

**Pacific Northwest Research Station
Ecosystem Processes and Function Program
Wildlife Ecology Team
Annual Report 1987 - 2012**

January 2013

Study:

Demographic characteristics of northern spotted owls (*Strix occidentalis caurina*) on the Olympic Peninsula Study Area, Washington 1987–2012

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

The Olympic Peninsula Demographic 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 for the Northwest Forest Plan (Lint et al. 1999). The Olympic 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 are 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. 2011). The most recent published range-wide meta-analysis was a monograph in *Studies in Avian Biology* No 40, “Population Demography of Northern Spotted Owls” (Forsman et al. 2011).

Study Area and Methods

The 2230 km² 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 Olympic National Forest. A separate report on surveys conducted in Olympic National Park (Gremel 2012) is available from the National Park Service.

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. Historical spotted owl territories (hereafter “sites”) within the study

area are surveyed each year using standardized protocols to monitor occupancy and productivity (Franklin et al. 1996, Lint et al. 1999). Monitored sites are surveyed a minimum of 3 times each year to determine if sites are 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. The sightings and recaptures of previously banded owls are used to estimate survival rates (Pollock et al. 1990, Burnham et al. 1996, Forsman et al. 2011).

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, Lint et al. 1999). Protocols used for determination of reproductive parameters were described in Lint et al. (1999). All spotted owl surveys and captures were conducted under U.S. Fish and Wildlife Service 10(a)(1)(a) "Recovery Permit TE-026280-11, and Washington State Scientific Collection Permit # 12-200; banding under Dr. Eric Forsman's Master Banding Permit No. 21249; and with animal handling protocols approved by Oregon State University's Institutional Animal Care and Use Committee (IACUC) [IACUC number 3628].

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. The sites were selected whether they were currently occupied or not. Because of this decision and other changes in the number of sites monitored over time, counts of number 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. 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 continued to be monitored from the 2006 field season onward.

2012 Research Accomplishments

Site Occupancy and detection probabilities

During the 2012 field season, we conducted 263 site visits to 47 owl territories (mean = 5 visits per site, range 3–11). Of the 47 sites monitored, 37 (79%) had no responses from spotted owls, 6 (13%) were occupied by pairs, 2 (4%) were occupied by resident single birds and 2 "floaters" were detected (Table 2, Figure 2). The two floater detections were likely the same bird detected at two adjacent sites in the Tunnel Creek drainage. The pattern of territory occupancy on the study area indicates a gradual decline in the number of occupied sites from 1998–2012 (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 that sites have been abandoned. Spotted owls tend to be less responsive in non-nesting years, so it is possible that at least some individuals may have been present but went undetected. Surveys in subsequent years are required to confirm if a site is truly unoccupied.

To assess detection probabilities and occupancy rates of spotted owls, we developed a series of single-season multi-state occupancy models in Program Presence 5.5 (MacKenzie et.al 2005) using 7 site visits to assess the occupancy rate and detection probability of spotted owls on the study area in 2012. The model with the lowest AIC value was a 2-group constant probability model which was 8.7 AIC units higher than the nearest competing model. This 2-group model suggested that spotted owl detection probabilities were high (0.860 ± 0.066) at sites where spotted owls were resident and relatively low (0.096 ± 0.64) at sites that were not occupied or occupied by “floaters”.

Taking into account the detection probabilities, this 2-group multistate model estimated the proportion of sites occupied (Psi) to be 0.45 ± 0.24 which is higher than the naïve estimate (0.19) based on simple counts (Figure 2).

Number of Owls Marked

In 2012 we confirmed the bands of 10 non-juvenile spotted owls (4 males, 6 females), and detected an additional 5 spotted owls but did not confirm their color bands (Table 1). This compares to a high of 69 owls on 41 territories in the same area in 1992. We banded 1 new adult female and one nestling just outside our normal survey area in 2012. The newly captured birds bring the total number of spotted owls banded between 1987–2012 on our banding permit to 925 birds, including 363 individuals first banded as adults (birds > 2 years old), 81 birds banded as sub-adults, and 481 banded as fledglings (Figure 3, Table 4).

Reproduction

Of 6 females whose nesting status was determined in 2012, 5 (83%) nested (Figure 4, Table 4). However, 3 of the 5 nesting attempts failed, and only 2 young were produced. The estimate of fecundity in 2012 (0.17) was below average and the population was just coming off three consecutive years in which no young were produced by the owls that we monitored.

Barred Owl Detections

During 2012, we recorded 68 barred owl detections at 26 of the historical spotted owl territories that we monitored (Figure 6). The number of sites with barred owl detections in 2012 was slightly higher than the 23-year mean (21.7 ± 3.42). But the 66 detections in 2012 was down from the 2010 high for the number of detections in a single year (Figure 7)

Discussion

Forsman et al. (2011:44) estimated Λ_{RJS} for the spotted owl population on the Olympic Peninsula at 0.957 ± 0.020). This suggested a population decline of 4.3% per year, and is in close agreement with our 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 2006-11, the count data indicated that 65–82% of the historical spotted owl territories became unoccupied by spotted owls. The continued growth in the barred owl population and gradual decline in occupancy of historic spotted owl sites suggests that the spotted owls on the Olympic Peninsula are facing extreme competition from barred owls.

Problems Encountered

Access issues continue to make it a challenge to complete the annual surveys. Road closures, reduced road maintenance, and loss of bridges on the trail systems continue to reduce access to many sites. We now access many areas on foot or ATV 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 remain excellent.

Publications, Presentations and Technology Transfer Completed:

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. Locations of spotted owl and barred owl detections were provided to the Washington Department of Fish and Wildlife commercial licensing division as required in the Washington Scientific Collection Permit.
- c. We provided Washington State Department of Transportation's biologist current occupancy and reproductive status information on selected owl sites for environmental assessments of transportation 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. We compiled an updated database on dispersal of spotted owls on the Olympic Peninsula for an analysis of adult and juvenile dispersal that is being conducted by Drs. David Wiens and Jeff Hollenbeck at the USFS FRESC unit in Corvallis, OR

Duration of the Study:

- a. Initiated in FY 1987.
- b. Contingent upon future funding. This project is part of the northern spotted owl element of the Effectiveness Monitoring Program for the Northwest Forest Plan (Lint et al. 1999) and is currently funded through fiscal year 2013.

Acknowledgments

This study was funded by the USDI Bureau of Land Management, USDA Forest Service Region 6, and the USDA Forest Service Pacific Northwest Research Station. We work closely with our cooperators at the Olympic National Park, Olympic National Forest, to ensure coverage of owl territories, many of which overlap boundaries between landowners.

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Table 1. Number of non-juvenile spotted owls detected per year in the Olympic Peninsula Study Area, 1987–2012. 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 sites	Males			Females			Total number of owls detected
		Adult	Subadult	Unknown age	Adult	Subadult	Unknown age	
		1987	13	10	0	2	9	
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
2011	47	6	0	1	5	0	0	12
2012	47	4	0	4	6	0	1	15

Table 2. Percent of spotted owl territories on the Northern Olympic Peninsula Study Area in which we located pairs, singles, floaters, or no owls, 1987–2012. 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
2011	45	4	9	7	80
2012	47	13	4	2	81

^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 on the PNW Olympic Study Area, 1987– 2012. Non-fledglings are listed by age class (S1= 1 yr old, S2= 2 yrs old). Adult = ≥ 3 yrs old.

Year	Males			Females			Totals	
	Fledglings	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	1
2011	0	0	0	1	0	0	0	1
2012	1	0	0	0	0	0	1	2
Totals	481	27	20	177	14	20	186	925

Table 4. Annual reproductive statistics for female spotted owls on PNW's Olympic Peninsula Study Area, Washington, 1987–2012.

Year	Proportion of females that nested ¹			Proportion of females that produced young ²			Proportion of nesting females that produced young ³		
	N	Prop.	95% C. I.	N	Prop.	95% C. I.	N	Prop.	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	–
2011	3	0.00	–	3	0.00	–	31	0.00	–
2012	6	0.83	–	5	0.40	–	5	0.40	–
Mean		0.42	SE 0.07		0.32	SE 0.06		0.47	SE 0.07

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: 1987–2012. Fecundity was defined as the number of female young produced per female owl, assuming a 50:50 sex ratio of offspring. Estimates were calculated for individual females for which reproduction output was documented by 31 August.

Year	Number of territories	Number females			Adults		Subadults		Age unknown		Combined	
		Adult	Subadult	Unknown age	b	SE	b	SE	b	SE	b	SE
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: 1987–2012. 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	–
2011	3	3	0	0	0.000	–	–	–	–	–	0.000	–
2012	6	6	0	0	0.167	0.105	–	–	–	–	0.167	0.105
Mean					0.257	0.054	0.198	0.067	0.148	0.052	0.246	0.050

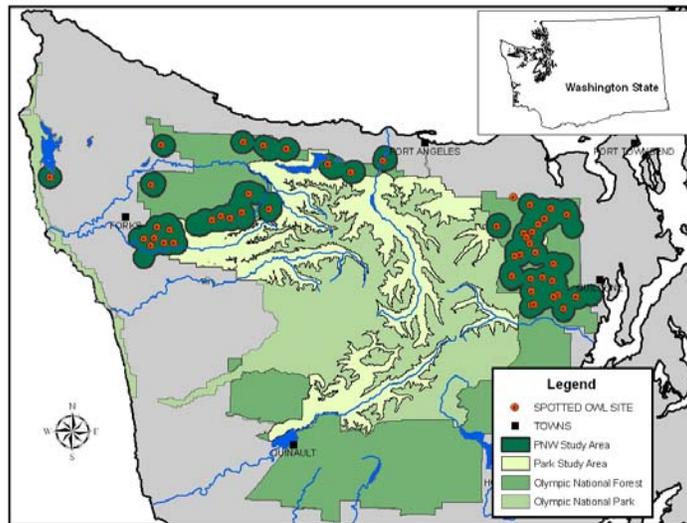


Figure 1. Distribution of spotted owl sites monitored by PNW on the Olympic Spotted Owl Demographic Study Area, 2012.

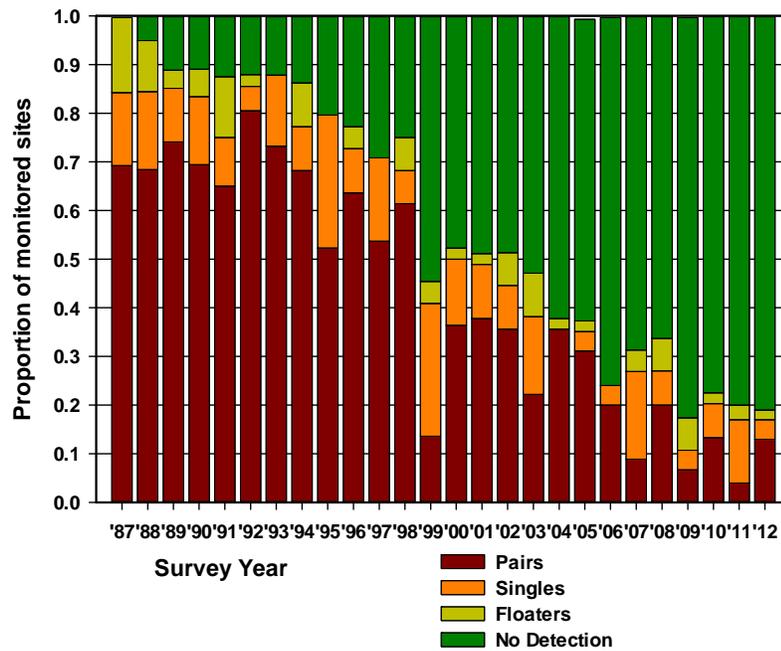


Figure 2. Proportion of monitored owl sites on the Olympic Study Area in which we detected pairs, resident singles, floaters, or no spotted owls, 1987–2012

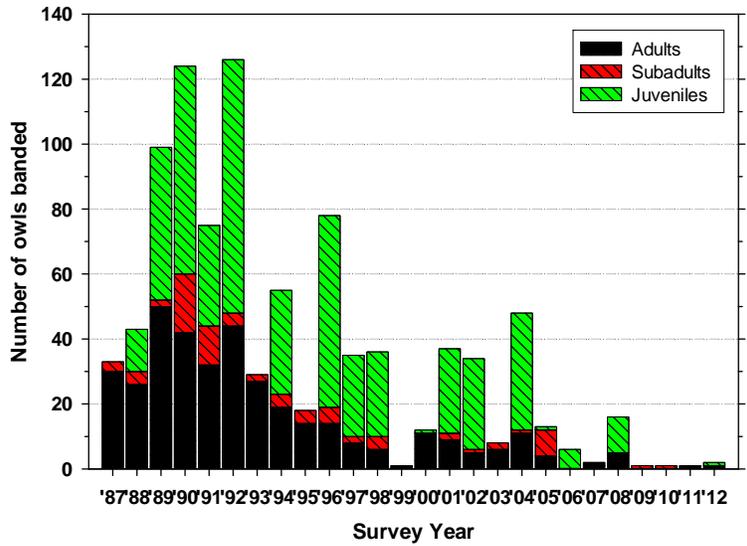


Figure 3. Number of adult, subadult, and juvenile spotted owls banded by PNW on the Olympic Peninsula Study Area, 1987–2012.

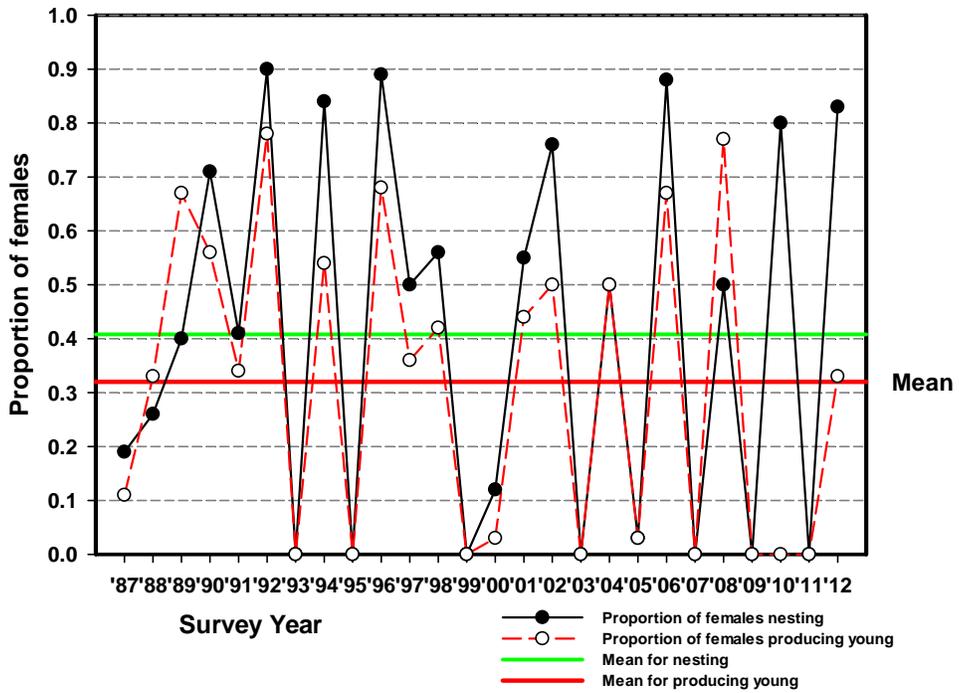


Figure 4. Proportion of female spotted owls nesting and proportion producing young on the National Forest portion of the Olympic Peninsula Study Area, 1987–2012.

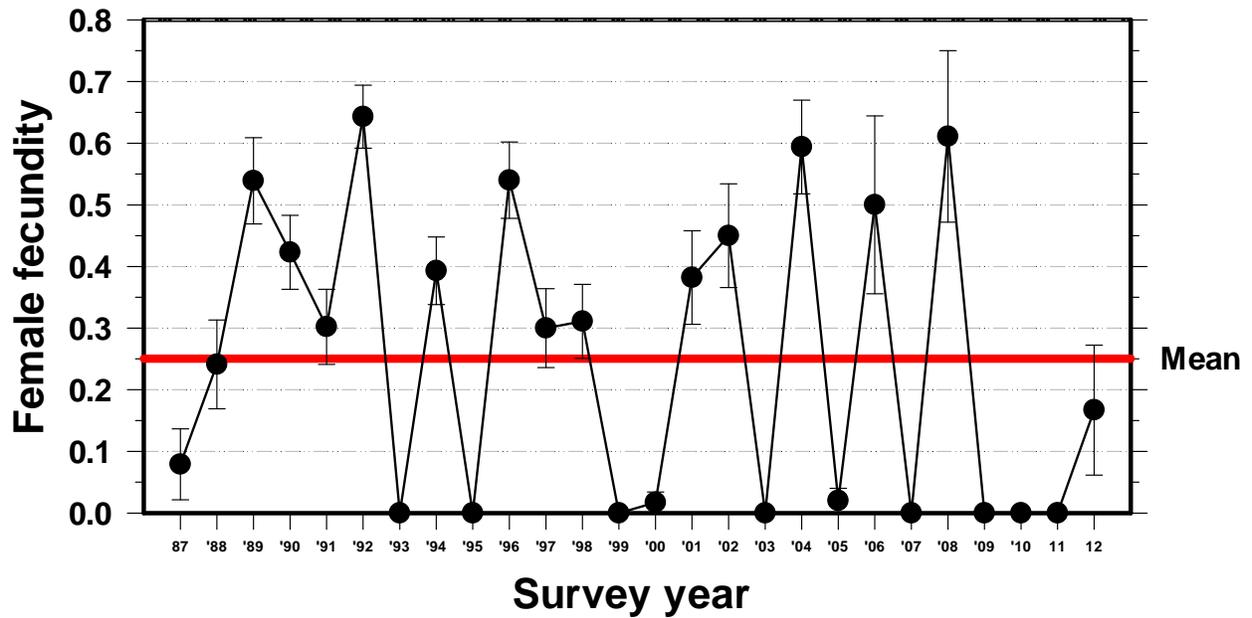


Figure 5. Estimated annual fecundity of female spotted owls on the Olympic National Forest portion of the Olympic Peninsula Demographic Study Area, 1987–2012. Estimates were based on all age-classes combined.

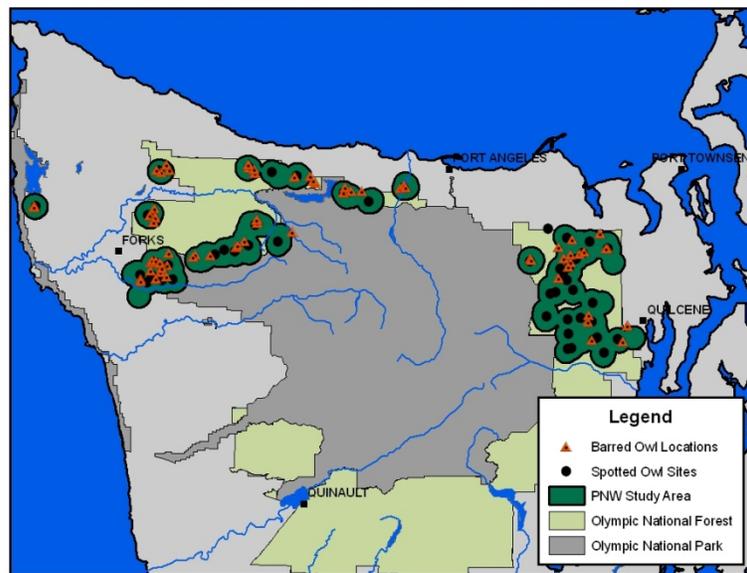


Figure 6. Locations of barred owl detections on the Olympic National Forest portion of the Olympic Peninsula Demographic Study Area during the 2012 field season. Black circles indicate long-term spotted owl site centers surveyed in 2012.

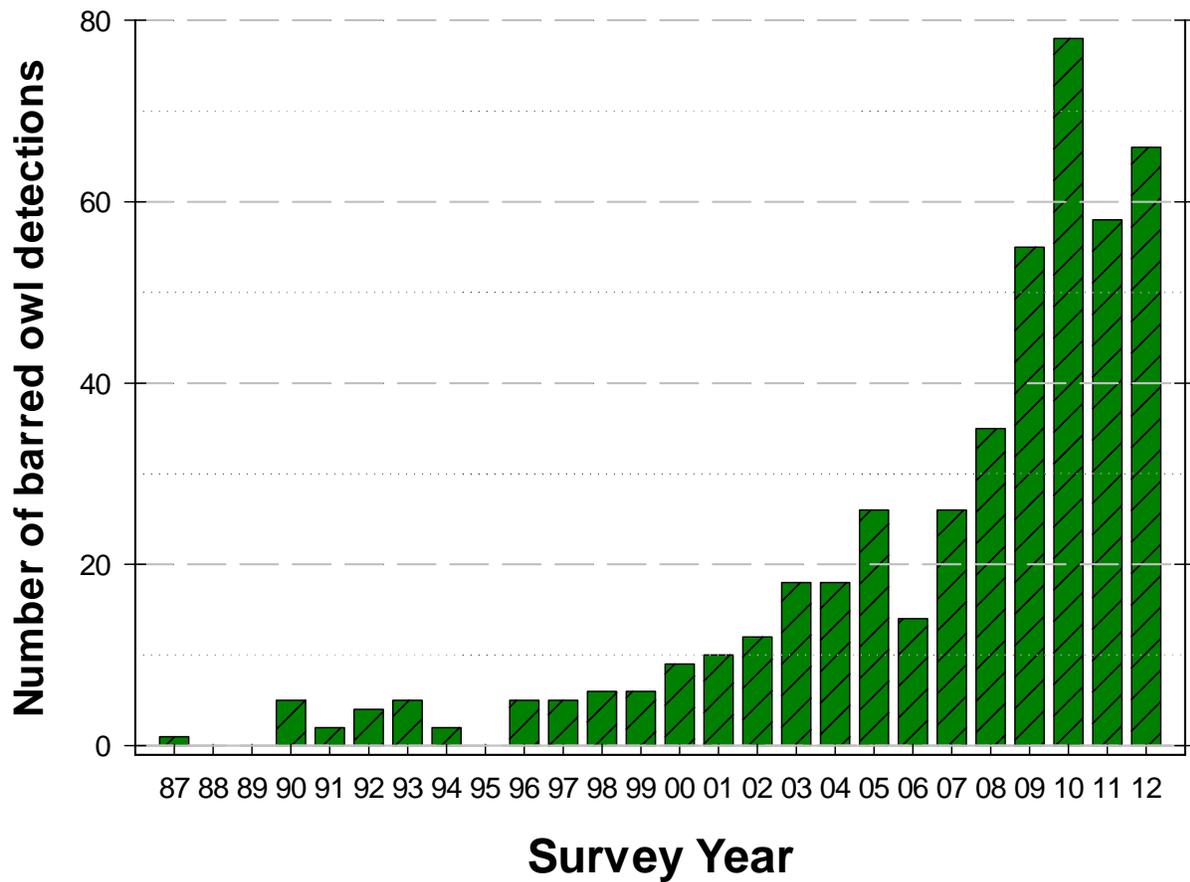


Figure 7. Total number of barred owl detections during surveys at 45 long-term monitored sites on the northern Olympic Peninsula Study Area, 1987–2012.