Assessment of Northern Spotted Owls After The Vision Wildfire Point Reyes National Seashore

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Introduction

In October 1995, a wildfire burned over 12,000 acres in the Point Reyes National Seashore and adjacent lands located in Marin County, California. The Vision Fire encompassed 20% of the Seashore, and burned intensely in many areas, including portions of Bishop pine and douglas-fir forests with known or potential northern spotted owl (*Strix occidentalis caurina*) habitat. Fire suppression activities were in place throughout the area to control the burn, and combined with impacts from a severe fire, may have had adverse impacts on northern spotted owls in the area. As a federally threatened species (USDI 1990), the northern spotted owl is a species of special management concern in the park (50 CFR 402.1).

Northern spotted owls occupy relatively large home ranges and defend their territories from other northern spotted owls. Throughout much of their range, they remain on their territories year-round. Since 1988, limited surveys of northern spotted owls have been conducted within the Seashore and have documented their occurrence within what is now the burn perimeter. Daytime roosts, or nests, are at the center of activity for a territory and are used to estimate the location of each territory (Thomas et al. 1990). In Marin County, a territory is at least 0.5 mile diameter in size, based on the nearest distance between some roosts (Chow 1995).

We initiated this study following the Vision Fire to 1) determine how northern spotted owls may have been affected by the fire or fire-fighting efforts, 2) prescribe mitigation for negative, or potentially negative effects, to northern spotted owls, and 3) assess effects of mitigation in the burn area related to bulldozer-line placement, and the selection and removal of hazardous trees (USDI 1996). To assess the potential effects of the fire on northern spotted owl, we studied the post-fire occupancy of known sites, their productivity, habitat associations and diet.

Methods

The study area is comprised of both burned and unburned portions of the park with known or suspected northern spotted owl territories (Figure 1). The study area included 1) forested areas within the Vision wildfire of the Seashore, 2) a 0.5 mile area buffer around the fire perimeter, and 3) two areas of similar habitat within the park boundary but outside the burned area with known northern spotted owl sites (Tomales Bay State Park and Firtop peak areas). The study area encompassed approximately 5,500 acres (3,400 "burn" acres and 2,100 of non-burn acres) of forest dominated by either Bishop pine-hardwood (Bishop pine) or douglas fir forests (Figure 1).

Surveys were conducted immediately following the fire and during the spring and summer 1996, following the methods of Forsman (1983) and Franklin et al. (1990). Surveys were conducted to determine northern spotted owl occupancy and reproductive status. Within one

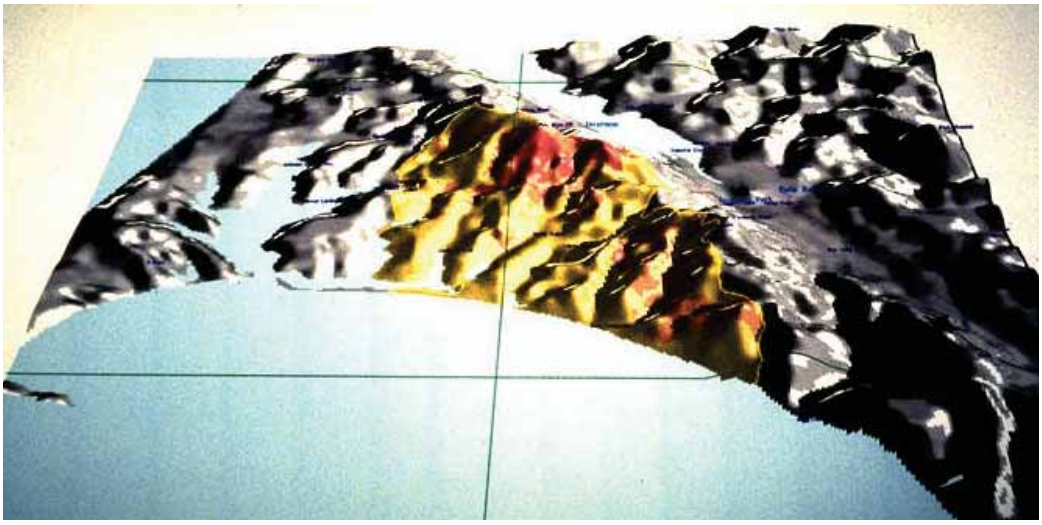

Figure 1
Extent of the 1995 Vision Fire.

Northern spotted owl (© Susan Van Der Wal)

month of the fire (October - November 1995), several informal surveys were conducted in some areas. All other data was collected during the breeding season (1 March - 31 August). Information on other current Marin County northern spotted owl sites was made available with the cooperation Golden Gate National Recreation Area and under contract with the Point Reyes Bird Observatory, Stinorthern spotted owln Beach, California.

Initial post-fire calling surveys were conducted during the night and day in a limited area of the burn. In the spring of 1996, night surveys were conducted to detect owls, with at least three night surveys in areas of non-response to confirm non-occupancy. In areas where a response was detected, day visits were conducted to determine residency and reproductive status. Occupied sites were categorized as roost or nest sites. "Roosts sites" were daytime locations of a pair or at least one adult northern spotted owl, and "nest sites" were locations of nests. Evidence of fire and fire suppression activities within northern spotted owl territories were also noted.

Habitat data were obtained for occupied sites found in and outside of the burned area. The sites were mostly in Bishop pine and Douglas-fir forest. Three northern spotted owl sites outside of the study area were also included because of the small sample size of the study area: two nest sites in redwood habitat in south Marin and a roost site in a hardwood-dominated forest were included in the data analysis. To characterize northern spotted owl habitat, 26 variables were measured at each site or plot (Appendix A). For nest sites, an additional ten habitat variables were measured. We selected ten random sites were selected in Bishop pine and douglas fir habitat to determine if owls occurred in particular forested areas or were randomly distributed in the Seashore. Plots were centered on a roost or nest tree for all occupied sites, but trees were not necessarily plot centers at random sites.

Components of the forest habitat were measured following the methods of recent northern spotted owl habitat studies (Seamans 1994, LaHaye 1988, Call 1990). Plots were measured between 15 July and 1 August. The variable-radius plot method was used (Mueller-Dombois and Ellenberg 1974) with a 20 basal factor prism (Bell and Dilworth, 1988) to determine which trees were within each plot. To sample the understory types and estimate their percent cover, the line-intercept method was used (Mueller-Dombois and Ellenberg 1974) on a 22.9m line oriented in a random direction from the plot center. These data were collected to characterize and compare the forest structure of occupied sites (roost and nest sites) to the available Bishop pine and douglas fir forests. To determine if there were habitat variables significantly correlated with occupied sites, the data was analyzed using the Pearson correlation matrix, and a stepwise logistic regression with the (Wilkinorthern spotted owln et al. 1992).

Egested northern spotted owl pellets were collected opportunistically in the 1996 breeding season from all occupied sites in the study area to obtain information on northern spotted owl diets among sites (n = 12) and to investigate important prey species and diet variations associated with habitat. Wherever possible, all pellets were cleared from sites. Throughout Marin County pellets were also collected by other land managers in cooperation with this project. A representative sample of pellets was analyzed for this report. Pellet age was estimated as "old," "this season," or "fresh," based on the condition of the pellet at the time of collection. Most prey items were identified to genus or species using mammal keys (Ingles, 1965, Jameson and Peeters 1988), but some birds and mammal bones could not be identified without comparison with museum specimens. Diet composition was estimated by frequency and percent biomass of prey items, based on mean weights of prey (estimated for unknown genera) (Jameson and Peeters 1988).

To obtain some indication of prey availability, sooted track plates were set in Bishop pine and douglas fir forest areas both inside and outside of the burn. Nine plots were established with two baited track plates each and run for 6-20 days (Barrett, 1983) between 5 June and 10 July. Plates placed within 200m of the burn perimeter were considered "burn" sites, and all others were considered "unburned" sites. All mammal tracks were identified using a track plate key (Taylor and Raphael 1988). The information collected is only considered anecdotal to the overall results since the sample (n = 9) was too small to give complete coverage of the study area.

Results

Occupancy

During the immediate post-fire surveys in November, only one female was heard in the evening just west of the Inverness Ridge area in a severely burned patch of Laguna Canyon, and during the day in Haggarty Gulch (outside burn; only positive results were considered

Adult owl with chick (© Susan Van Der Wal)

because they were conducted outside of the breeding season and owls are less likely to respond to calls). It is believed these were both responses from the female of Mt. Wittenberg (see Chow 1995). During the 1996 breeding season, a total of 14 sites were found occupied by northern spotted owls within the survey area (Table 1, Figure 1).

During the 1996 breeding season, all sites occupied in recent years were occupied within one mile of the burned area (seven) and one new pair was discovered (Meadow Trail). Of these eight sites closest to the burn, pair status and their roost location were confirmed at seven sites and a single male (unknown social status and roost) at one site. The male of unknown social status was from the Baldy Trail site where a pair has been heard in the area in the past (S. Bunnell, Cal. Academy of Sciences, pers. comm.). The precise day roost location was not found for the Baldy Trail site, which could have revealed whether the site was occupied by a pair.

Northern spotted owls with activity centers within the burn perimeter, Inverness, Mt. Wittenberg, and Drakes View were of special concern. Impacts on northern spotted owls from the fire and fire-fighting activities are not yet known but are evident near each of the three sites. Of these sites, only the activity center of Inverness site had been previously located. In 1996, the Inverness male was at the same roost location and the female was at a roost an estimated 200m away. The nest used in 1995 and the roosts were within approximately 400m of the burn. Thus firelines created by bulldozers along the burn perimeter were in their center of activity. In mid-August an adult (reported) northern spotted owl carcass was recovered from a highway less than 1 mile from both the Inverness and the Drakes View activity centers (J. Evens, Avocet Res., pers. comm.). Follow-up surveys have not yet been made for these sites, but it is possible the individual was from either of these sites.

Pre-fire and the initial post-fire survey detections of the Mt. Wittenberg pair indicated this

Table 1. Summary of spotted owl occupied sites

Site	Location	Owner	Occup	Reprod	#Young	Forest-type	Site-type
MR001	Tomales Bay -1	TBSP	Single	no		pine-oak	non-burn
MR002	Tomales Bay - 2	PVT	Pair	no		pine-oak	non-burn
MR003	Inverness	PVT	Pair	no		oak-bay-pine	burn
MR004	Bear Valley	PORE	Pair	no		fir-oak-bay	burn
MR005	Stewart Trail	PORE	Pair	active	1	fir-oak-bay	non-burn
MR018	Mt. Wittenberg	MIXED	Pair	no		fir-oak	burn
MR021	Drakes View Dr.	MIXED	Pair	no		fir-oak-bay	burn
MR022	Firtop	PORE	Pair	no		fir-oak-bay	non-burn
MR027	Pebble Beach	TBSP	Pair	no		oak-pine	non-burn
MR028	Invern Valley	PVT	male	unknown		pine	non-burn
MR029	Bear Valley Trail	PORE	Single	no		fir-oak-bay	burn
MR030	Baldy Trail	PORE	Single	unknown		fir-bay-oak	burn
—	Horse Trail	PORE	Pair	active	0	fir-oak-bay	burn
—	Tomales Bay 3	TBSP	Pair	no		oak-bay-pine	non-burn
—	Meadow Trail	PORE	Pair	no		oak-bay	burn
LC	Laguna Canyon	PORE	none	unknown		fir	burn
PP1	Predicted pr-Santa Maria *mMaria	PORE	none	unknown		fir	burn
PP2	Predicted pr-Bucklin	PORE	none	unknown		pine	burn

pair might have been using a portion of what burned forest habitat and may have shifted to a new roost site after the fire. During the 1996 breeding season, daytime locations were outside of the burned area, but within approximately 400 m of the burn perimeter on Inverness Ridge. Based on their daytime locations during the 1996 season, the portions of Sky Trail which were widened to create firelanes were within the territory of this pair. Habitat use patterns and activity center for the Mt. Wittenberg pair remains unclear, however, because evidence of regular occupancy was lacking at locations visited.

The Drakes View pair likely shifted to a new roost site after the fire, because the pair was roosting an estimated 30m from the burn perimeter, between two developed residential roads, and in a stand with more younger, and shorter subcanopy trees than other Douglas-fir roost sites. This pair was detected in several previous years higher in the drainage during nighttime surveys, in areas which were intensely burned (S. Bunnell, pers. comm.). The 1996 roost was located near residences, and efforts to save residences may have coincidentally preserved patches of northern spotted owl habitat.

In the non-burn portions of the study area, a total of six pairs were located. Daytime roosts had been located previously for five of the six pairs, and one new pair was located (at Shell Beach). One site was abandoned mid-season when the female disappeared and the male was found injured soon after and was eventually euthanized. No northern spotted owls were detected west of Inverness Ridge in 1996, both in the burned and unburned areas (Figure 1). A pair of northern spotted owls had been detected several times on the ridge in the area of the Fire Lane and Sky Trail junction, but was most likely the Mt. Wittenberg pair from Haggarty Gulch (east of the ridge). Outside the study area, an additional 21 sites were found occupied (twelve pairs and nine single owls).

Reproduction

Two pairs attempted breeding within the study area in 1996, Horse Trail and Stewart Trail. The Horse Trail pair was within 0.5 miles of the burn, and Stewart Trail pair was located outside the burn. Through nesting status surveys conducted in mid-June it was determined that the Horse Trail pair had failed to fledge young. We suspected that the young were predated upon because plucked fledgling feathers were found at the site. Another possible impact to the pair could have been noise disturbance caused by park staff when a tree was cut (with a chainsaw) within approximately 100m of the nest sometime between 15 May and 20 June. There were no other hazardous tree removals within 0.25 miles of an active nest in 1995 or 1996. The other pair which bred, MR005, had one fledgling.

The three sites closest to the burn did not breed in 1996 (Inverness, Mt. Wittenberg and Drakes View). Elsewhere in Marin County four pairs bred out of ten sites surveyed for reproductive status. These breeding pairs were all located in redwood forest habitat. Of these, three sites fledged one chick each, and one pair failed in their nesting attempt.

Habitat

Habitat data from fifteen occupied sites were analyzed and compared to ten randomly chosen plots within Bishop pine and Douglas-fir forests. In a preliminary analysis, thirteen of

Table 2. Habitat variables of spotted owl (n=15) and random (n=10) sites.

	Occupied Mean	Occupied % C.V.	Random Mean	Random % C.V.
Elevation (m)	101.4	47.7	155.8	60.6
Aspect (degrees)	169.3	30.8	125.3	93.2
Structural				
canopy (%)	80.3	17.5	57.1	36.7
strata (1-5)	3.4	36.7	3.3	20.5
shrub height(m)	1.8	93.2	2.2	96.9
Basal Area (sq m/ha)				
total	72.1	35.4	50.1	29.5
conifer	35.8	84.3	17.0	108.1
mature	18.8	81.9	13.3	88.2
large	16.7	131.6	6.9	122.7
young	9.3	117.7	7.4	98.6
Understory (%)				
shrub	16.1	144.6	26.6	110.3
small trees	7.6	134.4	7.5	270.1
duff	48.4	52.7	11.8	

the 26 variables collected were selected for this assessment (Table 2). The Pearson correlation matrix was run on nine variables and showed that the number of forest strata layers was the best predictor of occupied habitats ($p = .06$). In relation to other variables measured, strata tended to be correlated with aspect ($p = .07$) and significantly correlated with basal area of large trees ($p < .05$). Strata was negatively correlated with the elevation ($p = -.05$) and slightly negatively correlated with the basal area of conifers ($p = -.09$). In the stepwise logistic regression model, the amount of duff cover best defined occupied sites ($X^2 = 0.03$, *McFaddens's Rho-squared* = 0.4786, $p < .05$). When duff cover was eliminated from the regression, the variables which best defined northern spotted owl habitat were the percent of canopy cover ($X^2 = 0.072$, *McFadden's Rho-squared* = 0.4198, $p < .05$) and direction of slope aspect ($X^2 = 0.022$, *McFadden's Rho-squared* = 0.4198, $p = .07$). For occupied sites (both nesting and roosting), the averages for duff cover was 48.4%, for canopy cover 80.5%, and for aspect 169.3°.

Prey

Approximately 65 pellets from 12 sites were analyzed for diet. Both prey diversity and proportion of the total biomass for different prey types were compared between northern spotted owl sites in Douglas-fir and Bishop pine forest habitats (Table 3). A subsample of the pellets collected that were known or estimated to be egested in 1996 were targeted for analysis; however, when older pellets were included for all seasons, the results of analyses added a few more species (Table 4).

Dusky-footed woodrats (*Neotoma fuscipes*) were the most common prey type found at all sites. A variety of species was found in the pellets but species composition differed between the two forest types. At Bishop pine sites, prey types also included a jay-sized bird, and a shrew (*Sorex* sp). At douglas fir sites, other prey types included two mammal species similar in size to the woodrat (mammal "A" and "B"), and a California vole (*Microtus californicus*). In analysis of all-season pellets, other species in Bishop pine pellets included a microtine rodent, and at Douglas-fir sites, a small bird and a cricetine rodent.

Based on the biomass measured in weight of prey consumed, the most important prey was the dusky-footed woodrat for all sites, comprising at least 60% of the diet at douglas fir sites, and over 90% at Bishop pine sites (both spring-only and all-season analyses) (Figure 2,3). No skulls or other positive identifiable pieces were found of mammal "A" and "B," but given the large size range of dusky-footed woodrats (184-358g) and structural similarities to their bones, it is possible these two prey types were also woodrats, yielding over 90% prey biomass of woodrats at douglas fir sites as well.

Track plates were also used to identify potential prey near occupied sites. Tracks were detected on the sooted plates at all but one burned site. The non-burned plots ($n = 4$) generally had more species detected with average of 2.3 species compared to burned sites ($n = 5$) (average = 1.6 species). The most common species identified on the track plates in both site types was the gray fox (*Urocyon cinereoargenteus*) (six sites), followed by raccoon (*Procyon lotor*) (four sites). Equal samples were found in burn and non-burn sites for dusky-footed woodrat tracks (one each) and small mammals (two each).

Discussion

The results from 1996 surveys should be considered preliminary. The methods used to characterize habitat, analyze diet, and detect prey availability were exploratory, and will need to be refined in future years. Nevertheless, the methods used were useful in providing the first

Table 3. Spotted owl pellet analyses collected in spring 1996.

	mamm. A	Neotoma fusc.	mamm. B	Microtus calif.	bird	Peromyscus sp.	Mus sp.	Sorex sp.	Total Pellets
Mean wt. (g)*	300	271	270	53.5	50	24.5	18	10.5	
Individuals fr.									
Bishop pine:	0	10	0	0	1	7	0	1	12
Composition:	0%	92%	0%	0%	2%	6%	0%	0%	
Individuals fr.									
Douglas fir:	3	13	3	4	0	5	1	0	20
Composition:	16%	63%	14%	4%	0%	2%	0%	0%	

*Mean weight estimated for unknown genera

insights into needs of northern spotted owls in the Seashore and the potential effects of fire. Continued research will help to assess habitat preferences, determine how fire and fire-suppression activities affected northern spotted owl distribution and reproduction, and detect long-term effects on the northern spotted owls.

Occupancy and Reproduction

Historic occupancy information is primarily based on surveys conducted between 1988-1991 (S. Bunnell, pers. comm.). Prior to the 1995 fire, the National Park Service had conducted limited surveys in the study area (Chow 1995). In the first year- assessment (1996), all known sites from previous surveys were occupied during the breeding season. Thus occupancy rate of known sites did not seem to be significantly affected by the fire and fire suppression activities. No owls were detected coming from the west side of the Inverness Ridge, an area that had not had any known sites and had never been completely surveyed in the past. All known or suspected northern spotted owls pairs were pair-occupied except for one site, (Mt. Baldy), where a female was never seen or heard in 1996. Of the sites nearest to the fire, the roost habitat information from the Drakes View pair differs from other douglas fir roost sites measured and may be an indication that they shifted their roost site. The forest structure at their 1996 main roost had a larger component of younger trees compared to similar unburned roosts of other pairs.

Although site occupancy did not appear significantly affected by the fire, only two pairs in the study area attempted nesting, and both nests were at least 0.5 mi. from the burn perimeter. The number of sites (n = 13), though, was too few to draw conclusions. Some possible causes for low reproduction are 1) the fire and fire suppression activities were physiologically stressful to the owls; 2) the prey base was reduced, 3) the population is at carrying capacity, 4) the Seashore does not have good nesting habitat, or 5) severe winter storms early in the season (Franklin et al. 2000, Forsman et al. 2002). Trends in reproductive rates of northern spotted owls in Marin County is not known because past reproductive surveys have been limited.

Within the non-burned habitats surveyed countywide in 1996, four of six pairs in redwood forest type attempted breeding, while only two of eight pairs in Douglas-fir forest type bred. One pair in each of the two habitat types had nesting failure. One pair was suspected to have abandoned nesting after a late storm (a redwood site), and plucked fledgling feathers at another site indicated young were predated (a douglas fir site).

Habitat

Northern spotted owl roosts and nest sites tended to have higher amounts of duff cover and canopy cover, on slopes facing south by south east. These habitat variables appeared to be selected by northern spotted owls over what was generally available; however, a larger sample size is necessary to support these results. If additional data supports these findings, we may infer that the fire may not have affected the preferred northern spotted owl habitat because most of the burn was on the west-facing slope of Inverness Ridge.

Habitat studies of northern spotted owls in other areas (of all three subspecies; northern (*S.o. caurina*) , California (*S.o. occidentalis*), New Mexican (*S.o. lucida*) also found these variables to be good predictors of owl habitat (Seamans 1994, Call 1990, LaHaye 1988). Other researchers also determined that variables such as higher basal area of total trees, of conifers, of large trees, of mature trees and snags were good predictors; however, this study did not find similar correlations. Differences between habitat analyses may be due to different habitat, collection methods, or sample size.

Table 4. Spotted owl pellet analyses collected from all seasons.

	mamm. A	Neotoma fusc.	mamm. B	Microtine	Microtus calif.	bird	Cricetine	Peromyscus	Mus sp.	bird sp.	Sorex sp.	Total Pellets
Mean wt. (g)*	300	271	270	65	53.5	50	30	24.5	18	15	10.5	
Individuals fr.												
Bishop pine:	1	26	0	1	0	1	0	14	0	0	1	30
Composition:	4%	90%	0%	1%	0%	1%	0%	5%	0%	0%	0%	
Individuals fr.												
Douglas fir:	4	21	6	0	5	0	1	8	1	1	0	35
Composition:	13%	63%	18%	0%	3%	0%	0%	2%	0%	0%	0%	

*Mean weight estimated for unknown genera

Owl on Inverness Ridge
(© Susan Van Der Wal)

Prey

Pellet analysis results suggest that the northern spotted owl diet (by weight and frequency) in Douglas-fir and Bishop pine forests in the Seashore consists primarily of woodrats. A variety of other species are also eaten, but most of the biomass is composed of woodrats. Other studies of northern spotted owl diet yielded similar results, with northern spotted owls relying on one or two species of small mammals for the majority of their diet (Carey et al.1992, Laymon 1988, Thrailkill and Bias 1989). Two species of particular importance to northern spotted owls are the northern flying squirrel (*Glaucomys sabrinus*) and the woodrat (*Neotoma* sp.) (Zabel et al. 1995, Smith et al. 1999). Dusky-footed woodrats are fairly abundant in this region (Willy 1992), and may be supplying northern spotted owls with ample prey. Interestingly, pellets collected outside the study area from sites in redwood and hardwood forest types in Marin had a predominance of California pocket gophers (*Thomomys bottae*) and California meadow voles (*Microtus californicus*).

The track plate method used was insufficient to determine prey availability for northern spotted owls. The group of most interest were small mammals from which the availability of potential prey could be compared between sites; however, the results of the initial plots indicated this method was not detecting sufficient samples of the target group. Attracting non-target species may have also disrupted the experiment since species such as gray fox or raccoon usually consumed all the bait. Additionally, interpretation of the tracks was compromised by fog drip distorting the track impression.

Recommendations

The immediate effects of the fire and fire suppression activities are not clear, and more monitoring is required to gain a better understanding. For a relatively long-lived and reclusive species such as the northern spotted owl, it is inappropriate to draw conclusions from a single breeding season. Nevertheless, these data yield some insights into northern spotted owl habits that can guide future research.

Areas of current and future research that will guide management in understanding the potential effects of fire and fire suppression actions on northern spotted owl include 1) broaden the study area and increase sample size in order to strengthen power of analyses of habitat associations, 2) study primary prey of northern spotted owl, dusky-footed wood rats, to determine their distribution and abundance pre and post hazard fuel reduction, 3) study variability of northern spotted owl diet by season, by year and by habitat, and 4) continue long-term monitoring of known sites to enhance understanding of factors affecting reproduction, productivity, juvenile dispersal, and survivorship.

Finally, continue adaptive management by the Seashore for the protection of northern spotted owls in order to mitigate effects of the fire and fire suppression activities. Adaptive management includes coordination of park activities with park biologists to insure northern spotted owl sites are not disturbed during the breeding season by maintenance activities such as the removal of hazardous trees, trail maintenance, hazard fuel reduction, or exotic plants. Additional mitigation measures and management strategies may be needed if monitoring studies determine that annual recruitment rate is lower than annual mortality.

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Juvenile northern spotted owl (© Susan Van Der Wal)

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