Impacts and Policy Implications of Barred Owl Expansion, Fire Regime Management, and Other Factors on Spotted Owl Conservation

Michael Montgomery

Writer's Comment: As a young birder, I was captivated by the description of spotted owls in my Peterson Field Guide. *On backpacking trips in Big Sur's Ventana Wilderness, I would go to sleep hoping to hear one. I had even read a little about their controversial association with old-growth forests. But before writing this paper, I had no idea that protecting spotted owls could be so complicated. (And now I can hazard a pretty good guess as to why I never encountered one in Big Sur: recurrent wildfires have likely stripped the area of suitable nest-sites.) As it turns out, the factors currently influencing spotted owl survival make an already delicate situation all the more difficult, and after delving into the literature, I was surprised to discover that few, if any, studies have analyzed the complexities in a comprehensive manner. Now, after attempting to do just that, I can appreciate how daunting the decisions facing biologists and policymakers really are. I only hope this paper can help in that process.*

Instructor's Comment: In my UWP 102B course (Writing in the Disciplines: Biological Sciences), we end the quarter with a research paper, and the demands are high. One option, for students interested in wildlife and conservation issues, is to collect the evidence about such an issue and present management recommendations, a common practice in actual professional journals. Furthermore, the essay must be written at the level of working professionals. In a journal, such a paper would report original research, but as much as I would like to, we cannot leave Davis and look at cheetahs or narwhals for months. Instead, we look at the existing research. Michael started with what

I thought would be a straightforward paper on the spotted owl, but as the project progressed, he found complexities and connections with other species and the whole environment that I would never have guessed existed, and I have personal familiarity with the matter. I believe some of his conclusions are unique; a grad student might just poach them for an MS project. For an undergraduate course—and for a student still in his first year—that is going well above and beyond the call of duty.

– Scott Herring, University Writing Program

Throughout their range, spotted owls (*Strix occidentalis*) exhibit a strong preference for old-growth forest. The presence of mature trees and vertically layered canopy cover exceeding 70% are two of the most important predictors of nest site occupancy (Mills et al. 1993), likely due to a combination of abundant nest- and roost-sites, prey availability, and microclimatic insulation (Wilcove 1990). Because of this close association, spotted owls are a crucial indicator species of old-growth ecosystems, and their survival has often directly conflicted with timber harvesting. Today, despite decreased logging pressure, they continue to decline, and competition with barred owls (*Strix varia*) and wildfire-related habitat loss figure prominently among possible causes.

Figure 1: Political cartoon capturing some of the controversy's prevailing sentiments (courtesy Block 1990).

Historical Context

Prior to the 1970s, little was known of spotted owl ecology. Of the three subspecies—the northern (*S. o. caurina*), California (*S. o. occidentalis*), and Mexican (*S. o. lucida*)—*S. o. caurina* has been the focus of

most research. The first studies of its biology in Oregon (Forsman et al. 1984) and California (Gould 1977) revealed a wider distribution and closer affinity for climax conifers than previously thought, immediately calling to attention the significant threat that clearcutting—which had intensified in the Northwest following World War II—posed to its survival (Yaffee 1994).

By the early 1990s, tensions between the timber industry and environmentalists over the subspecies' future erupted into a long-standing national controversy, with groups such as the Wilderness Society quickly adopting *S. o. caurina* as a symbol and logging companies such as Weyerhaeuser decrying it as a threat to regional economies. In 1994, the establishment of an old-growth reserve network under the Northwest Forest Plan tipped the scale in favor of spotted owls, although—as many activists claimed from the very start, and as the evidence increasingly shows—it has not been enough to ensure their long-term survival (Yaffee 1994).

Current Threats

Today, both *S. o. caurina* and *S. o. lucida* are listed as threatened under the Endangered Species Act (Ganey et al. 2013). The general shift in agency focus from timber sales to ecosystem conservation that began with the Northwest Forest Plan has successfully reduced logging of their habitat (DellaSala et al. 2015), but spotted owl populations remain in decline—2.8% annually in the case of *S. o. caurina* (Davis et al. 2011). Several contributors have been suggested.

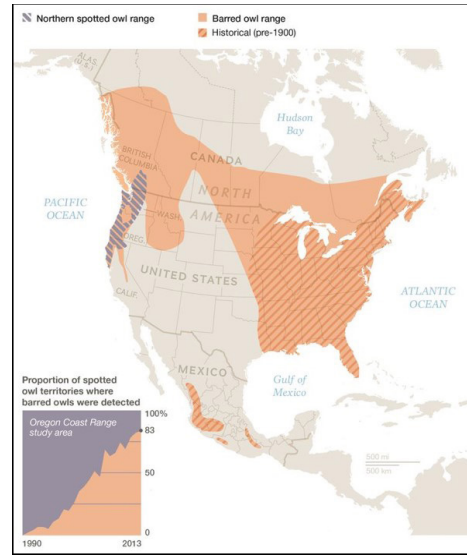

Figure 2: Map of barred owl range expansion, showing current overlap with S. o. caurina *(courtesy Hawk 2014).*

Barred Owl Expansion

Once only found east of the Great Plains, barred owls have in recent decades undergone a massive range expansion and now completely co-occupy the range of *S. o. caurina* (Gutiérrez et al. 2007). The potential for this congeneric invader to competitively exclude spotted owls has been known since the 1990s, but today is of paramount concern. Not only are barred owls larger and ecologically superior competitors than spotted owls, with smaller home ranges, less specialized habitat requirements, and higher reproductivity and population densities, their diet and nest-site preferences are similar (Diller et al. 2016), putting the two species in direct, often one-sided competition. Across the range of *S. o. caurina*, barred owl presence has been strongly linked to decreased site occupancy and reproductive success (Diller et al. 2016). Comparable impacts on *S. o. occidentalis* are expected if expansion into California continues (Tempel et al. 2016).

Great Horned Owl (*Bubo virginianus*) Predation

When old-growth is logged, the resulting increase in edge effect and habitat fragmentation favors the expansion of niche generalists like great horned owls (*Bubo virginianus*), which routinely have been documented preying upon juveniles of the smaller, less aggressive *S. o. caurina* (Johnson 1992). Studies since the 1980s have acknowledged this predation as one possible factor behind spotted owl decline (Forsman et al. 1984), but with the recent subsidence in logging, there is little indication its impact remains significant.

Effects of Historical and Present-day Timber Harvesting

Clearcutting and selective harvesting lead to long-term shifts in forest composition and habitat suitability (Loehle et al. 2011). However, while historical disturbances certainly contribute to limiting spotted owl populations in the present (Clark et al. 2013), ongoing forestry practices likely play a greater role. According to a growing body of research, this role—at least for certain silvicultural treatments—may not be all negative; in fact, partially harvested stands may actually provide better foraging (Irwin et al. 2013; also, see below).

Nonetheless, a threat from logging still exists, albeit in subtler—and

arguably more dangerous—form: post-wildfire salvage logging. Because such logging occurs primarily on private inholdings (Clark et al. 2013), it is less visible than the once-extensive clear-cuts that dominated debate in the 1990s, and its effects on spotted owls have received less attention (Lee et al. 2013). But for both *S. o. caurina* (Clark et al. 2013) and *S. o. occidentalis* (Lee et al. 2013), post-fire salvage logging has been shown to contribute significantly to declines in nest site occupancy, beyond—and in the case of *S. o. occidentalis*, nearly equal to—those associated with fire alone (Clark et al. 2013). In the Sierra Nevada, *S. o. occidentalis* may even exhibit greater aversion for burned stands that were subsequently logged than those that only burned (Lee et al. 2012). For both subspecies, post-fire logging appears to be a major source of increased extinction, especially in conjunction with remnant effects of historical harvests and the increased incidence of high-severity fire (Clark et al. 2013; again, see below).

Habitat Loss Due to Wildfire and Fire Regime Management

In the absence of sustained commercial logging pressure, wildfire is now the leading cause of spotted owl habitat loss (Davis et al. 2011), especially at lower elevations (Lee et al. 2013) and on mountain ranges' eastern slopes (Forsman et al. 2015). Across the species' range, decades of fire suppression have resulted in increased forest fuel loads, reductions in forest heterogeneity, and more frequent high-severity fires (Tempel et al. 2015). To combat heightened fire risk, management agencies are increasingly implementing medium-intensity treatments, such as mechanical thinning and prescribed burns, that reduce surface and ladder fuel accumulation (Stephens et al. 2016). For spotted owls, which nest primarily in the cavities, broken tops, and dead snags that are characteristic of late-successional conifers (Verner et al. 1992), this simplification of vertical forest structure poses a complex problem.

When fuel treatments reduce canopy cover below a certain threshold, the loss of potential nest sites and cover from predators like great horned owls has been shown to initially negatively impact spotted owl survival (Stephens et al. 2016). But if extreme fire conditions persist, and if medium-intensity prescriptions prove successful in reducing fire frequency and severity—and thus the associated widespread habitat loss—the treatments' long-term benefits to spotted owls will likely

outweigh immediate losses of nest- and roost-sites (Tempel et al. 2015).

Furthermore, while all three subspecies preferably nest in closed-canopy forest, they will frequently forage at its edges (Johnson 1992), where a heterogeneous mosaic of shrubs and saplings harbors a more abundant and diverse prey community (Tempel et al. 2015). In theory, then, the gaps created by understory removal and canopy thinning may actually improve owl fitness by generating more edge effect and increasing the availability of prey such as dusky-footed wood rats (*Neotoma fuscipes*), although it is unclear to what extent (Tempel et al. 2014).

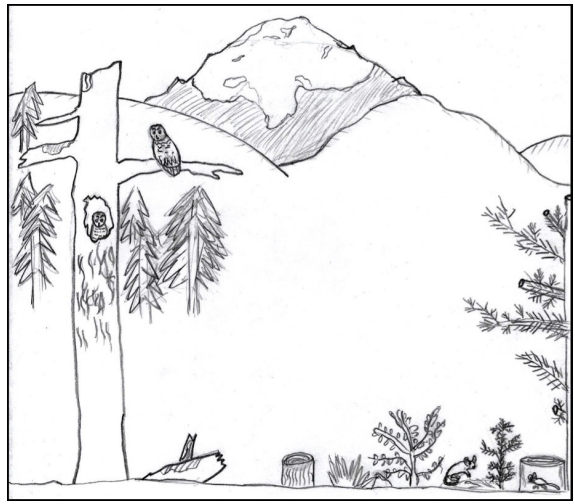

Figure 3: One possible outcome of selective forest management. Note the adjacency of unharvested old-growth and early successional and thinned vegetation, as well as the characteristics that make each uniquely relevant for spotted owl conservation, such as nest- and roost-site availability and prey abundance.

Management Implications

Since the 1990s, wildfire and barred owl encroachment have largely replaced commercial logging as the principal causes of spotted owl decline. Unfortunately for policymakers and scientists, both situations are complex and not well understood, and more quantitative research is needed before implementation of any large-scale conservation measures.

Barred Owl Removal

The threat from barred owl invasion on *S. o. caurina* is significant enough to have many worried about the subspecies' extirpation and eventual extinction (Gutiérrez et al. 2007), to the point that lethally removing barred owls—both in limited numbers, to facilitate coexistence, and in entire populations, to eliminate competition completely—from known spotted owl habitat has become a promising option. When barred owls were removed from timberland in northern California, *S. o. caurina* site occupancy increased markedly (Diller et al. 2016), leading to wider conversation over the cost, feasibility, and ethics behind such a strategy. In 2011, the US Fish and Wildlife Service prioritized barred owl removal in its Revised Recovery Plan for the Northern Spotted Owl (USFWS 2011), and hundreds of barred owls have since been removed from four sites throughout Washington, Oregon, and California (OFWO 2016).

Managing Fire Regimes Under Future Climate Change

Under most climate change models, the Northwest is expected to experience wetter winters and hotter, drier summers. On its own, this would pose a significant threat to a species like spotted owls, which are already sensitive to regional climatic variations (Glenn et al. 2010). In combination with the increased high-severity fire occurrence that is also predicted under most models (Liu et al. 2013), this threat is only amplified, and preventing wildfires becomes paramount to protecting spotted owl habitat. But the situation is hardly that simple. In fact, fire severity may actually lessen with climate change, due to decreases in plant productivity and burnable biomass (Parks et al. 2016); in that case, fuel reductions may lose any advantage they once conferred, for only under conditions of heightened fire risk were they anything but counterproductive for spotted owls in the first place (Tempel et al. 2015).

And even this is an oversimplification, as it ignores the possibility of improved foraging that such treatments likely provide (Stephens et al. 2016). Indeed, if fuel reductions can be implemented in a manner that avoids prime nesting habitat, they may actually maximize owl foraging benefits while minimizing costs to reproduction. And by generating a mosaic where closed-canopy old-growth is interspersed with patches of early-seral vegetation (see Figure 3), they may also recreate conditions of

the historical fire regime under which spotted owls evolved (Stephens et al. 2016).

In any event, the specific impacts of fuel treatments have been largely unexplored, and in combination with the uncertainties of climate change and the logistical challenges of wide-scale barred owl removal, they make protecting old-growth perhaps the most reliable way to shield the species from future change (Glenn et al. 2010), one that continues to provide a well-known habitat refugium for spotted owls while other options are investigated.

Works Cited

Block H. 1990. "Damn spotted owl!" Library of Congress [Internet, figure]. [cited 2017 June 8].

Clark DA, Anthony RG, Andrews LS. 2013. Relationship between wildfire, salvage logging, and occupancy of nesting territories by northern spotted owls. J Wildlife Manage. [cited 2017 June 7]; 77(4): 672-688. In Wiley Online Library [Internet]. Hoboken (NJ): John Wiley and Sons. [2013 Apr 15].

Davis, RJ, Dugger KM, Mohoric S, Evers L, Aney WC. 2011. Northwest Forest Plan—the first 15 years (1994-2008): status and trends of northern spotted owl populations and habitats [Internet]. Portland (OR): US Department of Agriculture, Forest Service; [cited 2017 June 4]; 147 p.

DellaSala DA, Baker R, Heiken D, Frissell CA, Karr JR, Nelson SK, Noon BR, Olson D, Strittholt J. 2015. Building on Two Decades of Ecosystem Management and Biodiversity Conservation under the Northwest Forest Plan, USA. Forests [Internet]. [cited 2017 June 3]; 6(9): 3326-3352.

Diller LV, Hamm KA, Early DA, Lamphear DW, Dugger KM, Yackulic CB, Schwaz CJ, Carlson PC, McDonald TC. 2016. Demographic response of northern spotted owls to barred owl removal. J Wildlife Manage. [cited 2017 June 14; 80(4): 691-707. In Wiley Online Library [Internet]. Hoboken (NJ): John Wiley and Sons. [2016 Apr

17].

Forsman ED, Meslow EC, Wight HM. 1984. Distribution and Biology of the Spotted Owl in Oregon. Wildlife Monogr. [cited 2017 June 14]; 87: 3-64. In JSTOR [Internet]. New York (NY): Ithaca Harbors.

Forsman ED, Sovern SG, Taylor M, Biswell BL. 2015. Home Range and Habitat Selection by Northern Spotted Owls on the Eastern Slope of the Cascade Mountains, Washington. J Raptor Res. [cited 2017 June 14]; 49(2): 109-128. In BioOne [Internet]. Washington (DC): BioOne Complete. [2015].

Ganey JL, Apprill DL, Rawlinson TA, Kyle SC, Jonnes RS, Ward JP Jr. 2013. Nesting habitat of Mexican spotted owls in the Sacramento Mountains, New Mexico. J Wildlife Manage. [cited 2017 June 3]; 77(7): 1426-1435. In Wiley Online Library [Internet]. Hoboken (NJ): John Wiley and Sons. [2013 Aug 28].

Glenn EM, Anthony RG, Forsman ED. 2010. Population trends in northern spotted owls: Associations with climate in the Pacific Northwest. Biol Conerv. [cited 2017 June 6]; 143(11): 2543-2552. In ScienceDirect [Internet]. Amsterdam (Netherlands): Elsevier. [2010 July 16].

Gould, GI Jr. 1977. Distribution of the spotted owl in California. Western Birds [Internet]. [cited 2017 June 6]; 8(4): 131-146.

Gutiérrez RJ, Cody M, Courtney S, Franklin AB. 2007. The invasion of barred owls and its potential effect on the spotted owl: a conservation conundrum. Biol Invasions [Internet]. [cited 2017 June 14]; 9: 181-196.

Hawk J. 2014. Map of northern spotted owl range and barred owl range in North America. National Geographic [Internet, figure]. [cited 2017 June 8].

Irwin LL, Rock DF, Rock SC. 2013. Do northern spotted owls use harvested areas? Forest Ecol Manag. [cited 2017 June 14]; 310: 1029-1035. In ScienceDirect [Internet]. Amsterdam (Netherlands): Elsevier. [2013 Apr 29].

Johnson DH. 1992. Spotted Owls, Great Horned Owls, and Forest Fragmentation in the Central Oregon Cascades [dissertation].

Oregon State University. 139 p.

Lee DE, Bond ML, Siegel RB. 2012. Dynamics of Breeding-Season Site Occupancy of the California Spotted Owl in Burned Forests. The Condor [Internet]. [cited 2017 June 14]; 114(4): 792-802.

Lee DE, Bond ML, Borchert MI, Tanner R. 2013. Influence of fire and salvage logging on site occupancy of spotted owls in the San Bernardino and San Jacinto Mountains of Southern California. J Wildlife Manage. [cited 2017 June 14]; 77(7): 1327-1341. In Wiley Online Library [Internet]. Hoboken (NJ): John Wiley and Sons. [2013 Aug 28].

Liu Y, Goodrick SL, Stanturf JA. 2013. Future US wildfire potential trends projected using a dynamically downscaled climate change scenario. Forest Ecol Manag. [cited 2017 June 14]; 294: 120-135. In ScienceDirect [Internet]. Amsterdam (Netherlands): Elsevier. [2012 Aug 9].

Loehle C, Irwin L, Beebe J, Fleming T. 2011. Factors Influencing the Distribution of Northern Spotted Owls in the Eastern Cascades, Washington. Northwestern Naturalist [Internet]. [cited 2017 June 14]; 92(1): 19-36.

Mills SL, Fredrickson RJ, Moorhead BB. 1993. Characteristics of Old-Growth Forests Associated with Northern Spotted Owls in Olympic National Park. J Wildlife Manage. [cited 2017 June 6]; 57(2): 315-321. In JSTOR [Internet]. New York (NY): Ithaca Harbors.

OFWO (Oregon Fish and Wildlife Office). 2016. Barred Owl Study Update. Portland (OR): US Fish and Wildlife Service; [cited 2017 June 14].

Parks SA, Miller C, Abatzoglou JT, Holsinger LM, Parisien MA, Dobrowski SZ. 2016. How will climate change affect wildland fire severity in the western US? Environ Res Lett [Internet]. [cited 2017 June 14]; 11(3): 035002.

Stephens SL, Miller JD, Collins BM, North MP, Keane JJ, Roberts SL. 2016. Wildfire impacts on California spotted owl nesting habitat in the Sierra Nevada. Ecosphere. [cited 2017 June 6]; 7(11): e01478. In Wiley Online Library [Internet]. Hoboken (NJ): John Wiley and Sons. [2016 Nov 7].

Tempel DJ, Gutiérrez RJ, Whitmore SA, Reetz MJ, Stoelting RE, Berigan WJ, Seamans ME, Peery MZ. 2014. Effects of forest management on California Spotted Owls: implications for reducing wildfire risk in fire-prone forests. Ecol Appl. [cited 2017 June 6]; 24(8): 2089-2106. In Wiley Online Library [Internet]. Hoboken (NJ): John Wiley and Sons.[2014 Dec 1].

Tempel DJ, Gutiérrez RJ, Battles JJ, Fry DL, Su Y, Guo Q, Reetz MJ, Whitmore SA, Jones GM, Collins BM, Stephens SL, Kelly M, Berigan WJ, Peery MZ. 2015. Evaluating short- and long-term impacts of fuels treatments and simulated wildfire on an old-forest species. Ecosphere. [cited 2017 June 14]. In Wiley Online Library [Internet]. Hoboken (NJ): John Wiley and Sons. [2015 Dec 11].

Tempel DJ, Keane JJ, Gutiérrez RJ, Wolf JD, Jones GM, Koltunov A, Ramierez CM, Berigan WJ, Gallagher CV, Munton TE, Shaklee PA, Whitmore SA, Peery MZ. 2016. Meta-analysis of California spotted owl (*Strix occidentalis occidentalis*) territory occupancy in the Sierra Nevada: Habitat associations and their implications for forest management. The Condor [Internet]. [cited 2017 June 14]; 118(4):747-765.

USFWS (US Fish and Wildlife Service). 2011. Revised Recovery Plan for the Northern Spotted Owl (*Strix occidentalis caurina*). Portland (OR): US Fish and Wildlife Service; [cited 2017 June 14]; 258 p.

Verner J, Gutiérrez RJ, Gould GI Jr. 1992. The California Spotted Owl: General Biology and Ecological Relations. In: Verner J, McKelvey KS, Noon BR, Gutiérrez RJ, Gould GI, Beck TW, editors. The California spotted owl: a technical assessment of its current status. Albany (CA): Pacific Southwest Research Station. p. 55-77.

Wilcove DS. 1990. Of Owls and Ancient Forests. In: Norse EA, author. Ancient Forests of the Pacific Northwest. Washington (DC): Island Press. p 76-83.

Yaffee SL. 1994. The Wisdom of the Spotted Owl: Policy Lessons for a New Century. Washington (DC): Island Press. 431 p.