AN ABSTRACT OF THE THESIS OF

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Since their range expansion into the Pacific Northwest, anecdotal evidence suggests that northern barred owls (*Strix varia varia*) may be displacing northern spotted owls (*Strix occidentalis caurina*). My objectives were to characterize barred owl distribution and population increase in Oregon, investigate spotted owl territory performance before and after barred owl detection, and document cases of hybridization between barred owls and spotted owls. Between 1974-1998, 706 unique barred owl territories were reported in Oregon. At five spotted owl demographic study areas in Washington and Oregon, barred owl detections increased rapidly between 1987-1999. After barred owls were detected within 0.80 km of the spotted owl territory center, occupancy of spotted owls declined, and there was a significant likelihood of spotted owl displacement when barred owls were either currently or previously present. When barred owls were detected between 0.81-2.40 km from the spotted owl territory center, there was no difference in mean occupancy of spotted owls after barred owls were detected, and spotted owl detection rates when barred owls were currently or previously present were not significantly different from territories without barred owls. There was no effect on spotted owl reproductive performance after barred owls were detected within 0.80 km or between 0.81-2.40 km of the territory center.

When barred owls were detected within 0.80 km of a spotted owl territory center, 46% of the spotted owls moved > 0.80 km and 39% were never found again. In comparison, at territories without barred owls, only 21% of spotted owls moved > 0.80 km, and only 11% disappeared completely. When barred owls were detected between 0.81-2.40 km from the territory center there was no difference in rates of movement or disappearance of spotted owls between territories with and without barred owls. Reports of hybridization between spotted owls and barred owls are uncommon. Between 1974 and 1999, 24 adult and 26 juvenile hybrids were confirmed in Washington and Oregon. Data from this study suggest that barred owls pose a threat to spotted owls but it is too soon to predict whether trends observed in this study will continue, or will spread to other areas.

The Range Expansion of the Northern Barred Owl: An Evaluation of the Impact on Spotted Owls

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RANGE EXPANSION OF THE NORTHERN BARRED OWL: AN EVALUATION OF THE IMPACT ON SPOTTED OWLS

INTRODUCTION

In the Pacific Northwest and northern California, there is considerable anecdotal evidence that suggests that the recent range expansion of the northern barred owl (*Strix varia varia*) represents a threat to the northern spotted owl (*Strix occidentalis caurina*) (Taylor and Forsman 1976, Hamer et al. 1989, Vincent 1990, Dunbar et al. 1991, Dark et al. 1998, Leskiw and Gutiérrez 1998). Barred owls are congeneric with northern spotted owls and some authors consider them a superspecies (Mayr and Short 1970). Northern spotted owls are currently listed as threatened under the Endangered Species Act (United States Fish and Wildlife Service 1990).

Historically, the range of the barred owl was limited to the eastern United States and eastern Canada (Bent 1938). In the early 1900s the range of the barred owl gradually expanded westward across Canada to British Columbia, then north into southeast Alaska and south into western Montana, Idaho, and Washington (Grant 1966, Campbell 1973, Reichard 1974, Shea 1974, Boxall and Stepney 1982, American Ornithologists' Union 1983, Sharp 1989, Dunbar et al. 1991, Wright and Hayward 1998). Barred owls first appeared in Oregon in 1974 (Taylor and Forsman 1976) and California in 1981 (Dark et al. 1998).

Avifaunal range expansions in North America are common and have been attributed to anthropogenic or natural causes, or both (DeSante and George 1994, Johnson 1994, Root and Weckstein 1994). Woodlands that developed on the Great Plains during glacial periods became grasslands during warmer interglacial periods, thereby creating a barrier to the east-west movement of forest-dwelling species (Knopf 1986). More recently, changes in climate and natural forest cover, as well as tree planting and fire suppression, have created forest cover in grasslands and

prairies that may have facilitated range expansions of forest birds (Ehrlich et al. 1988, Johnson 1994).

Hypotheses that have been proposed to explain the range expansion of the barred owl across Canada include changes in climate (Johnson 1994), tree planting and development of riparian forest (Dark et al. 1998) or increased adaptation to coniferous forests (Boxall and Stepney 1982). Range expansions of other North American owls during the same period include the apparent expansion of the boreal owl (*Aegolius funereus*) from Canada southward to Colorado and northern New Mexico (Johnson 1994) and movements of barn owls (*Tyto alba*) into parts of British Columbia and California (DeSante and George 1994). In Europe, the tawny owl (*Strix aluco*) was first documented in Finland in 1875 and has since expanded its range northward, becoming common in southern Finland (Mikkola 1983).

Although some have suggested that the range expansion of the barred owl into the Pacific Northwest was facilitated by forest management practices (Hamer 1988, Root and Weckstein 1994, Dark et al. 1998, König et al. 1999), there is no data to support or refute this hypothesis. In fact, the range expansion may have occurred regardless of forest management activities (Johnson 1994). Barred owls appear to be habitat generalists that can occupy a broad range of forest conditions, from highly fragmented forests in managed landscapes to pristine forests in Wilderness Areas (Shea 1974, Hamer 1988, Dunbar et al. 1991, Wright and Hayward 1998). In a study of habitat use by barred owls in the North Cascades of Washington, Hamer et al. (1989) found that although some individual barred owls selected young forests, the majority used old-growth, mature and young forests in proportion to availability. This suggested that in general, barred owls did not select any particular forest age class among those that were available to them. Thus, it is by no means clear that the range expansion of the barred owl has been facilitated by forest management activities. In any event, to state unequivocally that "Logging

actually favours the expansion of this species... " (König et al. 1999:328) without mention of other equally probable hypotheses is misleading and possibly erroneous.

As a result of the recent range expansion, the range of the barred owl now overlaps most of the range of the northern spotted owl. Barred owls have become common in southwestern British Columbia, western Washington, western Oregon and in other areas west of the northern Rocky Mountains (Dark et al. 1998). Surveys in southern British Columbia indicate that barred owls outnumber spotted owls nearly 4:1 (Dunbar et al. 1991). Despite the increasing sympatry between barred owls and spotted owls, the effects of the barred owl invasion on spotted owl populations have not been quantified. Of primary concern is the potential impact of barred owls on the long-term viability and persistence of spotted owls.

Three types of competition are possible when two species occur in the same area. These are consumptive, territorial and encounter competition (Schoener 1983). During consumptive competition, a quantity of some resource is consumed by an individual, thereby depriving other individuals of it. A reduction in food or habitat resources in the presence of barred owls could increase energetic stress on spotted owls (Hamer 1988, Hamer et al. 1989). Barred owls are food generalists, whereas a large percentage of the diet of the spotted owl comes from a few species (Hamer et al. 2001). However, in the North Cascades of Washington, Hamer et al. (2001) found that the summer diets of spotted owls and barred owls overlapped by 76%, which suggests that the two species probably do compete for food in areas where they are sympatric. That food is limiting for spotted owls is suggested by the fact that they do not breed every year (Forsman et al. 1984, Franklin et al. 1999).

Territorial and encounter competition are more direct than consumptive competition. During territorial competition, "...an individual aggressively defends, or by its behavior signals its intention to defend, a unit of space against other individuals..." (Schoener 1983:258). Encounter competition occurs when two or more individuals interact, and results in "...time or energy losses, theft of food,

injury, or death by predation, fighting or mere accident." (Schoener 1983:258). Barred owls are slightly larger than spotted owls (Earhart and Johnson 1970) and appear to be behaviorally dominant to spotted owls in most encounters (Hamer et al. 1989, Dark et al. 1998, Swindle pers. com.). Observers have noted that spotted owls often do not respond to vocal cues in the presence of barred owls and may go undetected during surveys if barred owls are present (Reid pers. com., Sovern pers. com.). In other instances, barred owls may chase or even prey on spotted owls (Leskiw and Gutiérrez 1998, Forsman pers. com., Hamer pers. com., Loschl pers. com.). How any of these interactions ultimately affect the breeding behavior and reproductive success of spotted owls in the vicinity of barred owls is unknown.

Hybridization between spotted owls and barred owls (Hamer et al. 1994, Dark et al. 1998) suggests that barred owls directly impact the reproductive success of spotted owls by breeding with them, and vice versa. Interspecific hybridization has been documented in 52 of 516 non-marine North American birds (Mayr and Short 1970). Documented cases of hybridization in birds of prey outside of captivity are rare. Eastern (*Otus asio*) and western screech owls (*Otus kennicottii*) are known to hybridize in eastern Colorado and southern Texas (Mayr and Short 1970, Johnsgard 1988). In Europe, the tawny owl and ural owl *(Strix uralensis*) are only known to hybridize in captivity (Voous 1989). Possible biological outcomes of hybridization include 1) extensive hybridization which threatens the genetic integrity of both species; 2) development of a subpopulation of mostly hybrid individuals; 3) selection that acts against hybrids and favors effective isolating mechanisms; 4) low levels of hybridization in the population without loss of identity of either species, or 5) random occurrence of hybridization (Mayr 1963, Short 1969).

My objectives in this study were to describe the current status of the barred owl in Oregon and to investigate the potential impacts of barred owls on spotted owls. My predictions were that spotted owls would have lower occupancy and reproductive rates on territories where barred owls were detected than territories

where barred owls were not detected. I also predicted that disappearance of spotted owls from territories after barred owl detection would be higher than on territories where barred owls were not detected. In addition, I summarized records of hybridization between barred owls and spotted owls in Washington and Oregon through 1999.

STUDY AREA

The study area for compilation of barred owl records was the state of Oregon. Data used to examine relationships between barred owls and spotted owls were summarized from five, long-term demographic study areas in Washington and Oregon (Fig. 1). The demographic study areas were large areas where several different research groups used mark-recapture methods to estimate trends in spotted owl populations between 1987-1999 (Table 1). These areas were surveyed several times every year to locate banded owls, band any new owls that were detected, and document nesting status and productivity of owls (Franklin et al. 1996). Although they differed somewhat in terms of precipitation, elevation and tree species composition, all of the demographic study areas were mountainous regions covered by a mosaic of coniferous forests, including young, mature and old forest (Franklin and Dyrness 1988, Forsman et al. 1996). Two of the demographic study areas (Olympic Peninsula, HJ Andrews) were located primarily on federal lands and three (Cle Elum, Oregon Coast Range, Roseburg) were in areas that included a mixture of federal and private lands. The boundaries of the Olympic Peninsula and Roseburg Study Areas were the same for all years of the study, whereas the size of the Cle Elum, Oregon Coast Range and HJ Andrews Study Areas was increased in 1994-1996 to include additional owls (Table 1).

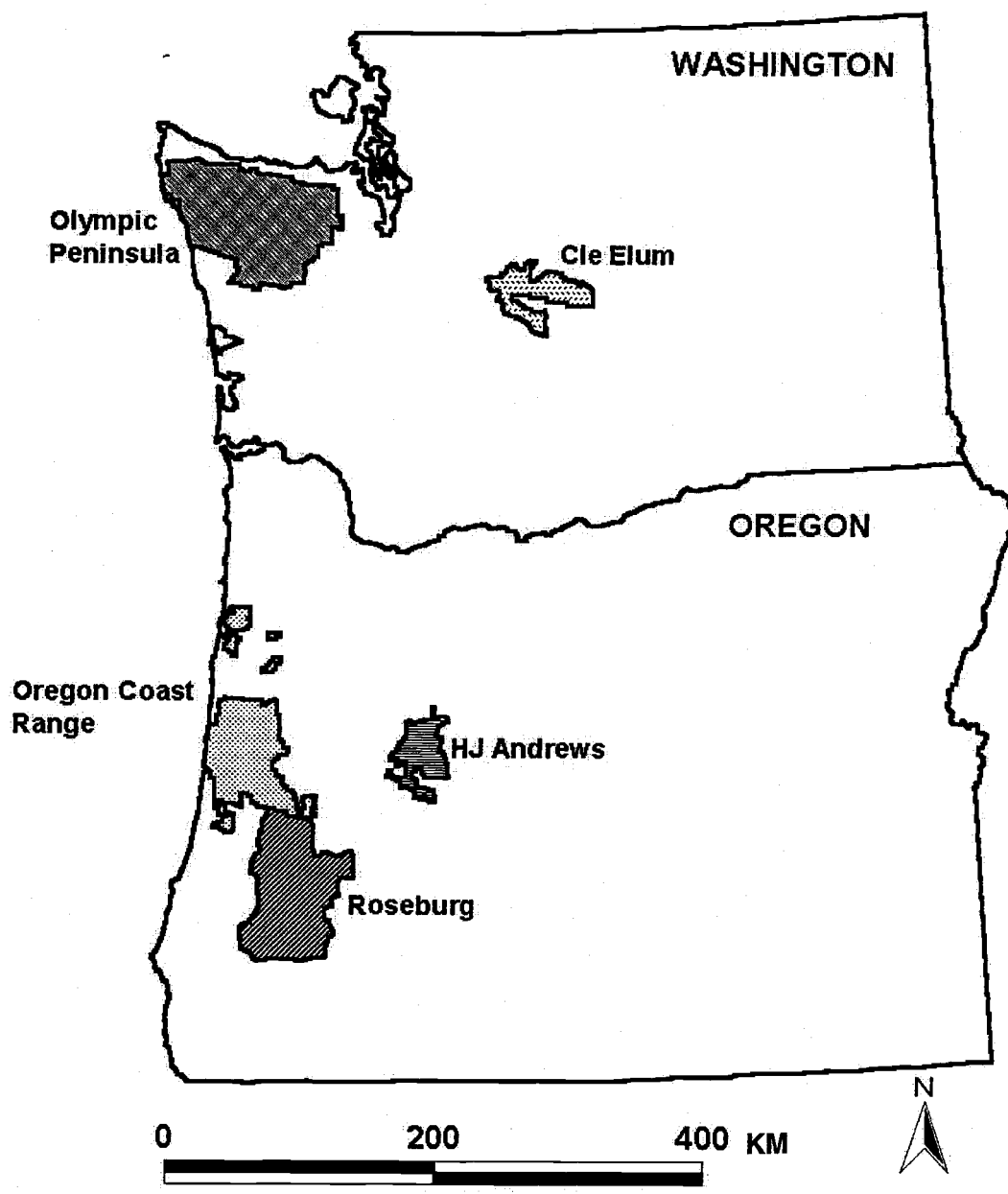

Figure 1. Location of Northern Spotted Owl Demography Study Areas in Washington and Oregon.

Table 1. Description of Northern Spotted Owl Demography Study Areas in Washington and Oregon (Forsman et al. 1996:13).

Study Area	Study Period	Original Study Area Size (km^2)	Reconfigured Study Area Size (km^2)[a]
Cle Elum (WA)	1989-1999	1,763	1,784
Olympic Peninsula (WA)	1987-1999	8,145	---
Oregon Coast Range (OR)	1990-1999	2,749	3,918
HJ Andrews (OR)	1987-1999	1,075	1,526
Roseburg (OR)	1987-1999	6,044	---

[a] Years that study area boundaries were reconfigured were: Cle Elum (1996); Oregon Coast Range (1994); HJ Andrews (1996).

METHODS

DISTRIBUTION

To characterize the distribution and rate of increase of barred owls in Oregon I reviewed the literature and solicited information on sightings of barred owls from more than 300 individuals from public agencies, private companies and birding organizations. I sent a form letter and questionnaire to wildlife and forest management professionals working for public agencies and private companies, as well as private citizens. Many biologists and technicians from timber companies, consulting firms and state and federal agencies provided data that were collected incidentally during spotted owl surveys. Data from Breeding Surveys, Christmas Bird Counts and casual observations were also compiled. After reviewing the data I excluded questionable or duplicate records.

Most barred owl records that I obtained included the date and Universal Transverse Mercator (UTM) coordinates of the sighting plus information on the type of detection (audible or visual) and number and sex of owl(s). In cases where observers provided legal locations of owls, I converted these to UTM coordinates by assigning the locations to the UTM coordinates at the center of the section, quarter-section or sixteenth-section in which the observation occurred.

To produce a conservative estimate of the number of different "territories" represented by observations of barred owls, I plotted all locations on a map. Then, in cases where there were multiple locations within a 1.43 km radius, I assumed that the locations represented a single territory, unless I had evidence indicating otherwise. A 1.43 km radius is the average area (644 ha) of a barred owl annual home range in Washington (Hamer 1988).

Each year that barred owls were recorded at a territory more than once, I reduced all barred owl locations in the territory to a single set of UTM coordinates representing the center of activity for that year. When possible the center of activity

was based on the location of a nest or sightings of fledged young. If no nest or young were observed then I estimated the center of activity based on locations where pairs or single owls were observed. If there were multiple sightings of a single owl or pair of owls in the same year, early detections (i.e., during courtship or breeding) were used as the center of activity, rather than those that occurred later in the season.

Most information on spotted and barred owl locations came from surveys on demographic study areas, where surveyors followed strict protocols in order to locate spotted owls and estimate their productivity each year (Franklin et al. 1996). The primary method of survey was to use a vocal lure (vocal imitation or playback of spotted owls calls) to stimulate owls to defend their territories (Reid et al. 1999). Spotted owl territories were surveyed at least three times each year to locate and confirm banded owls, band any new owls that were detected and determine the nesting status and number of young produced by each pair (Franklin et al. 1996). Surveys were conducted primarily during the breeding season (1 March-31 August). Based on the information obtained from surveys, researchers identified the center of activity in each spotted owl territory each year. When possible the center of activity was based on a nest or location of fledged young. If no nest or young was observed, then the center of activity was based on one of the following in order of rank: diurnal locations of a pair, female or male, or nocturnal locations of a pair or single owl. For determination of the center of activity, visual locations were ranked higher than audible locations and early detections (courtship or nesting) were ranked higher than detections that occurred late in the season. If no owls were found, the territory was considered unoccupied.

Although barred owls were not the target of vocal lure surveys on demographic study areas, they were responsive to spotted owl calls and were often detected during surveys of spotted owls (Hamer 1988, Dunbar et al. 1991). When barred owl(s) were seen or heard during spotted owl surveys, observers recorded

the location, date, time of observation, type of response (i.e., audible/visual), number and sex of the individual(s) and reproductive status (if known).

ANNUAL RATE OF INCREASE

I estimated the rate of increase of barred owls in demographic study areas based on the annual rate of increase in the percent of spotted owl territories where barred owls were detected. I conducted the analysis at two scales around each territory (0.80 km and 2.40 km radius circles) to see if trends were similar regardless of the frame of reference. The 2.40 km radius circle (1808 ha) approximates the annual home range size of spotted owls in the Pacific Northwest. I limited the analysis to territories that were surveyed for at least six consecutive years and in which a spotted owl pair was present during at least one year. I used regression analysis to evaluate annual trends in the data. To simplify the analysis, I excluded territories occupied by hybrids or spotted owls that were paired with barred owls. I compiled a separate list of all reported cases of mixed-species pairs and hybrids and calculated the frequency of interspecific matings versus spotted owl matings.

IMPACTS OF BARRED OWLS ON SPOTTED OWLS

I used data from five demographic study areas in Washington and Oregon to test for differences in occupancy and reproduction of spotted owls at territories where barred owls were detected versus territories where barred owls were never detected. All analyses were conducted at two spatial scales (0.80 km radius and 0.81-2.40 km concentric ring) around the center of each spotted owl territory. The two spatial scales were used to determine if the influence of barred owls was greater if they occurred in the core area of use of the spotted owls (0.80 km radius) versus more peripheral areas of the home range (0.81-2.40 km concentric ring).

I used five statistical comparisons to evaluate the impact of barred owls on spotted owls, as follows:

1. At spotted owl territories where barred owls were detected, (BO+ territories) I used paired t-tests to compare measures of occupancy of spotted owls in years before and after barred owls were detected on each territory.

2. I used paired t-tests to compare occupancy of spotted owls between BO+ territories versus territories where barred owls were never detected (BO- territories).

3. I used one-sample t-tests to compare reproduction of spotted owl pairs between BO+ territories versus BO- territories.

4. I used logistic regression to investigate whether spotted owl detection at individual territories decreased in years when barred owls were present or in years after barred owls were present at BO+ territories relative to BO- territories.

5. I used χ^2 tests to compare known fates of spotted owls in BO+ and BO- territories. The objective of this analysis was to determine if owls in BO+ territories were more likely to move or disappear than were owls in BO- territories.

In all of the above analyses, a BO+ territory was a spotted owl territory in which barred owls were detected within a 0.80 km radius or 2.40 km radius of the center of activity during one or more years of survey. If no spotted owls were found in the year that barred owls were detected, then barred owl locations were compared to the most recent spotted owl location in previous years at the territory. In this manner, the first year in which barred owl(s) were detected within a specified distance from the spotted owl territory center could be identified, regardless of whether a spotted owl had been detected in the same year.

A BO- territory was a spotted owl territory where barred owls were not detected within 2.40 km of the center of activity in any year of the survey. In order

to categorize spotted owl territories as either BO+ or BO-, I made eight simplifying assumptions, as follows:

1. If a barred owl was present in a spotted owl territory, the barred owl would be detected during the surveys for spotted owls. That is, I assumed that territories without barred owl detections did not have barred owls.

2. Barred owls had the same effect on spotted owls regardless of whether a single barred owl or a pair of barred owls were detected in a territory.

3. If a barred owl(s) was detected in the area of overlap between two spotted owl territories (2.40 km radius circles) both territories were considered BO+ territories. Any potential barred owl "effects" were not assumed to be minimized or somehow dissipated between the two territories.

4. The impact of barred owls on spotted owls was the same regardless of whether there was a single barred owl detection in one year versus multiple detections of barred owls in the same year.

5. The impact of barred owls on spotted owls was the same regardless of whether barred owls were detected in only one year versus multiple years.

6. If present, spotted owls could be detected, regardless of whether barred owls were present or had been previously present at the spotted owl territory.

7. The impact of barred owls on spotted owls was not influenced by age or length of tenure of spotted owls at a territory.

8. Elevation was not a factor when considering the potential influence of barred owls on spotted owls.

I included spotted owl territories in the analysis only if they were surveyed in at least six consecutive years, including at least three years of survey prior to the first detection of barred owls. In addition, I required that spotted owl territories be occupied by a pair of spotted owls in at least one of the three years prior to the first barred owl detection. I defined the pre-barred owl period (pre-BO) as the survey years prior to the first barred owl detection. The post-barred owl period (post-BO)

consisted of the first year that barred owls were detected and at least two subsequent years.

MEASURES OF SPOTTED OWL OCCUPANCY AND REPRODUCTION

I used two different scoring systems to evaluate the annual performance of BO+ and BO- territories. The first was a 5-class scoring system that evaluated occupancy of the territory, as follows:

0 = no owls

1 = single male or female owl detected, resident status unknown

2 = resident female or male (multiple detections, or a single observation of a banded owl after three territory surveys)

3 = resident female or male with response (audible or visual) from owl of the opposite sex, but not sure if they were paired

4 = resident pair present (multiple detections or single observation of banded owls after three territory surveys)

The second scoring system that I used to evaluate performance of BO+ and BO- territories was a 3-class system that compared reproduction of resident spotted owl pairs (category 4, above) before and after barred owls were detected, as follows:

0 = no difference in reproductive status between BO+ and BO- territories (either young found at both or at neither)

1 = young found at BO+ territory; no young found at BO- territory

-1 = no young found at BO+ territory; young found at BO- territory

To test for differences in spotted owl occupancy and reproduction at territories with and without barred owls I used paired samples of BO+ and BO- territories. Each BO+ territory was paired with a randomly chosen BO- territory (Table 2). At each territory in each paired sample I divided the data into two samples corresponding to the pre-BO and post-BO periods. In other words, I divided the data at each BO- territory into two sample periods that corresponded to the same years as the pre-BO and post-BO samples for the paired BO+ territory. In all cases, I selected paired samples that were surveyed for the same years, or I truncated the data so that paired samples were surveyed for the same years (Table 2). I averaged the annual scores at each BO+ and BO- territory to estimate mean occupancy (Appendix A) during the pre-BO and post-BO periods. Then, I subtracted the mean score from the post-BO period from the mean score from the pre-BO period to obtain the mean difference ($\bar{d}$) between the two scores.

Table 2. Three case history examples of spotted owl occupancy scores from paired samples of territories in which barred owls were detected (BO+) or not detected (BO-). Years in which barred owls were detected are indicated by asterisks (*).

Paired sample number		Survey Year									Mean diff ($\bar{d}$)[a]
		1	2	3	4	5	6	7	8	9	
1	BO+	4	4	4	0	4	4	4*	4*	4	-0.67
1	BO-	4	4	4	4	4	2	4	4	4	-0.33
2	BO+	4	4	4	4*	4*	3*	0	0	4	1.50
2	BO-	4	4	4	4	4	4	4	4	4	0
3	BO+	4	4	4	2	0*	0	0*	0*		3.50
3	BO-	4	4	4	4	4	4	4	4		0

[a] The mean difference in occupancy at BO+ territories was estimated by subtracting the mean occupancy score from years after barred owls were detected from the mean occupancy score from years before barred owls were detected. The mean difference in occupancy at BO- territories was estimated by dividing the data into two samples corresponding to the same years as the pre- and post-barred owl periods in the paired BO+ territory.

I limited the reproductive analysis to territories where pairs of spotted owls were present at least once in the pre-BO period and once in the post-BO period. Thus, for each territory included in this analysis I had at least one record of reproductive performance before and after barred owls were detected in the territory. My objective in limiting the sample in this manner was to isolate the influence of barred owls on the reproductive performance of spotted owls without the confounding effects of occupancy. The example below (Table 3) corresponds to the same three territories illustrated in Table 2. Mean reproduction was estimated by averaging the annual scores at each set of matched BO+ and BO- territories during the pre-BO and post-BO periods (Appendix B). Then, I subtracted the mean scores from the post-BO period from the mean score from the pre-BO period to obtain the mean difference ($\bar{d}$) between the two scores.

Table 3. Three case history examples of spotted owl reproductive scores based on a year-by-year comparison of reproduction at paired samples of territories in which barred owls were detected (BO+) or not detected (BO-). Years in which barred owls were detected are indicated by asterisks (*). Paired sample 3 is shown to illustrate a sample that would have been removed from the analysis because a spotted owl pair was not present after the first barred owl detection.

Paired sample number	Survey Year									Mean diff ($\bar{d}$)[b]
	1	2	3	4	5	6	7	8	9	
1	-1	0	0	A[a]	0	A	-1*	0*	-1	0.42
2	1	-1	-1	0*	1*	A*	A	A	0	-0.67
3	0	0	1	A	A*	A	A*	A*		

[a] A = spotted owl pair absent from BO+ territory or BO- territory or both.
[b] The mean difference in reproductive performance territories was estimated by subtracting the mean reproductive score from years after barred owls were detected from the mean reproductive score from years before barred owls were detected.

Because of the high number of BO+ territories on the Cle Elum Study Area, there were few BO- territories available for the analysis of occupancy and reproduction with paired samples on that area. Therefore, I paired BO+ territories on the Cle Elum Study Area to randomly selected BO- territories from the Roseburg Study Area. I justified this based on the assumption that barred owl effects on occupancy and reproduction should be the same regardless of study area. All comparisons of territory performance pre- and post- barred owl were based on the mean difference ($\bar{d}$) between occupancy scores, or reproduction scores, before and after barred owls were detected.

DIFFERENCE IN DETECTION OF SPOTTED OWLS PRE- AND POST-BARRED OWL

I used logistic regression to test the hypothesis that presence (detection) of spotted owls declined in years when barred owls were present, or in years after barred owls were present at BO+ territories relative to BO- territories. Unlike the previous analysis, in which a paired t-test was used to evaluate the degree to which spotted owl occupancy declined at territories after barred owl detection (i.e., decline in territory status from pair to single status), this test was used to analyze the likelihood of a territory becoming unoccupied.

The response variables were binomial counts of spotted owl territories with or without spotted owl detections for each year of survey. Spotted owls were either present (1) or not detected and considered absent (0) (Appendix C). The explanatory variables were: 1) barred owls not detected in current year or in previous years (0, 0); 2) barred owls detected in current year only (1, 0) and 3) barred owls detected in previous years but not in current year (0, 1). I tested for differences between BO+ and BO- territories by using (1) as an indicator variable for BO+ territories, and (0) as an indicator variable for BO- territories.

The population proportion of spotted owls detected or probability (π) was dependent on explanatory variables through a nonlinear link function. The nonlinear part was completely captured by the logit of π (Ramsey and Schafer 1997:605). Quasi-likelihood analysis was used to account for extra-binomial variation (Ramsey and Schafer 1997:612). Significance levels of coefficients were determined with drop-in-deviance χ^2 tests. Confidence intervals for parameters were based on likelihood ratios. I used the same set of paired samples and the same frame of reference (0.80 km radius and 0.81-2.40 km concentric ring) as in the analysis of territory performance.

FATE OF SPOTTED OWLS AT TERRITORIES WITH AND WITHOUT BARRED OWLS

For this analysis, I used data from the Roseburg Study Area because of the large sample size and because the area was surrounded by other areas that were being surveyed for spotted owls (Franklin et al. 1996). Thus, if an owl disappeared from a territory on the Roseburg Study Area, there was a good chance it would be resighted on adjacent study areas.

To describe the fate of spotted owls, in addition to the six-year minimum survey, a spotted owl pair had to be present in the year prior to or during the first year of barred owl detection. If a pair was present at a territory the first year barred owls were detected, the same pair had to have been present at the territory in one or more of the three years pre-BO. The requirement that spotted owls be paired reduced the potential for movement for reasons unrelated to barred owl presence. For example, spotted owls that lose their mate through death or separation, are more likely to move to a new territory (Forsman et al. In prep.). Young owls (1-2 years old) were also excluded because they are more likely to disperse than adults (Forsman et al. In prep.). After BO+ territories meeting the above requirements were identified, they were paired with randomly selected BO- territories. I computed the relative percentages of the following potential spotted owl fates at BO+ versus BO- territories:

1. Remained at the original territory for at least one year after barred owls were detected.

2. Moved > 0.80 km to a new center of activity during or after the first year of barred owl detection.

3. Not detected after the first year of barred owl detection or in any subsequent year.

I analyzed spotted owl fates using a χ^2 test. I compared data from BO+ and BO- territories and tested the hypothesis that the percentage of spotted owls that either moved or disappeared from their territories was not influenced by barred owl presence. I used a P-value of 0.05 as the criteria for statistical significance, but I also considered $0.05 < P \leq 0.10$ as indicative of weak statistical relationships.

RESULTS

DISTRIBUTION

The first record of a barred owl in Oregon was a pair observed in the Wenaha River drainage of the Blue Mountains in the northeast corner of the state in June 1974 (Taylor and Forsman 1976). Barred owls were reported in the same area through 1978. Subsequently, there were sightings of barred owls in the Oregon Cascades Range near Mt. Hood in Clackamas and Hood River Counties in 1979 (Harrington-Tweit et al. 1979). In 1981, single adults were detected in the southern Cascades in the Mountain Lakes Wilderness, Klamath County and on the west side of the Cascades in Lane County (Nehls 1998).

After these early records, sightings of barred owls rapidly accumulated, and by 1998, I estimated there were 706 territories where barred owls were observed in one or more years in Oregon (Fig. 2). Although the southward progression of barred owl records in the Washington Cascades (Harrington-Tweit et al. 1979, Hamer 1988) suggests that barred owls moved into western Oregon after moving south in the Cascades Range, it is also possible that they moved southwest from northeastern Oregon into the Cascades (Fig.2).

The distribution of barred owl territories identified in 1974-1998 is heavily skewed toward western Oregon (Fig. 2). Although this may reflect actual differences in relative abundance of barred owls in eastern and western Oregon, it is more likely the result of survey effort. Western Oregon has been intensively and extensively surveyed for spotted owls since the early 1970's, whereas few studies of owls have been conducted in eastern Oregon. Much of southeast Oregon is not forested, so the paucity of barred owl records in that region is probably due primarily to the absence of suitable habitat.

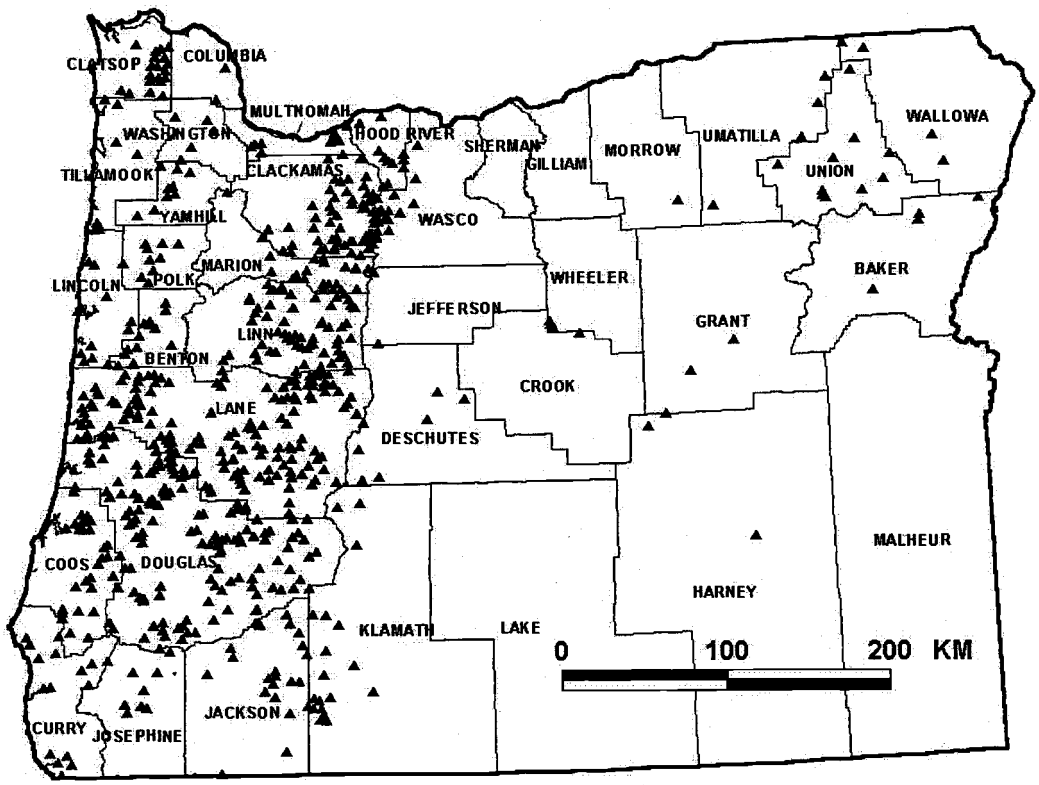

Figure 2. Location of 706 barred owl territories reported in Oregon, 1974-1998.

My estimate of the number of occupied barred owl territories found each year indicates a rapidly increasing linear relationship ($t_{10} = 8.09$, $P < 0.001$, $r^2 = 0.87$) in the number of barred owl territories after 1986 (Fig. 3). The cumulative number of new barred owl territories discovered between 1974-1998 shows an exponential increase ($t_{23} = 10.62$, $P < 0.001$, $r^2 = 0.84$) (Fig. 4). From 1989-1998, approximately 50 new barred owl territories were reported each year (Fig. 4). The 706 territories depicted in Figs. 2-4 were derived from 2,468 barred owl detections.

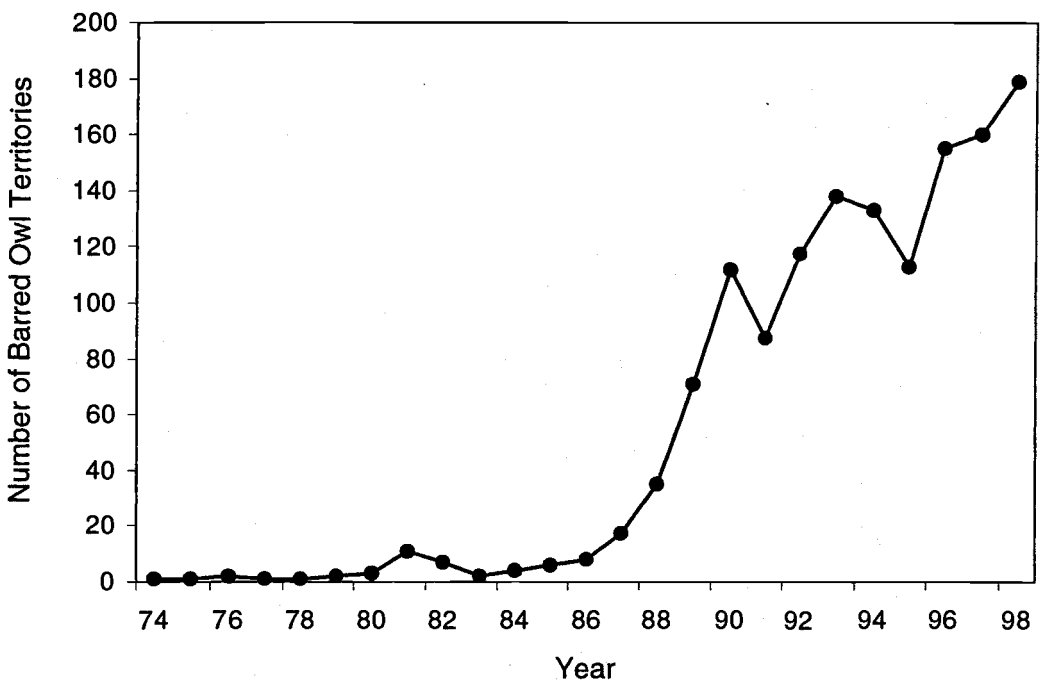

Figure 3. Estimated number of occupied barred owl territories reported each year in Oregon, 1974-1998.

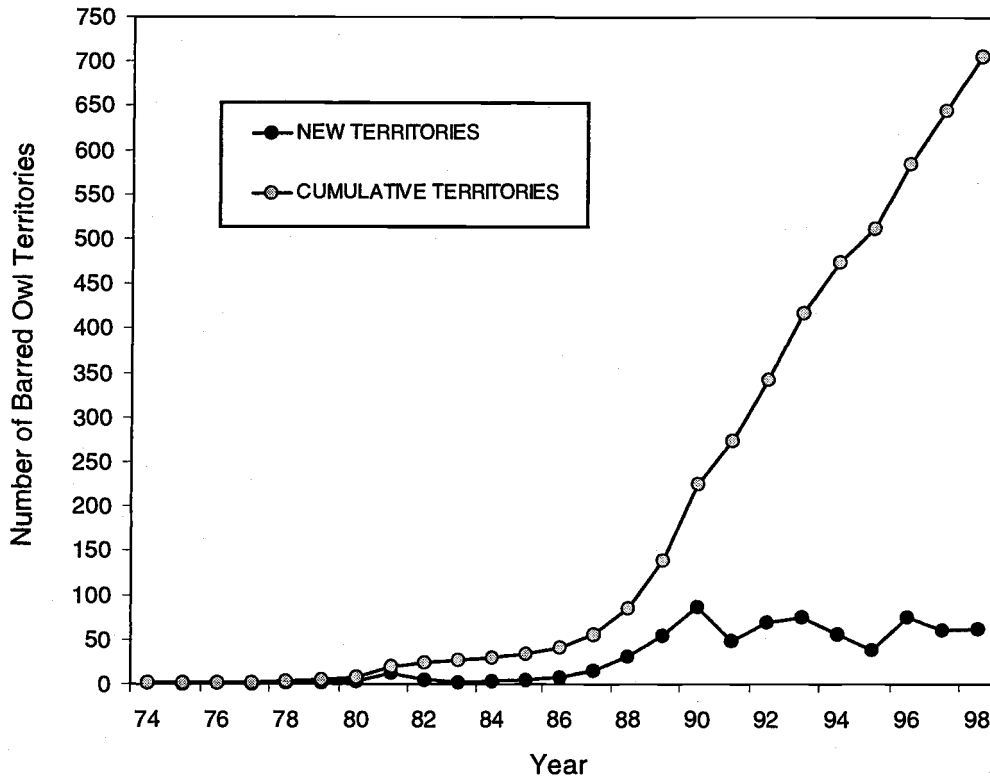

Figure 4. Estimated number of new and cumulative barred owl territories reported each year in Oregon, 1974-1998.

ANNUAL RATE OF INCREASE

There was a positive linear association between percent of spotted owl territories with barred owl detections and year on nearly all demographic study areas, regardless of which circle size was used as the frame of reference (Figs. 5-6). The only exception was the Cle Elum Study Area, where the number of spotted owl territories with barred owl detections was positively correlated with year at the 0.80 km circle size but not at the 2.40 km circle size (Table 4).

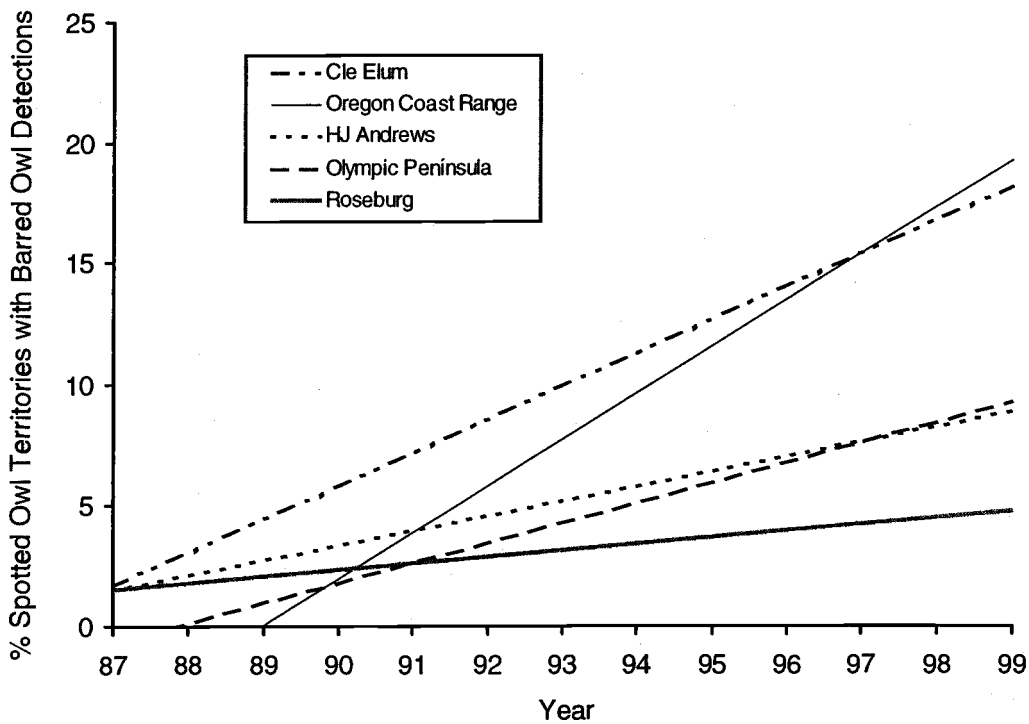

Figure 5. Linear regression of percent of spotted owls territories with barred owl detections within 0.80 km of the territory center: Northern Spotted Owl Demography Study Areas in Washington and Oregon, 1987-1999.

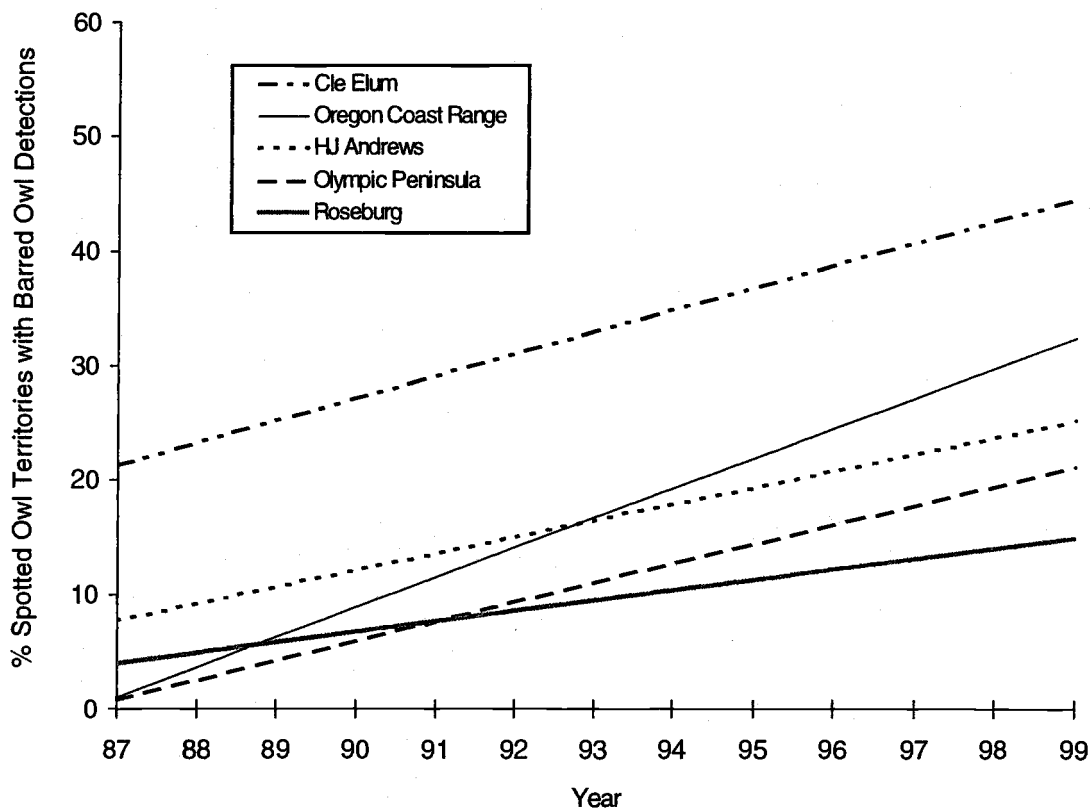

Figure 6. Linear regression of percent of spotted owls territories with barred owl detections within 2.40 km of the territory center: Northern Spotted Owl Demography Study Areas in Washington and Oregon, 1987-1999.

Table 4. Results of linear regression analyses of proportion of spotted owl territories with barred owl detections on survey year.

Study Area	Study Period	Number of Territories	Results from Linear Regression	
			0.00-0.80 km	0.00-2.40 km
Cle Elum (WA)	1989-99	66	$r^2 = 0.50$ $t_9 = 2.99$ $P = 0.015$	$r^2 = 0.18$ $t_9 = 1.41$ $P = 0.192$
Olympic Peninsula (WA)	1987-99	91	$r^2 = 0.66$ $t_{11} = 4.61$ $P < 0.001$	$r^2 = 0.65$ $t_{11} = 4.47$ $P < 0.001$
Oregon Coast Range (OR)	1990-99	174	$r^2 = 0.86$ $t_8 = 6.87$ $P < 0.001$	$r^2 = 0.85$ $t_8 = 6.64$ $P < 0.001$
HJ Andrews (OR)	1987-99	110	$r^2 = 0.53$ $t_{11} = 3.49$ $P = 0.005$	$r^2 = 0.49$ $t_{11} = 3.22$ $P = 0.008$
Roseburg (OR)	1987-99	251	$r^2 = 0.50$ $t_{11} = 3.27$ $P = 0.008$	$r^2 = 0.70$ $t_{11} = 5.10$ $P < 0.001$

SPOTTED OWL OCCUPANCY

Within Territories, pre- and post- Barred Owl

At BO+ territories, mean occupancy scores declined ($t_{83} = 7.11$, $P < 0.001$) after barred owls were detected within 0.80 km of territory centers (Table 5). When barred owls occurred 0.81-2.4 km from the territory center, mean occupancy scores of spotted owls were marginally lower ($t_{84} = 1.89$, $P = 0.062$) after barred owls were first detected (Table 5).

Table 5. Occupancy scores at spotted owl territories in years before and after barred owls were detected.

	Distance between barred owl detection(s) and center of spotted owl territory			
	0.00-0.80 km		0.81-2.40 km	
	$\bar{x}$	SE	$\bar{x}$	SE
Pre-barred owl score	3.42	0.08	3.25	0.09
Post-barred owl score	2.16	0.16	2.98	0.13
Mean difference ($\bar{d}$)	1.26	0.18	0.27	0.14

Between Territories with and without Barred Owls

The paired comparison of occupancy scores indicated that, after barred owls were detected within 0.80 km of the territory center, spotted owl occupancy declined at BO+ territories relative to BO- territories ($\bar{d} = 1.11$, SE = 0.222,

$t_{83} = 4.99$, $P < 0.001$). When barred owls were detected at distances 0.81-2.40 km from the territory center, there was no difference in occupancy of spotted owls between BO+ and BO- territories ($\bar{d} = -0.180$, SE = 0.177, $t_{84} = -1.02$, $P = 0.311$).

SPOTTED OWL REPRODUCTIVE PERFORMANCE

The paired comparison of reproductive scores indicated that, after barred owls were detected in spotted owl territories, there was no difference in spotted owl reproduction at BO+ territories relative to BO- territories regardless of whether the frame of reference was the 0.80 km radius circle ($\bar{d} = 0.007$, SE = 0.106, $t_{49} = 0.07$, $P = 0.946$) or the 0.81-2.40 km concentric ring ($\bar{d} = -0.036$, SE = 0.081, $t_{68} = -0.44$, $P = 0.664$).

DIFFERENCE IN DETECTION OF SPOTTED OWLS PRE- AND POST-BARRED OWL

The logistic regression analysis of BO+ and BO- territories indicated that the odds of detection of spotted owls declined after barred owls were observed within 0.80 km of the territory center in the current year ($X^2 = 14.26$, $P < 0.001$) or in previous years ($X^2 = 7.01$, $P = 0.008$) (Table 6). When barred owls were present within 0.80 km of the territory in the current year, the odds of finding a spotted owl at a BO+ territory were 0.28 times that of finding a spotted owl at a BO- territory (Table 6). When the frame of reference was the 0.81-2.40 km concentric ring, the likelihood of detection of spotted owls did not differ between BO+ and BO- territories, regardless of whether barred owls were present in the current year ($X^2 = 2.22$, $P = 0.136$) or in previous years ($X^2 = 0.55$, $P = 0.459$) (Table 6).

Table 6. Results of logistic regression analysis comparing the odds of spotted owl detection between BO+ and BO- territories[a] when barred owls were present or in years after barred owls were present.

Distance[b]	Explanatory Variables	Estimate	SE	df	Odds ratio[c]	95% CI
0.00-0.80 km	Barred owl detected in current year only	-1.261	0.334	65	0.28	0.15 - 0.55
0.00-0.80 km	Barred owl detected in previous years only	-0.808	0.305	65	0.45	0.25 - 0.81
0.81-2.40 km	Barred owl detected in current year only	-0.550	0.370	65	0.58	0.28 - 1.19
0.81-2.40 km	Barred owl detected in previous years only	0.233	0.314	65	1.26	0.68 - 2.33

[a] BO+ = spotted owl territory with barred owl detections; BO- = spotted owl territory with no barred owl detections.
[b] Distance between barred detection(s) and center of spotted owl territory.
[c] Indicates the odds of finding a spotted owl at a BO+ territory compared to a BO- territory.

FATE OF SPOTTED OWLS AT TERRITORIES WITH AND WITHOUT BARRED OWLS

At sites where barred owls were detected within 0.80 km of the territory center, 46.4% of spotted owls moved > 0.80 km and 39.3% were never seen again (Table 7). In comparison, 21.4% of the spotted owls at BO- territories moved > 0.80 km during the same period, and only 10.7% disappeared completely. There was convincing evidence that the percentage of spotted owls that moved or disappeared from their territories was influenced by the presence of barred owls ($\chi^2_1 = 16.60$, $P < 0.001$) (Table 7). When barred owls were detected 0.81-2.40 km from the territory center there was no evidence that the presence of barred owls influenced the occupancy of spotted owls ($\chi^2_1 = 0.259$, $P = 0.611$) (Table 7).

Spotted owls that moved after barred owls were detected tended to move farther than spotted owls that moved when barred owls were not present (Table 7). However, the samples were so small that I did not try to conduct statistical tests of distances moved.

Table 7. Fate of spotted owls after the first barred owl detection, Roseburg Study Area, Oregon, 1987-1999. Territories were surveyed a minimum of six years and spotted owl pairs were present the year prior to or during the year of first barred owl detection, or both.

			Fate of Spotted Owls at Territories after Barred Owl Detection			
Distance[a]	Territory[b]	n	% Present	% Not found	% Moved	Avg. distance moved (km)[c]
0.00-0.80 km	BO+	28	14.3	39.3	46.4	3.95
	BO-	28	67.9	10.7	21.4	3.36
0.81-2.40 km	BO+	32	43.7	37.5	18.8	3.68
	BO-	32	37.5	46.9	15.6	1.11

[a] Distance between barred owl detection and center of spotted owl territory.
[b] BO+ = spotted owl territory with barred owl detections; BO- = spotted owl territory with no barred owl detections.
[c] Indicates average straight-line distance moved for all owls that moved at least 0.80 km.

HYBRIDS

During 1974-1999, a total of 50 hybrids were observed in Washington and Oregon, including 24 adults and 26 juveniles (Table 8, Appendix D). Nine of the hybrid juveniles were first generation (F1), and 16 were second generation (F2). The parents of one juvenile hybrid were not observed, so it could not be determined if it was an F1 or F2. There were five reports of male spotted owls paired with female barred owls, but no reports of female spotted owls paired with male barred owls. There were three cases in which male spotted owls paired with female F1 hybrids and two cases where female spotted owls paired with male F1 hybrids. Male F1 hybrids paired with female barred owls at seven territories, and female F1 hybrids paired with male barred owls at five territories. There were no cases in which both pair members were hybrids. Of the five pairs in which male spotted owls were paired with female barred owls, all produced offspring (Table 8). From 1987-1999 the frequency of interspecific matings on demographic study areas was extremely low compared to the total number of spotted owl matings, suggesting that the rate of hybridization was very low (Table 9). No interspecific matings were reported on the Olympic Peninsula or Cle Elum Study Areas.

Table 8. Observations of spotted owl/barred owl pairs or hybrids in Washington and Oregon, 1974-1999.

Number of Territories	Species Combinations			Number of juveniles produced
	Male	Female	Unknown Sex	
5	Spotted	Barred		9 F1[b]
5	Barred	F1		2 F2
3	Spotted	F1[a]		0
7	F1	Barred		13 F2
2	F1	Spotted		1 F2
1	F1	Unk. spp.		0
1	F1			0
6			F1	0
1				1 F1 or F2

[a] One female F1 in this category was paired with a barred owl in a subsequent year.
[b] Three F1 juveniles in this category were later recaptured as adults and therefore were not counted as juveniles.

Table 9. Frequency of spotted owl matings (SO) versus interspecific matings (IS) of spotted owls, barred owls or hybrid owls on five Spotted Owl Demography Study Areas in Washington and Oregon, 1987-1999.

	Olympic Peninsula		Cle Elum		Oregon Coast Range		HJ Andrews		Roseburg	
	SO	IS	SO	IS	SO	IS	SO	IS	SO	IS
YEAR										
1987	0.125	0.000					0.200	0.000	0.195	0.000
1988	0.370	0.000					0.407	0.000	0.244	0.000
1989	0.653	0.000	0.647	0.000			0.174	0.000	0.362	0.000
1990	0.596	0.000	0.622	0.000	0.432	0.000	0.363	0.000	0.453	0.000
1991	0.317	0.000	0.556	0.000	0.110	0.000	0.163	0.000	0.297	0.000
1992	0.758	0.000	0.774	0.000	0.500	0.000	0.624	0.000	0.522	0.006
1993	0.000	0.000	0.146	0.000	0.106	0.000	0.000	0.000	0.162	0.000
1994	0.612	0.000	0.744	0.000	0.430	0.000	0.274	0.000	0.400	0.006
1995	0.000	0.000	0.475	0.000	0.097	0.000	0.186	0.000	0.164	0.013
1996	0.673	0.000	0.824	0.000	0.639	0.009	0.560	0.000	0.603	0.000
1997	0.372	0.000	0.111	0.000	0.252	0.000	0.209	0.000	0.354	0.000
1998	0.511	0.000	0.788	0.000	0.355	0.009	0.300	0.000	0.435	0.000
1999	0.000	0.000	0.375	0.000	0.108	0.000	0.108	0.015	0.344	0.008
AVG FREQUENCY	**0.384**	**0.000**	**0.551**	**0.000**	**0.303**	**0.002**	**0.274**	**0.001**	**0.349**	**0.003**

DISCUSSION

The 706 barred owl territories identified in 1974-1998 in Oregon are a conservative estimate for at least two reasons. First, my collection of barred owl records was extensive, but not exhaustive. The majority of data were obtained from public agencies. I was able to obtain data from only a small percentage of the private landowners in Oregon. Second, most spotted owl survey efforts on federal lands in 1990-1999 were limited to demographic study areas, and survey data from intervening areas were not available.

My study suggests that when barred owls invade spotted owl territories, mean occupancy of spotted owls declines, and spotted owls are often displaced from their territories. There appears to be no effect on reproductive performance when spotted owl pairs are found at territories after barred owls have been detected. This suggests that the primary effect of barred owls is displacement of spotted owls, as opposed to a reduction in reproductive rate.

My analyses of spotted owl territory performance and displacement were based on two critical simplifying assumptions. These were that barred owls could be detected during surveys for spotted owls and that spotted owls could be detected if they occurred in areas where barred owls were present. Both of these assumptions were probably violated to some extent. For example, when biologists conducted surveys of spotted owl nest areas, they did not always survey all areas within a 2.40 km radius of the historic nest territory. So it is possible that incomplete surveys or non-response of barred owls may have resulted in an underestimate of the number of territories where barred owls were present. It is also possible that spotted owls may have been less detectable in territories where barred owls were present simply because they were intimidated by the barred owls and were less likely to respond to vocal lure surveys. However, my analysis of fates

of spotted owls after barred owls were detected suggested that lower rates of occupancy were probably due primarily to displacement of spotted owls as opposed to inhibition of territorial behavior.

The fact that mean occupancy of spotted owls declined after barred owls were detected within 0.80 km of the territory center, but did not change when barred owls were detected at greater distances, suggests that the frequency and intensity of interactions between the two species is negatively correlated with distance between them. However, it should be noted that barred owl presence within 0.80 km of the spotted owl territory center does not necessarily lead to displacement or a decline in reproductive performance, as some pairs of spotted owls persisted (or new ones arrived and bred) at territories even after barred owls were detected near the territory center (Appendices A-C).

Although my analysis indicated that spotted owl reproduction was unaffected by the presence of barred owls, it was based on cases where spotted owls were present in at least one year after barred owls were detected. One problem with this analysis is that it is possible that the only reason that spotted owls were able to persist after barred owls were detected was because the barred owls moved on and settled elsewhere. If this was the case, then it is understandable why the reproductive rate of spotted owls would not be affected. A multivariate model that included the number of years that barred owls were present and the actual distance between the barred owls and spotted owls in each year would probably be more informative, albeit much more complex.

To simplify my analysis of spotted owl displacement, I used the presence or absence of barred owls at spotted owl territories as a binomial variable. They were either present or absent (1,0) in at least one year of the observation period. I did not distinguish between cases where barred owls were detected in multiple years at a territory versus cases where they were only detected once. I also did not distinguish between cases where only single barred owls were detected versus cases where pairs

of barred owls were detected. Multivariate models that included the number of years barred owls were detected at each spotted owl territory, and the number and reproductive status of barred owls that were detected each year, might better explain relationships between the species. Development of such models will require much more complete information on barred owls than was available in my study.

Displacement of spotted owls by barred owls could increase competition for territories between adult and young spotted owls and could also lead to death if individual owls are unable to find new territories due to lack of suitable habitat. It is also possible that the high proportion (39%) of spotted owls that disappeared after barred owls were detected within 0.80 km of the territory center could reflect some level of actual predation on spotted owls. There is only one reported case in which it was reasonably certain that a barred owl killed a spotted owl (Leskiw and Gutiérrez 1998), but there have been numerous reports of barred owls chasing or attacking spotted owls (e.g., Hamer pers. com., Forsman pers. com., Loschl pers. com.). These observations suggest that barred owls may kill or injure spotted owls.

Despite the fact that large numbers of spotted owl territories are monitored every year in Canada and the western United States, there have been only five records of mixed-species pairs of barred owls and spotted owls and 24 records of adult F1 hybrids. In addition, a total of seven F1 hybrids were reported in California by 1996 (Dark et al. 1998). These numbers suggest that hybridization between the two species is a rare event. Whether hybridization will continue at relatively low levels is unknown. It is possible that hybridization could actually decline as barred owls become more numerous and have increased access to conspecific mates (Mayr 1963, Cody 1969). Although all five mixed-species pairs of spotted owls and barred owls that have been observed consisted of a male spotted owl paired with a female barred owl, it is unclear if this was due to mate choice or was the result of sampling methods used in demographic studies. In contrast to male barred owls, male spotted owls are easy to observe and can be easily induced to lead an observer to their nest,

thus revealing the identity of their mate (Forsman 1983, Reid et al. 1999). In addition, because of the focus of the spotted owl demographic studies, observers made a concerted effort to follow up on all responses from spotted owls. In contrast, responses from male barred owls are rarely followed up to determine the identity of their mate. As a result of these biases, it is possible that cases where male barred owls were paired with female spotted owls or hybrids may be under-reported compared to cases in which male spotted owls were paired with female barred owls or with hybrids. This situation will only be clarified if researchers make an effort to identify the mates of male barred owls that are detected.

If barred owls continue to increase in number, it will become increasingly important to be able to identify spotted owl territories as either BO+ or BO- territories. This presents a scientific dilemma, because anecdotal evidence suggests that surveys targeting barred owls (i.e., using barred owl calls instead of spotted owl vocalizations) may reduce spotted owl responses during the survey period (Hamer et al. 1989). In addition, vocal lure surveys of spotted owls may predispose them to harassment or predation by barred owls by causing them to expose themselves while they are defending their territories against non-existent intruders. These problems need additional study to determine if they are serious issues or can be dealt with using modified survey techniques.

Inferences from this study can probably be extended to most federal lands in Washington and Oregon within the range of the spotted owl. My results suggest that land managers and regulatory agencies should regard barred owls as a threat to spotted owls, particularly if barred owls continue to increase in number as they have during the past 25 years. Should current trends continue, two scenarios seem possible: barred owls could eventually displace spotted owls, or barred owls and spotted owls could reach some state of "equilibrium," with both species present throughout the area or with spotted owls present only in some parts of their historic range (Gill 1980, Confer and Knapp 1981, Rising 1983). Based on information

from my study, it seems unlikely that spotted owls will be able to out-compete barred owls unless conditions in a localized area exclude barred owls in favor of spotted owls.

The degree to which barred owls and spotted owls can coexist needs further study. More research is needed on (1) barred owl home range size in the Pacific Northwest, (2) spatial relationships between spotted owls and barred owls and (3) resource (space, nests, food) partitioning between the two species in areas of sympatry. More data is also needed on the fate of spotted owls after barred owls invade their territories to better understand the long-term consequences of displacement. Although I assumed that forest management practices were the same at territories with and without barred owl detections during the study period, habitat differences were not investigated. Ideally, future analyses should incorporate habitat variables in order to better understand spotted owl and barred owl interactions in relation to natural and human-induced alteration of the landscape.

Recent analyses of survival rates and population trends of spotted owls (Forsman et al. 1996, Franklin et al. 1999) have not attempted to evaluate the potential influence of barred owls on survival rates of spotted owls. As a result, it is not possible to evaluate the extent to which recent declines in spotted owl populations are due to barred owls as opposed to other environmental factors (e.g., weather patterns or habitat loss). Future analyses of population trends of spotted owls need to address these issues, as simple analyses of population trends without some understanding of the relative influence of different contributing factors is not very useful.

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APPENDICES

APPENDIX A

A1. Occupancy scores at spotted owl territories where barred owls were detected within 0.80 km of the territory center[a]. Highlighted cells indicate years that barred owls were detected from 1987-1999. Pre- and post-BO columns indicate mean occupancy scores before and after barred owls were first detected.

Status	ID[b]	SA[c]	pre-BO	87	88	89	90	91	92	93	94	95	96	97	98	99	post-BO	mean diff ($\bar{d}$)[d]
BO+	1	CLE	3.43				4	4	4	0	4	4	4	4	4	4	4.00	(0.57)
BO+	2	CLE	4.00				4	4	4	4	4	4	0	0	4	4	2.86	1.14
BO+	3	CLE	4.00						4	4	4	4	4	2	4	4	3.60	0.40
BO+	4	CLE	4.00					4	4	4	2	0	0	0	0	0	0.33	3.67
BO+	5	CLE	2.40			4	0	0	4	4	4	4	4	4	4	4	4.00	(1.60)
BO+	6	CLE	4.00			4	4	4	4	4	4	4	4	2	2	0	2.00	2.00
BO+	7	CLE	3.50				4	2	4	4	0	0	2	0	0	0	0.33	3.17
BO+	8	CLE	2.40			4	4	4	0	0	0	0	0	0	0	0	0.00	2.40
BO+	9	CLE	4.00			4	4	4	4	4	4	0	0	0	0	0	0.00	4.00
BO+	10	CLE	2.50					4	4	2	0	0	0	0	0	2	0.40	2.10
BO+	11	CLE	4.00							4	4	4	4	4	4	4	4.00	0.00
BO+	12	HJA	3.67							4	3	4	4	4	4	4	4.00	(0.33)
BO+	13	HJA	3.00	4	4	4	0	2	4	2	0	2	2	0	1	0	1.44	1.56
BO+	14	HJA	4.00				4	4	4	4	4	4	4	2	2		2.67	1.33
BO+	15	HJA	3.33	2	4	4	4	4	4	4	4	4	1	2	4	1	3.20	0.13
BO+	16	HJA	4.00			4	4	4	4	4	4	4	2	4	4	4	3.71	0.29
BO+	17	HJA	3.80						4	3	4	4	4	4	4	4	4.00	(0.20)
BO+	18	HJA	4.00	4	4	4	4	4	4	2	4	4	4	4	1	0	3.10	0.90
BO+	19	HJA	2.40			4	4	0	4	0	0	0	0				0.00	2.40
BO+	20	HJA	4.00	4	4	4	4	4	4	4	2	4	0	1	0	0	1.17	2.83
BO+	21	HJA	4.00	4	4	4	4	4	4	2	2	1	0	0	2	0	1.00	3.00
BO+	22	HJA	4.00	4	4	4	4	4	4	4	4	4	4	4	4	2	3.67	0.33
BO+	23	HJA	4.00	4	4	4	4	4	4	2	4	0	1	0	1	0	1.50	2.50
BO+	24	OCR	4.00						4	4	4	1	0	2	4	0	1.40	2.60
BO+	25	OCR	2.67							0	4	4	4	4	4	1	3.25	(0.58)
BO+	26	OCR	4.00						4	4	4	4	4	4	0	0	1.33	2.67
BO+	27	OCR	2.67				2	2	4	4	4	4	4	4	4		4.00	(1.33)
BO+	28	OCR	2.83					2	2	2	4	3	4	0	0	1	0.33	2.50
BO+	29	OCR	3.25				1	4	4	4	4	4	4	4	4	2	3.67	(0.42)
BO+	30	OCR	4.00					4	4	4	4	4	0	0	0	0	0.00	4.00
BO+	31	OCR	3.33				2	4	4	4	4	4	4	2	4		3.67	(0.33)
BO+	32	OCR	1.33								0	0	4	4	4	4	4.00	(2.67)
BO+	33	OCR	1.33							0	0	4	4	4	4	4	4.00	(2.67)
BO+	34	OCR	4.00				4	4	4	4	2	4	4	4	4	1	3.17	0.83
BO+	35	OCR	2.50				1	4	2	3	3	2	4	4	4	1	3.00	(0.50)
BO+	36	OCR	4.00								4	4	4	4	0	0	1.33	2.67
BO+	37	OCR	4.00						4	4	4	4	4	4	4	4	4.00	0.00
BO+	38	OCR	4.00							4	4	4	4	4	4	4	4.00	0.00
BO+	39	OCR	2.17					2	2	0	4	1	4	4	4	4	4.00	(1.83)
BO+	40	OCR	4.00				4	4	4	2	0	1	0	0	0	0	0.43	3.57
BO+	41	OCR	3.60				4	4	4	4	2	4	2	4	4	4	3.60	0.00

Status	ID[b]	SA[c]	pre-BO	87	88	89	90	91	92	93	94	95	96	97	98	99	post-BO	mean diff (d̄)[d]
BO+	42	OCR	3.14				1	1	4	4	4	4	4	0	0	0	0.00	3.14
BO+	43	OCR	3.67				4	2	4	4	4	4	4	0	2	2	2.00	1.67
BO+	44	OCR	4.00						4	4	4	4	4	4	4	4	4.00	0.00
BO+	45	OCR	3.29				2	4	3	4	4	4	2	0	1	0	0.33	2.95
BO+	46	OCR	4.00				4	4	4	4	4	0	1	0	0	0	0.20	3.80
BO+	47	OLY	3.00		2	4	3	2	4	4	2	2	4	4	4	2	3.14	(0.14)
BO+	48	OLY	1.50					2	0	0	4	4	4	4	4	0	3.20	(1.70)
BO+	49	OLY	4.00					4	4	4	4	0	0	0			0.00	4.00
BO+	50	OLY	4.00	4	4	4	4	4	4	2	0	2	0	0	0	0	1.00	3.00
BO+	51	OLY	4.00				4	4	4	4	4	0	4	3	4	0	2.20	1.80
BO+	52	OLY	4.00	4	4	4	4	4	4	4	3	4	0	0	2	2	2.38	1.63
BO+	53	OLY	4.00			4	4	4	4	4	4	4	0	0	2	0	0.50	3.50
BO+	54	OLY	2.00	4	4	0	0	4	0	0	0	0	1	2	0	0	0.43	1.57
BO+	55	OLY	1.71			4	4	0	0	0	4	0	0	4	4	0	2.00	(0.29)
BO+	56	OLY	3.78		4	4	4	4	4	4	4	2	4	4	4	2	3.33	0.44
BO+	57	OLY	3.86			4	4	4	4	4	4	3	4	0	0	0	1.00	2.86
BO+	58	OLY	2.50		4	4	2	0	0	0	0	0	0				0.00	2.50
BO+	59	OLY	3.22	4	4	4	4	1	2	2	4	4	0	4	4	2	2.50	0.72
BO+	60	RSB	4.00	4	4	4	4	4	4	4	4	2	0	0	0	2	0.80	3.20
BO+	61	RSB	4.00	4	4	4	4	4	2	4	4	4	0	2	2	4	3.00	1.00
BO+	62	RSB	4.00		4	4	4	4	4	0	2	4	4	4	4	4	3.25	0.75
BO+	63	RSB	2.67					4	0	4	2	0	0				0.67	2.00
BO+	64	RSB	3.67	4	4	4	4	2	4	0	0	1	0	2	4	1	1.14	2.52
BO+	65	RSB	3.00				2	4	2	4	0	4	4	0	4	2	2.33	0.67
BO+	66	RSB	4.00	4	4	4	4	4	4	4	4	2	0	0	0	0	1.43	2.57
BO+	67	RSB	2.75			1	4	4	2	0	0	0	0	0	1	1	0.29	2.46
BO+	68	RSB	3.00			1	4	4	2	0	1	0	0	2			0.83	2.17
BO+	69	RSB	4.00	4	4	4	4	4	4	2	4	4	4	4	4		3.75	0.25
BO+	70	RSB	3.33				4	4	4	0	4	4	4	4	4	4	4.00	(0.67)
BO+	71	RSB	3.00				2	4	4	2	4	2	0	1	0	1	0.50	2.50
BO+	72	RSB	3.56	4	4	2	4	3	4	4	3	4	4	4	4	4	4.00	(0.44)
BO+	73	RSB	4.00				4	4	4	4	4	2	4	2	2	1	2.71	1.29
BO+	74	RSB	2.57	4	0	0	4	4	4	2	0	2	1				1.00	1.57
BO+	75	RSB	4.00	4	4	4	4	4	4	4	4	4	4	3	4	4	3.89	0.11
BO+	76	RSB	3.00			4	4	4	0	4	4	4	4	4	4	4	4.00	(1.00)
BO+	77	RSB	3.00			0	4	0	4	4	4	4	4	4	4	0	2.67	0.33
BO+	78	RSB	3.75		4	2	4	4	4	4	4	4	1	0	0	0	0.25	3.50
BO+	79	RSB	4.00		4	4	4	4	4	4	4	2	4	4	4	4	3.71	0.29
BO+	80	RSB	4.00	4	4	4	4	4	4	4	4	4	4	2	4	4	3.33	0.67
BO+	81	RSB	4.00	4	4	4	4	4	4	1	0	0	0	2	1		1.14	2.86
BO+	82	RSB	3.20			4	4	0	4	4	4	4	0	0	0	0	1.33	1.87
BO+	83	RSB	3.13			2	2	4	4	4	4	4	1	2	0	1	1.00	2.13
BO+	84	RSB	4.00	4	4	4	4	4	2	0	0	0	1	2	4	0	1.70	2.30

[a] Occupancy scores were as follows: 0 = no owls, 1= single male or female owl detected, resident status unknown, 2 = resident female or male, 3 = resident female or male with

response (audible or visual) from owl of the opposite sex, 4 = resident pair present.
[b] ID = Territory identification number.
[c] SA = Study Areas: CLE = Cle Elum, HJA = HJ Andrews, OCR = Oregon Coast Range, OLY = Olympic Peninsula, RSB = Roseburg.
[d] mean diff ($\bar{d}$) = Mean occupancy score from the post-BO period subtracted from the mean occupancy score from the pre-BO period. Numbers in parentheses are negative numbers.

A2. Occupancy scores at spotted owl territories where no barred owls were detected within 2.40 km of the territory center and that were used as paired comparisons to territories where barred owls were detected within 0.80 km of the territory center[a]. Highlighted cells indicate years that barred owls were detected at the BO+ territory with which the BO- territory was paired (see Appendix A1). Pre- and post-BO columns indicate mean occupancy scores before and after barred owls were first detected at BO+ territories.

Status	ID[b]	SA[c]	pre-BO	87	88	89	90	91	92	93	94	95	96	97	98	99	post-BO	mean diff ($\bar{d}$)[d]
BO-	1	CLE	4.00				4	4	4	4	4	4	4	4	4	4	4.00	0.00
BO-	2	CLE	4.00				4	4	4	4	4	4	4	0	1	0	2.43	1.57
BO-	3	CLE	2.67						4	0	4	4	2	4	4	2	3.20	(0.53)
BO-	4	CLE	4.00					4	4	4	4	4	4	4	4	4	4.00	0.00
BO-	5	CLE	3.60			2	4	4	4	4	4	4	4	1	4	2	3.17	0.43
BO-	6	CLE	0.86			0	2	0	0	0	0	4	0	4	4	4	3.00	(2.14)
BO-	7	CLE	4.00				4	4	4	4	4	4	4	0	0	1	2.17	1.83
BO-	8	CLE	2.80			4	2	2	2	4	4	2	4	4	4	4	3.67	(0.87)
BO-	9	CLE	2.67			2	4	0	4	2	4	4	4	4	0	4	3.20	(0.53)
BO-	10	CLE	3.00					4	4	2	2	0	0	0	0	0	0.00	3.00
BO-	11	CLE	4.00							4	4	4	4	4	4	4	4.00	0.00
BO-	12	HJA	4.00							4	4	4	3	4	4	0	2.75	1.25
BO-	13	HJA	3.75	3	4	4	4	4	4	0	4	4	4	4	4	4	3.56	0.19
BO-	14	HJA	3.33				4	4	4	4	4	0	0	0	4		1.33	2.00
BO-	15	HJA	4.00	4	4	4	4	4	4	0	4	2	4	4	2	4	3.20	0.80
BO-	16	HJA	4.00			4	4	4	4	3	2	2	4	2	0	0	1.86	2.14
BO-	17	HJA	3.80						4	4	3	4	4	4	4	4	4.00	(0.20)
BO-	18	HJA	4.00	4	4	4	2	4	4	4	4	4	4	4	4	4	3.80	0.20
BO-	19	HJA	3.60			4	4	4	4	2	4	4	4				4.00	(0.40)
BO-	20	HJA	4.00	4	4	4	4	4	4	4	4	4	4	4	4	4	4.00	0.00
BO-	21	HJA	3.83	3	4	4	4	4	4	4	4	4	4	4	4	4	4.00	(0.17)
BO-	22	HJA	4.00	4	4	4	4	4	4	4	4	4	2	4	4	4	3.67	0.33
BO-	23	HJA	4.00	4	4	4	4	4	4	4	4	4	4	4	4	4	4.00	0.00
BO-	24	OCR	1.67						1	4	0	1	0	1	0	0	0.40	1.27
BO-	25	OCR	2.33							1	2	4	4	4	4	4	4.00	(1.67)
BO-	26	OCR	3.60						4	2	4	4	4	4	4	2	3.33	0.27
BO-	27	OCR	3.00				2	3	4	0	0	0	0	0	2		0.33	2.67
BO-	28	OCR	1.67					1	0	1	4	4	0	0	1	4	1.67	0.00
BO-	29	OCR	3.25				4	4	2	3	4	2	4	4	4	4	3.67	(0.42)
BO-	30	OCR	3.60					2	4	4	4	4	2	0	4	4	2.50	1.10
BO-	31	OCR	2.67				0	4	4	4	4	4	4	4	4		4.00	(1.33)
BO-	32	OCR	4.00								4	4	4	4	4	4	4.00	0.00
BO-	33	OCR	4.00							4	4	4	4	4	4	4	4.00	0.00
BO-	34	OCR	4.00				4	4	4	4	4	4	4	4	4	4	4.00	0.00
BO-	35	OCR	3.25				1	4	4	4	4	4	4	4	4	4	4.00	(0.75)
BO-	36	OCR	2.00								4	0	2	0	1	0	0.33	1.67
BO-	37	OCR	4.00						4	4	4	4	4	0	4	4	3.20	0.80

Status	ID[b]	SA[c]	pre-BO	87	88	89	90	91	92	93	94	95	96	97	98	99	post-BO	mean diff ($\bar{d}$)[d]
BO-	38	OCR	3.50							2	4	4	4	4	4	4	4.00	(0.50)
BO-	39	OCR	1.33					0	3	1	0	0	4	4	4	4	4.00	(2.67)
BO-	40	OCR	2.67				4	0	4	2	4	4	4	4	4	4	3.71	(1.05)
BO-	41	OCR	3.60				4	2	4	4	4	4	4	4	4	4	4.00	(0.40)
BO-	42	OCR	1.29				0	0	1	2	1	1	4	4	4	4	4.00	(2.71)
BO-	43	OCR	4.00				4	4	4	4	4	4	4	4	4	2	3.50	0.50
BO-	44	OCR	3.60						4	4	4	2	4	4	4	4	4.00	(0.40)
BO-	45	OCR	3.29				1	2	4	4	4	4	4	4	4	4	4.00	(0.71)
BO-	46	OCR	4.00				4	4	4	4	4	4	2	4	4	4	3.60	0.40
BO-	47	OLY	3.40		2	3	4	4	4	2	1	0	0	0	0	0	0.43	2.97
BO-	48	OLY	4.00					4	4	4	4	4	4	4	4	2	3.60	0.40
BO-	49	OLY	3.50					4	4	4	2	2	4	2			2.67	0.83
BO-	50	OLY	4.00	4	4	4	4	4	4	4	2	0	2	0	0	0	1.50	2.50
BO-	51	OLY	1.40				0	2	4	1	0	2	4	4	4	0	2.80	(1.40)
BO-	52	OLY	2.80	4	4	2	4	0	4	3	2	2	4	4	4	4	3.38	(0.58)
BO-	53	OLY	2.29			4	3	3	0	0	2	4	4	4	4	0	3.00	(0.71)
BO-	54	OLY	4.00	4	4	4	4	4	4	4	4	4	4	4	4	0	3.43	0.57
BO-	55	OLY	4.00			4	4	4	4	4	4	4	2	0	2	2	1.50	2.50
BO-	56	OLY	3.67		2	4	4	4	4	4	4	3	4	4	2	0	2.00	1.67
BO-	57	OLY	3.71			2	4	4	4	4	4	4	4	4	4	0	3.00	0.71
BO-	58	OLY	3.50		4	4	4	2	4	4	4	3	4				3.80	(0.30)
BO-	59	OLY	3.67	2	4	4	4	4	4	4	4	3	4	4	4	0	3.00	0.67
BO-	60	RSB	3.50	4	4	1	4	4	4	3	4	3	4	4	4	4	3.80	(0.30)
BO-	61	RSB	3.33	4	2	4	4	2	4	2	3	4	4	4	4	4	3.50	(0.17)
BO-	62	RSB	3.00		4	4	2	2	4	4	4	4	4	4	4	2	3.75	(0.75)
BO-	63	RSB	1.67					0	1	4	4	4	4				4.00	(2.33)
BO-	64	RSB	3.67	4	4	2	4	4	4	4	4	4	4	4	4	4	4.00	(0.33)
BO-	65	RSB	3.25				2	4	3	4	1	4	4	4	4	2	3.17	0.08
BO-	66	RSB	2.00	0	0	0	4	4	4	4	4	4	4	4	4	4	4.00	(2.00)
BO-	67	RSB	3.25			4	3	2	4	4	4	4	4	4	4	4	4.00	(0.75)
BO-	68	RSB	4.00			4	4	4	0	4	4	4	4	4			3.33	0.67
BO-	69	RSB	2.50	0	2	4	4	4	4	4	4	2	4	0	4		3.25	(0.75)
BO-	70	RSB	3.00				0	4	4	2	4	4	4	2	0	4	2.50	0.50
BO-	71	RSB	3.17				4	4	2	4	4	1	0	0	1	1	0.50	2.67
BO-	72	RSB	2.89	4	4	1	0	1	4	4	4	4	4	1	1	4	2.50	0.39
BO-	73	RSB	2.67				4	2	2	1	0	1	0	4	0	4	1.43	1.24
BO-	74	RSB	4.00	4	4	4	4	4	4	4	4	4	0				2.67	1.33
BO-	75	RSB	4.00	4	4	4	4	4	4	4	4	4	4	1	4	2	3.44	0.56
BO-	76	RSB	2.00			0	0	4	4	2	4	4	2	2	4	4	3.14	(1.14)
BO-	77	RSB	3.75			4	4	4	4	4	4	2	4	4	4	4	4.00	(0.25)
BO-	78	RSB	4.00		4	4	4	4	4	4	4	4	4	4	4	4	4.00	0.00
BO-	79	RSB	3.40		1	4	4	4	4	4	1	3	4	4	4	2	3.14	0.26
BO-	80	RSB	3.20	4	4	4	4	4	4	2	0	4	2	2	4	4	3.33	(0.13)
BO-	81	RSB	4.00	4	4	4	4	4	4	4	4	4	4	2	4		3.71	0.29

Status	ID[b]	SA[c]	pre-BO	87	88	89	90	91	92	93	94	95	96	97	98	99	post-BO	mean diff ($\bar{d}$)[d]
BO-	82	RSB	3.60			4	4	2	4	4	4	4	4	4	4	4	4.00	(0.40)
BO-	83	RSB	3.63			1	4	4	4	4	4	4	4	4	4	4	4.00	(0.38)
BO-	84	RSB	4.00	4	4	4	4	4	4	4	4	4	4	4	4	4	4.00	0.00

[a] Occupancy scores were as follows: 0 = no owls, 1= single male or female owl detected, resident status unknown, 2 = resident female or male, 3 = resident female or male with response (audible or visual) from owl of the opposite sex, 4 = resident pair present.
[b] ID = Territory identification number.
[c] SA = Study Areas: CLE = Cle Elum, HJA = HJ Andrews, OCR = Oregon Coast Range, OLY = Olympic Peninsula, RSB = Roseburg.
[d] mean diff ($\bar{d}$) = Mean occupancy score from the post-BO period subtracted from the mean occupancy score from the pre-BO period. Numbers in parentheses are negative numbers.

A3. Occupancy scores at spotted owl territories where barred owls were detected between 0.81 and 2.40 km of the territory center[a]. Highlighted cells indicate years that barred owls were detected from 1987-1999. Pre- and post-BO columns indicate mean occupancy scores before and after barred owls were first detected.

Status	ID[b]	SA[c]	pre-BO	87	88	89	90	91	92	93	94	95	96	97	98	99	post-BO	mean diff ($\bar{d}$)[d]
BO+	1	CLE	2.83			4	4	2	2	1	4	4	4	4	0	0	2.40	0.43
BO+	2	CLE	4.00			4	4	4	4	4	4	4	4	4	4	4	4.00	0.00
BO+	3	CLE	3.00				4	2	2	4	2	4	4	4	4	4	3.67	(0.67)
BO+	4	CLE	3.60				4	4	4	2	4	4	4	4	4	4	4.00	(0.40)
BO+	5	CLE	4.00			4	4	4	4	4	4	4	4	4	4	4	4.00	0.00
BO+	6	CLE	4.00				4	4	4	4	4	4	4	4	4	2	3.71	0.29
BO+	7	CLE	4.00				4	4	4	4	4	4	4	4	4	4	4.00	0.00
BO+	8	CLE	3.33			4	2	4	4	2	0						2.00	1.33
BO+	9	CLE	4.00			4	4	4	4	4	4	4	4	4	4	0	3.20	0.80
BO+	10	HJA	2.75	1	4	4	4	4	4	0	1	0	1	0	4	4	1.80	0.95
BO+	11	HJA	2.00						0	0	4	4	4	4	4	4	4.00	(2.00)
BO+	12	HJA	3.86			4	4	4	4	3	4	4	4	4	4	4	4.00	(0.14)
BO+	13	HJA	3.40			1	4	4	4	4	4	4	4				4.00	(0.60)
BO+	14	HJA	4.00			4	4	4	4	4	4	4	4	4	4	4	4.00	0.00
BO+	15	HJA	1.20	0	0	0	0	0	0	2	2	4	4	4	4	4	4.00	(2.80)
BO+	16	HJA	3.00						4	4	4	0	1	0	1	2	1.00	2.00
BO+	17	HJA	3.33		4	4	2	3	4	4	4	4	4				3.83	(0.50)
BO+	18	HJA	4.00		4	4	4	4	4	4	4	4	4	4	4	4	4.00	0.00
BO+	19	HJA	2.33			3	4	0	3	4	4	4					3.75	(1.42)
BO+	20	HJA	3.83			4	4	4	4	4	3	0	0	0	0	0	0.00	3.83
BO+	21	HJA	2.33				2	4	4	4	0	0	0	0	4	4	2.00	0.33
BO+	22	HJA	4.00	4	4	4	4	4	4	4							4.00	0.00
BO+	23	HJA	3.80	4	4	3	4	4	4	4	4	4	4	4	4	4	4.00	(0.20)
BO+	24	HJA	3.50				4	4	4	1	4	4	4	4	4	2	3.50	0.00
BO+	25	HJA	3.20			4	4	4	2	2	0	0	0	0			0.00	3.20
BO+	26	HJA	2.67		2	2	4	4	4	4	4	4	4	4	4	4	4.00	(1.33)
BO+	27	HJA	2.80						4	0	2	4	4	4	4	4	4.00	(1.20)
BO+	28	HJA	4.00	4	4	4	4	4	4	4	4	4	4	4	4	4	4.00	0.00
BO+	29	HJA	3.70	2	4	4	3	4	4	4	4	4	4	4	4	0	2.67	1.03
BO+	30	HJA	3.70	4	4	4	4	4	4	4	4	4	1	0	0	0	0.00	3.70
BO+	31	HJA	2.00				0	2	4	2	4	2					2.67	(0.67)
BO+	32	OCR	3.00							1	4	4	4	0	4	4	3.00	0.00
BO+	33	OCR	3.33				4	4	4	2	2	4	4	4	4	4	4.00	(0.67)
BO+	34	OCR	1.00				0	0	0	4	0	4	4	4	4	4	3.33	(2.33)
BO+	35	OCR	3.67				4	3	4	2	0	4	4	2	4		2.67	1.00
BO+	36	OCR	3.67				4	3	4	4	4	4	4	4	0	2	3.14	0.52
BO+	37	OCR	4.00						4	4	4	4	4	4	4	4	4.00	0.00
BO+	38	OCR	2.86				4	4	4	0	4	0	4	2	2	0	1.33	1.52
BO+	39	OCR	4.00				4	4	4	4	4	4	4	4	4	4	4.00	0.00
BO+	40	OCR	3.00				4	4	4	1	1	4	0	2	4	4	2.50	0.50
BO+	41	OCR	4.00				4	4	4	0	4	4	4	4	4	4	3.43	0.57

Status	ID[b]	SA[c]	pre-BO	87	88	89	90	91	92	93	94	95	96	97	98	99	post-BO	mean diff ($\bar{d}$)[d]
BO+	42	OCR	3.00				1	4	4	4	4	4	4	4	4	4	4.00	(1.00)
BO+	43	OCR	4.00						4	4	4	4	4	4	2		3.50	0.50
BO+	44	OCR	2.40				4	1	4	3	0	0	4	4	4	4	3.20	(0.80)
BO+	45	OCR	4.00				4	4	4	4	4	4	4	4	4	4	4.00	0.00
BO+	46	OCR	4.00								4	4	4	4	4	4	4.00	0.00
BO+	47	OCR	2.75				2	2	4	3	1	2	4				2.33	0.42
BO+	48	OLY	3.67		2	4	4	4	4	4	4	4	4	4	4	0	3.33	0.33
BO+	49	OLY	3.00			4	4	2	4	3	4	0	1	4	4	4	3.25	(0.25)
BO+	50	OLY	2.33	4	0	2	0	4	4	2	2	4	4	4	4	4	3.43	(1.10)
BO+	51	OLY	3.67	3	4	4	4	4	4	4	4	4	4	4	4	0	3.60	0.07
BO+	52	OLY	3.80		3	4	4	4	4	4	4	3	4	4	4	4	3.86	(0.06)
BO+	53	OLY	3.50				4	4	4	2	1	4	4	4	4	0	2.83	0.67
BO+	54	OLY	3.86			4	4	4	3	4	4	4	4	4	4	4	4.00	(0.14)
BO+	55	OLY	2.89	2	1	4	4	4	4	4	0	3	0	2	4	0	1.50	1.39
BO+	56	OLY	3.50					4	4	2	4	1	1	4	4	4	2.80	0.70
BO+	57	OLY	3.83			3	4	4	4	4	4	4	4	0	0	0	1.60	2.23
BO+	58	RSB	3.33	4	2	2	4	4	2	4	4	4	4	4	4	4	4.00	(0.67)
BO+	59	RSB	3.71			4	4	2	4	4	4	4	4	2	0	4	2.50	1.21
BO+	60	RSB	3.71			2	4	4	4	4	4	4	4	4	4	2	3.50	0.21
BO+	61	RSB	3.00				4	4	4	4	2	0	0	0	2	2	1.00	2.00
BO+	62	RSB	4.00			4	4	4	0	0	0	2	0				0.40	3.60
BO+	63	RSB	4.00	4	4	4	4	4	4	4	4	4	4	0	2	4	3.14	0.86
BO+	64	RSB	2.50			2	2	2	4	4	4	4	4	4	0	0	2.86	(0.36)
BO+	65	RSB	4.00	4	4	4	4	4	4	4	4	4	4	4	2	4	3.80	0.20
BO+	66	RSB	3.00			4	4	4	0	4	4	4	4	4	4	2	3.71	(0.71)
BO+	67	RSB	2.67	4	4	0	0	0	0	0	0	0	2	0	0	1	0.30	2.37
BO+	68	RSB	4.00			4	4	4	4	4	4	4	4	4	4	1	3.40	0.60
BO+	69	RSB	1.60				2	0	4	2	0	0	4	4	4	4	3.20	(1.60)
BO+	70	RSB	4.00				4	4	4	4	4	1	3	0	0	4	2.29	1.71
BO+	71	RSB	4.00	4	4	4	4	4	4	4	4	2	4	4	4	4	3.71	0.29
BO+	72	RSB	3.67	4	4	4	4	4	4	4	4	1	4	4	4	4	4.00	(0.33)
BO+	73	RSB	2.17	1	2	2	4	0	4	2	0	1	0	4	1	2	1.43	0.74
BO+	74	RSB	1.60		0	0	0	4	4	4	0	0	1	1	0	0	0.86	0.74
BO+	75	RSB	3.50	4	4	2	1	4	4	4	4	4	4	0	0	0	0.00	3.50
BO+	76	RSB	1.67	0	1	1	1	3	4	2	4	4	4				3.50	(1.83)
BO+	77	RSB	4.00				4	4	4	2	4	1	0				1.75	2.25
BO+	78	RSB	2.00				3	2	4	1	0	0	0	0	4	2	1.20	0.80
BO+	79	RSB	4.00	4	4	4	4	4	4	4	4	4	4	4	4	4	4.00	0.00
BO+	80	RSB	2.33	4	2	1	0	2	4	4	1	0	2	4	0	4	2.10	0.23
BO+	81	RSB	3.75	4	4	4	3	4	4	4	4	4	1	4	4		3.63	0.13
BO+	82	RSB	3.60	4	4	2	4	4	4	4	4	4	4	2	4	4	3.75	(0.15)
BO+	83	RSB	1.60			0	4	4	0	0	4	0	4	4	4	4	3.33	(1.73)
BO+	84	RSB	2.33	1	2	4	4	2	4	4	4	4	4	4	4	4	3.80	(1.47)
BO+	85	RSB	4.00			4	4	4	4	4	4	4	4	4	4	4	4.00	0.00

[a] Occupancy scores were as follows: 0 = no owls, 1= single male or female owl detected, resident status unknown, 2 = resident female or male, 3 = resident female or male with response (audible or visual) from owl of the opposite sex, 4 = resident pair present.
[b] ID = Territory identification number.
[c] SA = Study Areas: CLE = Cle Elum, HJA = HJ Andrews, OCR = Oregon Coast Range, OLY = Olympic Peninsula, RSB = Roseburg.
[d] mean diff ($\bar{d}$) = Mean occupancy score from the post-BO period subtracted from the mean occupancy score from the pre-BO period. Numbers in parentheses are negative numbers.

A4. Occupancy scores at spotted owl territories where no barred owls were detected within 2.40 km of the territory center and that were used as paired comparisons to territories where barred owls were detected between 0.81 and 2.40 km of the territory center[a]. Highlighted cells indicate years that barred owls were detected at the BO+ territory with which the BO- territory was paired (see Appendix A3). Pre- and post-BO columns indicate mean occupancy scores before and after barred owls were first detected at BO+ territories.

Status	ID[b]	SA[c]	pre-BO	87	88	89	90	91	92	93	94	95	96	97	98	99	post-BO	mean diff ($\bar{d}$)[d]
BO-	1	CLE	3.00			4	4	2	4	2	2	4	2	4	4	2	3.20	(0.20)
BO-	2	CLE	1.00			0	0	2	1	0	0	4	0	1	1	1	0.75	0.25
BO-	3	CLE	4.00				4	4	4	4	4	4	4	1	4	4	3.50	0.50
BO-	4	CLE	4.00				4	4	4	4	4	4	0	0	0	0	0.80	3.20
BO-	5	CLE	2.43			4	4	4	0	1	0	4	4	2	4	4	3.50	(1.07)
BO-	6	CLE	4.00				4	4	4	4	4	4	4	4	4	0	3.43	0.57
BO-	7	CLE	4.00				4	4	4	4	4	4	4	4	4	4	4.00	0.00
BO-	8	CLE	4.00			4	4	4	4	4	4						4.00	0.00
BO-	9	CLE	3.33			2	4	4	4	4	2	2	2	2	4	4	2.80	0.53
BO-	10	HJA	2.75	1	2	2	4	4	4	1	4	4	4	4	4	4	4.00	(1.25)
BO-	11	HJA	2.50						2	0	4	4	4	4	4	4	4.00	(1.50)
BO-	12	HJA	3.71			4	4	4	4	2	4	4	4	2	4	4	3.50	0.21
BO-	13	HJA	4.00			4	4	4	4	4	4	4	4				4.00	0.00
BO-	14	HJA	2.71			4	4	4	4	2	1	0	4	4	4	4	4.00	(1.29)
BO-	15	HJA	4.00	4	4	4	4	4	4	4	4	4	4	4	4	4	4.00	0.00
BO-	16	HJA	3.50						4	4	4	2	4	0	4	2	2.50	1.00
BO-	17	HJA	3.00		4	2	3	2	3	0	4	1	4				2.33	0.67
BO-	18	HJA	3.33		2	4	4	4	4	4	1	4	4	2	2	4	3.22	0.11
BO-	19	HJA	3.33			4	4	2	4	2	4	2					3.00	0.33
BO-	20	HJA	3.83			4	4	4	4	3	4	4	4	4	4	4	4.00	(0.17)
BO-	21	HJA	3.83				4	4	4	4	4	3	4	0	4	1	2.25	1.58
BO-	22	HJA	4.00	4	4	4	4	4	4	4							4.00	0.00
BO-	23	HJA	4.00	4	4	4	4	4	4	2	3	4	4	4	4	4	3.63	0.38
BO-	24	HJA	3.67				4	4	4	4	2	4	4	4	4	4	4.00	(0.33)
BO-	25	HJA	3.60			4	4	4	4	2	4	4	4	4			4.00	(0.40)
BO-	26	HJA	3.33		2	4	4	4	4	4	4	4	4	4	4	4	4.00	(0.67)
BO-	27	HJA	1.80						4	1	4	0	0	4	0	4	2.67	(0.87)
BO-	28	HJA	3.71	2	4	4	4	4	4	4	2	2	1	0	0	1	1.00	2.71
BO-	29	HJA	4.00	4	4	4	4	4	4	4	4	4	4	0	4	4	2.67	1.33
BO-	30	HJA	4.00	4	4	4	4	4	4	4	4	4	4	4	4	1	3.00	1.00
BO-	31	HJA	4.00				4	4	4	0	1	0					0.33	3.67
BO-	32	OCR	4.00							4	4	4	2	4	4	2	3.00	1.00
BO-	33	OCR	4.00				4	4	4	4	4	4	4	4	4	4	4.00	0.00
BO-	34	OCR	3.25				4	1	4	4	4	4	4	4	4	4	4.00	(0.75)
BO-	35	OCR	2.67				4	4	0	0	4	4	4	2	4		3.00	(0.33)
BO-	36	OCR	3.33				4	4	2	1	0	0	0	0	0	0	0.14	3.19
BO-	37	OCR	2.60						4	4	4	0	1	4	4	4	4.00	(1.40)
BO-	38	OCR	2.57				4	4	4	2	0	0	4	4	4	4	4.00	(1.43)
BO-	39	OCR	3.33				2	4	4	1	4	1	3	0	3	2	2.00	1.33

Status	ID[b]	SA[c]	pre-BO	87	88	89	90	91	92	93	94	95	96	97	98	99	post-BO	mean diff (d̄)[d]
BO-	40	OCR	4.00				4	4	4	4	4	4	4	4	4	4	4.00	0.00
BO-	41	OCR	3.33				4	2	4	4	4	4	4	4	4	4	4.00	(0.67)
BO-	42	OCR	4.00				4	4	4	4	4	4	0	0	0	0	1.71	2.29
BO-	43	OCR	4.00						4	4	4	4	4	4	4		4.00	0.00
BO-	44	OCR	1.80				0	2	1	2	4	4	0	0	0	0	0.80	1.00
BO-	45	OCR	3.86				3	4	4	4	4	4	4	4	4	4	4.00	(0.14)
BO-	46	OCR	4.00								4	4	4	4	4	4	4.00	0.00
BO-	47	OCR	3.50				2	4	4	4	4	4	4				4.00	(0.50)
BO-	48	OLY	4.00		4	4	4	4	4	4	4	4	4	4	4	2	3.67	0.33
BO-	49	OLY	3.29			4	4	3	2	2	4	4	4	2	4	0	2.50	0.79
BO-	50	OLY	4.00	4	4	4	4	4	4	3	3	0	4	4	4	4	3.14	0.86
BO-	51	OLY	3.67	3	4	4	4	4	4	2	3	4	4	4	4	0	3.30	0.37
BO-	52	OLY	0.80		0	0	0	0	4	3	4	3	4	4	4	0	3.14	(2.34)
BO-	53	OLY	3.50				2	4	4	4	4	4	4	0	2	2	2.67	0.83
BO-	54	OLY	2.86			4	2	4	4	0	4	2	4	4	0	0	2.00	0.86
BO-	55	OLY	4.00	4	4	4	4	4	4	4	4	4	4	4	4	0	3.00	1.00
BO-	56	OLY	4.00					4	4	4	4	4	4	4	4	0	3.20	0.80
BO-	57	OLY	4.00			4	4	4	4	4	4	2	4	0	0	0	1.20	2.80
BO-	58	RSB	3.56	4	4	4	4	2	4	2	4	4	3	4	4	4	3.75	(0.19)
BO-	59	RSB	3.29			4	4	4	2	1	4	4	0	0	3	4	1.75	1.54
BO-	60	RSB	1.86			4	4	0	0	1	4	0	4	4	4	4	4.00	(2.14)
BO-	61	RSB	4.00				4	4	4	4	4	4	1	4	0	2	1.75	2.25
BO-	62	RSB	3.33			2	4	4	0	4	4	2	1				2.20	1.13
BO-	63	RSB	3.33	4	0	4	4	4	4	2	4	4	4	4	2	4	3.43	(0.10)
BO-	64	RSB	1.25			1	4	0	0	1	1	0	2	2	0	0	0.86	0.39
BO-	65	RSB	4.00	4	4	4	4	0	0	4	4	4	4	4	4	4	3.20	0.80
BO-	66	RSB	3.25			1	4	4	4	0	0	4	4	4	4	4	2.86	0.39
BO-	67	RSB	4.00	4	4	4	1	4	2	1	0	2	0	2	1	4	1.70	2.30
BO-	68	RSB	4.00			4	4	4	4	4	4	4	4	4	4	1	3.40	0.60
BO-	69	RSB	3.00				4	2	4	4	1	0	4	0	0	1	1.00	2.00
BO-	70	RSB	4.00				4	4	4	0	4	4	1	0	0	0	1.29	2.71
BO-	71	RSB	3.67	4	4	4	4	2	4	4	4	1	4	4	1	4	3.14	0.52
BO-	72	RSB	3.33	4	2	4	4	3	4	1	4	4	4	4	2	4	3.50	(0.17)
BO-	73	RSB	2.33	4	1	2	3	0	4	4	2	2	3	4	4	2	3.00	(0.67)
BO-	74	RSB	3.80		4	3	4	4	4	4	4	4	4	2	1	4	3.29	0.51
BO-	75	RSB	3.60	4	0	4	4	4	4	4	4	4	4	4	4	4	4.00	(0.40)
BO-	76	RSB	4.00	4	4	4	4	4	4	4	4	4	1				3.25	0.75
BO-	77	RSB	4.00				4	4	4	4	1	0	1				1.50	2.50
BO-	78	RSB	3.20				0	4	4	4	4	4	4	4	4	4	4.00	(0.80)
BO-	79	RSB	3.43	4	4	4	4	4	4	0	4	4	4	4	2	0	3.00	0.43
BO-	80	RSB	4.00	4	4	4	4	4	4	4	4	4	4	4	4	4	4.00	0.00
BO-	81	RSB	4.00	4	4	4	4	4	4	4	4	4	2	1	4		3.38	0.63
BO-	82	RSB	4.00	4	4	4	4	4	2	4	1	4	4	4	4	4	3.38	0.63
BO-	83	RSB	3.00			4	4	2	1	4	4	4	2	4	1	1	2.67	0.33
BO-	84	RSB	4.00	4	4	4	4	4	4	2	4	4	2	2	2	1	2.90	1.10
BO-	85	RSB	3.38			4	4	4	0	3	4	4	4	4	0	4	2.67	0.71

[a] Occupancy scores were as follows: 0 = no owls, 1= single male or female owl detected, resident status unknown, 2 = resident female or male, 3 = resident female or male with response (audible or visual) from owl of the opposite sex, 4 = resident pair present.
[b] ID = Territory identification number.
[c] SA = Study Areas: CLE = Cle Elum, HJA = HJ Andrews, OCR = Oregon Coast Range, OLY = Olympic Peninsula, RSB = Roseburg.
[d] mean diff ($\bar{d}$) = Mean occupancy score from the post-BO period subtracted from the mean occupancy score from the pre-BO period. Numbers in parentheses are negative numbers.

APPENDIX B

B1. Reproductive scores of spotted owl pairs at territories where barred owls were detected within 0.80 km of the territory center relative to spotted owl pairs at territories where no barred owls were detected within 2.40 km of the territory center[a]. Highlighted cells indicate years that barred owls were detected from 1987-1999 and numbers in parentheses are negative numbers. Pre- and post-BO columns indicate mean scores before and after barred owls were detected.

ID[b]	SA[c]	pre-BO	87	88	89	90	91	92	93	94	95	96	97	98	99	post-BO	mean diff ($\bar{d}$)[d]
1	CLE	(0.17)	x	x	x	(1)	0	0	x	0	0	0	(1)	0	(1)	(0.67)	0.50
2	CLE	1.00	x	x	x	1	1	1	0	(1)	(1)	x	x	x	x	(0.67)	1.67
3	CLE	0.50	x	x	x	x	x	1	x	0	0	x	x	0	x	0.00	0.50
4	CLE	0.50	x	x	x	x	x	1	0	0	0	(1)	x	(1)	x	(0.50)	1.00
5	CLE	0.75	x	x	x	x	x	x	0	1	1	1	(1)	1	(1)	(0.33)	1.08
6	HJA	(0.50)	x	x	x	x	x	x	0	x	(1)	x	0	0	x	0.00	(0.50)
7	HJA	0.00	x	0	0	x	x	(1)	x	x	x	x	x	x	x	(1.00)	1.00
8	HJA	(0.50)	x	(1)	0	(1)	1	(1)	x	0	x	x	x	x	x	(0.25)	(0.25)
9	HJA	0.33	x	x	x	x	x	1	x	x	0	0	0	1	(1)	0.00	0.33
10	HJA	0.00	0	0	0	x	0	(1)	x	0	0	0	0	x	x	(0.17)	0.17
11	HJA	0.14	0	0	1	1	(1)	0	0	x	0	x	x	x	x	0.00	0.14
12	HJA	0.14	0	1	0	0	0	0	0	(1)	0	x	0	(1)	x	(0.50)	0.64
13	HJA	(0.20)	0	0	(1)	0	0	(1)	x	0	x	x	x	x	x	(0.50)	0.30
14	OCR	0.00	x	x	x	x	x	x	x	x	0	0	0	(1)	x	(0.33)	0.33
15	OCR	0.00	x	x	x	x	x	0	x	0	0	0	0	x	x	0.00	0.00
16	OCR	0.00	x	x	x	x	0	x	x	0	x	0	0	1	x	0.25	(0.25)
17	OCR	(0.50)	x	x	x	x	(1)	0	0	0	0	0	x	1	x	0.20	(0.70)
18	OCR	(1.00)	x	x	x	x	x	x	x	x	x	(1)	0	0	0	0.00	(1.00)
19	OCR	0.00	x	x	x	x	x	x	x	x	0	0	0	1	x	0.33	(0.33)
20	OCR	(0.25)	x	x	x	0	0	0	(1)	x	0	0	0	0	x	0.00	(0.25)
21	OCR	0.00	x	x	x	x	0	x	x	x	x	(1)	0	1	x	0.00	0.00
22	OCR	0.00	x	x	x	x	x	1	(1)	0	0	0	x	1	0	0.25	(0.25)
23	OCR	(0.67)	x	x	x	x	x	x	x	(1)	(1)	0	0	0	0	0.00	(0.67)
24	OCR	0.00	x	x	x	x	x	x	x	x	x	0	0	0	0	0.00	0.00
25	OCR	0.00	x	x	x	0	x	0	0	x	0	x	0	(1)	0	(0.25)	0.25
26	OCR	0.20	x	x	x	1	x	0	0	1	(1)	1	x	x	x	1.00	(0.80)
27	OCR	0.00	x	x	x	x	x	1	0	0	x	(1)	0	(1)	0	(0.33)	0.33
28	OLY	(1.00)	x	x	x	x	x	x	x	(1)	0	0	1	(1)	x	0.00	(1.00)
29	OLY	0.20	1	0	0	0	0	(1)	x	x	x	x	x	x	x	(1.00)	1.20
30	OLY	0.00	x	x	x	x	x	0	x	x	x	0	x	0	x	0.00	0.00
31	OLY	(0.33)	0	(1)	x	0	x	(1)	x	x	x	x	x	x	x	(1.00)	0.67
32	OLY	0.00	x	x	0	0	0	0	0	0	x	0	(1)	x	x	(1.00)	1.00
33	OLY	(0.60)	x	x	x	0	(1)	(1)	0	(1)	x	1	x	x	x	1.00	(1.60)
34	OLY	(0.25)	x	(1)	0	0	x	x	x	0	x	x	(1)	0	x	(0.50)	0.25
35	RSB	(0.50)	(1)	x	0	0	x	x	x	x	1	x	x	x	0	0.33	(0.83)
36	RSB	0.00	x	0	0	x	x	1	x	x	(1)	1	(1)	1	x	0.20	(0.20)
37	RSB	(0.50)	0	(1)	x	(1)	x	0	x	x	x	x	x	0	x	0.00	(0.50)
38	RSB	0.00	x	x	x	x	0	x	0	x	0	0	x	0	x	0.00	0.00
39	RSB	0.33	x	x	x	1	0	0	0	(1)	x	x	x	x	x	(0.50)	0.83

ID[b]	SA[c]	pre-BO	87	88	89	90	91	92	93	94	95	96	97	98	99	post-BO	mean diff ($\bar{d}$)[d]
40	RSB	0.00	x	x	0	0	0	0	x	0	x	0	x	0	x	0.00	0.00
41	RSB	(0.50)	x	x	x	x	0	0	x	(1)	(1)	1	x	x	0	0.50	(1.00)
42	RSB	0.40	0	0	x	x	x	1	0	x	1	(1)	x	x	(1)	(1.00)	1.40
43	RSB	(0.25)	0	0	(1)	0	0	0	0	0	0	0	x	(1)	x	(0.14)	(0.11)
44	RSB	(1.00)	x	x	x	x	(1)	x	x	0	0	x	x	1	0	0.25	(1.25)
45	RSB	(0.50)	x	x	x	(1)	x	0	0	(1)	0	(1)	0	(1)	x	(0.50)	0.00
46	RSB	(0.50)	x	x	(1)	0	0	(1)	1	x	x	1	1	1	x	1.00	(1.50)
47	RSB	(0.29)	(1)	(1)	0	0	0	0	x	x	0	x	x	0	(1)	(0.50)	0.21
48	RSB	(0.20)	(1)	0	1	(1)	0	(1)	x	x	x	x	x	x	x	(1.00)	0.80
49	RSB	(0.25)	x	x	1	(1)	x	(1)	0	(1)	1	x	x	x	x	0.00	(0.25)
50	RSB	(0.33)	1	(1)	(1)	0	1	x	x	x	x	x	x	1	x	0.67	(1.00)

[a] Scores between spotted owl pairs at territories with barred owls (BO+) and spotted owl territories without barred owls (BO-) for each year were as follows: 0 = no difference in young between BO+ and BO- territories, 1 = young produced at BO+ territory, no young produced at BO- territory, (1) = no young produced at BO+ territory, young produced at BO- territory, x = no spotted owl pair at one or both territories.

[b] ID = Territory identification number.

[c] SA = Study Areas: CLE = Cle Elum, HJA = HJ Andrews, OCR = Oregon Coast Range, OLY = Olympic Peninsula, RSB = Roseburg.

[d] mean diff ($\bar{d}$) = Mean reproductive score from the post-BO period subtracted from the mean reproductive score from the pre-BO period.

B2. Reproductive scores of spotted owl pairs at territories where barred owls were detected between 0.81 and 2.40 km of the territory center relative to spotted owl pairs at territories where no barred owls were detected within 2.40 km of the territory center[a]. Highlighted cells indicate years that barred owls were detected from 1987-1999 and numbers in parentheses are negative numbers. Pre- and post-BO columns indicate mean scores before and after barred owls were detected.

ID[b]	SA[c]	pre-BO	87	88	89	90	91	92	93	94	95	96	97	98	99	post-BO	mean diff ($\bar{d}$)[d]
1	CLE	0.50	x	x	0	1	x	x	x	x	0	x	0	x	x	0.00	0.50
2	CLE	0.50	x	x	x	1	x	x	0	x	0	0	x	1	0	0.25	0.25
3	CLE	0.00	x	x	x	0	0	0	x	0	1	x	x	x	x	1.00	(1.00)
4	CLE	0.25	x	x	0	0	0	x	x	x	1	0	x	(1)	0	(0.33)	0.58
5	CLE	0.00	x	x	x	0	1	(1)	(1)	1	1	0	0	0	x	0.17	(0.17)
6	CLE	0.40	x	x	x	0	1	1	(1)	1	1	0	0	0	0	0.20	0.20
7	CLE	0.00	x	x	1	x	(1)	1	x	x	x	x	x	x	x	1.00	(1.00)
8	CLE	0.00	x	x	x	0	0	(1)	1	x	x	x	x	1	x	1.00	(1.00)
9	HJA	(0.33)	x	x	x	0	(1)	0	x	x	x	x	x	0	0	0.00	(0.33)
10	HJA	(0.50)	x	x	x	x	x	x	x	0	(1)	(1)	1	0	0	0.00	(0.50)
11	HJA	(0.17)	x	x	0	(1)	0	0	x	0	0	(1)	x	0	0	(0.33)	0.17
12	HJA	0.50	x	x	x	0	1	1	0	1	1	0	x	x	x	0.67	(0.17)
13	HJA	0.00	x	x	0	0	0	0	x	x	x	0	1	0	0	0.25	(0.25)
14	HJA	0.00	x	x	x	x	x	x	x	x	0	0	0	0	0	0.00	0.00
15	HJA	(1.00)	x	(1)	x	x	x	x	x	1	x	1	x	x	x	1.00	(2.00)
16	HJA	0.20	x	x	0	1	0	0	0	x	0	1	x	x	0	0.33	(0.13)
17	HJA	0.00	x	x	x	0	x	x	x	0	x	x	x	x	x	0.00	0.00
18	HJA	0.00	x	x	x	x	1	(1)	0	x	x	x	x	0	x	0.00	0.00
19	HJA	0.00	0	0	0	0	0	0	0	x	x	x	x	x	x	0.00	0.00
20	HJA	(0.25)	(1)	0	x	0	0	1	x	x	0	1	(1)	0	0	0.17	(0.42)
21	HJA	(0.25)	x	x	x	(1)	0	(1)	x	x	1	(1)	1	(1)	x	(0.33)	0.08
22	HJA	(0.33)	x	x	x	0	0	(1)	0	(1)	0	0	1	0	(1)	0.00	(0.33)
23	HJA	1.00	x	x	x	x	x	1	x	x	x	x	0	x	0	0.00	1.00
24	HJA	0.25	x	1	0	x	0	0	0	1	0	0	x	(1)	x	(1.00)	1.25
25	OCR	0.00	x	x	x	x	x	x	x	0	0	x	x	0	x	0.00	0.00
26	OCR	0.00	x	x	x	0	0	0	x	x	0	(1)	1	0	0	0.00	0.00
27	OCR	0.00	x	x	x	x	x	x	0	x	0	0	0	1	0	0.25	(0.25)
28	OCR	0.00	x	x	x	0	x	x	x	x	0	0	x	1	x	0.33	(0.33)
29	OCR	0.33	x	x	x	x	x	1	0	0	x	x	(1)	0	(1)	(0.67)	1.00
30	OCR	0.00	x	x	x	x	0	0	x	1	x	x	x	x	x	1.00	(1.00)
31	OCR	(0.50)	x	x	x	(1)	0	(1)	x	x	0	x	x	0	0	0.00	(0.50)
32	OCR	(0.50)	x	x	x	(1)	x	0	x	0	1	1	0	0	1	0.50	(1.00)
33	OCR	(0.50)	x	x	x	x	(1)	0	0	0	0	x	x	x	x	0.00	(0.50)
34	OCR	0.00	x	x	x	x	x	0	0	0	0	(1)	(1)	x	x	(0.67)	0.67
35	OCR	(0.33)	x	x	x	x	0	0	0	(1)	0	(1)	0	0	0	0.00	(0.33)
36	OCR	0.00	x	x	x	x	x	x	x	0	0	0	0	1	0	0.33	(0.33)
37	OCR	(1.00)	x	x	x	x	x	(1)	x	x	x	0	1	(1)	0	0.00	(1.00)
38	OLY	(0.20)	x	x	(1)	0	0	0	0	1	0	0	0	0	x	0.20	(0.40)
39	OLY	0.00	x	x	1	0	x	x	x	(1)	x	x	x	0	x	0.00	0.00
40	OLY	0.33	0	x	x	x	1	0	x	x	x	x	0	0	0	0.00	0.33
41	OLY	0.00	x	0	0	1	0	0	x	x	0	0	(1)	(1)	x	(0.14)	0.14
42	OLY	0.00	x	x	x	x	x	0	x	(1)	x	0	(1)	0	x	(0.50)	0.50
43	OLY	1.00	x	x	x	x	1	1	x	x	0	1	x	x	x	0.50	0.50

ID[b]	SA[c]	pre-BO	87	88	89	90	91	92	93	94	95	96	97	98	99	post-BO	mean diff (d̄)[d]
44	OLY	(0.67)	x	x	(1)	x	(1)	x	x	0	x	(1)	(1)	x	x	(1.00)	0.33
45	OLY	(0.40)	x	x	0	0	(1)	(1)	0	x	x	x	x	1	x	1.00	(1.40)
46	OLY	0.00	x	x	x	x	0	0	x	0	x	x	0	(1)	x	(0.50)	0.50
47	OLY	0.20	x	x	x	0	0	0	0	1	x	1	x	x	x	1.00	(0.80)
48	RSB	0.00	0	x	x	(1)	x	x	x	1	0	x	0	0	1	0.33	(0.33)
49	RSB	0.50	x	x	0	1	x	x	x	1	0	x	x	x	(1)	(1.00)	1.50
50	RSB	0.50	x	x	x	1	x	x	x	0	x	0	0	1	x	0.33	0.17
51	RSB	0.40	0	x	1	1	0	0	x	0	(1)	0	x	x	x	(0.33)	0.73
52	RSB	0.33	0	0	1	(1)	x	x	(1)	0	0	(1)	1	x	0	(0.29)	0.62
53	RSB	0.50	x	x	x	1	0	x	x	x	0	(1)	(1)	0	x	(0.50)	1.00
54	RSB	0.00	x	x	0	1	(1)	0	0	0	0	0	0	0	x	0.00	0.00
55	RSB	0.00	x	x	x	x	x	0	x	x	x	1	x	x	x	1.00	(1.00)
56	RSB	0.00	x	x	x	0	0	0	x	0	x	x	x	x	x	0.00	0.00
57	RSB	0.00	0	0	0	0	x	0	0	0	x	0	0	x	0	0.00	0.00
58	RSB	(0.40)	(1)	x	1	0	x	(1)	x	(1)	x	0	0	x	(1)	(0.33)	(0.07)
59	RSB	0.00	x	x	x	x	x	0	x	x	x	x	0	x	x	0.00	0.00
60	RSB	0.00	x	x	x	x	0	0	(1)	x	x	x	x	x	x	(1.00)	1.00
61	RSB	1.00	x	x	x	x	x	1	x	0	0	x	x	x	x	0.00	1.00
62	RSB	(1.00)	x	x	x	x	x	(1)	x	x	x	x	x	0	x	0.00	(1.00)
63	RSB	0.17	0	0	0	1	(1)	1	x	0	0	0	1	x	x	0.25	(0.08)
64	RSB	(1.00)	(1)	x	x	x	x	0	0	x	x	x	0	x	0	0.00	(1.00)
65	RSB	0.00	0	1	(1)	x	0	1	x	(1)	0	x	x	0	x	0.00	0.00
66	RSB	0.50	1	0	x	1	0	x	(1)	x	1	(1)	x	(1)	0	(0.40)	0.90
67	RSB	1.00	x	x	x	1	x	x	x	0	x	x	1	x	x	0.50	0.50
68	RSB	1.00	x	x	1	1	x	0	x	(1)	1	x	x	x	x	0.25	0.75
69	RSB	0.00	x	x	1	0	0	x	x	0	0	(1)	0	x	0	0.00	0.00

[a] Scores between spotted owl pairs at territories with barred owls (BO+) and spotted owl territories without barred owls (BO-) for each year were as follows: 0 = no difference in young between BO+ and BO- territories, 1 = young produced at BO+ territory, no young produced at BO- territory, (1) = no young produced at BO+ territory, young produced at BO- territory, x = no spotted owl pair at one or both territories.

[b] ID = Territory identification number.

[c] SA = Study Areas: CLE = Cle Elum, HJA = HJ Andrews, OCR = Oregon Coast Range, OLY = Olympic Peninsula, RSB = Roseburg.

[d] mean diff (d̄) = Mean reproductive score from the post-BO period subtracted from the mean reproductive score from the pre-BO period.

APPENDIX C

C1. Presence (1) or absence (0) of spotted owls at territories where barred owls were detected within 0.80 km of the territory center. Highlighted cells indicate years that barred owls were detected from 1987-1999.

Status	ID[a]	SA[b]	87	88	89	90	91	92	93	94	95	96	97	98	99
BO+	1	CLE				1	1	1	0	1	1	1	1	1	1
BO+	2	CLE				1	1	1	1	1	1	0	0	1	1
BO+	3	CLE						1	1	1	1	1	1	1	1
BO+	4	CLE					1	1	1	1	0	0	0	0	0
BO+	5	CLE			1	0	0	1	1	1	1	1	1	1	1
BO+	6	CLE			1	1	1	1	1	1	1	1	1	1	0
BO+	7	CLE				1	1	1	1	0	0	1	0	0	0
BO+	8	CLE			1	1	1	0	0	0	0	0	0	0	0
BO+	9	CLE			1	1	1	1	1	1	0	0	0	0	0
BO+	10	CLE					1	1	1	0	0	0	0	0	1
BO+	11	CLE							1	1	1	1	1	1	1
BO+	12	HJA							1	1	1	1	1	1	1
BO+	13	HJA	1	1	1	0	1	1	1	0	1	1	0	1	0
BO+	14	HJA				1	1	1	1	1	1	1	1	1	
BO+	15	HJA	1	1	1	1	1	1	1	1	1	1	1	1	1
BO+	16	HJA			1	1	1	1	1	1	1	1	1	1	1
BO+	17	HJA						1	1	1	1	1	1	1	1
BO+	18	HJA	1	1	1	1	1	1	1	1	1	1	1	1	0
BO+	19	HJA			1	1	0	1	0	0	0	0			
BO+	20	HJA	1	1	1	1	1	1	1	1	1	0	1	0	0
BO+	21	HJA	1	1	1	1	1	1	1	1	1	0	0	1	0
BO+	22	HJA	1	1	1	1	1	1	1	1	1	1	1	1	1
BO+	23	HJA	1	1	1	1	1	1	1	1	0	1	0	1	0
BO+	24	OCR						1	1	1	1	0	1	1	0
BO+	25	OCR							0	1	1	1	1	1	1
BO+	26	OCR						1	1	1	1	1	1	0	0
BO+	27	OCR				1	1	1	1	1	1	1	1	1	
BO+	28	OCR					1	1	1	1	1	1	0	0	1
BO+	29	OCR				1	1	1	1	1	1	1	1	1	1
BO+	30	OCR					1	1	1	1	1	0	0	0	0
BO+	31	OCR				1	1	1	1	1	1	1	1	1	
BO+	32	OCR								0	0	1	1	1	1
BO+	33	OCR							0	0	1	1	1	1	1
BO+	34	OCR				1	1	1	1	1	1	1	1	1	1
BO+	35	OCR				1	1	1	1	1	1	1	1	1	1
BO+	36	OCR								1	1	1	1	0	0
BO+	37	OCR						1	1	1	1	1	1	1	1
BO+	38	OCR							1	1	1	1	1	1	1
BO+	39	OCR					1	1	0	1	1	1	1	1	1
BO+	40	OCR				1	1	1	1	0	1	0	0	0	0
BO+	41	OCR				1	1	1	1	1	1	1	1	1	1
BO+	42	OCR				1	1	1	1	1	1	1	0	0	0

Status	ID[a]	SA[b]	87	88	89	90	91	92	93	94	95	96	97	98	99
BO+	43	OCR				1	1	1	1	1	1	1	0	1	1
BO+	44	OCR						1	1	1	1	1	1	1	1
BO+	45	OCR				1	1	1	1	1	1	1	0	1	0
BO+	46	OCR				1	1	1	1	1	0	1	0	0	0
BO+	47	OLY		1	1	1	1	1	1	1	1	1	1	1	1
BO+	48	OLY					1	0	0	1	1	1	1	1	0
BO+	49	OLY					1	1	1	1	0	0	0		
BO+	50	OLY	1	1	1	1	1	1	1	0	1	0	0	0	0
BO+	51	OLY				1	1	1	1	1	0	1	1	1	0
BO+	52	OLY	1	1	1	1	1	1	1	1	1	0	0	1	1
BO+	53	OLY			1	1	1	1	1	1	1	0	0	1	0
BO+	54	OLY	1	1	0	0	1	0	0	0	0	1	1	0	0
BO+	55	OLY			1	1	0	0	0	1	0	0	1	1	0
BO+	56	OLY		1	1	1	1	1	1	1	1	1	1	1	1
BO+	57	OLY			1	1	1	1	1	1	1	1	0	0	0
BO+	58	OLY		1	1	1	0	0	0	0	0	0			
BO+	59	OLY	1	1	1	1	1	1	1	1	1	0	1	1	1
BO+	60	RSB	1	1	1	1	1	1	1	1	1	0	0	0	1
BO+	61	RSB	1	1	1	1	1	1	1	1	1	0	1	1	1
BO+	62	RSB		1	1	1	1	1	0	1	1	1	1	1	1
BO+	63	RSB					1	0	1	1	0	0			
BO+	64	RSB	1	1	1	1	1	1	0	0	1	0	1	1	1
BO+	65	RSB				1	1	1	1	0	1	1	0	1	1
BO+	66	RSB	1	1	1	1	1	1	1	1	1	0	0	0	0
BO+	67	RSB			1	1	1	1	0	0	0	0	0	1	1
BO+	68	RSB			1	1	1	1	0	1	0	0	1		
BO+	69	RSB	1	1	1	1	1	1	1	1	1	1	1	1	
BO+	70	RSB				1	1	1	0	1	1	1	1	1	1
BO+	71	RSB				1	1	1	1	1	1	0	1	0	1
BO+	72	RSB	1	1	1	1	1	1	1	1	1	1	1	1	1
BO+	73	RSB				1	1	1	1	1	1	1	1	1	1
BO+	74	RSB	1	0	0	1	1	1	1	0	1	1			
BO+	75	RSB	1	1	1	1	1	1	1	1	1	1	1	1	1
BO+	76	RSB			1	1	1	0	1	1	1	1	1	1	1
BO+	77	RSB			0	1	0	1	1	1	1	1	1	1	0
BO+	78	RSB		1	1	1	1	1	1	1	1	1	0	0	0
BO+	79	RSB		1	1	1	1	1	1	1	1	1	1	1	1
BO+	80	RSB	1	1	1	1	1	1	1	1	1	1	1	1	1
BO+	81	RSB	1	1	1	1	1	1	1	0	0	0	1	1	
BO+	82	RSB			1	1	0	1	1	1	1	0	0	0	0
BO+	83	RSB			1	1	1	1	1	1	1	1	1	0	1
BO+	84	RSB	1	1	1	1	1	1	0	0	0	1	1	1	0

[a] ID = Territory identification number.
[b] SA = Study Areas: CLE = Cle Elum, HJA = HJ Andrews, OCR = Oregon Coast Range, OLY = Olympic Peninsula, RSB = Roseburg.

C2. Presence (1) or absence (0) of spotted owls at territories where no barred owls were detected within 2.40 km of the territory center and that were used as paired comparisons to territories where barred owls were detected within 0.80 km of the territory center. Highlighted cells indicate years that barred owls were detected at the BO+ territory with which the BO- territory was paired (see Appendix C1).

Status	ID[a]	SA[b]	87	88	89	90	91	92	93	94	95	96	97	98	99
BO-	1	CLE				1	1	1	1	1	1	1	1	1	1
BO-	2	CLE				1	1	1	1	1	1	1	0	1	0
BO-	3	CLE						1	0	1	1	1	1	1	1
BO-	4	CLE					1	1	1	1	1	1	1	1	1
BO-	5	CLE			1	1	1	1	1	1	1	1	1	1	1
BO-	6	CLE			0	1	0	0	0	0	1	0	1	1	1
BO-	7	CLE				1	1	1	1	1	1	1	0	0	1
BO-	8	CLE			1	1	1	1	1	1	1	1	1	1	1
BO-	9	CLE			1	1	0	1	1	1	1	1	1	0	1
BO-	10	CLE					1	1	1	1	0	0	0	0	0
BO-	11	CLE							1	1	1	1	1	1	1
BO-	12	HJA							1	1	1	1	1	1	0
BO-	13	HJA	1	1	1	1	1	1	0	1	1	1	1	1	1
BO-	14	HJA				1	1	1	1	1	0	0	0	1	
BO-	15	HJA	1	1	1	1	1	1	0	1	1	1	1	1	1
BO-	16	HJA			1	1	1	1	1	1	1	1	1	0	0
BO-	17	HJA						1	1	1	1	1	1	1	1
BO-	18	HJA	1	1	1	1	1	1	1	1	1	1	1	1	1
BO-	19	HJA			1	1	1	1	1	1	1	1			
BO-	20	HJA	1	1	1	1	1	1	1	1	1	1	1	1	1
BO-	21	HJA	1	1	1	1	1	1	1	1	1	1	1	1	1
BO-	22	HJA	1	1	1	1	1	1	1	1	1	1	1	1	1
BO-	23	HJA	1	1	1	1	1	1	1	1	1	1	1	1	1
BO-	24	OCR						1	1	0	1	0	1	0	0
BO-	25	OCR							1	1	1	1	1	1	1
BO-	26	OCR						1	1	1	1	1	1	1	1
BO-	27	OCR				1	1	1	0	0	0	0	0	1	
BO-	28	OCR					1	0	1	1	1	0	0	1	1
BO-	29	OCR				1	1	1	1	1	1	1	1	1	1
BO-	30	OCR					1	1	1	1	1	1	0	1	1
BO-	31	OCR				0	1	1	1	1	1	1	1	1	
BO-	32	OCR								1	1	1	1	1	1
BO-	33	OCR							1	1	1	1	1	1	1
BO-	34	OCR				1	1	1	1	1	1	1	1	1	1
BO-	35	OCR				1	1	1	1	1	1	1	1	1	1
BO-	36	OCR								1	0	1	0	1	0
BO-	37	OCR						1	1	1	1	1	0	1	1
BO-	38	OCR							1	1	1	1	1	1	1
BO-	39	OCR					0	1	1	0	0	1	1	1	1
BO-	40	OCR				1	0	1	1	1	1	1	1	1	1

Status	ID[a]	SA[b]	87	88	89	90	91	92	93	94	95	96	97	98	99
BO-	41	OCR				1	1	1	1	1	1	1	1	1	1
BO-	42	OCR				0	0	1	1	1	1	1	1	1	1
BO-	43	OCR				1	1	1	1	1	1	1	1	1	1
BO-	44	OCR						1	1	1	1	1	1	1	1
BO-	45	OCR				1	1	1	1	1	1	1	1	1	1
BO-	46	OCR				1	1	1	1	1	1	1	1	1	1
BO-	47	OLY		1	1	1	1	1	1	1	0	0	0	0	0
BO-	48	OLY					1	1	1	1	1	1	1	1	1
BO-	49	OLY					1	1	1	1	1	1	1		
BO-	50	OLY	1	1	1	1	1	1	1	1	0	1	0	0	0
BO-	51	OLY				0	1	1	1	0	1	1	1	1	0
BO-	52	OLY	1	1	1	1	0	1	1	1	1	1	1	1	1
BO-	53	OLY			1	1	1	0	0	1	1	1	1	1	0
BO-	54	OLY	1	1	1	1	1	1	1	1	1	1	1	1	0
BO-	55	OLY			1	1	1	1	1	1	1	1	0	1	1
BO-	56	OLY		1	1	1	1	1	1	1	1	1	1	1	0
BO-	57	OLY			1	1	1	1	1	1	1	1	1	1	0
BO-	58	OLY		1	1	1	1	1	1	1	1	1			
BO-	59	OLY	1	1	1	1	1	1	1	1	1	1	1	1	0
BO-	60	RSB	1	1	1	1	1	1	1	1	1	1	1	1	1
BO-	61	RSB	1	1	1	1	1	1	1	1	1	1	1	1	1
BO-	62	RSB		1	1	1	1	1	1	1	1	1	1	1	1
BO-	63	RSB					0	1	1	1	1	1			
BO-	64	RSB	1	1	1	1	1	1	1	1	1	1	1	1	1
BO-	65	RSB				1	1	1	1	1	1	1	1	1	1
BO-	66	RSB	0	0	0	1	1	1	1	1	1	1	1	1	1
BO-	67	RSB			1	1	1	1	1	1	1	1	1	1	1
BO-	68	RSB			1	1	1	0	1	1	1	1	1		
BO-	69	RSB	0	1	1	1	1	1	1	1	1	1	0	1	
BO-	70	RSB				0	1	1	1	1	1	1	1	0	1
BO-	71	RSB				1	1	1	1	1	1	0	0	1	1
BO-	72	RSB	1	1	1	0	1	1	1	1	1	1	1	1	1
BO-	73	RSB				1	1	1	1	0	1	0	1	0	1
BO-	74	RSB	1	1	1	1	1	1	1	1	1	0			
BO-	75	RSB	1	1	1	1	1	1	1	1	1	1	1	1	1
BO-	76	RSB			0	0	1	1	1	1	1	1	1	1	1
BO-	77	RSB			1	1	1	1	1	1	1	1	1	1	1
BO-	78	RSB		1	1	1	1	1	1	1	1	1	1	1	1
BO-	79	RSB		1	1	1	1	1	1	1	1	1	1	1	1
BO-	80	RSB	1	1	1	1	1	1	1	0	1	1	1	1	1
BO-	81	RSB	1	1	1	1	1	1	1	1	1	1	1	1	
BO-	82	RSB			1	1	1	1	1	1	1	1	1	1	1
BO-	83	RSB			1	1	1	1	1	1	1	1	1	1	1
BO-	84	RSB	1	1	1	1	1	1	1	1	1	1	1	1	1

[a] ID = Territory identification number.
[b] SA = Study Areas: CLE = Cle Elum, HJA = HJ Andrews, OCR = Oregon Coast Range, OLY = Olympic Peninsula, RSB = Roseburg.

C3. Presence (1) or absence (0) of spotted owls at territories where barred owls were detected between 0.81 and 2.40 km of the territory center. Highlighted cells indicate years that barred owls were detected from 1987-1999.

Status	ID[a]	SA[b]	87	88	89	90	91	92	93	94	95	96	97	98	99
BO+	1	CLE			1	1	1	1	1	1	1	1	1	0	0
BO+	2	CLE			1	1	1	1	1	1	1	1	1	1	1
BO+	3	CLE				1	1	1	1	1	1	1	1	1	1
BO+	4	CLE				1	1	1	1	1	1	1	1	1	1
BO+	5	CLE			1	1	1	1	1	1	1	1	1	1	1
BO+	6	CLE				1	1	1	1	1	1	1	1	1	1
BO+	7	CLE				1	1	1	1	1	1	1	1	1	1
BO+	8	CLE			1	1	1	1	1	0					
BO+	9	CLE			1	1	1	1	1	1	1	1	1	1	0
BO+	10	HJA	1	1	1	1	1	1	0	1	0	1	0	1	1
BO+	11	HJA						0	0	1	1	1	1	1	1
BO+	12	HJA			1	1	1	1	1	1	1	1	1	1	1
BO+	13	HJA			1	1	1	1	1	1	1	1			
BO+	14	HJA			1	1	1	1	1	1	1	1	1	1	1
BO+	15	HJA	0	0	0	0	0	0	1	1	1	1	1	1	1
BO+	16	HJA						1	1	1	0	1	0	1	1
BO+	17	HJA		1	1	1	1	1	1	1	1	1			
BO+	18	HJA		1	1	1	1	1	1	1	1	1	1	1	1
BO+	19	HJA			1	1	0	1	1	1	1				
BO+	20	HJA			1	1	1	1	1	1	0	0	0	0	0
BO+	21	HJA				1	1	1	1	0	0	0	0	1	1
BO+	22	HJA	1	1	1	1	1	1	1						
BO+	23	HJA	1	1	1	1	1	1	1	1	1	1	1	1	1
BO+	24	HJA				1	1	1	1	1	1	1	1	1	1
BO+	25	HJA			1	1	1	1	1	0	0	0	0		
BO+	26	HJA		1	1	1	1	1	1	1	1	1	1	1	1
BO+	27	HJA						1	0	1	1	1	1	1	1
BO+	28	HJA	1	1	1	1	1	1	1	1	1	1	1	1	1
BO+	29	HJA	1	1	1	1	1	1	1	1	1	1	1	1	0
BO+	30	HJA	1	1	1	1	1	1	1	1	1	1	0	0	0
BO+	31	HJA				0	1	1	1	1	1				
BO+	32	OCR							1	1	1	1	0	1	1
BO+	33	OCR				1	1	1	1	1	1	1	1	1	1
BO+	34	OCR				0	0	0	1	0	1	1	1	1	1
BO+	35	OCR				1	1	1	1	0	1	1	1	1	
BO+	36	OCR				1	1	1	1	1	1	1	1	0	1
BO+	37	OCR						1	1	1	1	1	1	1	1
BO+	38	OCR				1	1	1	0	1	0	1	1	1	0
BO+	39	OCR				1	1	1	1	1	1	1	1	1	1
BO+	40	OCR				1	1	1	1	1	1	0	1	1	1
BO+	41	OCR				1	1	1	0	1	1	1	1	1	1
BO+	42	OCR				1	1	1	1	1	1	1	1	1	1
BO+	43	OCR						1	1	1	1	1	1	1	
BO+	44	OCR				1	1	1	1	0	0	1	1	1	1

Status	ID[a]	SA[b]	87	88	89	90	91	92	93	94	95	96	97	98	99
BO+	45	OCR				1	1	1	1	1	1	1	1	1	1
BO+	46	OCR								1	1	1	1	1	1
BO+	47	OCR					1	1	1	1	1	1	1	1	1
BO+	48	OLY		1	1	1	1	1	1	1	1	1	1	1	0
BO+	49	OLY			1	1	1	1	1	1	0	1	1	1	1
BO+	50	OLY	1	0	1	0	1	1	1	1	1	1	1	1	1
BO+	51	OLY	1	1	1	1	1	1	1	1	1	1	1	1	0
BO+	52	OLY		1	1	1	1	1	1	1	1	1	1	1	1
BO+	53	OLY				1	1	1	1	1	1	1	1	1	0
BO+	54	OLY			1	1	1	1	1	1	1	1	1	1	1
BO+	55	OLY	1	1	1	1	1	1	1	0	1	0	1	1	0
BO+	56	OLY					1	1	1	1	1	1	1	1	1
BO+	57	OLY			1	1	1	1	1	1	1	1	0	0	0
BO+	58	RSB	1	1	1	1	1	1	1	1	1	1	1	1	1
BO+	59	RSB			1	1	1	1	1	1	1	1	1	0	1
BO+	60	RSB			1	1	1	1	1	1	1	1	1	1	1
BO+	61	RSB				1	1	1	1	1	0	0	0	1	1
BO+	62	RSB			1	1	1	0	0	0	1	0			
BO+	63	RSB	1	1	1	1	1	1	1	1	1	1	0	1	1
BO+	64	RSB			1	1	1	1	1	1	1	1	1	0	0
BO+	65	RSB	1	1	1	1	1	1	1	1	1	1	1	1	1
BO+	66	RSB			1	1	1	0	1	1	1	1	1	1	1
BO+	67	RSB	1	1	0	0	0	0	0	0	0	1	0	0	1
BO+	68	RSB			1	1	1	1	1	1	1	1	1	1	1
BO+	69	RSB				1	0	1	1	0	0	1	1	1	1
BO+	70	RSB				1	1	1	1	1	1	1	0	0	1
BO+	71	RSB	1	1	1	1	1	1	1	1	1	1	1	1	1
BO+	72	RSB	1	1	1	1	1	1	1	1	1	1	1	1	1
BO+	73	RSB	1	1	1	1	0	1	1	0	1	0	1	1	1
BO+	74	RSB		0	0	0	1	1	1	0	0	1	1	0	0
BO+	75	RSB	1	1	1	1	1	1	1	1	1	1	0	0	0
BO+	76	RSB	0	1	1	1	1	1	1	1	1	1			
BO+	77	RSB				1	1	1	1	1	1	0			
BO+	78	RSB				1	1	1	1	0	0	0	0	1	1
BO+	79	RSB	1	1	1	1	1	1	1	1	1	1	1	1	1
BO+	80	RSB	1	1	1	0	1	1	1	1	0	1	1	0	1
BO+	81	RSB	1	1	1	1	1	1	1	1	1	1	1	1	
BO+	82	RSB	1	1	1	1	1	1	1	1	1	1	1	1	1
BO+	83	RSB			0	1	1	0	0	1	0	1	1	1	1
BO+	84	RSB	1	1	1	1	1	1	1	1	1	1	1	1	1
BO+	85	RSB			1	1	1	1	1	1	1	1	1	1	1

[a] ID = Territory identification number.
[b] SA = Study Areas: CLE = Cle Elum, HJA = HJ Andrews, OCR = Oregon Coast Range, OLY = Olympic Peninsula, RSB = Roseburg.

C4. Presence (1) or absence (0) of spotted owls at territories where no barred owls were detected within 2.40 km of the territory center and that were used as paired comparisons to territories where barred owls were detected between 0.81 and 2.40 km of the territory center. Highlighted cells indicate years that barred owls were detected at the BO+ territory with which the BO- territory was paired (see Appendix C3).

Status	ID[a]	SA[b]	87	88	89	90	91	92	93	94	95	96	97	98	99
BO-	1	CLE			1	1	1	1	1	1	1	1	1	1	1
BO-	2	CLE			0	0	1	1	0	0	1	0	1	1	1
BO-	3	CLE				1	1	1	1	1	1	1	1	1	1
BO-	4	CLE				1	1	1	1	1	1	0	0	0	0
BO-	5	CLE			1	1	1	0	1	0	1	1	1	1	1
BO-	6	CLE				1	1	1	1	1	1	1	1	1	0
BO-	7	CLE				1	1	1	1	1	1	1	1	1	1
BO-	8	CLE			1	1	1	1	1	1					
BO-	9	CLE			1	1	1	1	1	1	1	1	1	1	1
BO-	10	HJA	1	1	1	1	1	1	1	1	1	1	1	1	1
BO-	11	HJA						1	0	1	1	1	1	1	1
BO-	12	HJA			1	1	1	1	1	1	1	1	1	1	1
BO-	13	HJA			1	1	1	1	1	1	1	1			
BO-	14	HJA			1	1	1	1	1	1	0	1	1	1	1
BO-	15	HJA	1	1	1	1	1	1	1	1	1	1	1	1	1
BO-	16	HJA						1	1	1	1	1	0	1	1
BO-	17	HJA		1	1	1	1	1	0	1	1	1			
BO-	18	HJA		1	1	1	1	1	1	1	1	1	1	1	1
BO-	19	HJA			1	1	1	1	1	1	1				
BO-	20	HJA			1	1	1	1	1	1	1	1	1	1	1
BO-	21	HJA				1	1	1	1	1	1	1	0	1	1
BO-	22	HJA	1	1	1	1	1	1	1						
BO-	23	HJA	1	1	1	1	1	1	1	1	1	1	1	1	1
BO-	24	HJA				1	1	1	1	1	1	1	1	1	1
BO-	25	HJA			1	1	1	1	1	1	1	1	1		
BO-	26	HJA		1	1	1	1	1	1	1	1	1	1	1	1
BO-	27	HJA						1	1	1	0	0	1	0	1
BO-	28	HJA	1	1	1	1	1	1	1	1	1	1	0	0	1
BO-	29	HJA	1	1	1	1	1	1	1	1	1	1	0	1	1
BO-	30	HJA	1	1	1	1	1	1	1	1	1	1	1	1	1
BO-	31	HJA				1	1	1	0	1	0				
BO-	32	OCR							1	1	1	1	1	1	1
BO-	33	OCR				1	1	1	1	1	1	1	1	1	1
BO-	34	OCR				1	1	1	1	1	1	1	1	1	1
BO-	35	OCR				1	1	0	0	1	1	1	1	1	
BO-	36	OCR				1	1	1	1	0	0	0	0	0	0
BO-	37	OCR						1	1	1	0	1	1	1	1
BO-	38	OCR				1	1	1	1	0	0	1	1	1	1
BO-	39	OCR				1	1	1	1	1	1	1	0	1	1
BO-	40	OCR				1	1	1	1	1	1	1	1	1	1

Status	ID[a]	SA[b]	87	88	89	90	91	92	93	94	95	96	97	98	99
BO-	41	OCR				1	1	1	1	1	1	1	1	1	1
BO-	42	OCR				1	1	1	1	1	1	0	0	0	0
BO-	43	OCR						1	1	1	1	1	1	1	
BO-	44	OCR				0	1	1	1	1	1	0	0	0	0
BO-	45	OCR				1	1	1	1	1	1	1	1	1	1
BO-	46	OCR								1	1	1	1	1	1
BO-	47	OCR					1	1	1	1	1	1	1	1	1
BO-	48	OLY		1	1	1	1	1	1	1	1	1	1	1	1
BO-	49	OLY			1	1	1	1	1	1	1	1	1	1	0
BO-	50	OLY	1	1	1	1	1	1	1	1	0	1	1	1	1
BO-	51	OLY	1	1	1	1	1	1	1	1	1	1	1	1	0
BO-	52	OLY		0	0	0	0	1	1	1	1	1	1	1	0
BO-	53	OLY				1	1	1	1	1	1	1	0	1	1
BO-	54	OLY			1	1	1	1	0	1	1	1	1	0	0
BO-	55	OLY	1	1	1	1	1	1	1	1	1	1	1	1	0
BO-	56	OLY					1	1	1	1	1	1	1	1	0
BO-	57	OLY			1	1	1	1	1	1	1	1	0	0	0
BO-	58	RSB	1	1	1	1	1	1	1	1	1	1	1	1	1
BO-	59	RSB			1	1	1	1	1	1	1	0	0	1	1
BO-	60	RSB			1	1	0	0	1	1	0	1	1	1	1
BO-	61	RSB				1	1	1	1	1	1	1	1	0	1
BO-	62	RSB			1	1	1	0	1	1	1	1			
BO-	63	RSB	1	0	1	1	1	1	1	1	1	1	1	1	1
BO-	64	RSB			1	1	0	0	1	1	0	1	1	0	0
BO-	65	RSB	1	1	1	1	0	0	1	1	1	1	1	1	1
BO-	66	RSB			1	1	1	1	0	0	1	1	1	1	1
BO-	67	RSB	1	1	1	1	1	1	1	0	1	0	1	1	1
BO-	68	RSB			1	1	1	1	1	1	1	1	1	1	1
BO-	69	RSB				1	1	1	1	1	0	1	0	0	1
BO-	70	RSB				1	1	1	0	1	1	1	0	0	0
BO-	71	RSB	1	1	1	1	1	1	1	1	1	1	1	1	1
BO-	72	RSB	1	1	1	1	1	1	1	1	1	1	1	1	1
BO-	73	RSB	1	1	1	1	0	1	1	1	1	1	1	1	1
BO-	74	RSB		1	1	1	1	1	1	1	1	1	1	1	1
BO-	75	RSB	1	0	1	1	1	1	1	1	1	1	1	1	1
BO-	76	RSB	1	1	1	1	1	1	1	1	1	1			
BO-	77	RSB				1	1	1	1	1	0	1			
BO-	78	RSB				0	1	1	1	1	1	1	1	1	1
BO-	79	RSB	1	1	1	1	1	1	0	1	1	1	1	1	0
BO-	80	RSB	1	1	1	1	1	1	1	1	1	1	1	1	1
BO-	81	RSB	1	1	1	1	1	1	1	1	1	1	1	1	
BO-	82	RSB	1	1	1	1	1	1	1	1	1	1	1	1	1
BO-	83	RSB			1	1	1	1	1	1	1	1	1	1	1
BO-	84	RSB	1	1	1	1	1	1	1	1	1	1	1	1	1
BO-	85	RSB			1	1	1	0	1	1	1	1	1	0	1

[a] ID = Territory identification number.
[b] SA = Study Areas: CLE = Cle Elum, HJA = HJ Andrews, OCR = Oregon Coast Range, OLY = Olympic Peninsula, RSB = Roseburg.

APPENDIX D

D. Unique observations of spotted owl/barred owl pairs or hybrids in Washington and Oregon, 1974-1999.

Observer name[a]	Landowner[b]	Subdivision	ST	Territory Name	YR	Species[c]			
						male	female	unknown	juvenile
Forsman, E.	USFS	Mt. Baker	WA	BAKER LAKE	89	F1	B		
Fleming, T.	DNR		WA	BEEKS CANYON	94	S	B		
Fleming, T.	DNR		WA	BEEKS CANYON	94	"	"		F1
Fleming, T.	DNR		WA	BEEKS CANYON	94	"	"		F1
Christopherson, R.	NP	North Cascades	WA	BIG BEAVER WETLAND	95	F1	B		
Reid, J.	BLM	Roseburg	OR	BOB BUTTE	93	F1	B		
Reid, J.	BLM	Roseburg	OR	BOB BUTTE	94	"	"		F2
Reid, J.	BLM	Roseburg	OR	BOB BUTTE	94	"	"		F2
Lint, J.	BLM	Roseburg	OR	BOB BUTTE	95	"	"		F2
Lint, J.	BLM	Roseburg	OR	BOB BUTTE	95	"	"		F2
Fleming, T.	USFS	Wenatchee	WA	CULVER GULCH	91	F1	S		
Lint, J.	BLM	Coos Bay	OR	DAN MELTON	94	F1	B		
Bohler, J.	USFS	Umpqua	OR	EAST LEMOLO	99	B	F1		
O'Brien, T.	USFS	Rogue River	OR	EAST VIEW	95			F1	
Anderson, B.	Private	Weyerhauser	WA	HOFFSTADT MOUNTAIN	98	S	B		
Anderson, B.	Private	Weyerhauser	WA	HOFFSTADT MOUNTAIN	98	"	"		F1
Bahe, S.	BLM	Salem	OR	KILCHIS RIVER	95				F1 or F2
Goode, J.	USFS	Rogue River	OR	LICK CREEK	92	F1	U		
Thrailkill, J.	USFS	Willamette	OR	LITTLE BOULDER CR IA	98	F1			
Lint, J.	BLM	Roseburg	OR	MAUPIN ROAD	96	B	F1		

D. (continued)

Observer name[a]	Landowner[b]	Subdivision	ST	Territory Name	YR	Species[c] male	female	unknown	juvenile
Lint, J.	BLM	Eugene	OR	MEADOW CREEK	96	S	B		
Lint, J.	BLM	Eugene	OR	MEADOW CREEK	96	"	"		F1
Lint, J.	BLM	Eugene	OR	MEADOW CREEK	96	"	"		F1
Seaman, E.	NP	Olympic	WA	MOSQUITO FLATS	94	B	FI		
Pearson, B.	USFS	Gifford Pinchot	WA	OSBORNE MOUNTAIN	94			F1	
Forsman, E.	DNR		WA	OZETTE LAKE	91	S	F1[d]		
Forsman, E.	DNR		WA	OZETTE LAKE	94	B	"		
Pearson, B.	USFS	Gifford Pinchot	WA	PACKWOOD LAKE	96			F1	
Godwin, S.	BLM	Medford	OR	PASS THE BUCK	92	S	F1		
Lint, J.	BLM	Roseburg	OR	POWELL CREEK	99			F1	
Thrailkill, J.	USFS	Willamette	OR	SLICK CREEK	99	F1	B		
Thrailkill, J.	USFS	Willamette	OR	SLICK CREEK	99	"	"		F2
Anderson, B.	Private	Weyerhauser	OR	SMITH CREEK	97			F1	
Forsman, E.	DNR	Stevenson	WA	SPRING CREEK	94	S	F1		
Ellingson, A.	ODF	Astoria	OR	SQUAW RIDGE	99	B	F1		
Ellingson, A.	ODF	Astoria	OR	SQUAW RIDGE	99	"	"		F2
Ellingson, A.	ODF	Astoria	OR	SQUAW RIDGE	99	"	"		F2
Lint, J.	BLM	Roseburg	OR	ST JOHNS CREEK	94	F1	B		
Lint, J.	BLM	Eugene	OR	SWAMP CREEK	98	F1	S		
Lint, J.	BLM	Eugene	OR	SWAMP CREEK	98	"	"		F2

D. (continued)

Observer name[a]	Landowner[b]	Subdivision	ST	Territory Name	YR	Species[c] male	female	unknown	juvenile
Lint, J.	BLM	Roseburg	OR	TURKEY CREEK BARRED	92	S	B		
Lint, J.	BLM	Roseburg	OR	TURKEY CREEK BARRED	95	"	"		F1
Lint, J.	BLM	Roseburg	OR	TURKEY CREEK BARRED	99	"	"		F1
Lint, J.	BLM	Roseburg	OR	TURKEY CREEK BARRED	99	"	"		F1
Godwin, S.	BLM	Medford	OR	UPPER LICK	87	F1	B		
Godwin, S.	BLM	Medford	OR	UPPER LICK	90	"	"		F2
Godwin, S.	BLM	Medford	OR	UPPER LICK	90	"	"		F2
Godwin, S.	BLM	Medford	OR	UPPER LICK	91	"	"		F2
Godwin, S.	BLM	Medford	OR	UPPER LICK	91	"	"		F2
Godwin, S.	BLM	Medford	OR	UPPER LICK	91	"	"		F2
Godwin, S.	BLM	Medford	OR	UPPER LICK	93	"	"		F2
Godwin, S.	BLM	Medford	OR	UPPER LICK	96	"	"		F2
Godwin, S.	BLM	Medford	OR	UPPER LICK	96	"	"		F2
Davis, R.	USFS	Umpqua	OR	UPPER STEELHEAD	91			F1	
Lint, J.	BLM	Eugene	OR	WEST ALLISON	94	S	B		
Lint, J.	BLM	Eugene	OR	WEST ALLISON	94	"	"		F1

[a] Observer Name = name of person who provided data.
[b] Landowner, Subdivision = land ownership where owls were detected (BLM = Bureau of Land Management, USFS = United States Forest Service, NP = National Park, DNR = Department of Natural Resources, ODF = Oregon Department of Forestry).
[c] Species: B = barred owl, S = spotted owl, F1 = first generation hybrid, F2 = second generation hybrid.
[d] Female F1 also paired with barred owl in 1994.