

Fighting Fire with Fire: How Relationships Between Plants and Fire Can Be Improved Through Prescribed and Cultural Fire.

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Interdisciplinary Synthesis and Expanded Understanding:

Interactions between plants and fire have been vastly affected by a policy of fire suppression which has existed in western North America since the onset of colonization. Fire suppression is a management practice which excludes fire from the landscape whenever possible with the rationale that fire is harmful or inherently dangerous. Fire suppression policy has historically banned the Cultural Fire practices of Indigenous peoples as a mechanism of their genocide. Practices which exclude good fire from the landscape have negative impacts on Indigenous people and native plant communities, while increasing the risk of catastrophic, unplanned wildfires.



Figure 1- Plants and fire. Image from Water News Network.

Fire is an important force in clearing dead plant matter – detritus- from ecosystems of all vegetation types. Nearly every landscape type in Western North America is adapted for fire and has historically been managed by Indigenous peoples with regular intervals of controlled burns. When fire is removed from the landscape for longer times than the intended return interval, detritus accumulates and adds large amounts of available fuel to the ecosystem. 150+ years of fire suppression management practices have led to massive accumulation of fuels in landscapes across the west, creating larger and more destructive fires. As the fuel load of an area increases, the intensity of a fire also increases. As intensity increases, vegetation is more affected by fire and plant communities struggle to recover.



Figure 2 Aftermath of Caldor Fire in El Dorado County, three years postfire. Photo taken by Megan Hatcher, 2024.

Many Indigenous people tried to speak out and represent good fire as a management practice in the early 1900s. A Karuk man called Klamath River Jack wrote to the department of Fish and Game in 1916 emphasizing the importance and long history of controlled fire in Northern California, and begging the state officials to support putting cultural and prescribed fire back onto the landscape. His arguments were that a lack of fire destroyed Indigenous food systems and that people were starving without the land management practices they had been using for millennia. The forest ranger's response was that fire would kill the trees, create more detritus on the forest floor, and harm personal property. The ranger's solution for the starving Indigenous community was for them to buy and eat white people's food. This set of correspondence between Klamath River Jack and the Dept of Fish and Game illustrates an unfortunate view of colonialist superiority. These land managers truly had no idea what they were talking about in terms of ecological response to fire. Their response to Klamath River Jack shows their commitment to the settler colonial project of denying Native communities their traditional land management practices and destroying systems of food sovereignty

in the hopes of forcing Indigenous people to conform to colonial economies and food systems. Fire suppression is also cultural suppression.

And, Jack, if your acorns are wormy, don't blame it on the white man keeping fire out of the country – there are a good many other things that keep bugs alive. And I have seen the best kind of acorn crops in places that never felt a fire. Anyway, there are other things that make better flour than acorns; why not plant some grain and vegetables and fruit trees on that flat back of your cabin? That's white man's grub, but its pretty good.

Yours truly,

(Signed) Jim Casey

Forest Ranger

Figure 3- Forest Ranger's response to Klamath River Jack. Ranger Jim Casey provides poor ecological analysis, and tells Jack to conform to white food systems. Photo from a letter sent by Klamath River Jack.

Fire suppression is also focused on protecting timber harvest, not the forest ecosystem. Early colonizers thought that resources were theirs for the taking and felt entitled to commodify everything they could get their hands on. This mode of thinking meant that trees were, and are still, viewed as a commodity which should be extracted from the landscape. These mindsets continue to this day, making people feel entitled to kill and remove these massive organisms which make up the basis of many ecosystems. Early settlers did not want fires to occur in the forests because they thought it would kill the trees, which then could not be used or sold as building materials. This self-centered and capitalist approach to land management still pervades modern forestry spaces and informs fire suppression policies.



Figure 4 Men Logging old growth trees in Humboldt County, CA. Illustrates extractive practices and entitled mindset of 19th and 20th century land management. Photo by Augustus Ericson.

Suppression practices have normalized a negative opinion on fire and pervaded the public's perception of fire. This has made the average person afraid of having fire in the landscape and makes them think that all fire is bad for the ecosystem. People fear for their property and think they are helping the forests but genuinely do not understand the importance of fire as an ecological process. They are caught up in their values which center personal property and extractive practices above all else. The landscape we know has existed with fire for time immemorial and it needs fire to thrive. The landscape which has existed for thousands of years should be valued and understood more by the public to inform more positive associations with fire.

One large public figure in fire suppression is Smokey Bear. Smokey bear serves as a tool of propaganda for fire suppression practices and misleads the public in thinking that fire is inherently bad for every organism in the landscape. This is misleading as most plants in the western united states are adapted for fire and rely on it to eliminate competition for light, clear detritus from the ground, and create ideal conditions for seed dispersal. In fact, many conifers in California are serotinous, meaning they rely exclusively on fire to open their cones and disperse their seeds. Smokey gives the impression not only that fire is harmful but also that fires are immoral and dangerous. In this way, Smokey the bear perpetuates colonial practices of removing cultural fire from the land and outlawing Indigenous land management practices. The removal of Cultural fire from Native communities disrupts connection to the land as well as food sovereignty for people who use cultural fire. By perpetuating the idea that all fire is bad, Smokey the bear villainizes indigenous people who use cultural

fire for land management and for their food systems, furthering the settler colonial project to drive Indigenous peoples from their land and outlaw their practices.



Figure 5- Propaganda Poster featuring Smokey the Bear. Photo from the National Agricultural Library.

Prescribed fire is a tool which is making a comeback in some land management spaces. Prescribed fire is good fire, in that it helps clear detritus from the forest in a controlled manner. Many times, excess fuels are removed from an area before a controlled burn so that the fire intensity remains low and existing vegetation is not harmed. Areas which have been recently burned with prescribed fire cannot re-ignite when an uncontrolled wildfire comes through. If enough land is treated with prescribed fire, it can slow or stop a wildfire in its tracks. The movement of using prescribed fire is growing rapidly in Humboldt County but has yet to catch on in other parts of the rural west.



Figure 6 Prescribed burn in oak woodland as part of a ridgetop fuel break. Photo taken by Tristan Fritch, 2026.

The relationship between plants and fire is reciprocal and has existed for as long as plants have adapted to landscapes with active fire ecology. Plants constantly produce organic matter which in turn makes up the fuel load of an ecosystem- how much organic fuel is there that could burn at any given time. When fire is applied consistently to the landscape, the fuel load is kept at a low level and the fires themselves, in turn, stay small and have low intensity. When fire is suppressed, woody debris and other dead plant matter build up in forested areas to create dense fuel beds which burn longer, hotter, and with more intensity. This has resulted in increasing size and severity of fires in the west and in California in the last century, as can be seen today by massive complex fires occurring nearly every year across the state. Fire and plant ecologies are inextricably linked and together are affected by the impacts of fire suppression.



Figure 8 Monkeyflowers – Diplacus torreyi- growing near Caldor Fire. Photo by Megan Hatcher, 2024.

One way to quantify and analyze the relationship between plants and fire is with mapping software and GIS (Geographic Information Systems) practices. Satellite

imagery can provide valuable data insight into the effects of fire and the regeneration of plants in the postfire burned area.

The increase in fire size and frequency since the onset of fire suppression is shown by Figures 4-6. These maps show the massive shift over time from scarce and small fires in the early 1900s to larger and more common fires across the state just between 2018 and 2025. Another way to quantify the effects of fire using maps is to do a Normalized Burn Ratio Index (NBR) to compare an area before and after a fire. This index produces a map split into classes of fire severity to show exactly where the severity and intensity of the fire was greatest.



Figure 9- California Fire perimeters between 1908 and 1918. Fires are shown in red. Compare to figures 10 and 11. Map from Esri, USGS, and NASA.



Figure 10- California Fire perimeters between 1948 and 1958. Fires are shown in red. Compare to figures 9 and 11. Map from Esri, USGS, and NASA.

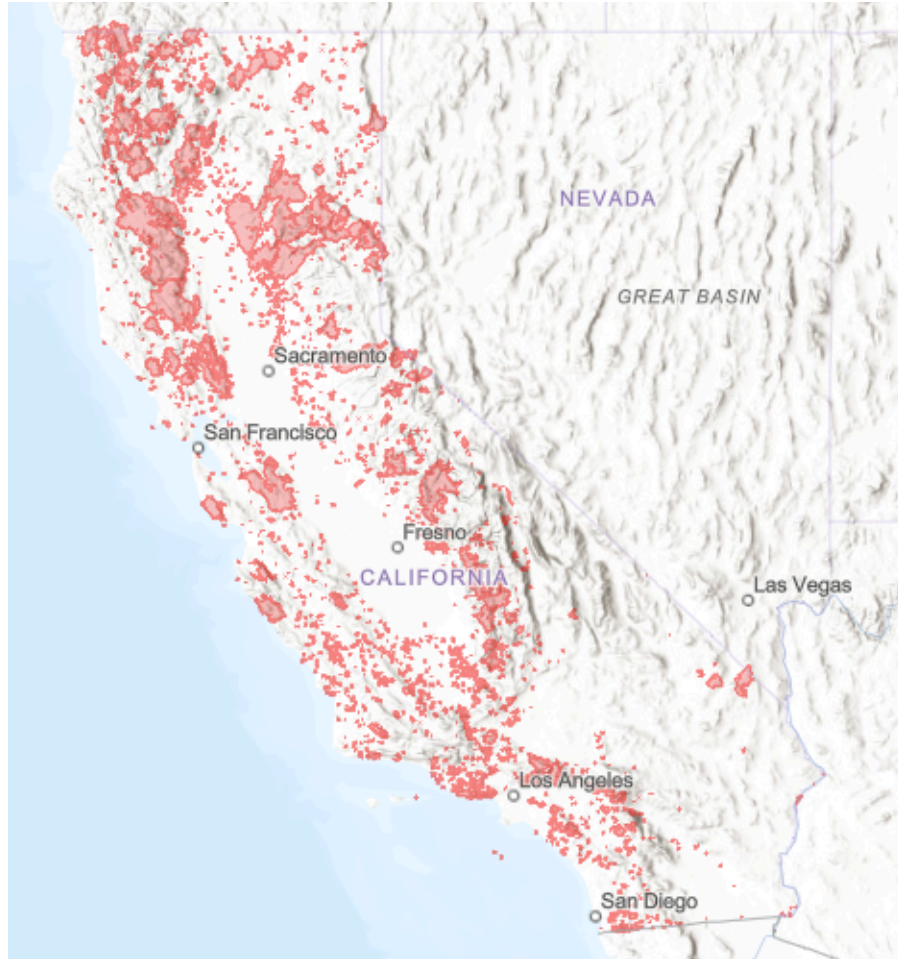


Figure 11-California Fire perimeters between 2018 and 2025. Fires are shown in red. Compare to Figures 9 and 10. Map from Esri, USGS, and NASA.

By comparing reflection of individual wavelengths before and after a fire, geospatial analysis can show the spatial extent of damage done by a fire in a particular area and quantify the severity of the burn. After some time has passed after a fire, analysis can be done to determine vegetation health and density in the burned area. Figure 7 and Table 1 go together to demonstrate the burn severity of the Caldor fire, a large wildfire which burned in 2021 in the El Dorado National Forest, just southwest of lake Tahoe. I chose this fire to demonstrate how large proportions of extreme wildfires burn at a high severity.

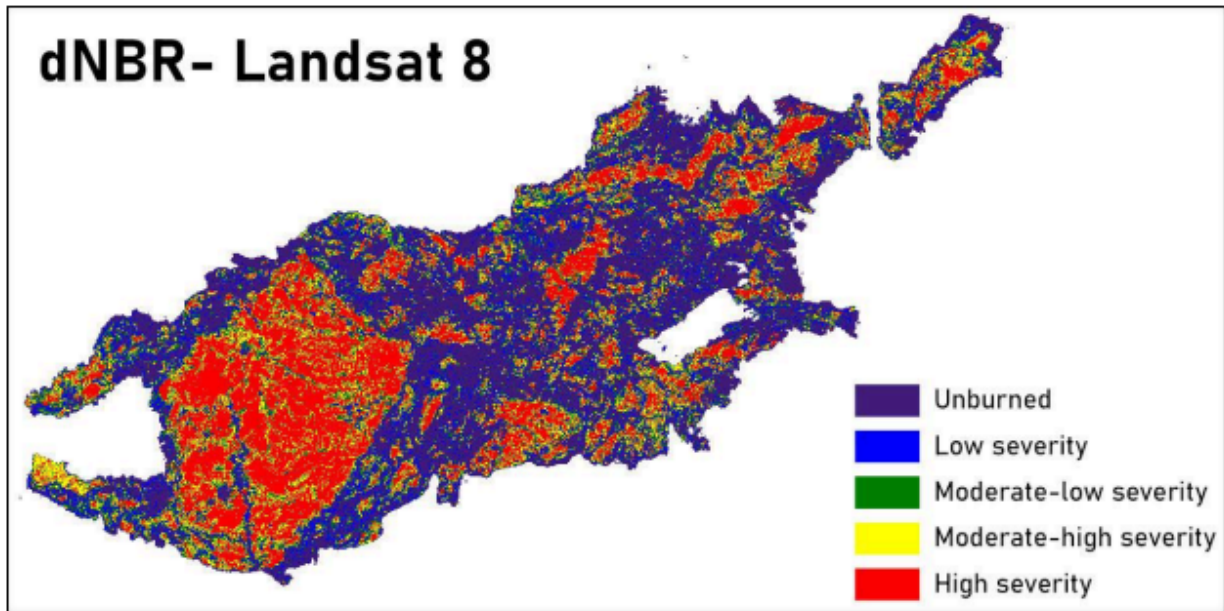


Figure 12 Landsat 8 burn severity map at 30m resolution, sorted into severity classes. Analysis done by Megan Hatcher.

Table 1: Landsat 8 classification displaying acreage of each burn severity classification and the proportion of the total area burned at each severity level. Analysis done by Megan Hatcher.

Classification	Acreage	Percent of total
Unburned	73,705	33.0
Low severity	33,531	15.0
Moderate-low severity	27,136	12.2
Moderate-high severity	30,855	13.8
High severity	57,789	25.9
Total	223,015	100.0

The data in Figure 9 and Table 1 show that the largest proportion of burned areas in the Caldor fire burned at High intensity. This is a pattern which plays out across the state as large wildfires occur with increasing frequency and severity. High fuel loads caused by decades of fire suppression lead to more severe fires. This can be analyzed and shown using mapping technology and GIS.



Figure 13- Aftermath of Caldor fire three years postfire. Note the lack of woody vegetaiton regeneration and the structureless, eroded soil. Photo taken by Megan Hatcher, 2024.

Reflection on the Interdisciplinary Process:

I feel that my interdisciplinary ability gives me a deeper understanding of ecological processes over a large spatial extent. Combining Fire science, Botany, and Geospatial science feels so seamless that I am surprised it isn't a regular major. The plants in a plant community affect how intense and severe a fire will burn. Some plants are so fire adapted that they put oil in their bark and tissues to encourage ignition of that plant when fire is present. Many plants rely on fire to open their seed cones and allow for seed dispersal – an adaptation called Serotiny. The relationship between plants and fire has been upended by fire suppression. As fires are burning with more fuel at higher intensity, they destroy plants which are adapted to lower intensity fires. The damage of high intensity fires is greater on plant communities than historical fire regimes. This data can be quantified using GIS and mapping software to generate a map of fire intensity and vegetation regrowth following a fire. This software uses wavelength data from satellite images to analyze fire behavior and effects from the sky.

Plants and fire are also inextricably linked to Indigenous right issues. Access to land and ability to practice traditional relationships with more than human relatives has been a huge struggle for Indigenous people under colonization. Plants provide native people with physical and spiritual nurturing which keeps their traditional knowledge and food systems alive. Fire is often used culturally to manage the land for increased food production and growth of culturally valuable plant species. Cultural Fire practices are passed down orally through communities, making it a valuable form of cultural and generational learning systems. When Cultural fire is outlawed, Indigenous communities are deprived of their Food Sovereignty, their knowledge systems, and their intergenerational connectedness. Fire suppression is cultural suppression.



Figure 14 Columbine- Aquilegia Formosa- growing in Caldor fire Burn scar three years postfire. Photo taken by Megan Hatcher, 2024.

Fire suppression is such a strong public mindset that it's hard to convince many people that fire is not inherently destructive. Figures like Smokey the Bear have hammered in strict fire exclusion to the psyche of most Americans and convinced them to be unconditionally afraid of fire. People fear for timber harvest, personal property, and air quality. They do not know that air quality is far better when land is burned with

prescribed fire than when it is burned under an uncontrolled wildfire. People have been misled by the information fed to the public about fires over the past 150 years.

Applying prescribed fire to the landscape is necessary but seems scary to people who are afraid of fire. Strategically burning about 10-15 % of land area can significantly decrease the likelihood of wildfires. People need to see fire as a management tool instead of something to exclude. There should be newer, more comprehensive programs being implemented to change public opinion of fire into a more positive conversation. Educating people is one of the best ways to change the perception of fire and to increase public approval of prescribed fire efforts.



Figure 15 Prescribed burn in oak woodland as part of a ridgetop fuel break. Photo taken by Tristan Fritch, 2026.

Recommendations for Addressing the Problem:

In terms of solutions to the problem of fire suppression, my suggestion is threefold. First, prescribed fire should be made more accessible to landowners by one means or another- either by encouraging landowners to allow prescribed burn units onto their land to carry out burns or through training to encourage the landowner themselves

to do prescribed fire. A solution to the suppression of cultural fire would be to make legislation which legalizes cultural burns with less strict regulation than there is now and empower Indigenous communities to reignite their connection to fire. A third solution to fire suppression would be to change public perception of fire through educational programs and community outreach. Let indigenous people do their own cultural fire practices and involve them in conversations about land management practices. This would alleviate the inherent fear that the public has of fire as a whole and hopefully push for more prescribed fire on public and private lands.



Figure 16 Buckwheat- Eriogonum nudum- growing in Caldor fire burn scar three years postfire. Note eroded soil, burned woody debris, and tree stumps cut down postfire. Photo taken by Megan Hatcher, 2024.

Short-term solutions to fire suppression involve putting fire back on the landscape a little bit at a time. The continuance of prescribed fire programs would greatly reduce the

risk of catastrophic wildfires in areas treated with good fire. While prescribed fire has become normalized in Humboldt County, it is still wildly unpopular in other counties in the state and regions across the west. Another short-term solution is to roll back legislation that prohibits cultural fire in Indigenous communities. Some bills have already passed which permit cultural burns in some part of the state, but Cal Fire hasn't caught up to upholding that legislation and Indigenous people may still be cited for carrying out cultural burns. Indigenous communities deserve to carry out cultural burns without the fear of legal retribution from the settler colonial state.



Figure 17- Man applies Prescribed fire with a Drip Torch. Photo from Sonoma County Regional Parks.

Long-term solutions are like the short-term ones. Over the next years and decades, prescribed fire should become a regular practice within land management across the state, with larger areas burned as fuel loads are gradually reduced across the forests. Legislation inhibiting cultural fire should be replaced by laws which encourage the practice of cultural burns and social programs that empower Indigenous people and put resources into cultural fire programs. Another long-term solution should be public educational programs which encourage people to learn about good fire and view fire as a management practice, not just a destructive force. If public perception of fire shifts, it would be easier for fire positive legislation to be passed.



Figure 18- Aftermath of Caldor fire taken three years postfire. Note lack of woody vegetation regeneration. Photo taken by Megan Hatcher, 2024.

Next Steps

Some limitations faced in trying to combat fire suppression are the ignorance and intellectual theft related to cultural fire. As with any Indigenous rights issue, there is a long history of cultural suppression and forced assimilation into colonial society. These prejudices run deeper than most people realize and are embedded in the ways people think about fire. As prescribed fire through the forest service and other state agencies become popularized and more common, there is a perception that these state agencies “discovered” prescribed fire as a land management practice. Indigenous people have held the knowledge of how to apply fire to the landscape for thousands of years and should be credited with the knowledge being used today. Not crediting Indigenous peoples in the knowledge of prescribed fire is intellectual theft and a breach of data sovereignty- the concept of Native communities having rights and sovereignty over their teachings and TEK. Settler colonial institutions seek to either ignore Indigenous knowledge systems or completely discredit them for the benefit and glory of state

agencies. Fire agencies should be working alongside Indigenous communities to incorporate good fire practices into land management while giving credit to those knowledge systems and communities.



Figure 19 Lily -Lilium washingtonianum- in Caldor fire burn scar three years post fire. Photo taken by Megan Hatcher, 2024.

Another limitation is the inherent fear of fire that has been instilled in the public. People have bought into the idea that all fire is bad and destructive. They fear the destruction of property, the destruction of forest ecosystems, and the destruction of timber harvest. These fears are misled and come from over a century of public information programs demonizing fire in any form – thanks, Smokey. People also complain about air quality problems from smoke. It has been found that prescribed fires

with low intensity produce far less smoke than an uncontrolled fire of the same size and a higher intensity

A great way to study the effect of fire on plant communities at the landscape level is to use GIS as a data analysis tool. There is all kinds of open-source satellite imagery that anyone can access and even more proprietary data available to government agencies that can be used to monitor fire severity and plant recovery after a fire. GIS should be implemented more to understand the relationship between plants and fire, and to model predictions for fire behavior under climate change. This is a valuable tool which should not be ignored.



Figure 20 Prescribed fire in Douglas Fir Forest on Prosper Ridge in Petrolia, CA. Photo taken by Trisan Fritch, 2026.

Conclusion:

The interdisciplinary approach to fire science is crucial in understanding every aspect of the world which fire touches. It is necessary to incorporate the understanding of ecological and cultural aspects of fire to move forward with land management practices which create a safer and more equitable world, adapted to work with fire

instead of against it. It is also important to understand the ecological effects of fire on plant communities and patterns of plant regeneration after a fire. Geospatial sciences offer a unique opportunity to analyze spatial distribution of plant and fire relationships.

Fire is an inevitable ecosystem disturbance which must be facilitated by prescribed and cultural fire to avoid catastrophic, uncontrolled fires. If we don't respect fire, it's going to burn us.

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