The Myth of “Overgrown” Forests

Claims by the Trump Administration, some Congressional leaders, and the logging industry that our forests are “overstocked” is misleading and scientifically inaccurate.

With the false narrative that federal public forests are “overgrown” or “overstocked” (i.e., too dense), logging advocates are promoting a series of logging bills which would severely weaken federal environmental laws. These legislative proposals would dramatically increase commercial logging levels ostensibly to “restore” natural forest density, and reduce “fuels” to prevent large, intense wildland fires. Each of these claims are strongly contradicted by the best available science.

Science shows that our forests are considerably less dense than they were historically.

McIntyre et al. (2015)\(^1\) compared two data sets from thousands of field plots surveyed in the 1920s and 1930s to a modern data set conducted throughout California’s forests and found that current forests are 19% less dense than historical forests in terms of live tree “basal area”, which is essentially the overall amount of tree mass present. Current Sierra Nevada forests are 30% less dense in live tree basal area than there were historically. This makes sense when one considers that, since 1850, many forests have been repeatedly subjected to varying forms of logging, removing a moderate to large portion of the live tree basal area.

\(^1\) McIntyre, P.J. et al. 2015. Proceedings of the National Academy of Sciences of the USA 112: 1458-1463.

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Baker and Hanson (2017)\textsuperscript{2} analyzed century-old U.S. Forest Service records obtained from the National Archives and found that historical forests were two to three times denser than recent Forest Service studies assume. The Forest Service based their estimates on early 20\textsuperscript{th} century surveys that used transects 132 feet wide and one-quarter mile long. None of the Forest Service studies acknowledged that these early 20\textsuperscript{th} century surveys were based on visual estimates of the transect widths, and that the surveyors were consistently underestimating the width of the transects and dramatically underestimating the true forest density.

\textit{“We continued to travel through the forest, in which the road was rendered difficult by fallen trunks, and obstructed by many small trees, which it was necessary to cut down...A laborious day, which had advanced us only six miles...”}

October 21, 1845, Expedition of Jon C. Fremont and Kit Carson, Blue Mountains, Oregon

\textit{“The trail passed sometimes through very thick young timber, in which there was much cutting to be done; but, after travelling a few miles, the mountains became more bald...”}

October 22, 1845, Expedition of Jon C. Fremont and Kit Carson, Blue Mountains, Oregon

Recent research based on field data gathered in the 1800s by surveyors with the U.S. General Land Office (now the Bureau of Land Management) finds that tree density in historic ponderosa pine and mixed-conifer forests and forests of the southwestern U.S. was highly variable. There were many areas of moderately dense to very dense forest, naturally regenerating after mixed- and high-intensity fires.\textsuperscript{3} These findings were corroborated by dozens of historical sources, and modern reconstruction studies of historical forests, and were more extensively accuracy-checked than any other dataset on this subject in scientific history.

Nor were historical forests dominated by large trees, as is often incorrectly assumed. Baker and Williams (2015)\textsuperscript{4} found that historical forests, in dry mixed-conifer and ponderosa pine forest types, included diverse tree sizes and species, and that $52 - 92\%$ of the trees were less than about 16” in diameter which, together with medium and large trees, provided landscape heterogeneity and resilience to different disturbance events.

\textit{Long-unburned forests with the highest live tree basal area burn mostly at low and moderate intensities.}

The proponents of these logging bills claim that, after a century of fire suppression, our forests are too

\textsuperscript{2} Baker, W.L., and C.T. Hanson. Ecosphere 8: Article e01935.


dense and overstocked to allow fires to safely occur. They say that fires will burn far too intensely, and that millions of forest acres must instead be intensively logged. However, the scientific studies that have investigated this question have consistently found this assumption to be untrue. These long-unburned forests do not burn more intensely than other areas, generally because they have higher forest canopy cover, creating more cooling shade, which keeps forest floor material moister. Also, in forests with high density and high canopy-cover that have not burned in decades, relatively little sunlight reaches the forest floor, so many lower branches, small trees, and shrubs in the understory die back and diminish, making it harder for crown fire to occur. For these reasons, empirical research shows that high levels of pre-fire forest biomass (higher forest density) is not an important predictor of higher fire intensity, when fires occur—weather conditions is by far the most important variable.

In contrast, forests that are subjected to a typical “fuels reduction” logging project have increased wind speeds and sun exposure, without the shade and shelter provided by the high forest canopy cover. Hotter, drier, and windier conditions allow fires to spread more quickly and burn more intensely.

It is common for very dense forests to burn at low-intensity in summer wildland fires. Prior to being restored by the Star fire of 2001 on the Eldorado National Forest in the Sierra Nevada, this forest had not burned in at least several decades. Photo by Chad Hanson, 2002.

Broad assumptions that denser forests are stressed and are susceptible to high levels of disease and tree mortality from native insects are not supported by science.

Ganey and Vojta (2011), for example, expected that drought and beetle induced tree mortality would be highest at lower elevation sites which are already warmer and drier, but instead found that tree mortality in Southwestern U.S. forests was not strongly related to either elevation or stand density and was spatially variable. They acknowledged that it was unclear if reducing tree density would effectively reduce mortality in periods of severe drought. Cochran and Barrett (1995) examined ponderosa pine stands and found that, even at high stand density levels, “there was no apparent correlation between stand density and mortality”. Efforts to reduce overall tree mortality through logging (e.g., “thinning”) typically ends up killing more trees than it prevents from dying (Six et al. 2014).

Oliver (1995) found that, as relatively young ponderosa pine stands grew older and reached very high stand density levels, native beetles reduced stand density by only about 13-20%, after which stands gradually get denser once again, and so on. The stands do not experience high levels of tree mortality, as is often incorrectly assumed. Similarly, Oliver (2005) found that young ponderosa pine forests that grew to very dense levels subsequently experienced tree mortality of only 17% of the basal area. Oliver (2005) noted that tree mortality levels “declined over the years” as the forests grew older and denser. Cochran and Barrett (1999) found that ponderosa pine stands go through a period of moderate tree mortality from competition and native beetles when they are of intermediate age but, after about 85 years of age, annual tree mortality in these stands drops to near zero, even as they continue to grow denser.

The reality is that forests can naturally experience brief periods of significant “snag recruitment” during major droughts, but this is not caused by dense forest conditions. Even when such snag recruitment events occur, many live trees are always mixed with the new snags, creating excellent habitat heterogeneity. For example, over a decade ago there was a significant snag recruitment event across 1.5 million acres of lodgepole pine forests in Colorado, and much mythology and misinformation quickly arose about large swaths of forest being “lost”. However, Rocca and Romme (2009) surveyed these areas, and largest patch of forest that they could find with no live trees was only about 1 acre in size. The same is true in the ponderosa pine and mixed-conifer forests of the Sierra Nevada, which recently experienced a significant pulse of snag recruitment in the some areas of the western slope of the southern part of the range—even in the areas mapped as having the very highest levels of tree mortality, many live trees are interspersed among the new snags, as the images below demonstrate.

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One of the areas mapped by the U.S. Forest Service as having the highest levels of recent tree mortality from drought and native bark beetles in the southwestern Sierra Nevada. Notice the abundance of live trees amongst the new snags.

**Dense forests naturally self-thin. This healthy tree mortality creates critical structural forest complexity for wildlife, builds soil integrity, and enhances forest resilience.**

Zachmann et al. (2018)\(^{14}\) found in the Tahoe Basin that both managed and unmanaged areas were moving in a similar direction in that both are experiencing declines in forest density, both are increasing the average size of individual trees, and downed woody material is decomposing and diminishing in most size classes. The number of large trees increased in untreated areas but decreased in treated (logged) areas. They suggest that untreated and long-unaltered areas are “self-thinning” and naturally recovering from decades of resource extraction and fire suppression. Letting natural processes occur in our forests as they have for thousands of years creates landscape heterogeneity, helping to maintain our full compliment of native biodiversity, and improves forest resilience in the face of climate change. Potter (2017)\(^{15}\) analyzed forest stand mortality from aircraft surveys over the central and southern Sierra Nevada and found that on all sites, for all species, most of the tree mortality was comprised of smaller trees, less than 18 inches in diameter.


A patch of snag forest habitat (left), naturally regenerating 12 years after high-intensity fire; and Black-backed woodpeckers (right), which depend on snags, and snag forest habitat, for both food and homes.

Contrary to common misconceptions, we do not currently have an overabundance of “snag forest habitat” compared to historical levels

Snags, or standing dead trees, and downed woody material are critical forest ecosystem components that are largely eliminated when forests are targeted for so-called “fuel reduction” logging. Despite recent native beetle and wildfire activity in the Sierra Nevada, for example, snag forest habitat—patches of forest composed mostly of snags—is still rare at the landscape scale, and comprises only about 6% of the forests of the Sierra Nevada, whereas this unique habitat comprised 14-30% of Sierra Nevada forests historically, before fire suppression (Hanson 2017). Though it may seem counter-intuitive to some, these patches of “snag forest habitat”—whether they are created by fire or by drought and native insects—are “ecological treasures”, not catastrophes, according to a broad consensus of hundreds of U.S. scientists (http://johnmuirproject.org/wp-content/uploads/2015/09/Final2015ScientistLetterOpposingLoggingBills.pdf). In fact, snag forest habitat supports levels of native biodiversity and wildlife abundance that is comparable to old-growth forest (DellaSala and Hanson 2015) (https://www.elsevier.com/books/the-ecological-importance-of-mixed-severity-fires/dellasala/978-0-12-802749-3).


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