Habitat Management Principles and Recommendations

The management principles and recommendations set forth below are designed to provide for the short and long term needs of the spotted owl by encouraging management actions that restore Sierra Nevada forests to conditions more reflective of the natural range of variability (NRV), while conserving key elements of spotted owl habitat. Moving these ecosystems towards conditions within NRV should provide a high likelihood of conserving the spotted owl in the face of global change, as these conditions, and the owl populations within them, persisted over time and varied climate regimes in the past. However, because current conditions are far outside NRV and many owls may be relying on such conditions, management actions must strike a balance between conserving existing owl habitat and moving the landscape towards NRV and sustainability of future owl habitat. Additionally, as climate change moves these systems into unprecedented conditions, even NRV can be seen only as a waypoint, not an endpoint, on the path to long term resiliency.

In many locations, managing for NRV may be in tension with retaining existing owl habitat, particularly where existing habitat is in locations that are outside NRV and not likely to be resilient or sustainable over time. Therefore, the management recommendations set forth below are designed to strike a reasonable balance between restoration-oriented management and protection of important owl habitat. Collectively, these recommendations propose an "ecosystem restoration and dynamic reserve" approach, which encourages restoration and resilience treatments in some areas and discourages management actions in others.

The "ecosystem restoration and dynamic reserve" approach emphasizes protecting high-quality owl habitat in areas closest to identified owl sites and in sites on the landscape that can support this high quality habitat, and taking more intensive restoration actions outside of owl sites. At the owl Protected Activity Center (PAC) scale, the general goal is to retain and protect high-quality nesting and roosting habitat, even when such habitat may be outside NRV and not resilient over time. At the owl Territory scale, the general goal is move toward NRV through active management, to confer resiliency to the Territory and PAC over time, while promoting key CSO habitat elements and characteristics. At the owl home range and landscape scales, the goal is to actively manage toward NRV.

Commented [SCS1]: can we move away from this designation to a more 'dynamic reserve' approach to protecting these acres as 'key nest/roost' acres, in a dynamic way that better reflects the ecology of the system? seems like the term PAC, even if we evolve its meaning, carries the baggage of static 'fence-and-avoid' conservation, not a 'dynamic reserve' approach

Habitat Definitions:
PAC = hand drawn polygon including best habitat around nest site
Core Use Area (or HRCA, or Territory) = 1000 ac circle around nest site within which you look for additional high quality habitat to promote and/or protect

Owl Habitat and Ecosystem Restoration

Management Principle I:

Sierra Nevada forests are largely deficient in the very large and old trees (and associated snags and downed logs) that were historically present and which are important components of owl habitat. Management actions should be taken to retain and recruit such trees.

Management Recommendations:

Retain and recruit high value large and old trees and structures

1. Within PACs [*and Territories?*], retain the largest, oldest, and other high value CSO nest and roost trees (both live and dead). Outside of Territories, retain the largest, oldest trees (both live and dead) consistent with NRV. Particular attention should be given to retaining those large and/or old trees with high value habitat characteristics such as multiple tops, broken tops or irregular crowns, nesting/roosting structures, cavities with decay, large diameter limbs, etc. (North et al. 2009)
2. *Across the landscape, retain all live conifers > 33 in dbh (owl nest tree lower quartile) - may just go with traditional value (30 in)*
   a. A recommended upper diameter benchmark does not suggest that it is desirable to remove all trees less than 33 inches in diameter. Tree selection for removal should be based on stand specific structural and species compositional goals (e.g. maintaining areas of high canopy cover, maintaining multiple canopy strata).
   b. Exceptions to this recommendation may occur where restoration or resiliency goals cannot be met without targeted removal. Exceptions should consider the number, extent, distribution, and species composition of large trees with respect to project site specific goals. Examples include, but are not limited to:–
      i. In low to mid elevation pine-dominated mixed conifer forests where the removal of shade tolerant tree greater than 33 inches dbh may promote the growth, vigor, and development of shade intolerant species to more effectively meet species composition and restoration goals
      ii. When using natural regeneration to meet uneven-age management goals in pine dominated forest types, removal of shade tolerant trees greater than 33 inches dbh from the canopy seedbank to promote the establishment, growth, and development of multi-cohort pine stand.
      iii. Removal of trees greater than 33 inches dbh surrounding identified rust resistant sugar pine to improve the growth and vigor of these trees and maintain this valuable genetic resource on the landscape
      iv. Removal of conifers greater than 33 inches dbh that are encroaching into aspen and black oak forest types
3. Retain valuable snags for owls [define wildlife snags as greater than 15 inches dbh and greater than 20 feet in height]. Give preference to retain the largest snags with valuable wildlife habitat structures such as broken tops, cavities, multiple-tops, and broken limbs within an array of decaying stages throughout the landscape, and especially within areas of dense, multi-storied forests.

Commented [SCS2]: QUESTION (perhaps for scientists): can we estimate NRV for the size and density of large trees at the stand scale? That is, how do we determine NRV at the less-than-landscape scale? We have the GTR-220 and related LMU/AET/CWD notions that we would have "more" and "larger" big trees in more mesic areas, but are these quantifiable in any way to give managers benchmarks to help define the number and size of large trees (and snags) to shoot for in different locations?

Commented [SCS3]: Question: How does this relate to above; need some clarity on how this #2 relates to #1. Is the DBH limit/benchmark for PACs? PACs and Territories? Beyond?

Commented [SCS4]: QUESTION: What does this mean? How does it clarify the prior sentence?

Commented [SCS5]: QUESTION: is this MR for green forests or all forests, including those with severe burns, insect loss, etc.? Need clarity on this
QUESTION: Do the snag retention rules vary by spatial category or driven by NRV everywhere? I.e., any special rules for PACs and/or territories?

QUESTION: What are the 15" and 20' figures based on? - from framework, find citation

QUESTION: how do we know when we don't have enough and need to create more vs. just keeping what is there?

clarify language that not about salvage

a. Snag retention levels should be based on number, extent, and distribution of existing snags relative to site conditions, topography, and natural range in variability for the specific forest type. Snag retention goals should be quantified by number of on a larger stand level unit area basis (e.g. number of snags > 15 inches dbh per 10 acres).
b. Snags should be irregularly distributed in clumps, and according to site conditions. Consider clumping of codominant and dominant live trees surrounding desirable large snags to provide cover and wind protection
c. Consider removing or treating accumulations of smaller snags that fall outside the natural range of variability on a site specific basis to meet fuels management objectives. Current trends in snag dynamics suggest that snags are more abundant but significantly smaller than historical conditions. These snags serve less habitat quality structure but greatly contribute to fuels loading and mortality events due to drought, insects, etc. may create small snag levels outside the NRV (Knapp 2015)

Commented [SCS6]: QUESTION: can we include some benchmark ranges from NRV data?

4. Actively manage areas outside PACs to recruit and protect large, old, and structurally complex trees.

a) Where stand characteristics allow, use multi-cohort (e.g. uneven aged) management to promote a range of tree size and age classes to recruit future larger trees more similar to the NRV.
b) Where large or especially old trees are at high risk due to competition, drought, insects and pathogens and/or fire, reduce stand densities to reduce competitive stress on large trees and increase growth (McDowell et al 2003, Fettig et al 2007, McDowell and Allen 2015). For example:

    i. Where maintenance of high canopies is the primary objective, consider radial thinning around desired legacy trees to minimally maintain individual tree vigor and inter-tree competition.
    ii. In later-seral stands where maintenance of large, old trees and moderate to high density conditions is a priority, consider reduce stand densities to maintain stand vigor and avoid density dependent mortality due to inter-tree competition. (e.g. reduce stand densities to ensure that density does not exceed 55-60% of maximum stand density index) (Long et al. 2004, Long et al 2012, Lehmkuhl et al 2015)
    iii. In later and mid-seral stands where recruitment of large trees is a priority and canopies within NRV is acceptable, reduce stand densities to promote the development of large diameter trees with full open-grown crowns (e.g. reduce stand densities to the lower limit of full site occupancy or below – approximately 35% or less of maximum stand density index)(Long et al. 2004, Long et al 2012, Lehmkuhl et al 2015) while promoting or retaining structural heterogeneity within the stand as noted below.
    iv. Recruit future large snags through retention of largest, oldest, and decadent trees, consistent with the recommendations described above.

Commented [SCS7]: QUESTION: what does this mean?

Management Principle II:

Sierra Nevada forests lack much of the heterogeneity and variation that was historically present and which are important for owl habitat resiliency and foraging. Management actions should be taken to increase forest heterogeneity, with a goal of seeking to approximate the mosaic of conditions present within the natural range of variation.

Management Recommendations:

Management actions should move the landscape towards seral stage, density, and canopy diversity within the NRV to increase habitat resiliency and heterogeneity, as well as habitat improvement for owl prey species.

1. Manage towards a mix of seral stages and canopy conditions more reflective of the natural range of variation, with 10-40% of the landscape [*e.g. 10,000-40,000 ac or HUC6 watershed?]* in closed canopy conditions (defined as 40%-100% cc for YP, 50%-100% cc for mixed conifer; *but something about importance of 70%+ for owl and diversity of conditions*).
    a. In Yellow pine and mixed conifer forests: 10-15% of the landscape in early seral stages; 5-15% in mid closed, 20-30% in mid open, 25-55% in late open, and 5-20% in late closed
    b. In true fir forests (red fir and white fir): 10-20% of the landscape in early seral conditions, 10-20 in mid-closed, 15-20% in mid-open, 25-50% in late open, and 10-25% in late-closed
2. Manage forest habitat to promote heterogeneity at multiple scales.
    a. At the landscape level, stands should vary in density and canopy cover congruent with ecological gradients based on topographic position, soil, elevation, aspect, and vegetation type.
        i. Drier conditions associated with upper slope, ridge top and southwest aspects should be managed for smaller tree-clumps, larger openings, lower basal area and a higher percentage of pine and oak species. *[any number ranges, metrics to include here?]*
        ii. More mesic locations such as lower slope and valley bottom sites on more productive soils should be managed to support large tree clumps, higher canopy closure, smaller openings and a higher percentage of fire-sensitive, shade-tolerant species such as fir and incense cedar. *[any number ranges, metrics to include here?]*
        iii. Focus management on the development of a range of conditions across space and time to provide a network of areas that may have lower canopy cover and basal area (based on NRV) interspersed with areas of high canopy cover to enhance juxtaposition of nesting/roosting with foraging habitat, including the creation of small openings and managing for "soft edge" habitat, and treatment boundaries that follow topographic or ecological gradients or ecotones.
    b. Manage for a patchy mosaic of shrubs and understory vegetation, separated by more open understory areas to reduce fuels continuity, increase habitat heterogeneity, and support owl prey—with a goal of 10-25% shrub cover at the Territory scale (North et al. 2002, North et al. 2009, North and Sherlock 2012).

Commented [SCS8]: add visualization/illustrations

Commented [JLR9]: Evaluated at what scale? See landscape scale described in Early Adopter Plans

Commented [SCS10]: repeat more about smaller scale following on this landscape scale (appears elsewhere in document now)

Commented [SCS11]: QUESTION: What aspect(s)? Northern? Also, you've laid out conceptual guidance for dry and wet sites; do you need any guidance for intermediate sites (and how they are identified/located)?

Commented [SCS12]: define

Commented [SCS13]: QUESTION: whats the desired patch size range?

c. Within stand structure should be punctuated at fine resolution by gaps in a pattern of individual trees, clumps, and openings (ICO).
   i. High canopy cover should be maintained in patches, especially in more mesic sites, such as in drainages, riparian areas, and swales and on north and east slopes, and should be separated by more open stands (especially on more xeric slopes and ridges)
   ii. Gaps should range in size based on the NRV (generally from *0.03 to 3 acres in size)*. Gap size and frequency should vary by forest type, landscape context, natural fire regimes, and topographic position (e.g. gap size and frequency should mimic high fire severity patch sizes characteristic of the forest type's natural fire regime; gaps may be smaller and less frequent in valley bottoms and may be larger and more frequent in ridgetop positions)

3. Manage for owl prey species habitat through enhancement of regeneration, promotion of habitat heterogeneity, and retention of high canopy cover dependent on site conditions [*discuss with scientists – do we need to break out separate guidance for prey species? should moving towards NRV cover that?*]
   a. In Yellow Pine Mixed conifer manage owl prey species habitat primarily for woodrats, deer and brush mice, and northern flying squirrels. In mixed conifer-black oak habitats, consider treatments that retain or enhance oak growth and reproduction (especially for oaks >13 inches dbh), promote 5 to 20% shrub and herbaceous plant cover, and retain a sufficient density of large logs to promote woodrat habitat (White 1966, Innes et al. 2007, Kelt et al. 2014, Roberts et al. 2015).
   b. In higher elevation mixed conifer and true fir forests (red fir and white fir), manage prey species habitat, primarily for northern flying squirrels, by retaining higher canopy cover comprised of older and large trees (i.e. >50% canopy cover) and retaining large forest structures in patches (large trees, decayed snags). In addition, promote forage conditions for flying squirrels (e.g., truffles, edible canopy lichens), including sufficient surface litter and sparse, spatially-variable coarse woody debris (Meyer et al. 2007b, Smith 2007, Pyare et al. 2010, Lehmkuhl et al. 2006).
   c. In all forest types, promote structural heterogeneity and understory diversity to promote diverse habitat conditions for owl prey species, including large tree clusters of various sizes often with interlocking canopies, greater understory diversity with variable cover (especially in riparian areas), and other forest structural features emphasized under management principle 2.

Management Principle III

High value owl habitat is at significant risk from stressors and disturbances such as fire, drought, insects, pathogens, and changing climate. Management should move forest conditions towards the Natural Range of Variation to increase resilience and help ensure the long term persistence of owl habitat. To achieve a balance between short-term needs and long-term conservation, land management should be prioritized to maximize restoration and resilience treatments while minimizing adverse impacts to important owl habitat.

Commented [SCS14]: QUESTION: How does this differ from your landscape-level guidance? Also, any benchmarks for the size of patches/clumps of density? You have gap/opening benchmarks following; would be good to have the same for patches/clumps.

Lydersen – proportional range of stand in gaps?

Commented [SCS15]:
QUESTION: Can you give more specific guidance for managers on how to determine gap size and distribution?
And, what about other historic mortality dynamics (e.g., insect-outbreak patches).
Also, how are managers to determine amount and distribution of patches?

Commented [MM16]: I can definitely help with this section.

Commented [MM17]: Not really. I think you do need this section since some recommendations are different from NRV. – lets find anything that adds info in this section and incorporate it in other sections – add the 'why' to NRV management

Commented [MM18]: Northern flying squirrels are also common in these forest types – more so oftentimes than woodrats. I would strongly suggest also managing for this species in these forest types.

Commented [MM19]: On second thought, I think it would be better no to separate these out into two veg types. Probably best to combine as a single typ but with 3 recommendations.

Commented [MM20]: These additional suggestions are for woodrats and flying squirrels.

Commented [MM21]: We and no one else in the Sierra Nevada has ever found that an association between northern flying squirrels or truffles and large coarse woody debris – this is actually from the Pacific Northwest. We did often find an association with the cover and depth of litter & duff on the soil surface. I've inserted the recommendation from the CA spotted owl assessment Chapter 3.

Commented [SCS22]: towards one end of the NRV range at higher elevations for prey specifically

Management Recommendations

Active forest management is important to mitigate the risks posed to the owl and its habitat from unnaturally severe wildfire, insect and pathogen mortality, drought, and climate change. Active forest management for the benefit of the spotted owl includes mechanical treatments, prescribed fire, managed wildfire/wildland fire use, and fire suppression. The overarching goal for prioritizing treatments at the landscape and project levels should be to locate and design treatments that provide for the long-term restoration and resilience of the forested habitat in which the spotted owl lives while avoiding or minimizing short-term adverse impacts to spotted owl habitat and individuals. By strategically prioritizing land management actions, using both mechanical treatments and fire, land managers may be able to make progress toward NRV without impacting important owl habitat

1. Strategic fire hazard reduction – using both mechanical treatments and prescribed/managed fire – is important to minimize the loss of dense-canopied forests with large trees.
    a. Mechanical treatments should be designed so that behavior of a fire coming into the area under moderate conditions would be primarily confined to the understory with only occasional torching of single trees or small groups of trees; primarily killing understory and consuming forest litter and CWD (Safford and Van der Water 2013).
    b. Reduction of density and average tons/ac of coarse woody debris towards the natural range of variation should be undertaken to reduce fire hazard
        i. Retain on average *3-5 tons of large (>20-in diameter) logs per acre*. Log density should vary across the landscape based on NRV, with some patches of high abundance on more mesic higher productivity sites (5 tons/ac) and others with lower densities on drier less productive sites (<1 tons/ac).

Commented [SCS23]: for variation, needs to be per 10 acres make clear that's an average and will exceed in some places, and be less than in others – emphasize variation

2. Reducing stand density in over-stocked stands – using both mechanical treatments and prescribed/managed fire – is important to minimize the loss of important owl habitat elements.
    a. Manage towards historic tree densities, ranging from 60 to 328 trees per hectare (24 – 132 trees/ac) where larger trees are present. Where larger trees are lacking, manage to allow trees space to survive and grow, while recognizing that higher than historic tree densities may be appropriate in some *areas [Territories deficient in dense forest?]* in the short term to provide adequate canopy cover and basal area for owls.
    b. Mimic fire-driven mortality by removing smaller trees and fire-sensitive species in overly dense areas, managing towards dominance (2/3 of mature trees) by fire - tolerant species (pines).
    c. Consider varying levels of treatment and treatment effectiveness based on current and suitable habitat value to create heterogeneity at multiple scales (Lehmkuhl et al 2015) For example:
        i. Within occupied or unoccupied nesting and roosting habitat employ no treatment or light treatments to reduce fuel and potential fire behavior and risk to wildfire.
        ii. Within suitable nesting and roosting habitat and in later-seral stands (CWHR 5M/5D/6) where maintenance of large and old trees and mid to higher density canopy conditions is a priority, employ light to modest treatments to reduce stand

Commented [SCS24]: vary by forest type densities to reduce fuel accumulations and avoid density dependent mortality. (e.g. ensure that stand density does not exceed 55-60% of maximum stand density index and reduce fire behavior) (Long et al. 2004, Long et al 2012, Lehmkuhl et al 2015)

   iii. Within foraging habitat and in mid-seral stands (CWHR 4M/4D)that have the potential to develop into nesting and roosting habitat where recruitment of large trees is a priority and lower density canopies may be acceptable, employ modest to fully effective treatments to reduce stand densities to reduce fuel accumulations, restore forest structure, and promote the development of large diameter trees with full open-grown crowns (e.g. reduce stand densities to the lower limit of full site occupancy – approximately 35% of SDI (Long et al. 2004, Long et al 2012, Lehmkuhl et al 2015).

   iv. Within non-habitat stands, employ fully effective treatments to create canopies and stand densities reflective of forests that experience an active fire regime.

  d. manage for mixed species composition (increase resilience to insect outbreaks)

3. Use the biophysical environment (e.g. topography, soils, climate water deficit) to prioritize treatments where they maximize potential benefits (e.g., by affecting fire behavior in strategic locations, North et al. 2012) and minimize potential impacts on owl habitat. For example, prioritize treatments on terrain with relatively warm microclimates (e.g., ridgetops, south and west slopes). [*need more systematic incorporation of prioritization principles]*

4. In large post-disturbance areas, management should be undertaken to increase the long-term resilience of the habitat –*discussion with scientists?*

  a. *Post-fire restoration projects need to balance short term foraging benefits, risk of high severity re-burn effects, and long term benefits of reforestation and restoration treatments. Natural range of variation of disturbance severity, frequency, patch size, and scale of ecological forest types should inform post-fire restoration efforts. The development of post-fire restoration strategies that consider NRV and habitat for owls and their prey will help assist with post-fire restoration efforts.*

  b. When the effects of a disturbance are within the natural range of variability (*e.g. 10-15% high severity burn patches with the majority of patches < 100 acres (YPMC), <XX (Fir); something about bug-killed areas outside of NRV*), and post disturbance conditions are within the NRV (e.g. XXXX), standing dead or dying trees should be left on the landscape for their ecological benefits to owls and other wildlife.

  c. Limited retention of patches experiencing stand replacing fire (e.g. <10-15% of fire) may be ecologically appropriate, especially if those retention areas are designed to fall within topographic areas or forest types that would experience such fire effects under NRV (Collins and Stephens 2010).

  d. When post disturbance conditions are outside the natural range of variability, a variety of post-disturbance management actions may be considered, with preference for those actions that increase long-term resilience, while providing for short-term connectivity and habitat needs as possible.

   i. Design post-disturbance restoration projects to develop forest structure and process congruent with natural disturbance regimes and effects. In the case of fire,

Commented [SCS25]: but not all 'suitable nesting/roosting habitat right? because much of what's currently 'suitable' may be located in areas not able to support that suitability over time?

Commented [SCS26]: conflicts with other MRs, seems to propose a different approach than what is laid out elsewhere in these MRs, such that you're creating parallel and confusing MRs.

Commented [SCS27]: Dana to write some e.g. (ridge-top white fir, patches within NRV but habitat not)

Commented [SCS28]: we don't want to confuse a natural distribution of fire severities with an area being within NRV. For example, you could have an area that was far outside NRV prior to burning but burned with a distribution of fire intensities within NRV – e.g., primarily low-moderate severity with some patches of high – but the area itself is still far outside NRV and potentially warranting treatment. Bottom line: a NRV distribution of fire (or other disturbance) does not turn a non-NRV landscape into an NRV landscape – a manager needs to look at the residual condition in its entirety.

particular attention should be given to severity and patch size and re-burn dynamics.

ii. Design projects to manage the development of fuel profiles over time. This includes activities to: (1) remove sufficient standing and activity generated material to balance short-term and long-term surface fuel loading; and (2) protect remnant old forest structure (surviving large trees, snags, and large logs) from high severity re-burns or other severe disturbance events in the future.
   1. Develop fuel treatments that create optimal post treatment fuel loading ranges (NRV) that are < 5-20 tons per acre for dry site ponderosa pine and <5-30 tons per acre for fir types (Brown and others 2003).
   2. Use harvest methods that remove slash from site (such as whole tree yarding) to prevent short term increases in surface fuel loading that increase reburn fire intensity (Johnson et al 2013).

iii. Design treatments to promote future fire and drought resilience by, for example: (1) preferentially planting fire-tolerant species; (2) planting lower densities of trees and/or variable spacing; (3) promoting conditions that allow for future management of wildfire and prescribed fire, *etc.*

iv. Design treatment to protect and maintain critical owl habitat. This includes: (1) considering areas that burned under low to moderate severities where forest vegetation is still largely intact as potentially suitable for forest restoration treatments (e.g. forest restoration but excluding post-fire salvage and tree planting); (2) providing for sufficient quantities of large snags; (3) maintaining existing large woody material as needed; (4) providing for additional large woody material and ground cover as needed; (5) accelerating development of mature forest habitat through reforestation and other cultural means; and (6) providing for a mix of seral stages over time.

v. Something about edge habitat, proximity to other burn or non-burn types?

vi. *something for bug kill patches specifically*

5. *integrate 'Prioritization Principles' somewhere*

Management Principle IV

Fire is an essential ecological process in the forests occupied by the spotted owl, and is critical to the maintenance of owl habitat heterogeneity and resiliency through time. Management actions should be taken to increase the amount and types of fire on the landscape, with an emphasis on those that fall within the natural range of variation.

Management Recommendations:

Apply and manage wildland fire for long-term restoration and to benefit owl habitat.

1. Apply prescribed fire that provides for a mix of severities while limiting high severity patches of stand replacing fire to generally less than 5-15% of the area (Collins and Stephens 2012) in generally less than 5-10 acre patches (Show and Kotok 1924, Collins and Stephens 2010; North et al Assessment). *Avoid creating openings larger than 75-100 acres*. Consider fuel moisture and winds when designing prescriptions and developing firing patterns that promote heterogeneity and focus seasonality of prescriptions to consider

Commented [JLR29]: I would add NRV component in here – what would that look like?

Commented [SCS30]: set this up as giving folks the info they need to empower them to actually get fire on the ground without pre-treatment

Commented [SCS31]: Based on the Eyes (2015) thesis and work by Darren Clark, I think this value that starts to have a negative impact on owls is somewhere around 30-40 ha. Need to consult with Susan Roberts if you want these values.

hazards and risk by landscape/topographic position (LMU or CWD-AET). Consider strategic placement of firelines, seasonality and use of firing patterns that reduce flame lengths

2. Plan prescribed fire under weather and fuel moisture conditions that promote habitat resiliency and owl habitat values, including burn prescriptions that promote mosaic fire effects within the natural range of variability. Tactics should recognize that fires during moderate fire weather conditions can benefit owl habitat, but severe fire has the potential to remove canopy and important owl habitat elements
   a. Perform risk assessments prior to and during fire season to assess conditional thresholds under which desired conditions can be met for the strategic use of fire.
      i. Use the National Fire Danger Rating System Burning Index [BI] and Energy Release Component [ERCs] indices to determine seasonality and relative risk. Indices between seasonal Average and Maximum will produce the greatest mix of fire severities but may trend to high severity. Consider ERC trends near the 20-year Average to get appropriate mix of fire severities.
      ii. Create a Management Action Point (trigger) that allows for pre-planned fire suppression actions to reduce high intensity fire (FL. >12 feet) and high severity patches when crown fire patch size exceeds the *5-10 acre patch size for YPMC, 5-15 acres for true fir.*
3. Design prescribed fires to leave some unburned patches, especially in larger burn units, to provide heterogeneity and refugia for owl prey. Fire refuges should generally occur in topographically protected areas such as stream confluences, lower slopes, benches and headwalls, and *should make up 10-25% of the total area* within a burn perimeter (Camp et al 1997; Mallek etal 2013; Meyer 2015 Draft).
4. 4. Promote low to moderate intensity fire behavior that reduces scorch height and keeps results in tree mortality more similar to the NRV (can exceed 50% of trees under 10 inches dbh)~~Promote low to moderate intensity fire behavior that reduces scorch height and keeps tree mortality to less than~~ *50% of trees under 10 inches dbh* [*discussion with scientists*]. High dead and down fuel moisture content in first entry burns reduces the likelihood of torching subsequently reducing the extent of severe fire. Fire objectives should manage for a mosaic of fire effects through developed fire behavior objectives, for example:
   a. Top kill 50-80% of encroaching brush vegetation over multiple prescribed fire entries.
   b. Limit bole scorch heights to less than 20 feet
   c. Consume 75% of dead and down fuels <9 "over multiple prescribed fire entries.
5. Decisions on if and how to manage natural fire ignitions must consider not just single pieces of the puzzle but how those indicators combine that could provide short term and long term fire effects or benefits. Climate change (increasing temperatures) seasonal drying, time of season, remaining duration of season, potential for large fire growth , departure from NRV (or FRID), seasonal outlook, National Fire Planning Levels (fire resource availability), air quality and particulate dispersion.
   a. management of natural fire ignitions should be encouraged where conditions allow, with a goal of restoring a mean fire return interval of 10-20 years to low to mid-elevation owl habitat (25-40 year fire return interval in red fir forests)

Commented [SCS32]: I would allow even more mortality, as this will depend greatly on how much pre-fire densities exceed NRV. In many fir stands, for example, we would need to reduce the density of these trees by more than 50% typically to get it close to the NRV. Consider changing to promote NRV.

Commented [SCS33]: You may want to expand this range to fit the diversity of forest types. For example, this mean FRI will be 25-40 years for red fir forests. Ponderosa pine, on the other hand will be 5-15 years.

b. Relative risk for loss of core nesting and roosting habitat as measured by flame length, burning index and ERC for duration of burn season must to be addressed prior to management of natural ignitions. Use Relative Risk inputs in Wildland Fire Decision Support System (WFDSS) to address values at risk, hazards and probability (note: burn intensities will vary across the range of the CSO strategy area due to forest types, elevation, seasonality and moisture availability – one size does not fit all and managers need to consider all levels of relative risk prior to management of fire in CSO territories).

6. Fuel and fire management strategies should integrate both mechanical and fire treatments as appropriate into a comprehensive approach that focuses on the re-introduction of fire on the landscape as a critical ecosystem process while balancing treatment effectiveness and implementation constraints to best meet restoration goals within acceptable temporal bounds.
   a. Re-introduction of fire as an ecosystem process should be considered as a critical goal in restoration projects.
   b. Prescribed and managed fire should be prioritized in forest types that are currently within NRV or not far departed from NRV.
   c. In landscapes that are far departed from natural fire regimes, primary goals of fuels and fire management should include both restoration of forest structure and composition and the re-introduction of both prescribed and managed fire as a landscape process. (idea that fuels treatment alone doesn't always equal restoration)
   d. Where forest structure, densities, or fuel dynamics are far departed from NRV mechanical treatments should be considered as effective means to reduce stand densities, restore forest structure, and reduce the risk of losing critical old forest habitat.
   e. Where mechanical treatments are applied, follow-up, or coincidental, fire applications should be included to meet process and function goals/desired conditions
   f. Mechanical treatments should be considered as an effective means to establish a fuel-reduce "anchor point" from which prescribed and managed fire could be strategically expanded on the landscape as an essential disturbance process. Prescribe and managed fires should also be considered to expand upon mechanical treatments "anchor points".

High Quality nesting/roosting habitat retention and recruitment

Management Principle V:

Densely-canopied forest stands with large and old trees are important elements of spotted owl habitat (especially for nesting and roosting). Such conditions should be retained and recruited across the landscape, consistent with the natural range of variability and the likelihood of persistence under a changing climate. *Special status should be allocated to such conditions where owls currently use them [rephrase, meaning: establish PACs or something like that]* Due to the dynamic nature of the ecosystems inhabited by owls, owl Territories and PACs should shift in space over time and should not remain static. Priority should be given to retaining and protecting recruiting existing patches of densely-canopied forest stands with large and old trees, where: 1) such patches exist in locations that are likely to have supported such conditions prior to European settlement; 2) such patches have a high likelihood of retaining such conditions in the future. [*requires refinement*] When forests at the landscape scale fall within NRV and are managed for NRV, specifically identified and specially managed territories and PACs may no longer be needed.

Commented [ret34]: too speculative?

Management Recommendations

1. Provide Spotted Owl nesting and roosting habitat. When owls are located through protocol surveys occupying a certain area, managers should designate a Protected Activity Center (PAC) and Territory associated with that owl location *[description of when you START managing habitat as core nest/roost rather than NRV]*
    a. Within each territory, delineate a 300 acre **PAC** to include (1) known and suspected nest stands and (2) High quality nest/roost habitat, including high canopy cover (≥60%), an abundance of large (>61 cm dbh; 24 in) trees, higher than average basal area, an abundance of coarse woody debris, 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) – [*the best available habitat in descending order (CWHR 6, 5M, 5D, 4D, 4M) in as contiguous a fashion as possible*]
    b. The high quality nest/roost habitat described above should be maintained on the most mesic, higher productivity sites available within the territory that are most likely to support this habitat in the long term (Underwood et al. 2010). (using Malcolm's analysis or LMU).
        i. *Where possible, PACs should be delineated utilizing the highest quality habitat on the most productive and mesic sites consistent with NRV and less severe fire behavior that may be sustained in the long term. (e.g. riparian areas, valley bottoms, and north and east slopes).*
        ii. High canopy cover should be maintained in patches, especially in more mesic sites, such as in canyons and swales and on north and east slopes, and should be separated by more open stands (especially on more xeric slopes and ridges)
        iii. Retain some overtopping and multi-storied canopy conditions, including some shade-tolerant understory trees (firs and cedars), especially in drainages, swales, and canyon bottoms and on north and east-facing slopes.
        iv. Marginal habitat and habitat that falls outside of NRV (xeric sites, southwest facing slopes, ridgetops) should not be included in PAC delineation, if practicable.
        v. In some cases PAC delineation may include marginal or less sustainable sites regardless of NRV (i.e. even if they are outside of the NRV), until such time as recruitment of quality nesting roosting habitat in more NRV appropriate places is achieved or realized
2. *Within Territories but outside of PACs, designate, maintain, and recruit high quality nesting and roosting habitat in ecological appropriate locations [(CWHR 5M/5D/6) – or modified with Step 1 results].*
    a. *Within each territory, designate and retain additional high quality nest/roost habitat (CWHR 5M/5D/6) outside of the PAC where site conditions will promote or sustain this*

Commented [SCS35]: what does 'designate' mean specifically here?

Commented [SCS36]: wait for Step 1 and 2 results to see if we want to revise the 'NRV at Core Area scale' premise *habitat in the future (e.g. more mesic sites, drainage or valley bottom positions, North/east slopes, etc.)*

b. Recruit the development of high quality nesting/roosting in sustainable areas or consistent with NRV. Recruitment treatments should retain existing structures key forest structure and elements (i.e: large legacy tree components, snags, areas of high canopy cover >70%CC, etc.) to reach suitable nest/roost habitat in the as quickly as feasible.

3. *As PACs occur in dynamic ecosystems, and their occupancy or utilization may change over time, management should not treat PAC boundaries as static.*
   a. *As changes occur, PACs should be modified to incorporate areas of owl use and remap boundaries to exclude marginal habitat.*
   b. PAC boundaries should be modified based on use, latest occupancy, & site/habitat conditions.
      i. If habitat within PACs is a) no longer occupied (*as evidenced by XX years of surveys*) and b) outside of NRV, PAC delineation may be re-evaluated to enable restoration treatments. (*conversation with scientists – what science to we have to suggest some point of removal or not*)
   c. After a stand-replacing event, evaluate habitat conditions within a 1.5-mile radius around the activity center to identify opportunities for re-mapping the PAC. If there is insufficient suitable habitat for designating a PAC within the 1.5-mile radius, consider removing PAC status from the habitat.
      i. In post-fire environments: If the PAC burns at low, moderate severity, or mixed severity PAC retaining or re-mapping PAC based on areas of occupancy and overstory survival.
      ii. In post-fire environments, if greater than 50% of the PAC burns with 90% BA mortality or greater, then consider removal of the PAC *unless surveys indicate continued occupancy*.

Management Principle VI

Active management to significantly modify stand structure should be avoided in PACs where there is recent evidence of owl of occupancy

Management Recommendations

1. Avoid mechanical treatments in PACs to the greatest extent possible, unless such treatments are necessary to ensure resilience of the PAC over time.
2. When treatments in PACs are deemed necessary for long-term sustainability and resilience, prioritize restoration on drier sites that are most highly departed from desired condition to maximize restoration/resiliency value while minimizing reduction of core nest/roost habitat value
   a) PAC treatment strategy should retain high quality nesting/roosting structure characteristics including large, old trees, high canopy cover, multi-storied, etc. The treatments may include prescribed fire and/or mechanical treatment.

Commented [SCS37]: If these conditions already exist, wouldn't they already be part of the PAC?

Commented [SCS38]: Want something more explicit regarding development and protection of roosting/nesting habitat

Commented [SCS39]: John and Zach to propose a potential mechanism to make recommendations

Is 2 years enough to make recommendations? (probably not)

Landscape scale prioritization - come up with criteria: e.g. landscape position, breeding status or evidence, occupancy over certain time period, location relative to population (e.g. central)

secondary criteria based on disturbance

tertiary criteria based on some linkage analysis of key to metapopulation connectivity or not

intersect PAC prioritization with ecological prioritization system

maybe it falls under PAC treatment

Commented [SCS40]: need to differentiate between different types of mechanical

Commented [SCS41]: what does this really mean, and who decides it?
put in examples or triggers that would make it necessary

e.g. SDI above imminent mortality threshold on dry sites

God Squad

just cross reference to prioritization principles (it's the last priority)

learning by doing – experimental approach, larger scale

structure: largely avoid, but experimental design in which to maybe do it on local and learning scale
not about strict guidance for within – priority = systematically see how this happens

b) Avoid mechanical harvest treatment within a 500-foot radius buffer around a spotted owl activity center to protect the microsite conditions for nesting owls. Hand thinning within the 500-foot radius buffer may be allowed to reduce hazardous fuels conditions.

c) Generally retain trees *> 12 in dbh [XX in dbh? science to support – we know trees <24 inches are much more abundant today than historically]* in high quality nest/roost habitat within PACs. In PACs located on dryer sites (YPMC) that are highly departed from NRV removal of trees > 12 in diameter may be necessary. Ensure that treatments do not reduce canopy cover below 50% and avoid treating more than 30% of the PAC in *per decade.*

Commented [SCS42]: <12 inches + burning could get you somewhere for fire resilience, but unlikely to get you anywhere for drought/insect resilience

d) Prioritize patches within PACs for treatment based on:
   i. The patch of habitat is located in an area where it is likely unsustainable and has potential for conveying natural disturbances across the landscape in ways that jeopardize large patches of owl habitat.
   ii. There are nearby areas that are more likely to sustain owl habitat and are either currently habitat or likely to become habitat within a short time frame (e.g., 30 years).
   iii. The patch of habitat does not appear to be associated with an owl nest or to promote successful dispersal between existing home ranges or territory clusters.
   iv. The area will still retain some habitat function after treatment, while still meeting the intended restoration objective.

Commented [SCS43]: added (following GTR 915)

e) Among PACs, highest priority for treatment should be given to areas with the lowest contribution to productivity:
   i. PACS presently unoccupied and historically occupied by territorial singles only
   ii. PACS presently unoccupied and historically occupied by pairs
   iii. PACS presently occupied by territorial singles only
   iv. PACS presently occupied by pairs
   v. PACS currently or historically reproductive

3. Prescribed fire and managed fire are encouraged within PACs to reduce the risks of habitat loss from fire, insect/pathogens, drought, and climate change, when the fire intensity can be maintained at low or moderate levels.
   a. Utilize prescribed burning within high quality nest/roost habitat to reduce hazardous fuels and restore mosaic conditions.
      i. Protect nesting and roosting habitat and retain canopy density by designing prescriptions under weather and moisture conditions that focus on surface and understory ladder fuels, retaining overs-tory trees and multistoried canopies. Consider early season burns where litter and duff buildup around base of large Older “structural legacy” trees may pose risk of cambial damage during burning. High severity stand replacing fire should be avoided in activity centers by taking advantage of high fuel and duff moisture conditions that provide for low intensity and provide resiliency while retaining canopy cover.
      ii. Consider raking and clearing around nest and roost trees down to bare mineral soil to protect from ignition during firing phase especially if fire scars are present (Hood 2010). Where retention of large trees is an objective – late spring prescribed burning when soil and duff are wet but surface fuels are dry enough to carry a low-

to moderate-intensity fire (<3 foot flame length) with low duration may be necessary in order to minimize large pine (tree) mortality.

iii. Consider pre-treatment to protect/retain key habitat elements (e.g. legacy trees, large diameter trees, pockets of high canopy cover, large snags, etc.)

iv. balance height-to-live crown and downed fuel risk to minimize fire hazard (hand removal of medium sized trees may increase fuel load

4. LOPs? See bin below

a. e.g. no LOP for fire, but suggested best practices regarding prioritizing non-active breeding sites over active breeding sites during breeding season

b. suggest no change or slight changes to current mechanical LOPs? conversation with scientists about relevant info

Bin – to discuss with scientists:

1. Limited Operating Periods
2. Post Fire Restoration (more or different than what's already in there?)
3. non PAC approach?
4. more on climate change?

1. Tabled for discussion with scientists: based on science is an LOP needed, and what would it look like? how would it differ for different types of activities?

1. Limited operating periods (LOPs) may be necessary to avoid adverse impacts, reduce stress and disturbance of breeding and nesting owls. Noise disturbance has been documented from both human and management activities with varying results to both behavioral stress as well as reproductive success. Wasser et al (1997) reported high stress levels due to road noise though Tempel and Gutierrez (2004) did not. Very little information is available related to owl stress and disturbance from prescribed fire operations and smoke.

c. *Implement best management practices and strategic LOPs for management actions that may harm or disturb owls during breeding and nesting season (is there a difference?), such as performing prescribed fires when wind conditions will minimize smoke and avoiding sustained noisy actions (e.g., mastication) in nest habitat during breeding season*

d. *Limited operating periods should be applied from XXX to XXX within ¼ mile (800 meters) of verified nest site for mechanical harvesting equipment and other tree cutting activities. If nest site is not verified apply LOP to PAC. Distance is from 2004 ROD, should it be different?*

e. *LOPs may necessary for prescribed fire operations. If fire spread cannot be kept ¼ mile away from verified nest, apply LOP to PAC from March 1 to May 15th. Is smoke an issue or are flames?*

f. *What about handwork within ¼ mile during breeding?*

g. *Limited Operating Periods for Specific Activities. These activities are generally prohibited during the specified periods within ¼ mile of nest stands unless a project-specific biological evaluation determines that potential benefits to fisher habitat outweigh the potential for harm to fishers.*

Limited Operating Period	**Prohibited Activities**
March 1 to June 30	Logging, thinning, tree cutting. Salvage logging in moderate or low severity burns (<75% BA mortality) or within *¼ mile* of the perimeter of high severity burns (>75% BA mortality). Mastication Construction and development of infrastructure Hazard tree removal
March 1 to May 1	*Prescribed fire underburning.- is this even needed?*
March 15 to May 1	*Burning large slash or debris piles.*