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9 August 2016

Jerry Brown, Governor
State of California

Dear Governor Brown,

Thank you for the invitation to speak with your staff, and CalFire staff, at your office on July 11, 2016 regarding the recent creation of an estimated 66 million new “snags” (standing dead trees) in California’s forests due to the combination of drought and native bark beetles. I appreciate the promises that your staff made at the opening of the July 11th meeting—specifically, that this is just the beginning of the discussion between your staff and forest/fire scientists, such as myself, and that future discussions will be broadened to include additional independent scientists who are not affiliated with the logging industry. This is particularly important, given that, at our July 11th discussion, I was the only independent scientist who was invited to speak, and five of the six scientists invited to give presentations were either full-time U.S. Forest Service representatives (four of the other five) or were affiliated with the Forest Service in terms of research partnerships and funding (one of the other five). The U.S. Forest Service is in the business of commercial logging on public lands, and actively promotes increased logging of both live and dead trees.

The representatives of the Forest Service did not discuss the many native wildlife species that depend on patches of snags (standing dead trees)—both small and large—from either drought/native-beetles or fire, or the fact that many of these species are now at risk due to habitat loss and destruction from fire suppression and the logging of this “snag forest habitat”. While they advocated for widespread logging of snag forest habitat, and generally described snag forest habitat mainly as “fuel” and commodities, it is important to bear in mind that their position is strongly at odds with the overwhelming and growing consensus of scientists who oppose snag forest logging as one of the most ecologically destructive of all forest management practices. The vast majority of ecologists see this rare and unique forest type as highly important wildlife habitat, not “fuel”. For example, in September of 2015, over 260 scientists sent a letter to President Obama and Congress opposing proposals to conduct more snag forest logging on federal public lands, noting that “‘complex early seral forest,’ or ‘snag forest,’ is quite simply some of the best wildlife habitat in forests” (<http://johnmuirproject.org/wp-content/uploads/2015/09/Final2015ScientistLetterOpposingLoggingBills.pdf>).

Moreover, while the Forest Service representatives at our July 11th meeting repeatedly advocated for the logging of snag forest (with retention of some “clumps” of snags, interspersed in the clearcuts) and subsequent creation of tree plantations, and promoted these logging policies ostensibly as “heterogeneity” and “resilience”, the 262 scientists who wrote the September 2015 letter specifically

rejected this claim as unscientific. The scientists concluded that this “unique habitat [snag forest habitat] is not mimicked by clearcutting”, and pointed out that snag forest habitat “is the least protected of all forest habitat types, and is often as rare, or rarer, than old-growth forest”. Further, they noted that the published science strongly indicates that logging destroys snag forest habitat, severely harms natural forest regeneration, and often increases, rather than decreases, future fire intensity. This enormous disconnect between the strong weight of scientific opinion, on the one hand, and the advocacy for snag forest logging by Forest Service representatives, on the other hand, underscores the importance of your staffs’ promise at our July 11th meeting to ensure that, in the future discussions with scientists at your offices on this issue, the representation will be greatly broadened to better reflect existing scientific opinion and expertise.

Given the skewed nature of the July 11th meeting, in terms of scientific representation, and the resulting constraints on responding to the many statements made by Forest Service representatives, in this memorandum I will briefly respond to several scientific mischaracterizations made by Forest Service staff at the meeting.

Snags and Fire Severity/Spread

At several points during our July 11th meeting, Forest Service representatives stated that the scientific studies which conclude that snags do not increase fire severity are from lodgepole pine and subalpine forests in the Rocky Mountain region, and do not apply to mixed-conifer and ponderosa pine forests in California. Forest Service representatives further claimed that, even if there is no short-term increase in fire severity where there are higher snag levels, there will be an increase in future years as snags fall. Both of these statements are strongly contradicted by existing empirical studies.

There are three empirical studies that have investigated the effects of actual fires in areas with known pre-fire snag levels from recent drought and bark beetles, and which pertained to ponderosa pine and mixed-conifer forests. The first, Bond et al. (2009), which I co-authored, was conducted in mixed-conifer and ponderosa/Jeffrey-pine forests of the San Bernardino National Forest in southern California, where fires occurred immediately after a large pulse of snag recruitment from drought/beetles. Bond et al. (2009) “found no evidence that pre-fire tree mortality influenced fire severity”.

The second, Hart et al. (2015), which was published in the Proceedings of the National Academy of Sciences, investigated whether there is a relationship between snag levels from drought/beetles and the rate of fire spread in conifer forests across the western U.S., including ponderosa pine-dominated forests of California. Hart et al. (2015) found the following:

“Contrary to the expectation of increased wildfire activity in recently infested red-stage stands, we found no difference between observed area and expected area burned in red-stage or subsequent gray-stage stands during three peak years of wildfire activity, which account for 46% of area burned during the 2002–2013 period.”

In other words, in both the initial stage of snag recruitment, when dead needles are still on the trees (“red-stage”), and in the later stage, years later, after needles and some snags have fallen (“gray-stage”), fire did not spread faster or burn more area in forests with high levels of snags from drought and native beetles. This was also true specifically in ponderosa pine forests, where there was no significant effect

on fire spread of tree mortality from drought/beetles, and where fire spread was nearly identical regardless of snag levels (see Hart et al. 2015, Figure 3D).

The third, Meigs et al. (2016), was conducted in mostly mixed-conifer and ponderosa pine forests of the Pacific Northwest (south to the California border), and found the following:

“In contrast to common assumptions of positive feedbacks, we find that insects generally reduce the severity of subsequent wildfires. Specific effects vary with insect type and timing, but both insects decrease the abundance of live vegetation susceptible to wildfire at multiple time lags. By dampening subsequent burn severity, native insects could buffer rather than exacerbate fire regime changes expected due to land use and climate change.”

Specifically with regard to the mountain pine beetle, a native species associated with the current snag recruitment in California’s ponderosa pine and mixed-conifer forests, Meigs et al. (2016) found that fire severity was the same between stands with high levels of snags from drought/beetles and unaffected forests, when fires occurred during or immediately after the pulse of snag recruitment, and then fire severity consistently **declined** in the stands with high snag levels in the following decades (see Meigs et al. 2016, Figure 3a).

Ken Pimlott, Director of CalFire, recently stated that he does not dispute this science (<http://www.sandiegouniontribune.com/news/2016/jul/25/california-gov-wildfire-prevention-strategies/>). Yet the State of California continues to disseminate information—web-based and otherwise—claiming that snag patches substantially increase fire intensity and spread, and the Governor’s emergency proclamation, which makes this same incorrect assertion, has not been withdrawn or modified. Nor has the State withdrawn the proposal, which is promoted on this same incorrect basis, to facilitate widespread logging of recent snags across vast areas of public forestlands in remote “Tier Two” forests (forests that are not immediately adjacent to roads, powerlines, and homes).

Actual Spatial Extent and Degree of Snag Forest Habitat

At the July 11th meeting, the Forest Service representatives, without citing to any scientific sources, claimed that the current amount of snag forest habitat (forest habitat dominated by snags, downed logs, shrubs, and young regenerating trees, rather than by live, mature trees) in Sierra Nevada forests is “unprecedented”, due to the combination of the 66 million new snags since 2010 from drought/beetles, and recent fires like the Rim fire. This is inaccurate. The Forest Service’s GIS data regarding the 66 million new snags in unburned forests shows that 193,761 acres have over 50 snags per acre (http://www.fs.usda.gov/detail/r5/forest-grasslandhealth/?cid=fsbdev3_046696), or about 1.4% of the 14 million acres of conifer forest in the Sierra Nevada management region (<https://www.wildlife.ca.gov/Data/CWHR>) (see Figure 1 below). However, as discussed below, and as shown in Appendix A, the Forest Service’s mapping is very coarse, and perhaps half of these 193,761 acres have little or no recent snag recruitment (i.e., they are comprised almost entirely of live trees), so the actual area of snag forest habitat in these unburned forests is likely closer to 100,000 acres—less than 1% of the conifer forests in the Sierra Nevada management region.

These are the areas wherein a large proportion of the trees are snags, though it must be noted that the snags can be as small as about 6 or 7 inches in diameter, so it is a mix of small and larger snags, interspersed with groups and patches of live trees. There was only a nominal area of unburned forest with over 50 snags per acre during the earlier years of the Forest Service's aerial monitoring program.

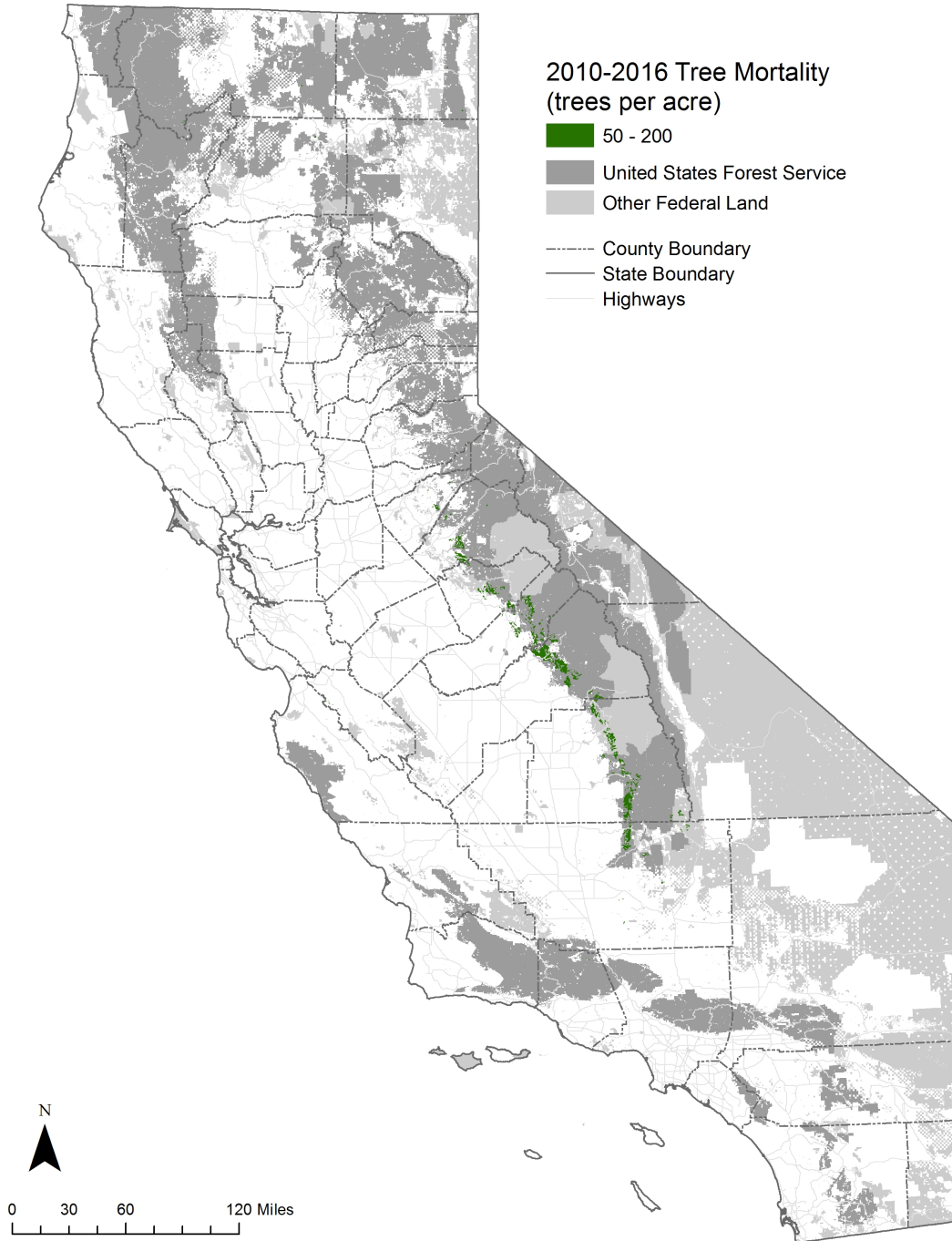


Figure 1. Snag forest habitat created by drought and native beetles in unburned forests of the Sierra Nevada management region from 2010 through June of 2016.

With regard to post-fire habitat, estimates vary slightly to moderately depending on which forest GIS data set is used (e.g., <https://www.wildlife.ca.gov/Data/CWHR>), and the tree mortality threshold chosen to define high-severity fire (www.mtbs.gov), but there have been approximately 2.3 million acres of wildland fire in conifer forests of the Sierra Nevada since 1984, and approximately 25% of this, on average, has been high-severity fire (www.mtbs.gov). Thus, there have been approximately 575,000 acres of snag forest habitat created by fire since 1984 in the Sierra Nevada. A substantial portion of this has been clearcut after fires over the years, and this practice continues on both private lands and national forest lands. Leaving this issue aside for the moment, if none of the 575,000 acres of snag forest habitat created by fire had been subjected to post-fire logging, and if we add the acres of unburned snag forest habitat created in recent years in the Sierra Nevada forests, a little under 800,000 acres of snag forest were created by fire or drought/beetles since 1984. Again, much of this has been removed by snag forest logging practices on private and public lands, but even if this had not occurred, these 800,000 acres would represent less than 6% of the approximately 14 million acres of conifer forest in the Sierra Nevada management region (due to snag forest logging practices on public and private lands, snag forest habitat actually comprises only about 3-4% of Sierra Nevada conifer forests--see <http://data.fs.usda.gov/geodata/edw/datasets.php>).

Historically, estimates of the proportion of snag forest habitat (complex early seral forest) generally ranged from 14% to 20% of conifer forests of the Sierra Nevada. For example, Show and Kotok (1925) estimated that one acre out of every seven on average was in this habitat type in the early 20th century. Based on numerous fire history studies that investigated the historical rate of high-severity fire, over the course of a century about one-third (or more) of the forest experienced high-severity fire (Table 1). It takes approximately 35-45 years typically for a stand of conifers in the Sierra Nevada to transition from early successional conditions to mid-successional forest (e.g., from seedlings to dominant trees of more than 9 inches in diameter) (Hanson and Odion 2016a, Figure 2). Therefore, over the course of a century, historically, while a third or more of the forest would experience high-severity fire, most of the high-severity fire areas in the first 50-60 years of the century would have naturally regenerated and transitioned to mid-successional forest by the end of the century, such that about 14% of the forest would on average be comprised by complex early seral forest at any given time, if we base estimates on the more conservative figures in Table 1 below. If estimates are based on studies reporting somewhat higher rates of historical high-severity fire in Table 1 below, then higher proportions of the forest landscape would have been comprised by complex early seral forest at any given time.

Table 1. High-Severity Fire Comprised a Substantial Portion of Historical Mixed-Conifer, Ponderosa Pine, and Fir Forests in the Sierra Nevada and Cascade Regions

Study	% High-Severity	Time Period
Bekker & Taylor (2001)	52-63%	75 yrs
Beaty & Taylor (2001)	18-70%	43 yrs
Baker (2014)	31-39%	110 yrs
Hanson & Odion (2016a,b)	22%	60 yrs

Therefore, based on the foregoing, current amounts of complex early seral forest, or “snag forest habitat”, from drought and native bark beetles, and fire, are not in excess of the upper bounds of the natural range of variation in Sierra Nevada forests and, in fact, are unnaturally low, consistent with findings that forest bird species associated with this habitat type are now rare and/or declining in population significantly more than birds associated with unburned or low-severity burned forest (Hanson 2014). Even if the amount of snag forest habitat created by drought and native beetles doubles in the next few years, we will still likely not have as much of this habitat type now as we did historically, and forests of the Sierra Nevada will still be overwhelmingly dominated by mature forest comprised mainly of live trees with varying levels of snags. The main change in these forests—those dominated by live trees—is that a substantial portion of them will have much healthier levels of snags, ecologically, than they did previously, due to the recent pulse of snag recruitment.

For example, the California Spotted Owl depends on dense, old forests with about 30 to 55 square feet per acre of snag basal area (about 10 to 40 medium to large snags per acre, depending on the size of the snags) for nesting and roosting habitat (Verner et al. 1992) (http://www.fs.fed.us/psw/publications/documents/psw_gtr133/psw_gtr133.pdf; see also Vol. 3, Chapter 3, p. 73 of the Final EIS for the 2001 Sierra Nevada Forest Plan Amendment), and often even higher levels for foraging habitat (Bond et al. 2009), because snags and downed logs (after the snags fall to the ground) create excellent habitat for the owl's small mammal prey species (Bond et al. 2013) (<http://www.wildnatureinstitute.org/spotted-owl.html>). The U.S. Fish and Wildlife Service has determined that Endangered Species Act (ESA) listing of the owl may be warranted due in part to threats from logging of snags. The rare Black-backed Woodpecker depends upon areas with at least several dozen snags per acre—primarily in post-fire habitat—in order to have enough food to survive, since the birds feed on the larvae from native wood-boring beetles found mainly under the bark of dead trees in fires (Tingley et al. 2014) (<http://www.birdpop.org/pages/blackBackedWoodpecker.php>). The U.S. Fish and Wildlife Service has also determined that this woodpecker species might need to be listed under the ESA due to habitat loss from logging of snags. The mink-like Pacific fisher, a Sensitive Species, depends upon forests with an average of 31 square feet per acre of snag basal area for resting habitat (Purcell et al. 2009) (<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.665.4928&rep=rep1&type=pdf>), which translates to approximately 10 to 25 snags per acre (e.g., a snag 14 inches in diameter has about 1 square foot of basal area, and a snag 24 inches in diameter has just over 3 feet of basal area).

Even Within the Largest Patches of Highest Snag Recruitment from Drought/Beetles, There Are Still Many Live Trees of All Sizes, and There is High Natural Heterogeneity

At the July 11th meeting, one of the Forest Service’s representatives claimed that the largest patch of recent snag forest habitat from drought and native beetles was a 20,000-acre area with not a single remaining live tree, and used this assertion to advocate for intensive snag forest logging followed by creation of tree plantations. This is not inaccurate. On July 14th, I surveyed the largest patch of highest snag recruitment, which is the green patch in Figure 1 above on the western side of Sierra National Forest, northeast of Fresno (and west, northwest, and southwest of Shaver Lake). Contrary to the Forest Service’s claims about 100% tree mortality and homogenous type conversion to non-forest, I instead found a highly heterogeneous, complex and rich forest ecosystem. Within this area, there is a highly

variable mix of conditions. In some sites most of the overstory trees are snags, and all of the overstory trees are snags in some highly localized spots, while immediately adjacent to such areas are sites with little or no mortality of overstory trees. Still other sites have a fine-scale mix of live trees and new snags. What's more, even in the localized sites with the highest levels of overstory tree mortality—i.e., highest recruitment of large snags—there is generally little or no mortality of the conifer seedlings, saplings, pole-sized trees, and many lower/mid-canopy conifers, and such understory trees are healthy and growing vigorously, with deep green needles and abundant new (2016) growth. These conditions are not consistent with type-conversion away from conifer forest but, rather, are consistent with a large occurrence of initiation of new forest stands, and increased heterogeneity and complexity in forests that were previously quite homogeneous mature forest with moderate/high canopy cover and few snags.

If these areas are not logged, the existing data indicate that they may well represent an enhancement in overall habitat conditions for species such as the California Spotted Owl and Pacific Fisher, since some nesting/roosting (owl), and denning/resting (fisher), habitat that previously was deficient in snags now has healthy snag levels, while still retaining sufficiently high canopy cover, juxtaposed to sites now dominated by snags, downed logs, shrub patches, and regenerating conifers and oaks—structural conditions which represent outstanding foraging habitat for both owls and fishers (Bond et al. 2009, Hanson 2013, Hanson 2015). If these snag forest habitat areas are not logged, they will certainly benefit the many shrub and cavity-nesting birds that are declining in population in the Sierra Nevada (Hanson 2014).

Moreover, if the Forest Service implements its proposal to essentially clearcut these snag forest habitat areas (while leaving some small groups of snags here and there, interspersed in the clearcuts, as they suggested) and create tree plantations, the ground-based logging would kill nearly all of the currently vigorous understory growth of conifers, and would convert a rich, complex, heterogeneous habitat into a series of sterile tree farms. Selling such enormous amounts of timber from public forestlands to private logging companies, and retaining the revenue, would of course benefit the Forest Service, but it would destroy these ecologically important forest ecosystems. Moreover, the assertion by the Forest Service's representatives—that “salvage” logging and tree plantation establishment will reduce future fire intensity ostensibly by removing “fuels”—is simply not scientifically credible, as the evidence indicates that such logging, and the plantations that follow, generally tend to increase future fire intensity, since plantations often burn very hot, fueled further by residual logging slash debris, and highly combustible invasive weeds that are heavily spread and increased by “salvage” logging (see, e.g., Odion et al. 2004, Thompson et al. 2007, McGinnis et al. 2010).

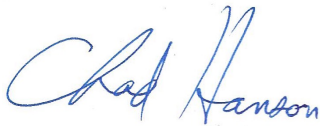
In Appendix A (attached), I have included a series of representative photos of the heterogeneous conditions within this patch of snag forest, which is the largest patch of highest tree mortality, from recent drought and native beetles, mapped by the Forest Service in the entire Sierra Nevada.

Please try to keep in mind that the current science is telling us, loudly, that these snag forest habitat patches are not losses of forests—they *are* forests. What is it about an old-growth forest that appeals to us? They are rich in wildlife and biodiversity, they are complex, and numerous imperiled wildlife species depend on them—at least in part—for their survival. The very same thing is true of snag forest habitat.

When we come upon a large patch of old forest, thousands of acres in size, we rejoice because we now understand its value beyond commodities. Why do we not do the same when we find a large patch of snag forest habitat, especially given that, even after recent large fires and drought, we still have far, far less snag forest habitat than old forest in the Sierra Nevada? Fundamentally, it has to do with the deep-set cultural misunderstandings about snag forest habitat, exacerbated by powerful financial incentives of land management agencies with commercial logging programs to demonize and misrepresent this habitat and advocate for clearcuts and tree plantations. If this is allowed, it would not only remove enormous amounts of carbon from our forests, and pump much of that carbon into the atmosphere through biomass burning, exacerbating human-caused climate change, but would also further threaten many native wildlife species that benefit from snag forest habitat and do not have enough habitat to maintain their populations.

Please let me know if you have any questions. Thanks.

Sincerely,

A handwritten signature in blue ink that reads "Chad Hanson". The signature is fluid and cursive, with the first name "Chad" being larger and more prominent than the last name "Hanson".

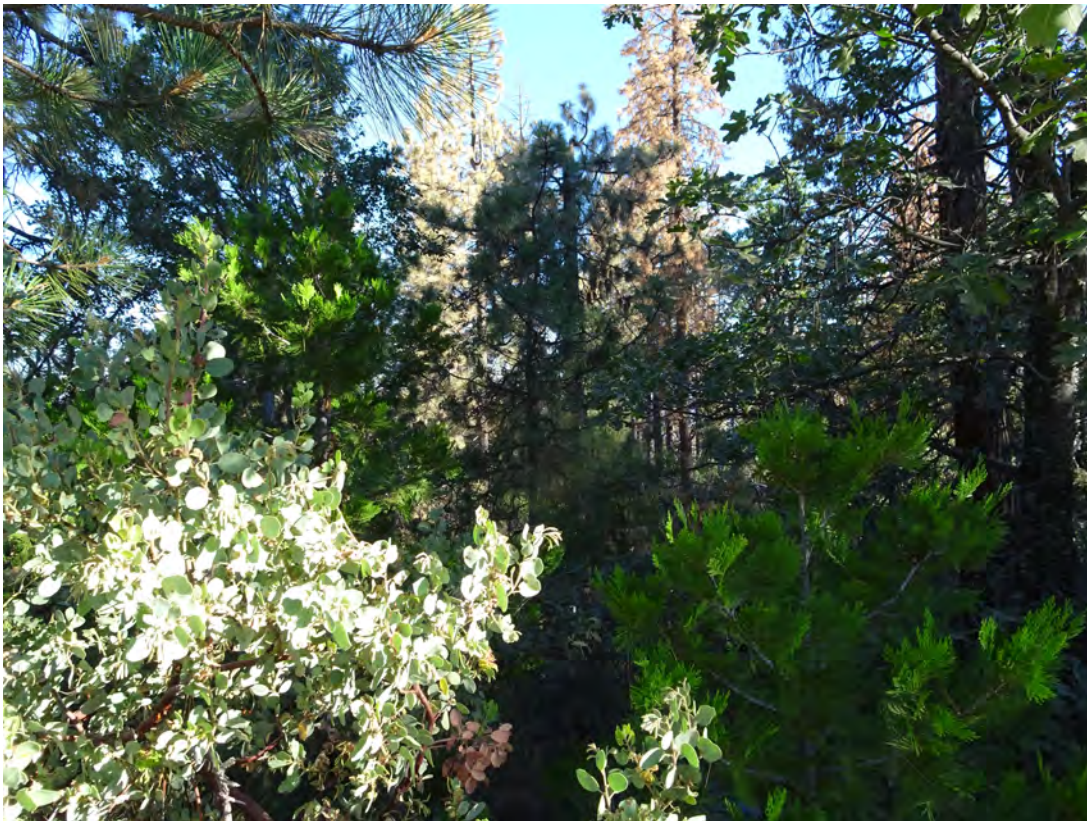
Chad Hanson, Ph.D., Research Ecologist
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Note: Most of the citations to sources in the text above are available at www.johnmuirproject.org, and all are available upon request.

Appendix A
Shaver Lake Unburned Snag Patch
July 2016



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