# Draft Proposed Framework for the California Spotted Owl Conservation Strategy Version 0.0 (5-27-16)

**Note to reader:** This is still a very draft framework, with many holes to fill, concepts to develop more fully, questions to answer, and sections to be developed. We apologize for any challenges this may create in reading it, but wanted to get input and thoughts on an early draft. Throughout the document and appendices, gaps, notes, and questions are included in italics to highlight them. Italicized comments are not intended to represent the full suite of lingering holes and questions, only some main concepts that have already been identified. We appreciate your time and interest in the development of a Conservation Strategy for the California Spotted Owl.

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## Introduction

The California spotted owl (*Strix occidentalis occidentalis*) is a species of conservation concern that occurs primarily on public land in the Sierra Nevada, the mountains of central coastal California, and the peninsular and transverse ranges of southern California. For the last 24 years, the California spotted owl technical assessment (CASPO) has provided the foundation for conservation of the species (Verner et al. 1992). Since the publication of the CASPO report, new scientific information has emerged, threats to the species have shifted and evolved, and research has indicated that many of the California spotted owl (CSO) populations have been declining (Assessment 2016, Tempel et al. 2014b, Connor et al. 2014). All of these factors, and others, suggest that a new approach to CSO conservation is needed, building on the foundations established by the CASPO report.

This Draft Framework for the California Spotted Owl Conservation Strategy (Conservation Strategy or Strategy) aims to establish a robust and implementable approach to conservation of the CSO in the near- and long-term. The Strategy focusses on National Forest System (FS) lands within the Sierra-Cascade Ecoregion, which make up the majority of the CSO range. However, aspects of the Strategy can and should be applied throughout the species' range, and effective Strategy implementation will require a multi-agency, multi-ownership, collaborative effort. This Strategy is founded on scientific information presented in the CSO Conservation Assessment (Assessment 2016) and other foundational scientific documents such as Natural Range of Variation Assessments (Safford and Stevens in review) conducted for the Sierra-Cascade region. Additionally, the Strategy incorporates local management experience and expertise as well as new scientific analyses.

Given that habitat conditions are dynamic—with fires, management actions, habitat development, climate change, and other processes constantly rearranging landscape conditions over different spatial and temporal scales—the goal of this strategy is not to maximize owl habitat value simultaneously everywhere, but to promote a resilient and dynamic mosaic of habitat conditions that can support owls through time while minimizing the risk that large and severe disturbances increase the population's extinction risk. A thriving owl population will also require minimizing potential adverse effects of management actions and other threats on owls and their habitat and reducing specific mortality factors that may limit population size and resiliency.

The Strategy is organized into seven main sections: The first three sections lay out guiding principles, vision, desired conditions, and goals and objectives for CSO conservation. The fourth section of the Strategy outlines broadly the general approach taken to develop conservation measures that will meet the goals and objectives. The fifth section then provides specific draft conservation measures and recommendations. Sixth, the Strategy provides a framework for future monitoring and adaptive management to ensure achievement of conservation goals, incorporation of new information, and adjustment to future conditions (*in development*). Finally,

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the Strategy describes a decision support tool to aid in conservation implementation (*to be developed*).

Additionally, there are two main appendices for the Strategy. Appendix 1 provides a summary of conditions and trends in CSO populations and their habitat. This summary of background information is divided into two main sections, the first summarizing owl ecology and threats to the population, and the second summarizing past, current, and future conditions. The majority of this information is also available in the Conservation Assessment and other scientific syntheses. The second appendix includes further details and specific actions to consider for implementation of the draft conservation measures described in section five. *Additional supporting information is under development.*

This Strategy is a living document, and should be updated regularly as conditions evolve, new information becomes available, and new tools are developed.

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## Glossary

To be developed

*Note to reader: there are still many instances in this draft framework and appendices in which concepts are not fully defined, this will be addressed and included in a glossary as the draft is further developed.*

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# 1. Guiding Principles

1. Halting recent CSO population declines requires a better understanding of proximate and ultimate causes of the declines, and is a critical component of conservation of the species into the future.
2. Maintaining a well-distributed network of occupied territories across the CSO range will increase meta-population stability and population resilience to the effects of climate change and other environmental stressors. This will depend on the maintenance of both a sufficient abundance and distribution of owls and a sufficient amount and distribution of suitable habitat to support a sustainable owl population in the near- and long-term.
3. Despite lingering uncertainties, proposed conservation measures to mitigate new and emerging threats to the CSO (e.g., Barred owl range expansion; mega-fires) should be implemented in an adaptive learning framework to address these threats and prevent eventual tipping points in expected population persistence.
4. Different ecological features are important to the CSO at several spatial scales, with the scales of greatest importance to the owl being the protected activity center and territory, embedded within overlapping home ranges and the larger landscape. Maintaining key habitat elements within the protected activity centers and territories is likely to promote species conservation through enhanced occupancy and demographic performance. Increasing habitat restoration and heterogeneity at the territory, home range, and landscape scales is likely to help protect key habitat elements, confer broad-scale resilience, and provide opportunities for recruitment of new territories in the context of dynamic forest conditions.
5. The forests that support the CSO populations are dynamic ecosystems that operate at multiple scales (from sub-stand to landscape), and support a range of vegetation types and structures, and shifting functions and processes that vary over space and time. Forest conditions are generally greatly departed from the historical conditions (natural range of variation) that were likely more resilient to a wide range of processes and stressors. Forest conditions that existed under the natural range of variation (NRV) are expected to be more resilient under predicted future conditions than are current conditions, but even restoration to NRV conditions will likely confer insufficient forest resilience to the full future range of conditions.
6. Monitoring, adaptive management, and further development of conservation targets and measures are necessary to address the remaining uncertainties in CSO ecology and conservation. Key knowledge gaps remain, including viable population sizes and distributions, mortality factor impacts, and how to increase habitat resilience under changing climates. CSO conservation, and this Conservation Strategy, must continue to evolve as new information and changing conditions inform revisions and improvements.

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## 2. Vision and Desired Conditions

Considering the Guiding Principles, the vision for the future of the CSO is:

*a thriving (healthy, resilient, and stable) population of owls, well distributed throughout available habitat and interbreeding among populations, whose habitat is heterogeneous and resilient to disturbances at multiple scales and over the long term (decades to centuries).*

Based on the past, current, and future conditions described in Appendix 1, to realize the vision described above, this Conservation Strategy is designed to achieve the following desired conditions:

- Suitable habitat is well distributed and sufficient to support sustainable owl populations, addressing the needs for both high quality nesting/roosting habitat and habitat that is resilient to disturbances and climate change, considering the Natural Range of Variation and recognizing that Sierra Nevada forests are dynamic ecosystems that will support a range of vegetation types and structures that vary over space and time.
- CSO populations are maintained or enhanced throughout their historic range across the Sierra Nevada; CSO populations are maintained across the range as habitat is transitioned to be more resilient and as ecosystems in the Sierra Nevada transition from the current situation towards Natural Range of Variation and eventually to Future Range of Variation.
- Non-habitat threats to CSOs are minimized.
- CSOs and their habitat are managed in an adaptive framework, to address the existing scientific uncertainty and changing conditions.

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## 3. Goals and Objectives

To achieve the vision and desired conditions above, the following goals and objectives were developed:

**Goal 1.** Maintain a well-distributed and stable CSO population across the CSO range.

Objectives:

A. Identify CSO mortality causes and reduce mortality risk factors.
B. Prevent barred owls from reaching the critical density that would allow exponential expansion of their range and abundance.
C. Minimize disturbance that may negatively influence CSO breeding success.

**Goal 2.** Promote and maintain a well-distributed and connected network of high quality owl habitat across the CSO range.

Objectives:

A. Promote/maintain important existing, and promote development of new, nesting, roosting, and foraging habitat in occupied territories.
B. Retain and recruit sufficient high-canopy cover areas for nesting and roosting at all spatial scales, particularly at the protected activity center and territory scales, and particularly in areas where such conditions will be resilient in the future.
C. Retain and recruit large, old, and structurally complex trees and snags.
D. Retain dense tree clusters and clumps of multi-storied tree canopies, interspersed with small gaps.
E. Minimize risk of habitat loss associated with altered disturbance regimes.

**Goal 3.** Restore and maintain resilient habitat conditions that minimize the risk of environmental disturbances and climate change to CSO persistence.

Objectives:

A. Work with dynamic forest processes and identify biophysical conditions that are likely to support key CSO habitat features now and into the future.
B. Increase habitat heterogeneity at multiple scales (sub-stand to landscape), including dense, multi-storied stands, open single-strata stands, and early seral habitat.
C. Restore composition, pattern, and structure of understory and overstory vegetation to align with the conditions in which the CSO evolved and persisted historically, while also accounting for projected changes in landscape characteristics.
D. Allow for natural disturbance dynamics to shape and maintain resilient forests.

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## 4. Process for Developing Draft Conservation Measures

The conservation measures set forth below are designed to achieve the desired conditions identified above and to provide for the short- and long-term needs of the California spotted owl (CSO) by conserving key elements of CSO habitat (Goal 2), by increasing resistance and resilience of Sierra Nevada forests to multiple disturbances (Goal 3), and by minimizing impacts of non-habitat threats like the Barred Owl on the CSO (Goal 1). Here we describe the process used to develop conservation measures based on the guiding principles, desired conditions, goals, and objectives described in sections one through three, as well as the past, current, and future conditions described in Appendix 1.

*(NOTE: this section is incomplete and the main focus below so far is the habitat aspects, needs further development of conservation measures to address other issues)*

### Habitat-Based Conservation Recommendations (Goals 2 and 3)

As summarized in Appendix 1 (and Assessment) CSO nesting and roosting habitats are dominated by high canopy cover, large trees, higher than average basal area, and multiple canopy layers comprised of trees of different sizes (Bias and Gutiérrez 1992, Blakesley et al. 2005, Moen and Gutiérrez 1997, North et al. 2000). Additionally, CSO nest in the oldest and largest live and dead trees, especially those having structural defects like cavities, broken tops, and platforms (Verner et al. 1992a, Gutiérrez et al. 1992 North et al. 2000). Conservation of these key features across the landscape is thus a key component of this strategy.

As also summarized in Appendix 1 (and Assessment), the pattern (the spatial configuration of habitat elements), structure, composition and processes of Sierra Nevada forests are far outside the Natural Range of Variation (NRV), which represented the range of conditions in which the spotted owl evolved and persisted prior to European settlement of California. This significant departure from NRV has reduced the abundance and diversity of important habitat elements and poses a serious risk of losing owl habitat to fire, insects, disease, and drought. Active forest management, using both mechanical methods and fire, is needed to restore Sierra Nevada forests toward NRV, to provide for the long-term conservation of the spotted owl. Restoration to more resilient conditions, and towards conditions that will be more compatible with the full range of future conditions, while ensuring the maintenance of CSO populations during the transition, is thus a key component of this strategy.

It is important to recognize that the NRV values discussed in Appendices 1 and 2 are based on forest conditions that were prevalent generally 100-300 years ago, an era of relatively cool, moist conditions. Climate change has and will likely continue to result in increased temperatures and less available soil moisture in mid-elevation Sierra Nevada forests, with the ultimate effect being that forests will need to be even more drought and fire resilient than under NRV conditions. Currently, there is too much scientific uncertainty to accurately predict the Future Range of Variation (FRV), to use in place of NRV for this Strategy. However, because current forest

conditions are far more homogenous and dense than prevailing forest conditions under NRV, restoring forests using NRV values will provide a useful starting point in moving Sierra Nevada forests toward conditions that will also be more resilient in the face of a warming climate. Moreover, because many NRV values were derived from studies within contemporary reference landscapes in addition to historic information sources, most NRV values may be representative of resilient forest ecosystems under current warming climate conditions, adding to their value as a suitable starting point. As climate change moves Sierra Nevada forests into unprecedented conditions, NRV should be seen as a necessary waypoint on the path to long-term resiliency. NRV should not be seen as a target endpoint, given projections of future conditions, but will instead provide a foundation for future movement towards FRV.

In some instances, managing toward NRV may be in tension with retaining nesting and roosting habitat, especially where existing nesting and roosting habitat is located in areas that would not have supported such habitat under a natural fire regime. As habitats are transitioned towards NRV and eventually towards FRV, the maintenance of habitat in key locations will be an important aspect of balancing the near- and long-term CSO conservation and ensuring maintenance of the CSO population during transition to more resilient conditions. This will include, in many cases, the retention of dense forests considered key habitat for owls, even though such areas may exhibit conditions outside of NRV, and be more vulnerable to wildfires, bark beetle infestations and other disturbances.

The proposed habitat-based recommendations set forth below are designed to address the dual conservation needs of providing high quality nesting and roosting habitat and increasing the resilience of that habitat. They recognize the importance of retaining nesting and roosting habitat as the forest transitions to a restored and more resilient condition. Collectively, these recommendations take an "ecosystem restoration and dynamic reserve" approach, which is comprised of four core components: 1) Protection of high-quality nesting and roosting habitat features, focused primarily in owl Protected Activity Centers (PACs); 2) Promoting development of these features where there is currently a deficit (i.e., the biophysical environment is capable of supporting these features); 3) Measures that are designed to achieve NRV-based restoration across the landscape with the intent of creating heterogeneity consistent with the biophysical environment; and 4) Fostering large-scale application of managed and prescribe fire to maintain dynamic ecosystem structure and function.. This combination of landscape-scale restoration with focused reserve areas is intended to move forests towards conditions in which resilient owl habitat will be broadly distributed throughout the Sierra Nevada, and the owls will thrive (assuming minimization of other threats, e.g. Barred Owl) without further need for either forest restoration or specially managed reserves.

### Dynamic Reserve Network

California Spotted Owls consistently select densely-canopied forest stands with large and old trees for nesting and roosting, making such stands critically important for the conservation of the species. Restoring landscape conditions toward the natural range of variation (NRV), should

help retain and recruit owl nesting and roosting habitat in areas that are most likely to be resilient in the long term and that are widely distributed across the range of the species. However, in transitioning from current conditions to those consistent with NRV, an additional layer of protection is needed for the core area of nesting and roosting habitat surrounding an owl's nest tree or activity center. This area has been referred to as the "Protected Activity Center" or "PAC" under Forest Service land management plans for the last several decades. PACs have been treated as reserve areas, where certain land management activities are generally avoided.

### Resilience and Restoration

One primary component of CSO conservation is to restore Sierra Nevada forests to, or at least toward, NRV (see Appendix 1). Restored forests provide two essential benefits to the species. First, restored forests include the range of conditions in which the species evolved and persisted prior to European settlement, thereby providing the species the full complement of habitat it needs to carry out all its essential life functions. Second, restored forests are more heterogeneous and resistant/resilient to many disturbances, such as fire, insects, disease, drought, and climate change, thereby reducing the risk of losing essential CSO habitat in the future.

Present departures from NRV that are specifically relevant to the owl include: 1) a lack of forest heterogeneity and seral-stage variation, which are important for owl habitat resiliency and foraging; 2) an overall densification of forests due to a century of fire suppression, which puts owl habitat at risk of loss due to fire, insects, disease, and drought; 3) a deficiency in very large, old trees (and associated snags and downed logs), which are important components of owl nesting, roosting, and foraging habitat; 4) a reduction in shade-intolerant and fire-resistant tree species, which are important components of fire-resilient forests; 5) some deficiency in the cover or diversity of understory forbs and shrubs at localized scales coupled with a surplus of understory litter and woody debris, which detracts from owl prey habitat and increases the risk of habitat loss to fire; and, 6) a disrupted fire regime that includes too little low- and moderate-severity fire and too much high-severity fire, which adversely affects vegetation structure, composition, and function, and which destroys large blocks of important owl habitat (see Appendix 1).

Forest management, using both mechanized and fire treatments, can help move forests used by owls towards NRV by, among other things: 1) modifying seral stage and canopy-cover diversity and reducing forest density to increase habitat heterogeneity and resiliency; 2) retaining and recruiting large and old trees, snags, and downed logs; 3) increasing the proportion of shade-intolerant and fire-resistant tree species; 4) increasing the diversity of understory conditions to include more forbs and shrubs and less surface fuels; and 5) increasing the amount and types of fire on the landscape within NRV and reducing the amount of fire that is outside NRV. The best available science indicates that without active forest management to move toward NRV, forest conditions are likely to become further departed, less resilient to a changing climate, and less likely to provide the CSO with the diverse habitat it needs to persist into the future.

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### Minimization of Other Key Threats (Goal 1)

The non-habitat based recommendations set forth below are designed to minimize the threats to CSO long-term viability associated with Barred Owls, rodenticide, diseases, and climate change. Because these represent emergent and evolving threats, these recommendations take an adaptive management approach comprised of two main components: 1) Further study and assessment of threat levels and potential mitigation measures; and 2) efforts to remove or mitigate immediate threats as they arise.

*To be further developed to incorporate key threats, to develop conservation measures (given both uncertainty and growing importance of various threats)*

## 5. Draft Proposed Conservation Measures

The proposed conservation measures described below (and the further details described in Appendix 2) are designed to achieve the desired conditions identified above and to provide for the short- and long-term needs of the CSO. The proposed conservation measures include four general strategies, each with a set of more specific actions to facilitate conservation of the CSO. In parentheses, after each conservation measure, is the number of the objective it is designed to achieve.

While many of the details provided to foster implementation of conservation measures (see Appendix 2) include quantitative benchmarks or are framed in prescriptive terms, these measures should not be read as a set of strict directives. Rather, these recommendations are meant to provide a science-based starting point to make well-informed choices for the conservation of the species, recognizing that conservation measures like these cannot, and should not, provide a cookie-cutter approach to species conservation across the entire range. Implementation of conservation measures must be considered in the context of local conditions, new information, and a changing climate. While conservation measures were drafted to provide a general approach to species conservation that will work in many places in the CSO range, when the best available scientific information and local knowledge indicate that species conservation objectives can be best achieved by actions that deviate from specific recommendations set forth below, actions should be adjusted accordingly. Further details to implement each measure are described in Appendix 2.

### A. Conservation of Key CSO Habitat and Habitat Elements (Goal 2)

A1. Designate PACs to protect the most important nesting and roosting areas in occupied owl territories. (Objective 2A)

A2. To ensure that the PAC system provides the greatest benefit to the owl and incorporates the natural disturbance regimes and dynamic nature of owl habitat, PACs should not be static. The PAC system should be dynamic and respond to changing landscape conditions and owl utilization. For example, PAC boundaries should be modified in response to significant changes in the physical environment or new data on owl use and occupancy. PACs should

be added to the system when survey data indicates territorial occupancy by owls, and retired when they have not been occupied for an extended period of time. (Objectives 2A, 3A)

A3. Minimize disturbance in PACs, including disturbance to owls during breeding season and disturbance to key owl habitat, while increasing resilience and sustainability of PACs. (Objectives 1C, 2D, 2E, 3D)

A4. Retain and recruit high-canopy-cover areas at the territory scale, particularly in areas where such conditions align with the biophysical environment. (Objectives 2A, 2B, 2D)

A5. Retain and recruit large, old, and structurally-complex trees and snags, consistent with the abundance and distribution of such trees under NRV to provide key elements of owl nesting and roosting habitat, and also benefits northern flying squirrel, a primary owl prey species. (Objective 2C)

A6. Minimize risk of habitat loss associated with altered disturbance regimes. (Objective 2E)

## B. Restoration of Resilient Forest Conditions guided by the Natural Range of Variation (Goal 3)

B1. Increase vegetation heterogeneity to approximate the distribution and pattern of seral stages and canopy-cover classes under NRV. Restoring the proportion and pattern of seral stage and canopy-cover classes to NRV should improve owl nesting, roosting, and foraging habitat and also reduce the risk of losing key habitat to severe disturbances. (Objectives 3A, 3B)

B2. Retain and recruit large, old, and structurally-complex trees and snags, consistent with the abundance and distribution of such trees under NRV to provide key elements of owl nesting and roosting habitat, and also benefit the northern flying squirrel, a primary owl prey species. (Objective 2C)

B3. Reduce tree densities to approximate the range of densities that would have been likely under NRV and are likely to be more sustainable under a changing climate. Restoring stands to densities consistent with NRV is likely to significantly reduce the risk of losing important owl habitat to severe disturbances and may also increase the abundance and diversity of owl prey species. (Objectives 3B, 3C, 3D)

B4. Restore the approximate proportionality and distribution of tree species on the landscape consistent with NRV. Increasing the abundance and distribution of fire-resistant pine trees consistent with NRV will aid in the restoration of disturbance compatible with owl habitat development. (Objective 3C)

B5. Restore the composition, pattern, and structure of understory live vegetation and woody debris, consistent with NRV. Restoring understory conditions consistent with NRV should improve the abundance and diversity of owl prey species and reduce the risk of owl habitat loss from fire, and increase the potential to restore natural disturbance dynamics. (Objectives 2E, 3B, 3C, 3D)

B6. Restore natural disturbance dynamics consistent with NRV to help shape and maintain resilient forests. Restoring natural disturbance regimes will benefit the owl by creating and maintaining forest conditions similar to those in which the owl evolved and that are likely to persist in the future, providing a dynamic and heterogeneous mix of nesting, roosting, and foraging habitat, as well as diverse and abundant prey habitat. (Objective 3D)

B7. After a natural disturbance, facilitate habitat development towards NRV (or projected FRV), through active restoration where conditions are outside NRV or support of natural processes where conditions are within NRV. Restoring disturbed landscapes will benefit the owl by

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fostering the development of forest conditions similar to those in which the owl evolved and that are likely to persist in the future, providing a dynamic and heterogeneous mix of nesting, roosting, and foraging habitat, as well as diverse and abundant prey habitat. (Objectives 3A, 3B, 3C, 3D)

B8. Expeditiously restore Sierra Nevada forests within the range of the CSO. Active forest management will be required at an urgent pace and massive scale to avoid ever more acreage moving further outside NRV. This will require use of all available tools – including treatments like mechanical and fire, regulatory and policy mechanisms like MOUs, and collaborations and partnerships. Expeditious forest restoration will benefit the spotted owl by moving landscapes closer to the conditions in which the spotted owl evolved and that are likely to persist into the future, while simultaneously reducing the significant risks posed to extant owl habitat that is threatened by disturbances far outside NRV. (Objectives 2B, 2E, 3A, 3B, 3C, 3D)

## C. Minimization of Key Non-Habitat Threats (Goal 1)

C1. Determine and monitor the extent and density of barred owls within and near the CSO range. (Objective 1B)

C2. Prevent barred owls from reaching the critical density that would allow exponential expansion of their range and abundance. (Objective 1B)

C3. Increase understanding of effects of disease and contaminants on CSO fitness. (Objective 1A)

## D. Foster Climate Adaptation of CSO and their habitat to Facilitate Long-Term Conservation (Goal 3)

1. *To be developed*

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# 6. Monitoring and Adaptive Management

## Habitat Monitoring

*To be developed*

## Monitoring other threats

### Barred Owl Monitoring

The success of a barred owl management program could be gauged based on how effectively it maintained barred owl numbers near their current low levels and prevented the rapid and sustained increases observed within the range of the northern spotted owl. In principle, joint barred and spotted owl surveys would indicate the extent to which barred owls remained in (or re-colonized) areas they occurred in during the first series of removals, as well as whether spotted owls returned to areas from which barred owls were removed. Multi-species occupancy models would provide a rigorous statistical approach for estimating the joint occupancy of the species and understanding the extent to which remaining barred owls limited the distribution of spotted owls. As information on the effectiveness of initial barred owl management efforts develops, inventory surveys and removals strategies could be refined as part of an adaptive management program.

### Monitoring disease, parasites, and contaminants

*To be developed*

*What further research/monitoring is needed to determine current and potential future impacts of rodenticide on CSO?*

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# 7. Decision Support

*To be developed*

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