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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), U.S. Geological Survey, Oregon Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon.

Biologists: L. Steven Andrews (Project Leader), S. Adams, J. Brooks, L. Duchac, L. Friar, and T. Phillips, Oregon Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon.

3. Introduction:

Background

Northern spotted owls have been the subject of public policy and wildlife management concern for nearly 40 years. Early research indicated that the species was associated with late-successional forest (Forsman et al. 1984). These forests were rapidly being converted through timber harvest into young stands managed on economic short rotations, particularly on private land. Efforts to conserve the species on Federal administered lands originally focused on preserving habitat within the home range of owl pairs in Spotted Owl Habitat Areas (SOHA) or Conservation Agreement Areas. This approach was superseded by the establishment of forest reserves directed towards managing larger areas with multiple owl pairs in Habitat Conservation Areas (HCA) (Thomas et al. 1990). These efforts accelerated when northern spotted owls were listed by the US. Fish and Wildlife Service as a Threatened sub-species based on the loss of their preferred habitat, an overall decline in population size and a lack of regulatory mechanisms to ensure their conservation (USDI 1990). The implementation of a Final Draft Recovery Plan for the Northern Spotted Owl (USDI 1992) was deferred in lieu of the development of the *Northwest Forest Plan,* a management strategy that included late-successional reserves across the Pacific Northwest designed to conserve an array of species including the northern spotted owl, associated with older forests (Thomas et al. 1993, USDA and USDI 1994, Lint et al. 1999).

The Northwest Forest Plan included provisions for monitoring the status and population trends of species of concern and associated with older forest. *The Northern Spotted Owl Effectiveness Monitoring Program for the Northwest Forest Plan* included a number of demographic study areas non-randomly distributed across the species range. The southern Oregon Cascades Northern Spotted Owl Demographic study (CAS) was incorporated into this monitoring program in 1997 (Lint et al. 1999).

The general framework of the study was not originally based on an established design. Many of the historic spotted owl territories within the CAS study area were initially identified during surveys conducted by the USDA-Forest Service (USFS) and Oregon Dept. of Fish and Wildlife (ODFW) for proposed management activities. Beginning in the 1970's, surveys by agency personnel and Eric Forsman (then a graduate student at Oregon State University) were conducted at known spotted owl territories, proposed timber sale areas, other research project areas, areas chosen randomly for sampling, SOHAs and HCAs. USFS personnel (with assistance from USDI-Bureau of Land Management (BLM)) began banding spotted owls in 1987 on the Rogue River-Siskiyou National Forest and 1990 on the Fremont-Winema National Forest. Personnel from the Oregon Cooperative Fish and Wildlife Research Unit (OCFWRU) began assisting with surveys and banding on USFS lands in 1990. In 1991 most USFS lands were incorporated into the Siskiyou and Cascade Mountains Spotted Owl Study Area (SCA), a large demographic study encompassing mixed ownership lands in southwestern Oregon. From 1992 to 1996 part of the Klamath Ranger District west of Klamath Falls was visited as a part of the Surveyor Mountain Spotted Owl Density Study Area by the Klamath Falls Resource Area-Lakeview District BLM. USFS monitoring efforts were largely discontinued on the Rogue River-Siskiyou National Forest by 1993, and OCFWRU personnel assumed most of the responsibilities. The OCFWRU continued to survey on the Fremont-Winema National Forest as a part of the Siskiyou and Cascades Mountains Study Area or in support of efforts by USFS personnel and private contractors. USFS surveys outside of proposed management areas were discontinued by 1996 on the Klamath Ranger District.

When the CAS was established in 1997 as one of the eight long-term monitoring sites in the *Northern Spotted Owl Effectiveness Monitoring Program for the Northwest Forest Plan* the study area incorporated portions of the Siskiyou and Cascade Mountains Study Area and the Surveyor Mountain Density Study Area and continued the ongoing survey effort. In this report we include all survey effort beginning in 1990 when project personnel began conducting survey visits on the footprint of the area that eventually became the CAS (Figure 1).

Potential Benefit or Utility of the Study

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). Demography data from this study area has been included in six meta-analyses of spotted owl vital rates across the species range (Anderson and Burnham 1992, Burnham et al. 1994, 1996, Franklin et al. 1999, Anthony et al. 2006, Forsman et al. 2011, Dugger et al. 2016), with the most recent held in January 2014. These data were important for the 2004 review of the species' threatened status (USFWS 2004), the Final Recovery Plan for the Northern Spotted Owl, the Designation of Revised Critical Habitat for the Northern Spotted Owl, and the Experimental Removal of Barred Owls to Benefit Threatened Northern Spotted Owls Final Environmental Impact Statement (USDI 2011, 2012, 2013).

Study Objectives

a) Conduct annual monitoring surveys and banding of individual owls on historic spotted owl territories on the Southern Oregon Cascades Northern Spotted Owl Demography Study Area following established protocols (Forsman 1995, Lint et al. 1999).

b) Use these data to determine the proportion of historic territories where northern spotted owls are detected, and to determine sex and age composition, and the reproductive success of detected owls.
c) Use these data to develop and maintain capture history databases of individually marked spotted owls and detection histories for historic owl territories required for participation in periodic analyses to estimate fecundity, survivorship, recruitment, the rate of population change, and occupancy dynamics using a mark-recapture modeling approach.
d) Examine northern spotted owl diets, nesting habitat, and interspecific interactions with barred owls.
e) Communicate results to other researchers examining northern spotted owl ecology.

4. Study Area

The CAS incorporates approximately 2,400 km^2 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).

The total number of surveyed spotted owl sites has increased over time, as new sites were added when previously unmonitored owls were detected and a total of 171 sites were surveyed in 2016. There are 90 sites within the boundaries of the study that have been surveyed continuously from 1992 to 2016 and this subset of owl territories were among those used to estimate the annual rate of population change (λ) in the last 3 meta-analyses (Anthony et al. 2006, Forsman et al. 2011, Dugger et al. 2016).

5. Methods

a. 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 then allows us to periodically estimate survival, reproductive rates, and annual rate of population change, as well as occupancy dynamics (Wagner et al. 1996, Franklin et al. 1999, Anthony et al. 2006, Forsman et al. 2011, Dugger et al. 2011, Dugger et al. 2016). 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).

An important component of the CAS study area are the LSRs: 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).

b. Field Methods:

The methods employed in this demographic study follow a standardized protocol for collecting data that allows the estimation of survival, productivity, rate of population change (lambda) (Forsman 1995) and site occupancy (MacKenzie et al. 2003, Olson et al. 2005). Field work begins in late March and until the end of May (or June 15th at elevations above approximately 1371m) our primary effort is to detect spotted owls, determine their sex and age, re-sight previously banded individuals, and assess their social or nesting status. In the early breeding season historic spotted owl territories (owl cores) are visited during the day to check if owls are present. Biologists survey the areas using visual cues and spotted owl vocalizations, made using their own voices, instruments (hoot flutes) or digital game callers. Depending on the initial results subsequent visits generally follow two different protocols: 1) if spotted owls are located they are presented with mice in order to determine their sex, age, banding, social and reproductive status of the individuals, and 2) if not located historic sites are revisited during the day (roadless areas) or checked using call-back surveys from established points on road systems during the night. When owls are located, mousing protocols require that a minimum 3 mice be taken by owls, but that number generally ranges from 4 or more during most of the field season. The fates of mice taken is used to assess the status of the owl or pair of owls. After young have fledged determining productivity is a primary objective, so spotted owls are presented with 4 or more mice and whether or not mice are delivered to juvenile spotted owls is used to assess reproductive success. When no owls have been located on initial day visits to historic territories night surveys are conducted that include the playing of spotted owl calls intermittently from historical call points for 10 minutes, with all responses by all owl species documented. The number of call points range from one to 10 depending on the site. At territories where there are spotted owl detections during nighttime surveys follow-up visits are conducted using the same procedures previously outlined to determine the sex, age, banding, social and reproductive status of the owls. In areas where spotted owls are never detected, a minimum of 3 surveys (day visits in roadless areas otherwise as night visits) are conducted during the breeding season. Throughout the field season efforts are made to capture and individually mark all unbanded spotted owls with unique U.S. Fish and Wildlife Service bands (size 7B) and plastic color bands. For additional details on the survey methodology see Forsman (1995).

c. Analytical Methods:

The analytical approach of the study follows two parallel efforts which report the short-term status and long-term trends in spotted owl numbers and vital rates. The first component of reporting presents the annual results of the projects survey efforts. This annual report summarizes the basic statistics of naïve site occupancy, numbers of owls detected by sex and age, the

productivity of owls which have been located as determined by the standard protocol, and the age and sex of owls banded each season. The second component occurs approximately every 5 years and meets the requirements of the *Northern Spotted Owl Effectiveness Monitoring Program for the Northwest Forest Plan* (Lint et al. 1999) by estimating trends in spotted owl occupancy, survival, lambda and productivity. The CAS has most recently participated in a range-wide meta-analysis of spotted owls in January 2014 (Dugger et al. 2016) as a part of this requirement. It was the sixth in a series of demographic workshops that were convened initially in 1991 (Anderson and Burnham 1992), again in 1993 (Burnham et al. 1994, 1996), and then every five years since 1993 (1998: Franklin et al. 1999; 2004: Anthony et al. 2006; 2009: Forsman et al. 2011; 2014: Dugger et al. 2016). For details of the analysis and results see Dugger et al. (2016).

6. Survey Results:

Detection Rates and Population Trends

In 2016 we surveyed all 171 historic spotted owl territories on the study area at a level of effort sufficient to meet the requirements of the site occupancy protocol and owls were detected at 46 of the sites (Figure 2). Pairs were detected at 30 sites, single owls were detected at 6 sites, and owls of unknown social status were detected at 10 sites (Table 1). The percentage of sites where spotted owls were detected on the study area (27%) represented a 3.0% decrease from 2015 (30%; $\bar{x}$ = 63.2 %, SE = 4.07, n = 27 years). Of the 171 sites surveyed during 2016, spotted owl pairs were located at 30 (18%) of the sites which was a decrease in the proportion of pairs located at these same sites in 2015 and much lower than the long-term average ($\bar{x}$ = 48.6%, SE = 3.64, n = 27 years). At the 90 sites with continuous survey effort between 1992 and 2016 (and used in the λ analysis) banded spotted owls, either single or paired, were detected at 19% of the sites in 2016 (17 sites) which was a decrease in the proportion of sites where banded owls were detected in 2015 (24%; $\bar{x}$ = 49.8%, SE = 3.67, n = 25 years).

Breeding Propensity

Seventeen owl pairs were surveyed to protocol to determine nesting status (i.e., proportion of pairs that attempted to nest each year; Forsman 1995), and 5 of these pairs exhibited nesting behavior (29%) a large decrease from 2015 (85%). On average, 54% (SE = 4.88) of pairs detected each year attempted to nest, although breeding propensity rates are highly variable (min. = 3%; max = 88%; n = 27 years). One owl pair confirmed to be nesting in 2016 (by June 1st for sites < 1371m. and June 15th for sites ≥ 1371m. in elevation) appeared to fail to fledge young (20% failure rate). The mean rate of nest failure for pairs determined to be nesting in all years (1990-2016; n = 27) was 16% (SE = 1.81; min. = 0.0, max. = 33.3).

By the end of the field season, 30 pairs were confirmed at sites where owls were detected, of these 21 were checked for the number of young produced, and 8, including 4 pairs not surveyed to protocol for nesting status determination (i.e., located for the first time after June 1 or June 15, 2016), successfully reproduced ($\bar{x}$ = 23.8, SE = 2.81, n = 27 years; min. = 1; max. = 56). The number of young produced per successful pair (1.75) in 2016 was similar to the average during the study ($\bar{x}$ = 1.57, SE = 0.051, n = 27 years; Table 2).

We calculated productivity as the mean number of young fledged per paired female monitored for reproductive success (NYF). Overall, average NYF was 0.67 (SE = 0.091, n = 21) for all females

(ages combined) in 2016 which was similar to the long-term average ($\bar{x}$ = 0.70, SE = 0.078, n = 27 years; min. = 0.02, max. = 1.49; Figure 3).

Age and Sex Distribution

In 2016 78 non-juvenile owls were detected ($\bar{x}$ = 163.4, SE = 9.57, n = 27 years) and this total included 41 males, 36 females, and one sex unknown; the lowest number of owls detected during the history of the study. On average 46% of the owls of known sex detected each year on the study area are females, and the percentage of females in 2016 was 47% (Table 3). Similar to other study areas (Dugger et al. 2016), the sex-ratio for territorial owls is male-biased, with the ratio of females relative to males varying from 0.72 to 0.96 depending on year (Figure 4).

There were 66 owls we could assign to an age class in 2016 with 92.0% adults (≥ 3 years old) and 8.0% subadults, about the same age distribution as 2015 (91.7 and 8.3% respectively; Table 3). There were 5 subadults located (3 female and 2 males), which is less than the average for all years ($\bar{x}$ = 8.4, SE = 0.87; min. = 2, max. = 19, n = 27 years). We could not ascertain the age of 19% of the study population (15 owls) which is near the average for all years ($\bar{x}$ = 18.3%, SE = 2.30, n = 27 years). The majority of unknown age owls represent auditory detections usually during nighttime surveys without visual observation; possibly reflecting non-territorial individuals.

Banding and Resighting

In 2016, we banded 11 owls: 9 fledglings, 1 subadult (1st year female) and 1 adult (≥3 years old male) on the study area. A total of 48 banded non-juvenile owls (subadults and adults) of known identity (including newly banded owls) were seen at least once during the season (Table 4); a large decrease of 19% from 2015 (59). Territorial females of known age (i.e., initially captured as juveniles, 1st year or 2nd year subadults) averaged 7.4 years (SE = 1.47, n = 12; min. = 1, max. = 15) and known-age territorial males averaged 7.8 years (SE = 1.56, n = 12; min. = 1, max. = 15). The oldest owl we observed was a female banded as an adult in 2000, so a minimum of 3 at that time and ≥19 years of age in 2016.

There were 4 documented inter-territory movements of banded owls in 2016 on the demographic study area. Three owls banded as juveniles (2009, 2010, 2014) were located at non-natal sites within the study area, and 1 owl previously banded as an adult was relocated on a new territory within the study area.

A total of 212 movements have been recorded on the study area from 1990-2016 and the mean movement distance was 15.8 km for females (SE = 1.79, n = 92; min. = 0.4, max. = 88.0) and 9.1 km (SE = 0.82, n = 120; min. = 0.8, max. = 44.2) for males.

Barred Owls

The range of the barred owl (*Strix varia*) has expanded during the last century and now overlaps that of the northern spotted owl (Livezey 2009, Wiens et al. 2014). Barred owls were first detected within the boundaries of the CAS in 1981 (*Pers. comm.* Rick Hardy, Wildlife Biologist (Ret.), USFS). 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

spotted owl territories on the study area has increased from a low of 4.1% to a high of 39% in 2016 (Figure 8). Cumulatively, barred owls have been detected at 82% 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 annual proportion of surveyed areas with barred owl detections ($r = -0.95$, $p \leq 0.001$). 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 not detected during spotted-owl specific surveys conducted on the area each year. However, detection rates are high enough to estimate detection probability and co-occurrence occupancy dynamics of both barred and spotted owls using a two-state, two-species, and multi-season occupancy model (Dugger et al. 2016). Using occupancy models that incorporate detection rates (e.g., MacKenzie et al. 2003, Richmond et al. 2010), 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, Dugger et al. 2016).

Problems Encountered

The winter of 2015-2016 brought a heavy snow pack and a large number of windfall trees to the study area. Snow reduced or blocked access to many owl sites until late May. As the snow line receded we devoted considerable effort to road clearing. Field work was hampered by these two factors. This reduced the level of effort we were able to devote to day work, primarily in the months of April and May, and we likely missed owls that had been present on breeding territories earlier in the season. By the beginning of August approximately 120 hours of personnel time had been devoted to road clearing (44 afternoon shifts). Several road systems remained blocked by trees at the end of the survey season as we discontinued access work because of the elevated risks associated with fire season restrictions.

Brush encroachment into road ways and damage to road surfaces due to landslides and winter rain/snow run-off has become another factor gradually restricting access to spotted owl sites. This has created additional time constraints for reasons of both personnel safety and to prevent vehicle damage, particularly during nighttime occupancy visits. Several road systems are no longer drive-able and we have begun to regularly conduct our visits as walk-in routes. We expect for this situation to continue and possibly worsted in the coming years as roads are actively or passively decommissioned.

7. Discussion:

In 2016 productivity decreased substantially from the relatively high productivity of 2014 and 2015. Cooler temperatures in the early nesting season are associated with decreased productivity and there is also evidence that increased precipitation during winter is associated with lower productivity in the southern Oregon Cascades (Dugger et al. 2005, Forsman et al. 2011, Dugger et al. 2016). 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 higher reproduction in both 2009-2010. The annual total number of young produced on the study area generally declined or increased slightly in the previous six years so in 2016 productivity was lower and less indicative of the even-odd year cycle seen early in the study and more similar to the pattern observed between 2009-2011 (Figure 3).

The total number of spotted owls detected and the number of previously banded owls identified each year has generally declined during the course of the study. The trend towards lower numbers of spotted owls continued in 2016, and was the lowest recorded for the study (including the number of banded owls). Recruitment of 3 owls into the territorial population originally banded as juveniles was higher than in 2015 (2), which is more than what might have been predicted given that the winter was cooler and wetter than average and therefore differed from the long-term trend in the λ meta-analysis where higher recruitment of territorial owls was noted after cooler, dryer winters (Dugger et al. 2016). The decrease in identifying previously banded owls was consistent with both the individual study area survival analysis for the southern Cascades as well as in the meta-analysis of survival which indicated that higher winter temperatures and lower early nesting season precipitation were associated with increased survival (Dugger et al. 2016). It is likely however, that in part the decrease in the number of spotted owls detected in 2016 can be attributed to reduced survey effort owing to the restricted access to many owl sites and that owls which may have been present on territories in the early breeding season went undetected later in the year. Fewer sites documented barred owl detections in 2016 than in 2015 but cumulatively, the number of sites on the CAS study area where barred owls were detected in 2016 increased, and the proportion of sites with at least one barred owl detection rose to 82%. Spotted owl detection probabilities in the southern Oregon Cascades appear to decline on territories where barred owls are also detected at least once during a survey season (Dugger et al. 2011, Dugger et al. 2016).

There were fewer historic territories where we detected spotted owls than in previous years similar to the decline we have observed for individual spotted owl detections. In the southern Oregon Cascades the most significant factors affecting extinction and colonization rates for spotted owl sites is area of suitable habitat and the presence of barred owls (Dugger et al. 2011, Dugger et al. 2016). Wildfires (affecting 18 spotted owl core areas since 2008) and timber harvest have reduced the area of suitable habitat on the CAS study in recent years and may be a factor in the decline in site occupancy. Given the strong association between barred owl detections and increased site extinction and decreased site colonization probabilities (Dugger et al. 2016), it is likely that displacement of spotted owls from historic territories contributed to the decline in proportion of sites where spotted owls were detected in 2016. Barred owl presence on a territory also reduces spotted owl detection rates so the apparent decline in site occupancy for a single season could be attributable to a decrease in spotted owl responses (Dugger et al. 2011, Dugger et al. 2016).

We have observed geographic differences in the distribution of sites occupied by spotted owls within the study area. The central portion of the study area on both the west and east slopes of the Cascades had lower rates of apparent occupancy (i.e., proportion of sites where spotted owls were detected) than observed at the northern and southern parts of the study area. The study encompasses a diverse range of vegetation zones, however, initial spotted owl apparent occupancy at the onset of the study was geographically more even than in 2016. There is evidence from other species that sub-populations on the margins of the species range are vulnerable to localized extirpations owing to increased extinction probabilities and may have reduced recolonization probability related to dispersal (Doherty et al. 2003, Holt et al. 2004). It is noteworthy in this regard that the eastern boundary of the study area where many spotted owl territories appear to be unoccupied approximates the eastern extent of the species range boundary in southern Oregon so spotted owl occupancy at these sites may be inherently more at risk of localized extirpations.

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10. Tables:

Table 1. Number of northern spotted owl sites surveyed to protocol (Forsman 1995) and the number of these sites where spotted owls were detected on the Southern Oregon Cascades Northern Spotted Owl Demography Study Area, Rogue River-Siskiyou and Fremont-Winema National Forests, Oregon, 1990-2016.

Year	# Sites Surveyed	# Sites w/ Pairs	# Sites w/ Single Owls	# Sites w/ Social Status Unknown[a]	Total Occupied Sites	# of Sites Unoccupied[b]	% 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
2014	171	36	5	12	53	118	31
2015	171	36	8	8	52	119	30
2016	171	30	6	10	46	125	27

[a] Sites with a response by a male and/or female that did not meet pair or single status with ≥ 3 night visits.
[b] A minimum of 3 nighttime visits or day visits (roadless areas) without a detection was needed to infer unoccupied status.

Table 2. Summary of reproductive success of northern spotted owl pairs from all sites surveyed to protocol for reproductive status (Forsman 1995) on the Southern Oregon Cascades Northern Spotted Owl Demography Study Area, Rogue River-Siskiyou and Fremont-Winema National Forests, Oregon, 1990-2016.

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
2014	35	28	47	80	1.68	1.34
2015	32	20	31	63	1.55	0.97
2016	21	8	14	38	1.75	0.67

Table 3. Age and sex of northern spotted owls detected on the Southern Oregon Cascades Northern Spotted Owl Demography Study Area, Rogue River-Siskiyou and Fremont-Winema National Forests, Oregon, 1990-2016.

Year	Adults (M,F)	Subadults (M,F)	Age Unknown (M,F)	Age and Sex Unknown	All Non-Juveniles	All Juveniles
1990	54 (30,24)	2 (1,1)	96 (53,43)	25	177	26
1991	112 (58,54)	7 (3,4)	84 (46,38)	51	254	33
1992	139 (77,62)	8 (4,4)	97 (46,51)	51	295	121
1993	136 (76,60)	12 (5,7)	46 (24,22)	21	215	16
1994	139 (73,66)	11 (7,4)	31 (17,14)	10	191	66
1995	126 (64,62)	9 (7,2)	16 (12,4)	12	163	24
1996	123 (61,62)	5 (4,1)	17 (10,7)	6	151	46
1997	114 (63,51)	7 (2,5)	16 (9,7)	13	150	18
1998	133 (70,63)	4 (3,1)	22 (14,8)	8	167	45
1999	122 (71,51)	7 (1,6)	15 (9,6)	3	147	12
2000	111 (65,46)	10 (2,8)	22 (16,6)	2	145	59
2001	151 (80,71)	10 (4,6)	25 (20,5)	3	189	18
2002	157 (86,71)	14 (6,8)	27 (17,10)	2	200	98
2003	168 (90,78)	14 (3,11)	21 (15,6)	1	204	39
2004	140 (71,69)	11 (5,6)	23 (15,8)	0	174	106
2005	157 (78,79)	19 (11,8)	30 (20,10)	2	208	32
2006	145 (78,67)	18 (9,9)	21 (13,8)	3	188	31
2007	151 (76,75)	7 (2,5)	20 (13,7)	1	179	67
2008	101 (55,46)	7 (2,5)	23 (13,10)	1	132	1
2009	115 (60,55)	2 (1,1)	16 (7,9)	2	135	49
2010	116 (58,58)	10 (7,3)	22 (13,9)	0	148	48
2011	97 (50,47)	4 (3,1)	15 (8,7)	0	116	10
2012	98 (55,43)	3 (3,0)	22 (12,10)	1	121	22

Cont.

Year	Adults (M,F)	Subadults (M,F)	Age Unknown (M,F)	Age and Sex Unknown	All Non-Juveniles	All Juveniles
2013	68 (35,33)	6 (3,3)	27 (14,13)	1	102	13
2014	74 (39,35)	6 (4,2)	11 (7,4)	1	92	47
2015	64 (33,31)	6 (5,1)	18 (9,9)	0	88	31
2016	57 (33,24)	5 (2,3)	15 (6,9)	1	78	14

Table 4. Number of northern spotted owls newly banded, re-sighted, and recaptured on the Southern Oregon Cascades Northern Spotted Owl Demography Study Area, Rogue River-Siskiyou and Fremont-Winema National Forests, Oregon, 2016.

	Owls newly banded			Owls re-sighted			Owls recaptured		
Age class	Males	Females	Unknown	Males	Females	Unknown	Males	Females	Unknown
Adults	1	0	0	25	18	0	2	0	0
Subadults	0	1	0	0	0	0	1	0	0
Juveniles	-	-	9	-	-	-	-	-	-

11. Figures:

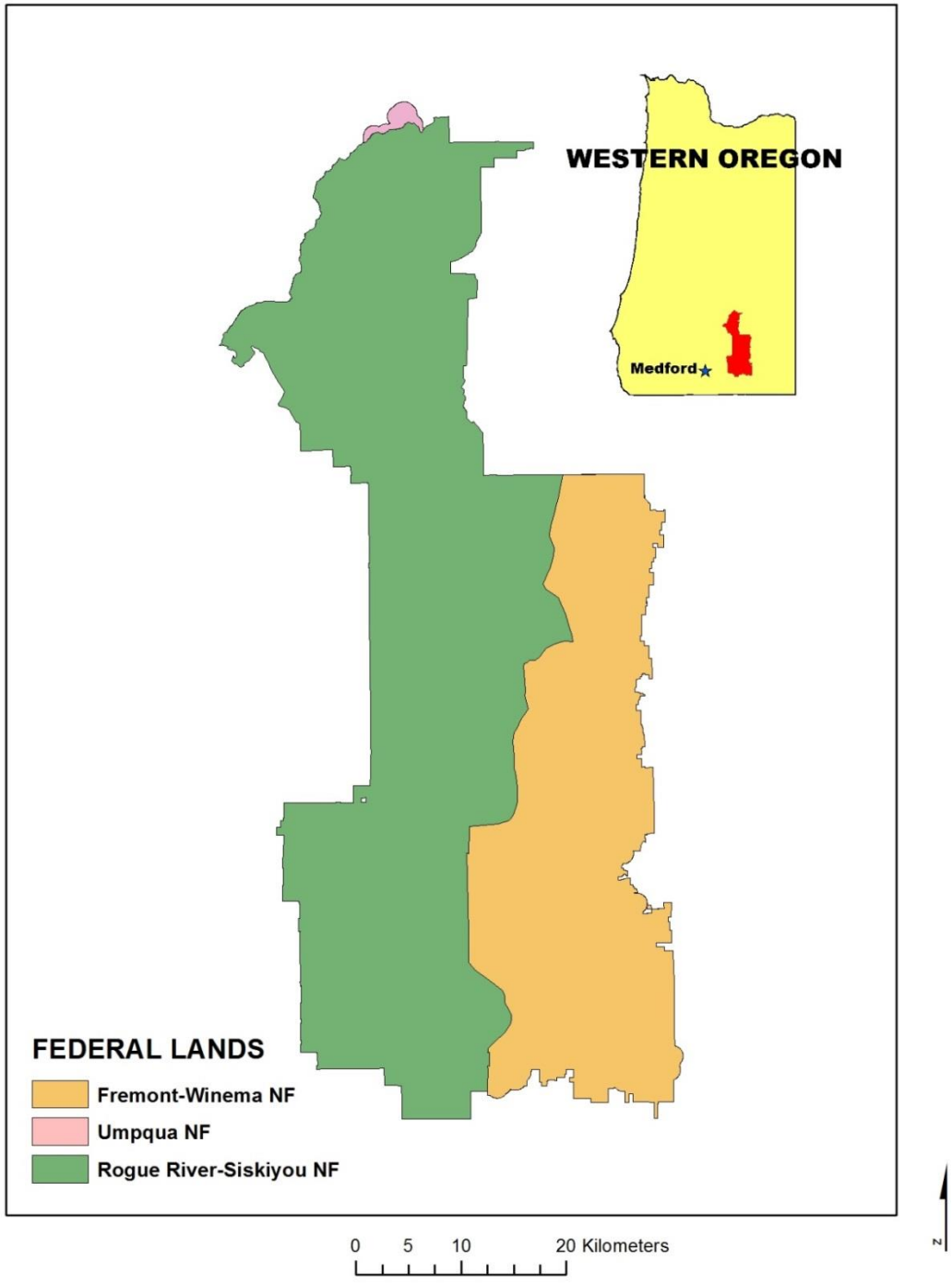

Figure 1. The Southern Oregon Cascades Northern Spotted Owl Demography Study Area, Rogue River-Siskiyou and Fremont-Winema National Forests, Oregon, 1990-2016.

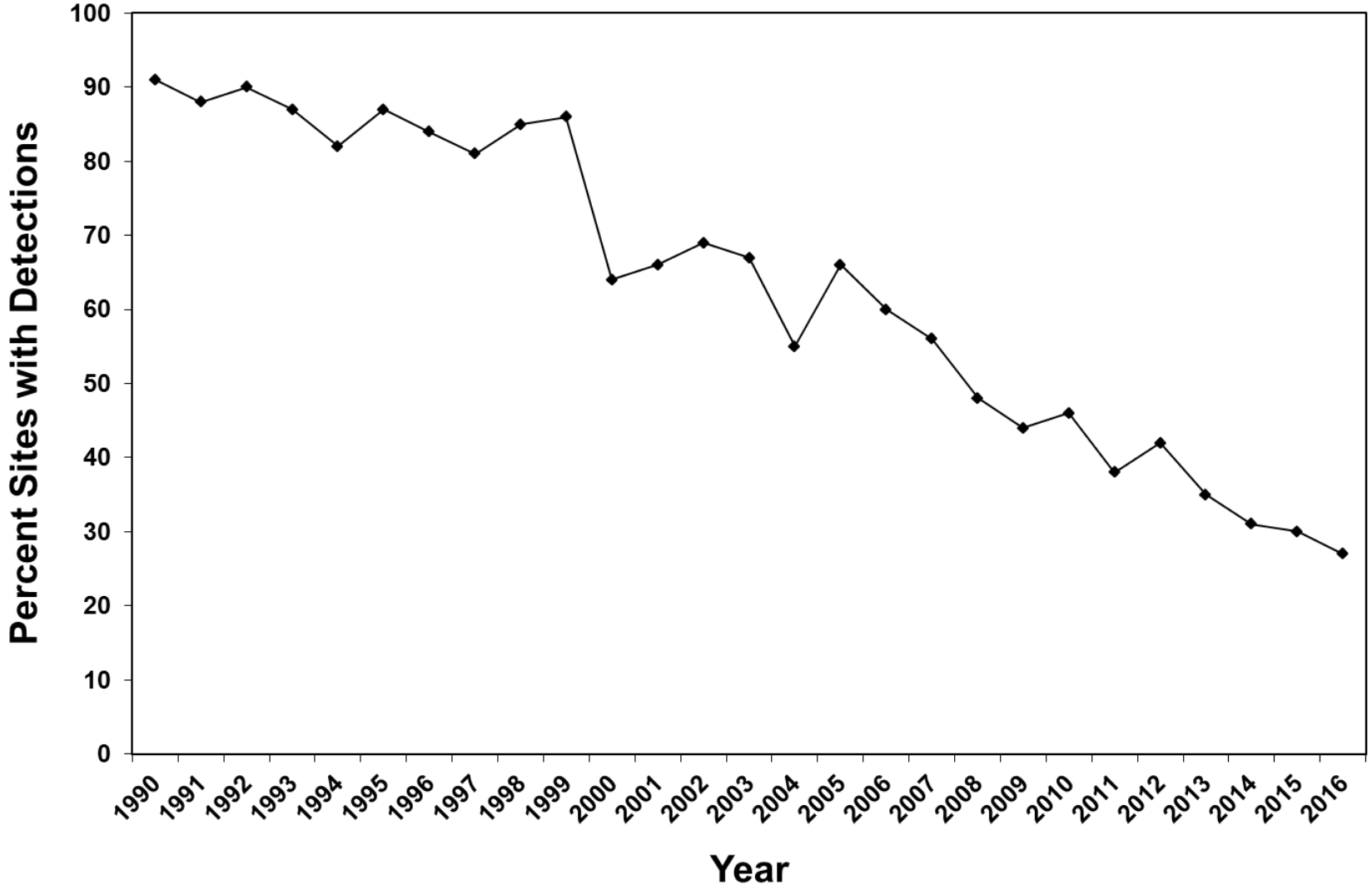

Figure 2. Percentage of all sites surveyed annually with ≥ 1 spotted owl detected on the Southern Oregon Cascades Northern Spotted Owl Demography Study Area, Rogue River-Siskiyou and Fremont-Winema National Forests, Oregon, 1990-2016.

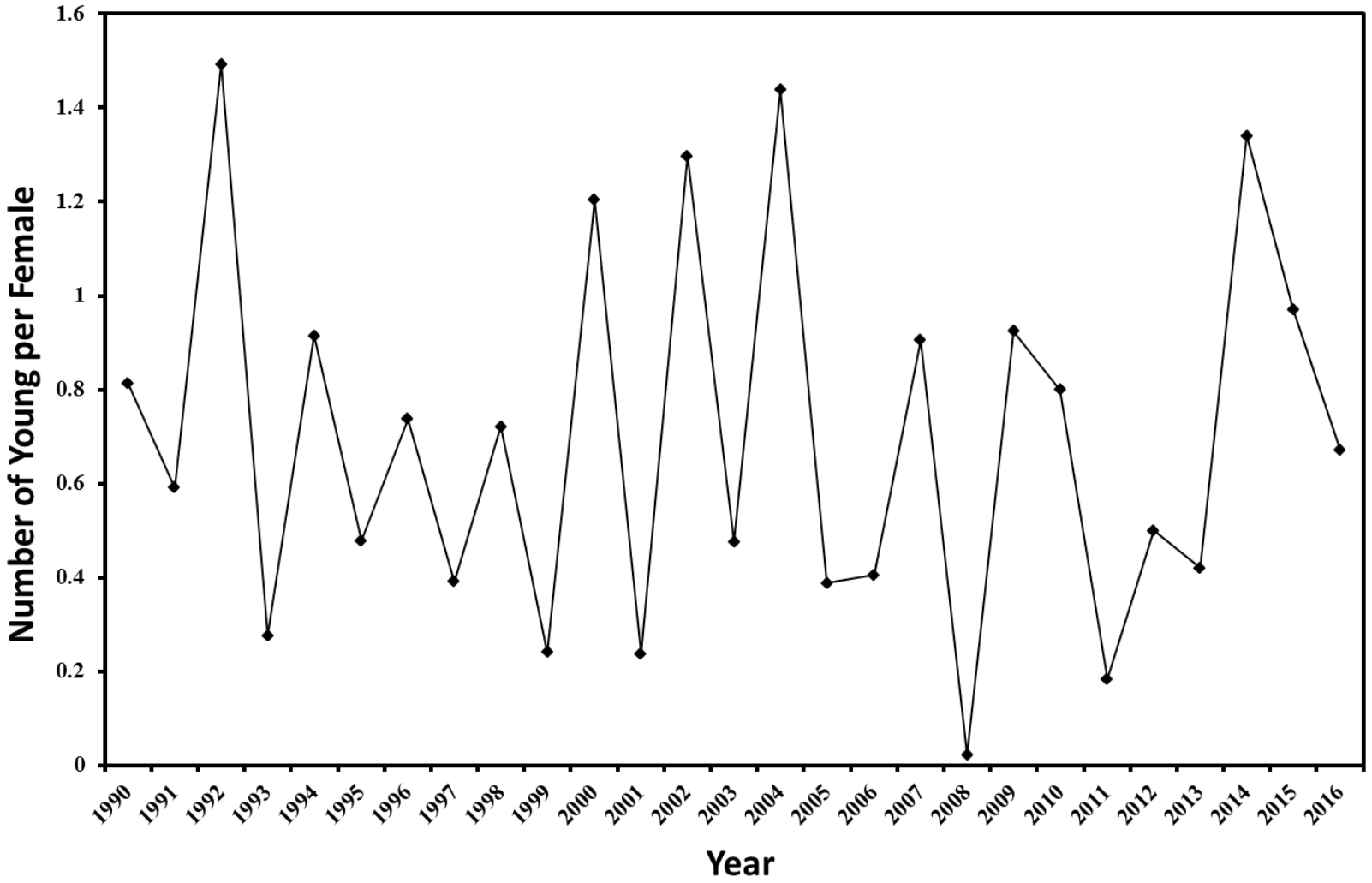

Figure 3. The mean annual number of young fledged (NYF) per female spotted owl surveyed to protocol for reproduction on the Southern Oregon Cascades Northern Spotted Owl Demography Study Area, Rogue River-Siskiyou and Fremont-Winema National Forests, Oregon, 1990-2016.

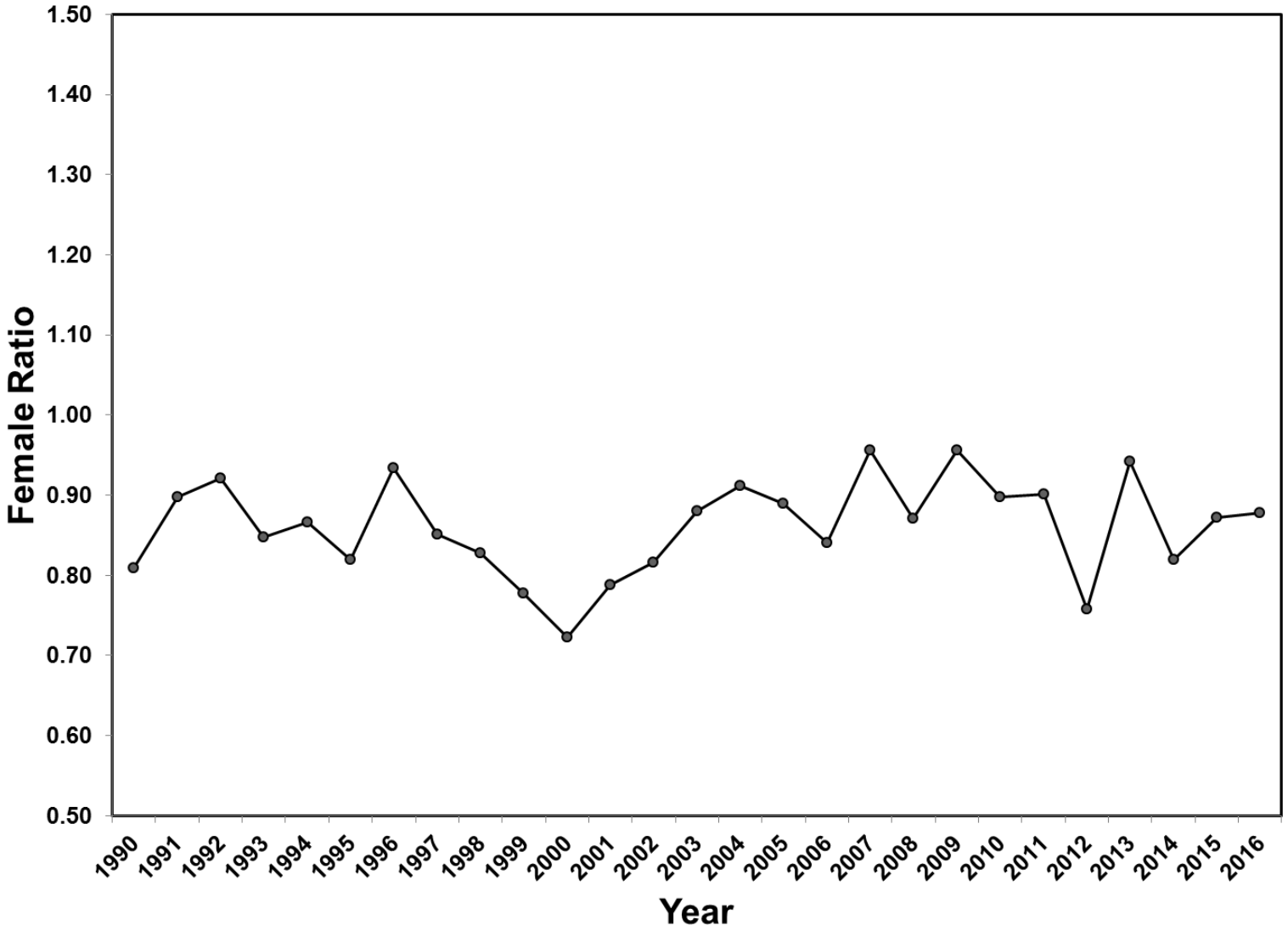

Figure 4. Ratio of female to male spotted owls on the Southern Oregon Cascades Northern Spotted Owl Demography Study Area, Rogue River-Siskiyou and Fremont-Winema National Forests, Oregon, 1990-2016.

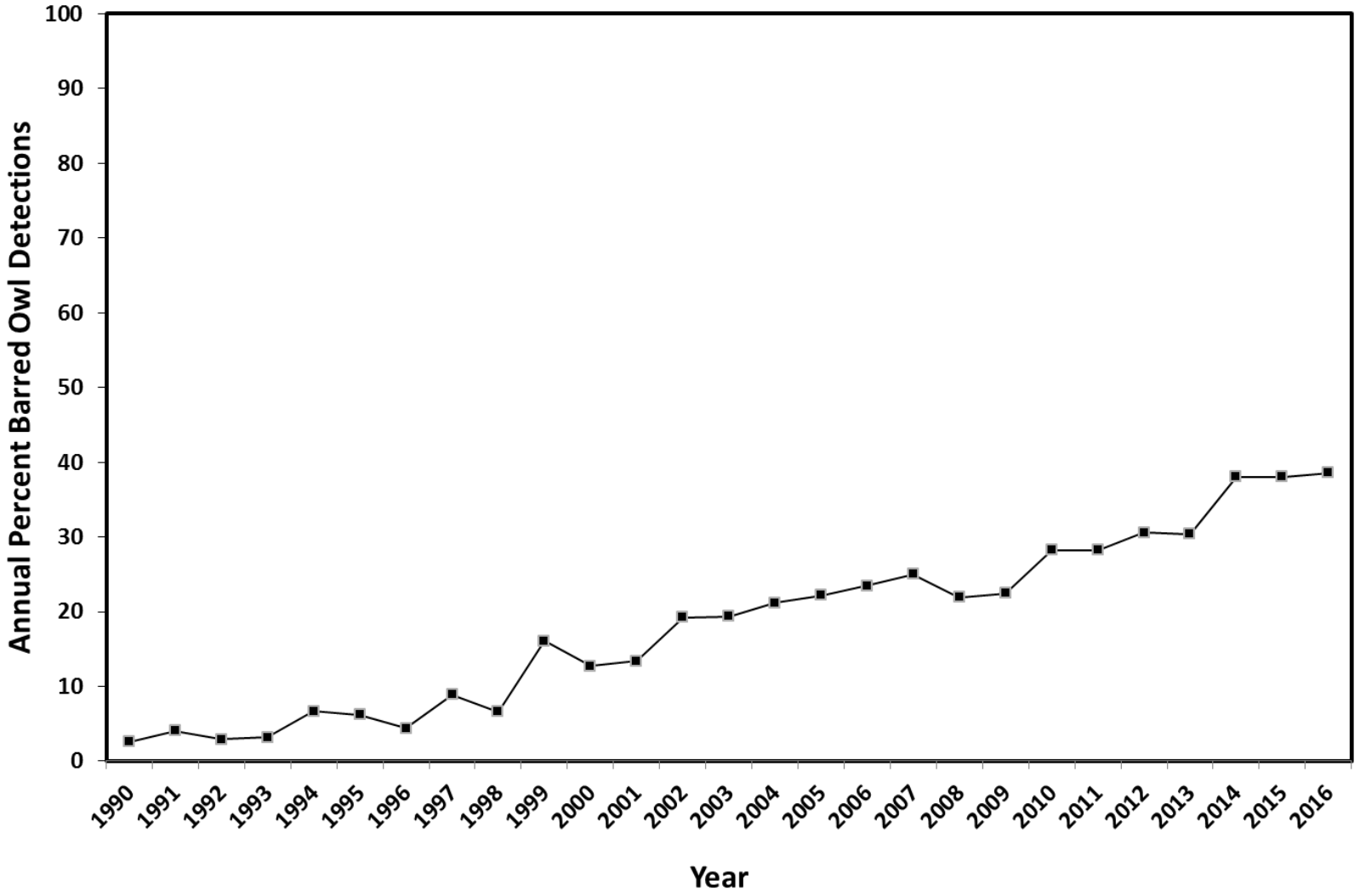

Figure 5. The annual percentages of historic spotted owl territories surveyed where barred owls were detected on the Southern Oregon Cascades Northern Spotted Owl Demography Study Area, Rogue River-Siskiyou and Fremont-Winema National Forests, Oregon, 1990-2016.

12. Manuscripts in FY 2016:

Davis, R.J., and L.S. Andrews. 2016. Current and Potential Distribution of red tree voles based on habitat models. *In* Distribution, Habitat, Diet, and Management of the Red Tree Vole and Sonoma Tree Vole, E. Forsman (Editor). PNW-GTR-948. 119pp

Presentations

Andrews, S., 2016. Northern Spotted Owl Vital Rates in the Southern Oregon Cascades 1991-2013. Meeting with BLM and USFS biologists at the Medford Interagency Office January 20, 2016, Medford, OR.

Dugger, K.M., 2016. The effects of habitat, climate and Barred Owls on the long-term demography of Northern Spotted Owls. Department of Wildlife Seminar series at Humboldt State University April 7, 2016, Arcata, CA.

Technology Transfer Completed in FY 2016

Project personnel provided the USDA-USFS Ranger Districts, USDI-BLM Resource Areas, and USDI-Crater Lake National Park with information and coordinated surveys.

13. Appendix A:

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. Day searches will often immediately precede night surveys in case spotted owls present at a site are hesitant to vocalize in the vicinity of barred owls at night. If no detections are noted these day visits are tallied as a part of the night visit effort. The majority of the visits required to determine whether an owl was present on a site are conducted as nighttime surveys. From 1994 to 2015, 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 1). Across all visits, the proportion of nighttime surveys has varied annually while increasing (min. = 24%; max. = 68%; Figure 1).

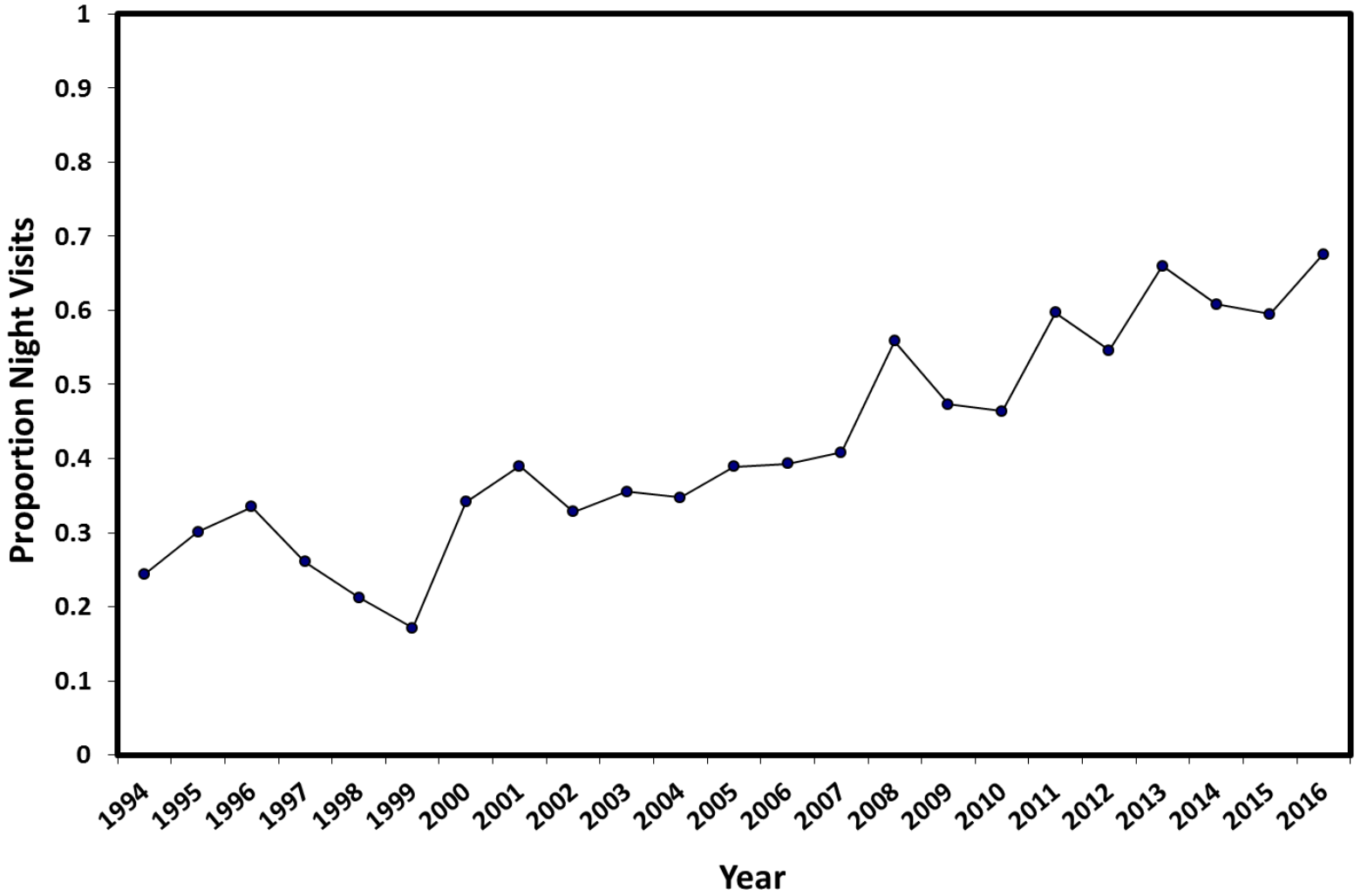

Figure 1. The annual proportion of total visits conducted as nighttime surveys of historic spotted owl territories on the Southern Oregon Cascades Northern Spotted Owl Demography Study Area, Rogue River-Siskiyou and Fremont-Winema National Forests, Oregon, 1994-2016.