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Concerning

Climate Change and Public Lands: Examining Impacts and Considering Adaptation Opportunities

I am Dr. Elaine Oneil, a forest scientist and management consultant specializing in forest health, climate change, and forest carbon accounting. My comments are focused on research I conducted while at the University of Washington that examined the impacts of climate change on forest carbon in the 11 western states. Key results from that research, combined with data on wildfire impacts, forest management, and regional forest health strategies will be used to provide context for the comments.

Commentary can be categorized into four main themes:

1.	Forests are suffering from too many trees for the site and extant climate conditions. Overstocking creates conditions that kill trees. That mortality combined with wildfire has changed the calculus for defining the optimal strategies for climate mitigation and adaptation in forests.
2.	Management provides for improved firefighting capability and improved forest carbon outcomes in nearly every forest type across the 11 western states.
3.	Wildfire ignition is random, but the consequences of wildfires are driven by forest cover conditions, climate, and prevailing weather patterns. Forests that have too many trees, and which contain large amounts of dead trees, produce conditions for wildfires that are uncontrollable, with devastating consequences to the forest, the adjacent landowners and communities, and the budgets of land management agencies.
4.	Like any other potential natural disaster, wildfire mitigation demands a response. Letting nature take its course is not supported by the science of forest carbon dynamics.

Forest Carbon Primer

Trees remove carbon dioxide from the atmosphere using photosynthesis to produce wood, roots, needles, leaves, and branches. Carbon is also released via respiration, either directly from the plant, or indirectly via decomposition or combustion pathways. Growth, and therefore carbon accumulation in forests is constrained by limiting factors that range from climatic parameters driving growing season, moisture and temperature conditions, to nutrient availability, competition, and species growth habit and longevity. There is some variability in carbon content between tree components and species but on average trees are about 50% carbon by dry weight. This has led some to suggest that leaving forests to grow without management or interruption would be a sound climate solution. That is only true if you ignore biological principles that dictate forest growth and death, including site carrying capacity. And in our western forest landscapes where most of our public lands are located, that is only true if you ignore fire.

Forests are suffering from having too many trees for the site and extant climate conditions. Overstocking creates conditions that kill trees. That mortality combined with wildfire has changed the calculus for defining the optimal strategies for climate mitigation and adaptation in forests.

What we are seeing in the western US is an epidemic – of insects and disease and wildfires - brought on in large part by An Epidemic of Too Many Trees. That epidemic is summarized in a TED talk called the Era of Megafires and is described it in much greater detail in a hour long multimedia presentation that is available here. Wildfire data from the National Interagency Fire Center supports the idea that we are in an Era of Megafires. Their wildfire statistics show that the average acres burned since 2000 has doubled relative to the prior 4 decades, with 10 of the worst fire years on record occurring since 2000 (excluding 2018 data which is not available yet).

Every ten years a US forest inventory report (Resource Planning Assessment or RPA) is published that summarizes growth, harvest, and mortality by region, forest landowner, and forest type. Data are collected over a ten-year period, so the final numbers are more representative of an average for the 10 year period than a summary of the endpoint. These data show a four-fold increase in mortality on National Forests in the 40-year period from 1976-2016. Of total forest growth on National Forests about 2/3 is lost to wildfires, insects and disease (Figure 1). Wildfire is not the only mortality agent that is on the rise on federal lands. Insects and diseases are prevalent and their threat is growing (Littell et al 2010).

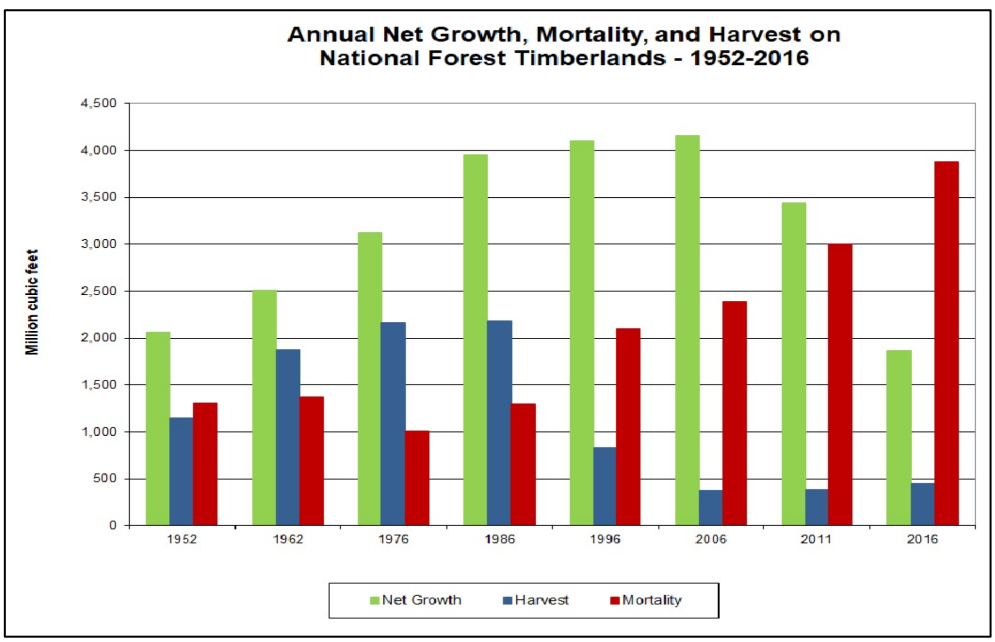

Figure 1 Growth, Mortality, and Harvest on National Forest Timberlands 1952-2016. Data provided by Oswalt et al. 2018.

The current rate of mortality is unsustainable. This may well lead to a tipping point wherein additional uncontrolled damage can be expected. It is doubtful that any one scientist or group of scientists has any idea where that tipping point is and what reaching it might cause. With policies and management approaches that pull us back from that brink by reducing risk and building resilience we can ensure that these forests remain a part of our heritage and serve a vital role as carbon sinks into the future.

Management provides for improved firefighting capability and improved forest carbon outcomes in nearly every forest type across the 11 western states.

Fire scientists who have studied the fire ecology of these systems for decades have long advocated for management action to mitigate fire risk and bring the forest condition into alignment with the fire ecology of the west (Agee and Skinner 2005, Skinner et al 2004). Fire impacts can be substantially reduced by thinning treatments that restore densities more like those observed before fire suppression was introduced. Multiple studies have shown that thinning reduces fire severity, sufficient for firefighters to gain control and maintain forest structure, tree seed source, and other values (e.g. Agee and Skinner 2005, Moghaddas 2006, Skinner et al. 2004). General principles of fire management based on long term research have been integrated into tools that can assess the impacts of fire and management for any combination of site, stand and climate conditions. These tools were used to model nine different forest management treatments on over 25,000 forest inventory plots in Arizona, California, Colorado, Idaho, Montana, New Mexico, Nevada, Oregon, Utah, Washington, and Wyoming. Results show that in most cases, managing forests created a more favorable forest carbon outcome (Figure 2b) than letting nature take its course (Figure 2a).

Figure 2 a) unmanaged forest with 100% mortality from wildfire and b) managed forest with jackpot burns to reduce fuel loads

Even better carbon outcomes are possible if harvested material is large enough to be used for solid wood products as the wood also stores carbon during its use phase (Oneil and Lippke 2010).

Research identifies how to mitigate climate impacts at both the stand and landscape level. In dry forests it starts with greatly reducing the number of trees, keeping fire resistant species, and interrupting fuel ladders so that fires don't spread as easily (Moghaddas 2006). Across the west, this treatment method has been proven to keep forests alive when wildfires hit. It can be easily replicated across the landscape using a systematic approach that considers adjacent landowners, in order to create a patchwork of defensible space that is more akin to historical natural conditions on our forests.

Under future climate conditions which predict longer, drier, hotter, summers (Littell et al 2010, McKenzie et al 2004) we can expect regeneration failure in burned forests, which will push these forests towards being a net carbon source. Mitigation measures include thinning the forests to prevent the loss of all trees and to reduce the fire impacts on soils somewhat so that successful regeneration is more likely. By thinning we also are building resilience into the existing trees, and ideally choosing the specimens and species that we think can survive and perpetuate on these landscapes.

Wildfire ignition is random, but the consequences of wildfires are driven by forest cover conditions, climate, and prevailing weather patterns. Forests that have too many trees, and which contain large amounts of dead trees, produce conditions for wildfires that are uncontrollable, with devastating consequences to the forest, the adjacent landowners (Figure 3) and communities, and the budgets of land management agencies.

Coordination across landowners is required. So is infrastructure that can handle the harvested material. Shared stewardship approaches like we have in Washington State, including use of the Good Neighbor Authority and local Forest Collaboratives, should continue to be supported and encouraged as a fundamental mechanism to move forward with keeping our public lands, and adjacent forest lands, healthy, fire resilient, and green.

Figure 3 Wildfire impacts on adjacent state and private forest land from ignition on public forest land

Like any other potential natural disaster, wildfire mitigation demands a response. Letting nature take its course is not supported by the science of forest carbon dynamics.

Jerry Franklin (ecologist) and Jim Agee (fire scientist) from the University of Washington offer their perspective on the need for a rationale national forest policy that incorporates ecology, fire science, known benefits of treatment and social benefits. Their perspective is that “Letting nature take its course in the current landscape is certain to result in losses of native biodiversity and ecosystem functions and other social benefits…” (Franklin and Agee 2003).

Other social benefits include smoke free summers. Emissions from wildfires are not inconsequential. In addition to the large amounts of carbon dioxide released, there are also releases of methane, nitrous oxides, and volatile organic carbons which are all potent greenhouse gases that have a greater atmospheric impact than the release of carbon dioxide alone (Wiedinmyer and Neff 2007). The net result is that emissions from wildfires can produce higher carbon dioxide equivalent values than the total equivalent carbon dioxide equivalent (CO_2e) content of the biomass that is consumed (data analysis of factors in Weidinmyer et al 2006). This means that a 20% reduction in forest carbon stocks from wildfire generates more than a 20% increase in CO_2e in the atmosphere.

Summary

We have experienced two decades of unprecedented mortality in our western forests, and much of that mortality is concentrated on federal lands. In some states, mortality on public forests has reached a point where they are now emitting carbon rather than sequestering it thus exacerbating our current greenhouse gas emissions profile. Forest health treatments that reduce tree density, create canopy discontinuities, and open patches will become both the climate mitigation and adaptation strategy on these forests. They will also more closely replicate historical forest conditions. Letting forests die and burn in anticipation that the past will replicate itself in a future with large uncertainties around climate conditions is a high-risk approach.

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