

**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, 1987–2009.

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 review*). The most recent published range-wide meta-analysis was described 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 report is scheduled for release in spring 2010 (Forsman et al. *in review*).

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 2009).

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 48 continuously-monitored spotted owl sites from the approximately 95 historic owl territories previously monitored by PNW. The 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 all tables reflect this change in sampling effort for the 2006 field season onward.

2009 Research Accomplishments

Number of Areas Where Owls Were Located

During the 2009 field season, we conducted 218 site visits to 48 owl territories (mean = 4.7 visits per site, range 2–10). Twenty-six of these territories are on the eastern slope of the Olympic Mountains along the north end of

the Hood Canal and the remaining sites are on the northwest corner of the peninsula near Forks (Table 1, Figure 1). At least one spotted owl was detected at 9 (19%) of the monitored sites. We confirmed 13 non-juvenile spotted owls (12 adults, 1 subadult; Table 2). Of the 48 sites we monitored, 39 (81%) had no responses from spotted owls, 3 (6%) were occupied by pairs, 3 (6%) were occupied by resident single owls, and 4 “floaters” were detected (Table 3). One of the floaters was an “additional female” located within the territory of a historical pair which was also confirmed as none nesting this year. The pattern of territory occupancy on the study area indicates a gradual decline in the number of occupied sites from 1998–2009 (Figure 2, Table 3). The decline seems most severe in low elevation areas on the west side of the peninsula on the former Soleduck Ranger District. Only 1 of the 5 sites in the Soleduck Study Area that were occupied in 2008 had spotted owl detections this year. However, one very low elevation site, which has not been occupied since 2002, had an adult male confirmed there on one visit.

The failure to detect spotted owls at sites that were occupied in 2008 does not guarantee the sites have been abandon. Olympic Peninsula spotted owls traditionally become none responsive and tend to wander off their territories in these non-breeding years. In 2009, no nesting attempts were detected among the birds that were confirmed on our monitored sites or the adjacent Olympic National Park sites (Gremel 2009). Surveys in subsequent years are required to confirm if any of these sites are truly unoccupied.

Number of Owls Marked

We confirmed the identity of 9 spotted owls in 2009 based on their color bands and banded 1 new territorial female. This was a non-reproductive year on the peninsula; therefore no fledglings were detected or banded in 2009. The newly captured bird brings the total number of spotted owls banded on PNW’s banding permits between 1987–2009 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 surveys, 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, and under Washington State Scientific Collection Permit # 09-131 .

Reproduction

We determined the nesting status of 4 of 7 female spotted owls at monitored sites by the June 15th cutoff and none attempted to nest. The proportion nesting is calculated for females whose nesting status has been determined by 15 June. This means that the 2009 estimate of the proportion of the population that nested was 0.00 (Figure 4, Tables 4-5). The adjacent study in Olympic National Park also confirmed no spotted owls nesting in 2009 (Gremel 2009). Spotted owl productivity (fecundity) is calculated as the number of female young produced per territorial female, assuming a 50:50 sex ratio of nestlings. Spotted owl fecundity on the Olympic Study Area has been highly variable and this was the seventh year since 1987 the fecundity was zero on the study area. Since 2002, owls in the study area have fallen into a pattern of alternating years of reproduction and no reproduction (Figure 4). 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).

Barred Owl Detections

We did not specifically survey for barred owls during the spotted owl demographic surveys on the study area, but all barred owls detected during spotted owl surveys were recorded and mapped. During 2009, we recorded 66 barred owl detections at 19 spotted owl sites (Figures 6). Although the number of barred owl detections in 2009 was slightly higher than the 20-year mean ($\bar{x} = 21.7$, $SE=3.42$), the results are not directly comparable with previous years because we surveyed fewer spotted owl sites in 2006-09 than in the early years. However, the trend from 2006-2009 (Figure 6) suggests that barred owl numbers particularly in the Quilcene area are catching up with the numbers of barred owl detections we had in the Quinault area early in the study.

To compare the intensity of barred owl activity between spotted owl site centers; we summarized the numbers of barred owl detections within 800 m of the combined annual site centers for each spotted owl territory as an index. By using this distance-based index, the number of barred owls detections at a given site could be lower or higher than the number recorded during surveys for a particular site because barred owl detections on an adjacent site would be included in the index if the detection was within the 1000 m limit.

Our index of the percentage of spotted owl territories having barred owl detections has steadily grown from less than 10 percent of territories surveyed in 1990 to a high of 50 % in 2009 (Figure 8). Barred owl detection rates on the northern sites that we are currently monitoring have lagged behind detection within the Olympic National Park (Figure 8). Using our detection within 800 m of a site center index, the park's detection rate has averaged approximately 2.4 times higher than for National Forest.

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 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 65–81% 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.

Additional Studies

Barred owl Surveys -Two additional sampling efforts were started on the study area in 2008. A pilot study was started in two watersheds on the Hood Canal Ranger District near Quilcene to better assess the abundance of barred owl populations around our spotted owl sites. Surveys were conducted in the Big Quilcene River and Jimmycomelately Creek watersheds. Calling stations along a series of road transects were surveyed. At each station barred owl call were played for 20 minutes and all barred and spotted owl responses were recorded and the birds location mapped.

No barred owls were detected during the surveys in the Big Quilcene River drainage during these surveys. However, we consistently detected barred owls around historic spotted owl sites in the Jimmycomelately Creek drainage. Within the area of one historic spotted owl site we detected what appeared to be 4 different barred owl pairs. We intend to continue and expand this barred owl sampling in 2010.

Quinault spotted owl surveys – During the spring of 2009 we conducted surveys along the Humptulips River Valley to determine if any spotted owls remained in this drainage. Surveys were conducted along the main road system and sampled parts of 7 historic spotted owl territories. No spotted owls were detected during this limited sampling and we intend to conduct additional sampling in 2010 as time permits.

Problems Encountered

Access issues continue to make it a challenge to complete the annual surveys within the protocol's timeline using just two field 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. A knee injury to one of our biologists, while accessing a remote site, delayed occupancy sampling of some site during May. Olympia National Park provided a substitute crew for a two week period during this time until other surveyors were available.

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:

Publications:

Funk, W. C., E. D. Forsman, M. Johnson, T. D. Mullins, S. M. Haig. 2009. Evidence for recent population bottlenecks in northern spotted owls (*Strix occidentalis caurina*). Conservation Genetics: 1-9.

Bailey, L. L., J. A. Reid, E. D. Forsman, J. D. Nichols. 2009. Modeling co-occurrence of northern spotted and barred owls: Accounting for detection probability differences. Biological Conservation. in press.

Presentations:

Elizabeth M. Glenn, Robert G. Anthony, Eric D. Forsman, Gail S. Olson. 2009. Effects of climate on demographic performance of northern spotted owls in the Pacific Northwest. The 2009 Annual Meeting of the Oregon Chapter of the Wildlife Society.

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 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. Compiled captures histories and occupancy data from the Olympic National Park and Olympic National Forest for use in a cooperative study with K. Dugger and R. Anthony at the Oregon State University Cooperative Wildlife Research Unit.
- f. 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
- g. We participated in the northern spotted owl demographic analysis workshop in Corvallis, OR. This workshop, held in January 2009, was the fifth 5-year analysis of the status and population trend conducted on the species. Data from the Olympic National Forest (PNW) was combined with Olympic National Park and was analyzed along with data from 10 other demographic studies. The results from this analysis provided range-wide estimates of the population trends. The report from this analysis is in review and will be released spring 2010.

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 2010.

Acknowledgments

This study was funded by the USDA Forest Service Region 6, USDI Bureau of Land Management, and the USDA Forest Service Pacific Northwest Research Station. We work closely with our cooperators at the Olympic National Forest, Olympic National Park and the Washington Department of Natural Resources to ensure coverage of owl territories, many of which overlap boundaries between landowners. The Olympic National Park graciously provided a 2-person survey crew for 2 weeks to supplement a PNW crew after a knee injury sidelined one of the PNW biologists.

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Table 1. Total number of spotted owl territories surveyed and number of owl pairs, young fledged, and young banded on the Olympic National Forest Study Areas in 2009.

| Study Area | Survey area location (Eastside vs. Westside) | Total number of territories surveyed | Number of occupied territories | Number of territories with owl pairs | Number of young fledged | Number of young banded |
|------------|--|--------------------------------------|--------------------------------|--------------------------------------|-------------------------|------------------------|
| Quilcene | East | 26 | 7 | 3 | 0 | 0 |
| Soleduck | West | 22 | 2 | 0 | 0 | 0 |
| Totals | | 48 | 9 | 3 | 0 | 0 |

Table 2. Number of non-juvenile spotted owls detected per year in the Olympic Peninsula Study Area, 1987–2009. 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 | 43 | 20 | 2 | 5 | 17 | 0 | 4 | 48 |
| 1988 | 39 | 29 | 4 | 3 | 29 | 0 | 4 | 69 |
| 1989 | 61 | 52 | 1 | 2 | 44 | 1 | 3 | 103 |
| 1990 | 76 | 55 | 9 | 5 | 57 | 6 | 4 | 136 |
| 1991 | 87 | 66 | 5 | 6 | 58 | 5 | 4 | 144 |
| 1992 | 87 | 67 | 4 | 5 | 65 | 7 | 2 | 150 |
| 1993 | 88 | 60 | 3 | 7 | 52 | 1 | 9 | 132 |
| 1994 | 93 | 56 | 3 | 12 | 60 | 2 | 8 | 141 |
| 1995 | 90 | 54 | 2 | 6 | 41 | 0 | 7 | 110 |
| 1996 | 81 | 49 | 5 | 5 | 48 | 3 | 6 | 116 |
| 1997 | 75 | 50 | 1 | 3 | 45 | 1 | 4 | 104 |
| 1998 | 71 | 51 | 4 | 5 | 45 | 3 | 7 | 115 |
| 1999 | 69 | 17 | 0 | 2 | 17 | 0 | 3 | 39 |
| 2000 | 82 | 40 | 1 | 3 | 31 | 0 | 4 | 78 |
| 2001 | 86 | 36 | 1 | 12 | 38 | 0 | 8 | 95 |
| 2002 | 92 | 37 | 4 | 10 | 31 | 0 | 6 | 88 |
| 2003 | 95 | 29 | 1 | 0 | 20 | 1 | 0 | 51 |
| 2004 | 95 | 32 | 0 | 3 | 23 | 4 | 5 | 67 |
| 2005 | 104 | 27 | 1 | 5 | 25 | 5 | 4 | 67 |
| 2006 ^a | 45 | 10 | 0 | 1 | 8 | 0 | 1 | 20 |
| 2007 | 45 | 9 | 0 | 2 | 4 | 0 | 4 | 19 |
| 2008 | 48 | 12 | 0 | 0 | 10 | 0 | 2 | 24 |
| 2009 | 48 | 6 | 0 | 0 | 5 | 1 | 1 | 13 |

^a Starting in 2006 sampling effort on the study was reduced to sites on the northern half of the peninsula.

Table 3. Percent of spotted owl territories on the Olympic Peninsula Study Area in which we located pairs, singles, floaters, or no owls, 1987– 2009. 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 | 43 | 70 | 26 | 4 | 0 |
| 1988 | 61 | 79 | 15 | 3 | 3 |
| 1989 | 45 | 82 | 10 | 5 | 3 |
| 1990 | 76 | 79 | 12 | 5 | 4 |
| 1991 | 87 | 71 | 17 | 4 | 8 |
| 1992 | 87 | 82 | 5 | 4 | 9 |
| 1993 | 88 | 61 | 18 | 5 | 16 |
| 1994 | 93 | 66 | 12 | 5 | 17 |
| 1995 | 90 | 46 | 24 | 7 | 23 |
| 1996 | 81 | 67 | 6 | 5 | 22 |
| 1997 | 75 | 61 | 11 | 7 | 21 |
| 1998 | 71 | 71 | 11 | 3 | 14 |
| 1999 | 69 | 16 | 23 | 1 | 60 |
| 2000 | 82 | 37 | 19 | 0 | 44 |
| 2001 | 86 | 45 | 9 | 7 | 39 |
| 2002 | 92 | 38 | 9 | 9 | 45 |
| 2003 | 95 | 25 | 12 | 10 | 53 |
| 2004 | 95 | 34 | 3 | 2 | 61 |
| 2005 | 94 | 31 | 5 | 1 | 63 |
| 2006 ^b | 45 | 20 | 5 | 0 | 75 |
| 2007 | 45 | 11 | 16 | 2 | 71 |
| 2008 | 48 | 19 | 6 | 6 | 69 |
| 2009 | 48 | 6 | 6 | 8 | 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.

^b Starting in 2006 sampling effort on the study area was reduced to sites on the northern half of the peninsula.

Table 4. Number of spotted owls banded each year on the Olympic Study Area, 1987– 2009. 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 | 127 |
| 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 |
| Totals | 480 | 24 | 19 | 177 | 14 | 20 | 184 | 922 |

Table 5. Proportion of female spotted owls that nested, fledged young, and nested and fledged young, on the Olympic Peninsula Study Area, Washington, 1987–2009.

| 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 | – | – |
| Mean | | 0.40 | SE 0.07 | | 0.35 | SE 0.06 | | 0.51 | 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 6. Estimated fecundity of female spotted owls on the Olympic Peninsula Study Area: 1987–2009. 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 6 (Continued). Estimated fecundity (b) of female spotted owls on the Olympic Peninsula Study Area: 1987–2009. 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 | – |
| Mean | | | | | 0.287 | 0.053 | 0.198 | 0.067 | 0.148 | 0.052 | 0.288 | 0.050 |

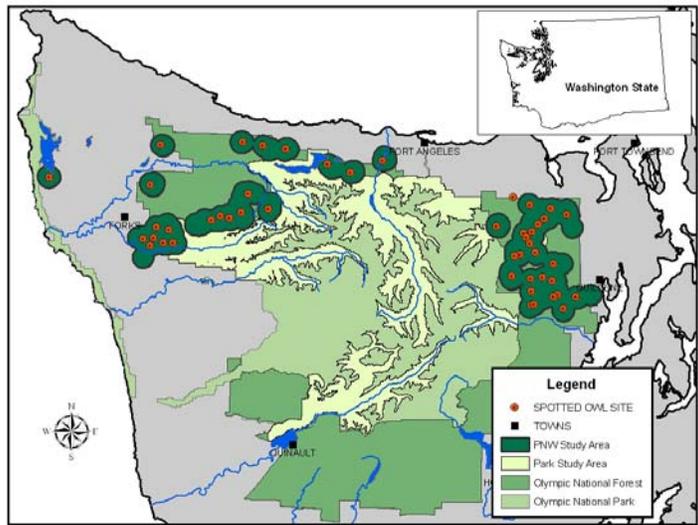


Figure 1. Distribution of spotted owl sites monitored by PNW on the Olympic Spotted Owl Demographic Study Area, 2009.

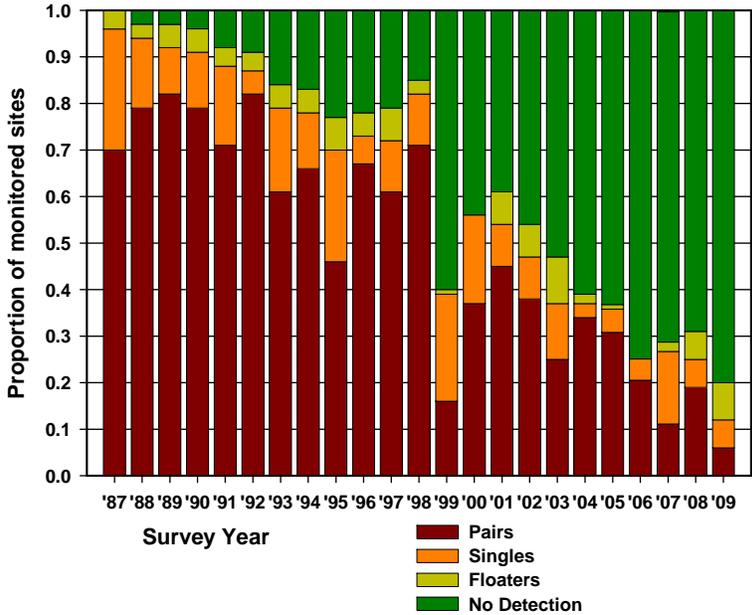


Figure 2. Proportion of monitored owl sites on the Olympic Peninsula Study Area in which we detected pairs, resident singles, floaters, or no spotted owls, 1987–2009

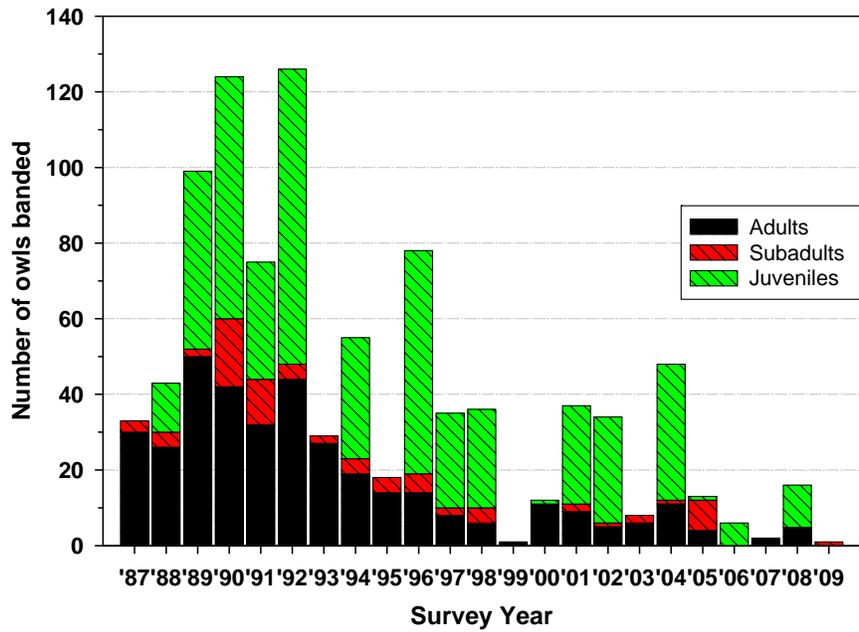


Figure 3. Number of adult, subadult, and juvenile spotted owls banded on the PNW portion of the Olympic Peninsula Study Area, 1987–2009.

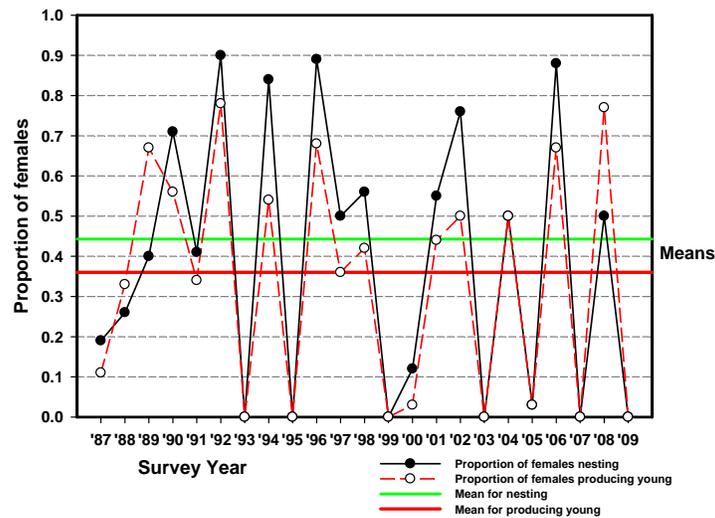


Figure 4. Proportion of female spotted owls nesting and proportion producing young on the National Forest portion of the Olympic Peninsula Study Area, 1987–2009.

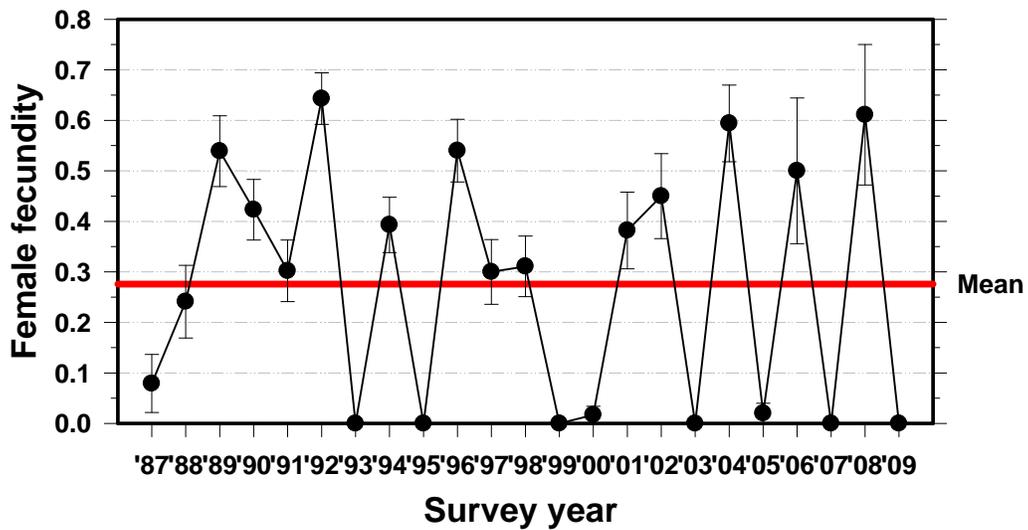


Figure 5. Estimated annual fecundity of female spotted owls on the Olympic National Forest portion of the Olympic Peninsula Demographic Study Area, 1987– 2009. Estimates were based on all age–classes combined.

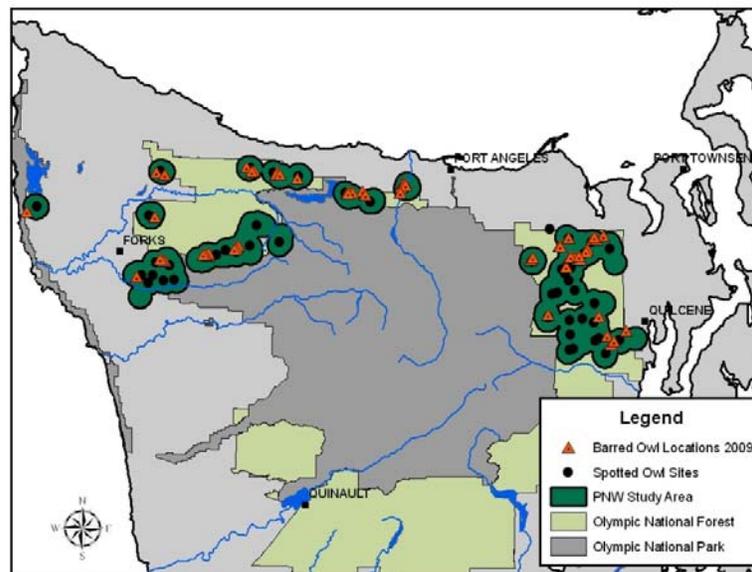


Figure 6. Locations of barred owl detections on the Olympic National Forest portion of the Olympic Peninsula Demographic Study Area during the 2009 field season. Black circles indicate long-term spotted owl site centers surveyed in 2009.

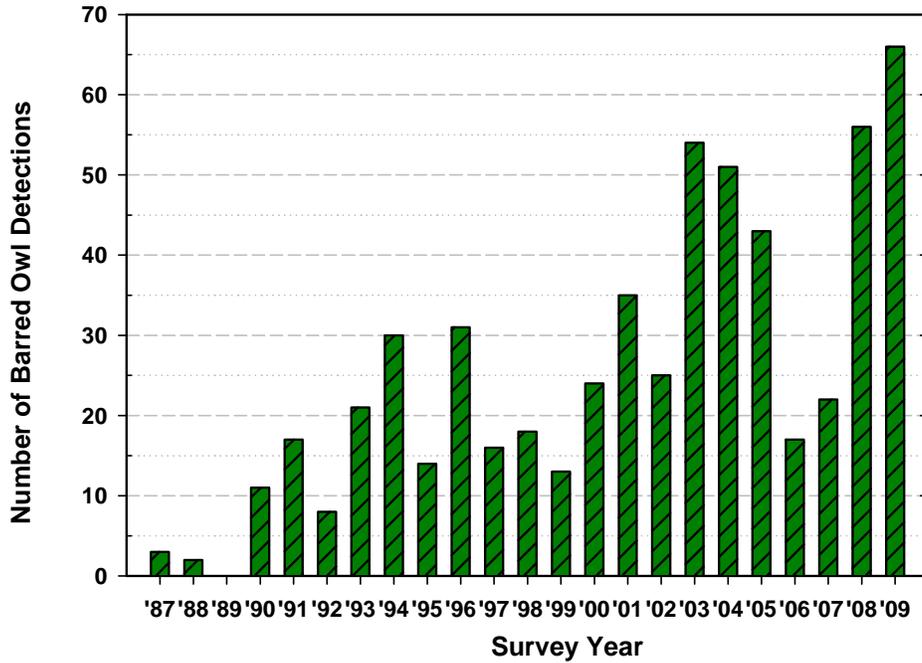


Figure 7. Number of barred owl detections on the PNW portion of the Olympic Peninsula Study Area, 1987–2009. Detections in 2006–2009 are only for the reduced number of long-term monitoring sites sampled in these years.

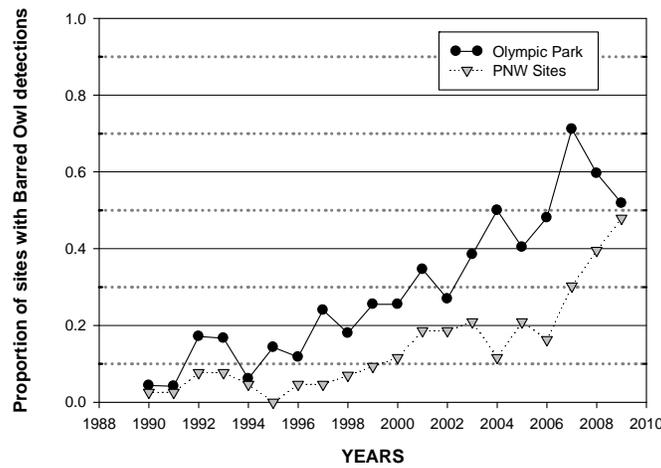


Figure 8. The proportion of spotted owl sites centers by year with barred owl detections within 800 m of the cumulative core areas for the National Forest sites compared to the Olympic National Park sites, 1990–2009.