

**Pacific Northwest Research Station
Ecosystem Processes and Function Program
Wildlife Ecology Team
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Study:

Demographic characteristics of northern spotted owls (*Strix occidentalis caurina*) on the Olympic Peninsula Study Area, Washington, 1987–2010.

Principal Investigator(s) and Organization(s):

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Study Objectives:

- The objectives of this study are to elucidate the population ecology of the northern spotted owl (*Strix occidentalis caurina*) on Forest Service lands on the Olympic Peninsula, Washington, to include estimates of population age structure, reproductive rates, survival rates, and population trends.
- Document changes in barred owl (*Strix varia*) numbers within the study area.

Potential Benefit or Utility of the Study:

This study is one of eight long-term demographic studies that constitute the federal monitoring program for the northern spotted owl under the Effectiveness Monitoring Program of the Northwest Forest Plan (Lint et al. 1999). The Olympic Peninsula Demographic Study was designed to monitor vital rates and population trends of spotted owls on the peninsula. Data collected by the Pacific Northwest Research Station (PNW) on Olympic National Forest is combined with data collected by the National Park Service to assess the status of the owl population in this province. During a regional meta-analysis, these data are used to make inferences regarding detection probabilities, survival rates, habitat suitability and the effects of different landscape conditions on the rates of population changes in spotted owl populations (Forsman et al. 1996, Franklin et al 1999, Anthony et al. 2006, Forsman et al. *in press*). The most recent published range-wide meta-analysis was in the Wildlife Monograph, “Status and Trends in Demography of northern spotted owls, 1985-2003” (Anthony et al. 2006). A reassessment of the demographic data for this species using an additional five years of data was completed in 2009 and a Avian Species Monograph is scheduled for release in 2011 (Forsman et al. *in press*).

Study Area and Methods

The study area is located on the Olympic Peninsula, principally on public forests administered by the Olympic National Forest and the Olympic National Park (Figure. 1). Information in this report focuses on results of surveys and monitoring conducted by PNW on the national forest (A separate report available from the Olympic National Park describes the spotted owl monitoring in Olympic National Park (Gremel 2010).

The Olympic Peninsula Study Area included 2228 km² of owl habitat of which approximately 948 km² are principally on public lands administered by the Olympic National Forest. Prior to the establishment of the Northwest Forest Plan in 1994, the national forest within the study area was managed with a primary emphasis on timber production. Subsequent to the adoption of the Northwest Forest Plan, most of the area within the national forest was designated as a Late-Successional Reserve in which the primary objective is to manage for old forest conditions.

Historic owl territories (hereafter “sites”) within the study areas are surveyed each year using standardized protocols (Franklin et al. 1996). Monitored sites are surveyed a minimum of 3 times each year to determine if the site is occupied by spotted owls and to determine nesting status and numbers of young produced by each pair of owls. All owls detected within the study area are color-banded with unique bands so that they can be resighted and identified each year without recapture.

Methods used in this study have been described in a variety of published sources (e.g., Forsman 1983, Franklin et al. 1990, Franklin 1992, Franklin et al. 1999, Reid et al. 1999). Protocols used for determination of reproductive parameters were described in Lint et al. (1999). Sightings and recaptures of previously banded owls are used to estimate survival rates (Pollock et al. 1990, Burnham et al. 1996).

Changes in sampling effort: In 2006, the Effectiveness Monitoring Program reduced funding for the PNW portion of the Olympic Study resulting in a reduction in the long-term monitoring effort in this province. We selected 45 continuously-monitored spotted owl sites from the approximately 95 historic owl territories previously monitored by PNW. The reduced set of sites were selected from the northern half of our original study area and sites selected were those that had the longest continuous survey histories in this portion of the study area whether they were currently occupied or not. As a result of this decision and other changes in the number of sites monitored over time, counts of individuals detected and banded on an annual basis are not easily interpreted. Trends in proportion of sites occupied by spotted owls and proportion of sites where barred owls are detected are a better way of evaluating this type of information. We provide graphical representations of both interpretations of the data. Results provided in this report, including most tables, reflect the reduction in the number of long-term monitoring sites and display information for only those sites that were monitored for the 2006 field season onward.

2010 Research Accomplishments

Number of Areas Where Owls Were Located

During the 2010 field season, we conducted 243 site visits to 45 owl territories (mean = 4.8 visits per site, range 3–9). We confirmed the bands of 12 non-juvenile spotted owls (6 male and 6 females) (Table 1) and detected another 4 owls at 3 additional territories. This compares to a high of 69 owls on 41 territories in the same area in 1992. Of the 45 sites we monitored, 35 (78%) had no responses from spotted owls, 6 (13%) were occupied by pairs, 3 (7%) were occupied by resident single birds and 1 “floater” was detected (Table 2, Figure 2). The pattern of territory occupancy on the study area indicates a gradual decline in the number of occupied sites from 1998–2010 (Figure 2, Table 2). The decline seems most severe in low elevation areas of the peninsula. However, the failure to detect spotted owls at sites in one year does not guarantee the sites have been abandoned. Olympic Peninsula spotted owls traditionally become non-responsive and tend to wander off their territories in non-breeding years. Surveys in subsequent years are required to confirm if a site is truly unoccupied.

Number of Owls Marked

We confirmed the identity of 11 spotted owls in 2010 based on their color bands and banded 1 new territorial 2-year-old subadult male. The newly captured bird brings the total number of spotted owls banded between 1987–2010 on PNW’s banding permits to 922 birds, including 361 individuals first banded as adults (birds > 2 years old), 81 birds banded as sub-adults, and 480 banded as juveniles (Figure 3, Table 4). In addition, 4 adult barred owls have been banded during the study.

All owl captures and banding of spotted owls were conducted under Dr. Eric Forsman’s master banding permit #21249; U.S. Fish and Wildlife Service 10(a)(1)(a) “Recovery Permit TE-026280-11, Washington State Scientific Collection Permit # 10-139 and with animal handling protocols approved by Oregon State University’s Institutional Animal Care and Use Committee (IACUC) [IACUC number 3628].

Reproduction

We determined the nesting status of 5 of 8 female spotted owls at monitored sites by the June 15th cutoff and 4 attempted to nest. The proportion nesting is calculated for females whose nesting status has been determined by 15 June. This means that the 2010 estimate of the proportion of the population that nested was 0.80 (Figure 4, Tables 4) However the 2010 nesting season was colder and rainier than most and all 4 pairs that attempted to nest failed to fledge any young. Spotted owl productivity (fecundity) is calculated as the number of female young produced per territorial female, assuming a 50:50 sex ratio of nestlings. Given that no young fledged this year fecundity for 2010 was 0.00 (Table 5). Spotted owl fecundity on the Olympic Study Area has been highly variable and this was the eighth year since 1987 the fecundity was zero on the study area and the first time that the study has had consecutive years with no young being produced. Since 2002, owls in the study area had fallen into a pattern of alternating years of reproduction and no reproduction (Figure 4-5) but 2010 has broken that trend. The high among-year variation in reproductive rates that we observed is typical of Spotted Owls (Forsman et al. 1984, Franklin et al. 1999). However, in contrast to some

other study areas, high and low reproductive years on the Olympic Study Area did not consistently follow an alternate year pattern until 2002. Prior to 2002 the pattern was less cyclic and the low reproductive years occurred at longer intervals (Figure 5, Table 6). However, there were consecutive years with low reproduction in 1999-2000 (Tables 4-5) but the Olympic Study Area differed from most other study areas in having occasional years when no females nested (1993, 1995, 1999, 2003, 2007, 2009). Even in the worst years, most other study areas had at least a few females that nested (Anthony et al. 2006).

This year was also unique in that this was the first year that reproductive patterns differed between Forest and the Olympic National Park. While the sample of owl on the forest did not fledge any young, the Park did have some pairs that fledged young in 2010 (Scott Gremel, ONP, personal communication). This difference is likely just a result of the very low number of pairs remaining on the study area as nesting was attempted.

Barred Owl Detections

We did not specifically survey for barred owls during the spotted owl demographic surveys on the study area, but we recorded and mapped all barred owls detected during spotted owl surveys. During 2010, we recorded 92 barred owl detections at 24 spotted owl sites (Figures 6). The number of sites with barred owl detections in 2010 was slightly higher than the 23-year mean ($\bar{x} = 21.7$, $SE=3.42$). The 92 total barred owl detections this year is the highest number of barred owls detected in a single year (Figure 7), however, the results are not directly comparable with previous years because survey effort at spotted owl sites vary between years. However, the trend from 2006-2010 suggests that barred owl numbers in the northern sites are catching up with the numbers of barred owl detections we had in the Quinault area early in the study.

Discussion

The analysis conducted by Anthony et al. (2006) estimated Λ_{RJS} for the spotted owl population on the Olympic Peninsula at 0.956 (se 0.032). This estimate suggested a population decline of 4.4% per year on the Olympic Peninsula and is in close agreement with the count data, which suggests that approximately 63% of the historical owl territories in the study area became unoccupied between 1990 and 2005. In the subset of sites sampled in the northern half of the original study area on the Olympic National Forest during 2006-09, the count data suggests that 65–82% of the historical owl territories were unoccupied.

Fecundity rates on the study area continue to be extremely variable. The fecundity rate in 2008 was the second highest in the 21 year history of the study. Although the number of occupied sites continues to decline, the fecundity rate in nesting years continues to be good. And the 2008 fecundity rates for adult females on our study were also comparable (0.63 ± 0.16 , $N=8$ vs. 0.67 ± 0.08 , $N=15$) to those on the adjacent Olympic National Park study area (Gremel 2009). This high year-to-year variation in fecundity has mostly been a function of the proportion of the population attempting to nest rather than nest failure rates over the duration of the study. We suspect that the extreme annual fluctuation in reproduction on the Peninsula is the result of fluctuations in prey biomass or weather, or both, but there are no long-term data on prey populations on the Peninsula, so a test of the prey hypothesis is not possible.

Problems Encountered

Access issues continue to make it a challenge to complete the annual surveys within the protocol's timeline using two biologists. Road closures, reduced road maintenance, winter blow-down, and loss of bridges on the trail systems continue to reduce access to many sites. We now access many areas on foot that used to be accessible by road.

No owls were injured during capture and banding, and communication and coordination with our cooperators at the Olympic National Forest, Olympic National Park, and Washington Department of Natural Resources was excellent.

Publications, Presentations and Technology Transfer Completed in FY 2007-08:

Technology Transfer Activities:

- a. Detailed summaries of survey results and current occupancy and reproductive status determinations provided to the Olympic National Forest's biologists for project planning purposes.
- b. Summaries and digital copies of all survey forms showing current occupancy and reproductive status determinations were provided to the Washington Department of Fish and Wildlife.
- c. We provided Washington State Department of Transportation's biologist current occupancy and reproductive status information on selected owl sites for environmental assessments of transportations projects on the Olympic Peninsula.
- d. Selected demographic data were shared with various other federal, state, and private timber organizations for their management activities.
- e. Contributed spotted owl movement data from the Olympic Peninsula study area for a continuing analysis of spotted owl movements pattern in the Pacific Northwest. M. Johnson and S. Haig, USGS, Corvallis, OR

Duration of the Study:

- a. Initiated in FY 1987.
- b. Contingent upon future funding. This project is part of the long-term northern spotted owl Effectiveness Monitoring Program for the Northwest Forest Plan (Lint et al. 1999) and currently funded through fiscal year 2011.

Acknowledgments

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Table 1. Number of non-juvenile spotted owls detected per year in the Olympic Peninsula Study Area, 1987– 2010. Counts were limited to a subset of owl territories on Forest Service lands that were surveyed most consistently. Age codes indicate adult, subadult, or owls with age unknown.

Year	Number of owl territories	Males			Females			Total number of owls detected
		Adult	Subadult	Unknown	Adult	Subadult	Unknown	
1987	13	10	0	2	9	0	1	22
1988	19	11	2	3	29	0	1	46
1989	27	23	0	1	18	0	2	44
1990	36	23	2	2	28	0	2	57
1991	40	28	2	2	27	1	2	62
1992	41	30	3	2	31	2	0	68
1993	41	29	3	2	29	0	6	69
1994	44	29	0	4	33	1	2	69
1995	44	30	0	3	26	0	1	60
1996	44	29	1	2	29	0	1	62
1997	41	27	0	0	22	1	1	51
1998	44	29	1	2	26	1	1	60
1999	44	9	0	1	11	0	1	22
2000	44	23	0	0	15	0	1	39
2001	45	13	0	2	18	0	0	33
2002	45	17	0	2	14	0	0	33
2003	45	16	0	1	10	0	1	28
2004	45	16	0	0	14	1	1	32
2005	45	15	0	0	14	2	0	31
2006	45	10	0	1	8	0	1	20
2007	45	9	0	2	4	0	4	19
2008	45	12	0	0	10	0	3	25
2009	45	6	0	0	3	1	1	11
2010	45	5	1	2	6	0	2	16

Table 2. Percent of spotted owl territories on the Northern Olympic Peninsula Study Area in which we located pairs, singles, floaters, or no owls, 1987–2010. Summary is based on a subset of the total data, including only the most consistently monitored sites on Forest Service and Washington State DNR lands.

Year	Number of territories monitored	Percent with pairs	Percent with single owls	Percent with floaters ^a	Percent with no detections
1987	13	69	15	15	0
1988	19	68	16	11	5
1989	27	74	11	4	11
1990	36	69	14	6	11
1991	40	65	10	13	12
1992	41	81	5	2	12
1993	41	73	15	0	12
1994	44	68	9	9	14
1995	44	52	27	0	21
1996	44	64	9	5	23
1997	41	52	17	0	29
1998	44	61	7	7	25
1999	44	14	27	5	55
2000	44	36	14	2	48
2001	45	38	11	2	42
2002	45	36	9	7	49
2003	45	22	16	9	53
2004	45	36	0	2	62
2005	45	31	4	2	62
2006	45	20	4	0	76
2007	45	9	18	4	69
2008	45	20	7	7	67
2009	45	7	4	7	82
2010	45	13	7	2	78

^a A “floater” is a single owl that was seen or heard on at least one occasion, but could not be confirmed as a resident on a particular territory.

Table 3. Number of spotted owls banded each year on the Olympic Study Area, 1987– 2010. Non-juveniles are listed by age class (S1= 1 yr old, S2= 2 yrs old). Adult = ≥ 3 yrs old.

Year	Juveniles	Males			Females			Totals
		S1	S2	Adult	S1	S2	Adult	
1987	0	2	1	15	0	0	15	33
1988	13	1	3	11	0	0	13	41
1989	46	1	0	22	0	1	25	95
1990	62	6	3	19	1	7	22	120
1991	31	5	3	17	2	2	15	75
1992	78	1	2	23	0	1	21	126
1993	0	1	1	15	1	1	12	31
1994	32	1	1	8	1	1	11	55
1995	0	3	1	13	0	0	2	19
1996	58	0	2	5	0	3	9	77
1997	25	0	1	2	1	0	6	35
1998	26	1	1	2	2	0	4	36
1999	0	0	0	0	0	0	1	1
2000	1	0	0	6	0	0	5	12
2001	26	1	0	2	1	0	7	37
2002	28	1	0	1	0	0	4	34
2003	0	1	0	5	1	0	1	8
2004	36	0	0	6	1	0	5	48
2005	1	2	0	1	3	3	3	13
2006	6	0	0	0	0	0	0	6
2007	0	0	0	1	0	0	1	2
2008	11	0	0	2	0	0	3	16
2009	0	0	0	0	0	1	0	1
2010	0	0	1	0	0	0	0	0
Totals	480	27	20	176	14	20	185	922

Table 4. Proportion of female spotted owls that nested, fledged young, and nested and fledged young, on the Olympic Peninsula Study Area, Washington, 1987–2010.

Year	Proportion of females that nested ¹			Proportion of females that produced young ²			Proportion of nesting females that produced young ³		
	N	Mean	95% C. I.	N	Mean	95% C. I.	N	Mean	95% C. I.
1987	16	0.19	0.00–0.40	19	0.11	0.00–0.26	3	0.67	0.00–1.00
1988	19	0.26	0.05–0.48	27	0.33	0.14–0.52	5	1.00	–
1989	20	0.40	0.16–0.64	39	0.67	0.51–0.82	8	1.00	–
1990	35	0.71	0.56–0.87	52	0.56	0.42–0.70	24	0.63	0.42–0.83
1991	46	0.41	0.27–0.56	53	0.34	0.21–0.47	19	0.79	0.59–0.99
1992	48	0.90	0.81–0.99	63	0.78	0.67–0.88	43	0.86	0.75–0.97
1993	51	0.00	–	54	0.00	–	0	0.00	–
1994	49	0.84	0.73–0.94	56	0.54	0.40–0.67	41	0.66	0.51–0.81
1995	35	0.00	–	36	0.00	–	0	0.00	–
1996	37	0.89	0.79–1.00	50	0.68	0.55–0.81	33	0.67	0.50–0.84
1997	34	0.50	0.32–0.68	45	0.36	0.21–0.50	17	0.76	0.54–0.99
1998	43	0.56	0.40–0.71	45	0.42	0.27–0.57	24	0.71	0.51–0.90
1999	10	0.00	–	12	0.00	–	0	0.00	–
2000	25	0.12	0.00–0.26	30	0.03	0.00–0.10	3	0.33	0.00–1.00
2001	31	0.55	0.36–0.73	34	0.44	0.27–0.62	17	0.88	0.71–1.05
2002	29	0.76	0.59–0.92	30	0.50	0.31–0.69	22	0.68	0.47–0.89
2003	26	0.00	–	26	0.00	–	18	0.00	–
2004	32	0.78	0.63–0.93	32	0.75	0.68–0.82	25	0.84	0.70–0.98
2005	29	0.03	0.00–0.19	29	0.03	0.00–0.19	29	0.03	0.00–0.19
2006	8	0.88	0.77–1.00	9	0.67	0.54–0.83	8	0.75	0.52–0.98
2007	7	0.00	–	0	0.00	–	0	0.00	–
2008	4	0.50	0.01–0.94	9	0.77	0.31–0.98	4	0.50	0.01–0.94
2009	6	0.00	–	6	0.00	–	0	–	–
2010	5	0.80	–	5	0.00	–	5	0.00	–
Mean		0.42	SE 0.07		0.33	SE 0.06		0.50	SE 0.08

¹ Estimates were calculated for females whose nesting status was determined by 15 June.

² Estimates were calculated for females whose reproductive status was determined by 31 August.

³ Estimates were calculated for females whose nesting status was determined by 15 June and reproductive status by 31 August.

Table 5. Estimated fecundity of female spotted owls on the Olympic Peninsula Study Area: 1987–2010. We defined fecundity as the number of female young produced per female owl, assuming a 50:50 sex ratio of offspring.

Year	Number of territories	Number females			Adults		Subadults		Age unknown		Combined	
		Adult	Subadult	Unknown age	b	SE	b	SE	b	SE	b	SE
1987	19	18	0	1	0.083	0.061	–	–	0.000	–	0.079	0.058
1988	27	25	0	2	0.240	0.077	–	–	0.250	0.250	0.241	0.072
1989	39	39	0	0	0.539	0.070	–	–	–	–	0.539	0.070
1990	52	46	5	1	0.467	0.065	0.100	0.100	0.000	–	0.423	0.060
1991	53	50	3	0	0.310	0.064	0.167	0.167	–	–	0.302	0.061
1992	63	57	6	0	0.658	0.053	0.500	0.183	–	–	0.643	0.051
1993	54	49	0	5	0.000	–	–	–	0.000	–	0.000	–
1994	56	53	1	2	0.415	0.057	0.000	–	0.000	0.000	0.393	0.055
1995	36	36	0	0	0.000	–	–	–	–	–	0.000	–
1996	50	43	3	4	0.558	0.067	0.333	0.167	0.500	0.289	0.540	0.062
1997	45	43	0	2	0.314	0.067	–	–	0.000	0.000	0.300	0.064
1998	45	39	3	3	0.308	0.065	0.500	0.289	0.167	0.167	0.311	0.060
1999	12	11	0	1	0.000	–	–	–	0.000	–	0.000	–

Table 5 (Continued). Estimated fecundity (b) of female spotted owls on the Olympic Peninsula Study Area: 1987–2010. We defined fecundity as the number of female young produced per female owl, assuming a 50:50 sex ratio of offspring.

Year	Number of territories	Number females			Adult		Subadult		Age unknown		Combined	
		Adult	Subadult	Unknown age	b	SE	b	SE	b	SE	b	SE
2000	30	29	0	1	0.017	0.017	–	–	0.000	–	0.017	0.017
2001	34	33	0	1	0.364	0.076	–	–	0.000	–	0.382	0.076
2002	30	28	0	2	0.446	0.087	–	–	0.500	0.500	0.450	0.084
2003	26	22	1	1	0.000	–	0.000	–	0.000	–	0.000	–
2004	32	23	4	5	0.739	0.076	0.375	0.239	0.100	0.100	0.594	0.076
2005	29	22	5	2	0.023	0.023	0.000	–	0.000	–	0.017	0.017
2006	9	8	0	1	0.500	0.163	–	–	0.500	–	0.500	0.144
2007	7	7	0	0	0.000	–	–	–	–	–	0.000	–
2008	11	9	0	1	0.625	0.157	–	–	0.50	–	0.611	0.139
2009	6	5	1	0	0.000	–	0.000	–	–	–	0.000	–
2010	5	5	0	0	0.000	–	–	–	–	–	0.000	–
Mean					0.287	0.053	0.198	0.067	0.148	0.052	0.288	0.050

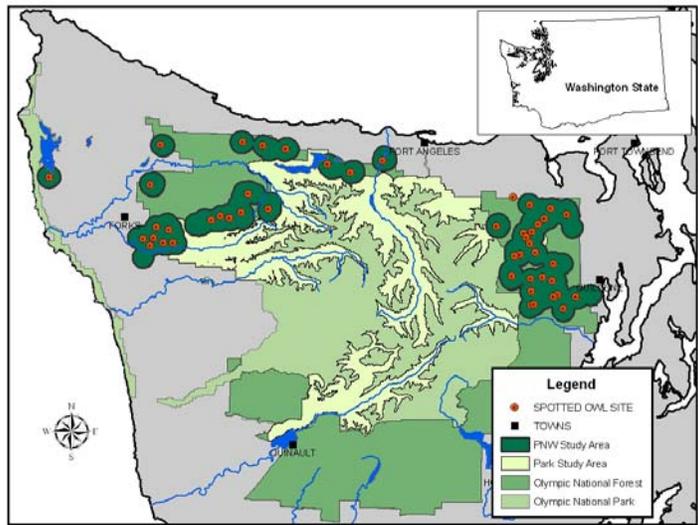


Figure 1. Distribution of spotted owl sites monitored by PNW on the Olympic Spotted Owl Demographic Study Area, 2010.

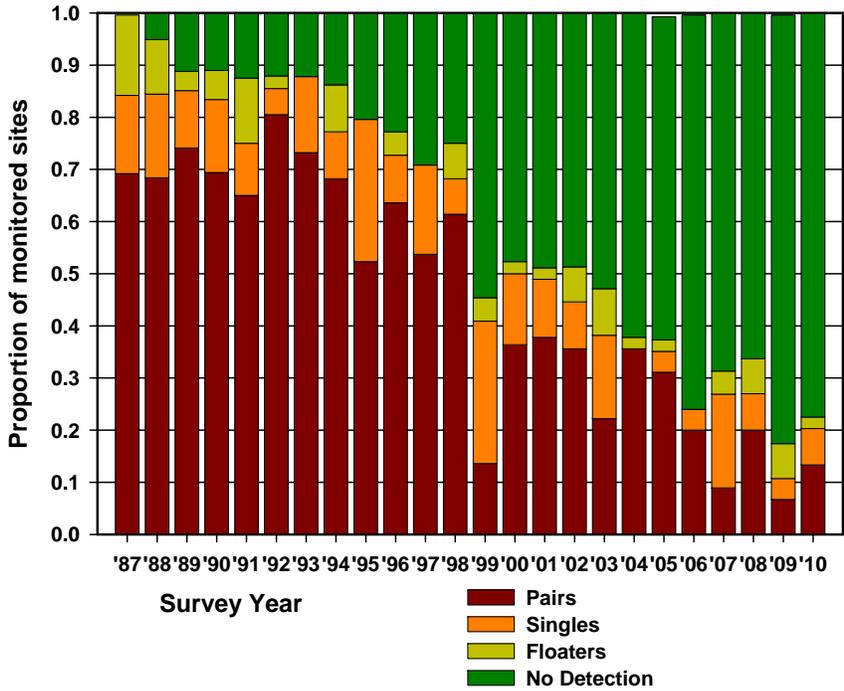


Figure 2. Proportion of monitored owl sites on the Northern Olympic Peninsula Study Area in which we detected pairs, resident singles, floaters, or no spotted owls, 1987–2010

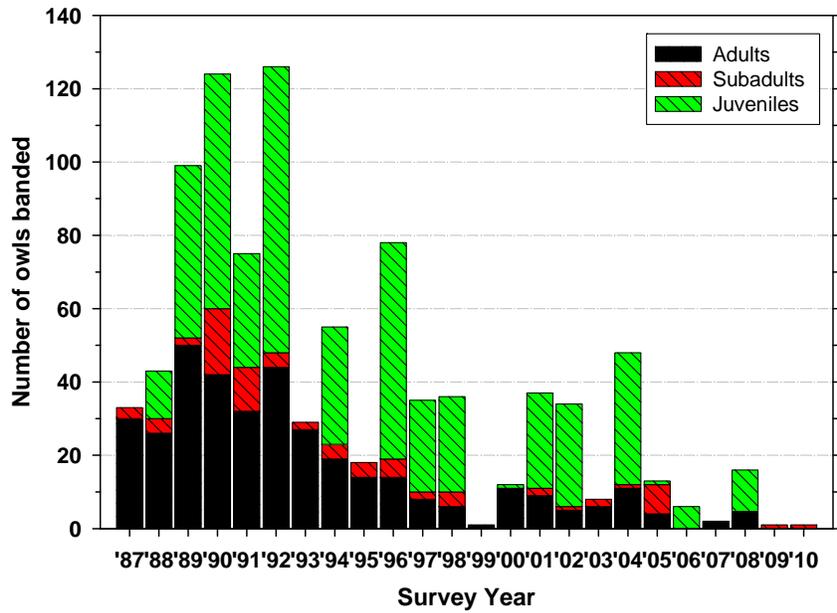


Figure 3. Number of adult, subadult, and juvenile spotted owls banded on the PNW's Olympic Peninsula Study Area, 1987–2010.

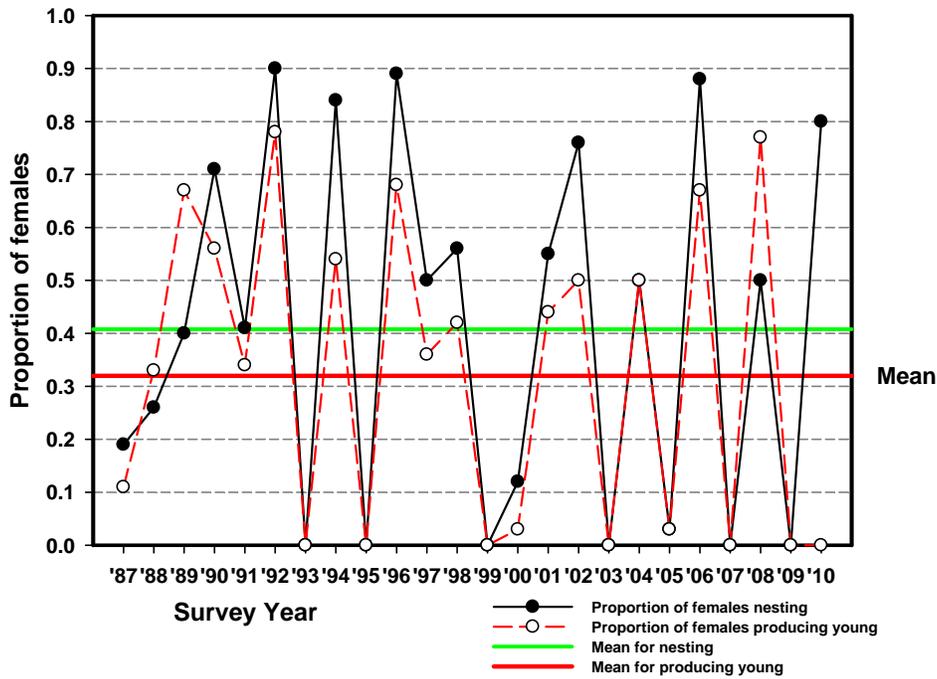


Figure 4. Proportion of female spotted owls nesting and proportion producing young on the National Forest portion of the Olympic Peninsula Study Area, 1987–2010.

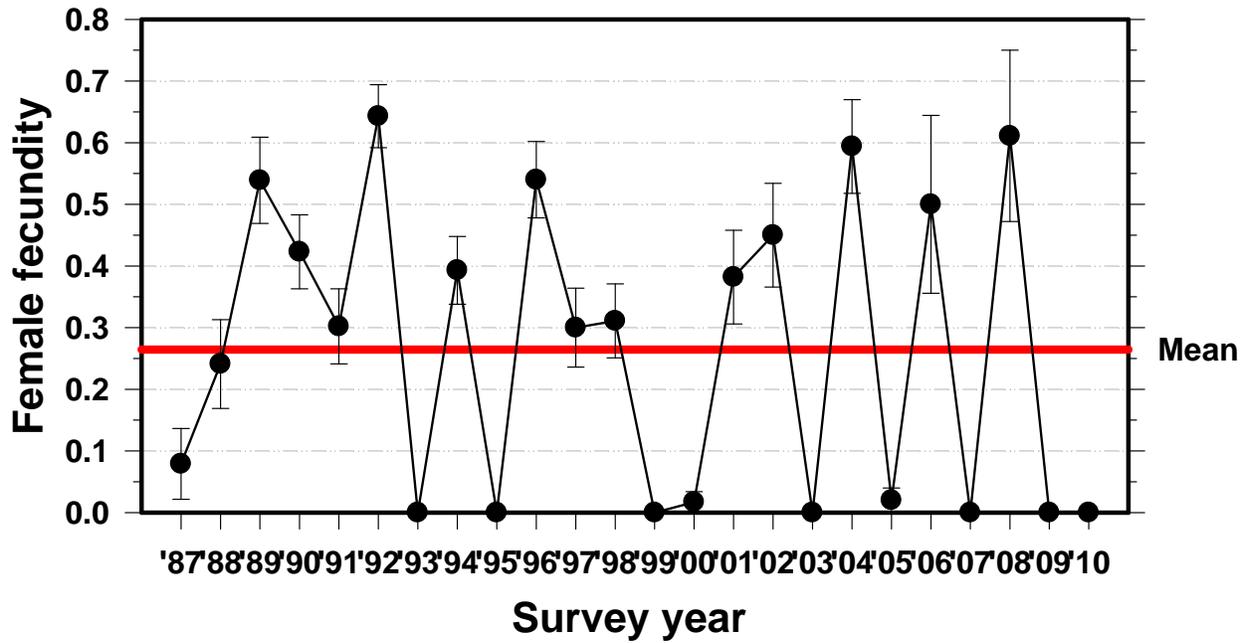


Figure 5. Estimated annual fecundity of female spotted owls on the Olympic National Forest portion of the Olympic Peninsula Demographic Study Area, 1987– 2010. Estimates were based on all age-classes combined.

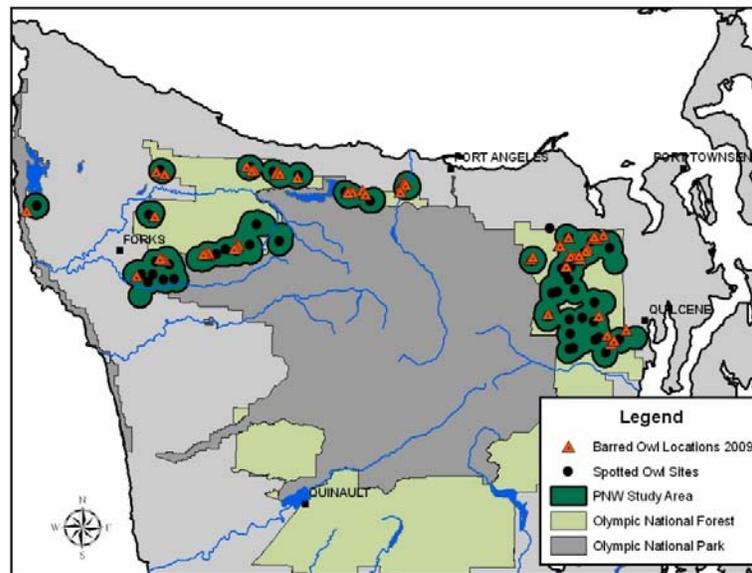


Figure 6. Locations of barred owl detections on the Olympic National Forest portion of the Olympic Peninsula Demographic Study Area during the 2010 field season. Black circles indicate long-term spotted owl site centers surveyed in 2010.

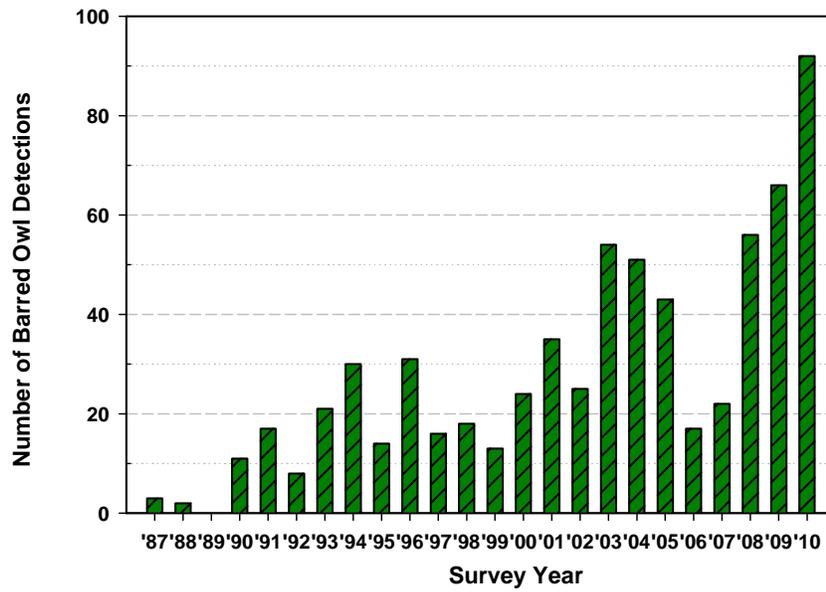


Figure 7. Total number of barred owl detections on the PNW portion of the Olympic Peninsula Study Area, 1987–2010. Detections in 2006–2010 are only for the reduced number of long-term monitoring sites sampled in these years.