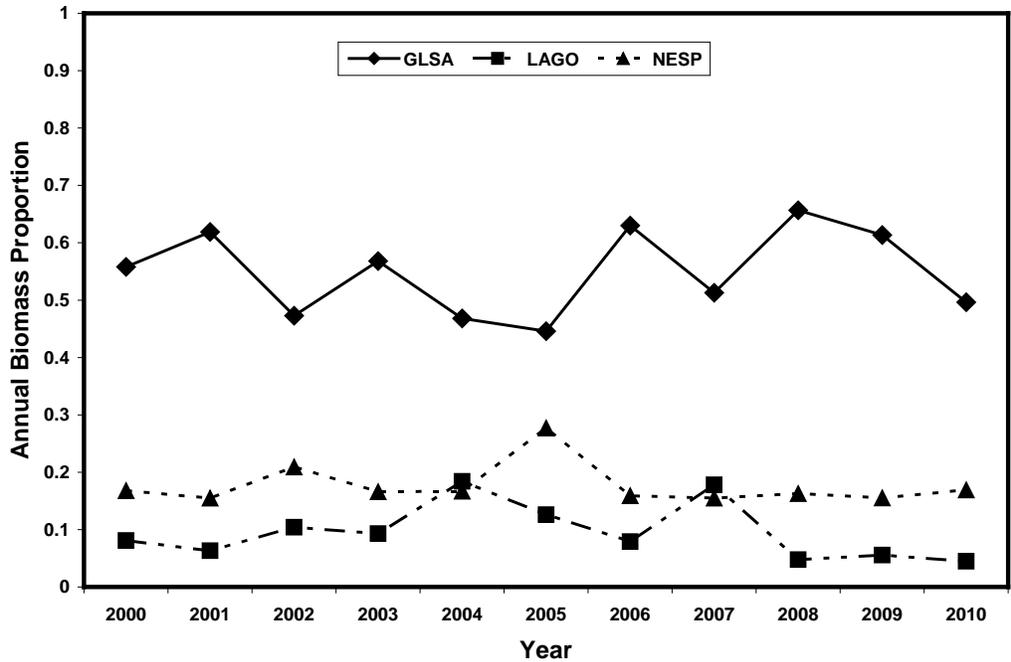


Figure 8. The annual biomass proportion of flying squirrels (GLSA = *Glaucomys sabrinus*), woodrats (NESP = *Neotoma* species) and Lagomorphs (LAGO) in regurgitated spotted owl pellets on the Southern Cascades Study Area, Rogue River-Siskiyou and Fremont-Winema National Forests, Oregon, 2000-2010.

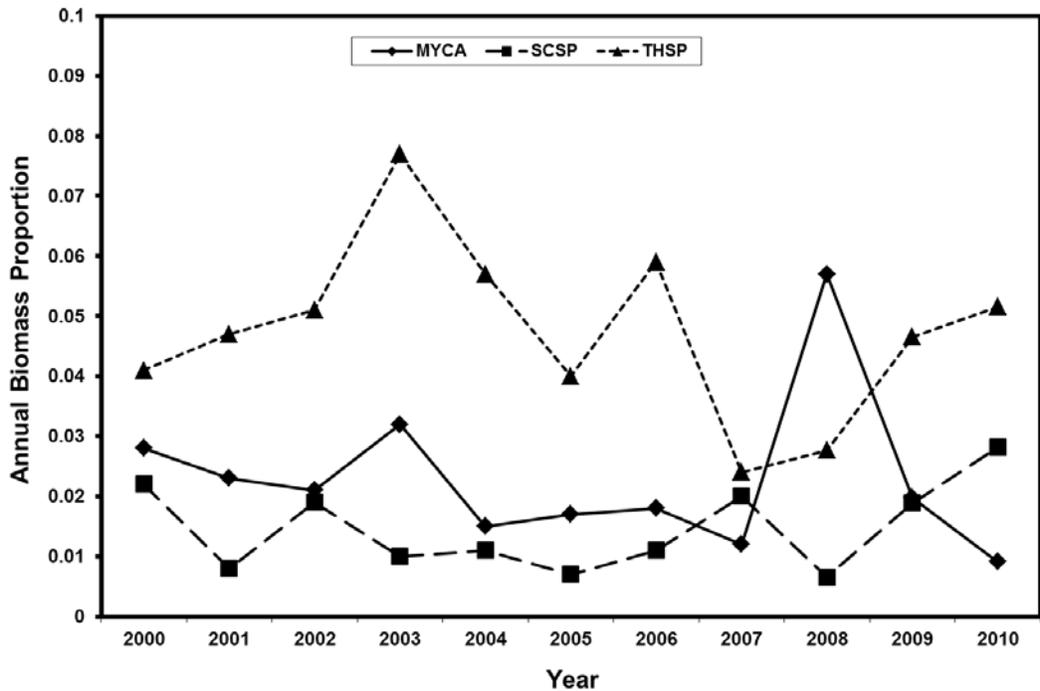


Figure 9. The annual biomass proportion of western red-backed voles (MYCA = *Myodes californicus*), moles (SCSP = *Scapanus* species) and pocket gophers (THSP = *Thomomys* species) in regurgitated spotted owl pellets on the Southern Cascades Study Area, Rogue River-Siskiyou and Fremont-Winema National Forests, Oregon, 2000-2010.

## Survey Effort

By 1994 more than 90% of the sites currently visited in the demographic study had been identified. The number of visits conducted to spotted owl territories on the study area varies between years based on the requirements of the survey protocol relative to detecting single owls and pairs, and determining annual productivity. The proportion of day and night visits is also influenced by snowpack with more night visits being conducted in years where early season access to owl sites is limited. The majority of the visits required to determine whether an owl was present on a site are conducted as nighttime surveys. From 1994 to 2013, as the proportion of territories where owls are detected has declined, the amount of survey effort dedicated to productivity assessments has also declined and the effort for determining whether owls are present or not, has gradually increased (Figure 10). Across all visits, the proportion of nighttime surveys has varied annually but has generally increased (min. = 24%; max. = 66%) (Figure 10).

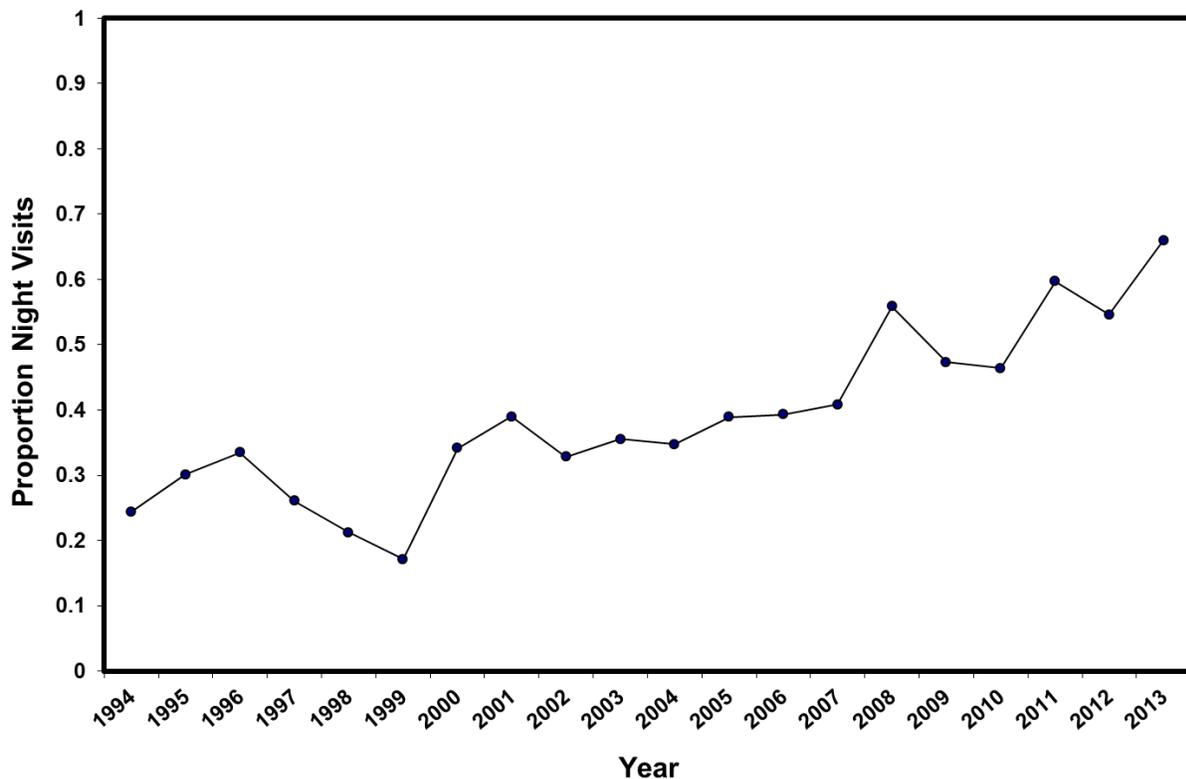


Figure 10. The annual proportion of total visits conducted as nighttime surveys of historic spotted owl territories on the Southern Cascades Study Area, Rogue River-Siskiyou and Fremont-Winema National Forests, Oregon, 1994-2013.

## Apparent Survival, Fecundity, and Population Trend

In 2014 a workshop will be conducted to analyze range-wide demographic data of northern spotted owls. The workshop will be held as a requirement of the *Northern Spotted Owl Effectiveness Monitoring Program for the Northwest Forest Plan* (Lint *et al.* 1999). This will be the 6<sup>th</sup> in a series of workshops conducted every 5 years to estimate fecundity, apparent survival,

and rates of population change for both specific sub-regions of the species geographic distribution and across the range of northern spotted owls. Additionally, a two-state occupancy analysis will be conducted for barred owls and spotted owls in 2014. Preliminary results from the workshop are expected by the fall of 2014.

## **Discussion**

In 2013 field work was aided by low snow pack and mild temperatures which improved our access to most of the higher elevation sites on the study area. The improved access permitted us to begin a schedule of swing shifts with night work at the onset of the field season. It would be expected that the detection rates of spotted owls might be improved by the addition of early season night surveys. However, despite our more extensive night time survey effort in the spring, the number of spotted owls detected and the number of sites determined to have spotted owls present was the lowest ever recorded on the study.

The number of spotted owl pairs we located in 2013 was the fewest detected during the study. More spotted owls may have been paired than we could determine by protocol, however, since there were a large number of sites where owls were detected but social status could not be assigned according to protocol.

In 2013 productivity decreased relative to 2012, and no nests appeared to have failed. Higher levels of precipitation and cooler temperatures in the early nesting season are both associated with decreased productivity in the southern Cascades so the mild weather and low snowpack might have been a factor in the high nest success that we documented (Dugger *et al.* 2006, Forsman *et al.* 2011). Barred owls are known to have disrupted spotted owl nesting at individual territories on the study area in the past and more nest failures might have been expected given the continuing increase in the cumulative number of historic spotted owl territories with barred owl detections. We did not observe an effect of barred owl density on spotted owl nesting success in 2013.

During the course of the study productivity has periodically followed a strong biannual pattern of alternating high and low years, disrupted by low productivity in both 2005-2006 and relatively high reproduction in both 2009-2010. Productivity in 2013 was similar to that observed in 2009-2010 in that the number of young fledged per pair declined from 2012 but not steeply. However, the annual total number of young produced on the study area has declined as fewer spotted owl pairs are located, either nesting or non-nesting.

## **8. Acknowledgments:**

We would like to acknowledge the many individuals who have also contributed to the success of this project, including: Eric Forsman (Wildlife Biologist, Pacific Northwest Research Station), Ray Davis (Old Forest and Northern Spotted Owl Monitoring Lead, Interagency Regional Monitoring Team), Dave Clayton (Forest Wildlife Biologist, Rogue River-Siskiyou National Forest), Amy Markus (Forest Wildlife Biologist, Fremont-Winema National Forest), Jen Sanborn (Wildlife Biologist, South Zone, Fremont-Winema National Forest), Sheila Colyer (Wildlife Biologist, High Cascades Ranger District, Rogue River-Siskiyou National Forest), Lisa Lyon (Wildlife Biologist, South Zone, Fremont-Winema National Forest), Steve Hayner (Wildlife Biologist, Klamath Falls Resource Area, Lakeview District BLM), Robin Snider (District

Wildlife Biologist, Medford District BLM), Dave Roelofs (Wildlife Biologist, Butte Falls Resource Area, Medford District BLM) and Steve Godwin (Wildlife Biologist, Ashland Resource Area, Medford District BLM) . We also thank the Rogue River-Siskiyou and Fremont-Winema National Forest Supervisors Offices', the Regional Office of the U.S. Forest Service, and the Klamath Falls, Roseburg, and the Portland Offices' of the U.S. Fish and Wildlife Service for their support. We thank the Medford Interagency Office and Medford District BLM for providing work space and logistical support in 2013.

This report is dedicated to the memory of Dr. Robert G. Anthony, the former PI on this project as well as a mentor, colleague, and friend to many of us in the world of spotted owl conservation and management.

**9. Research Plans for FY 2014:**

- a. Participation in a meta-analysis of spotted owl demographic rates and occupancy scheduled for January 2014.
- b. Continue the collection of pellets and analysis of spotted owl diets.
- c. Continue to assist personnel from Crater Lake National Park with their banding program.

**10. Publications in FY 2013:**

Clark, D.A., R.G. Anthony, and L.S. Andrews. 2013. Relationship between Wildfire, Salvage Logging and Occupancy of Nesting Territories by Northern Spotted Owls. *Journal of Wildlife Management* 77:672-688.

**11. Technology Transfer Completed in FY 2013:**

- a. K. Dugger and S. Andrews participated in data preparation and summarization for the meta-analysis of spotted owl demographic rates scheduled for January 2014.
- b. K. Dugger and S. Andrews participated in data coordination efforts with personnel from other demographic studies.
- c. Project personnel provided the USDA-USFS Ranger Districts, USDI-BLM Resource Areas, and USDI-Crater Lake National Park with information in preparation of the meta-analysis workshop and coordinated surveys.

**13. Duration of the Study:**

- a. Initiated in 1990.
- b. This project is part of the long-term Northern Spotted Owl Effectiveness Monitoring Program for the Northwest Forest Plan (Lint *et al.* 1999).

#### 14. Literature Cited:

- Anthony, R.G., E.D. Forsman, A.B. Franklin, D.R. Anderson, K.P. Burnham, G.C. White, C.J. Schwarz, J. Nichols, J. Hines, S.H. Ackers, L.S. Andrews, B.L. Biswell, P.C. Carlson, L.V. Diller, K.M. Dugger, K.E. Fehring, T.L. Fleming, R.P. Gerhardt, S.A. Gremel, R.J. Gutierrez, P.J. Happe, D.R. Herter, J.M. Higley, R.B. Horn, L.L. Irwin, P.J. Loschl, J.A. Reid, and S.G. Sovern. 2006. Status and trends in demography of Northern Spotted Owls, 1985-2003. Wildlife Monographs No. 163: 1-48.
- Burnham, K.P., D.R. Anderson, and G.C. White. 1996. Meta-analysis of vital rates of the northern spotted owl. Pp. 92-101 in E.D. Forsman, S. DeStephano, M.G. Raphael and R. J. Gutierrez (editors), Demography of the Northern Spotted Owl. Studies in Avian Biology No. 17.
- Dugger, K.M., S. Andrews, E. Fleigel, L. Friar, D. Strejc and F. Wagner. 2010. Demographic Characteristics and Ecology of Spotted Owls (*Strix occidentalis caurina*) in the Southern Oregon Cascades. Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon. 30p.
- Dugger, K.M., R.G. Anthony, and L.S. Andrews. 2011. Transient dynamics of invasive competition: barred owls, spotted owls, habitat, and the demons of competition present. Ecological Applications 21:2459-2468.
- Forsman, E.D. 1995. Appendix A: Standardized protocols for gathering data on occupancy and reproduction in spotted owl demographic studies. Pp. 32 - 38 in J. Lint, B. Noon, R. Anthony, E. Forsman, M. Raphael, M. Collopy, and E. Starkey. 1999. Northern spotted owl effectiveness monitoring plan for the Northwest Forest Plan. U. S. Forest Service Gen. Tech. Rep. PNW-GTR-440. 43p.
- Forsman, E.D., R.G. Anthony, K.M. Dugger, E.M. Glenn, A.B. Franklin, G.C. White, C.J. Schwartz, K.P. Burnham, D.R. Anderson, J. E. Nichols, J.E. Hines, J.B. Lint, R.J. Davis, S.H. Ackers, L.S. Andrews, B.L. Biswell, P.C. Carlson, L.V. Diller, S.A. Gremel, D.R. Herter, J.M. Higley, R.B. Horn, J.A. Reid, J. Rockweit, J.P. Schaberl, T.J. Snetsinger, and S.G. Sovern. 2011. Demographic trends of Northern Spotted Owls, 1985-2008. Studies in Avian Biology No. 40.
- Franklin, A.B., K.P. Burnham, G.C. White, R.G. Anthony, E.D. Forsman, C. Schwartz, J.D. Nichols, and J.E. Hines. 1999. Range-wide status and trends in northern spotted owl populations. USGS Colorado Cooperative Fish and Wildlife Research Unit, Colorado State University, Fort Collins, CO.
- Franklin, J.F., and C.T. Dyrness. 1973. Natural vegetation of Oregon and Washington. Oregon State University Press, Corvallis. 417p.
- Lint, J.B., B.R. Noon, R.G. Anthony, E.D. Forsman, M.G. Raphael, M.I. Collopy and E.E. Starkey. 1999. Northern spotted owl effectiveness monitoring plan for the Northwest Forest Plan. U.S. Department of Agriculture - Forest Service. Gen. Tech. Rpt. PNW-GTR-444. 43p.

- Livezey, K.B. 2009. Range expansion of barred owls, part I: chronology and distribution. *American Midland Naturalist* 161:49-56.
- USDA and USDI. 1994. Final supplemental impact statement on management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl. 2 volumes. U. S. Department of Agriculture - Forest Service and U.S. Department of Interior - Bureau of Land Management, Portland, OR. Irregular pagination.
- USDA. 1997. Oregon Eastern Cascades Physiological Province Late Successional Reserve Assessment. U. S. Department of Agriculture - Forest Service, Klamath Falls, OR. 85p.
- USDA. 1998. Southern Cascades Late Successional Reserve Assessment. U. S. Department of Agriculture - Forest Service, Roseburg, OR. 254p.
- USDI. 2008. Final recovery plan for the northern spotted owl (*Strix occidentalis caurina*). U.S. Fish and Wildlife Service, Portland, OR.
- USDI. 2011. Revised Recovery Plan for the Northern Spotted Owl (*Strix occidentalis caurina*). U.S. Fish and Wildlife Service, Portland, OR. xvi + 258p.
- USDI. 2013. Experimental Removal of Barred Owls to Benefit Threatened Northern Spotted Owls Final Environmental Impact Statement. Oregon Fish and Wildlife Office U.S. Fish and Wildlife Service, Portland, OR. 467p.
- USFWS (U.S. Fish and Wildlife Service). 2004. Northern spotted owl: Five Year Review Summary and Evaluation. USDI Fish and Wildlife Service, Portland, Oregon. 73p.
- Wiens, J.D., R.G. Anthony, and E.D. Forsman. 2011. Barred owl occupancy surveys within the range of the northern spotted owl. *Journal of Wildlife Management* 75:531-538.

Appendix 1. Number of northern spotted owl sites surveyed and their respective occupancy on the Southern Cascades Study Area, Rogue River-Siskiyou and Fremont-Winema National Forests, Oregon, 1990-2013<sup>a</sup>.

Year	# Sites Surveyed	# Sites w/ Pairs	# Sites w/ Single Owls	# Sites w/ Social Status Unknown <sup>b</sup>	Total Occupied Sites	# of Sites Unoccupied <sup>c</sup>	% Sites Occupied
1990	78	54	6	11	71	7	91
1991	123	81	5	22	108	15	88
1992	138	107	3	14	124	14	89
1993	126	78	9	22	109	17	86
1994	120	80	4	14	98	22	81
1995	97	62	8	14	84	13	87
1996	91	65	4	7	76	15	84
1997	90	58	4	11	73	17	81
1998	91	67	2	8	77	14	85
1999	81	58	7	5	70	11	86
2000	126	55	10	16	81	45	64
2001	149	80	1	18	99	50	66
2002	161	83	11	17	111	50	69
2003	165	91	5	14	110	55	67
2004	165	73	1	17	91	74	55
2005	167	87	7	17	111	56	66
2006	166	76	9	15	100	66	60
2007	168	79	4	11	94	74	56
2008	169	48	10	23	81	88	48
2009	169	57	5	13	75	94	44
2010	170	60	2	17	79	91	46
2011	170	51	3	11	65	105	38
2012	170	44	11	15	71	99	42
2013	171	36	4	20	60	111	35

<sup>a</sup> All sites which were surveyed to protocol; status as determined by protocol (Forsman 1995).

<sup>b</sup> Sites with a response by a male and/or female that did not meet pair or single status with  $\geq 3$  night visits.

<sup>c</sup> A minimum of 3 nighttime visits without a detection was needed to infer unoccupied status.

Appendix 2. Number of spotted owl sites surveyed to protocol and their respective occupancies by Land-use Allocation on the Southern Cascades Study Area, Rogue River-Siskiyou and Fremont-Winema National Forests, Oregon, 1997-2013<sup>a</sup>.

Land-Use Allocation <sup>b</sup>	Year	# Sites Surveyed	# Sites w/ Pairs	# Sites w/ Single Owls	# Sites w/ Social Status Unknown	Total Occupied Sites	# Sites Unoccupied	% Sites Occupied
<u>Matrix</u>								
	1997	28	20	0	4	24	4	86
	1998	24	18	0	1	19	5	79
	1999	20	17	0	2	19	1	95
	2000	38	17	1	5	23	15	61
	2001	46	22	1	5	28	18	61
	2002	50	24	4	7	35	15	70
	2003	52	28	0	6	34	18	65
	2004	53	22	0	8	30	23	57
	2005	53	28	1	5	34	19	64
	2006	53	23	0	4	27	26	51
	2007	53	23	3	2	28	25	55
	2008	53	15	4	8	27	26	51
	2009	53	17	1	2	20	33	38
	2010	53	15	2	4	21	32	40
	2011	53	15	2	2	19	34	36
	2012	53	15	2	3	20	33	38
	2013	54	13	1	6	20	34	37
<u>LSR</u>								
	1997	53	34	3	6	43	10	81
	1998	58	40	2	7	49	9	84
	1999	52	37	6	2	45	78	87
	2000	79	32	9	9	50	29	63
	2001	86	49	0	12	61	25	71
	2002	94	51	6	10	67	27	71
	2003	95	52	4	6	62	33	65
	2004	95	42	0	9	51	44	53
	2005	96	51	4	9	64	32	67
	2006	96	45	8	10	63	33	66
	2007	98	47	1	9	57	41	58
	2008	98	26	5	14	45	53	46
	2009	98	36	2	11	49	49	50
	2010	99	40	0	11	48	51	52
	2011	99	32	1	9	42	57	42
	2012	99	26	7	11	44	55	44
	2013	99	19	3	12	34	65	34

Cont.

<b>Land-Use Allocation</b>	<b>Year</b>	<b># Sites Surveyed</b>	<b># Sites w/ Pairs</b>	<b># Sites w/ Single Owls</b>	<b># Sites w/ Social Status Unknown</b>	<b>Total Occupied Sites</b>	<b># Sites Unoccupied</b>	<b>% Sites Occupied</b>
<b>Wilderness</b>								
	1997	9	4	1	1	6	3	67
	1998	9	9	0	0	9	0	100
	1999	9	4	1	1	6	3	67
	2000	9	6	0	2	8	1	89
	2001	17	9	0	1	10	7	59
	2002	17	8	1	0	9	8	53
	2003	18	11	1	2	14	4	78
	2004	17	9	1	0	10	7	59
	2005	18	8	2	3	11	5	71
	2006	17	8	1	1	10	7	59
	2007	17	9	0	0	9	8	53
	2008	18	7	1	1	9	9	50
	2009	18	4	1	1	6	12	33
	2010	18	5	0	2	7	11	39
	2011	18	4	0	0	4	14	22
	2012	18	4	2	1	7	11	39
	2013	18	4	0	2	6	12	33

<sup>a</sup> See Table 1 for column heading definitions.

<sup>b</sup> See the Northwest Forest Plan (1994) for a description of Matrix and LSR Land-use Allocations.

Appendix 3. Summary of reproductive success of northern spotted owls on the Southern Cascades Study Area, Rogue River-Siskiyou and Fremont-Winema National Forests, Oregon, 1990-2013<sup>a</sup>.

Year	# Pairs Checked	# Pairs Fledging Young	# Young Fledged	% Pairs Producing Young	Average # of Young/Successful Pair	Average # of Young/Pair
1990	32	18	26	56	1.44	0.81
1991	44	17	26	39	1.53	0.59
1992	75	55	112	73	2.04	1.49
1993	58	11	16	19	1.45	0.28
1994	70	35	64	50	1.83	0.91
1995	46	14	22	30	1.57	0.48
1996	61	30	45	49	1.50	0.74
1997	46	12	18	26	1.50	0.39
1998	61	32	44	53	1.38	0.72
1999	50	7	12	14	1.71	0.24
2000	49	34	59	69	1.74	1.20
2001	76	11	18	15	1.64	0.24
2002	74	51	96	69	1.88	1.30
2003	82	23	39	28	1.70	0.48
2004	73	56	105	77	1.88	1.44
2005	80	23	31	29	1.35	0.39
2006	74	19	30	26	1.58	0.41
2007	74	41	67	55	1.63	0.91
2008	44	1	1	2	1.00	0.02
2009	53	27	49	51	1.81	0.92
2010	60	29	48	48	1.66	0.80
2011	49	6	9	12	1.50	0.18
2012	44	15	22	34	1.47	0.50
2013	31	8	13	26	1.63	0.42

<sup>a</sup> All sites which were surveyed to reproductive protocol (Forsman 1995).

Appendix 4. Summary of reproductive success for northern spotted owls, by Land-use Allocation, on the Southern Cascades Study Area, Rogue River-Siskiyou and Fremont-Winema National Forests, Oregon, 1997-2013<sup>a</sup>.

Land-Use Allocation <sup>b</sup>	Year	# Pairs Checked	# Pairs Fledging Young	# Young Fledged	% Pairs Producing Young	Average # of Young/Successful Pair	Average # of Young/Pair	Mean Fecundity <sup>b</sup> , # Females
<u>Matrix</u>								
	1997	17	6	9	35	1.50	0.53	0.264 (17)
	1998	16	10	13	63	1.30	0.81	0.375 (16)
	1999	15	6	10	40	1.67	0.67	0.333 (15)
	2000	14	7	11	50	1.57	0.79	0.393 (14)
	2001	20	4	6	20	1.50	0.30	0.143 (21)
	2002	22	12	24	55	2.00	1.09	0.545 (22)
	2003	23	6	11	26	1.83	0.48	0.229 (24)
	2004	22	18	32	82	1.78	1.46	0.659 (22)
	2005	28	8	10	29	1.25	0.36	0.167 (30)
	2006	22	6	10	27	1.67	0.46	0.217 (23)
	2007	20	11	19	55	1.72	0.95	0.452 (21)
	2008	14	0	0	0	NA	0.00	0.000 (17)
	2009	17	11	20	65	1.82	1.18	0.556 (18)
	2010	15	7	12	47	1.71	0.80	0.375 (16)
	2011	15	3	4	20	1.33	0.26	0.133 (15)
	2012	14	5	7	37	1.40	0.50	0.269 (13)
	2013	12	2	3	17	1.50	0.25	0.313 (16)
<u>LSR</u>								
	1997	27	6	9	22	1.50	0.33	0.167 (27)
	1998	37	21	30	57	1.43	0.81	0.405 (37)
	1999	32	1	2	3	2.00	0.06	0.031 (32)
	2000	29	23	40	79	1.74	1.38	0.667 (30)
	2001	47	7	12	15	1.71	0.26	0.128 (47)
	2002	45	33	60	73	1.82	1.33	0.667 (45)
	2003	48	15	25	31	1.67	0.52	0.276 (49)
	2004	42	30	58	71	1.93	1.38	0.674 (43)
	2005	45	12	18	27	1.50	0.40	0.202 (47)
	2006	44	12	18	27	1.50	0.41	0.191 (47)
	2007	46	28	45	61	1.61	0.98	0.450 (50)
	2008	23	1	1	4	1.00	0.04	0.020 (25)
	2009	32	14	26	44	1.86	0.81	0.394 (33)
	2010	40	21	32	53	1.52	0.80	0.425 (40)
	2011	30	3	5	10	1.67	0.17	0.083 (30)
	2012	26	9	13	35	1.44	0.50	0.250 (26)
	2013	15	6	10	40	1.67	0.67	0.333 (15)

Cont.

Land-Use Allocation	Year	# Pairs Checked	# Pairs Fledging Young	# Young Fledged	% Pairs Producing Young	Average # of Young/Successful Pair	Average # of Young/Pair	Mean Fecundity <sup>b</sup> , # Females
Wilderness	1997	3	0	0	0	NA	0.00	0.000 (3)
	1998	8	2	2	25	1.00	0.25	0.125 (8)
	1999	3	0	0	0	NA	0.00	0.000 (3)
	2000	6	4	8	67	2.00	1.33	0.667 (6)
	2001	8	0	0	0	NA	0.00	0.000 (8)
	2002	7	6	12	86	2.00	1.71	0.857 (7)
	2003	11	2	3	18	1.50	0.27	0.125 (12)
	2004	9	9	15	100	1.67	1.66	0.833 (9)
	2005	7	3	3	43	1.00	0.43	0.188 (8)
	2006	8	1	2	13	2.00	0.25	0.143 (8)
	2007	8	2	3	25	1.50	0.38	0.188 (8)
	2008	6	0	0	0	NA	0.00	0.000 (7)
	2009	4	2	3	50	1.50	0.75	0.375 (4)
	2010	5	1	2	20	2.00	0.40	0.200 (5)
	2011	4	0	0	0	NA	0.00	0.000 (4)
	2012	4	1	2	25	2.00	0.50	0.200 (5)
	2013	4	0	0	0	NA	0.00	0.000 (4)

<sup>a</sup> All sites which were surveyed to reproductive protocol (Forsman 1995).

<sup>b</sup> Average fecundity estimate = number of female young produced per female owl (assume a 1:1 sex ratio of young at birth).

Appendix 5. Age and sex of northern spotted owls detected on the Southern Cascades Study Area, Rogue River-Siskiyou and Fremont-Winema National Forests, Oregon, 1990-2013.

Year	Adults (M,F)	Subadults (M,F)	Age Unknown (M,F)	Age Combined (M,F)	All Juveniles	Subadults (%)	Males (%)
1990	54 (30,24)	2 (1,1)	96 (53,43)	152 (84,68)	26	4	55
1991	112 (58,54)	7 (3,4)	84 (46,38)	203 (107,96)	33	6	53
1992	139 (77,62)	8 (4,4)	97 (46,51)	244 (127,117)	121	5	52
1993	136 (76,60)	12 (5,7)	46 (24,22)	194 (105,89)	16	8	54
1994	139 (73,66)	11 (7,4)	31 (17,14)	181 (97,84)	66	7	54
1995	126 (64,62)	9 (7,2)	16 (12,4)	151 (83,68)	24	7	55
1996	123 (61,62)	5 (4,1)	17 (10,7)	145 (75,70)	46	4	52
1997	114 (63,51)	7 (2,5)	16 (9,7)	137 (74,63)	18	6	54
1998	133 (70,63)	4 (3,1)	22 (14,8)	159 (87,72)	45	3	55
1999	122 (71,51)	7 (1,6)	15 (9,6)	144 (81,63)	12	5	56
2000	111 (65,46)	10 (2,8)	22 (16,6)	143 (83,60)	59	8	58
2001	151 (80,71)	10 (4,6)	25 (20,5)	186 (104,82)	18	6	56
2002	157 (86,71)	13 (5,8)	27 (17,10)	197 (108,89)	98	8	55
2003	168 (90,78)	13 (2,11)	21 (15,6)	202 (107,95)	39	7	53
2004	140 (71,69)	11 (5,6)	23 (15,8)	174 (91,83)	106	7	52
2005	157 (78,79)	19 (11,8)	30 (20,10)	206 (109,97)	32	11	53
2006	145 (78,67)	18 (9,9)	21 (13,8)	184 (100,84)	31	11	54
2007	151 (76,75)	7 (2,5)	20 (13,7)	178 (91,87)	67	4	51
2008	101 (55,46)	7 (2,5)	23 (13,10)	131 (70,61)	1	6	54
2009	115 (60,55)	2 (1,1)	16 (7,9)	133 (68,65)	49	2	51
2010	116 (58,58)	10 (7,3)	22 (13,9)	147 (78,70)	48	7	53
2011	97 (50,47)	4 (3,1)	15 (8,7)	116 (61,55)	10	3	53
2012	98 (55,43)	3 (3,0)	22 (12,10)	123 (70,53)	22	5	54
2013	68 (35,33)	6 (4,2)	27 (14,13)	101 (53,48)	13	8	53

Appendix 6. Number of spotted owls newly banded, re-sighted, and recaptured on the Southern Cascades Study Area, Rogue River-Siskiyou and Fremont-Winema National Forests, Oregon, 2013.

Age class	Owls newly banded			Owls re-sighted			Owls recaptured		
	Males	Females	Unk.	Males	Females	Unk.	Males	Females	Unk.
Adults	2	2	0	25	23	0	0	2	0
Subadults	1	0	0	0	0	0	2	0	0
Juveniles	-	-	3	-	-	-	-	-	-