

**Final Report
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Project Title

Productivity and Habitat Use of Spotted Owls in relation to fire severity in southwestern Oregon: Can prescribed burns be used to reduce fire hazards in spotted owl habitat?

Principle Investigators and Organizations

Dr. Robert G. Anthony (PI) - Oregon Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon.
Email: Robert.Anthony@oregonstate.edu
Phone: (541) 737-1954

Darren A. Clark (Graduate Research Assistant) - Oregon Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon.

Chris McAlear (Federal Cooperator) – U.S.D.I. Bureau of Land Management, Medford District, Butte Falls Resource Area, Medford, Oregon.

Study Area

This study was conducted within and around the Biscuit, Quartz, and Timbered Rock Fires in southwestern Oregon (Figure 1).

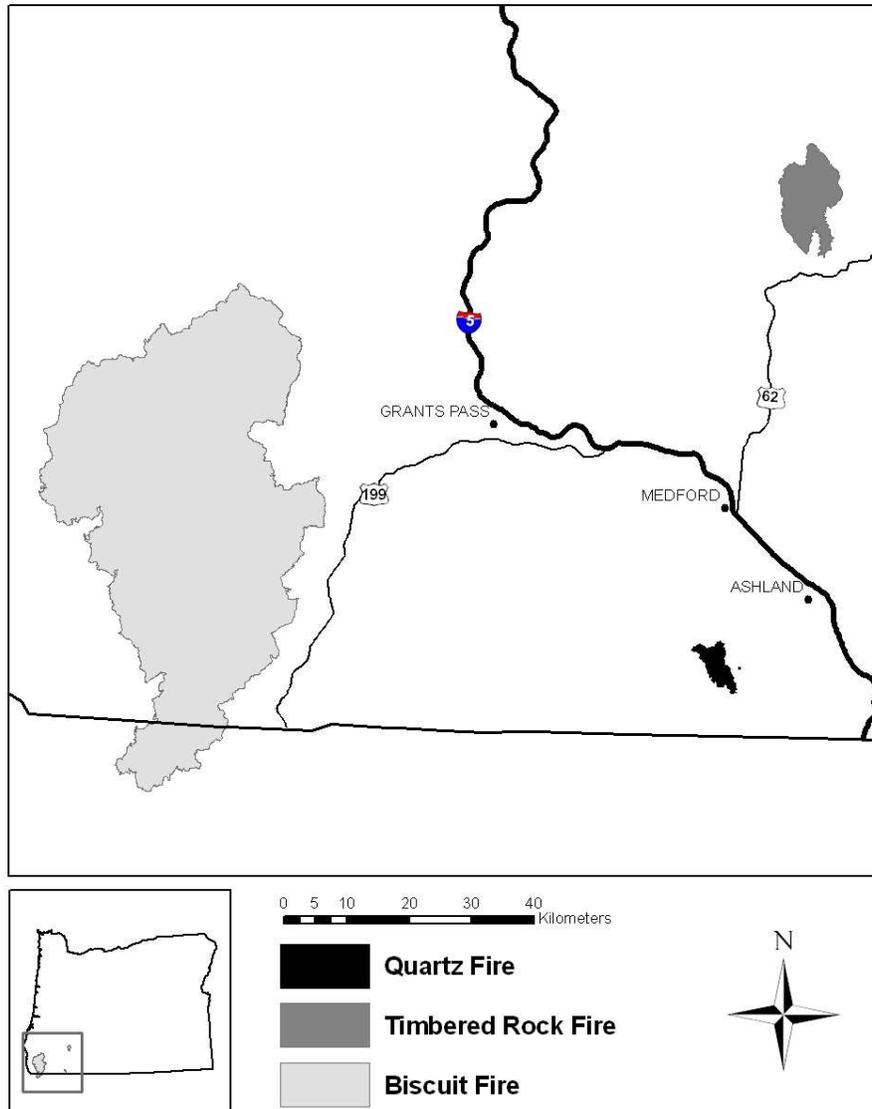


Figure 1. Location of the Biscuit, Quartz and Timbered Rock Fires in southwestern Oregon.

Biscuit Fire

The Biscuit Fire originated from several small fires, which were ignited by lightning in mid-July 2002. These fires eventually merged into a very large complex fire that covered approximately 201,436 ha of public and private lands. Fifty known spotted owl territories (49 on U.S. Forest Service and 1 on Bureau of Land Management lands) were within or adjacent to the fire boundaries. Spotted owl demographic surveys were conducted at 9 spotted owl territories on the eastern border of the Biscuit Fire during the 2003 – 2006 breeding seasons.

Quartz Fire

The Quartz Fire ignited during a lightning storm in August, 2001 and burned roughly 2,484 ha of public and private land. Demographic surveys were conducted at 7 owl territories within the fire and 2 territories at the edge of the fire that were partially burned. All territories were surveyed for 5 years following wildfire from 2002 – 2006. Radio-telemetry was conducted at 1 owl territory within the fire and 1 territory adjacent to the fire from April, 2005 – April, 2006.

Timbered Rock Fire

The Timbered Rock Fire ignited in mid-July, 2002 and burned approximately 11,028 ha of public and private land. Demographic surveys were conducted at all 22 known historic spotted owl territories for 4 years following the fire from 2003 – 2006. Spotted owls were monitored with radio-telemetry at 7 territories within the fire and 5 territories immediately adjacent to the fire from September 2004 – August 2006.

Study Objectives

- Investigate the short-term impacts of wildfire on spotted owl site occupancy.
- Determine the short-term impacts of wildfire on spotted owl survival and reproduction.
- Compare home range size of spotted owls before and after wildfire and of owls inside and outside burned areas.
- Describe differences in home ranges of spotted owls using fire and habitat explanatory variables.
- Assess habitat selection of spotted owls at a home range and landscape scale.
- Develop recommendations for the implementation of prescribed burning treatments in northern spotted owl habitat.

Significant Findings

Post-fire northern spotted owl site occupancy declined:

- Occupancy of spotted owl territories following the Timbered Rock Fire declined much more rapidly than unburned owl territories in the South Cascades Demography Area. The rapid decline in occupancy following the Timbered Rock Fire was driven by elevated extinction rates, which likely reflected increased emigration and decreased survival of spotted owls. Wildfire and subsequent salvage logging on private timberlands was likely responsible for the elevated extinction rates following the Timbered Rock Fire.
- Occupancy rates at the Biscuit, Quartz and Timbered Rock Fires all declined from 2003 – 2006. Initial occupancy rates at the three study areas were positively associated with increased amounts of roosting and foraging habitat with low severity burn within owl core areas, which suggested that some amount of habitat heterogeneity within the core area benefited initial occupancy. Furthermore, initial occupancy was negatively associated with increased amounts of hard edge within the core area, which suggested that habitat fragmentation negatively impacted initial occupancy following wildfire.
- Site extinction rates were the most critical factor influencing occupancy at the Biscuit, Quartz and Timbered Rock Fires from 2003 – 2006. Site extinction rates increased in a curvilinear manner as the amount of unsuitable habitat within the core area increased, suggesting that high severity fire and pre- and post-fire timber harvest negatively impacted spotted owl site occupancy. Furthermore, extinction was positively associated with hard edge, which suggested that occupancy was negatively impacted by habitat fragmentation from salvage logging and high severity fire.
- Spotted owl site colonization was relatively low following wildfire from 2003 – 2006 at the Biscuit, Quartz and Timbered Rock Fires and had minimal impacts on spotted owl site occupancy. Owl territories that had greater amounts of older forest that received a low severity burn had a higher probability of being colonized by spotted owls in post-fire landscapes. This finding was not surprising because spotted owls are often associated with older forests (Forsman et al. 1984, Thomas et al. 1990).

Northern spotted owls are still capable of producing young in burned landscapes:

- The number of young fledged per pair of spotted owls per year at burned landscapes at the Biscuit, Quartz and Timbered Rock Fires was not significantly different than unburned landscapes at the South Cascades Demography Area. However, we lacked sufficient statistical power to detect differences between these groups.
- It is apparent that spotted owl pairs that maintain territories within burned landscapes produce young at a similar rate to spotted owl pairs in unburned landscapes, which has been suggested by previous research (Jenness et al. 2004).

- Total reproductive output of spotted owl populations was negatively affected by wildfire. The total number of owl pairs within the burned landscapes declined following wildfire, therefore, less pairs were present to reproduce and less young were subsequently fledged.
- We lacked sufficient data to investigate the impacts of wildfire on territory specific reproductive output. Additional research is needed to examine these relationships.

Survival rates of owls in burned landscapes were lower than unburned landscapes:

- Annual survival rates of spotted owls that occupied territories in burned landscapes or that were displaced by wildfire were lower (0.64, 95% C.I. = 0.37 – 0.84) than those in unburned territories at the South Cascades Demography Area (0.85, 95% C.I. = 0.83 – 0.88) (Anthony et al. 2006), and owls in unburned habitat in this study (1.00, 95% C.I. = 1.00 – 1.00).
- Similarly, survival rates over the entire course of the study (19 months) for owls inside or displaced by fire were lower (0.33, 95% C.I. = 0.12 – 0.64) than for owls outside the fire (1.00, 95% C.I. = 1.00 – 1.00).
- These results likely indicate that wildfire and subsequent salvage logging negatively impacted survival rates of spotted owls by increasing the amount of unsuitable habitat which has been suggested to negatively impact spotted owl survival rates (Franklin et al. 2000, Olson et al. 2004, Blakesley et al. 2005, Dugger et al. 2005).
- We were unable to estimate the impacts of wildfire and salvage logging separately on spotted owl survival because they were highly interrelated and we lacked sufficient data to model these effects. Future research is needed to investigate the impacts of high severity fire and salvage logging on spotted owl survival rates.

Post-fire home ranges were larger than pre-fire home ranges:

- Annual home ranges of spotted owls prior to wildfire at Timbered Rock in the Miller Mountain Telemetry Study (Anthony and Wagner 1998) were on average 248 ha (95% C.I. = 82 – 491) smaller than home ranges of spotted owls in this study. Seasonal home range estimates provided similar results. This suggested that wildfire and subsequent salvage logging caused spotted owls to increase their home ranges.
- While home ranges of spotted owls were larger in the post-fire study than the pre-fire study, I did not observe owls outside the fire boundary having larger home ranges than owls inside the fire at the Timbered Rock Fire in this study.
- The habitat variable that best described home range size in this study was the length of hard edge within the home range. Annual home ranges increased as the amount of hard edge increased ($\beta = 30.7$, $SE = 2.7$, $p < 0.01$). Hard edge was defined as the interface between suitable and unsuitable habitat and represented the degree of habitat fragmentation. This suggested that owls increase home ranges in response to increased habitat fragmentation. In addition, there was a negative correlation observed between the length of hard edge and the amount of older forest within the home range ($r = -0.44$, $p = 0.04$) which provided indirect evidence that home range sizes increased with decreased amounts of older forest

as seen in previous research (Carey et al. 1992, Glenn et al. 2004, Hamer et al. 2007).

- The relationship observed between increased home range size and habitat fragmentation may help explain why home range size did not differ between owls inside and outside the Timbered Rock Fire. Several owl pairs outside the fire had the greatest amount of edge within their territories, and this contributed to their large home ranges and may have confounded our ability to detect differences between groups.

Radio-telemetry data provided new insights on the habitat selection of spotted owls in post-fire landscapes:

- Spotted owls selected nesting, roosting and foraging habitat with a low severity burn at a landscape and home range scale. This was expected because previous research has documented the disproportional use of the oldest and most structurally diverse habitats by spotted owls (Forsman et al. 1984, Thomas et al. 1990, Carey et al. 1992, Glenn et al. 2004, Forsman et al. 2005, Hamer et al. 2007). Furthermore, spotted owls disproportionately used habitats that had the least amount of fire damage and increased structural diversity within nesting, roosting and foraging habitat with a low severity burn. This habitat likely provides the greatest benefit to spotted owls in post-fire landscapes.
- Nesting, roosting and foraging habitat with moderate or high severity burns was selected by spotted owls at a landscape scale and used in proportion to availability within individual home ranges. Both of these habitats likely provide some benefit to spotted owls in post-fire landscapes. The selection of nesting, roosting and foraging habitat with a high severity burn was a surprising result because it was previously thought of as unsuitable owl habitat because it no longer provided sufficient canopy cover, structural complexity, and downed wood (Mills et al. 1993, Buchanan et al. 1995, North et al. 1999, Herter et al. 2002).
- Roosting and foraging habitat with a moderate severity burn was selected by spotted owls at a landscape scale and used in proportion to availability within individual home ranges which suggests that this habitat provides some benefit to spotted owls in post-fire landscapes. This habitat may be selected in post-fire landscapes because it may have increased prey abundance due to the heterogeneous thinning created by wildfire (Carey 2001).
- Roosting and foraging habitat with a low severity burn was not selected by spotted owls in post-fire landscapes, but was used in relatively high amounts compared to other cover types. This likely suggests that this habitat provides some benefit to spotted owls in burned landscapes.
- Roosting and foraging habitat with a high severity burn was not selected by spotted owls and was used less frequently than available within individual home ranges. This habitat provided little benefit to spotted owls in burned landscapes.
- Areas that were clear-cut salvage logged following wildfire were used in a similar manner to early seral forests and were used less frequently than available within individual home ranges. This indicated that areas that received clear-cut salvage logging following wildfire provided no benefits to spotted owls in burned landscapes.

Several abiotic factors were also important to habitat selection of spotted owls in post-fire landscapes:

- Some spotted owls selected areas closer to hard edges than at random, which has been documented in previous research (Zabel et al. 1995). This phenomenon had been hypothesized to occur because of increased prey densities in early-seral forests (Carey and Peeler 1995), but inference on this hypothesis was beyond the scope of this study.
- Owls also selected areas lower in elevation and closer to perennial streams in this study. Owls may use these areas disproportionately due to thermoregulatory benefits (Barrows 1981, Forsman et al. 1984), increased prey abundance (Carey et al. 1999), or decreased fire severities in riparian areas (Reeves et al. 2006).

Management Recommendations

Implementation of fuel reduction techniques to reduce fire hazard in spotted owl habitat:

- Based on the results of this research project, we predict that low intensity prescribed fire may be used to help reduce fire hazard in dry forest ecosystems occupied by spotted owls. Low intensity prescribed fires that affect the forest floor and only cause mortality to understory trees will likely not have negative impacts on spotted owls or their prey over the long-term. When implementing prescribed burning within a spotted owl territory, activities should be restricted to a small portion of a nesting territory within a short-time frame (e.g. 5 year period) to reduce the short-term impacts of prescribed fire on spotted owls and their prey.
- Recommendations on the development of mechanical thinning treatments in spotted owl habitat were beyond the scope of this study, and future research is needed to investigate the impacts of thinning treatments on spotted owls. Development of these prescriptions will be a major challenge facing wildlife and land managers, because the vegetation structure associated with quality spotted owl habitat is often in exact opposition to the goal of reducing wide spread fire hazard.

Management of post-fire landscapes for the conservation of spotted owls:

- Home ranges of spotted owls in this study were larger than normally documented in this region and suggested that spotted owls utilized a larger area following wildfire. Based on the average home range size of 661 ha observed in this study, we suggest that the minimum territory size for spotted owls in post-fire landscapes in southwest Oregon be defined by a circle with a 1.5 km radius centered on the nest tree/site center. This territory size may be used to identify and protect owl habitat during post-fire land management activities.
- Spotted owls selected nesting, roosting and foraging habitat with a low or moderate severity burn. Furthermore, owl territories that had greater amounts of nesting, roosting and foraging habitat with a low severity burn were more likely to be colonized by spotted owls. Therefore, we recommend these habitats be

- protected on public lands throughout the landscape during post-fire land management activities to encourage habitat use and colonization by spotted owls.
- Nesting, roosting and foraging habitat that received a high severity burn was selected by spotted owls in this study. Therefore, on public lands where the conservation of spotted owls is a priority, we recommend this habitat be protected within 1.5 km of occupied spotted owl territories and at unoccupied territories where sufficient habitat remains to promote colonization by spotted owls in the future.
 - The results from this project suggested that clear-cut salvage logging is not an appropriate land management activity in areas where the conservation of spotted owls is the primary objective. We recommend that no clear-cut salvage logging occurs within 1.5 km of occupied spotted owl nesting centers on publicly administered lands.
 - It remains to be seen if other salvage logging prescriptions that incorporate thinning are less detrimental to spotted owls than clear-cut salvage. If salvage logging is deemed to be an appropriate land management activity, we recommend caution be taken to ensure that salvage logging prescriptions have minimal impacts on spotted owls, their habitat and prey.

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Deliverables

Proposed	Delivered	Status
Progress Reports	2005 Joint Fire Science Program Annual Progress Report, Project 04-2-1-52, Productivity and Habitat Use of Spotted Owls in relation to fire severity in southwestern Oregon: Can prescribed burns be used to reduce fire hazards in spotted owl habitat?	Done
	2006 Joint Fire Science Program Annual Progress Report, Project 04-2-1-52, Productivity and Habitat Use of Spotted Owls in relation to fire severity in southwestern Oregon: Can prescribed burns be used to reduce fire hazards in spotted owl habitat?	Done
Manuscripts	Clark, D.A., R.G. Anthony, and L.S. Andrews. In preparation. Occupancy rates of northern spotted owls in post-fire landscapes of southwestern Oregon. Expect to submit to The Journal of Wildlife Management by early 2008.	In progress
	Clark, D.A., R.G. Anthony, F.F. Wagner, and L.S. Andrews. In preparation. Survival and productivity of northern spotted owls in post-fire landscapes of southwestern Oregon. Expect to submit to Journal of Raptor Research by early 2008.	In progress
	Clark, D.A., R.G. Anthony, F.F. Wagner, and L.S. Andrews. In preparation. Northern spotted owl home range size and composition in post-fire landscapes of southwestern Oregon. Expect to submit to The Condor by early 2008.	In progress
	Clark, D.A., R.G. Anthony, and L.S. Andrews. In preparation. Northern spotted owl habitat selection in post-fire landscapes of southwestern Oregon. Expect to The Journal of Wildlife Management by early 2008.	In progress
	<i>The four manuscripts generated from this research project will exceed the number originally proposed.</i>	
Master of Science Thesis	Clark, D.A. 2007. Demography and habitat selection of northern spotted owls in post-fire landscapes of southwestern Oregon. Thesis. Oregon State University, Corvallis, OR, USA. 202 pp.	Done

Deliverable	Description	Status
Guidelines for prescribed burning in spotted owl habitat	Incorporated in the Master of Science Thesis by Darren A. Clark.	Done
Posters	Andrews, S., and R. Anthony. 2004. Site occupancy and productivity of spotted owls after wildfires at three areas in southwestern Oregon. Presented at the Annual Meeting of the Oregon Chapter of The Wildlife Society.	Done
	Andrews, S., R. Anthony, T. O'Brien, and F. Wagner. 2005. Winter habitat use by northern spotted owls on Bureau of Land Management within the boundary of the Timbered Rock Fire. Presented at the Annual Meeting of the Oregon Chapter of The Wildlife Society.	Done
Presentations	Clark, D.A. and R.G. Anthony. 2007. Post-fire habitat use of northern spotted owls in southwest Oregon. 3 rd Annual Northern Spotted Owl Conference. Hosted by the U.S. Fish and Wildlife Service. Portland, OR, USA.	Done
	Clark, D.A., and R.G. Anthony. 2007. Post-fire northern spotted owl research in southwestern Oregon. Avian Ecology Seminar at Oregon State University. Corvallis, OR, USA.	Done
	Clark, D.A., and R.G. Anthony. 2007. Post-fire habitat use of northern spotted owls in southwestern Oregon. The Scientific Foundations of Post-fire Policy: New Findings, New Ideas. Hosted by the Oregon State University, College of Forestry. Corvallis, OR, USA.	Done
	Clark, D.A., and R.G. Anthony. 2007. Post-fire home ranges and habitat use of northern spotted owls in southwestern Oregon. Annual Meeting of the Oregon Chapter of The Wildlife Society. Pendleton, OR, USA.	Done

Proposed	Deliverable	Status
Presentations	Clark, D.A. 2007. Demography and habitat selection of northern spotted owls in post-fire landscapes of southwestern Oregon. Master of Science Thesis Seminar. Corvallis, OR, USA.	Done
	Clark, D.A., and R.G. Anthony. 2007. Demography and habitat selection of northern spotted owls in post-fire landscapes of southwestern Oregon. A Workshop for Local Land Managers. Medford, OR, USA.	Done
Field Trip	Occupancy, productivity and habitat use of spotted owls after wildfires in southwestern Oregon. 2004. Hosted by the Bureau of Land Management and the U.S. Fish and Wildlife Service.	Done