Summary Findings

Sierra Nevada mixed-conifer forests require a new management strategy that goes beyond short-term fuel treatment objectives and incorporates long-term ecological restoration and habitat improvement into forestry practices. This strategy is compatible with current landscape fuel treatments (i.e., SPLATs, DFPZs and WUI Defense zones), but strives to incorporate ecological restoration and improved wildlife habitat needs that have not been explicitly addressed. This strategy can be implemented using a multiage silvicultural system to meet fuel reduction, ecosystem restoration, and wildlife habitat objectives. Important facets of the strategy include:

- **Mechanical fuels management:** When stands cannot be burned, reducing fuels to moderate fire behavior is still a key priority because wildfire is likely to burn the area eventually. A few of the ecological benefits of fire are achieved with mechanical fuel reduction, but thinning is not an effective substitute for fire in affecting ecosystem processes. Reducting surface fuels is as important as reducing ladder fuels.
- **Limit use of crown separation in fuel treatments:** Sparingly apply canopy bulk density reduction and increased tree crown separation only in key strategic zones. More research is needed, but current models suggest its effects on reducing crown fire spread are limited, and the regular leave-tree spacing does not mimic tree patterns in active-fire-regime forests.
- **The ecological importance of fire:** Prescribed fire can help reduce surface fuels and restore some of the ecological processes with which mixed-conifer forests have evolved.
- **Treatments focused on affecting fire behavior:** Efforts to restore pre-European forest conditions are likely to fail in the face of climate change and also do not provide flexible prescriptions that adapt to different site conditions. Focus treatments on affecting potential fire behavior by manipulating fuel conditions, thereby allowing forests to equilibrate to fire under modern conditions and increasing forest heterogeneity.
- **Retention of suitable structures for wildlife nest, den, and rest sites:** Trees providing suitable structure for wildlife include large trees, and trees with broken tops, cavities, platforms, and other formations that create structure for nests and dens. These structures typically occur in the oldest trees. Develop and adopt a process for identifying, and thus protecting, such trees by field staff for all future inventory and prescription-marking crews.
- **Stand-level treatments for sensitive wildlife:** Areas of dense forest and relatively high canopy cover are required by California spotted owls, fishers, and other species. Identify and manage areas where, historically, fire would have burned less frequently or at lower severity owing to cooler microclimate and moister soil and fuel conditions for the higher stem and canopy densities that they can support.
- **Large trees and snags:** Given their current deficit in mixed-conifer forest and the time necessary for their renewal, protect most large trees and snags from harvest and inadvertent loss owing to prescribed fire.
- **Landscape-level treatments for prey of sensitive wildlife:** In the absence of better information, habitat for the prey of owls and fishers may best be met by mimicking the variable forest conditions that would be produced by frequent fire. Reductions in stem

density and canopy cover would emulate the stand structure produced by local potential fire behavior varying by a site's slope, aspect, and slope position.

- **Retain hardwoods and defect trees and promote shrub patches:** Hardwoods (particularly black oak) and defect trees (i.e., those with cavities, broken tops, etc.) are valued wildlife habitat and should be protected whenever possible. Increasing understory light for shrub patch development, can increase habitat for some small mammals and birds.
- **Riparian forest fuel reduction:** Prescribed burning of riparian forest will help reduce fuels in these corridors that are also important wildlife habitat.
- **Spatial dispersion of treatments:** Trees within a stratum (i.e., canopy layers or age cohorts) would often be clumped, but different strata would usually be spatially separated for fuel reasons. Give particular attention to providing horizontal heterogeneity to promote diverse habitat conditions.
- **Spatial variation in forest structure:** "Average" stand conditions were rare in active-fire forests because the interaction of fuels and stochastic fire behavior produced highly heterogeneous forest conditions. Creating "average" stand characteristics replicated hundreds of times over a watershed will not produce a resilient forest, nor one that provides for biodiversity. Managers could strive to produce different forest conditions and use topography as a guide for varying treatments. Within stands, important stand topographic features include concave sinks, cold air drainages, and moist microsites. Landscape topographic features include slope, aspect, and slope position.
- **Stand density and habitat conditions vary by topographic features:** Basic topographic features (i.e., slope, aspect, and slope position) result in fundamental differences in vegetation composition and density producing variable forest conditions across the Sierra landscape. Drainage bottoms, flat slopes, and northeast-facing slopes generally have higher site capacity, and thus treatments retain greater tree densities and basal areas.
- **Tree-species-specific prescriptions:** Hardwoods and pines, with much lower densities in current forests compared with historical conditions, would rarely be thinned. Thinning would be focused on firs and incense-cedar. Address pine plantations separately.
- **Silvicultural model and strategy:** Tree diameter distributions in active-fire forests vary but often are nearly flat due to periodic episodes of fire-induced mortality and subsequent recruitment. Stand treatments that significantly reduce the proportion of small trees and increase the proportion of large trees compared to current stand conditions will improve forest resilience.
- **Treatment of intermediate-size trees:** In most cases, thinning 20- to 30-in d.b.h. trees will not affect fire severity, and, therefore, other objectives for their removal should be provided. Where those objectives are identified, silvicultural prescriptions would only remove intermediate-size trees when they are shade-tolerants on mid or upper slope sites.
- **Field implementation of silvicultural strategy:** Modify marking rules to ones based on species and crown strata or size and structure cohorts (a proxy for age cohorts) rather than uniform diameter limits applied to all species.
- **Allocation of growing space:** A large proportion of the growing space would be allocated to the largest tree stratum.
- **Assessment of treatment effects:** Emphasis is on what is left in a treated stand rather than what is removed.