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State Supervisor

U.S. Fish and Wildlife Service

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Please find attached a scientific peer review of the Appendix C of the Northern Spotted Owl Draft Revised Recovery Plan (2010). The Society for Conservation Biology (along with the American Ornithological Union) was previously contracted by the FWS to provide a peer review of the 2010 Northern Spotted Owl Draft Revised Recovery Plan. Because of the relatively short (30 day) comment period allowed for review of Appendix C, we secured peer reviews from 2 of the 4 experts in the field of avian management and conservation biology who previously participated in the SCB/AOU peer review of the 2010 Draft Revised Recovery Plan. What follows is a synthesis of the reviews in a single document, and I am submitting it to the USFWS on behalf of the Society for Conservation Biology (North American Section).

Sincerely,

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Review of Appendix C [Development of a Modeling Framework to Support Recovery Implementation and Habitat Conservation Planning] of the 2010 Draft Revised Recovery Plan for the Northern Spotted Owl, on behalf of The Society for Conservation Biology (North American Section) .

What follows is a synthesis of two anonymous peer reviews of Appendix C of the Draft Revised Recovery Plan. The reviewers were drawn from the group of experts in the field of avian management and conservation biology who previously participated in the SCB/AOU peer review of the 2010 Draft Revised Recovery Plan.

OVERVIEW

As we emphasized in our previous peer review of the main document of the 2010 Draft Revised Recovery Plan for the Northern Spotted Owl, the habitat and viability modeling process used in the plan makes appropriate use of available data and is based on an appropriate set of methods for informing the recovery planning process. The approach is also innovative and may serve as a model for recovery planning for other species where similarly extensive data exists and the conservation context warrants such spatially explicit planning. Inevitably, substantial uncertainty remains in the results of such modeling efforts, even for a well-studied species such as the Northern Spotted Owl. However, use of such a replicable, quantitative modeling approach is essential as a decision support tool in the recovery planning process if the process is to fulfill the mandate for use of the "best available scientific and commercial data". We detail below remaining areas where modeling methodology can be improved. We note where the modeling group has responded to our earlier review comments on the 2010 Draft Revised Recovery Plan and where they still need to address our previous comments.

The question of how results should inform planning is a distinct (but related) question to review of modeling methodology itself. Despite the rigor of the modeling methodology, major elements of the application of modeling results in the recovery planning process remain problematic. Therefore we describe several aspects in which this latter stage of the use of models to support decisions should be improved in order for the process to meet scientific standards and support effective recovery actions. We focus on issues related to integration of model results in the planning process first because they are in our assessment more problematic than remaining methodological issues.

GENERAL ISSUES

The major limitation of the 2010 Draft Revised Recovery Plan identified by peer reviewers was that it lacked detail on actual reserve scenarios that would be considered for implementation. The Appendix, although it provides detail on how this question could be addressed, does not respond to this problem. The FWS states that such analysis is being deferred to the critical habitat designation process. We believe that it is essential that recovery planning documents and the recovery planning process:

1) Provide an operational definition of population recovery;
2) Clearly state the criteria that will be used to rank the various scenarios and management alternatives;
3) Designate critical habitat (CH) as part of the recovery planning process (preferably by a formally constituted recovery team);
4) Designate CH based on the best scientific data available with consideration of economic or other relevant issues;
5) Tie CH directly to the recovery objectives as a critical part of the risk assessment process—for example, the statement of recovery objectives as target probabilities of persistence over a specified time frame. For species threatened by habitat loss, these objectives can be expressed as a required amount and spatial arrangement of habitat needed for recovery;
6) Map CH with sufficiently high spatial resolution so that it distinguishes non-habitat from currently suitable habitat and habitat that is potentially suitable and necessary to meet recovery objectives;
7) Identify as CH those habitat areas, both occupied and currently unoccupied, that if protected in some suitable manner, ultimately allows the Service to determine that the species is no longer endangered or threatened based on the statutory listing factor addressing habitat;
8) Designate CH in such a manner as to: a) provide necessary information for Section 10 permits and HCPs; b) inform the process of land acquisition and incentives programs, and c) clarify the meaning of “harm” in the definition of “take.”;
9) Identify measures and actions to protect CH.

MAXENT MODELING

Discuss possible sample selection bias and propagation of uncertainty across models

One of the key assumptions of the Maxent modeling is that the presence locations were based on a random sample of the focal population. In the case of the NSO demographic studies we know this not to be the case. We would like to see some additional discussion or analyses that address this possible source of bias in the Maxent model. For example, Elith et al. (2010, 2011) discuss potential approaches to account for survey bias that may be relevant here. Additionally, the degree of robustness of conclusions to propagation of model uncertainty across the three stages of the modeling process (Maxent-Zonation-Hexsim) should be discussed.

Discuss contrasts evident between Maxent models for different modeling regions, especially Redwood Coast Modeling Region

The conclusion that variables related to vegetation structure are of secondary importance in Maxent models in the certain modeling regions (e.g., RDC)[p.27] should receive more discussion as to context. It is plausible that NSO in the southern portion of the range would have a broader vegetation niche but narrower thermal niche, but the model structure could also be evidence of unmeasured vegetative attributes that only become important in certain forest types (e.g., redwood region). Does the estimated relative habitat value from the RDC agree with data from the Marin DSA as well as the Green Diamond DSA?

Use Strength of Selection to inform habitat classes

The Strength of Selection (SOS) results [p.33] suggest a broad plateau in (SOS) from 0.15-0.65. This information could be used to define boundaries of the class(es) of moderately suitable habitat, e.g., for defining dispersal habitat.

ZONATION MODELING

Revise legends and description of Zonation results

In some places in the document, legends referring to the Zonation results are inaccurate or unclear. For example, on p.42, the legend has it backwards on which solution the left and right panels refer to, and which color refers to the 40% and 50% Zonation. More importantly, in the 'locked-in' solution, Zonation was constrained to prioritize Congressional Reserves and LSRs, not all public lands, which changes the interpretation of results (in that much NSO habitat falls on non-reserve federal or state lands that could potentially form part of a reserve network).

<u>Provide greater context for comparison of constrained (locked-in) and unconstrained solutions</u>

These alternate Zonation options are described [p. 41] methodologically, but more context should be given as to how the contrast between constrained and unconstrained Zonation scenarios can be used to inform plan development. If only unconstrained scenario were analyzed, yet reserve network delineation and critical habitat designation considered primarily public lands, there would be a disconnect between Zonation results and planning. Thus both options are complementary sources of information.

More generally, the document should clarify how Zonation results are used in the plan development process. It appears (e.g., p. 73) that Zonation results are used to create alternative reserve scenarios that are then evaluated in Hexsim. But do these scenarios carry over to design of the final reserve network, or are they merely exploratory or example scenarios? Given the information provided it is not possible to evaluate or compare the eventual set of candidate reserve designs.

<u>Provide more complete comparison of Zonation priority classes and Maxent RHS results</u>

If the Zonation scenarios are used to inform final reserve delineation, it is important to understand how much habitat (represented by the Maxent RHS results) is captured within the Zonation-based priority zones. The appendix provides tables describing the proportion of total RHS habitat value captured within different Zonation priority levels. However, Maxent results are not necessarily calibrated to owl density, i.e., one hectare with RHS of 0.9 is not necessarily equal in conservation value to two hectares with RHS value 0.45. Therefore, tables should be prepared cross-tabulating Zonation levels to RHS classes, e.g., the Zonation ‘top 70%’ level captures x% of RHS > 0.9,.., x% of RHS < 0.15.

The 0.15 RHS level is an appropriate lower cutoff as habitat with 0.15 RHS may plausibly contribute to e.g., dispersal habitat given the plateau of moderately suitable RHS evident in the SOS plot results (see above). Similarly, it would be informative to also display Zonation priority levels exceeding ‘top 70%’ (e.g., top 80%, 90%) in tables and maps as some of these areas may be important for connectivity planning in areas where more-suitable habitat is not available.

HEXSIM MODELING

Clarify decision-support context of PVA modeling

As stated in our review of the main recovery plan document, it is important to clarify how population viability analysis (PVA)(e.g., using tools such as Hexsim) can appropriately inform recovery planning. The Appendix acknowledges [e.g., p. 61,64] the widely-supported conclusion (e.g., Traill et al. 2010) that PVAs are better used to rank options rather than provide absolute predictions of persistence. Similarly, the PVA process should focus on drawing qualitative insights from model behavior rather than focus on specific aspects of model behavior, e.g., temporal trends, that are likely less robust to uncertainty.

Although these points are acknowledged, two aspects of the analysis do not seem to reflect this perspective. Excessive focus is given to temporal trends in the figures (e.g., C16-C18), and statements such as "determined by inspection that simulation year 50 was present day" [p.61] are problematic. Secondly, the statement that incorporation of environmental stochasticity (ES) is unnecessary because it would not change scenario ranks [p. 65] is problematic. Addition of ES can qualitatively change results and is an essential component of rigorous PVAs (Traill et al. 2009). For example, owl populations might persist under both Scenarios A and B in a modeling region such as the Olympics or Oregon Coast without ES but not in Scenario B when ES was included. Rankings of A and B might be indistinguishable in the simulations that did not include ES.

Additionally, due to their complexity (both with and without ES, but accentuated when ES is considered) the NSO scenarios have lengthy transient dynamics and high variability between replicates. In order to accurately rank reserve design scenarios, the simulations need to be performed with more years per replicate (e.g., 500 or 1000 years rather than 250 years) and more replicates (minimum 100 replicates per scenario). For example, small populations such as in the Olympics might experience population extirpation once in every 10 replicates, and use of 100 replicates is required to confidently estimate that extirpation probability.

Evaluate whether Hexsim parameters adequately incorporate variance in vital rates

The document states [pp. 49, 60] that the smallest and largest mean survival values from the 11 DSAs were used to set minimum and maximum values in Hexsim. Due to the use of population means rather than individual-level data, this approach may not fully represent the variance between minimum and maximum survival seen in the population as a whole. Thus a proportion of owl pairs in the field would be expected to show higher survival (and fecundity) than any owl in the high resource class, and lower rates than assigned to the low resource class. Underestimating variance in vital rates may cause qualitative changes in simulation results. If possible, parameters should be estimated based on the field data on the range in rates for individual pairs.

In NSOs, temporal process variance in fecundity is much higher than in survival. Was there any attempt in the Hexsim simulations to incorporate this pronounced difference in process variance? Since population growth rate in NSOs is much more sensitive to adult survival than fecundity, demographic theory would also suggest that fecundity have a much higher process variance.

<u>Expand sensitivity analyses</u>

The Appendix states [p.65] that the potential effect of habitat on reproduction was not analyzed in sensitivity analyses because the recent meta-analysis (Forsman et al. (2011)) found only ambiguous relationships between habitat and reproduction. However, the Forsman et al. (2011) monograph also found ambiguous relationships in some regions between survival and habitat. The appropriate approach, which this document adopts, is to use data from both the monograph and previous publications. Given this uncertainty, it is appropriate to explore fecundity/habitat relationships as part of the sensitivity analysis. In general, evaluation of results from a complex PVA scenario such as that for the NSO requires more extensive sensitivity analyses than are described in the document.

<u>Incorporate barred owl/habitat interaction and barred owl effect on reproduction in a subset of Hexsim simulations</u>

Recent research (Dugger et al. in press) documents interaction between habitat and barred owl effects, at least in portions of the NSO range. The Appendix alludes to this research [p.66], but such interactions are not incorporated in the simulations. Parameters based on Dugger et al. (in press) should be incorporated in the scenarios as part of sensitivity analyses. Qualitative changes in results may be expected due to such an interaction effect, which would accentuate the role of high-quality habitat in areas with high barred owl encounter rates. Recent research (e.g., Crozier et al. 2006) also suggests that presence of barred owls may affect NSO reproduction as well as survival. Simulations should incorporate this effect.

As noted in the previous SCB/AOU review, currently the barred owl effect in the model is different in kind from the habitat parameterization, and is effectively non-spatial. Barred owl effects should thus be described and interpreted separately from comparison of the habitat scenarios. It is not valid to state, for example, that a scenario that reduces barred owl effect by x% performs equivalently to a reserve scenario that protects x% of habitat.

Conduct comprehensive assessment of any proposed broad-scale thinning strategies

Additionally, although a 'no-reserve' conservation strategy for eastside dry-forest ecoprovinces has been proposed in earlier iterations of the plan, and the FWS continues to work on pilot projects with proponents of this approach, there is no discussion in the Appendix on how such a strategy might be evaluated and integrated with the broader rangewide strategy. Recent research (Odion et al. in review) suggests that the thinning treatments associated with the 'no reserve' strategy may have substantial effects on NSO at least in the short term, effects that would need to be evaluated in any comprehensive PVA.

Consider scenarios involving habitat and connectivity restoration

Given the current population trends and level of threat to NSO populations, a subset of the reserve scenarios evaluated should include more ambitious habitat protection and restoration, including restoration of connectivity between regions. This will necessarily involve some contribution from non-federal lands (e.g., to restore connectivity across areas with a low proportion of public lands).

In general, the potential contribution of moderately-suitable habitat (RHS > 0.15) to both reserve networks and connectivity or restoration areas is not adequately evaluated. In contrast, the scenario that explores effects of Recovery Action 10, involving protection of high-quality habitat outside of reserves, [p. 72] evaluates effects using a high RHS cutoff (>0.50) for habitat to be retained outside reserves. Similarly, use of 'top 70%' Zonation priority level [p.68; Table C24] to delineate the most extensive reserve scenario is insufficient to fully explore management options. Zonation results capture 70% of 'RHS habitat value' in much less than 70% of the land base. Based on Figure C9, the 'top 70%' is captured in approximately 40% of the analysis area, somewhat less than the 43% encompassed by the NWFP reserves. Given the status of the NSO, more extensive reserve scenarios need to be evaluated in the plan.

Clarify the geographic element of recovery goals

Both Hexsim results and observed trends in NSO regional populations suggest widely divergent levels of threat between regional populations. The recovery plan needs to clarify that maintenance of well-distributed populations is a key element of recovery, and what this implies in terms of criteria for evaluation of scenarios. The trend from both field surveys and simulations suggests decline and potential loss of northern populations and those at the margins of the range (Olympics, Oregon Coast). PVA simulations of the NSO metapopulation may exhibit alternate states, where populations in one or more modeling regions wink out and are not recolonized by dispersal. The plan should discuss whether these results suggest the need for different status for some portions of the range (e.g., Washington state), and what steps can be taken to ensure persistence in all modeling regions, beyond the general spectrum of scenarios evaluated in e.g., Table C18.

OTHER ISSUES

Genetic effects on viability

Previous peer reviews identified lack of consideration of genetic research (e.g., Funk et al. 2010) as an omission in the draft recovery plan. Ideally genetic effects would be integrated into the PVA, but if not, they should be considered qualitatively, especially for smaller and more isolated regional populations.

Climate change

Because climate variables were included in best models for all modeling regions in the Maxent analysis (p. 27-32), it is important to analyze what the potential effects of changes in these factors due to climate change will have on habitat value (RHS) in each region. RHS future projections could then be used as input to Hexsim simulations.

Multi-species planning

Although this is a single-species recovery plan, the management context created by the NWFP as a multi-species conservation strategy makes it imperative that any proposed NSO scenario be evaluated for its ability to conserve other old-growth associated species that currently are protected under the NWFP strategy. Some or all reserve scenarios evaluated should be constructed by building onto the current NWFP reserve network, which was designed in part to fulfill multi-species conservation goals.

Carbon analysis

The FWS and other federal agencies have recently sponsored studies evaluating the effect of alternate management strategies on carbon storage in PNW forests. This type of analysis should be integrated into the plan if feasible by evaluating carbon storage effects of alternate reserve scenarios.

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