Society for Conservation Biology

American Ornithologists' Union

24 November 2010

Brendan White
U.S. Fish and Wildlife Service
Oregon State Office

Brendan White,

Please find attached a review of the Northern Spotted Owl Draft Revised Recovery Plan (2010) on behalf of The Society for Conservation Biology (North American Section) and The American Ornithologists' Union. We requested reviews of this Plan from four leaders in the field of avian management and conservation biology, all of whom are familiar with management and conservation of the Northern Spotted Owl. I also coordinated the reviews by the same Societies on previous two versions of the Recovery Plan for the Northern Spotted Owl; these reviews were requested by the USFWS. What follows is a synthesis of the reviews in a single document, and I am submitting it to the USFWS on behalf of these Societies.

Sincerely,

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On behalf of
The Society for Conservation Biology (North American Section) and
The American Ornithologists' Union

Review of the 2010 Draft Revised Recovery Plan for the Northern Spotted Owl on behalf of The Society for Conservation Biology (North American Section) and The American Ornithologists' Union.

What follows is a synthesis of four anonymous reviews of the Draft Revised Recovery Plan from four leaders in the field of avian management and conservation biology, all of whom are familiar with management and conservation of the Northern Spotted Owl.

Overview:

Reviewers from three scientific societies judged the 2008 Northern Spotted Owl (NSO) recovery plan to be weakened both by 1) lack of the analyses necessary to support planning, as well as 2) bias in the management interpretations of what science was presented. In contrast, many of the analyses supporting the 2010 draft recovery plan are innovative, and in many respects offer a model for recovery planning for other species of concern. We are pleased and encouraged that the USFWS took seriously many of the constructive criticisms offered by peer reviewers. The current plan exhibits an earnest and legitimate attempt to incorporate science into this plan. USFWS is to be commended and encouraged for their efforts in preparing this document.

Importantly it withdraws the inadequate MOCA network as the basis of Northern Spotted Owl (NSO) recovery. It is unfortunate that full details on how this would be done are not yet available. However, the details given in Appendix C seem reasonable for as much as is given, and the modeling and advisory teams seem well qualified. The Draft also features much better treatment of fire, fire risk, and fire management; it deals more comprehensively with foraging and dispersal habitat. The Draft recognizes and stresses the importance of maintaining all existing NSO habitat, which is vital given the continuing population declines of the NSO and the increasing threat posed by expanding barred owl populations. The Draft is also strengthened by strongly endorsing the use of active, as opposed to passive, adaptive management as the preferred way of reducing gaps in knowledge.

However, some aspects of the 2010 plan remain problematic and require revision before the document can be expected to adequately support NSO recovery planning. The most problematic issue is that, by releasing a draft plan for review before major elements of the habitat and viability analyses were completed, the USFWS effectively precluded detailed peer review of the analyses. Additionally, this incomplete science necessarily makes it difficult to review any management interpretations of that science. We acknowledge that 6 weeks into the 8-week (at that time) review period, the USFWS offered to make a presentation of the habitat and viability analyses. However, (1) this was too late to be useful in our current reviews, (2) it is unclear how this could have been done while maintaining the anonymity of the reviewers, (3) an oral presentation would have been inadequate because it does not allow the same opportunities for scrutiny, reflection, and re-review that written text allows, and (4) disagreements over details from an oral presentation cannot be evaluated by a third party. Because one of the reviewers attended a briefing on the methods used in the habitat and viability modeling, that reviewer was able to comment knowledgably on that portion of plan's analyses, but the other reviewers could not, and all expressed frustration about this.

The plan itself contains only a very general description of the modeling, thus limiting substantive review by most other outside experts. This is a key shortcoming because a well-designed reserve network is key to ensuring NSO persistence, and habitat and viability modeling is key to assessing the efficacy of any proposed reserve network. Thus, **without further opportunity for peer review, the FWS cannot be confident that the final plan contains a reserve strategy that will ensure recovery goals.**

Given criticism of the 2008 plan by scientists, the premature release of the 2010 draft plan is a disturbing sign that the FWS remains uncertain as to the role of 'best-available science' in ESA implementation. Similar problems are evident with the discussion of fire and vegetation in the plan, where key citations are unpublished documents unavailable to peer reviewers. **Below we first briefly discuss several areas in which the plan needs substantial revision:**

(1) Analysis of Wildlife,

(2) Analysis of Genetic Risk,

(3) Barred Owls,

(4) Habitat Loss on Non-Federal Lands,

(5) Status of Washington State Populations,

(6) Habitat and Viability Modeling.

We then focus in detail on revisions that can make the habitat and viability modeling, which is a strong point of the recovery planning effort (although not of the draft document), even more rigorous and informative.

Analysis of Wildfire

As in the 2008 Plan, the 2010 Plan's analysis of wildfire as a risk factor to NSO persistence is flawed by several key assumptions that are unsupported in the literature. For example, a key assertion in the plan is that wildfire-related 'loss' of LSOG outpaced recruitment during the last decade. Firstly, it cannot be assumed that the area impacted by wildfire as mapped by the LandTrendr data (Moeur unpubl.) is equivalent to the area of lost NSO habitat. Fire-affected stands form important and unique landscape elements, and may be used by spotted owl as documented in recent studies (e.g., Clark 2007, Bond et al. 2009). Secondly, given the short (decadal) monitoring interval, the plan's interpretation of the LandTrendr data (that wildfire-related loss is outpacing recruitment, and that this constitutes a long-term threat to NSO) is inappropriate due to the long equilibrium interval expected for fire effects (high variance in the fire extent in any single decade), and the large amount of future LSOG in the recruitment 'pipeline' (Moeur unpubl.).

Analysis of Genetic Risk

The analysis of genetic risk factors to NSO population persistence remains inadequate in the 2010 plan. Recovery plans for well-studied species such as the NSO must consider genetic risk factors in order to meet current standards for scientific rigor. Typically genetic issues are considered as subsidiary in importance to direct threats for metapopulations of the size of the NSO metapopulation. However, they may be important in accentuating risk to certain subpopulations. Recent papers such as Funk et al. (2010) have suggested the importance of genetic bottlenecks in certain NSO populations. Despite this new information, the 2010 plan simply defers to a previous review of the Funk et al. study and related work at the time when they were unpublished manuscripts. This review (contained in SEI [2008]) was categorized as superficial by peer reviewers of the 2008 plan. The 2010 plan's discussion of these papers and genetic issues needs to be updated and expanded.

Barred Owls

The threat from Barred Owls is complex and challenging. The plan suggests (p. 109) that Barred and Spotted Owls will compete because they are similar in size and share habitat and prey requirements, which is true. Reviewers were mixed, however, in their reactions and suggestions regarding the potential effectiveness of barred owl control. It is recognized that recovery actions 27 and 28 (page 67) are extremely important, and that permitting to remove barred owls experimentally will surely be controversial with the public. However, one reviewer felt that these efforts are absolutely critical experiments for spotted owl recovery, and should be vigorously pursued, while another thought that shooting Barred Owls will likely be futile, and the only hope of maintaining Spotted Owls is to ensure that high quality habitat is available across their range. From this, we conclude (1) that efforts to manage barred owls need to be done in an experimentally sound way so that the effectiveness can be properly evaluated, and (2) that barred owl control should not substitute for appropriate habitat restoration and protection.

Habitat Loss on Non-Federal Lands

The LandTrendr data suggest that NSO habitat on private land disappeared rapidly during the period 1996-2006. Moeur (unpubl.) reviews the LandTrendr results and states "Nearly a half million acres of LSOG were harvested from non-federal lands between 1994 and 2007 (concentrated in the coastal provinces of Oregon and Washington)." This is likely to impede recovery goals in areas such the northern Oregon coast and southeast Washington. Some portions of this type of habitat may need to be prioritized for restoration and/or to enhance connectivity. This issue is not treated adequately in the plan.

Status of Washington State Population

Another weakness in the Draft is its superficial treatment of the inadequacies of existing regulations at the state level. Based on the recent meta-analysis, a steep population decline is evident in NSO populations in Washington state (Forsman et al. in press). The authors state that "The number of populations that have declined and the rate of decline on study areas in Washington and northern Oregon are noteworthy and should be cause for concern for the long-term sustainability of Spotted Owl populations throughout the range of the subspecies." The management implications arising from the higher degree of threat to NSO subpopulations in Washington state is not treated adequately in the plan. One reviewer who is familiar with the actions of state agencies in Washington suggests that regulations seem designed to facilitate continued declines in, rather than recovery of, NSO populations. Regulations regarding harvesting in and near occupied sites, criteria for determining sites to be no longer occupied or unlikely to be occupied in the future violate all principles of metapopulation dynamics. True, the Draft appropriately focuses on actions that can be taken by the Federal government, but it is clear that state agencies in Washington and Oregon have the potential to play key roles in NSO conservation efforts.

Habitat and Viability Modeling Based on Maxent, Zonation, and Hexsim

The habitat and viability modeling methods are sound and innovative. The planning team has used a coherent series of analysis tools to make best use of available data to inform planning. Two aspects deserve particular praise:

1) Use of newly available information (e.g., GNN vegetation layer, Forsman et al. (in press) NSO meta-analysis monograph, database of NSO locations, new delineation of modeling regions).

2) Use of 'state-of-the-art' modeling tools (Maxent, Zonation, Hexsim), which are connected in a logical process in which output from initial stages informs successively more complex modeling tools. Due to the effort made by the modeling team to solicit relevant data from the literature and experts, the structure of the Hexsim scenario is highly complex and potentially more informative than simpler models used in past NSO conservation planning. However, the modeling methods can and should be strengthened in key aspects in order to better inform recovery planning, and these are covered in the following sections. Because some of the comments starting in the next section have been shared informally with the modeling group, some these points may have already been addressed (although not in the Draft Plan).

Although the overall structure of the phases of the modeling protocol appears sound, however, as usual, **the devil is in the details, and the details are lacking**. What implementation actions the models will suggest are at present unknown. We do not know how experiments will be designed, the criteria for evaluating their outcomes, or the time frames over which informative results might be forthcoming.

Nevertheless, based on what is available and described in the Draft, we judge that there might be a serious weakness in the effort – it is vague and inconclusive approach to the application of active adaptive management. An insightful, scientifically sound, and economically appropriate ACTIVE adaptive management process does not just identify existing knowledge gaps. More importantly, it develops a procedure for assessing which ones are truly decision-critical. That is, for each substantive issue, it takes the existing range of uncertainty, models the outcomes assuming operation of processes at the extremes of existing uncertainty, and assesses the management implications of the results. In other words, for each management decision for which the model is relevant, active adaptive management asks whether the results imply different interventions or whether the most appropriate management policy is robust over the full range of uncertainty. Employment of this process enables managers to determine which components of uncertainty are truly decision-critical and which are not. Research efforts, which are always time and funding limited, can then be directed to the former, not wasted on the latter. The wording in the Draft related to the use of adaptive management provides no evidence that critical analyses of this sort have been considered or are being contemplated. The descriptions of experiments on forest stand structure, for example, are very vague. What are the goals? What management decisions will be affected? Similarly, what can one expect to learn from experimental removal of barred owls? Over what spatial scales? Over what time frames?

Consequently, this draft is a much different document than the previous draft—it is more of a general framework of principles to guide recovery (bordering on philosophy in some places) than specific prescriptions. However, this draft leaves many of the important decisions to a series of teams or work groups that have been formed to address a series of specific issues. That approach is reasonable, although **it makes the document somewhat diffuse and the process of evaluating the potential effectiveness of the recovery strategies nearly impossible.** Many of the Recovery Actions, for example, are presented with little information about how information will be gathered by whom to gauge the Recovery Criteria. **Therefore, rigorous evaluation of many of ideas described in the plan can only occur when the products produced by the work groups are made available in the future.**

Converting the general framework outlined in the plan into a meaningful implementation strategy—that is, incorporating the products promised by work groups into action—will be a real challenge, and will require constant and careful coordination. That process will be aided by establishing fixed timelines for these products and an explicit strategy to ensure that they are implemented meaningfully; without those elements, there will be little hope for recovering the species. These steps and schedules could form the basis for additional recover actions and criteria to ensure they are taken seriously.

Habitat-Related Comments

Although areas currently occupied by spotted owl are paramount to short-term conservation efforts for spotted owls, there are almost certainly areas of high quality habitat on the landscape that are unoccupied because any species in decline will almost certainly be at levels below carrying capacity. The importance of high quality habitat that is unoccupied is recognized as important in the plan (p. 25; see also pp. 31, 34, 51/52 and elsewhere) with the caveat "to the extent possible;" the importance of these areas is later marginalized (e.g., p. 50-52), with a more intense focus on conserving occupied areas. Discussion of retention of high quality spotted owl habitat has a disclaimer along the lines of 'Management actions that may have short-term impacts (specifically, timber management) but are beneficial to spotted owls in the long term meet the recovery intent of habitat conservation.' The vagueness of this statement makes it meaningless for practical application, and potentially opens up the door to approval of actions detrimental to owl recovery. For example, what would be a "short-term impact", and how would that be balanced against “benefits”. Under this statement, a treatment that might decrease growth rate by 20% over the next 200 years but increase it by 10% after 200 years would appear to be acceptable. Although I believe I understand the intended sentiment – that short-term tradeoffs may be beneficial in the long term – the language really needs to be more operational for this statement to have a positive effect (or at least avoid negative effects) on spotted owl recovery.

Conserving all areas of potential owl habitat, whether or not they are currently occupied (or whether or not they have ever been surveyed), is absolutely imperative to recovery, because these are the areas into which the species can recover. A narrow focus on occupied areas is a step to maintaining the status quo, which has proven ineffectual.

One way to identify these areas would be to use the habitat model described in Appendix C to highlight areas with high habitat potential and target these for conservation, regardless of their occupancy status. This habitat model, which should be quite good given the wealth of habitat information available for owl, will be an important tool to guide many steps in the recovery process.

Similarly, **with so much of nesting habitat of spotted owls lost, the plan underemphasizes the importance of restoration or “recruitment” efforts to increase the amount of nesting habitat on the landscape.** Although the plan discusses the need for habitat restoration (esp. in the context of management after fire), and discusses how silvicultural practices can facilitate the process, **too few of the Recovery Criteria and Actions focus on the critical need to increase habitat by letting degraded areas recover**. **A “no net loss” criterion for habitat (Recovery Action 2) is insufficient** for a species where current conservation measures are failing to stem well-established declines in almost every portion of the species range. Establishing strategies and measurable goals to ensure that sufficient areas are allowed to develop into habitat appropriate for spotted owls – despite the long time-line required even with silvicultural enhancement – are essential to long-term conservation of owls. The habitat model could be used here as well, as a basis for identifying these areas of likely future habitat by targeting areas that have all of the features required by owls except for forests of appropriate age.

On page 33, the Draft Plan describes the need for landscape-scale, science-based adaptive restoration treatments in the face of uncertainty of effects of past management and future climate change. We believe that the identified problem is real, and that the general approach reasonable. However, we are concerned that the bottom third of the paper somewhat undercuts the commitment to scientific answers to critical management questions by saying: “Methods as simple as formulating a specific question, monitoring the results of the action, and recording the information in a manner that is retrievable and useful to inform future decision making will contribute to our learning”. While it is absolutely true that taking these steps is better than nothing for gaining reliable knowledge, these steps are really not ‘simple’, and are so vague here that they may or may not be useful. For example, “monitoring the results of the action” is enormously complex, as of course is already painfully obvious to all involved in spotted owl research and management. In short, we would hate for this sentence to be taken as a cheap replacement for more expensive, but vastly more rigorous, targeted field and modeling studies.

Conduct broader peer review of Maxent models by field biologists

The planning team used a defensible modeling process for development of the Maxent models, and solicited expert input to develop the suite of candidate models. However, there has been some criticism from field biologists as to model accuracy, especially in the California modeling regions where topographic and other variables dominate over variables related to forest age and structure. Since the Maxent results form the foundation for the rest of the modeling process, it would be useful to review Maxent results for California with researchers from that area, e.g., those associated with the CA demographic studies.

Analyze threats from barred owl (BDOW) in a different context than habitat-based threats to viability, and frame Hexsim results as informing decisions rather than predicting outcomes

While it is appropriate that a subset of the Hexsim model scenarios include effects of BDOW on NSO demographic rates, it should be recognized that the means by which the effect of BDOW on NSO was modeled is qualitatively different that of how habitat effects were considered. The BDOW effect as modeled is effectively non-spatial, in that there are no data on either 1) BDOW distribution (below the scale of the modeling region), or linkage between BDOW abundance and habitat quality. There is new data (Dugger unpubl.) suggesting that habitat and BDOW threat factors may interact, in that extinction rates of NSO territories were higher on territories with BDOW detections, and this effect was stronger as the amount of habitat decreased. However, given the scarce available data, it is defensible to model BDOW as a non-spatial effect. But this imposes limitations on interpretation of the Hexsim model results. In a sense, the BDOW effect parameterization simply lead Hexsim to simulate an exponentially declining population (i.e., it lowers survival rates in all habitats below the level necessary for population persistence). In contrast, the relationship between habitat and demography is modeled in a spatial manner, based on the extensive published data on habitat/distribution and habitat/demography relationships (although this too is challenging as described below).

The contrast between model parameterization for the two main threat factors (habitat loss and BDOW) implies the need for two types of Hexsim simulations:

1) Equilibrium scenarios comparing alternate habitat configurations

These would compare equilibrium carrying capacity under different reserve scenarios. Typically one needs to run simulations for ~100-150 years before the population equilibrates. So simulations would be run for, e.g., 250 years, and results (population size and distribution) would be reported as averaged over, e.g., years 150-250. If environmental stochasticity is added (as suggested below), it is necessary to run multiple simulations (typically 50-100) per scenario, as the variance may be as important as mean population size. To make this more computationally feasible (as Hexsim by default runs replicates one after each other), the user can make multiple copies of each scenario and run them in parallel on one computer. Since these scenarios focus on equilibrium behavior, the results would not be interpreted as predicting a population trajectory over time. Most studies have shown that SEPM are better used to rank alternative managment options than to predict e.g., extinction time or transient dynamics, due to these latter metrics having high uncertainty to alternate parameterizations. These equilibrium scenarios may have to use 'optimistic' demographic parameter sets to be most informative. Populations in most parts of the NSO range show declines (Forsman et al. in press "populations on four study areas declined 40–60% during the study, and populations on three study areas declined 20–30%") yet many aspects of SEPM simulations that respond to stochastic factors (e.g., distinguishing effects of size and spacing of habitat clusters) are swamped when such rapid deterministic declines are modeled, so equilibrium scenarios such as described above are more informative.

2) Because the BDOW factor as parameterized predicts eventual extinction of many populations (in part due to its lack of a link to habitat condition), equilibrium scenarios containing a BDOW effect are uninformative (equilibrium is at zero). BDOW simulations thus offer a different type of decision support than habitat-based equilibrium scenarios. Simulations analyzing the effect of BDOW should instead focus on comparing the transient dynamics (population trajectory) with and without BDOW, but with an awareness of the limitations of the model. It is important to describe these BDOW-related results separately and to document the relative confidence (i.e., strengths and weaknesses) of the habitat and BDOW parameterization.

It is incorrect to interpret population trajectories output from Hexsim as predicting population status/size. There is little information on the current NSO population size outside of demographic study areas (DSA), and less on population size in the past. Transient dynamics in SEPM are often dominated by artifacts of the initial conditions in the model and, barring substantial effort at model calibration and sensitivity analysis, results should not be interpreted as predicting population size at a particular point in time.

<u>Incorporate environmental stochasticity into Hexsim scenarios</u>

Many of the more subtle effects of contrasts between alternate conservations strategies e.g., effects of reserve size and spacing on viability, may only become evident when environmental stochasticity is incorporated into the scenario. This is one of the strengths of using a complex model such as Hexsim, and should be taken advantage of to avoid the typically overly optimistic results obtained when environmental stochasticity is not considered. Environmental stochasticity may be especially important in declining populations, as Forsman et al. (in press) state: "variation [in survival] often corresponded closely to the variation in λ and was most noticeable in study areas where populations were declining the most, especially those in Washington."

<u>Address potential effects of climate change, in either a qualitative or quantitative manner</u>

Recent studies have addressed potential effects of climate change on NSO (e.g., Carroll 2010). Additionally, because the Maxent NSO models include climate variables that are also available as projections under future climate scenarios, it is feasible to calculate projected habitat value under future climates using the Maxent models. Despite the many inherent uncertainties in these projections, they are informative and preferable to not addressing this potential threat factor.

Conduct sensitivity analyses on assumptions concerning effect of habitat on demography

Currently, the Hexsim scenarios model habitat value (as derived from Maxent) as influencing NSO survival but not reproduction. This is a defensible interpretation of the literature, but other parameter structures are nearly as plausible. The modeling team explained (pers. comm. to one reviewer) that the decision to model the effects of habitat on survival was based on the assessment that populations are most sensitive to changes in adult survival rates, and substantial published literature (Franklin et al. 2000, Olson et al. 2004, Dugger et al. 2005) documents these effects. All of these modeling efforts found a significant effect of the amount of old forest around nest sites on survival rates. However, although the recent meta-analysis (Forsman et al. in press) represents the most important recent addition to the above studies, the team was unable to directly use habitat-demography relationships from this study to parameterize Hexsim. Although a habitat effect was significant and positive in the meta-analysis' fecundity models for Oregon, the habitat covariate was not significant in the best models for Washington as all of the confidence intervals overlapped zero, even though habitat was in the best models for these study areas. There was no comparable habitat data for California in the meta-analysis, so no results or conclusions were made for that portion of the owl's range. Consequently, the effects of habitat amount on fecundity were mixed and not very conclusive from the meta-analysis, which provided a considerable challenge in how to model such effects in HexSim. If one based the Hexsim parameterization directly on the meta-analysis results alone, they would suggest a habitat effect on fecundity in Oregon, but no effect on survival. The modeling team's approach was defensible, in that they used the metaanalysis to document the plausible range of demographic values, but also considered evidence from previous studies of a habitat effect on demography. Thus the range of survival values from the meta-analysis was used to represent the "potential" effects of the amount of habitat on survival. However, there is enough uncertainty in the above process, that alternate plausible parameterizations should be explored as part of the sensitivity analysis. A comparison of Hexsim scenarios with a range of parameter sets (e.g., 1) equilibrium vs. declining populations, and 2) habitat effects on survival only, fecundity only, and on both parameters), could provide general insights that can better inform planning that can a single parameter structure.

Explore alternative scaling of demography to habitat in HEXSIM

Current Hexsim scenarios are structured with three resource classes (low, moderate, and high), with the breakpoints set to 1/3 and 2/3 of an individual's target resource. It would be helpful as a sensitivity analysis to increase the number of resource classes (to e.g., 10) and see if this affects results. The demographic values assigned to the resource classes could be a straightforward interpolation from existing parameters for the 3 classes.

Consider potential role of lower-quality habitat

The team used Zonation settings that prioritized clumped habitat over fragmented habitat. This is generally appropriate, but, when combined with the fact that the lowest 30% of Zonation priority levels are not mapped, has the effect of excluding consideration of lower quality habitat. The underlying issue is what, if any, role does marginally suitable habitat play in recovery. Such fragmented and/or marginal habitat is seen in much of the northern Oregon coast and southeast Washington. Although of lower quality, some portion of this type of habitat may need to be prioritized in recovery planning to accomplish population restoration goals or to enhance connectivity. Planners should consider how habitat restoration can best build on existing remnant habitat to restore subpopulation viability where necessary.

Develop alternate habitat and landscape change scenarios

A difficult question, discussed at the recovery plan workshop, is what assumptions should be made concerning future habitat trajectories in reserve vs. non-reserve areas. LandTrendr assessment of habitat change in the past decade does not reveal a strong contrast between change on reserved vs. non-reserved federal lands. But unless assumptions are made that habitat in reserves will strongly differ from that in non-reserved areas, the Hexsim model will not predict contrasting NSO viability under alternate reserve scenarios. It is not feasible to used detailed models (e.g., stand-level growth and succession models) to predict habitat change on a regional scale. Similarly, no attempt is made in the plan to link alternate fire and fuels management strategies to NSO habitat in the Hexsim simulations. Given these uncertainties, several alternate habitat change assumptions should be compared as part of a sensitivity analysis. Arguments that intensive fire and fuels management strategies are necessary because recent severe fires within the range of the NSO are outside the historical range of variability are not supported by recent reconstructions of fire history over a 2,000 year period (Columbaroli and Gavin 2010).

Reference multi-species context of NSO conservation planning

The Northwest Forest Plan was a pioneering example of multi-species planning that recognized that land managers can no longer afford to create single-species recovery plans that ignore the conservation requirements of other species of concern. As several peer reviewers commented, one of the major shortcomings of the 2008 NSO recovery plan was that it sought to turn back the clock on this effort and ignored the multi-species context of NSO recovery. The 2010 plan should correct this error. The plan should acknowledge that the system of LSR was created to conserve multiple species, and thus there are benefits to building on the LSR network rather than delineating an entirely novel system of reserves based on a new NSO model. Secondly, the plan should compare alternate NSO-based reserve scenarios with data on priority areas for other old-growth associated species to determine which alternatives best capture habitat for multiple species.

Other Comments

- The phrase "adaptive management" is used throughout the document, but there is little evidence that a genuine, rigorous adaptive management strategy is being considered—adaptive management is much more than simply "formal scientific inquiry" (p. 33).

- Page 35: We agree that there may be more efficient ways to evaluate spotted owl 'trend' or 'population health'. However, we also are very glad to see the recommendation to retain the current methods ongoing in the network of demographic study areas. Not only are these producing high quality inferences of population dynamics with a long and growing time series of demographic data, but as mentioned in the plan these data are by far the best available for rigorous evaluation of barred owl effects, including experimental barred owl removals. Along the lines, recovery action #22 (P. 65) is very important.

- Page 36: We applaud the call for synergistic drivers of population dynamics, including climate change as well as other known stressors.

- Page 37-38: We support the proposal to use the 1990 physiographic province designations as recovery units. These carry at least a degree of population-ecology relevance, and have the advantage of historic data associated with them.

- The word "suitable" should be dropped from the document as a modifier for habitat. If an area is not suitable for a species, then it is not habitat. Modifiers such as nesting habitat and dispersal habitat make sense; "suitable" does not.

- Certainly, fire is a natural process. However, the majority of catastrophic fires that threaten owl habitat are the consequence of fire suppression, which is not part of the natural fire regime. Therefore, I'd suggest dropping the phrase "natural process" as a descriptor of fire in these circumstances.

- p. 44-46. The discussion of fire and fire-related processes presented here is quite good.

- p. 109. The bold face and italics used for these caveats are unnecessary because these studies must be correlational. The alternative, which is performing a manipulative experiment, requires introducing barred owls into multiple sites inhabited by spotted owls where barred owls do not yet exist. That would be a foolish. There is no need to establish a causal mechanism here; the pattern itself is entirely sufficient.

- p. 120. Moilanen and Kujala 2008 (Zonation) is not in the literature cited.

REFERENCES

Bond, M.L., D.E. Lee, R.B. Siegel, and J.P. Ward, Jr. 2009. Habitat use and selection by California spotted owls in a postfire landscape. Journal of Wildlife Management 73:1116-1124.

Carroll, C. 2010. Role of climatic niche models in focal-species-based conservation planning: assessing potential effects of climate change on Northern Spotted Owl in the Pacific Northwest, USA. Biological Conservation 143:1432-1437.

Clark, D.A. 2007. Demographic and habitat selection of northern spotted owls in post-fire landscapes of southwestern Oregon. Thesis. Oregon State University, Corvallis.

Colombaroli, D., and D. G. Gavin. 2010. Highly episodic fire and erosion regime over the past 2,000 y in the Siskiyou Mountains, Oregon. PNAS 107:18909-18914.

Dugger, K. M., F. Wagner, R. G. Anthony, and G. S. Olson. 2005. The relationship between habitat characteristics and demographic performance of Northern Spotted Owls in southern Oregon. Condor 107:863–878.

Forsman, E. D., et al. In press. Population demography of northern spotted owls: 1985–2008.

Franklin, A.B., D.R. Anderson, R.J. Gutiérrez, and K.P. Burnham. 2000. Climate, habitat quality, and fitness in northern spotted owl populations in northwestern California. Ecological Monographs 70:539–590.

Funk, W.C., E.D. Forsman, M. Johnson, T.D. Mullins, and S.M. Haig. 2010. Evidence for recent

population bottlenecks in northern spotted owls (Strix occidentalis caurina). Conservation Genetics 11:1013-1021.

Olson, G. S., E. M. Glenn, R. G. Anthony, E. D. Forsman, J. A. Reid, P. J. Loschl, and W. J. Ripple. 2004. Modeling demographic performance of Northern Spotted Owls relative to forest habitat in Oregon. Journal of Wildlife Management 68:1039–1053.

SEI [Sustainable Ecosystems Institute]. 2008. Scientific review of the draft northern spotted owl