California Board of Forest Effectiveness Monitoring Committee – Initial Concept Proposal

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Project Title: Understanding tradeoffs and synergies between California spotted owl protection and large landscape-scale forest resilience treatments

Project #:

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Project Duration: January 2027 – March 2029

Project Description:

Background and Justification

Large, high-severity wildfire is considered a major threat to forested ecosystems in California and the mature forest-dependent California spotted owl (CSO, *Strix occidentalis occidentalis*) (Jones et al. 2016; USDA FS 2019, Tempel et al. 2022). Over a 20-year period, almost 500,000 acres of forest have burned within the CSO range, with much of this area burned at high severity (USDA FS 2019). Trends in high severity fire are likely to increase in the future impacting a wider range of CSO habitat (Stephens et al. 2016). Due to rapid habitat loss and declining population, the CSO is currently under consideration for protection under the Endangered Species Act.

In response to trends in uncharacteristically severe fire and drought-induced tree mortality, fuels reduction and forest thinning treatments are being implemented to reduce the potential for stand-replacing fire and improve forest resilience to multiple stressors. These forest treatments are primarily accomplished through a combination of hand and mechanical thinning. California Forest Practice Rules (FPR) and National Forest Plans often prohibit treatments adjacent to CSO nests and within protected activity centers (PACs) or limit them to small-diameter hand-thinning, but the magnitude and scale of wildfire threat will require more intensive and larger-scale fuels reduction treatments, including within PACs. Numerous studies have recognized that short term negative impacts to CSO may occur from fuels reduction projects but the long-term benefits of protecting nesting habitat from being lost to a stand-replacing fire could far outweigh them (Gutiérrez et al. 2017; USDA FS 2019). As these management tools are applied widely across the landscape to significantly modify the horizontal and vertical configuration of forests, it is critical to understand their effects on CSO occupancy and habitat and that of their prey species. It is equally important to understand the impacts of FPRs designed to protect sensitive species such as the CSO, in terms of both (a) effectiveness in protecting sensitive species and (b) tradeoffs and synergies in achieving broader forest resilience objectives.

The Social and Ecological Resilience Across the Landscape (SERAL) project is a large collaborative effort on the Stanislaus National Forest applying widespread mechanical treatments aimed at restoring forest resilience and reducing the risk of catastrophic wildfire. To achieve goals of landscape resilience to natural disturbance and providing economic opportunities to local communities, the SERAL project increases the pace and scale of strategically placed mechanical thinning and fuels reduction treatments, including within CSO PACs and territories. Mechanical thinning and fuels reduction treatments aimed at fire hazard reduction may be seen as at odds with CSO habitat characteristics, often reducing canopy cover and removing intermediate canopy layers and surface fuels that provide cover for prey species. However, a growing body of research emphasizes the importance of forest structural heterogeneity, such as a matrix of early and late seral habitat, for CSO reproductive success and prey population abundance (e.g., dusky-footed woodrat, *Neotoma fuscipes*)(Kuntze et al. 2023). Landscape-scale implementation of mechanical treatments, such as those within the SERAL project, has the potential to generate forest openings and patches of early seral habitat, creating forest heterogeneity beneficial to CSO populations. Here, we aim to fill this critical knowledge gap by evaluating the impacts of mechanical treatments to CSO and woodrat habitat at multiple spatial scales to ultimately answer the question, can mechanical treatments simultaneously meet fuels reduction and wildlife habitat protection goals?

Objectives and Scope

The purpose of this project is twofold: (1) evaluate CSO status (occupancy) and habitat condition (both CSO and prey) before and after mechanical fuels reduction and forest thinning treatments within the SERAL project, and (2) evaluate whether forest resilience treatments that align with FPRs designed to protect sensitive species result in improved CSO status and habitat condition relative to treatments that diverge from FPRs. The work proposed here will focus on the first phase of the project spanning 94,383 acres of predominantly yellow pine-mixed conifer forest containing 53 CSO PACs. Given that these treatments are being implemented on Federal lands, treatments are designed and implemented under each Forest Plan rather than California FPRs, providing a unique opportunity to compare the effects of treatments that align with, and diverge from, FPR standards. The proposed project will answer the following questions:

1) How do CSO and woodrat habitat, including forest structure, composition, and configuration, change at multiple spatial scales (e.g. plot-, stand-, PAC-, territory-) before and after mechanical treatments?
2) How does CSO occupancy change before and after mechanical treatments? What habitat characteristics are associated with changes in occupancy?
3) Do mechanical treatments within the SERAL project simultaneously meet fuels reduction, forest resilience, and CSO protection objectives? Do treatments that more closely align with FPRs achieve one or both of these objectives better than treatments that diverge from FPRs?

While the proposed work is limited to NFS lands, the findings have great applicability to state and private timber lands that are using similar mechanical treatment techniques for fuels reduction and timber production. Studies have documented abundant CSO activity on privately-owned timber lands (Roberts et al. 2017, Hobart et al. 2019), and understanding the impacts of these management techniques on CSO populations will facilitate efficient application of management tools across the landscape that meet state and federal regulatory requirements associated with habitat protection.

Research Methods

The project leverages ongoing and planned CSO survey data (occupancy) within treatment areas with proposed field data collection and novel forest structure and landscape pattern characterization to address our research questions.

Question 1) To assess CSO and woodrat habitat, we will conduct pre- and post-treatment vegetation surveys within a subset of CSO PACs and territories (~12 PACs) that will be treated within the project timeline. We will sample immediately adjacent to the nest tree as well as the range of vegetation conditions throughout the PAC and territory, including treatment-generated openings. Vegetation sampling will use common forestry methods following the USDA Forest Service Common Stand Exam and capture known habitat characteristics important for CSO nesting and reproduction and woodrat abundance, such as tree size and density, species composition, and shrub cover.

A subset of these vegetation plots will serve as demonstration and validation sites for novel drone-based and GoPro-based photogrammetry methods that can characterize CSO-relevant elements of forest structure that are poorly captured through traditional field methods, as well as patterns at larger spatial scales (e.g. seral stage distribution). In partnership with the UC Davis Forest Change Analysis Lab (FOCAL), within each plot, 360-degree GoPro footage will be collected systematically across the plot and used to reconstruct a 3-D image ("digital twin") of the plot, better representing structural features such as horizontal and vertical continuity (i.e. ladder fuels). UC Davis will also collect drone imagery over the sampled PACs following a standard mapping flight pattern that optimizes stand structure reconstruction (Young et al. 2022) and species classification. Drone collections are used to generate high-resolution canopy height models and support individual tree detection, tree height estimation, and tree species and status estimations. Using these derived products, we can evaluate pre- and post-treatment landscape patterns. For example, we can assess the size, distribution, and configuration of different seral stages within a PAC and across multiple PACs before and after treatment. Accurate assessments of landscape pattern at this scale are very difficult to make using traditional field-based or airborne lidar-based data. The FOCAL Lab has recently completed several proof-of-concept projects using these methods. This low-cost "proximal remote sensing" approach will allow for assessment of the effectiveness of FPRs in creating and maintaining desired local- and meso-scale forest structures and communities that are not currently well captured by standard remote sensing or field-based methods.

Finally, we will compare changes in field-based habitat metrics and post-processed spatial data before and after treatments using statistical methods in R. We will use landscape ecology methods to identify spatial patterns such as seral stage patch characteristics within and across PACs. This spatial analysis will allow us to better quantify forest heterogeneity.

Question 2) To evaluate changes in CSO occupancy surrounding mechanical treatments, we will leverage an existing and ongoing CSO survey effort within the SERAL project. Institute for Bird Populations (IBP) has been conducting CSO surveys since 2020 in 71 PACs within the project area. Survey work will continue through 2028. The survey effort monitors active nest sites and quantifies annual reproductive success. This project supports analysis efforts to model survey data as a function of field-based and drone-based habitat data at multiple spatial scales before and after treatment. Other relevant remote sensing products such as recent fire history and climatic data may also be incorporated. Pairing these efforts together presents a unique opportunity to combine vegetation data tailored to CSO habitat condition at high temporal and spatial resolutions with a multi-year CSO population survey effort in a large landscape-scale project.

Question 3) Finally, to evaluate whether treatments simultaneously met fuels reduction, forest resilience, and CSO habitat protection goals, we will compare post-treatment forest conditions to desired conditions outlined in the SERAL project and treatment prescriptions. We will assess if post-treatment conditions reduce elements that drive high-severity fire (e.g. ladder fuels, coarse woody debris, tree density). We will parameterize fire spread and fire behavior models using the field-based data to demonstrate if fuels objectives were met. We will also place post-treatment conditions in the context of the natural range of variation for yellow pine-mixed conifer forests (Safford and Stevens 2017) to assess forest resilience outcomes. While we cannot evaluate long-term outcomes for CSO within the temporal scope of the proposed work, we will be able to describe the presence and distribution of important habitat elements following treatment and short-term CSO occupancy effects. While treatments are being implemented on Federal lands, placing outcomes in the context of specific prescription parameters will enable a comparison to current FPRs and identify the degree to which treatments aligned or deviated from FPRs. Finally, this work creates a critical baseline for longer-term CSO survey efforts within large landscape-scale projects.

Scientific Uncertainty and Geographic Application

The proposed project directly works to reduce uncertainty in the application of mechanical thinning and fuels reduction treatments within CSO PACs and other mature forest-dependent species. We are experiencing unprecedented forest loss due to high severity fire, drought, and insects and disease, necessitating unprecedented management intervention. Mechanical treatments within PACs at the scale and intensity planned within SERAL are largely unstudied and therefore require monitoring to avoid unintended consequences and inform future management strategies (i.e. adaptive management). The proposed listing of CSO under the ESA makes answers to these questions more critical as the need for fuels treatments expands across all lands.

The proposed work is highly relevant to all forested lands within the CSO range, stretching from the Sierra-Cascade, south along the Sierra Nevada, and to southern California. While the proposed work is limited to National Forest System lands, we would expect our findings to apply to all CSO habitat receiving mechanical forest treatments, including for timber production. Furthermore, we expect this study to have utility for other mature forest-dependent species such as the American goshawk and northern spotted owl.

Collaborations and Project Feasibility

The project is a collaborative effort between the Forest Service Region 5 Ecology Program, UC Davis FOCAL Lab, and IBP. PIs Estes and Hankin have a long-standing relationship with these partners and the support of local Stanislaus National Forest staff. The collection, processing, and evaluation of drone and GoPro data has been tested and sampling efforts will be designed around IBP's CSO survey network. CSO population dynamics can be highly variable, but the multi-year nature of the survey effort helps to capture interannual variability surrounding treatment implementation. Furthermore, while not the primary focus of this work, IBP is concurrently surveying 26 American goshawk PACs and could apply the same methodology to the habitat data collected through this study. While implementation of mechanical treatments can be a source of uncertainty, the SERAL project treatments are fully approved and are in the 2nd year of treatment implementation. The proposed work is well within the scope and ability of the project partners.

<u>Critical Question Theme and Forest Practice Rules or Regulations Addressed</u>:

Our research questions address the following critical monitoring questions (CMQs) and research themes:

1. Theme 6: Wildfire Resilience – CMQs (b), (c), (d), and (e)
    a. The proposed work evaluates whether timber operations and mechanical fuels reduction meet fuel hazard reduction goals while promoting forest conditions within the natural range of variation and that are resilient to fire, as well as retaining wildlife habitat structures.
    b. Relevant to rules/regulations: 14 CCR § 896, 897, 933.4/953.4(c) Fuelbreak/Defensible Space, 937/957 Hazard Reduction, 1038 Exemptions
2. Theme 7: Wildlife Habitat – Species and Nest Sites – CMQs Q1 (a), (b), and Q2 (c)
    a. The proposed work directly evaluates wildlife habitat for the proposed California spotted owl within mechanical treatments, including immediately adjacent to nest sites and throughout protected activity centers (PACs). While the project is not within the range of the northern spotted owl (*Strix occidentalis caurina)*, our findings will be highly relevant to treatments within the NSO range given similar habitat requirements common to CSO and NSO.
    b. Relevant to rules/regulations: 14 CCR § 939/959 Wildlife Practice [959.1, 959.2, 959.3, 959.4, 959.15, 959.16], 14 CCR § 932.7/952.7 Resource Conservation Standards; 14 CCR § 932.9/952.9 Cumulative Impacts, 14 CCR § 935.2/955.2
3. Theme 8: Wildlife Habitat – Seral Stages – CMQs (a), (b), and (c)
    a. The proposed project uses novel drone-based and ground-based photogrammetry methods to better capture horizontal and vertical forest structure and associated seral stage at multiple spatial scales. The sampling

strategy explicitly samples treatment-generated openings. Landscape distribution of seral stage patches is important for both CSO habitat and their primary prey species (woodrat).

   b. Relevant to rules/regulations: 14 CCR § 939/959 Wildlife Practice [959.1, 959.2, 959.3, 959.4, 959.15, 959.16], 14 CCR § 932.7/952.7 Resource Conservation Standards; 14 CCR § 932.9/952.9 Cumulative Impacts, 14 CCR § 935.2/955.2

4. Theme 9: Wildlife Habitat – Cumulative Impacts – CMQs (a), (b)
   a. The proposed project directly evaluates cumulative impacts to biological habitat conditions for CSO and associated prey species before and after mechanical treatments, including the matrix of habitat types that support nesting, roosting, feeding, and breeding. Pairing this work with ongoing CSO survey efforts and modeling occupancy as a result of treatment-driven habitat change will directly answer whether there are short-term adverse impacts to CSO populations.
   b. Relevant to rules/regulations: 14 CCR § 939/959 Wildlife Practice [959.1, 959.2, 959.3, 959.4, 959.15, 959.16], 14 CCR § 932.7/952.7 Resource Conservation Standards; 14 CCR § 932.9/952.9 Cumulative Impacts, 14 CCR § 935.2/955.2
5. Theme 10: Wildlife Habitat - Structures – CMQs Q1 (a), (b), and Q2 (a), (b)
   a. Similar to above, the proposed methods will measure the structural components of CSO and woodrat habitat to evaluate treatment impacts at larger spatial scales. Vegetation surveys surrounding mechanical treatments will allow us to assess whether treatments simultaneously met goals of fuels reduction (an ecological and social objective), forest resilience, and wildlife habitat protection. The presence of large oaks is an important habitat metric for CSO reproductive success and will be explicitly included in the sampling design.
   b. Relevant to rules/regulations: 14 CCR § 939/959 Wildlife Practice [959.1, 959.2, 959.3, 959.4, 959.15, 959.16], 14 CCR § 932.7/952.7 Resource Conservation Standards; 14 CCR § 932.9/952.9 Cumulative Impacts, 14 CCR § 935.2/955.2, 14 CCR § 933/953.
6. Theme 11: Hardwood Values – CMQs (a), (b)
   a. As mentioned above, methods include tree species identification and measurement to characterize forest composition before and after mechanical treatments.
   b. Relevant to rules/regulations: 14 CCR § 939.15/959.15 Wildlife Practice
7. Theme 12: Resilience to Disturbance in a Changing Climate – CMQs (a), (c), and (d)
   a. The ultimate goal of this work is to evaluate multiple objectives related to forest resilience to wildfire and climate change and the protection of wildlife habitat in a large landscape collaborative project. The proposed project leverages surveys tracking direct CSO population response to changes in forest structure,

composition, and configuration at multiple spatial scales. Forest condition data produced from this project allows us to quantify shifts towards desired conditions for the above objectives, and inform future treatments across similar landscape-scale forest resilience projects on both public and private lands.

b. Relevant to rules/regulations: 14 CCR § 896, 897, 14 CCR § 939/959 Wildlife Practice [959.1, 959.2, 959.3, 959.4, 959.15, 959.16], 14 CCR § 932.7/952.7 Resource Conservation Standards; 14 CCR § 932.9/952.9 Cumulative Impacts, 14 CCR § 933/953.

Requested Funding:

Total funding requested: $636,668

FY 26/27 (Winter 2026 – Spring 2027): $100,397

- Funding in the first fiscal year will be used for CSO survey data curation and analysis, crew hiring, field season planning, and one month of vegetation surveys.

FY 27/28 (Summer 2027 – Spring 2028): $265,430

- Funding in the second fiscal year will be used for a 3-person vegetation survey crew, drone imagery collection, analysis, and post-processing in pre-treatment CSO PACs that overlap with ongoing survey efforts. Recently treated PACs will also be sampled as time allows.

FY 28/29 (Summer 2028 – Spring 2029): $270,841

- Funding in the third fiscal year will be used for a 3-person vegetation survey crew, drone imagery collection, analysis, and post-processing in post-treatment CSO PACs that overlap with existing survey efforts. Following the conclusion of the field season, funding will support statistical data analysis linking CSO surveys, field- and drone-based forest condition metrics, and other remote sensing data. Finally, we will develop management briefs and presentations, produce at least one peer-reviewed publication, and share findings to the broader scientific, manager, and private landowner community at a relevant conferences or meetings.