February 28, 2021

RE: Comments on the Public Comment Draft: Greenhouse Gas Emissions of Contemporary Wildfire, Prescribed Fire, and Forest Management Activities (December 2020)

Ms. Anny Huang
Manager of the Emission Inventory Analysis Section
California Air Resources Board
1001 I Street, Sacramento, CA 95814
Sacramento, CA

Dear Ms. Huang and Air Quality Planning and Science staff,

We appreciate the effort to capture and explain the important information in the draft Greenhouse Gas Emissions of Contemporary Wildfire, Prescribed Fire, and Forest Management Activities Report (draft Report) as we grapple to understand the natural ecological processes and anthropogenic effects to the human environment that define our past and present California landscape. By better defining the processes and effects that shape our landscape, we can improve and stabilize California's fire and forest environment.

1. Meeting the legislative requirements of SB 901 (Dodd) 2018

The charge directed by Senate Bill SB 901 (Dodd) 2018 is a comprehensive one that should take into full account the potential emissions from wildfire, prescribed fire, and forest management activities. In terms of examining the carbon implications of forest management, it is critical that the Emissions Inventory Analysis be comprehensive and investigate all aspects of carbon emissions and capture (short-and-long term carbon stability; above ground and below ground emissions potential; reforestation and plantation survival; life cycle functions of wood products, etc.).

Based on the language in the State Senate Bill (SB 901)[1] it is important that a rigorous analysis of soil carbon loss be conducted as part of the emissions inventory. On two occasions in the

---

[1] **SEC. 4.**

Section 38535 is added to the Health and Safety Code, to read:

38535. The state board, in consultation with the California Department of Forestry and Fire Protection, shall develop all of the following:

recent history of development of the State's Forest Carbon Action Plan (May 2018) and this 2020 draft emissions monitoring report, it was made clear that despite research on monitoring carbon loss in forest soils (Lacroix 2016: Gershenson et. al. 2010; Smith et al. 2019, Chenyang et al. 2020; Post et al. 2001; Achat et al. 2015; Buckholz et al. 2016; James and Harrison 2016; Palmer et al. 2012; Vanguelova et al. 2016) and the clear statement of importance for retention of soil carbon in Governor Newsom's recent Biodiversity Executive Order N-82-20, that soil carbon loss related forest management is not being considered:

> ("These estimates do not include soil carbon" p.ii),

It is arbitrary and highly inconsistent for the Governor to praise the need for soil carbon retention in agriculture (in the Biodiversity Executive Order N-82-20), which will require monitoring and evidence to be valid, and then for CARB to ignore various forest management practices effecting below ground root material and soil organic matter that contribute to forest carbon stability and emissions. These practices occur on significant acreage throughout the Sierra Nevada and elsewhere where logging is followed by extensive site preparation (see below).

Failure to address soil organic material and below ground carbon stability (where roughly 50% or more of the overall carbon profile is located) will present an incomplete picture of forest carbon stability and will fail to identify factors related to timber harvest and site preparation that can contribute significant carbon sourcing. Recent soil carbon research states:

> "Forest harvest has been shown to cause major changes in soil C pools. Soil is the world's largest terrestrial C pool (Davidson and Janssens, 2006; Jobbagy and Jackson, 2000; Schlesinger and Bernhardt, 2013). There is approximately three times as much C in soils than in aboveground biomass and twice as much as in the atmosphere (Eswaran et al., 1993)." (in Lacroix et al. 2016).

2. Site Preparation must be considered and analyzed (See: Gershenson et. al. 2010 pg. 30)

Site preparation activities to clear land for new seedlings and improve soil fertility in the footprint of clear-cut harvests can have negative effects on overall carbon storage, as removal of debris and fertility enhancements create conditions favorable to microbial decomposition in soil

---

(a) A standardized system for quantifying the direct carbon emissions and decay from fuel reduction activities for purposes of meeting the accounting requirements for Greenhouse Gas Reduction Fund expenditures. This system may include standardized lookup tables by forest stand type, including for oak woodland forests, and harvest or other management prescriptions. The system shall acknowledge that certain expenditures, such as for planning, analysis, modeling, or outreach, will not have a direct greenhouse gas reduction benefit, but will facilitate necessary climate preparedness activities that will have direct greenhouse gas benefits.

(b) In consultation with academic experts, a historic baseline of greenhouse gas emissions from California's natural fire regime reflecting conditions before modern fire suppression. This shall be completed on or before December 31, 2020. The baseline may be included within the state board's natural working lands inventory.

(c) On or before December 31, 2020, and every five years thereafter, a report that assesses greenhouse gas emissions associated with wildfire and forest management activities.

carbon and increases in microbial decomposition of soil organic matter. (see Palmer et al. 2002; Gershenson, A., and Barsimantov, J., 2010).

Certain techniques, including the retention of soil cover on the forest floor, or converted to carbon in charcoal is more resistant to decomposition and is likely the primary reason for carbon accumulation following fire events (Kuzyakov et al. 2009). However, the intensity of site preparation, and therefore disturbance to soils, is generally correlated with increases in carbon losses (Jandl et. al. 2007), so the beneficial effects of converting biomass carbon into charcoal may be offset by disturbance to the site.

As with the case of harvest intensity, overall effects of site preparation on soil carbon are more negative with higher manipulation of the site. Ensuring that soil cover is left in place (or at a minimum converted to charcoal), reducing the amount of soil disturbance and mechanical mixing of forest floor-mineral soil, and making efforts to ensure that overall soil microclimate conditions do not change significantly, could minimize increases in microbial activity and soil carbon decomposition, dissolved organic carbon leaching, and soil erosion. Projects that involve plowing, deep ripping, or furrowing will result in soil carbon losses that may be mitigated by long-term (over 50 year) rotation schedules but should be avoided as some soil carbon loss may take much longer to be recovered. Figures 1-4 below illustrate examples of soil disturbance referenced here. Although some mechanical disturbance to the soil is inevitable as a result of harvest or site preparation activities, such disturbance should be minimized to ensure minimal soil carbon losses. In the recent Clean Development Mechanism of the Kyoto Protocol (CDM) Afforestation/Reforestation **guidelines for soil carbon management specify that such disturbance shall not exceed 10% of the project area**, which is an example of a conservation allowance for such disturbance and will likely result in significantly small soil carbon losses. See Appendix A below for images illustrating the extent and intensity of these practices in the Sierra Nevada.

Figures 1-4.

Figures 5-8 below illustrate several types of equipment used in site preparation in industrial forestry practice (to provide a general picture of ripping equipment). Many different equipment designs exist for site preparation, ripping, and sub-soiling throughout the world of forestry practice.

Figures 5-8.

The 2010 Climate Action Reserve's (CAR) paper titled ***Accounting for Carbon in Soils*** states, "Soil carbon accounts for 50-75% of all the forest carbon in temperate and boreal regions, so small changes in soil carbon can have significant influence on total ecosystem carbon storage."

The paper further states, "High disturbance site preparation activities, such as plowing, deep ripping, etc., will have significant negative effects on soil carbon, with losses as high as 30%, **and should be avoided**" (emphasis added). The type and residence time of soil carbon elements vary and range from short-lived (microbial biomass and labile root exudates), and medium-term materials, to decades to hundreds of years old materials (roots, trunks below ground), and ancient carbon (hundreds to thousands of years old) represented by (humins and humic acids), (CAR Report p.7).

Finally, the CAR Report p.11 states even though soil carbon stability and exchange is highly complicated and highly variable depending on a variety of factors, "current research suggests that one of the most critical components to successful soil carbon retention in forests is proper management, which reduces some types of disturbance, while actively encouraging processes that protect soil organic carbon from decomposition through both chemical and physical means."

The most extreme type of disturbance in industrial forest practice is deep ripping, plowing, furrowing, and sub-soiling disturbance in the top and mid-soil horizons. The physical disturbance to soils threatens remaining soil carbon stocks by accelerating rapid decomposition, allowing temperature increases, and breaking up soil aggregates all of which aid microbial decomposition (CAR Report p. 20).

While the 2010 CAR ***Accounting for Carbon in Soils*** report is not tailored specifically to California and some recommendations such as leaving significant logging slash post-harvest is not an appropriate soil carbon building strategy in the frequent-fire landscapes of California, the strong admonition to avoid and severely limit (to 10%) the amount of soil disturbance in the project area (subjected to ripping, plowing, sub-soiling, etc.) is emphatically repeated throughout the 47-page report.

The draft CARB Emissions Monitoring Report (December 2020) must consider the potential long-term soil carbon impacts to certain forest practices such as deep ripping, sub-soiling, plowing, and other practices utilized in industrial forestry as a part of routine site-preparation. It would be arbitrary to move forward validating or attempting to account for carbon loss or storage associated with forest management, including standard industrial forest practices, without examining the level of acres annually subjected to such site-preparation activities. California must not ignore soil carbon loss from post-harvest site disturbance associated with short rotation clear-cut forestry on one hand, while crediting such activities with any benefits, economic or otherwise, on the other. The lack of a comprehensive consideration of carbon stability in forest management activities is a current failure of the draft Emissions Monitoring Report to account for significant issues related to carbon storage and emissions - the very focus of major global, national, and state climate initiatives. This current failure must be addressed for California in particular, where we have been first to act to recognize, account for, and limit carbon emissions from all sectors to halt global warming.

Timber harvest records exist, inspections have occurred, and photos taken. Soil organic matter testing could have happened for some subset of the harvested landscape to at least demonstrate concern for the issue of loss of a critical C pool; conducting these tests and analyzing their findings must become a priority. Restating that soil carbon monitoring cannot be accomplished in the December 2020 GHG Emissions Monitoring Report, echoing claims from the 2018 Forest Carbon Action Plan, is unacceptable. Especially, in light of the information presented then and now, that it is possible to make estimates from study plots in similar soil types, elevations, climates, and practices.

3. Addressing the vulnerability of forest carbon stability associated with non-analog forest structural homogeneity.

The Forest Carbon Action Plan (May 2018) focuses on restoration of fire-excluded landscapes to limit carbon sourcing from wildfires and increase sequestration via increased carbon stability in frequent fire forests**. Looking at stand structure and associated fire risk that foster or limit ecosystem service is recognized in greenhouse gas protocols and cap-and-trade mechanisms, yet forest carbon is valued equally regardless of forest type (stand structure within or outside NRV for the specific landscape), an approach that fails to account for risk of carbon loss from disturbance in non-analog stand conditions" (Hurteau et al. 2009).**

To this point, the re-establishment of ecologically **non-analog stand structures** during reforestation strategies is to invite weakened resilience (the fire prone nature of non-analog, homogenous stand structures) in forest systems by planting trees like fire does not matter. It is critical for CARB and other state and federal partners to examine the history of plantation forestry in California, especially in areas that have been harvested or burned in (at least) the past 45-50 years, to understand the resilience (or lack of resilience) of these ecologically uncharacteristic practices. Looking back on the 2013 Rim Fire landscape is a good place to start. Figure 9 below illustrates the recent burn history of the Rim Fire area, illustrating an example of a landscape that has been harvested or burned, replanted in narrow-spaced, fire prone plantations, and then burned again, repeatedly. How CARB accounts for the carbon value in fire prone plantations must rest on the reforested areas surviving into a reasonable timeframe, andthat is a highly uncertain speculation at this point. The reforestation and fire history needs to be accumulated and disclosed to help the state better understand what to support (with restoration funds, human capital, and policy) and what to limit.

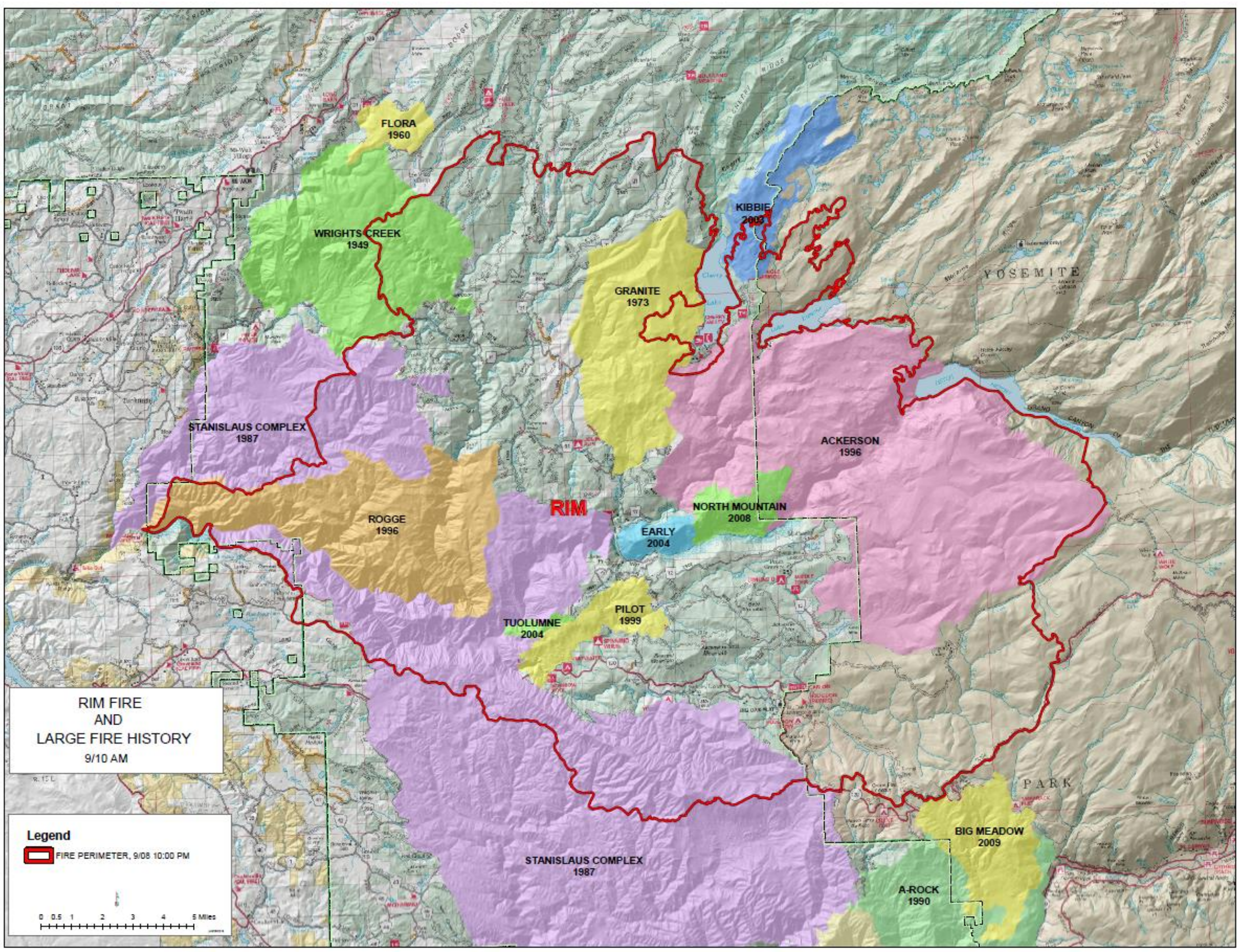
It is critical that the State fully embrace a "Reforestation for Resilience—North et al. 2019" strategy when planting trees in recently burned landscapes. This paper with its 26 authors explores deeply the failures of planting like fire does not matter. The paper offers several approaches that are based on ecosystem resilience and uses best available science on the matter of reforestation in California. Non-analog (uniform) plantation tree farms are much more susceptible to fires, drought, and beetle infestations then approaches that emphasize heterogeneity (Koontz et al. 2020; Kane et al. 2019).

Locally, plantation reburns on the El Dorado National Forest (in one fire perimeter) include the Cleveland Fire (1992), the St. Pauli Fire (2002), the Fred's Fire (2004) while just to the west, the 97,000-acre King Fire burned thousands of acres of plantations on industrial and Forest Service ground.

The 2013 Rim Fire is another example for the vulnerability and lack of resilience of uncharacteristic stand structures being burned, planted, and reburned which calls into serious question any carbon monitoring and mitigation approach that fails to account for risk of carbon loss from disturbance in non-analog stand conditions. **If wildfires are being fueled by ecologically uncharacteristic conditions that the State of California is permitting, and offering accolades for economic performance of these practices, while spending millions on fire suppression each year, then we argue it is past time to conduct a full scientific investigation of both soil carbon loss in industrial forestry practices and of uncharacteristic stand structure as an important and contributing variable influencing wildfire and forest carbon.** This investigation should include similar practices on federal lands such as reforestation from past logging and post-fire reforestation.

To be clear, we are not calling for the end of reforestation. We are calling for a new model of reforestation, one designed like fire matters and that is essential to forest resilience.

Figure 9. 2013 Rim Fire and Large Fire History (data from USDA Forest Service)



4. Non-Fire Forest Management Activities

The draft Report does not address non-fire forest management activities. Absent machinery and transport emissions, and wood processing and retail transport emissions there would be little wood processing going on in California. It is arbitrary to ignore these activities which are inextricably linked to forest management and need to be addressed. The wood life cycle function of wood products is also critical because assumptions regarding longevity and carbon "storage" benefits are part of the crediting of forest management practices in California which need independent examination.

On (pg. 5) the Report claims there is insufficient information to quantify the impact that forest management has on ecosystem processes under current climate conditions and extreme fire behavior. This statement is incorrect and unfounded when uncharacteristic stand structure is likely a significant contributor to extreme wildfire behavior and has been analyzed elsewhere (see Zald and Dunn 2018; Hurteau et al. 2009). We argue that stand structure along with other variables can be sorted out for this report.

Fred's Fire 2004 burning 1992 Cleveland Fire Plantations

St Pauli Fire (2002) burning more of 1992 Cleveland fire plantations.

5. Current Ecological Baseline

When assessing carbon emissions from fire and forest management, CARB should identify a current ecological baseline. The past level of emissions from fire in 1800 (Stephens et al. 2007) is very interesting but not relevant to the 2021 California landscape. We suggest working with UC fire scientists and Forest Service PSW researchers to get accurate estimates of today's vegetation-fire regime landscape to acquire a benchmark understanding of ecological fire need (Schweizer and Cisneros 2016). A good place to start is explained in (North et al. 2012). It is important to define what the natural relationship to ecological fire (including lightning and anthropogenic fire restoration) in California is before accounting for harmful emissions.

It is also important when characterizing carbon stack transformation to characterize a carbon stability goal and a science-based "picture" of resilient forests that fosters stability. We will have to transform forest carbon stocks by eliminating non-resilient and uncharacteristic stand structures and uncharacteristic tree densities with much more heterogeneity to achieve resilient large tree dominated, frequent fire forests in much of California. Starting with the SNEP Report in 1996, we have a good idea what a resilient forest system looks like. While the past may not be a perfect model for the 2100 future, it is certainly a good place to start.

6. Conclusion

Including stand structure in a wildfire behavior analysis, (i.e., assessing what variables were the primary drivers of the fire), is essential to gain clarity on the relative value or harm from certain forest manage practices. In terms of below ground soil carbon stability, we would like to see a strong annotated literature review of the current monitoring efforts (we offer several references) and a strong commitment to acquire a clear understanding of what is happening to roughly half of all the forest carbon -that which is below ground- due to forest management. This information needs to be part of the benchmark carbon and ecosystem functioning statement for ecosystems in California.

Thank you for this opportunity to comment on the draft Greenhouse Gas Emissions of Contemporary Wildfire, Prescribed Fire and Forest Management Activities.

Sincerely,

Craig Thomas, Director
The Fire Restoration Group
P.O. Box 244
Garden Valley, CA 95633
craigthomas068@gmail.com
(916) 708-9409

Greg Suba, Conservation Biologist
Sierra Forest Legacy
greg@sierraforestlegacy.org
(916) 622-2816

References

Achat, D., Fortin, M., Landmann, G. *et al*. (2015) Forest soil carbon is threatened by intensive biomass harvesting. *Sci Rep* **5,** 15991.

Buckholz, T., MD Hurteau, J Gunn, D Saah - Gcb Bioenergy, (2016) A global meta-analysis of forest bioenergy greenhouse gas emission accounting studies

Callicott, J.B., and Mumford, K. 1997. Ecological Sustainability as a Conservation Concept. *Conservation Biology* 11:1 (32-40).

Gershenson, A., and Barsimantov, J., 2010. Accounting for Carbon in Soils. Climate Action Reserve, Ecoshift Consulting www.ecoshift.com

Hurteau m.d., B.A. Hungate, GW Koch. (2009) Accounting for risk in valuing forest carbon offsets. Carbon Balance and Management 4(1) 1-5.

Hurteau, M.D., Matthew L. Brooks. (2011) Short- and Long-term Effects of Fire on Carbon in US Dry Temperate Forest Systems, *BioScience*, Volume 61, Issue 2

Hurteau, M., and North, M. (2009) Fuel treatment effects on tree-based forest carbon storage and emissions under modeled wildfire scenarios. Frontiers in Ecology and the Environment. Vol. 7, Issue 8.

Hurteau, M.D., AL Westerling, C Wiedinmyer, BP Bryant. (2014) Projected effects of climate and development on California wildfire emissions through 2100. Environmental science & technology, 2014

James, Jason; Harrison, Rob. 2016. "The Effect of Harvest on Forest Soil Carbon: A Meta-Analysis" *Forests* 7, no. 12: 308. https://doi.org/10.3390/f7120308

Lacroix, E.M., Petrenko, C.L., Friedland, A.J. 2016. Evidence of Losses From Strongly Bound SOM Pools After Clear Cutting in a Northern Hardwood Forest. *Soil Science*: March 2016. www.soilsci.com

Long, J.W., Tarnay, L.W., North, M.P. 2017, in press. Aligning Smoke Management with Ecological and Public Health Goals. *J. Forestry* 115:000-000. Published online January 19, 2017.

M North, M Hurteau, J Innes. (2009). Fire suppression and fuels treatment effects on mixed-conifer carbon stocks and emissions. Ecological applications. Vol. 19:6.

North, M.P., Collins, B. Stephens, S.L. (2012) Using Fire to Increase the Scale, Benefits, and Future Maintenance of Fuels Treatments. J. For. 110(7):392–401

North, M., A. Brough, J. Long, B. Collins, P. Bowden, D. Yasuda, J. Miller, and N. Sugihara. 2015. Constraints on mechanized treatment significantly limit mechanical fuels reduction extent in the Sierra Nevada. *J. Forestry* 113(1):40-48.

North, M.P., Jens T. Stevens, David F. Greene, Michelle Coppoletta, Eric E. Knapp, Andrew M. Latimer, Christina M. Restaino, Ryan E. Tompkins, Kevin R. Welch, Rob A. York, Derek J.N. Young, Jodi N. Axelson, Tom N. Buckley, Becky L. Estes, Rachel N. Hager, Jonathan W. Long, Marc D. Meyer, Steven M. Ostoja, Hugh D. Safford, Kristen L. Shive, Carmen L. Tubbesing, Heather Vice, Dana Walsh, Chhaya M. Werner, Peter Wyrsch. (2019). Reforestation for resilience in dry western U.S. forests. Forest Ecology and Management. Volume 432.

Palmer, W.D. Smith, B.L. Conkling (2002) Development of a protocol for monitoring status and trends in forest soil carbon at a national level, Environmental Pollution. Volume 116, Supplement 1.

Schweizer, D. and Cisneros, R. 2016. Forest fire policy: changing conventional thinking of smoke management to prioritize long-term air quality and public health. International Journal-Air Quality, Atmosphere and Health: published online April 2016.

Stephens, S.L., R.E. Martin, and N.E. Clinton. 2007. Prehistoric fire area and emissions from California's forests, woodlands, shrublands, and grasslands. For. Ecol. Manage. 251: 205–216.

Thompson, I., B. Mackey, S. McNulty, and A. Mosseler. 2009. *Forest Resilience, Biodiversity, and Climate Change*. Secretariat of the Convention on Biological Diversity, Montreal. Technical Series no. 43, 67 pp.

Vaillant, N.M. and Reinhardt, E.D. 2017. An Evaluation of the Forest Service Hazardous Fuels Treatment Program—Are We Treating Enough to Promote Resiliency or Reduce Hazard. *J. For*. 115: published online Jan. 2017.

Vanguelova, E.I., Bonifacio, E., De Vos, B. *et al*. (2016) Sources of errors and uncertainties in the assessment of forest soil carbon stocks at different scales—review and recommendations. *Environ Monit Assess* **188,** 630

USDA, Forest Service-PSW. 2009. General Technical Report PSW-GTR-220: An Ecosystem Management Strategy for the Sierran Mixed-Conifer Forests.

USDA, Forest Service-PSW. 2012. General Technical Report PSW-GTR-237: Managing Sierra Nevada Forests.

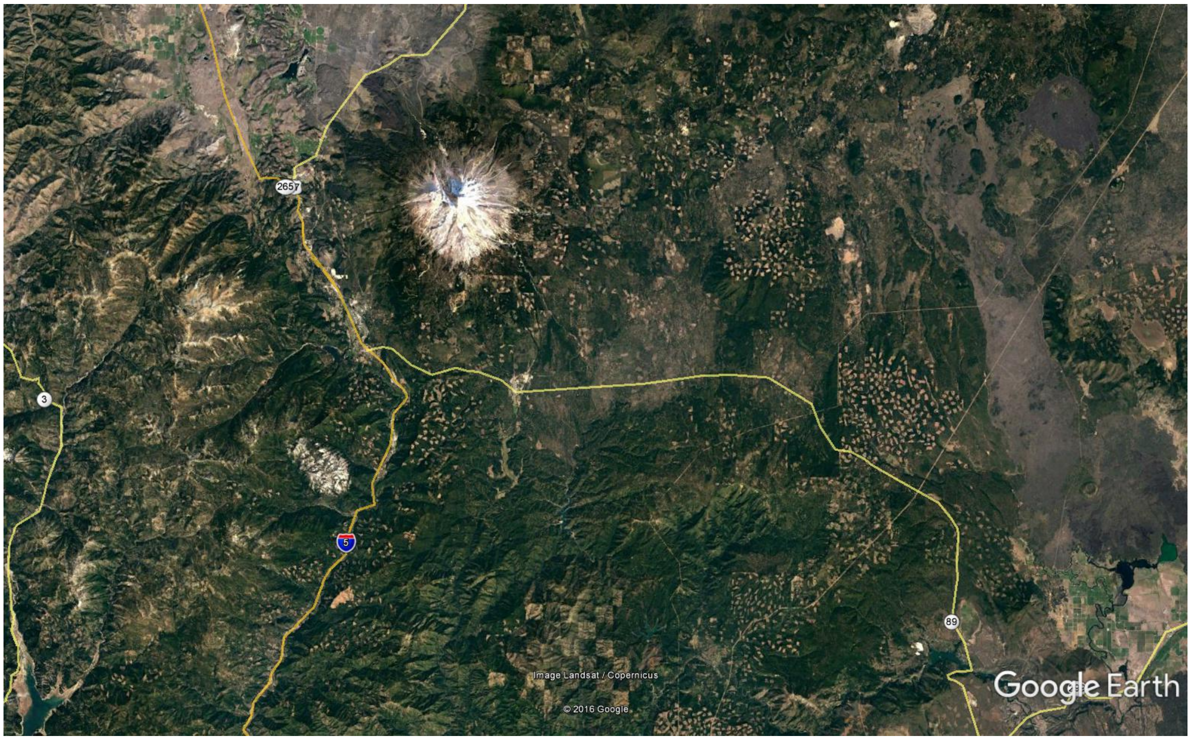
USDA, Forest Service, National Report on Sustainable Forests. 2010. FS 979.

Zald, H. and C. Dunn, (2017) Severe fire weather and intensive forest management increase fire severity in a multi-ownership landscape. Ecological Applications 28(4).

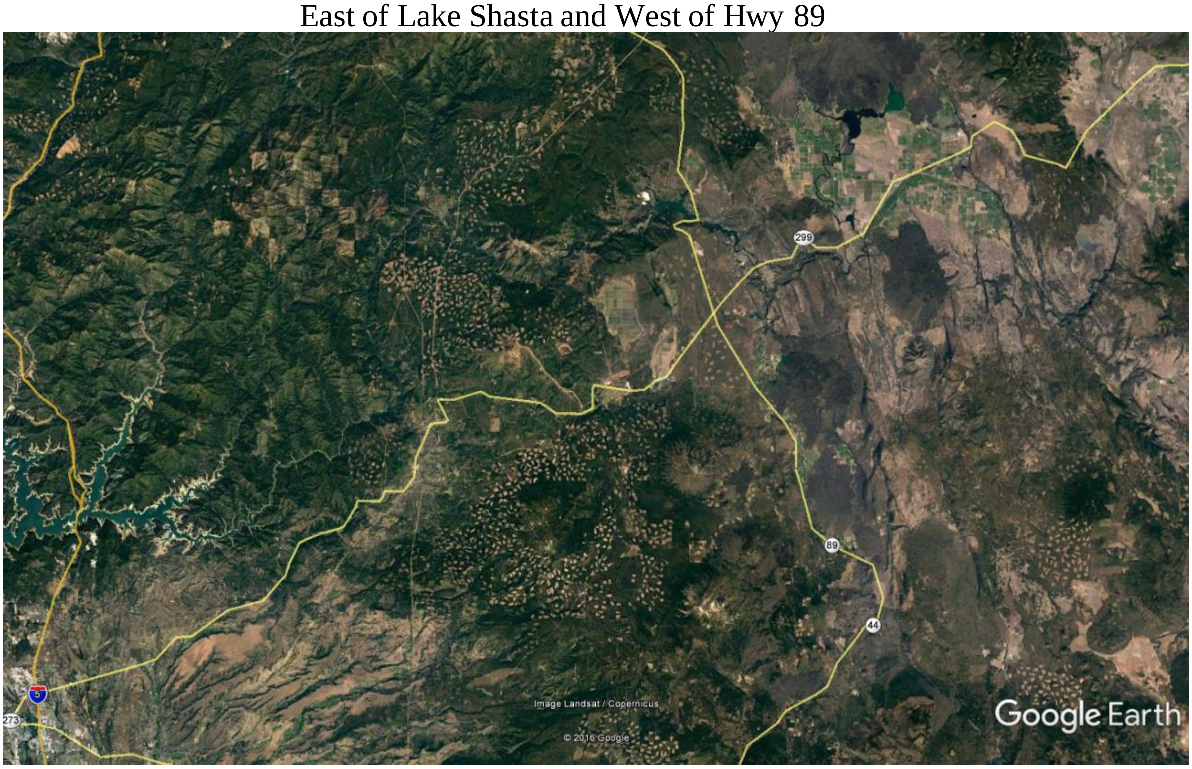
Appendix A: photos are 2016 Gogle Earth snapshots of 20-30 acre clear-cut patches

Industrial logging and fragmentation in the Sierra Nevada and Southern Cascades

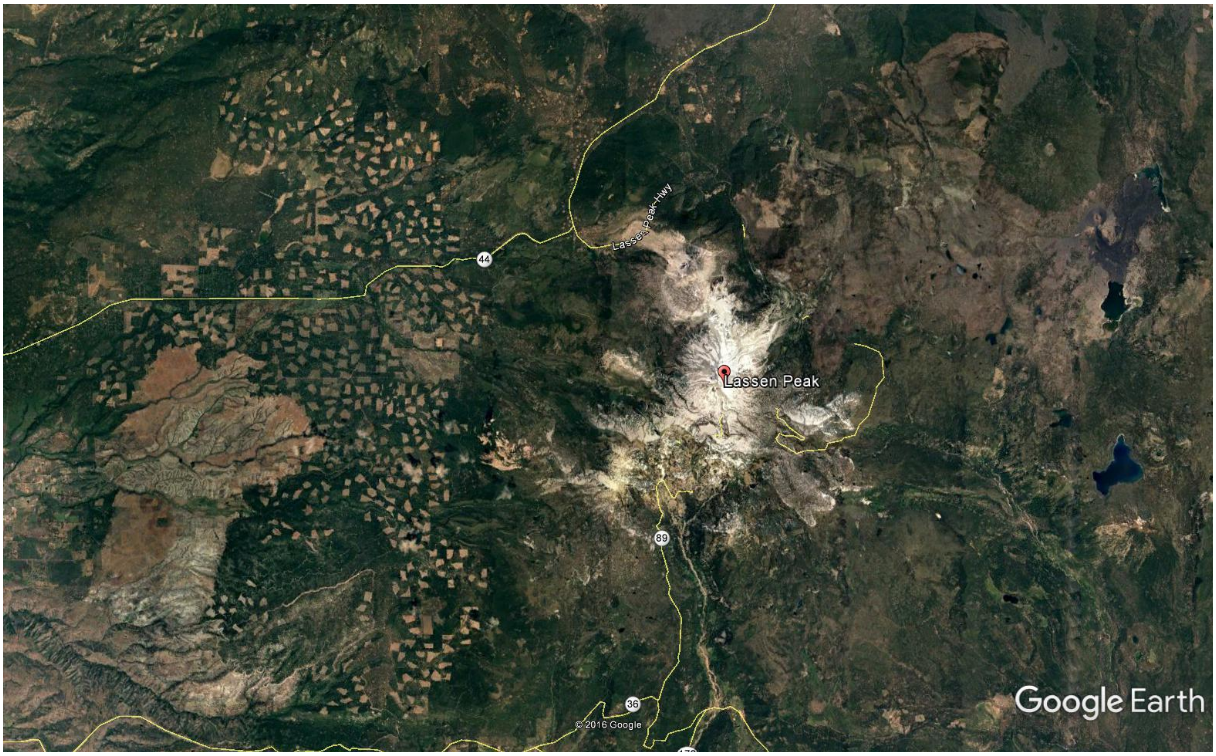
Mount Shasta Area



East of Lake Shasta and West of Hwy 89



West of Mt. Lassen National Park



North of Hwy 70 and West of Lake Almanor

Hwy 50 Corridor East of Placerville and West of Lake Tahoe

Highway 108 north to Highway 88 (Tuolumne Co, Calaveras Co., Amador Co.)