ANNUAL RESEARCH REPORT
FY 2001
29 October 2001

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, Gila Fox, Timothy Fox, David Giessler, Sheila Turner-Hane; Volunteer: Jeffery LaVoie. 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, 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, Forest Ecosystem Management Assessment Team 1993).

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 ecology 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 (Forest Ecosystem Management Assessment Team 1993) and will provide insights into how forest management can maintain and enhance spotted owl habitats.

The demographic parameters estimated by this study will 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 emphasis shifts from population monitoring to a habitat-based monitoring approach, this study also will provide critical information for developing and validating predictive models of demographic performance as a function of habitat condition.

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 classified by nesting and reproductive status 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 2001:

Site occupancy.

Survey effort in 2001 (162 sites) was similar to effort in 2000 (159 sites). Most of the occupied sites in 2001 were occupied by pairs (72 %) with substantially fewer occupied sites containing resident single owls (8 %) or single owls with unknown social status (20 %) (Table 1). Unoccupied sites accounted for 18 % of the total number of sites surveyed. The unoccupied sites were surveyed at least three times at night with the exception of four sites that lack adequate road or trail access. These sites were surveyed on foot four times during the day. One site that had been lumped with a nearby site in previous years was assigned unknown occupancy when a male spotted owl from a third site was discovered there on 6 August. The percentage of all sites that were occupied by pairs in 2001 was similar that observed since 1998 (Figure 1).

Four additional sites were surveyed in the LSRs and one site was combined with a neighboring site to better reflect the juxtaposition of territories. Two of the additional sites surveyed in the LSRs were in

the Fall Creek LSR; one is proposed as a new site to represent a second nesting pair which was found within an existing site and the other was not surveyed last year to avoid disturbing a pair at a neighboring site. In the Horse Creek LSR, banded male and female owls from a wilderness site were identified near a previously unoccupied site center and an intervening

Table 1. Occupancy and social status of northern spotted owl sites (territories) surveyed on the Central Cascades Study Area, Willamette National Forest, Oregon, 1987-2001.

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

[a] Occupancy and social status was 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.

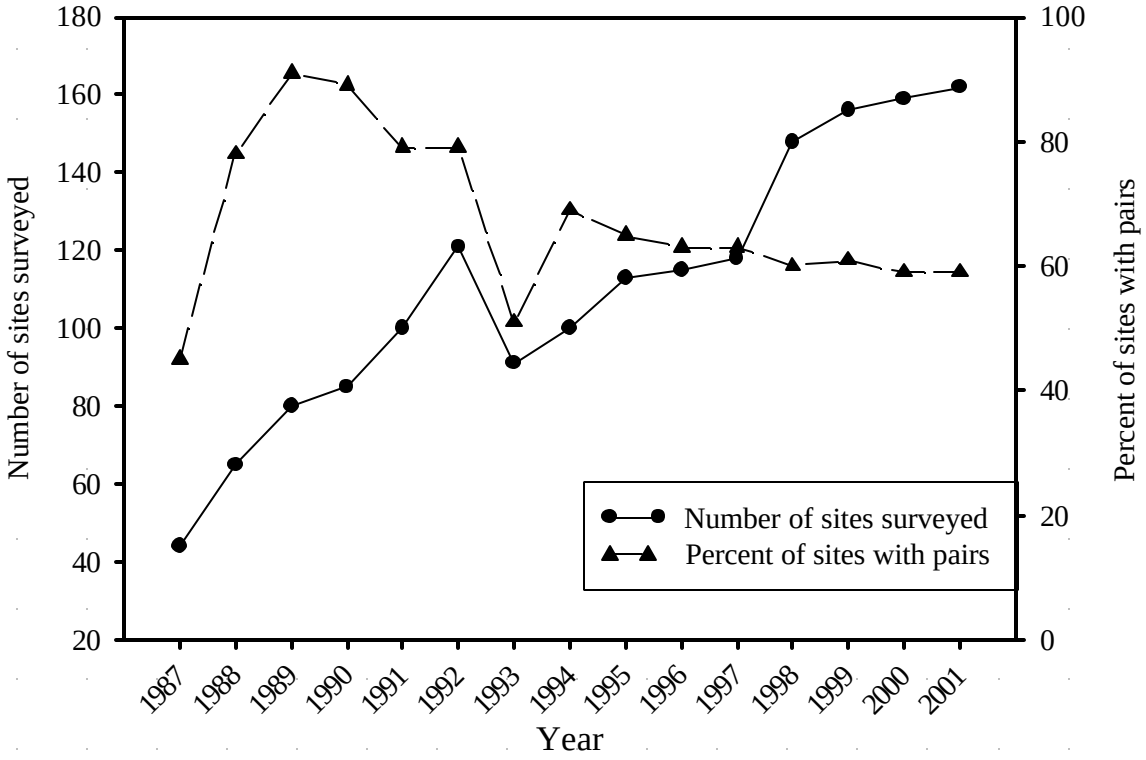

Figure 1. Number of sites surveyed for occupancy and the percentage of those sites occupied by pairs in the central Cascades study area, Willamette National Forest, Oregon from 1987 through 2001.

area, respectively (see Appendices 1 and 2 for the occupancy data from the LSRs). Nearly as many sites were surveyed in the LSRs as in the AMA and matrix allocations combined.

One additional site was surveyed on AMA lands and the same numbers of sites were surveyed in the matrix in 2001 (Table 2). The additional AMA site was not called last year to avoid disturbing a pair at a neighboring site. Six sites were surveyed in other land use allocations such as research natural areas and wild and scenic river corridors in 2001.

The highest rate of simple occupancy was in the matrix lands, while lower occupancy rates were calculated for the AMA and LSR (Table 2). LSR sites showed lower levels of pair occupancy (49%) relative to Matrix (70%) and AMA (61%) 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 Menagerie). The rate of pair occupancy in the Fall Creek LSR was comparable to the rates in the matrix and AMA sites (63%). There did not appear to be a consistent trend in pair occupancy over time or among land

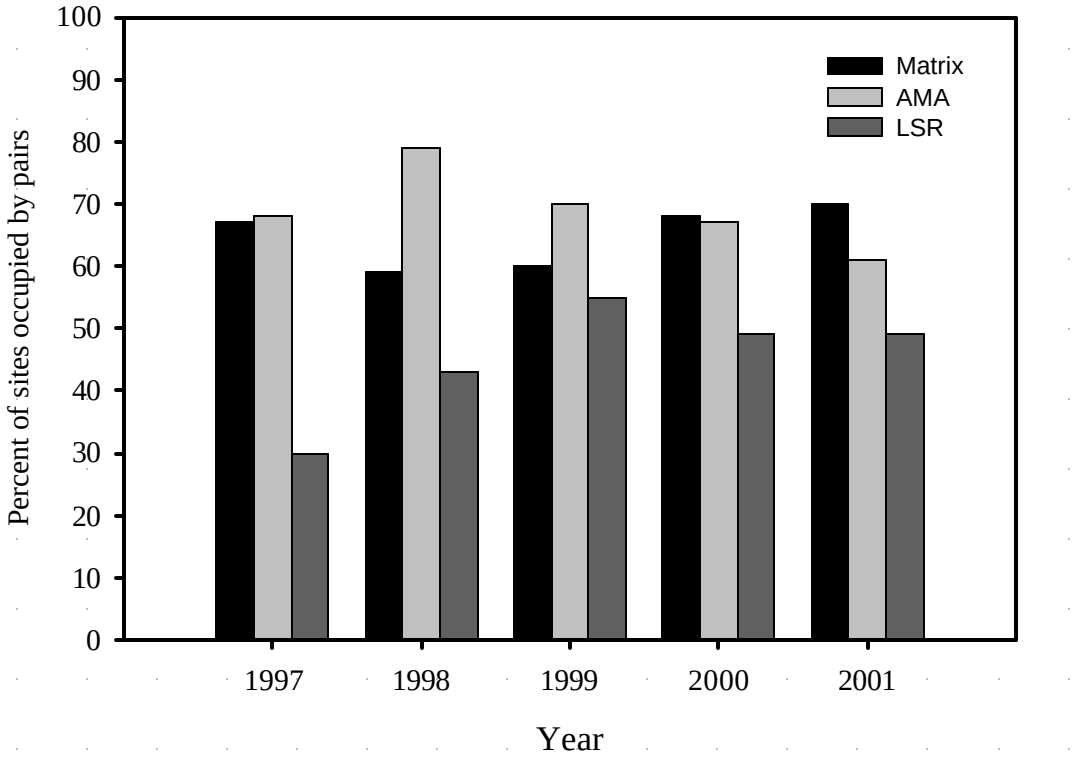

Figure 2. Percentage of site occupied by pairs of northern spotted owls compared among land use allocations in the central Cascades study area, Willamette National Forest, Oregon from 1997 through 2001.

uses during the five years that these data have been compared among land use allocations (Figure 2).

Sex and age composition.

At least 234 non-juvenile and 83 juvenile spotted owls were detected in 2001 (Table 3). The majority of these birds were at least three years old (81%). A relatively small number of owls were identified as one or two years old (3%). Of the owls that were not identified to age class (21%), most were detected as nocturnal auditory responses only and were not relocated on the daytime followup. All of the owls that were identified by reading their color bands were assigned to an age class and all of the nesting birds were identified as adults. Despite substantial variation among years and low numbers of subadults identified, there have been fewer subadult detections since 1992 than prior to that time. However, it is not apparent from these data whether this is due to depletion of the non-territorial subadult portion of the population, increased adult survival, decreased juvenile survival or changes in survey effort and observer abilities.

The sex ratio among adults (three-year-olds and older) continues to be slightly skewed toward males (1.08:1 for 2001, 1.12:1 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 somewhat more apparent among subadults and unclassified non-juveniles, although there is considerably more variation among years. Additionally, sex differences in detection probabilities are probably more extreme for non-breeding owls that for those defending a nest site.

Nest success.

We were able to survey 64 owl pairs prior to 31 May 2001 to conduct nesting status surveys according to protocol (Forsman 1995). The percentage of these pairs that attempted to nest (48%) was the same as the combined average for all previous years of the study (mean percent nesting/year = 48%, SE = 6.8) while the percentage of nesting pairs that fledged at least one young (81%) was higher than the average over all previous years (mean percent successful/year = 65%, SE = 6.0). Six nest failures were documented.

The biannual cycle in reproductive success previously reported in this and other studies is less apparent but still reflected in the percentage of pairs nesting since 1988 (Figure 3). As discussed below, the decrease in the number of pairs that attempted to nest between 2000 and 2001 is in contrast to an observed increase in nest success and the total fecundity of the population.

Reproductive success.

Eighty-seven pairs were surveyed for reproductive status prior to 31 August 2001 (Table 4). This includes the 64 pairs that were surveyed for nesting status as well as 23 additional pairs that either did not respond prior to 31 May 2001 or were located at high elevation sites that were inaccessible prior to that date. This represents the highest level of reproductive survey effort to date.

The average number of young produced per successful pair (1.69 young/successful pair) was higher than 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. The variation in the mean number of young produced by successful pairs was substantially reduced when 1993 is excluded (mean young/successful pair/year = 1.64, SE = 0.05). For all pairs surveyed for reproductive status, the average number of young produced in 2001 (0.93 young/all pairs) was higher than the average over previous years (mean young/all pairs/year = 0.60, SE = 0.10). Excluding 1993 from these calculations had little effect on this result (mean young/all pairs/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 2001 was 0.45 female young/adult female (SE = 0.050) which was higher than the average over previous years (mean

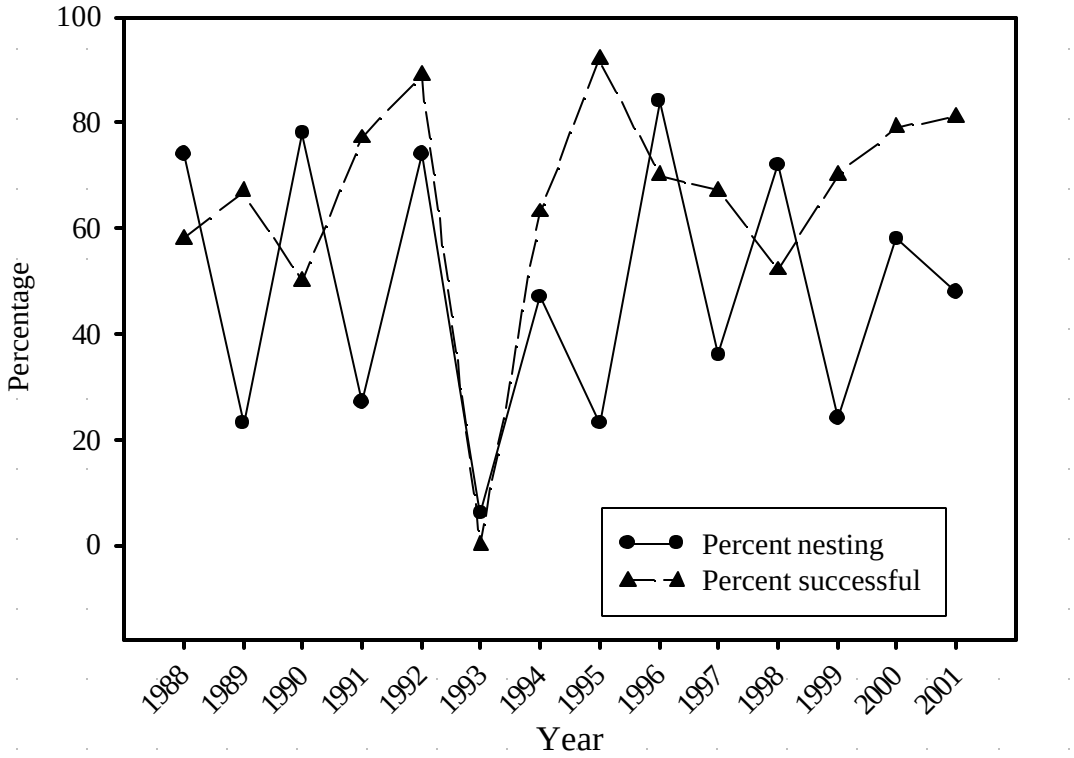

Figure 3. Percentage of pairs surveyed by 31 May that were nesting and the percentage of those nesting pairs that fledged at least one young in the central Cascades study area, Willamette National Forest, Oregon from 1988 through 2001. Nesting pairs that were located after 31 May are not included.

fecundity/year = 0.29, SE = 0.05). Both the average number of young over all pairs and fecundity deviated from the biannual cycle observed in previous years (Table 4, Figure 4).

A higher percentage of the pairs fledged young in the LSR sites than in the matrix and AMA allocations in 2001 (Table 5). Fecundity increased in the LSR sites from 2000 to 2001 and this estimate was higher than in any land allocation during any previous year (see Appendix 3 for summary reproductive statistics for individual LSRs). A slight decrease in fecundity was observed in the matrix sites and a slight increase was observed among the AMA sites.

Banding/re-observation.

One hundred and three owls were banded in 2001: 79 fledglings, 4 subadults, and 20 adults (Table 6). From 1987 through 2001, 497 non-juveniles and 554 fledglings have been banded for

Table 4. Summary of reproductive success surveys for northern spotted owls in the Central Cascades Study Area, Willamette National Forest, Oregon from 1988 through 2001.

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

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

a grand total of 1,051 owls. Based on re-observations of banded non-juvenile owls, the minimum average for males was 8.4 years (SE = 0.422) and 8.2 years (SE = 0.481) for females. The oldest owl located in 2001 was at least 17 years old.

There were 21 major inter-territory movements of owls in 2001. Fifteen 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, one in 1997, one in 1998,

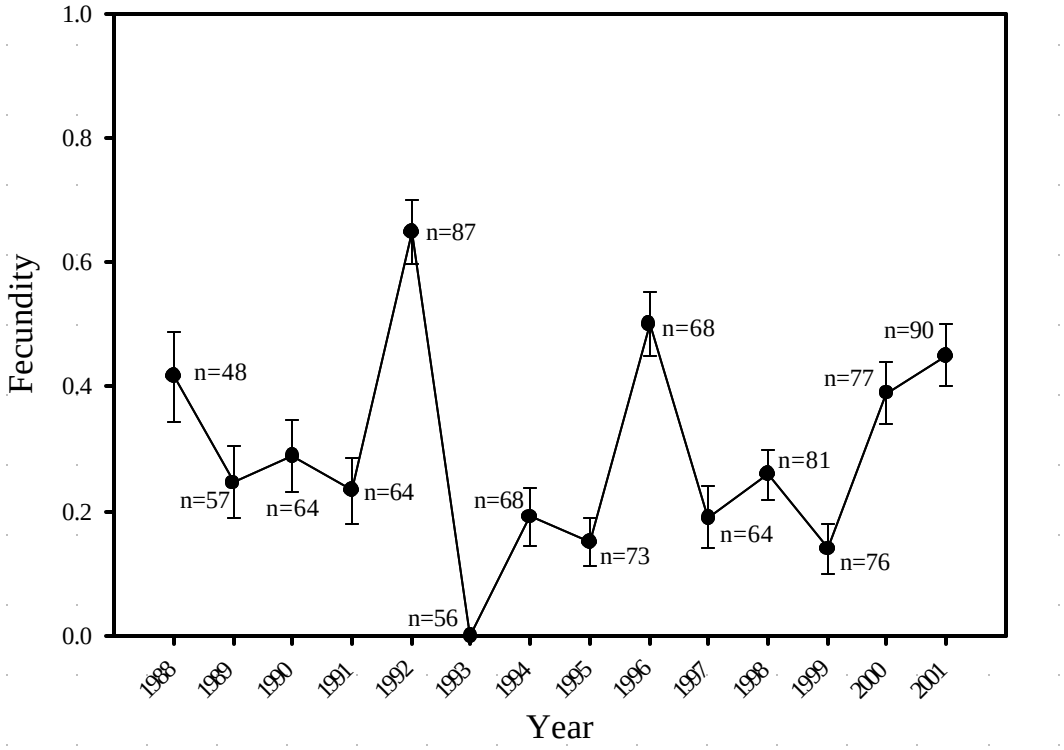

Figure 4. Annual fecundity estimates for the central Cascades study area, Willamette National Forest, Oregon from 1988 through 2001.

one in 1999, and two in 2000.

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 dispersal of banded owls into and out of the wilderness. While pair occupancy rates typically have been high at these sites, nesting attempts and productivity have been low (Table 7). Only two movements of birds into or out of the study area 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 2001, this adult male moved into the LSR from the wilderness and paired with a different adult female at a new site, nested and failed.

Table 6. Numbers of new spotted owls banded, re-sighted, and recaptured in the central Cascades study area, Willamette National Forest, Oregon during 2001.

	New owls banded			Owls re-sighted			Owls recaptured		
Age Class	Males	Females	Sex unknown	Males	Females	Sex unknown	Males	Females	Sex unknown
Adult	12	8	0	81	83	0	5 [a]	0	0
Subadult	2	2	0	0	0	0	2	1	0
Juvenile	-	-	79	-	-	-	-	-	-

[a] This total includes 3 owls wearing juvenile bands, 1 wearing a subadult band, and 1 wearing a radio

A variable amount of effort has been put into surveys in the interior of the Three Sisters Wilderness Area since 1991. These surveys were conducted during one-week pack trips in 1991, 1992, 1997, 1998, and 1999. As many as 16 sites have been included at various times and 19 spotted owls have been banded. Three movements between the study area and the wilderness have been documented: two juveniles and a two-year-old banded on the study area were relocated in the wilderness. An additional spotted owl banded in the wilderness was later relocated on the Warm Springs Indian Reservation. Protocol standards for determining nesting and reproductive status were not met because the visits occurred over a short time each year and all surveys were done during the day. The wilderness interior sites were not surveyed in 2000 and 2001 due to problems with access and the increased cost of hiring an outfitter to supply pack animals. The data from wilderness surveys are not included in the results from the overall demographic study. The quality of the data, the design of the surveys, the impact on the overall demographic study and the costs involved will be evaluated in deciding whether to resume the wilderness surveys.

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 2001:

The number of sites surveyed in 2001 has continued to increase since 1993. Much of this increase occurred between 1997 and 1998 when we began to monitor sites in the Fall Creek LSR. Three sites were added or created this year as spotted owls were located in new areas. In two

Table 7. Wilderness boundary sites surveyed concurrently with the demographic study in the central Cascades study area, Willamette National Forest, Oregon from 1997 through 2001.

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

cases, nesting pairs were located in intervening areas (Quaking Aspen and Upper Platt Creek) and we propose creating new managed points based on those nest locations. In the third case (Upper East Fork), banded male and female owls from two different sites were identified late in the season near a previously unoccupied site center. Upper East Fork was considered synonymous with the French Mountain site because the female simply moved to French Mountain and the male moved to neighboring Lowder Mountain when their nest stand was logged in 1996. We will consider Upper East Fork and French Mountain separately in the future although the night calling points coincide completely.

Simple occupancy has remained near 80% since 1995 and pair occupancy has stabilized at approximately 60% since 1998 despite an apparent decline after 1989. However, it is not known to what extent this pattern is confounded by the increased survey effort since the initiation of this study. Occupancy within the land use allocations considered here has varied over time, but long-term trends have not emerged. Pair occupancy among the LSR sites remains lower than in the AMA and matrix sites. This is due primarily to very low pair occupancy rates in the Hagan and Menagerie LSRs. The Fall Creek and Horse Creek LSRs show 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. We expect that additional pairs may be discovered in the Fall Creek LSR as we continue to survey existing sites and intervening areas.

More nest surveys were completed prior to the 31 May deadline in 2001 than in any previous year. This was largely due to a low snow pack from the previous winter that allowed us to access several sites earlier than in years with an average or greater snow pack. The percentage of owls nesting during the 2001 breeding season superficially appears to continue the biannual cyclical pattern previously

reported. However, it is important to note that the percentage of pairs nesting is calculated from a subset of pairs that were fed at least four mice on two occasions before 31 May. Despite earlier initial access, 23 additional pairs were discovered to be nesting after the protocol cutoff date for nest surveys but within protocol standards for reproductive surveys. Although 20 of these pairs simply were not located until after 31 May, three pairs had been given mice at least once prior to that date. In all three cases, all of the mice were either eaten or cached indicating that the owl was not nesting (although only the males were located). This underscores the importance of conducting additional visits in mid- to late-June to pairs initially classified as non-nesting based on pre-June visits. In particular, the behavior of a male owl with a prey item may not be a reliable indicator of non-nesting status. The biannual cycle is not apparent in the calculations of reproductive success and fecundity when the additional 23 pairs are included.

The reproductive status of more pairs was confirmed according to protocol in 2001 than in any previous year. The average number of young per pair over all pairs and fecundity were the third highest since the initiation of this study. Higher reproductive rates have been recorded only in 1992 and 1996. The high reproductive rate observed this year comes immediately following another high year (which had previously been the third highest reproductive rate). The large pulse of fledglings produced over the past two years 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 the data for the LSRs was 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; 24 of the 37 fledglings (65%) produced in the LSRs were produced in Fall Creek. In past years, the proportion of fledglings produced in Fall Creek has been even larger (1998: 67%, 1999: 80%). The other three LSRs are considerably smaller and a larger proportion of the habitat is of low quality than in Fall Creek. Habitat assessments are currently underway within the LSRs to quantify these differences in habitat quality.

8. Problems encountered:

An exceptionally low snow pack for the second year in a row allowed us to get to more sites prior to 31 May to determine nesting status than before 2000. Late season snow storms decreased this advantage somewhat and road conditions above roughly 1,000 - 1,500 m still precluded access to some sites prior to June, however. These areas are unlikely to be accessible during all but the driest years.

Histories for many of the Fall Creek sites still are not as extensive as the histories for most of our other sites. The activity centers for many Fall Creek sites are based on scattered locations of individual, non-banded owls rather than the locations of nest trees or banded pairs. For both of these reasons, determining social, nesting, and reproductive status for the new sites can be considerably more labor-intensive than for more familiar sites. Since initiating surveys in Fall Creek, we have made substantial

progress in locating pairs and nest sites and have banded 27 new paired adult males and 21 new paired adult females. We anticipate further improvements in locating non-banded adults and establishing sites centers based on nesting pairs in Fall Creek.

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 Menagerie 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 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. We expect that these difficulties will be minimized as survey efficiency is improved with additional site history information.

9. Acknowledgments:

Several people from the Willamette National Forest contributed both information and equipment that made this study possible. Ruby Seitz (Blue River Ranger District), Lisa Lyon (McKenzie 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 2002:

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. Continue collecting habitat assessment data within the LSRs to evaluate the potential of these areas to provide the habitat base for spotted owl recovery.

e. Initiate a simulation modeling study of spotted owl demographic performance within the Central Cascades AMA under scenarios based on the Northwest Forest Plan versus timber harvest based on historical fire regimes (Cissel et al. 1999).

f. Complete an analysis of spotted owl fledging dates for the Cascades and Coast Range Mountains.

g. Continue the analysis of spotted owl diet composition and update the pellet database to be compatible with other studies.

h. Consider alternative designs for the analysis of the Wilderness survey data.

11. <u>Publications and technology transfer completed in FY 2001</u>:

Publications.

Presentations.

a. S. Ackers, L. Andrews, R. Anthony, R. Claremont, E. Forsman, G. Fox, T. Fox, D. Giessler, E. Glenn, P. Loschl, G. Olson, W. Ripple, J. Thrailkill, and S. Turner-Hane presented a poster at the annual H. J. Andrews Symposium entitled "Spotted Owl Demography at the H. J. Andrews Study Area" (May, 2001).

b. S. Ackers conducted a field trip to active owl sites for the Oregon State University Fish and Wildlife Club (May, 2001).

c. T. Fox conducted a field trip to an old-growth forest stand for a group of 5th grade students from the McKenzie Outdoor School (May and Sept., 2001).

d. S. Ackers conducted a field trip to active owl sites for a group of undergraduates from the University of Tennessee, Martin (May, 2001)

e. S. Ackers gave a presentation about spotted owl ecology and management to a group of teachers in the Science and Math Investigative Learning Experiences program (May, 2001)

f. T. Fox gave a presentation about old growth forests and spotted owl ecology as part of the Nature Talks! public education program sponsored by the Cascade Center for Ecosystem Management (July, 2001).

g. T. Fox discussed spotted owl ecology and management for the Teachers in the Woods program (July, 2001).

h. T. Fox discussed old growth and spotted owl ecology to the Outdoor School Program at the U. S. Basketball Academy (August, 2001).

i. T. Fox discussed spotted owl ecology for a group of 5th grade students participating in the Salmonwatch program at the Trailbridge spawning channel (September, 2001).

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 provided data from two spotted owl sites to the U. S. Army Corps of Engineers to assist in their compliance with regulations surrounding construction at Cougar Dam.

c. S. Ackers attended monthly meetings of the Long-Term Ecological Research group (Corvallis).

d. S. Ackers provided demographic data to the predictive modeling group.

12. 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.

13. 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.

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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 2001.

		1998		1999		2000		2001	
LSR	MSNO [a]	Occupancy status [b]	Reprod. status [c]	Occupancy status	Reprod. status	Occupancy status	Reprod. status	Occupancy status	Reprod. status
Fall Creek	0124	SD	-	P	2	PU	?	P	N
	1012	Unoccupied		A	?	SU	-	A	2
	1013	NR	-	P	?	P	0	P	F
	1015 [d, f]	P	?	PU	?	Hybrid pair (STVA x STXX)		Hybrid pair (STOC x STXX)	
	1016	P	?	P	2	P	0	P	2
	1017	SU	-	SU	-	A	?	Unoccupied	
	1018	PU	?	PU	?	P	2	SU	-
	1019	P	?	P	N	P	2	P	1
	1020	P	?	RM	-	PU	?	P	2
	1021	P	?	PU	?	A	2	P	2
	1022	SU	-	P	N	PU	?	PU	?
	1028	SD	-	NR	-	not surveyed in 2000		SU	-
	1029	RM	-	RM	-	P	0	P	N
	1031	SD	-	A	?	A	0	P	1

		1998		1999		2000		2001	
LSR	MSNO [a]	Occupancy status [b]	Reprod. status [c]	Occupancy status	Reprod. status	Occupancy status	Reprod. status	Occupancy status	Reprod. status
	1043	SD	-	Unoccupied		Unoccupied		SU	-
Fall Creek	1101	SD	-	SD	?	SU	-	Unoccupied	
	1102	not surveyed in 1998		SU	-	P	?	SU	-
	1414	P	?	P	N	P	2	P	N
	2807	P	?	SU	-	P	2	P	2
	2808	not surveyed in 1998		SU	-	P	1	RM	-
	2817	P	?	SD	-	P	1	P	1
	2858/2899 [e]	SD	-	Unoccupied		Unoccupied		SU	-
	2861	SD	-	P	0	PU	?	Unoccupied	
	2863	Unoccupied		P	N	P	2	P	2
	2864	Unoccupied		Unoccupied		Unoccupied		Unoccupied	
	2865	P	?	RM	-	SU	-	Unoccupied	
	2888	not surveyed in 1998		SD	-	SU	-	P	2
	2889	P	?	P	N	SU	-	PU	N
	2891	NR	-	P	2	RF	N	P	2
	2895	P	?	P	N	P	1	P	1

		1998		1999		2000		2001	
LSR	MSNO [a]	Occupancy status [b]	Reprod. status [c]	Occupancy status	Reprod. status	Occupancy status	Reprod. status	Occupancy status	Reprod. status
	2897	Unoccupied		SD	-	Unoccupied		SU	-
	2900	P	?	P	2	P	F	P	2
	2949	Unoccupied		Unoccupied		Unoccupied		SU	-
Fall Creek	3550	SD	-	Unoccupied		A	0	P	1
	4082	SD	-	P	?	SU	-	RM	-
	4084	SU	-	PU	?	Unoccupied		Combined with 1031	
	4105	not surveyed in 1998		SD	-	Unoccupied		Unoccupied	
	4392	SD	-	P	0	P	2	P	0
	4420	NR	-	SU	-	SU	-	RM	-
	4421	SU	-	P	N	P	1	P	N
	4476	not surveyed in 1998		SU	-	P	2	P	0
	4549	not surveyed in 1998		not surveyed in 1999		P	F	Hybrid pair	2
	9600 [f]	not surveyed in 1998		Hybrid pair	1	Hybrid pair	?	Hybrid pair	?
	9601 [g]	not surveyed in 1998		not surveyed in 1999		not surveyed in 2000		P	2

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

		1997		1998		1999		2000		2001	
LSR	MSNO	Occ. status	Reprod. status	Occ. status	Reprod. status	Occ. status	Reprod. status	Occ. status	Reprod. status	Occ. status	Reprod. status
	2446	Unoccupied		P	?	P	2	P	1	P	2
	2828	SU	-	Unoccupied		Unoccupied		PU	?	Unoccupied	
Horse Creek	2830	NR	-	SU	-	RM	-	Unoccupied		SU	-
	3023	Unoccupied		SU	-	Unoccupied		SU	-	SU	-
	5043	SU	-	Unoccupied		Unoccupied		Unoccupied		Unoccupied	
	9602 [h]	not surveyed in 1997		not surveyed in 1998		not surveyed in 1999		not surveyed in 2000		P	F
Menagerie	0011	A	?	P	?	P	0	P	1	P	2
	0014	Unoccupied		Unoccupied		Unoccupied		SU	-	SU	-
	0619	SD	-	SD	-	SD	-	SU	-	SU	-
	0641	P	F	RF	-	P	0	SU	-	Unoccupied	
	0646	SU	-	SU	-	NR	-	Unoccupied		Unoccupied	
	2460	P	?	P	?	SU	-	SU	-	Unoccupied	
	2956	NR	-	A	?	RM	-	RF	N	PU	-
	2959	SU	-	NR	-	NR	-	Unoccupied		Unoccupied	
	2962	P	F	P	F	P	N	P	F	P	2

LSR	MSNO	1997		1998		1999		2000		2001	
		Occ. status	Reprod. status	Occ. status	Reprod. status	Occ. status	Reprod. status	Occ. status	Reprod. status	Occ. status	Reprod. status
	4098	Unoccupied		Unoccupied		not surveyed in 1999		Unoccupied		SU	-
	4196	P	?	P	?	P	0	RM	-	PU	-
	4405	RF	-	RF	-	SU	-	SU	-	P	0
	4488	RM	-	RM	-	PU	?	SU	-	Unoccupied	
	5052	NR	-	SU	-	SU	-	Unoccupied		Unoccupied	
	5053	NR	-	Unoccupied		not surveyed in 1999		Unoccupied		not surveyed in 2001	
	5058	SU	-	Unoccupied		NR	-	SU	-	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; UN = site unoccupied (at least three night or day 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.

[e] The Logan and L. Logan sites were surveyed as a single site in 2000.

[f] The U. S. Forest Service tracks the hybrid pair at MSNO 1015 independently as MSNO 9600.

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 2001.

LSR	Year	Sites surveyed to protocol	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)
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)
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)
Menagerie	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)

[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 2001.

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
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
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
Menagerie	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

[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.