A New Direction for California Wildfire Policy—Working from the Home Outward

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Executive Summary

California's state policies on wildfire need to change direction. The current policies are failing. They have not effectively protected homes, while they place dramatically increasing pressures on state and local budgets. Moreover, these policies are often based on notions about the role of fire in California's ecosystems that are not supported by sound science and do not reflect the changing climate. These policies try to alter vast areas of forest in problematic ways through logging, when instead they should be focusing on helping communities safely co-exist with California's naturally fire-dependent ecosystems by prioritizing effective fire-safety actions for homes and the zone right around them. This new direction—working from the home outward—can save lives and homes, save money, and produce jobs in a strategy that is better for natural ecosystems and the climate.

The impetus for this report is the Governor's Executive Order N-05-19, which instructed CalFire to develop wildfire policy recommendations for California. To help Governor Newsom chart a new evidence-based approach to these policies, the Leonardo DiCaprio Foundation invited experts from our partner organizations to prepare concise synopses of key points that are not likely to be included or emphasized in CalFire's recommendations. Those synopses are compiled in this report. In addition, we have prepared a list of specific steps that can help California embark on a new approach to wildfire policy that prioritizes home and community safety and works from the home outward.

Top recommendations include:

- Convene a task force focused specifically on wildfire safety for homes and communities, consisting of experts on home-safety features and community planning
- Ensure that the Governor has a diverse set of advisors on wildfire and forest policy, including experts who are not primarily advocating for logging-based strategies
- Direct SB 901 funds and other resources to prioritize support for retrofitting of homes that need to be more fire-safe and other home-safety actions

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A New Direction for California Wildfire Policy— Working from the Home Outward

Introduction

by Douglas Bevington, PhD, Forest Director, California Program, Leonardo DiCaprio Foundation

The Problem:

California's state policies on wildfire need to change direction. Those policies are currently steering resources into trying to alter vast areas of forest in problematic ways, when instead they should be focusing on helping communities safely co-exist with California's fire-dependent ecosystems by prioritizing effective fire-safety actions for homes and the zone around them.

In order to solve a problem, it needs to be defined clearly. Amid the effects of climate change, California is experiencing unprecedented levels of home destruction and loss of human life during wildfires, and fire suppression spending is bigger than ever. California has a human-safety problem during fires and also an economic problem from spiraling fire suppression costs, but California does not have an unnatural excess of forest fire in terms of either amount or severity. While recent fires are described as "record" in size, those statements are based on records from after California began suppressing fire. Prior to the advent of 20th century mechanized suppression, California's forests naturally experienced much more fire than now. Our forests need fire as an ecosystem process, and they naturally burn in a mixture of low, medium, and high-severity. (For peer-reviewed studies on these points, see pp. 12-13.)

California's current fire policies focus on how to do massive forest alterations, mainly through logging, to try to alter fire severity. Those policies are trying to address the wrong problem. Our forests do not need reduced fire amount or severity to be healthy. Moreover, altering forests to try to change fire severity is largely irrelevant to keeping homes safe during fires. Most home ignitions are not caused by coming into contact with high-severity fire (Syphard et al. 2017). For example, in the 2007 Grass Valley Fire, contact with high-severity forest fire was only responsible for 3% of the burned houses. The other 97% were due to low-severity fire, wind-blown embers, and flames from other houses (https://tinyurl.com/y33bdu9s). (This pattern can be readily seen in other fires in which burned houses are often next to unburned green trees.) Policies to address impacts to communities that are based on more logging as the solution, to try to alter fire severity, are an inefficient and ineffective way to protect homes.

Instead, research shows that the most effective steps to prevent homes from burning involve incorporating fire-safe features on buildings (e.g., roof materials, vent screens) and pruning vegetation in the zone 100 feet around houses (see pp. 8-9). When properly implemented, this approach works effectively even when faced with intense wildfires amid high temperatures and high winds, such as during the La Tuna Fire, in which more than 99% of houses within the fire path remained unburned (http://www.latimes.com/opinion/op-ed/la-oe-hanson-latuna-fire-homes-20180810-story.html). And these home-safety actions can produce jobs for rural communities (http://nreconomics.com/reports/2018-04-28_EnvNow_Report.pdf).

We need a policy focus that starts from the home outward, yet currently much of the attention and resources are being redirected to logging of vast forest areas far away from homes.

Calls for large-scale forest alterations to try to change fire severity are often based on erroneous claims that do not reflect a growing body of scientific research (see pp. 12-13) showing that:

- mixed-severity fire is a natural and necessary component of California's forests
- there is less forest fire of all severities now than there naturally should be
- logging has caused a shortage in the total volume of biomass/carbon in our forests now

Current forest-altering policies promote subsidized logging and biomass extraction that:

- take resources away from the actions that most effectively keep homes safe during fires
- are costly to taxpayers
- cause damage to forest ecosystems
- contribute to global warming by releasing stored forest carbon into the atmosphere

Associated efforts to promote forest extraction by including biomass in the state's Renewable Portfolio Standard and legislation that requires forest bioenergy procurement result in:

- increased costs for utility ratepayers
- utilities forced to select biomass power sources that are more expensive than solar and that emit more carbon dioxide than coal per unit of energy generated
- resources pulled away from zero-emission energy sources such as solar
- California biomass policies that are similar to those of the Trump administration

The Causes of this Problem:

For wildfire-related matters, California's officials and agencies have been relying too heavily on the recommendations of CalFire and the US Forest Service. These agencies have spent many decades promoting logging and intensive fire suppression, an approach that has produced high costs and poor results. Scientists widely agree that fire suppression has harmed forest ecosystems. And efforts to blame forest protection for current forest fire behavior ignore research results showing that forests with the highest levels of restrictions on logging burn at lower severities compared to forests with fewer restrictions on logging (https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/ecs2.1492). Yet, CalFire and the US Forest Service continue to advocate spending more on large-scale logging (using euphemisms such as "thinning" and "management") as a primary emphasis of fire policies.

The resulting policymaking processes have drawn heavily on US Forest Service-funded scientists while avoiding or misrepresenting the peer-reviewed research of independent scientists whose findings refute the justifications used to promote logging (e.g., https://tinyurl.com/y9sqmp76).

The current approach continues to pull resources away from actions directly around homes that would help communities to safely co-exist with fire-dependent ecosystems in California. And each time homes are lost, the same voices keep on calling for even more funding to be poured into the current failing strategies. It is time for a new direction guided by new voices.

The Purpose for this Report:

The immediate impetus for this report is the Governor's Executive Order N-05-19, which instructed CalFire to develop wildfire policy recommendations for California, due to be released later this month. If past is prologue, this document will be likely focused on redoubling the failed suppression and forest-alteration strategies that have dominated CalFire's approach so far. It will be built on fundamentally erroneous claims about the role of fire in California forests that exclude key scientific research on this subject (for examples, see pp. 12-13 of our report). CalFire may continue to apply what is in effect still a 20th century fire suppression strategy that is not appropriate for our 21st century climate (see pp. 10-11). There may be mention of 21st century technologies such as drones, but they will likely be applied in support of outdated suppression goals. There may even be some greater attention on prescribed fire, but if this tool is simply used in support of an outdated suppression strategy, the outcome will be problematic (see p. 13). And while CalFire may talk about the problem of climate change, its recommended policies are likely to be detrimental to the climate (see pp. 14-17). Above all, while there may be some mention of defensible space and houses, the overall outcome of CalFire's recommendations will likely be to direct funding mainly to suppression and logging, rather than redirecting resources to where they can be most effective by focusing on retrofitting homes and communities to be prepared for the inevitable wildfires in California's fire-dependent ecosystems (see pp. 8-9, 19).

To chart a new approach to wildfire policies in California, Governor Newsom will need to seek advice beyond the voices that have steered us into the current failed policies. To help address this need, the Leonardo DiCaprio Foundation invited experts from our partner organizations to prepare concise synopses of key points that are not likely to be included or emphasized in CalFire's recommendations (pp. 10-19). In addition, we are honored to include a piece by Dr. Jack Cohen, who recently retired from the US Forest Service (pp. 8-9). Dr. Cohen has been a pioneer in the study of the importance of home features and the zone right around them for preventing home ignitions during wildfires. Despite the significant implications of Dr. Cohen's research, not nearly enough has been done to incorporate these findings into current fire policies. As a recent article summarized, "Cohen thought he had come up with a way to save houses and to let fires burn naturally—he thought it was a win-win. And so in 1999, he presented a paper about his findings at a fire conference in front of people from the Forest Service and state fire agencies. These were people who were in a position to change policies. But Cohen says they were totally uninterested. Cohen's research implied that basically everything about how the Forest Service dealt with wildfires was wrong."(https://tinyurl.com/yb4rt45r) Through the research presented in this report, we hope to show that there is now an opportunity to take California's wildfire policies in a positive and effective new direction.

Solutions:

In light of these findings, we urge Governor Newsom to seek guidance beyond the CalFire recommendations before setting the course of California's wildfire policies. In particular, we recommend that he convene a task force focused specifically on wildfire safety for homes, consisting of experts on home-safety features and community planning. (The composition of this task force would therefore be different from the Forest Management Task Force). This task force should identify the most effective and cost-efficient actions to prevent home ignitions during wildfires, including potential roles for state policies and resources to support retrofitting of homes that need to be more fire-safe. By focusing resources on preparing homes and communities to safely coexist with inevitable wildfires through a new approach that works from the home outward, we can save lives and homes, save taxpayers' money, and produce jobs in a strategy that is better for California's natural ecosystems and the climate.

Recommendations

Based on the research cited in this report, we recommend that following steps can help state wildfire policies shift to a focus on safety and cost-efficiency by working from the homes outward, while avoiding subsidizing unnecessary logging:

- ➢ Convene a task force focused specifically on wildfire safety for homes and communities, consisting of experts on home-safety features and community planning. (The composition of this task force would therefore be different from the Forest Management Task Force). This task force should identify the most effective and cost-efficient actions to prevent home ignitions during wildfires, including potential roles for state policies and resources to support retrofitting of homes that need to be more fire-safe
- ➢ Ensure that the Governor has advisors on wildfire and forest policy beyond those primarily advocating for logging-based strategies, including:
    - Environmental groups that are actively challenging harmful logging projects, so as to better understand the science-based concerns with current projects
    - Scientists who are not financially dependent on the US Forest Service
    - Experts on defensible space and forest carbon
    - Fire management experts affiliated with the National Park Service
    - Experts on chaparral and non-conifer forest ecosystems where much of the recent home losses have occurred
- ➢ Take a leadership role on setting better standards for making homes fire-safe throughout California, and link eligibility for fire/forest-related state funds to the extent to which communities implement these fire-safety measures
- ➢ Direct SB 901 funds to home-safety actions rather than logging
- ➢ Remove forest biomass from the Renewable Portfolio Standard and do not mandate utility use of expensive biomass power sources
- ➢ Conduct independent review and reform of the SB 901-mandated forest carbon calculator
- ➢ Do not use California state funds to subsidize logging on national forests
- ➢ Revise CalFire's policies to better fit 21st century climate conditions, including independent review of the costs and impact from CalFire's use of large airtankers (see p. 11)
- ➢ Shift more resources from wildland fire suppression to municipal fire departments on the frontlines of keeping homes safe
- ➢ Support research and public education about the many benefits of retrofitting homes to become more fire-safe, including job-creation and reduction of loss of life and property
- ➢ Prevent unplanned human-caused wildfire ignitions, including by increasing the pace at which utilities bury their powerlines underground. This action will reduce a key fire ignition source while simultaneously avoiding other problems with aboveground powerlines.

A More Effective Approach for Preventing Wildland-Urban Fire Disasters

By Jack Cohen, PhD, Research Physical Scientist, US Forest Service, retired

Summary

Communities exposed to inevitable extreme wildfire conditions do not have to incur inevitable disastrous fire destruction. Research shows that the characteristics of a home and its immediate surroundings within 100 feet (30 meters) principally determine home ignitions. This area, called the home ignition zone (HIZ), defines wildland-urban (WU) fires as a home ignition problem and not a problem of controlling wildfires. Communities can readily reduce home ignitability within the HIZ to prevent WU fire disasters instead of increasing wildfire suppression that fails during extreme wildfire conditions. Reducing the ignition conditions within the HIZ to produce ignition resistant homes provides an effective alternative for preventing WU fire disasters without necessarily controlling extreme wildfires.

Inevitable Wildfires and Extreme Burning Conditions

Wildfire occurrence is inevitable and thus, a small percentage of wildfires will inevitably attain uncontrollable extreme wildfire conditions. For over one-hundred years U.S. fire suppression has successfully controlled 95 to 98 percent of wildfires with initial attack (Stephens and Ruth 2005). However, there is no historical evidence or current fire management trend to suggest that all wildfires can be excluded and if not excluded, controlled with an initial suppression response. Thus, we can assume the inevitability of wildfires and the occurrence of extreme wildfire conditions (Williams 2013). Most wildfires controlled at initial attack occur during moderate to high wildfire conditions. During severe conditions of drought, high winds, low relative humidity and multiple ignitions, 2 – 5 percent of the wildfires producing rapid growth with high burning intensities escape initial attack suppression.

The primary federal, state and local approach for protecting structures from wildfires and preventing community fire disasters is wildfire control using suppression added by pre-suppression fuel breaks and shrub and forest fuel treatments (Finney and Cohen 2003, Cohen 2010). However, disastrous community wildfire destruction (greater than 100 homes destroyed) has only occurred during extreme wildfire conditions when high wind speeds, low relative humidity and continuous flammable vegetation result in rapid fire growth rates and numerous spot ignitions from showers of burning embers (firebrands); that is, the conditions when wildfire control fails (Cohen 2010, Calkin et al. 2014).

Community fire destruction during wildfires will continue as long as wildfire suppression continues to be the primary residential protection approach. The inevitability of uncontrolled extreme wildfires suggests inevitable disastrous home destruction; however, research on how homes ignite during extreme wildfires indicates practical opportunities for effectively creating ignition resistant homes and thereby preventing community fire disasters without necessarily controlling wildfires (Cohen 2000; Cohen 2001; Cohen 2004; Cohen and Stratton 2008; Cohen 2010; Calkin et al. 2014; Cohen 2017). We can immediately see how homes were not ignited during a wildfire from the readily observable patterns of destruction.

Patterns of Home Destruction during Wildfires

Total home destruction surrounded by green tree canopies following the Camp Fire in Paradise, CA (Figure 1, left photo) has been reported as unusual; however, unconsumed vegetation adjacent to and surrounding total home destruction is the typical WU fire pattern associated with extreme wildfire conditions (Cohen 2000; Cohen and Stratton 2003; Cohen 2003; Cohen and Stratton 2008; Graham et al. 2012; Cohen 2017). The center photo (Figure 1) shows an example of a burning home that could have only ignited from lofted burning embers (firebrands) on the home and low intensity surface fire spreading to contact the home. The three photos (Figure 1) of home destruction with adjacent unconsumed shrub and tree vegetation indicate the following:

Figure 1.
Paradise, CA; 2018 Camp Fire

Southwest CO; 2002 Missionary Ridge Fire

S Cal; 2007 Grass Valley Fire

- ***High intensity wildfire did not continuously spread through the residential area as a wave or flood of flame.***
- ***Unconsumed shrub and tree canopies adjacent to homes did not produce high intensity flames that ignited the homes; ignitions could only be from firebrands and low intensity surface fires.***
- ***The 'big flames' of high intensity wildfires did not cause total home destruction.***

High intensity wildfires do not spread through residential areas such as Paradise. The continuous tree and shrub canopies required to maintain high intensity wildfire spread (crown fires) are broken by fuel gaps such as streets, driveways and home sites (Cohen 2010). Figure 2 shows how a crown fire spread to but could not continue beyond the first residential street. Although the crown fire terminated at the street, firebrands showered downwind into the residential area initiating fires resulting in several blocks of total home destruction (Cohen 2010). Extreme wildfire conditions initiate ignitions within residential areas but the residential fuels, structures and vegetation continue the residential burning resulting in total home destruction. Commonly, homes ignite and burn hours after the wildfire has ceased active burning near the community (Cohen and Stratton 2008, Cohen 2010).

Figure 2.

Figure 3.

Furthermore, the typical WU fire patterns indicate that conditions local to a home principally determine home ignitions with firebrands the principal source of ignitions within the residential area. The totally destroyed home in Figure 3 indicates firebrands as the only possible ignition source, potentially igniting the home directly and the flammable materials adjacent to the home. Firebrands are a given during extreme WU fire conditions; however, regardless of the distance firebrands were lofted, firebrand ignitions depend on the local conditions of the ignitable surfaces on or adjacent to a home.

An Effective Approach for Preventing WU Fire Disasters

Research (Cohen 2004) has quantified "local ignition conditions" to be an area of a home and its immediate surroundings within 100 feet (30 meters). This area is called the home ignition zone (HIZ) (Cohen 2010; NFPA 2018). The relatively small area of the HIZ principally determines home ignitions during extreme wildfires and defines WU fire destruction as a home ignition problem that can be prevented by readily addressing home ignition vulnerabilities within the HIZ without necessarily controlling wildfires. For example, an ignition resistant home does not have a flammable wood roof, flammable tree debris on the roof, in the rain gutters, on decks or on the ground within 5 feet (1.5 m) of flammable siding, no open firewood within 30 feet (9 m), or unscreened vents. Clearing the HIZ of vegetation is not necessary. As indicated by the typical patterns of WU fire destruction, shrub and tree canopies are not spreading high intensity fires through communities. The inevitability of uncontrolled extreme wildfires spreading to communities does not mean WU fire disasters are inevitable if we address the problem with the readily available approach of reducing home ignitability. Ignition resistant communities increase community fire protection effectiveness, life-safety options for residents and firefighters, and decrease wildfire suppression costs while preventing WU fire disasters without attempting to protect communities by controlling wildfires.

CalFire's 20th Century Fire Suppression Policy is Not Appropriate for a 21st Century Climate

by Timothy Ingalsbee, PhD, Executive Director, Firefighters United for Safety, Ethics, and Ecology

Up until the mid-20th century, we had a lot more fire on the land

Hundreds of fire history studies document that wildland fires burned significantly more area than burns now. Even in the 20th century up until the 1950s, several tens of millions of acres burned in the U.S. each year (NIFC).

Then we began mechanized firefighting in the 20th century

Federal agencies such as the U.S. Forest Service began fighting fires in 1905, but with minimal effectiveness due to the large expanse of undeveloped wildlands, the limited size of its workforce, and primitive technology. This changed in the post-World War II period with an influx of military surplus vehicles and equipment in fire suppression (Pyne 1982). Cutting firelines with bulldozers and airtankers dropping chemical retardants brought annual burned acreage crashing down. In California alone there was a 36% decline in area burned from the 1940s to the 1950s, the start of a trend of rapidly declining acres burned that continued until the 1980s (CalFire-A n.d.). This created a historically unprecedented shortage of fire on the landscape that is still adversely affecting fire-adapted ecosystems across the west.

But the post-war surge of suppression success accompanied a change in climate

At the same time that mechanized firefighting was pushing deeper into backcountry wildlands and containing nearly all wildfires at a small size, the climate had changed. A prolonged cool, wet period from a natural cycle of climate variability called the Pacific Decadal Oscillation (PDO) greatly aided firefighters' efforts in stopping wildfire spread (Littell et al. 2009, Peterson et al. 2011). This created an unprecedented shortage of fire on the landscape during the 1950s and 60s. During this post-war period with its anomalously and artificially low level of wildfire activity, people developed a distorted perception of wildfires as absolutely bad, along with a false sense of security that firefighters could put them all out (Murphy et al. 2018).

21st century climate change is making wildfires start easier and spread faster

At the end of the 20th century that cool, wet PDO cycle ended and was replaced with much warmer and drier conditions that are now being amplified by global warming from fossil-fuel emissions. Prolonged droughts punctuated by frequent severe fire weather conditions (high temperatures, high winds, and low relative humidity) are making vegetation ignite much easier and fires spread more rapidly. Beginning in the 1980s but accelerating after 2000, the signal of anthropogenic climate change is now registering in greatly increased wildfire activity that is leading to longer fire seasons and increased amount of acres burned.
But even this recent increase in large fires masks the fact that there still much less fire on the land than is necessary for maintenance of California's fire-adapted forest ecosystems (Sugihara et al 2006).

21st century climate is ending the efficacy of conventional firefighting

Conventional firefighting tactics of dumping retardant, cutting firelines, and lighting backfires cannot stop wind-blown flames from jumping over firelines or firebrands lofting in the sky and landing on flammable rooftops miles away from a wildfire's flaming front. Now that 21st century anthropogenic global warming is causing severe fire weather conditions to become more frequent, the efficacy of conventional suppression is further declining. Conventional firefighting strategies and tactics are unable to either prevent or suppress large wildfires that are now being driven by climatic conditions that will be with us for the far foreseeable future.

Suppression spending is soaring

In response to increasing wildfire activity, both federal and state agencies have been dramatically escalating their suppression spending over the last 30 years. For example, in 1986 CalFire spent only $15 million total on suppression, but in 2017 the agency spent a record $947 million, far exceeding its budget (CalFire 2018). In all but one year in the 21st century CalFire has spent over $100 million—and sometimes several hundreds of millions—on firefighting, a huge surge in spending from earlier decades. But CalFire's tactics remain rooted in a suppression-based approach that is proving more and more expensive and less and less effective in a 21st century climate. In fact, the last four years have seen the highest suppression spending in CalFire's existence—accompanied by huge urban fire disasters and record numbers of homes destroyed.

Expanding the fleet of airtankers would be a poor investment of taxpayer dollars

A signature example of a costly and increasingly ineffective 20th century approach to fire suppression is the emphasis on airtankers. Airtankers are one of the most expensive resources used in wildfire suppression, but several recent studies have found that airtankers are routinely deployed at times, places, and conditions where they are least useful or effective (Stonesifer et al. 2016; Stonesifer et al. 2015; Calkin et al. 2014; Thompson et al. 2012). They are particularly likely to be impaired by high winds associated with severe fire weather. CalFire regulation 8362.3.1.1 requires airtankers to be grounded when there is even moderate turbulence or windspeeds exceeding 35 mph (CalFire-B n.d.) Heavy smoke is another impediment to effective airtanker use. For example, while the Camp Fire raged through Paradise, a fleet of airtankers located literally next door in Chico was grounded by high winds and dense smoke.

Fighting fires in backcountry wildlands depletes resources needed to protect communities

Systematic attempts to exclude or suppress all fires regardless of whether or not they are near communities is costly to taxpayers and puts communities at risk from lack of suppression crews and resources actually protecting homes. For example, in 2016 a joint CalFire/USFS effort spent over $262 million on the Soberanes Fire that burned mostly in the Ventana Wilderness Area and became the most expensive wildfire suppression operation in U.S. history (Ingalsbee et al. 2018). A USFS internal investigation (USDA-FS 2017) concluded that the excessive spending reflected "systemic fire management issues" revolving around lack of fiscal accountability that have yet to be solved. These large expenditures on fire suppression in remote areas pull limited resources away from the actions that are most effective at preventing home loss during fires.

Recommendations:

- ➢ Wildland fires are ecologically necessary and inevitable, but losses of life and property in urban fire disasters need not be inevitable if we adopt new fire management policies and practices suitable for 21st century climate conditions. We need to move away from 20th century mechanized fire suppression strategies, tactics, and tools (e.g., large airtankers) that are inappropriate and increasingly ineffective in the current climate.
- ➢ Suppression resources should be redirected away from fighting fires in remote wildlands where fire is ecologically necessary and instead focused on directly protecting communities.
- ➢ Invest in preparing communities to live safely and sustainably in a fire-prone environment: retrofit homes to reduce home ignitability, improve emergency communications, maintain safe evacuation routes, construct community fire shelters, bury powerlines, and implement other infrastructure projects that could be part of a Green New Deal.

Common Myths about Forests and Fire

by Chad Hanson, PhD, Ecologist and Director, John Muir Project

Do We Currently Have an Unnatural Excess of Fire in our Forests? No. There is a broad consensus among fire ecologists that we currently have far less fire in western US forests than we did historically, prior to fire suppression (Hanson et al. 2015). For example, currently, we have about 200,000 acres of fire in California's forests per year on average, and 500,000 to 900,000 in the very biggest years. Historically, before fire suppression, an average year would see 1-2 million acres in California's forests (Stephens et al. 2007, Baker 2017). California's forests have always burned with a mixture of intensities, including patches of high-intensity fire. We have less fire of all intensities now, including less high-intensity fire (Stephens et al. 2007; Mallek et al. 2013; Baker et al. 2018).

Do Current Fires Burn Mostly at High-Intensity Due to Past Fire Suppression? No. Current fire is mostly low/moderate-intensity in western US forests, including the largest fires (Mallek et al. 2013, Baker et al. 2018). The most long-unburned forests experience mostly low/moderate-intensity fire (Odion and Hanson 2008; Miller et al. 2012; van Wagtendonk et al. 2012).

Do Large High-Intensity Fire Patches Destroy Wildlife Habitat or Prevent Forest Regeneration? No. Hundreds of peer-reviewed scientific studies find that patches of high-intensity fire create "snag forest habitat", which is comparable to old-growth forest in terms of native biodiversity and wildlife abundance (DellaSala and Hanson 2015). In fact, more plant, animal, and insect species in the forest are associated with this habitat type than any other (Swanson et al. 2014). Forests naturally regenerate in ecologically beneficial ways in large high-intensity fire patches (DellaSala and Hanson 2015, Hanson 2018).

Is Climate Change a Factor in Recent Large Fires? Yes. Human-caused climate change increases temperatures, which influences wildland fire. Some mistakenly assume this means we must have too much fire but, due to fire suppression, we still have a substantial fire deficit in our forests. For example, historically, snag forest habitat, from high-intensity fire and patches of snag recruitment due to drought and native bark beetles, comprised 14% to 30% of the forests in the Sierra Nevada (Show and Kotok 1925; Safford 2013; Baker 2014; Baker et al. 2018). Currently, based on federal Forest Inventory and Analysis data, it comprises less than 8% of Sierra Nevada forests.

Are Our Forests Unnaturally Dense and "Overgrown", and Do Denser Forests Necessarily Burn More Intensely? No. We currently have somewhat more small trees than we had historically in California, but we have fewer medium/large trees, and less overall biomass—and therefore less carbon (McIntyre et al. 2015). Our forests actually have a carbon deficit, due to decades of logging. Historical forests were variable in density, with both open and very dense forests (Baker et al. 2018). Recent studies by U.S. Forest Service scientists, regarding historical tree density, omitted historical data on small tree density and density of non-conifer trees. When the missing historical data were included, it was revealed that historical tree density was 7 times higher than previously reported in ponderosa pine forests, and 17 times higher than previously reported in mixed-conifer forests (Baker et al. 2018). Wildland fire is driven mostly by weather, while forest density is a "poor predictor" (Zald and Dunn 2018).

Are Recent Large Fires Unprecedented? No. Fires similar in size to the Rim fire and Rough fire, or larger, occurred prior to modern fire suppression (Bekker and Taylor 2010, Caprio 2016).

Do Occasional Cycles of Drought and Native Bark Beetles Make Forests "Unhealthy"? Actually, it's the opposite. During droughts, native bark beetles selectively kill the weakest and least climate-adapted trees, leaving the stronger and more climate-resilient trees to survive and reproduce (Six et al. 2018). In areas with many new snags from drought and native bark beetles, most bird and small mammal species increase in numbers in such areas because snags provide such excellent wildlife habitat (Stone 1995).

Do Forests with More Dead Trees Burn More Intensely? Small-scale studies are mixed within 1-2 years after trees die, i.e., the "red phase" (Bond et al. 2009, Stephens et al. 2018), but the largest analysis, spanning the entire western U.S., found no effect (Hart et al. 2015). Later, after needles and twigs fall and quickly decay into soil, and after many snags have fallen, such areas have similar or lower fire intensity (Hart et al. 2015, Meigs et al. 2016).

Does Reducing Environmental Protections, and Increasing Logging, Curb Forest Fires? No, based on the largest analysis ever conducted, this approach increases fire intensity (Bradley et al. 2016). Logging reduces the cooling shade of the forest canopy, creating hotter and drier conditions, leaves behind kindling-like "slash" debris, and spreads combustible invasive weeds like cheatgrass.

Do "Thinning" Logging Operations Stop Wildland Fires? No. "Thinning" is used as a euphemism for intensive commercial logging projects that kill and remove many of the trees in a stand, often including mature and old-growth trees. With fewer trees, winds, and fire, can spread faster through the forest. In fact, extensive research shows that commercial logging, conducted under the guise of "thinning", often makes wildland fires spread faster, and in most cases also increases fire intensity, in terms of the percentage of trees killed (Cruz et al. 2008, 2014).

Did the Rim Fire Emit Carbon Equal to Over 2 Million Cars? No. Recent unpublished reports from the Forest Service, and the California Air Resources Board regarding wildfire carbon emissions are based on a flawed model (FOFEM) that has repeatedly been shown to exaggerate carbon emissions by nearly threefold (French et al. 2011). Further, the FOFEM model falsely assumes that no post-fire regrowth occurs to pull CO2 out of the atmosphere. Field studies of large fires find usually only about 11% of forest carbon is consumed, and only 3% of the carbon in trees (Campbell et al. 2007), and vigorous post-fire forest regrowth absorbs huge amounts of CO2 from the atmosphere, resulting in an overall net decrease in atmospheric carbon within a decade after fire (Meigs et al. 2009).[1]

Would Landscape-Scale Prescribed Burning Reduce Smoke? No, it's the opposite. Prescribed fires do not stop wildland fires when they occur (Stephens et al. 2009), though they can alter fire intensity. However, any short-term reduction in potential fire intensity following prescribed fire lasts only 10-20 years, so using prescribed fires ostensibly as a means to reduce the intensity of wildland fires would require burning a given area of forest every 10-20 years (Rhodes and Baker 2008). This would represent a tenfold increase, or more, over current rates of burning (Parks et al. 2015). High-intensity fire patches produce relatively lower particulate smoke emissions (due to high efficiency of flaming combustion in higher-intensity fire patches) while low-intensity prescribed fires produce high particulate smoke emissions, due to the inefficiency of smoldering combustion. Therefore, even though high-intensity fire patches consume about three times more biomass per acre than low-intensity fire (Campbell et al. 2007), low-intensity fires produce 3-4 times more particulate smoke than high-intensity fire, for an equal tonnage of biomass consumed (Ward and Hardy 1991, Reid et al. 2005). As a result, a landscape-level program of prescribed burning would cause at least a ten-fold increase in smoke emissions relative to current fire levels.

1. For example, Campbell et al. (2007) found that the Biscuit fire of 2002 emitted an average of 19 tons of carbon per hectare, and Campbell et al. (2016) found that decay of fire-killed trees in the Biscuit fire emitted an average of about 0.75 tons of carbon per hectare per year over the first 10 years post-fire (there were lower emissions from decay in subsequent decades). Therefore, for the first 10 years post-fire, the total carbon emissions from the Biscuit fire (carbon emissions from the fire itself, plus subsequent emissions from decay) were approximately 26 tons of carbon per hectare. Meigs et al. (2009) (Table 5) report that, by only five years after fire, regrowth was pulling 3.1 tons of carbon per hectare per year out of the atmosphere. Therefore, by 10 years post-fire, this equates to approximately 31 tons of carbon pulled out of the atmosphere by regrowth—i.e., an overall net increase in carbon of 5 tons per hectare relative to pre-fire levels.

Facts about California Forests, Wildfires, and Carbon

by Dominick A. DellaSala, PhD, Chief Scientist, Geos Institute

California's forests are nature's climate solutions, readily absorbing and storing massive amounts of carbon in trees, dense foliage, and productive soils over decades to centuries (Griscom et al. 2017). Protecting the carbon stored in forests from logging is key to a climate-safe future for California. However, recent policies proposed by the state are seeking to elevate logging levels while rolling back environmental protections in response to wildfires. These policies are sometimes portrayed as ways to sequester and store more carbon in forests and wood products. However, there is a better way to address pressing climate issues in California by using the best available science in forestry-climate policies as follows.

Do Forest Fires Emit Massive Amounts of Carbon Dioxide? At the forest stand level, most studies in the Pacific Northwest indicate that individual forest fires emit small amounts of emissions (Campbell et al. 2007; Meigs et al. 2009; Mitchell 2015). At the state level, total annual emissions from wildfires are much less (generally <10%) than total annual emissions from logging even during active fire seasons (Meigs et al. 2009; Campbell et al. 2012; Law et al. 2018; Oregon Global Warming Commission 2018). Trees killed by wildfires are not combusted (aside from twigs and leaves), and they decompose slowly over decades to centuries while logging releases carbon rapidly (the concept of carbon absorption being slow-in from forest growth over time and fast-out from rapid release by logging). About half the carbon produced in wildfires remains bound to the soils for nearly a century, while the other half is stored for millennia (Singh et al. 2012). After fires, growth of surviving trees and new vegetation sequester carbon, offsetting emissions within about 5-50 years (depending on site factors; Meigs et al. 2009, Mitchell 2015).

Does Logging Store or Release Carbon? Depending on logging intensity, forest type, and forest age class, up to 62% of carbon stored within a forest is released to the atmosphere as CO2 pollution when forests are cut down due to decomposition (or burning) of logging slash, stumps, root wads, and soil carbon losses with additional emissions during transport and manufacturing of wood products, especially over large hauling distances (Oregon Global Warming Commission 2018, Law et al. 2018). The remaining 38% is temporarily embodied in wood product pools ranging from 1 year (paper) to decades (buildings) before decomposing and emitting CO2 in landfills (Oregon Global Warming Commission 2018). This loss is not made up for by planting trees or substitution of wood for steel in buildings (Law et al. 2018). Thus, wood product pools have a much shorter carbon retention "life span" than the carbon stored in unlogged forests (Law et al. 2018). Based on recent studies in the Pacific Northwest, carbon stocks in forests can be doubled if forests are protected from logging on federal lands, timber harvest rotations extended from 35 to 70 years on private lands, and other forestry improvements (Law et al. 2018). Avoiding emissions from deforestation and forest degradation is also recommended by the Intergovernmental Panel on Climate Change as an effective means for preventing warming in excess of 1.5°C globally. According to NASA's Earth Observatory (2017), California already is pushing temperature increases dangerously close to unsafe levels.

Does "Thinning" Reduce Emissions from Wildfires? Studies of landscape-scale logging ("thinning") to reduce the probability of crown fires show that this practice will not reduce carbon emissions under current or future climate scenarios and may in fact make matters much worse, especially if thinning residues are burned as biofuels (Meigs et al. 2009; Hudiburg et al. 2009, 2011; Campbell et al. 2012; Mitchell et al. 2012; Schulz et al. 2012; Law et al. 2013). This is because the amount of carbon removed by landscape-scale thinning and related activities to influence fire behavior is larger than that saved in a fire, and fire only occurs on a fraction of the areas thinned (Rhodes and Baker 2009, Campbell et al. 2012).

Conclusions

California's forests have always benefited ecologically from periodic mixed-severity fires that create diverse wildlife habitat, stimulate plant growth and nutrient cycling, and carbon sequestration. Overall, they are not a major source of emissions currently as most of the carbon remains on site after disturbance and new vegetation offsets losses. Much bigger emissions are produced by logging and other industrial sectors. Thus, policies that advocate for increased logging are inconsistent with California's otherwise ground-breaking climate change efforts, and the recommendations of the Intergovernmental Panel on Climate Change. Protecting forests from logging is a natural climate solution on par with global efforts to mitigate climate change impacts (Griscom et al. 2017). California has some of the most carbon dense forests on the planet and these forests should form the backbone of a comprehensive climate change strategy that includes avoiding and reducing emissions from all sectors while preparing for unavoidable consequences of rapidly advancing climate impacts.

Biomass Power is a False Solution

by Brian Nowicki, California Climate Policy Director, Center for Biological Diversity

Fire policies in California rely heavily on burning forest biomass for energy production paired with efforts to increase logging to alter forest fire behavior. Biomass power is often portrayed as being carbon neutral, but it is not. Instead, biomass facilities increase greenhouse gas emissions; undermine the transition to clean, renewable power; pose public health threats in already-disadvantaged communities; and distort policies for forest and fire management.

Biomass energy is more climate-polluting than coal.
Forest-sourced woody biomass energy generation emits about 50% more CO2 per megawatt-hour of electricity produced than coal-fired power and three times the CO2 of natural gas (Booth 2014). While the baseline emission rate for California's current electricity portfolio is about 500 lbs CO2 per MWh (CARB 2018), biomass can emit more than 3,000 lbs CO2 per MWh (Booth 2014), and smaller-scale facilities using gasification technology are similarly carbon-intensive (Ascent Environmental 2012).

Using forest biomass as a feedstock is a significant net negative impact to the climate.
In addition to smokestack emissions, an accurate accounting of the climate harms of biomass energy must include the carbon implications of the tree removals that generate the feedstock. Thinning operations tend to remove about three times as much carbon from the forest as would be avoided in wildfire emissions (Campbell et al. 2011), and the removal of live trees from the forest also results in a loss of future growth and carbon sequestration by those trees.

The climate damage of biomass can persist for decades to centuries.
Bioenergy converts stored carbon to CO2 instantaneously, while future resequestration or avoided decomposition may take years, decades, or even centuries to achieve atmospheric parity. Multiple studies have shown that it can several decades to discharge the "carbon debt" associated with bioenergy production, even where "waste" materials like timber harvest residuals are used for fuel (Manomet Center for Conservation Sciences 2010; Repo et al. 2010, McKechnie et al. 2011; Mitchell et al 2012; Schulze et al. 2012; Booth 2018). Where forests are harvested specifically for fuel, it can be decades to centuries, if ever, before the bioenergy system realizes a net carbon benefit (depending on harvest intensity, frequency, and forest characteristics) (Searchinger et al 2009; Hudiburg et al 2011; Campbell et al 2011; Mitchell et al. 2012). One study concluded that the resulting atmospheric emissions increase may even be permanent (Holtzmark 2012).

The Trump Administration and Congress have directed federal agencies to disregard the science and assume biomass is carbon neutral.
The 2018 federal omnibus appropriations bill included a provision that ignored the recommendations of federal agencies and a scientific advisory board, and simply directed agencies to issue regulations that "reflect the carbon-neutrality of forest bioenergy." Similarly, in April 2018, EPA administrator Scott Pruitt disregarded science-based rulemaking and simply directed his agency to pursue policies that promote biomass.

California state policy ignores the carbon impacts of biomass as a component of forest policy.
California's greenhouse gas cap-and-trade program does not count the emissions from biomass combustion when calculating the level of carbon pollution for which electricity companies must obtain or purchase credits for smokestack emissions. Other California law requires that electricity suppliers collectively purchase 250 MW of biomass power annually, and California's Forest Carbon Action Plan and Vegetation Treatment Plan both prioritize biomass energy as a driver for forest thinning projects that remove live trees from the forest. Each of these policies includes a de facto assumption that biomass energy is carbon neutral, without explicitly stating that finding or providing any determination of the carbon impacts of biomass.

Policies that subsidize forest biomass divert funds from zero-carbon sources like solar and wind and impede the transition to renewable energy.
Biomass energy can be five times as expensive as wind and solar, costing $199/MWh compared to $40/MWh for wind and solar (PG&E 2017). Yet California requires that electricity suppliers collectively purchase 250 MW of biomass power annually.

Biomass results in significant emissions of air pollutants, often in California's most polluted communities.
In addition to producing large amounts of CO_2, biomass generation can result in significant emissions of air pollutants that harm human health, including nitrogen oxides, carbon monoxide, particulate matter, and black carbon (Booth 2014). Biomass burning also emits large amount of hazardous air pollutants, including hydrochloric acid, dioxins, benzene, formaldehyde, arsenic, chromium, cadmium, lead, and mercury. Biomass emissions can exceed those of coal-fired power plants even after application of best available control technology.

The five most polluting biomass facilities in the San Joaquin Valley are located in the top four percent most disadvantaged census tracts in the state. For example, the Rio Bravo biomass plant in Fresno—which is expected to receive trees logged after the Rim Fire near Yosemite National Park, in a project promoted by the Sierra Nevada Conservancy—is located less than a half-mile from the Malaga Community Park, Malaga Elementary School and surrounding homes, in a neighborhood with a pollution burden score of 100 (Gale 2017).

Conclusion: Forest biomass energy is an expensive and highly polluting electricity source that is a false solution for the climate and for forest management.

Forest Fire Policies are Being Misapplied to Chaparral Ecosystems

by Richard Halsey, Executive Director, California Chaparral Institute

Chaparral is California's most extensive plant community. It is found in every county in the state. Characterized by drought-hardy shrubs, a Mediterranean-type climate, and infrequent, high-intensity fire, chaparral provides the habitat richness responsible for making California one of the most biodiverse regions on earth (Halsey and Keeley 2016). The chaparral's relationship to fire is dramatically different from that of California's forests. Actions that are often proposed for addressing fire in forest ecosystems are not appropriate in chaparral ecosystems and can lead to more flammable landscapes, destruction of critical habitat, and are an ineffective approach to protecting human communities built in these areas.

High-Intensity Fire Required

The natural fire regime for chaparral is characterized by large, high-intensity crown fires with a return interval of 30 – 150 years (Keeley and Fotheringham 2001; Lombardo et al. 2009; Safford et al. 2014). Research has demonstrated that the higher the intensity of the fire, the better the chaparral is able to recover (Keeley et al. 2005). Therefore, concerns over reducing fire intensity and severity are irrelevant to chaparral ecosystems; there's no such thing as a low-intensity chaparral fire except at the edges of fire perimeters or when localized conditions (e.g. boulders, wind shifts, moisture) reduce fire intensity. By the very nature of the physical structure of shrubs, high intensity fire is an inherent part of chaparral fires.

Long Fire Return Intervals are Required, and Too Much Fire Causes Loss of Chaparral

When compared to most forests, chaparral has comparatively long intervals between fires (30 – 150 years or more). Long fire return intervals are vital for the chaparral's ecological health. It can take up to thirty years for the native shrubs to build up enough seed in the soil to provide adequate germination rates post fire.

However, increases in fire frequency due to human-caused ignitions and the effects of climate change cause chaparral stands to become more open and are often invaded by nonnative grasses. Fire-return intervals fewer than 10 years have been shown to be highly detrimental to the persistence of chaparral species (Haidinger and Keeley 1993, Jacobsen et al. 2004). As grasses increase, the flammability of the chaparral ecosystem also increases. As a consequence, a positive feedback loop is created whereby more grass encourages frequent ignitions. Such frequent fires not only eliminate the native shrubs, but they facilitate the further spread of invasive weeds and grasses due to the fact that grass fires are less intense than shrubland fires. The type conversion process can ultimately lead to the complete replacement of native chaparral with nonnative grasses (Halsey and Syphard 2015).

Prescribed Burns and Vegetation Clearing are Destructive to Chaparral and Increase Fire

When fire management policies commonly used in forests—such as prescribed fire and vegetation clearing—are misapplied to chaparral, the results are destructive to the ecosystem and can actually increase fire. Since there is too much fire in chaparral plant communities due to human-caused ignitions, adding more through prescribed burns only increases the threat to the chaparral ecosystem's continued existence and conversion to invasive grasses that bring more frequent fires. Furthermore, prescribed burns are typically conducted in the late spring when the ecosystem is the most vulnerable to damage: the plants are growing, the soil is still moist, and many animal species are breeding. Therefore, prescribed burns can cause significant damage to plant growth tissues and destroy seeds in the soil due to soil moisture turning into steam, leading to chaparral type conversion.

Similarly, large-scale vegetation clearing projects (“fuelbreaks”) also cause the loss of native chaparral and the spread of invasive grasses that leads to more frequent fires. Amid the increasing dangers to chaparral from the effects of climate change, it is imperative that land management agencies do not exacerbate the loss of chaparral through activities like prescribed burns and large-scale habitat clearance projects away from homes. Instead, fire management in chaparral should focus on reducing the unnaturally high level of fire ignitions that has accompanied human development in this ecosystem (Keeley et al. 2005b, Keeley 2006, Syphard et al. 2007).

Focus on Homes and Their Immediate Surroundings to Make Fire-Safe Communities

While fire’s role in chaparral is different from in forests, the most effective way to keep homes from igniting during wildfires is the same in chaparral areas as in forest areas—focus on fire-safety features for homes and the zone right around them, rather than large-scale vegetation alteration in wildlands.

In a comprehensive study of the 2007 Witch Creek Fire in San Diego County, researchers found, "Wind-blown embers, which can travel one mile or more, were the biggest threat to homes in the Witch Creek Wildfire. There were few, if any, reports of homes burned as a result of direct contact with flames" from wildland fuels (IBHS 2008).

In a study examining 700,000 addresses in the Santa Monica Mountains and part of San Diego County researchers mapped the structures that had burned in those areas between 2001 and 2010, a time of devastating wildfires in the region (Syphard et al. 2012). Buildings on steep slopes, in Santa Ana wind corridors and in low-density developments intermingled with wild lands were the most likely to have burned. Nearby vegetation was not a big factor in home destruction. Looking at vegetation growing within roughly half a mile of structures, the authors concluded that the exotic grasses that often sprout in areas cleared of native habitat like chaparral could be more of a fire hazard than the shrubs. "We ironically found that homes that were surrounded mostly by grass actually ended up burning more than homes with higher fuel volumes like shrubs," Syphard said.

Working only on defensible space is not sufficient. Many homes with adequate defensible space have still burned to the ground because embers have entered through attic vents, ignited flammable materials around the home (litter in the gutter, wood stacks, wood fencing), or found their way under roofing materials (Maranghides and Mell 2009). The solution is to reduce the flammability of the home as much as possible: install ember resistant vents, Class A roofing, exterior sprinklers operated by an independent system, and remove flammable materials 100 feet from around the structure.

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