

**ANNUAL RESEARCH REPORT
FY 2002
5 December 2002**

1. Title:

The Ecology of Northern Spotted Owls (*Strix occidentalis caurina*) on the Willamette National Forest, Oregon: Habitat Use and Demography.

2. Principal Investigator and Organizations:

Principal Investigator: Dr. Robert Anthony (Demography-RWU 4203); Biologists: Dr. Steven Ackers (Project Leader), Rita Claremont, Jeffery LaVoie, David Giessler, Nicole Seaman, Jason Schilling, Sheila Turner-Hane. Oregon Cooperative Fish and Wildlife Research Unit (OCFWRU), Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon.

3. Study Objectives:

- a. Estimate site occupancy rates, sex and age composition, nesting success, reproductive success and fecundity of the population of northern spotted owls on the Willamette National Forest.
- b. Develop and maintain a capture history matrix of marked spotted owls to estimate survivorship from mark-recapture models.
- c. Obtain the data and parameter estimates required for future meta-analyses of fecundity, survivorship and finite population rate of change across the range of the northern spotted owl.
- d. Examine the relationships between the above demographic parameters and land use allocations designated under the Northwest Forest Plan (NWFP)(USDA and USDI 1994).
- e. Collaborate with other owl researchers and researchers from other disciplines examining northern spotted owl ecology throughout the Pacific Northwest.

4. Potential Benefit or Utility of the Study:

Studying the population demography, habitat selection, foraging ecology, and prey base of the northern spotted owl will continue to increase our understanding of the factors affecting spotted owl populations. Our results also address the validation and monitoring requirements of the NWFP (USDA and USDI 1994) and will provide insights into how forest management can

maintain and enhance spotted owl habitats.

The demographic parameters estimated by this study continue to be an important component of the meta-analyses of northern spotted owl populations throughout their range (Burnham et al. 1996, Franklin et al. 1999). As the potential for habitat-based monitoring develops, this study also provides critical information for developing and validating predictive models of demographic performance as a function of landscape characteristics.

5. Study Description and Survey Design:

Site occupancy, nest and reproductive success and fecundity are calculated through annual monitoring of a sample of northern spotted owl sites in the central Oregon Cascades. Color-banded spotted owls are identified at each site and their nesting and reproductive status determined according to established protocols (Forsman 1995). Results are calculated for the entire study area as well as for three NWFP land use allocations: late-successional reserves (LSR), adaptive management areas (AMA) and matrix. We are particularly interested in the productivity and survivorship of the owl sites in the four LSRs on the study area as these areas are intended to provide the habitat base for the recovery of the northern spotted owl.

Survivorship and population rate of change are calculated at five-year intervals under a mark-recapture framework. These results are used in the meta-analyses of the spotted owl populations throughout their range (Burnham et al. 1996, Franklin et al. 1999).

6. Research Accomplishments (Demography) for FY 2002:

Site occupancy.

Survey effort in 2002 (161 sites) was similar to effort in 2001 (162 sites). Most of the occupied sites in 2002 were occupied by pairs (69 %) with substantially fewer occupied sites containing resident single owls (9 %) or single owls with unknown social status (23 %) (Table 1).

Unoccupied sites accounted for 20 % of the total number of sites surveyed. The unoccupied sites were surveyed at least three times at night with the exception of two sites that lack adequate road or trail access. These two sites were surveyed on foot three times (MSNO 2959) and six times (MSNO 0641) during the day. The percentage of all sites that were occupied by pairs in 2002 was at its lowest point since 1993 (Figure 1). The net change in pair occupancy between 2001 and 2002 was a decrease of 5%: 19 sites were occupied by pairs in 2001 supported only a single owl (15) or were unoccupied (4) in 2002 while 12 sites that had been unoccupied (4) or contained a single owl (8) in 2001 contained a pair in 2002.

The same numbers of sites were monitored in the LSR and matrix land allocations as in 2001 (Table 2). One AMA site was not surveyed this year after the pair from a neighboring site was located and identified there on the first visit. Six sites were surveyed in other land use allocations such as research natural areas and wild and scenic river corridors in 2002.

Table 1. Occupancy and social status of northern spotted owl sites (territories) surveyed on the Central Cascades Study Area, Willamette National Forest, Oregon, 1987-2002.

Year	Sites surveyed ^a	Sites with pairs	Sites with single owls	Sites with social status unknown ^b	Occupied sites (%)	Unoccupied sites ^c	Sites with unknown occupancy ^d
1987	44	20	2	4	26 (59)	-	18
1988	65	51	2	1	54 (83)	-	11
1989	80	73	4	3	80 (100)	-	27
1990	85	76	0	3	79 (93)	6	27
1991	100	79	5	8	92 (92)	8	3
1992	121	96	4	14	114 (94)	7	28
1993	91	46	13	15	81 (89)	10	19
1994	100	69	7	22	98 (98)	2	19
1995	113	73	10	8	91 (80)	22	12
1996	115	73	11	6	90 (78)	25	5
1997	118	74	8	11	93 (79)	25	11
1998	148	89	7	18	114 (77)	34	18
1999	156	95	13	17	123 (78)	34	12
2000	159	94	8	27	129 (80)	32	0
2001	162	95	10	27	132 (81)	29	1
2002	161	87	11	29	127 (79)	33	1

^a Occupancy and social status were determined by 1995 protocols that require a minimum of three night visits.

^b Social status was undetermined at sites where responses were obtained from male and/or female owls but criteria for pair or resident single status was not met.

^c Unoccupied status includes sites that were surveyed at least three times at night with no responses or where owls were detected but were assigned residency to a neighboring site based on color bands or the spatial relationship between sites.

^d Sites with fewer than 3 night visits.

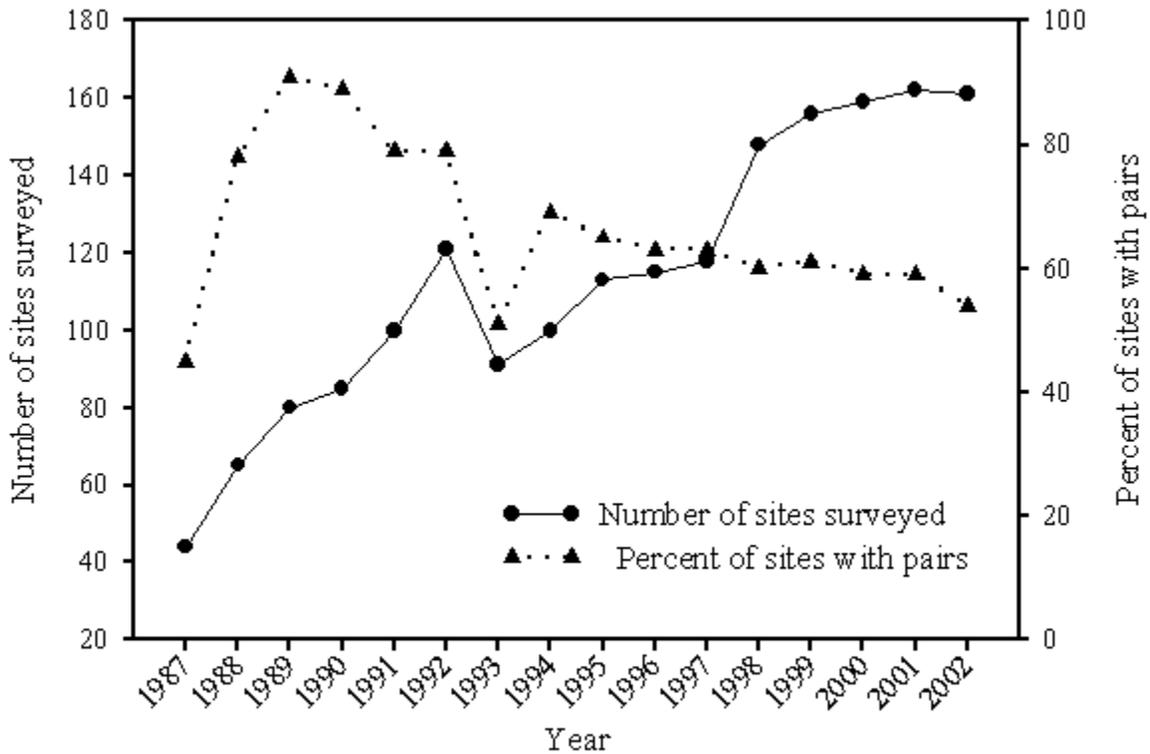


Figure 1. Number of sites surveyed for occupancy and the percentage of those sites occupied by pairs in the central Cascades study area, Willamette National Forest, Oregon from 1987 through 2002.

The highest rates of simple occupancy were in the matrix and AMA lands, while a lower rate was calculated for the LSRs (Table 2). LSR sites also showed lower levels of pair occupancy (45%) relative to Matrix (59%) and AMA (63%) sites (Figure 2). The difference between the LSR sites and the sites on other land use allocations was due primarily to low rates of pair occupancy at three of the four LSRs (Hagan, Horse Creek, and South Santiam). The rate of pair occupancy in the Fall Creek LSR was comparable to the rates in the matrix and AMA sites (61%)(see Appendix II). Pair occupancy in 2002 decreased by 11% in the matrix and 4% in the LSRs and increased by 2% in the AMA from 2001.

Sex and age composition.

At least 225 non-juvenile and 67 juvenile spotted owls were detected in 2002 (Table 3). The majority of the non-juvenile birds were at least three years old (75%). A relatively small number of owls were identified as one- or two-year-olds (5%). Of the owls that were not identified to age class (20%), most were detected as nocturnal auditory responses only and were not relocated on

Table 2. Occupancy and social status of northern spotted owl sites by Land-Use Allocation^a on the Central Cascades Study Area, Willamette National Forest, Oregon, 1997-2002. Protocol for determining occupancy and social status is the same as used in Table 1.

Land use allocation ^b	Year	Sites surveyed	Sites with pairs	Sites with single owls	Sites with unknown social status	Occupied sites (%)	Unoccupied sites	Sites with unknown occupancy
Matrix	1997	42	28	3	0	31 (74)	10	1
	1998	41	25	2	4	31 (76)	10	0
	1999	43	26	3	2	31 (72)	12	0
	2000	37	25	2	4	31 (84)	6	0
	2001	37	26	3	5	34 (92)	3	0
	2002	37	22	2	7	31 (84)	6	0
AMA	1997	47	32	3	1	36 (77)	11	0
	1998	43	34	0	4	38 (88)	5	0
	1999	43	30	2	4	36 (84)	7	0
	2000	43	29	2	4	35 (81)	8	0
	2001	44	27	4	5	36 (82)	8	0
	2002	43	27	4	5	36 (84)	6	1
LSR	1997	27	8	2	8	18 (67)	7	2
	1998	65	28	4	8	40 (62)	16	9
	1999	64	35	7	9	51 (80)	12	1
	2000	72	35	3	18	56 (78)	16	0
	2001	75	37	3	17	57 (76)	17	1
	2002	75	34	5	15	54 (72)	21	0

^a See the Northwest Forest Plan (USDA and USDI 1994) for a description of land use allocation forest management strategies.

^b Sites with LUA designation of “Other”, “Private”, and “Wilderness” are not included here.

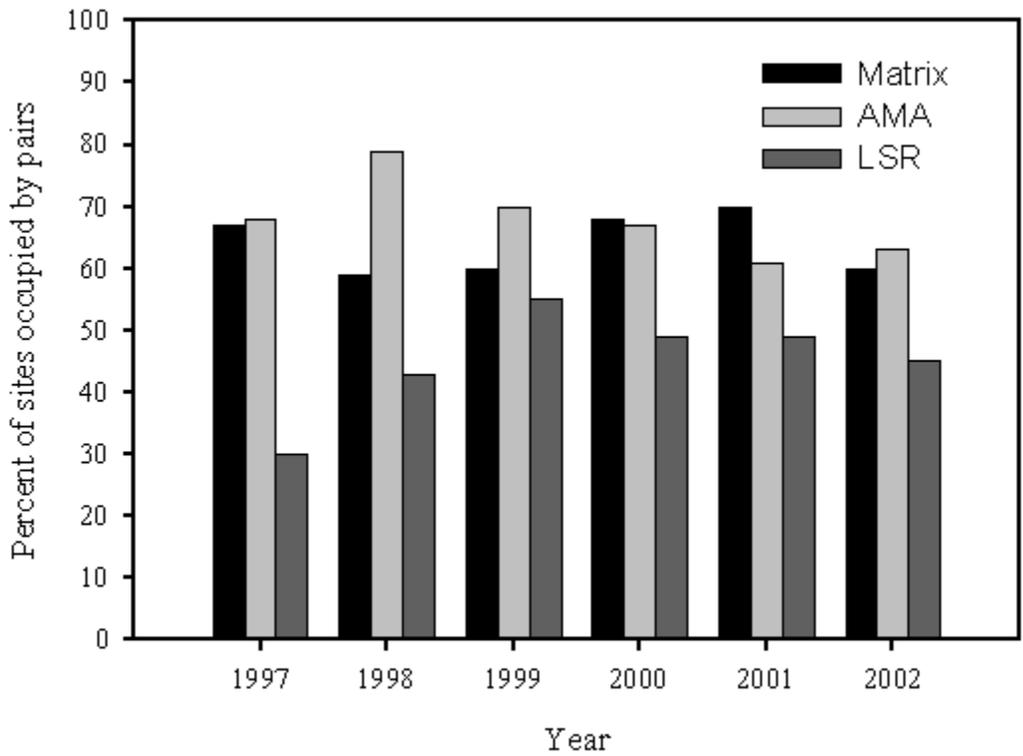


Figure 2. Percentage of sites occupied by pairs of northern spotted owls compared among land use allocations in the central Cascades study area, Willamette National Forest, Oregon from 1997 through 2002.

the daytime followup. All of the owls that were identified by reading their color bands were assigned to an age class.

The sex ratio among adults (three-year-olds and older) continues to be slightly skewed toward males (1.13:1 for 2002, 1.11:1 averaged over all years). The most likely explanation for this observation is that males are more responsive and therefore more detectable than females. This pattern is similar among subadults (1.10:1), although there is considerably more variation among years. The sex ratio among unclassified non-juveniles is more heavily skewed toward males (1.69:1). Most of these unclassified owls were detected only once at night and were never relocated for identification, which suggests that many of them were non-territorial owls. Sex differences in detection probabilities are probably more extreme for non-territorial owls than for those defending a territory.

Table 3. Sex and age composition of northern spotted owls on the Central Cascades Study Area, Willamette National Forest, Oregon, 1987-2002.

Year	Adults (M, F)	Subadults ^a (M, F)	Age unknown (M, F)	Non-juveniles ^b (M, F)	Juveniles ^c
1987	53 (29, 24)	6 (3, 3)	15 (14, 1)	74 (46, 28)	12
1988	98 (49, 49)	13 (9, 4)	9 (4, 5)	120 (62, 58)	40
1989	135 (72, 63)	13 (7, 6)	14 (8, 6)	162 (87, 75)	27
1990	134 (72, 62)	9 (2, 7)	28 (17, 11)	171 (91, 80)	37
1991	152 (82, 70)	12 (6, 6)	44 (25, 19)	208 (113, 95)	30
1992	170 (88, 82)	8 (3, 5)	30 (17, 13)	208 (108, 100)	116
1993	122 (72, 50)	6 (4, 2)	23 (16, 7)	151 (92, 59)	0
1994	144 (77, 67)	6 (0, 6)	14 (8, 6)	164 (84, 79)	28
1995	151 (76, 75)	2 (2, 0)	19 (13, 6)	172 (91, 81)	22
1996	140 (71, 69)	8 (4, 4)	17 (13, 4)	165 (88, 77)	68
1997	139 (71, 68)	9 (5, 4)	21 (9, 12)	169 (85, 84)	24
1998	172 (86, 86)	8 (6, 2)	40 (27, 13)	220 (119, 101)	42
1999	169 (89, 80)	2 (2, 0)	56 (36, 20)	227 (127, 100)	21
2000	169 (85, 84)	6 (5, 1)	53 (36, 17)	228 (126, 102)	60
2001	189 (98, 91)	7 (4, 3)	38 (25, 14)	234 (127, 107)	83
2002	168 (89, 79)	11 (4, 7)	46 (26, 20)	225 (119, 106)	67

^a One- and two-year-old age classes combined.

^b Adults and subadults combined.

^c Includes the total number of young located from 1 April to 31 August, including mortalities.

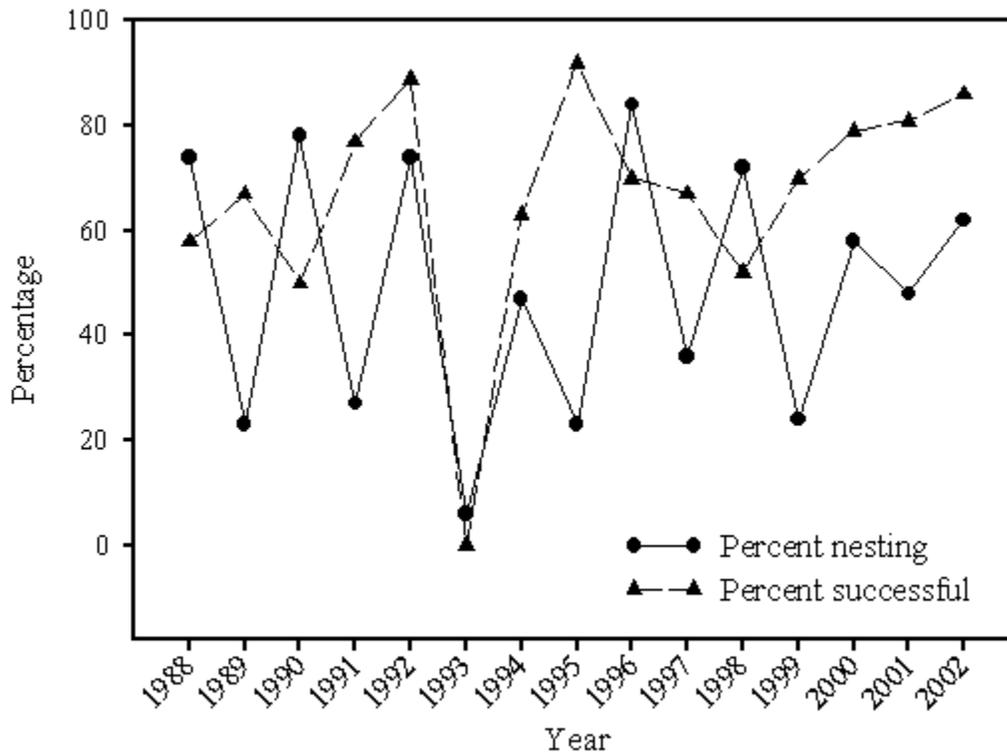


Figure 3. Percentage of pairs surveyed by 31 May that were nesting and the percentage of those nesting pairs that fledged at least one young in the central Cascades study area, Willamette National Forest, Oregon from 1988 through 2002. Nesting pairs that were located after 31 May are not included.

Nest success.

We were able to survey 60 owl pairs prior to 31 May 2002 to conduct nesting status surveys according to protocol (Forsman 1995). The percentage of these pairs that attempted to nest (62%) was higher than the combined average for all previous years of the study (mean percent nesting/year = 49%, SE = 6.4) The percentage of nesting pairs that fledged at least one young (86%) also was higher than the average over all previous years (mean percent successful/year = 67%, SE = 5.8). The percentage of pairs nesting since 1988 continues to show a biannual cycle as reported in this and other studies (Figure 3). Four nest failures were documented before 31 May and additional pair failed after 1 June near the time of fledging. Most of the nesting birds were identified as adults although two subadult females, one subadult male, and one unknown age male also nested.

Reproductive success.

Seventy-four pairs were surveyed for reproductive status prior to 31 August 2002 (Table 4). This includes the 61 pairs and one resident single female that were surveyed for nesting status as well as 14 additional pairs that either did not respond prior to 31 May 2002 or were located at high elevation sites that were inaccessible prior to that date.

The average number of young produced per successful pair (1.54 young/successful pair) was close to the combined average for all previous years of the study (mean young/successful pair/year = 1.53, SE = 0.13). With the exception of 1993 when no young were fledged, there was little variation in the number of young produced by pairs that successfully nested. When 1993 is excluded from this calculation (mean young/successful pair/year = 1.64, SE = 0.05), the mean number of young/successful pair/year for 2002 (1.54 young/successful pair) is less than mean over previous years, and the variation in the mean number of young produced by successful pairs is substantially reduced.

The average number of young produced among all pairs includes variation in the numbers of pairs that nest, variation in nest success, and variation in the number of young produced by successful pairs. Environmental conditions may affect spotted owl reproduction at all of these levels. For all pairs surveyed for reproductive status, the average number of young produced/pair in 2002 (0.80 young/pair) was higher than the average over previous years (mean young/pair/year = 0.60, SE = 0.10). Excluding 1993 from these calculations had little effect on this result (mean young/pair/year = 0.65, SE = 0.09; Figure 3).

Fecundity was calculated as the average number of female offspring per female surveyed for reproductive status according to protocol (Forsman 1995). The fecundity estimate for 2002 was 0.40 female young/adult female (Figure 4) which was higher than the average over previous years (mean fecundity/year = 0.29, SE = 0.05).

A higher percentage of the pairs fledged young in the LSR sites than in the matrix and AMA allocations in 2002 (Table 5). Fecundity decreased in the LSR sites from 2001 to 2002 although it remained higher than the fecundity from the matrix and AMA sites (see Appendix 3 for summary reproductive statistics for individual LSRs). A substantial decrease in fecundity was observed in the AMA sites while fecundity increased among the matrix sites from 2001 to 2002.

Banding/re-observation.

Eighty-seven owls were banded in 2002: 63 fledglings, 10 subadults, and 14 adults (Table 6). From 1987 through 2002, 521 non-juveniles and 617 fledglings have been banded for a grand total of 1,138 owls. Based on re-observations of banded non-juvenile owls, the minimum average age for males was 7.6 years (SE = 0.43) and 8.4 years (SE = 0.50) for females. The oldest owls located in 2002 were at least 18 years old.

Table 4. Summary of reproductive success surveys for northern spotted owls in the Central Cascades Study Area, Willamette National Forest, Oregon from 1988 through 2002.

Year	Number of pairs checked ^a	Number (%) of pairs fledging young	Number of young fledged	Average number of young per successful pair	Average number of young per pair (all pairs)
1988	39	20 (51)	35	1.75	0.90
1989	49	10 (20)	17	1.70	0.35
1990	63	29 (46)	36	1.24	0.57
1991	58	16 (28)	30	1.88	0.52
1992	61	47 (77)	86	1.83	1.41
1993	50	0 (0)	0	0.0	0.0
1994	63	21 (33)	28	1.33	0.44
1995	73	13 (18)	22	1.69	0.30
1996	66	42 (64)	68	1.62	1.03
1997	62	15 (24)	24	1.60	0.39
1998	78	28 (36)	42	1.50	0.54
1999	75	11 (15)	21	1.91	0.28
2000	75	37 (49)	60	1.62	0.80
2001	87	48 (55)	81	1.69	0.93
2002	74	39 (53)	60	1.54	0.81

^a Includes only pairs that were given at least four mice on two or more occasions prior to 31 August.

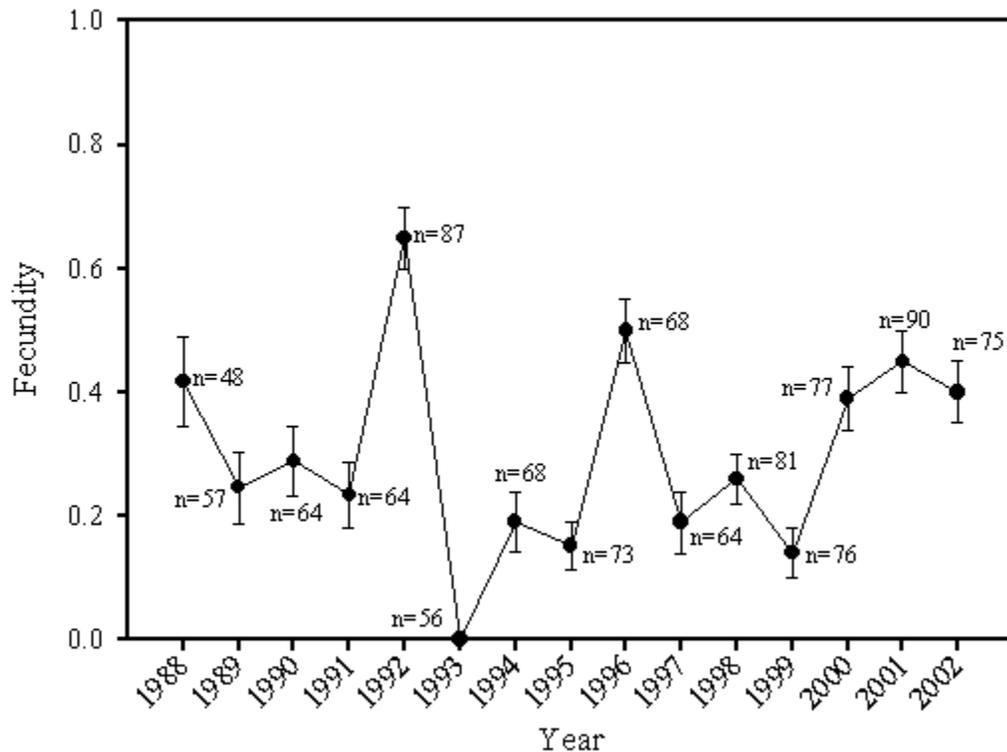


Figure 4. Annual fecundity estimates for the central Cascades study area, Willamette National Forest, Oregon from 1988 though 2002.

There were 18 major inter-territory movements of owls in 2002. Eleven adult owls were recaptured or re-sighted at different locations within our study area. Six owls originally banded as fledglings were recaptured and fitted with adult bands; one was originally banded in 1996, two in 1998, one in 2000, and two in 2001. An additional owl originally banded in 1996 as a juvenile and relocated in 1998 and a subadult were relocated again as an adult in 2002.

Wilderness surveys.

Five sites located in the Three Sisters Wilderness Area near the study area boundary have been surveyed on an irregular basis since 1989. In 1997, our project began surveying these sites to protocol standards because of the potential for the birds to use habitat on the study area and to monitor movements of banded owls across the study area/wilderness boundary. While pair occupancy rates had been high at these sites, nesting attempts and productivity have been low (Table 7). In 2002, pair occupancy reached its lowest point for the wilderness boundary sites and no young were produced.

Table 5. Summary of reproductive success surveys of northern spotted owls stratified by land use allocation on the Central Cascades Study Area, Willamette National Forest, Oregon from 1997 through 2002.

Land use allocation ^a	Year	Number of pairs ^b	Number (%) of pairs fledging young	Number of young fledged	Average number of young per successful pair	Average number of young per pair (all pairs)	Mean fecundity (number of females)
Matrix	1997	22	5 (23)	8	1.60	0.36	0.17 (23)
	1998	22	12 (55)	18	1.50	0.82	0.39 (27)
	1999	23	2 (9)	3	1.50	0.13	0.07 (23)
	2000	24	10 (42)	17	1.70	0.71	0.34 (25)
	2001	26	10 (38)	17	1.70	0.65	0.31 (27)
	2002	18	9 (50)	14	1.56	0.78	0.39 (18)
AMA	1997	29	9 (31)	15	1.67	0.52	0.26 (29)
	1998	31	7 (23)	9	1.29	0.29	0.15 (31)
	1999	28	4 (14)	8	2.00	0.29	0.14 (29)
	2000	24	12 (50)	20	1.67	0.83	0.42 (24)
	2001	24	14 (58)	24	1.71	1.00	0.46 (26)
	2002	24	9 (38)	13	1.44	0.54	0.27 (24)
LSR ^c	1997	5	0 (0)	0	0.00	0.00	0.00 (6)
	1998	21	7 (33)	12	1.71	0.57	0.26 (23)
	1999	20	5 (25)	10	2.00	0.50	0.25 (20)
	2000	23	14 (61)	22	1.57	0.96	0.46 (24)
	2001	33	22 (67)	37	1.68	1.12	0.56 (33)
	2002	28	19 (68)	31	1.63	1.11	0.53 (29)

^a Sites with LUA designation "Other" not reported.

^b Includes only pairs that were given at least 4 mice on two or more occasions prior to 31 August.

^c The LSR estimates computed for 1998 - 2002 include the Fall Creek LSR which was not surveyed in 1997.

Table 6. Numbers of new spotted owls banded, re-sighted, and recaptured in the central Cascades study area, Willamette National Forest, Oregon during 2002.

Age Class	New owls banded			Owls re-sighted			Owls recaptured		
	Males	Females	Sex unk.	Males	Females	Sex unk.	Males	Females	Sex unk.
Adult	7	7	0	77	72	0	3	2	0
Subadult	4	6	0	2	2	0	1	1	0
Juvenile	-	-	63	-	-	-	-	-	-

Only two movements of birds between the study area and the wilderness boundary sites have been documented. In 2000, an adult female moved from the Horse Creek LSR into the wilderness and paired with an adult male but did not nest. In 2002, this adult male moved into the LSR from the wilderness and paired with a different adult female at a new site, nested and failed.

Four additional sites located near the Three Sisters and Mount Washington Wilderness Area boundaries have been surveyed irregularly since 1987. Eight owls have been banded at these sites although only one was later relocated on the study area.

7. Discussion for FY 2002:

Survey effort has stabilized at just over 160 sites since incorporating the Fall Creek late-successional reserve in 1998. There will continue to be year-to-year variation by one or two sites each year because owl territories occasionally overlap more than one site center. For example, the County Creek and Carpenter Creek site centers established in 1994 are so close together that the one pair of owls in the area is commonly identified in both sites. To avoid excessive disturbance of the pair, we typically discontinue surveys at the second site where the pair is observed. There are usually only one or two situations like this each field season.

The discovery of new pairs of owls may increase the total number of sites slightly over the next few years although this increase is expected to be minimal. Next season we will be cooperating with the Middle Fork Ranger District to survey several areas in Fall Creek near young stands that are scheduled for thinning. This may reveal one or two new pairs although much of the habitat to be surveyed is only marginally suitable for spotted owls. We do not expect to expand our surveys within the rest of the study area except for increasing survey effort in and around unoccupied sites.

Simple occupancy has remained near 80% since 1995 although pair occupancy seems to have gradually declined since 1989 (Figure 1). The initial increase in pair occupancy from 1987 to 1989 is probably related to increased survey effectiveness as the study became established. The overall decrease in pair occupancy is consistent with a continued decline in spotted owl numbers although

Table 7. Wilderness boundary sites surveyed concurrently with the demographic study in the central Cascades study area, Willamette National Forest, Oregon from 1997 through 2002.

Year	Sites surveyed ^a	Sites with pairs	Number of pairs producing young	Number of young fledged
1997	5	4	1	2
1998	5	5	1	1
1999	5	5	0	0
2000	5	3	0	0
2001	5	4	0	0
2002	5	2	0	0

^a Includes only sites that were surveyed at least 3 times at night.

survivorship and population rate of change have not been recalculated since 1998. It is impossible to predict whether this decline will stabilize at a lower level to correspond with the loss of habitat that occurred in the late 1980's. Certainly, continued losses of pairs will negatively impact productivity and may accelerate the rate of population decline.

Occupancy within the land use allocations considered here has varied over time and long-term trends are not obvious (Figure 2). The greatest decrease in pair occupancy from 2001 to 2002 occurred in the matrix sites although this follows three years in which increases in pair occupancy were observed in the matrix. More consistent decreases in pair occupancy have been observed in the AMA and LSR sites since 1998. Pair occupancy among the LSR sites remains lower than in the AMA and matrix sites due primarily to very low pair occupancy rates in the Hagan, Horse Creek, and South Santiam LSRs (Appendix 2). The Fall Creek LSR shows occupancy rates slightly higher than the average over all sites. The Fall Creek LSR contains considerably more high quality, low elevation habitat than the other LSRs. For the the other three LSRs in the study area to provide a net surplus of young as discussed in the NWFP (USDA and USDI 1994), the habitat will need to develop characteristics better suited for spotted owl reproduction. The rate at which this development occurs will determine the extent that the LSRs will mitigate proposed timber harvest in the matrix and AMA allocations.

The biannual cyclical pattern in the percentage of pairs attempting to nest is still somewhat apparent albeit at a lower magnitude than prior to 2000. This pattern is not observed in nest success or in overall fecundity. Nest success has increased every year since 1998 although this may be due, in part, to decreases in overall pair occupancy. That is, if the least productive pairs are the first to split up, then the remaining high-productivity pairs would bias the estimates of nest

success and fecundity in a positive direction.

The high reproductive rate observed this year comes immediately following two consecutive high years of above average fecundity. The large pulse of fledglings produced since 2000 is expected to affect the territorial dynamics within the study area as well as increase dispersal out of the study area.

It is important to note that data for the LSRs were heavily weighted by the sites in the Fall Creek LSR due to its large size and high quality habitat. The high fecundity estimate for the LSR sites is largely due to reproduction occurring in the Fall Creek LSR: 27 of the 31 fledglings (87%) produced in the LSRs were produced in Fall Creek. In past years, the percentages of fledglings produced in Fall Creek have been comparable (1998: 67%, 1999: 80%, 2000: 90%, 2001: 66%). The average number of pairs and young found in Fall Creek are approximately three times greater than that found in the other three LSRs combined. This potentially represents a 50% greater contribution of offspring to the population than would be expected based on land area alone.

The percentage of sites containing at least a single barred owl (*Strix varia*) increased dramatically between 2000 and 2001; the high level of barred owl responses continued into 2002 as well (Figure 5). The percentage of sites containing pairs of barred owls has remained relatively constant although it is important to note that our survey methods are not designed to locate barred owls. Many of the nocturnal single barred owl responses may have been associated with pairs but these responses are not followed-up unless a spotted owl is also detected in the vicinity. The data do suggest, however, that barred owls are becoming increasingly common in the study area and several pairs of spotted owls have been either displaced or are inhibited from responding to our surveys as a result. In addition, a second hybrid owl was located on the study area in the Horse Creek LSR. This hybrid female was paired with a barred owl. Reproduction and nesting status were unknown. The hybrid owl discovered in Fall Creek in 1999 nested and produced two young this year. This hybrid was also captured and banded in 2002.

8. Problems encountered:

The winter of 2001-2002 produced a near average snow pack. Although road access into our highest elevation sites was not available until the end of June, we still were able to conduct visits earlier in the season using snowshoes or alternate routes into most of these sites. Several of the steepest and most remote sites in the South Santiam and Horse Creek late-successional reserves could not be accessed until late June. These areas are unlikely to be accessible prior to 1 June during all but the driest years.

Although survey effort was the same for all three land allocations, more difficult access decreased detection probabilities in the LSRs by an unknown magnitude. The secondary roads in the LSRs are no longer maintained making portions of these sites difficult to survey effectively. The Horse Creek and South Santiam LSRs encompass higher elevations than the AMA and matrix areas. The greater snow accumulation remaining in the spring at the high elevation sites delays the first

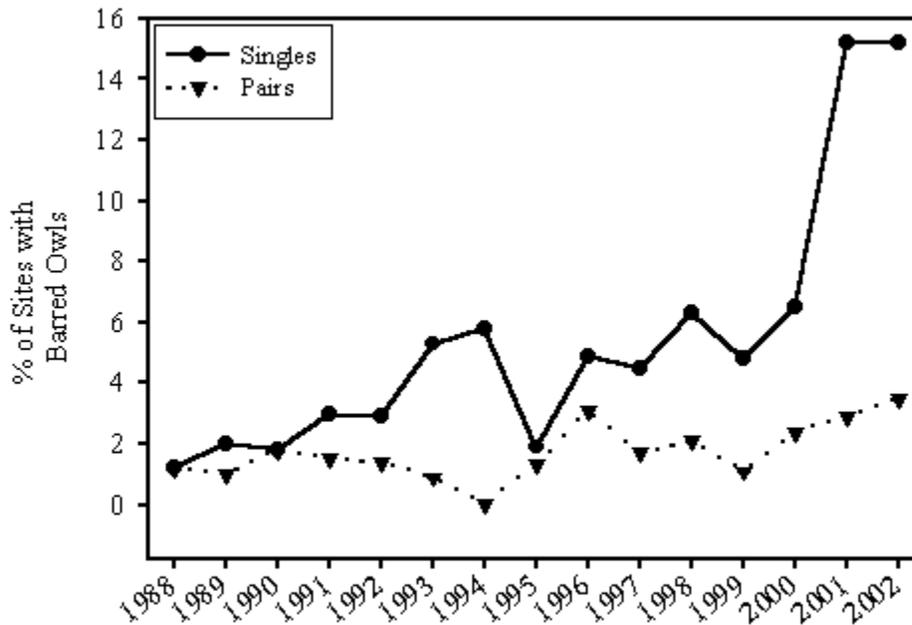


Figure 5. Percentage of sites where incidental detection of barred owls have occurred in the central Cascades study area, Willamette National Forest, Oregon from 1988 through 2002.

surveys until June when spotted owls may have already nested and failed. As a result, the nesting and reproductive status of more owls remained unresolved in the LSR sites than in the matrix or AMA sites.

9. Acknowledgments:

Several people from the Willamette National Forest contributed both information and equipment that made this study possible. Ruby Seitz and Lisa Lyon (McKenzie River Ranger District), Virgil Morris (Sweet Home Ranger District), and Kirk Lunstrom (Lowell Ranger District) are the principle Forest Service biologists that regularly consult with us regarding management activities near the owl sites and have provided valuable information regarding the history of several sites. Fred Swanson (Pacific Northwest Forestry Sciences Laboratory), Art McKee (Oregon State University) and the staff of the H. J. Andrews Experimental Forest provided housing and office facilities. Financial support was provided by the U. S. Forest Service and the Portland Field Office of the U. S. Fish and Wildlife Service. We also thank Steve Adey and Dave Stemper for their continued service to the project as weekend volunteers.

10. Research plans for FY 2003:

- a. Continue the demographic study of the northern spotted owl population in the central Cascades of Oregon.
- b. Continue comparing the demography of spotted owls among the matrix, AMA, and LSR land use allocations.
- c. Cooperate with the predictive modeling group at Oregon State University to provide data for the development and validation of habitat-based models of demographic performance.
- d. Contribute mark-recapture and monitoring data to the next regional meta-analysis of spotted owl population performance.
- e. Continue the analysis of spotted owl diet composition and update the pellet database to be compatible with other studies.
- f. Cooperate with the staff of the Middle Fork Ranger District in developing survey priorities for proposed thinning units in the Fall Creek late-successional reserve.

11. Publications and technology transfer completed in FY 2002:

Publications.

- a. Ackers, S. H. *In prep.* Long-term population monitoring of northern spotted owls: recent results and implications for the Northwest Forest Plan. *In:* Arabas, K. B. and J. Bowersox, III. (Eds.) *Forest Futures: Science, Politics, and Policy for the Next Century.* Rowman and Littlefield, Lanham, Maryland.

Presentations.

- a. S. Ackers presented a poster at the annual H. J. Andrews Symposium entitled “Northern Spotted Owl Research at the H. J. Andrews Experimental Forest (September 2002).
- b. S. Ackers presented a paper entitled: “Threatened and Endangered Species Monitoring Under the Northwest Forest Plan: Spotted Owl Demographics” at a conference at Willamette University (September 2002).
- c. S. Ackers discussed spotted owl ecology and demographic trends with Dr. Judy Li’s undergraduate class from OSU (September 2002).

- d. S. Ackers discussed spotted owl management and related forest management issues with an undergraduate class from Willamette University (September 2002).
- e. N. Seaman and J. LaVoie discussed spotted owl ecology and research methods with a group of middle school students from the Inner City Youth Institute (July 2002).
- f. S. Ackers took a group of teachers from the Teachers in the Woods program on a field trip to demonstrate and discuss the field methods used in spotted owl monitoring (July 2002).
- g. S. Ackers discussed spotted owl research and management with a group of students from Grant High School (May 2002).

Technology transfer.

- a. Project personnel coordinated spotted owl surveys with the district biologists of the Willamette National Forest and continued to provide locational and demographic information for their management needs.
- b. S. Ackers consulted with biologists and foresters from the Middle Fork Ranger District on a strategy to prioritize proposed thinning operations in the Fall Creek late-successional reserve.
- c. S. Ackers provided data from two spotted owl sites to the U. S. Army Corps of Engineers to assist in their compliance with regulations concerning construction at Cougar Dam.
- d. S. Ackers attended monthly meetings of the Long-Term Ecological Research group (Corvallis).
- e. S. Ackers provided demographic data to the predictive modeling group and attended their monthly meetings (Corvallis).
- f. S. Ackers attended monthly H. J. Andrews staff meetings at the H. J. Andrews Experimental Forest.

B. Duration of the study:

This study was initiated in FY 1987 and is part of the long-term monitoring plan for the northern spotted owl under the Northwest Forest Plan.

C. Literature cited:

Burnham, K. P., D. R. Anderson, and G. C. White. 1996. Meta-analysis of vital rates of the northern spotted owl. *Studies in Avian Biology* 17:92-101.

Forest Ecosystem Management Assessment Team (FEMAT). 1993. Forest ecosystem management: an ecological, economic and social assessment. Portland, OR. U. S. Department of Agriculture, U. S. Department of the Interior (and others). Irregular pagination.

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. U. S. Forest Service Gen. Tech. Rep. PNW-GTR-440. 43 pp.

Franklin, A. B., K. P. Burnham, G. C. White, R. G. Anthony, E. D. Forsman, C. Schwartz, J. D. Nichols, and J. Hines. 1999. Range-wide status and trends in northern spotted owl populations. Unpubl. report. Colorado Cooperative Wildlife Research Unit, Colorado State University, Fort Collins, Colorado, USA and Oregon Cooperative Fisheries and Wildlife Research Unit, Oregon State University, Corvallis, Oregon, USA. 71pp.

U. S. Department of Agriculture, Forest Service and U. S. Department of the Interior, Bureau of Land Management. 1994. Record of decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the northern spotted owl. Standards and guidelines for management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl. Washington, D. C. [Sections numbered separately].

Appendix 1. Occupancy and reproductive status of surveyed sites for the four late-successional reserves (LSR) in the Central Cascades Study Area, Willamette National Forest, Oregon from 1997 through 2002.

LSR	MSNO ^a	1998		1999		2000		2001		2002	
		Occ. status ^b	Repro. status ^c	Occ. status	Repro. status	Occ. status	Repro. status	Occ. status	Reprod. status	Occ. status	Reprod. status
Fall Creek	0124	SD	-	P	2	PU	?	P	N	P	2
	1012	Unoccupied		A	?	SU	-	A	2	P	N
	1013	NR	-	P	?	P	0	P	F	P	2
	1015 ^{d, f}	P	?	PU	?	Hybrid pair		Hybrid pair		Hybrid pair	
	1016	P	?	P	2	P	0	P	2	P	2
	1017	SU	-	SU	-	A	?	Unoccupied		SU	-
	1018	PU	?	PU	?	P	2	SU	-	P	N
	1019	P	?	P	N	P	2	P	1	SU	-
	1020	P	?	RM	-	PU	?	P	2	P	2
	1021	P	?	PU	?	A	2	P	2	P	2
	1022	SU	-	P	N	PU	?	PU	?	P	2
	1028	SD	-	NR	-	not surveyed		SU	-	Unoccupied	
	1029	RM	-	RM	-	P	0	P	N	P	2
	1031	SD	-	A	?	A	0	P	1	P	2
	1043	SD	-	Unoccupied		Unoccupied		SU	-	RM	-
1101	SD	-	SD	?	SU	-	Unoccupied		SU	-	

LSR	MSNO ^a	1998		1999		2000		2001		2002	
		Occ. status ^b	Repro. status ^c	Occ. status	Repro. status	Occ. status	Repro. status	Occ. status	Reprod. status	Occ. status	Reprod. status
Fall Creek	1102	not surveyed		SU	-	P	?	SU	-	P	?
	1414	P	?	P	N	P	2	P	N	P	2
	2807	P	?	SU	-	P	2	P	2	P	?
	2808	not surveyed		SU	-	P	1	RM	-	P	2
	2817	P	?	SD	-	P	1	P	1	P	?
	2861	SD	-	P	0	PU	?	Unoccupied		SU	-
	2863	Unoccupied		P	N	P	2	P	2	SU	-
	2864	Unoccupied		Unoccupied		Unoccupied		Unoccupied		Unoccupied	
	2865	P	?	RM	-	SU	-	Unoccupied		Unoccupied	
	2888	not surveyed		SD	-	SU	-	P	2	P	?
	2889	P	?	P	N	SU	-	P	N	P	?
	2891	NR	-	P	2	RF	N	P	2	P	1
	2895	P	?	P	N	P	1	P	1	P	N
	2897	Unoccupied		SD	-	Unoccupied		SU	-	Unoccupied	
	2899 ^e	SD	-	Unoccupied		Unoccupied		SU	-	SU	-
	2900	P	?	P	2	P	F	P	2	P	F
	2949	Unoccupied		Unoccupied		Unoccupied		SU	-	SU	-

LSR	MSNO ^a	1998		1999		2000		2001		2002	
		Occ. status ^b	Repro. status ^c	Occ. status	Repro. status	Occ. status	Repro. status	Occ. status	Reprod. status	Occ. status	Reprod. status
Fall Creek	3550	SD	-	Unoccupied		A	0	P	1	P	1
	4082	SD	-	P	?	SU	-	RM	-	RM	-
	4084	SU	-	PU	?	Unoccupied		Combined with 1031		Combined with 1031	
	4105	not surveyed		SD	-	Unoccupied		Unoccupied		Unoccupied	
	4392	SD	-	P	0	P	2	P	0	P	2
	4420	NR	-	SU	-	SU	-	RM	-	RM	-
	4421	SU	-	P	N	P	1	P	N	P	0
	4476	not surveyed		SU	-	P	2	P	0	P	2
	4549	not surveyed		not surveyed		P	F	Hybrids	2	SU	-
	4585	not surveyed		not surveyed		not surveyed		P	2	Unoccupied	
	9600 ^f	not surveyed		Hybrids	1	Hybrids	?	Hybrids	?	Hybrids	2

LSR	MSNO	1997		1998		1999		2000		2001		2002	
		Occ. status	Repro. status	Occ. status	Repro. status	Occ. status	Repro. status	Occ. status	Repro. status	Occ. status	Repro. status	Occ. status	Repro. status
Hagan	0112	Unoccupied		SU	-	Unoccupied		Unoccupied		SU	-	Unoccupied	
	2134	P	?	P	?	NR	-	BLM survey		BLM survey		BLM survey	
	3401	SU	-	P	F	Unoccupied		SU	-	P	1	RM	-
	4503	P	F	Unoccupied		RM	-	PU	?	P	2	P	N
	5070	NR	-	Unoccupied		I	-	SU	-	SU	-	Unoccupied	
	5071	NR	-	PU	?	RM	-	Unoccupied		SU	-	Unoccupied	
Horse Creek	0818	SU	-	P	?	P	?	PU	?	Unoccupied		Unoccupied	
	0835	Unoccupied		Unoccupied		Unoccupied		not surveyed		not surveyed		not surveyed	
	0850	P	?	P	?	PU	0	PU	?	P	2	SU	-
	0851	Unoccupied		Unoccupied		Unoccupied		not surveyed		SD	-	Unoccupied	
	0857	P	?	P	?	P	N	P	F	Unoccupied		SU	-
	0982	SU	-	P	?	P	N	P	0	P	2	P	N
	1736	SU	-	P	?	SU	-	SU	-	SU	-	P	0
	1737	I	-	Unoccupied		PU	?	Unoccupied		SU	-	Unoccupied	
	2428	SD	-	P	?	P	F	PU	?	P	N	P	1
	2446	Unoccupied		P	?	P	2	P	1	P	2	SU	-

LSR	MSNO	1997		1998		1999		2000		2001		2002	
		Occ. status	Repro. status	Occ. status	Repro. status	Occ. status	Repro. status						
Horse Creek	2828	SU	-	Unoccupied		Unoccupied		PU	?	Unoccupied		SU	-
	2830	NR	-	SU	-	RM	-	Unoccupied		SU	-	Unoccupied	
	3023	Unoccupied		SU	-	Unoccupied		SU	-	SU	-	Unoccupied	
	5043	SU	-	Unoccupied		Unoccupied		Unoccupied		Unoccupied		Unoccupied	
	9602 ^g	not surveyed		not surveyed		not surveyed		not surveyed		P	F	Unoccupied	
South Santiam	0011	A	?	P	?	P	0	P	1	P	2	P	1
	0014	Unoccupied		Unoccupied		Unoccupied		SU	-	SU	-	RM	-
	0619	SD	-	SD	-	SD	-	SU	-	SU	-	SU	-
	0641	P	F	RF	-	P	0	SU	-	Unoccupied		Unoccupied	
	0646	SU	-	SU	-	NR	-	Unoccupied		Unoccupied		Unoccupied	
	2460	P	?	P	?	SU	-	SU	-	Unoccupied		SU	-
	2956	NR	-	A	?	RM	-	RF	N	PU	-	SU	-
	2959	SU	-	NR	-	NR	-	Unoccupied		Unoccupied		Unoccupied	
	2962	P	F	P	F	P	N	P	F	P	2	P	1
	4098	Unoccupied		Unoccupied		not surveyed		Unoccupied		SU	-	Unoccupied	
	4196	P	?	P	?	P	0	RM	-	PU	-	P	1

LSR	MSNO	1997		1998		1999		2000		2001		2002	
		Occ. status	Repro. status	Occ. status	Repro. status	Occ. status	Repro. status	Occ. status	Repro. status	Occ. status	Repro. status	Occ. status	Repro. status
South Santiam	4405	RF	-	RF	-	SU	-	SU	-	P	0	PU	-
	4488	RM	-	RM	-	PU	?	SU	-	Unoccupied		P	?
	5052	NR	-	SU	-	SU	-	Unoccupied		Unoccupied		Unoccupied	
	5053	NR	-	Unoccupied		not surveyed		not surveyed		not surveyed		not surveyed	
	5058	SU	-	Unoccupied		NR	-	SU	-	Unoccupied		Unoccupied	

^a Master Site Number; the managed point in GIS analyses.

^b Occupancy status for each site was classified as: P = pair; A = pair plus one or more additional adults or subadults; RM = resident single male; RF = resident single female; PU = pair of owls detected only one of which meets the requirements for residency; SU = one or more owls detected but not meeting the above criteria and survey effort was at least three night visits; SD = one or more owls detected but not meeting the above criteria and survey effort was less than three night visits; NR = no responses in less than 3 night visits; I = one or more owls detected but occupancy status was assigned to another site.

^c Reproductive status for each site was classified as: 0, 1, 2, 3 = number of young produced; N = confirmed non-nesting; F = confirmed nest failure; ? = undetermined

^d The STOC pair at this site is now located at MSNO 4549 (West Slick Creek).

^e The Logan and L. Logan sites have been surveyed as a single site since 2000.

^f The U. S. Forest Service tracks the STXX x STVA hybrid pair at MSNO 1015 (Clark Creek) independently as MSNO 9600.

^g This site (Quaking Aspen) has not yet been assigned a MSNO.

Appendix 2. Summary of survey effort and site occupancy for the four late successional reserves (LSR) in the Central Cascades Study Area, Willamette National Forest, Oregon from 1997 through 2002.

LSR	Year	Sites surveyed	Occupied ^a sites (%)	Sites occupied by pairs (%)
Fall Creek	1997	0	-	-
	1998	22	17 (77)	13 (59)
	1999	35	30 (86)	23 (66)
	2000	40	33 (83)	25 (63)
	2001	41	35 (85)	25 (61)
	2002	41	36 (88)	25 (61)
Hagan	1997	4	3 (75)	2 (50)
	1998	5	3 (60)	2 (40)
	1999	5	3 (60)	0 (0)
	2000	5	3 (60)	1 (20)
	2001	5	5 (100)	2 (40)
	2002	5	2 (40)	1 (20)
Horse Creek	1997	10	7 (70)	3 (30)
	1998	13	9 (69)	7 (54)
	1999	13	9 (69)	7 (54)
	2000	12	9 (75)	7 (58)
	2001	13	9 (69)	5 (38)
	2002	14	7 (50)	3 (21)
South Santiam	1997	12	9 (75)	4 (33)
	1998	13	9 (69)	5 (38)
	1999	9	8 (89)	5 (56)
	2000	14	11 (79)	2 (14)
	2001	14	8 (57)	5 (36)
	2002	15	9 (60)	5 (33)

^a Sites were considered occupied if they were surveyed at least three times at night with one or more responses that could not be attributed to any other site.

Appendix 3. Summary reproductive statistics for the four late successional reserves (LSR) in the Central Cascades Study Area, Willamette National Forest, Oregon from 1997 through 2002.

LSR	Year	Nesting surveys ^a	Pairs nesting	Reproductive surveys ^b	Pairs fledging young (%)	Young fledged	Young per successful pair	Young per all pairs
Fall Creek	1997	Fall Creek not surveyed in 1997.						
	1998	9	7	10	4 (40)	8	2.00	0.80
	1999	8	2	12	4 (33)	8	2.00	0.67
	2000	10	8	18	12 (67)	20	1.67	1.11
	2001	13	6	23	15 (65)	24	1.60	1.04
	2002	17	14	22	15 (71)	27	1.80	1.23
Hagan	1997	1	1	1	0	0	0.00	0.00
	1998	1	1	1	0	0	0.00	0.00
	1999	0	0	0	0	0	0.00	0.00
	2000	0	0	0	0	0	0.00	0.00
	2001	1	1	2	2 (100)	3	1.50	1.50
	2002	1	0	1	0	0	0	0
Horse Creek	1997	1	0	1	0	0	0.00	0.00
	1998	2	0	5	2 (40)	2	1.00	0.40
	1999	4	2	5	1 (20)	2	2.00	0.40
	2000	3	2	3	1 (33)	1	1.00	0.33
	2001	3	2	5	3 (60)	6	2.00	1.20
	2002	2	1	3	1 (33)	1	1.00	0.33
S. Santiam	1997	3	2	3	0	0	0.00	0.00
	1998	3	2	4	1 (25)	2	2.00	0.50
	1999	1	0	3	0	0	0.00	0.00
	2000	1	1	2	1 (50)	1	1.00	0.50
	2001	2	2	3	2 (67)	4	2.00	1.33
	2002	2	2	3	3 (100)	3	1.00	1.00

^a Includes pairs given at least four mice on at least two occasions by 1 June, and all females examined for a brood patch by 30 June.

^b Includes all pairs and females given at least four mice on at least two occasions by 31 August.