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Solutions to California's Wildfires:

Indigenous Stewardship and Traditional
Ecological Knowledge

Kristiana Chan

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EXECUTIVE SUMMARY

In 2021, Governor Gavin Newsom released a new plan to address California’s pervasive wildfires. This plan incorporates the use of controlled burns, a technique used by various Indigenous tribes of the region to cultivate the land as well as lessen wildfire severity. This announcement came shortly after Newsom’s formal apology on behalf of the state’s treatment of Native people, such as the state funded genocide, the destruction of culture and livelihoods, the encouraged kidnapping of children, forced indentured servitude, and theft of land. Though this apology and efforts toward co-management are welcomed first steps, they will need to be met with action and acknowledgement of Tribal sovereignty. Otherwise, these statements will remain no different than other empty promises made by the United States government to Tribal Nations. To build these bridges of trust, the state government will need to entrust Native communities with leading operations on forest restoration and fire management. Additionally, the removal of permitting barriers and increasing accessibility to insurance for experienced fire practitioners can help streamline the process of bringing ‘good fire’ back to the landscape when conditions are ideal. Lastly, examining methods for upgrading the grid could help with preventing devastating wildfires caused by transmission line failures. Each of these steps is imperative for increasing cooperation and collaboration as well as shielding California from the impacts of climate change that are projected to worsen wildfire severity and frequency over the next century.

KEYWORDS

Indigenous Stewardship • Traditional Ecological Knowledge • Fire Management • Prescribed Burns • Cultural Burns • California • Land Back • Wildfires • Climate Change • Environmental Justice • Air Quality • National Parks • Fire Prevention • Forest Management

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INTRODUCTION

Until recently most cultural and prescribed burns were outlawed across California. Various barriers such as permitting, insurance, and liability prevented Tribal communities and landowners from performing these intentional and controlled burns (Clark et al, 2021). Fortunately, with Governor Gavin Newsom’s “Wildfire and Forest Resilience Action Plan” and his pledge of \$536 million dollars in funding toward wildfire prevention (Office of Governor Gavin Newsom, 2021), prescribed burns are finally being reexamined as a viable solution to preventing these devastating wildfires from occurring in the first place (Newsom et al., 2021). This plan aims to increase prescribed burns across the state from the current 125,000 acres per year (CA Air Resources Board, 2021) to 500,000 acres annually by 2025 (Newsom et al., 2021p. 70). To achieve this goal, funding will be distributed toward the automation of permitting, examination of liability/insurance options for burners, the establishment of training centers, and via grants for Tribal governments who practiced (prior to fire suppression policies) or practice cultural burns (Newsom et al., 2021p. 20).

Government interest in intentional burns to prevent wildfires might be new, yet these burns have been conducted by Indigenous peoples across the globe for thousands of years (Raish et al., 2005, p. 115). The introduction of fire to certain landscapes offers revitalization by removing dry, dead plant material, which promotes new and healthy growth along with the establishment of paths that act as fire breaks (Indiana Division of Fish and Wildlife, 2005, p. 1). This technique was particularly effective in California’s highly fire-prone forests (Raish et al., 2005, p. 115) and carried out by the northern-located Yurok, Karuk, and Hoopa Tribes (Buono, 2020), the central Santa Ynez Band of Chumash Indians (Cordero, 2018), and the southern-located Iipay Nation of Santa Ysabel and the Pala Band of Mission Indians (Historian: Dr.

Heather Daly, personal communication, May 25, 2021). These Nations (along with many others) used their Traditional Ecological Knowledge (TEK) to tend to the landscape and build fire resilience throughout the region (Anderson, 2005, p.1). However, due to the United States' policy of complete fire suppression from the early 20th century to nearly the present day (Forest History Society [FHS], n.d.), this technique of forest management, along with the cultural and preventative benefits of the use of fire was nearly lost. Fortunately, perceptions of the use of controlled fire to combat wildfires are shifting due to consensus among Indigenous communities, fire ecologists and researchers, and the overall better acceptance of TEK of recent (Rinkevich et al., 2011, p. 1).

Over the last century, fire suppression has been the primary method of addressing wildfires. However, according to the California Department of Forestry and Fire Protection (CAL FIRE), wildfire outcomes have not improved, nor has a significant reduction in property damage been found (Li & Banerjee, 2021, p. 1). In fact, recent data released by CAL FIRE shows wildfires increasing in frequency (longer fire seasons) and intensity since this policy was introduced, with peaks noted over the last two decades (Li & Banerjee, 2021, p.1). These peaks are correlated with the increased incidence of heatwaves and droughts over this period (Li & Banerjee, 2021, p.1) and attributable to anthropogenic climate change (Wehner et al., 2017, sect. 8.1.3, 8.3). Hotter temperatures and low precipitation provide the ideal conditions to spark wildfires via low humidity and increased accessibility to loads of dry and dead vegetation (Wehner et al., 2017, sect. 8.3). Based on the CMIP5 (Coupled Model Intercomparison Project 5) climate model, droughts are only projected to worsen as reduced snowpack over the Western Mountains persists, due to rising temperatures at higher altitudes (Wehner et al., 2017, sect. 8.1.2). These conditions are only projected to worsen over the next century, with researchers

predicting even more intense and frequent wildfires to continue impacting California, along with eliminating any progress on emissions reductions from other sectors (Clark et al, 2020, p. 4).

Since the 1980's CAL FIRE has performed prescribed burns on a very small scale (Terence, 2016), along with adopting a "let it burn" policy in unpopulated areas (policy limited by the increasing expansion of the wildland urban interface) (FHS, n.d.). In 2013, cultural burns were also brought back as the Yurok and Karuk Tribes were able to perform them in collaboration with CAL FIRE and the Nature Conservancy's Prescribed Fire Training Exchange (TREX) (Buono, 2020). Yet many barriers have delayed complete implementation. One large barrier that Newsom's action plan also cites is extensive regulation and expensive permitting requirements that delay burns when conditions are ideal (Clark et al., 2021, p.1). Many factors are needed to be taken into consideration in planning a safe and effective burn, and time lost consulting agencies and getting stuck in red tape is time lost further improving the environment's resilience toward wildfires (Clark et al., 2021, p. 1).

Another method of addressing wildfire prevention would be to upgrade/harden transmission lines. Though electric utility infrastructure is responsible for less than 10% of wildfires, power lines are responsible for about half of the most destructive fires in California's history (CA Public Utilities Commission, 2021). Hardening of the lines, i.e., making them more fire resilient, or building underground in the most high-risk areas are key to prevention, as well as addressing the persistent blackouts faced across the state (Gilmer, 2019). Wildfires can also be started by non-human activity, such as lightning strikes which are of particular concern in mountainous terrains toward the west yet only account for a mere 5% of the fires in California (Isaacs-Thomas, 2020).

BACKGROUND

Benefits of Cultural Burns

Cultural burns are performed for a variety of reasons. Hazel for instance, grows in a tangled bush when fire is absent from its environment (Buono, 2020; Robbins, 2016). When fire is carefully reintroduced and used to burn around a young hazel plant, it grows long, straight branches, perfect for basket weaving, an integral part of Yurok culture (Buono, 2020; Robbins, 2016). This technique works similar on the branches of three-leaf sumac, also used for basket weaving and cultivated by the Wuksachi Band of Mono Indians in Sierra Nevada (Sommer, 2020). Oak trees also thrive when treated with fire, producing acorns, a key part of the traditional diets of the Yurok, Karuk, and Hoopa Tribes (Buono, 2020). Fire can also be used to rotate herds of deer and elk out of and into grazing areas (Cahill, 2018). This use of fire thins out forest undergrowth, promoting new, nutrient rich growth that attracts herds, another staple of Yurok traditional diets (Cahill, 2018; Roos, 2020). This grazing rotation also promotes carbon sequestration as it prevents the animals from disrupting the soil stores of carbon (Stanley et al., 2018, p.249). Pictured below is a Yurok basket, filled with acorns and huckleberries.

Figure 1: Yurok hand-woven basket carrying subsistence diet staples: acorns and huckleberries.



“Good fire” © Kiliiii Yüyan

Burns are also helpful in rejuvenating various fruiting plants such as thimbleberries and raspberries, along with medicinal plants like wormwood (Cahill, 2018). Wormwood has a long history of use within Indigenous communities and can be used for a variety of ailments such as irritation from infection, certain intestinal issues, along with use as an effective insect repellent (Mickey, 2020). Another species important to subsistence diets that greatly benefits from burns is salmon. When forest density is sustainably reduced via cultural burns, less water draining from melting snowpack in the mountains will be picked up by trees along the way, resulting in fuller rivers, such as the Klamath River (Devis & Lieberman, 2017). This helps prevent heating events that would otherwise kill salmon that enter the river and go into shock due to the vast temperature change as shallow waters heat faster than the deeper ocean waters (Devis & Lieberman, 2017). Cultural fires also help clear brush and weeds out of streams that would otherwise block the salmon’s migration upstream to breeding grounds (Cahill, 2018). Ridding the forest of dry, flammable plant material promotes new growth which helps reduce wildfire severity and maintain California’s healthy landscapes (pre-colonization). Fire can also play a significant role in ceremonies and as a part of one’s cultural identity, as Margo Robbins, a

member of the Yurok Tribe puts it, “Our culture is fire dependent. Our people are hunters, gatherers and basket weavers” (2016).

A History of Discrimination & Violence Toward Indigenous Peoples

Cultural fire practitioners played a huge role in shaping this beautiful landscape for thousands of years. They were so skilled at respecting nature’s delicate balance that when naturalists such as John Muir visited the region, he believed it was untouched by man (Roos, 2020). This flawed belief that humans could not live in harmony with nature, along with pure racism and the paternalistic mindset of white supremacy set the stage for many of the policies that were put in place to steal Native Peoples’ land and destroy their lives and culture.

In the early 19th century, the U.S. government passed several acts to diminish Native American autonomy and ordered the seizure of the Cherokee Nation’s land in Georgia (Onion et al., 2018). In Alabama, following the devastating Battle of Horseshoe Bend, the U.S. government forced the cession of more than 20 million acres of the Poarch Band of Creek Indians’ land to the federal government (Onion et al., 2018). In 1830, President Andrew Jackson (slave-owner) and Congress passed the Indian Removal Act, forcing the Cherokee, Choctaw, Chickasaw, Creek and Seminole Nations to leave their ancestral lands and relocate to ‘Indian Territory’ in Oklahoma (Micalizio, 2020). This made over 25 million acres of fertile, lucrative farmland in the Southeast United States available to white settlers and slaveholders and relocated over 46,000 people, along with killing over 4,000 people due to starvation, disease, and exposure to extreme weather (Micalizio, 2020). Named the Trail of Tears, some Cherokee and Seminole groups held out for as

long as they could, with a group of Seminoles fighting federal troops for nearly a decade before being forced to surrender (Onion et al., 2019).

In 1850, California gained statehood and its first Governor Peter Burnett stated in his State of the State Address that an inevitable war of extermination will ensue between the races until the Indian race becomes extinct (Burnett, 1851). This statement, along with bounties openly encouraged and rewarded the slaughter of Native Americans and was funded by the California and U.S. government, effectively enshrining into law that white settlers could enslave Native Americans, take custody of their children, and make arrests (Blakemore, 2020). State money was allotted to arm local militias and build up a massive arsenal to kill Native people, with state militias raiding tribal outposts, and shooting and sometimes scalping Native Americans (Blakemore, 2020). Local settlers also took part in collecting local governments' bounties on Native American heads (Blakemore, 2020). It is estimated that these militia groups, joined by the U.S. Army, vigilante groups, and individuals massacred up to 16,000 Native Californians, in addition to the 100,000 who died from disease, starvation and homicide during the gold rush (Madley, 2016). The U.S. government and California state government spent \$1.7 million dollars to fund this not widely known genocide (Madley, 2016).

Encouraged by state policy, the Mariposa Battalion, a state militia, set out to remove and kill the Miwok Tribe of Yosemite Valley (Treuer, 2021). The 200 militiamen, after gold and armed with rifles, marched on Yosemite (Treuer, 2021). The Miwok Tribe hid, not looking for violence, while the militiamen burned their food stores "souring the valley's air with the smell of scorched acorns" (Treuer, 2021). The militiamen then found an inhabited village and burned their wigwam homes, shooting men, women, and children, murdering 23 people (Treuer, 2021).

They drove the Miwok Tribe from their ancestral homeland and forced them onto reservations (Treuer, 2021).

Passing of the Indian Appropriations Act created the reservation system that limited Native Americans to government allotted land and removed their rights to leave the area without permission (Onion et al., 2019). This interfered with traditional food gathering such as hunting, foraging, and fishing and forced Native Americans to adopt a commodities diet of wheat, grease, and sugar along with a U.S. instituted food ration (Native Americans in Philanthropy [NAP], 2021). Native people were also forced to wear non-Indian clothing and raise livestock (NAP, 2021). Starvation ensued and close-quartered living hastened the spread of diseases brought over by white settlers from livestock farming (Onion et al., 2019). Visits from Missionaries were also common as a further attempt to erase Indigenous culture and beliefs and to convert Native Americans to Christianity (Onion et al., 2019). Many Tribes actively resisted internment and the stealing of their lands leading to the Plains “Indian Wars” (NAP, 2021).

The establishment of National Parks in 1872 became yet another way the government forcibly pushed Native American communities off their land (Cordero, 2018). Supported by John Muir and President Theodore Roosevelt to preserve lands from human overuse, these parks stopped white settlement in certain areas, but were hugely detrimental to the Native American communities that were forcefully removed from their homelands and prohibited from their culturally significant sites and practices, along with their roles in land management (Cordero, 2018). The development of these National Parks highlights the realization that resources will eventually run out through settler colonialism and the capitalist mindset yet failed to consider the relationship many Indigenous Nations shared with the land, one where humans are a necessary part of the healthy ecosystem (Cordero, 2018).

The Dawes Act of 1887 marked the beginning of the allotment and assimilation era. This act allowed the government to divide reservations into plots of land for individuals to farm, yet also allowed the U.S. to section off the best, most resource-rich land on reservations to sell to white settlers (Howard University Law Library [HULL], 2018). By instituting tribal enrollment, where roll was maintained by the Bureau of Indian Affairs (BIA), further land could be withheld by denying one's tribal affiliation, which under this system depended upon one's relationship with government officials (HULL, 2018). Those who refused to abandon communal living for independent farming had food rations issued against them (HULL, 2018). The BIA also began kidnapping Native American children (HULL, 2018) and putting them into Indian Boarding schools that sought to "kill the Indian, save the man" as quoted by the Carlisle Indian School founder Richard H. Pratt (Daly, 2012, p. 1). Historian Dr. Heather Ponchetti Daly described how these schools severed the children's ties to their families and cultures and only taught the boys manual work and the girls domestic work with no higher education available (Personal communication, 2021). These attempts to 'whiten' Native Americans resulted in a large loss of Native languages and traditions¹ (HULL, 2018). Also in 1887, the court case *U.S. v. Clapox* ratified the Courts of Indian Offenses and set the stage for Native Americans to be charged under federal law (HULL, 2018).

The Indian Citizenship Act (Snyder Act), passed in 1924 provided tribal members dual citizenship with the United States. Next the Indian Reorganization Act of 1934, was passed to stop allotment policies and preserve Native American culture and help communities create Tribal Councils. This act was pushed for by the Commissioner of Indian Affairs, John Collier, an advocate for Native American culture based on his time spent among the Pueblos of New

¹ Just recently hundreds of children's bodies were found buried at residential schools in Canada, highlighting the violence that occurred within these schools and the families that never knew what happened to their stolen children.

Mexico (Daly, 2012, p. 25). Yet his perspective was based solely on his interactions with one tribe, vastly limiting his understanding of what Native communities wanted, leading to much dissent over the Indian New Deal (Daly, personal communication, 2021). Tensions rose further in California, as Collier did not attend the scheduled discussion of the new legislation in person, instead sending a representative to meet with the Tribes there (Daly, 2012, p.33). Many Tribal Nations in California already had functioning governments and concerns brought up during the meeting were not adequately addressed resulting in only 19% of California Tribes voting in favor of the bill (Daly, 2012, p. 62). Further confusion ensued after the passing of the bill, as many items that were promised to communities, did not make it to the final bill, resulting in further dissent and distrust of the U.S.'s promises (Daly, personal communication, Feb. 17th, 2021).

In 1953, House Concurrent Resolution 108 was passed by Congress, with the goal of abolishing tribes, selling reservation land, and relocating tribal members to urban areas (Native Voices, n.d.). This resolution effectively terminated the federal government's funding resources and services provided to tribes and shifted this obligation to be State's responsibilities, such as in California (Daly, personal communication, Jun. 1st, 2021). The 1958 Rancheria Act further aimed to terminate tribes, promising a slew of benefits and improvements to livelihood to those who complied, yet were unable to meet those promises (UCLA American Indian Center [UCLA], n.d., p. 13). Along with the generational trauma of forced assimilation, the termination period has still left many tribes unable to regain their status as a federally recognized tribe, meaning they do not have access to state funding (UCLA, n.d., p. 13).

This long history of disrespecting treaties, the continual acquisition of land for resources, complete violence and attempted genocide are important to remember as a foundation for the distrust held by many Indigenous Nations against the Federal government. This history full of

violence is also why the California government will need to be active in incorporating Indigenous stewardship of fire management and will need to follow plans and pledges with more than just words.

Fire Suppression

The Peshtigo Fire of 1871 engulfed the town of Peshtigo and several smaller surrounding communities, killing 1700 people (Lewis, 2011). The cause is thought to be due to small fires used for land-clearing by settlers that blew out of control, creating a firestorm (Massasoit Community College Library, 2017). On the same day, the Great Chicago Fire began, resulting in the deaths of 300 people, and an estimated \$200 million in damages, and an area of about four miles long and a mile wide destroyed (Onion et al., 2018). These events helped conservationists convince the U.S. government to set aside land as national protected forests and parks and prompted the creation of the U.S. Forest Service in 1905 to manage those lands (FHS, n.d.). The Big Blowup of 1910 was a series of forest fires that burned 3 million acres in two days across Montana, Idaho, and Washington (FHS, n.d.). For reference, the Seattle Board of Trustees called for the removal of Indians from the town in 1865 (Ott, 2014), Montana moved the Bitterroot Salish (Flathead), Pend d'Oreilles, and Kootenai Nations onto reservations in 1858 and again in 1891 (Native American Netroots, 2010), and Idaho removed the Shoshone, Paiute, and Bannock people in the late 1800s (Manning, 2016) representing the removal of Indigenous led stewardship of those regions. These disastrous fires prompted United State's policy to move toward addressing wildfires by focusing on complete suppression of all fire (FHS, n.d.).

The Forest Service first set out to ban all light burns despite opposition from Native American tribes as well as ranchers, farmers and timbermen who also used burns to manage the

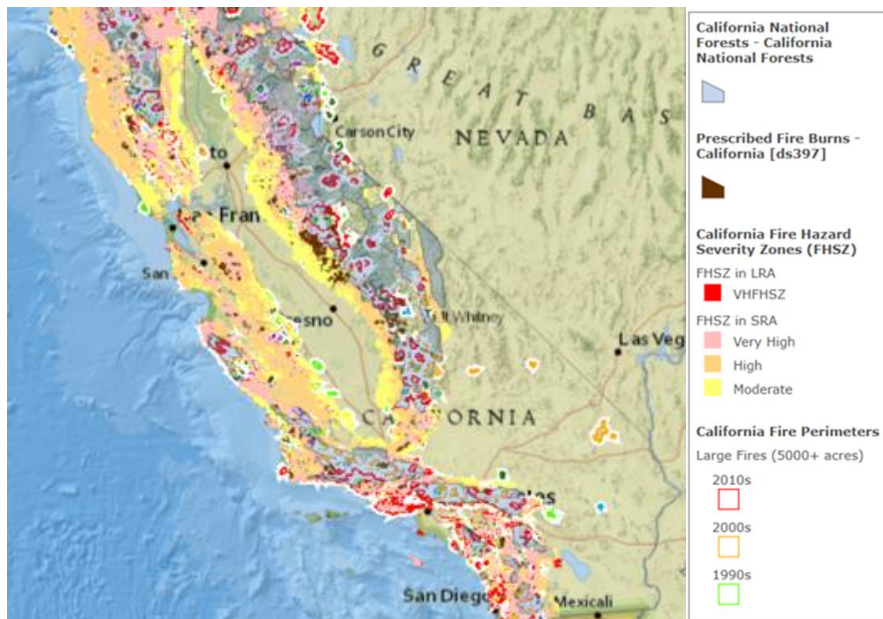
land (FHS, n.d.). The Forest Service set out to develop a network of roads, communication systems, lookout towers, and ranger stations to detect any wildland fires (FHS, n.d.). Not only were these fires viewed as an assault on communities, but even more threatening to valuable timber stores, with complete suppression (to Western thought) appearing as the best way to protect those resources (FHS, n.d.). Passage of the Weeks Act of 1911 allowed the federal government to work with states to protect both federal and non-federal lands and to participate in cooperative firefighting (FHS, n.d.).

Twenty years later, despite tactics of complete fire suppression, fire seasons did not improve, in fact several severe fire seasons plagued communities in the early 1930s (FHS, n.d.). This prompted the creation of the Civilian Conservation Corps, within the New Deal legislation, with the goal of building fire breaks and bringing more men to fight fires. In 1935, the 10 AM policy was put in place, decreeing that all fires must be put out by 10AM the following day. In 1944, the Smokey the Bear campaign was launched to spread propaganda over fire prevention with the message that all fire is bad. This message persists today and will likely help increase opposition against California's new prescribed fire legislation. A firefighting chemical assessment from 1961, that looked at various chemicals' ability to put out fires and stop the spread (Davis et al., 1961), failed to test these chemicals' effects or pervasiveness on the environment or on organisms. Other new technologies were also introduced to help aid in fire suppression such as airplanes and smokejumpers (people in protective suits that are dropped into remote areas to provide the initial attack) (FHS, n.d.).

During the 1960-70s views on fire shifted again, as research supported the positive role of fire on landscapes (FHS, n.d.). This led to the radical shift in policy by the Forest Service to allow natural-caused fires to burn when far away from settlements yet faced setbacks after the

1988 Yellowstone fires (FHS, n.d.). Since the 1990s, exurban sprawl has further complicated fire approaches as the wildland-urban interface expands (Li & Banerjee, 2021, p.1). This has been attributed to California's housing crisis and Proposition 13, which prevents property taxes from increasing more than 2% per year for incumbent homeowners (and for big businesses) (San Diego County Supervisor Nathan Fletcher, personal communication, Apr. 12th, 2021). In effect this proposition makes buying homes exorbitantly expensive as property values continue to skyrocket in the state, while current homeowners fight to prevent any new affordable housing or homeless shelter developments from passing in their areas (Fletcher, personal communication, Apr. 12th, 2021). This has pushed more people out of cities and into remote forested areas with highly subsidized insurance policies (Roberts, 2019). Though these subsidies have helped people afford homes, insurance companies and governments will need to be more transparent in the risk involved with moving to these high-risk areas (Roberts, 2019). Figure 2 below depicts the high-risk forested areas compared with prescribed burns that have taken place. The marked red, pink, and orange areas indicate varying levels of fire risk, occurring more frequently in the rural, forested areas (transparent blue), depicting the danger posed to residents and their properties. Wildfires per decade are shown by the red, orange, and green circles and prescribed burns conducted are indicated by brown, and located in the more central region. Prescribed burns will need to be increased immensely to help return California's forests to the balance established prior to European colonization and fire suppression policies (Clark et al, 2020).

Figure 2: Map of California’s areas treated with prescribed burns (brown) vs. areas most prone to wildfires.



National Parks and Forests + Native American Reservations

National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp. | The fire perimeter data is stewarded by CAL FIRE - FRAP, with data from CAL FIRE (including contract counties), USDA Forest Service Region 5, USDI Bureau of Land Management & National Park Service, and other agencies. | FRAP

Link to ArcGIS Map: <https://arcg.is/1v9XqL>

In 2011, the California Legislature passed Assembly bill X129 to provide funding for statewide fire prevention activities, such as fuel reduction projects, evacuation routes and infrastructure, updates to Community Wildfire Protection Plans, fire prevention education, mapping, and the implementation of fire plans (CAL FIRE, 2017). This bill included lands under the State Responsibility Area (state- and privately-owned forest, watershed, and rangeland) and was funded by the State Responsibility Area Fire Prevention Fee, to be paid by those who lived or owned businesses in highly fire prone areas (CAL FIRE, 2017). This fee was only in effect from 2016-2017, when it was suspended by Governor Jerry Brown until 2031 (CALFIRE, 2017). Funding for these efforts now comes from California’s cap and trade system that also aims to reduce emissions.

Fire Fighting Pollutants

PFAS or per- and polyfluoroalkyl substances are manmade chemicals found in a variety of common household items (Environmental Protection Agency [EPA], 2021). They are also particularly well suited for use in fire-fighting foam to put out gas and oil fires such as on military bases, industrial sites, oil refineries or airports (EPA, 2021). Though these chemicals are not used for wildfires (some municipal fire departments still have them on site), they can still get into the environment when wildfires destroy facilities holding these compounds and may leach into the soil and water (Karp & Mahaffey, 2020). PFAS is a persistent chemical, meaning it can build up and persist in the environment and in living things (EPA, 2021), with 95% of the U.S. population estimated to have been exposed and show measurable concentrations of PFAS in their blood (National Ground Water Association [NGWA], 2017). PFAS is linked to health effects such as liver damage, kidney damage, decreased fertility, pregnancy induced hypertension, increased cholesterol levels, thyroid hormone disruption and certain cancers (NGWA, 2017). Due to the risk to the environment, California lawmakers have voted for the ban of PFAS in municipal fire departments by 2022, and a ban from chemical plants and airport hangers by 2024, and from oil refineries by 2028 (Phillips, 2020).

Phos-Chek is the red substance that planes disperse over trees and property to stop advancing flames (U.S. Forest Service [USFS], 1998). Its chemical composition is mostly water, some fertilizer, colorants, thickeners, corrosion inhibitors, stabilizers, and bactericides (USFS, 1998). Upon contact with plants and wood, it reacts with the cellulose, stimulating the plant to release water vapor, raising the humidity in the area, and lowering the temperature of the burn (Andrews, 2019). However, older assessments by the U.S. Fish and Wildlife Service reported that plant life in North Dakota was shown to suffer after contact with firefighting chemicals and this weakening of the plants allowed for the rise of disease and invasive species (Andrews,

2019). Phos-Chek can also pose a risk of nitrate poisoning in animals consuming contaminated hay and other crops (USFS, 1998). This risk is amplified in Indigenous subsistence hunters, who as part of the higher trophic levels can carry higher concentrations of contaminants in their bodies (Kricheff, 2009). If these chemical drops occur over a stream or waterway (which can occur with poor visibility) the results can be lethal to local fish and aquatic organisms (USFS, 1998). This causes significant concentrations of ammonia that disrupts the ability of fish to extract energy from feed, resulting in lethargy, and eventually leading to coma and death (Banrie, 2013). These chemicals can also make their way into streams via leaching through the environment (Andrews, 2019).

Foam fire suppressants are another tool used to suppress wildfires. These act as strong detergents that can cause extreme drying and result in mild to severe chapping with skin contact (USFS, 1998). They are also mildly to severely irritating to eyes and protective goggles must be worn when in the vicinity of these concentrates (USFS, 1998). Exposure to waterways should be avoided due to its high wetting capabilities and its effect on fish, as it blocks gills, causing the fish to suffocate (USFS, 1998). Water enhancers are also used to combat wildfires as they are super absorbent and hold many times their weight in water (USFS, 1998). Though not reported as harmful to humans, personal protective equipment is still required with use, and they may be broken down when exposed to sunlight (USFS, 1998). They create very slippery conditions and are extremely hard to remove and may hasten deterioration of historical structures (USFS, 1998).

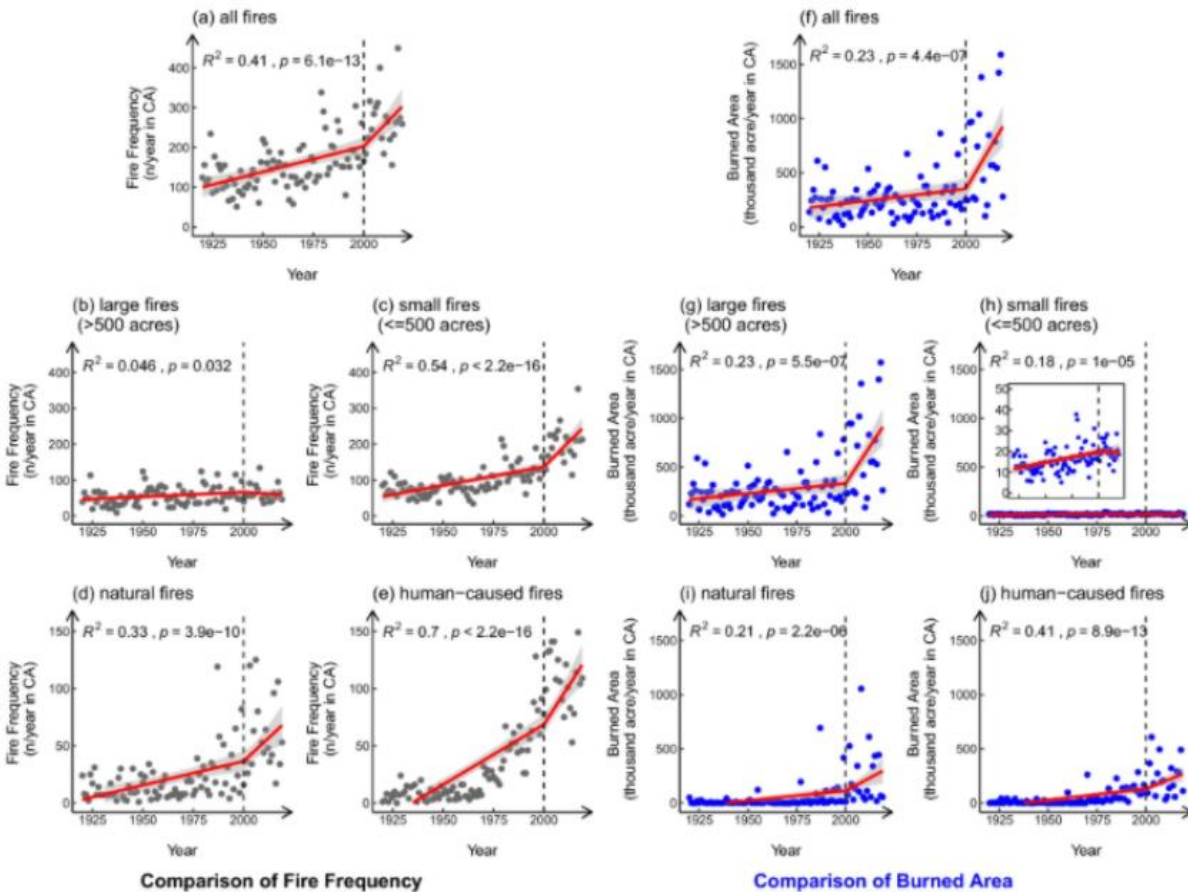
METHODS

Study Area

California's unique landscape, home to a wide range of ecosystems and communities, complicates the practicality of implementing large scale burns or letting wildfires burn themselves out unattended. This analysis aims to offer recommendations to improve Newsom's Fire Action Plan and account for better implementation, as well as increased attention toward tribal sovereignty to lead these operations.

First, wildfire severity and occurrence over the last century compared with pre-colonization was examined. A study by Li & Banerjee (2021) titled 'Spatial and Temporal pattern of wildfires in CA 2000-19' found a significant increase in the number of small human-caused fires and newly emergent hot spots correlated with the expansion of the wildland-urban interface. Data from CAL FIRE also indicated that areas burned due to large fires also increased significantly over time (Li & Banerjee, 2021). The figure below is adapted from Li & Banerjee's study with fire frequency to the left and total burned area to the right over the time span from 1920 to 2019. C and E show the increase in small, human-caused fires, particularly increasing after the year 2000. G, I and J depict the increase in area burned from large fires caused naturally and by humans after the year 2000. This increase in small fires is due to more people living in the high-risk rural areas, as well as fire suppression techniques to quell all fires immediately (Li & Banerjee, 2021).

Figure 3: Graphs comparing Fire Frequency over time on the left, and areas burned over time on the right.

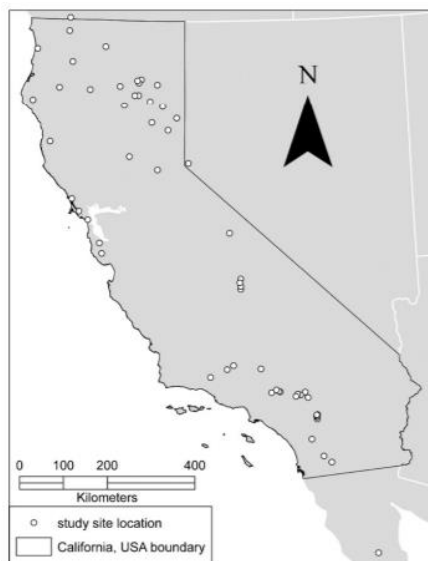


(Adapted from Li & Banerjee)

To compare this increase in wildfire frequency over the last century with conditions prior to European colonization, Indigenous histories and accounts were researched. Stephens et al. (2007)'s study 'Prehistoric fire area and emissions from California's forests, woodlands, shrublands, and grasslands' was used as a baseline for conditions pre-colonization. This study gathered ethnographic interviews to gain detailed records of the land over large spans of time as well as examined fire scars in various plant species (Stephens et al., 2007, p. 206). The figure

below depicts the locations of forest and woodland fire history used to estimate past fires in California (Stephens et al., 2007, p. 208). This study estimated that 4.4 million acres of California's wildlands burned each year prior to colonization (Stephens et al., 2007, p. 213). Dividing California's total acreage of 100 million, with the estimated 4.4 million acres, results in 4% of California's landscape being either treated with cultural burns or experiencing low grade wildfires.

Figure 4: Map of Stephens et al. areas predicted to have undergone controlled burns pre-colonization.



(Adapted from Stephens et al., 2007, p. 208)

Comparing this number of burns with acreage burned during the 2020 combined year to date report from CAL FIRE and Federal Statistics provides 4,257,863 acres burned (CAL FIRE, 2021), just 200,000 acres shy of the estimated burns pre-colonization. The difference here being due to more land available for fire treatment pre-colonization, whereas now, with the expanding WUI, many areas cannot be treated with regular burns due to the vicinity to communities. Yet it

is important to realize that these burns were controlled, low-grade fires, whereas today we see uncontrollable blazes that devastate communities.

Next, I reached out to various stakeholders to gain a better understanding of the policy and viewpoints on cultural burns. Bill Tripp, the Director of Natural Resources and Environmental Policy at Karuk Tribe pointed me toward the Karuk Tribe's policy analysis on current barriers to expanding cultural burning and recommended solutions. This handbook was very helpful in identifying the many barriers faced by cultural fire practitioners such as liability issues, lack of insurance, and permitting delays (Clark et al., 2021). I was fortunate enough to meet with Dr. Heather Ponchetti Daly, professor, and historian of Indigenous histories to gain a better understanding of the history of the U.S.'s treatment of Native Americans. Next, I researched success stories of cultural burns in recent times, as well as looked at the various suppression techniques and impacts. I then investigated prevention techniques, impacts from climate change, and wildfire causes to formulate a plan to address the expanding WUI, powerline failures, and incorporating tribal sovereignty. Lastly, I researched California's current policies and action plans regarding fires to find significant progress occurring during the last few months of this project. This led to a shift toward addressing issues missed by the legislation to improve it and holding the government accountable to promises of co-management of forested land and prescribed burns with tribes.

CURRENT POLICY

Return of Cultural & Prescribed Burns

Recent years have brought a renewed interest in fire ecology and its benefits on the landscape. With backing from western science and a new interest in Traditional Ecological Knowledge among the U.S. government (Buono, 2020), prescribed burns are being reexamined as the missing link to landscapes globally. Thanks to many years of activism and lawsuits against the Australian Government, Aboriginal Australians now control 15 million acres of land as part of the movement of revitalizing traditional fire management and land reclamation (Beck, 2020). Back in the U.S., the Prescribed Fire Training Exchange (TREX) has held nearly a hundred trainings over the last decade and trained about 3000 people (Bailey & Quinn-Davidson, 2019). TREX's large success is due to its cooperative burning model that delivers favorable outcomes to a diverse range of entities such as federal and state agencies, private landowners, tribes, and others while also incorporating local values, traditions, and forest ecology (Bailey & Quinn-Davidson, 2019). Each TREX training operates on the guiding principle that each participant, including Burn Bosses and Trainees, have something to learn from one another, and this built-in cooperation is designed to train people from all backgrounds in the safe handling of fire (Bailey & Quinn-Davidson, 2019). These trainings have also been immensely successful in shifting locals' views regarding fire. A TREX was held in Roslyn, Washington after the Jolly Mountain Fire and helped build the community's confidence in prescribed burns and now when residents see smoke, they know it is for building forest resiliency against wildfires (Bailey & Quinn-Davidson, 2019).

The Karuk and Yurok Tribes have also hosted many TREX trainings restoring cultural burns to their landscapes. Frank Lake, a Karuk tribal descendent and research ecologist with the Forest Service says tears were brought to his eyes during the 2015 TREX as his son held hands with one of the burn bosses (Buono, 2020). This scene reminded him of what their elders had always wanted, “They wanted us to come together to care for those trees, to not fear fire but to revere and respect it, and to fulfill our responsibility” (Buono, 2020). These collaborative events formed coalitions such as the Indigenous Peoples Burning Network and the Cultural Fire Management Council (Buono, 2020). These fire management organizations have been key to advocating for the return of fire to these landscapes. The successes in restoring some fire to Yurok and Karuk ancestral lands are only the beginning, as strict regulations and permitting often slow these efforts (Buono, 2020). Those who operate without permits or do not go through the typical bureaucratic steps face persecution and fines for using fire on their own private or public lands, despite holding treaty rights to carry out cultural practices such as traditional food gathering (Buono, 2020). According to Dr. Heather Daly, even during an emergency, such as the 2007 Witch Fires of San Diego, Indigenous people were prohibited from performing backfires, that burn off fuel and protect property from damage (personal communication, May 2021).

CAL FIRE has also been increasing the number of prescribed burns they perform, reaching a high of 40,000-50,000 acres per year in the 1980s (Terence, 2016). Yet budget cuts and a weary public brought this number down (Terence, 2016). In 2015, Ken Pimlott, former State Director of CAL FIRE, used a little-known clause to issue the Klamath TREX burn permits in Orleans during a burn ban (Terence, 2016). This allowed fuels to be removed, likely lessening the effects of the ongoing Valley fire at the time (Terence, 2016). This waiver to allow the TREX

to perform burns was meant to send a clear message across the state, that CAL FIRE managers had Pimlott's support in conducting burns (Terence, 2016).

POTENTIAL BARRIERS

Air Quality

Reduced air quality due to fires poses a legitimate concern, particularly to marginalized communities, yet removing fire from the landscape has not worked and each subsequent attempt has worsened air quality via more severe wildfires (Clark et al., 2021). However if we can shift this back to a more balanced state, we can potentially reduce the severity and frequency of wildfires, to be replaced by controlled burns that take care to only burn under certain atmospheric conditions (an unstable atmosphere means smoke is taken up and dispersed more widely, rather than concentrated closer to the ground) and when wind directions are pointing away from sensitive areas (Indiana Division of Fish and Wildlife, 2005, p. 2). To assist smoke sensitive neighbors, the Karuk Tribe loans out HEPA air filters (Terence, 2016), a program the government could similarly adopt.

The California Health report found that Latinos, African Americans, Asians, and low-income people in the state suffer from breathing significantly more tailpipe pollution than their white counterparts (Boyd-Barrett, 2019). Exposures at work or from transportation increase these groups' risks of developing heart disease, lung problems, exacerbated asthma, lung cancer, and premature death (Boyd-Barrett, 2019). Providing equitable solutions such as government issued HEPA filters to households and addressing transportation's role in releasing polluting emissions, along with industry will be needed in conjunction with fire policies to ensure marginalized communities are not impacted further. The Karuk Tribe cites the need to recognize smoke impacts from intentional fire as part of California's air quality baseline, as controlled burns

reduce smoke impacts, and allow more time to prepare and alert residents of planned burns as opposed to wildfires that may come with no warning (Clark et al., 2020, p. 13).

Transmission Lines

The 2018 Camp Fire that killed 85 people began due to an electrical transmission line failure (Isaacs-Thomas, 2020), as did the Witch Fire in San Diego. Outdated and poorly managed power lines have been responsible for a majority of human caused wildfires in the last two decades (Isaacs-Thomas, 2020). Further complicating matters is the fact that PG&E, Pacific Gas and Electric is bankrupt, making it unclear how the company could manage to improve the grid and harden their lines (Isaacs-Thomas, 2020). However, in San Diego, lawsuits against San Diego Gas and Electric company, prompted the \$1.5 billion dollar investment in upgrading their fire detection response capabilities, and line hardening (Roberts, 2019). This local approach to improving grids and making lines safer and more resilient is an easier solution than relying on an enormous company such as PG&E to provide these upgrades to the entire state.

Rolling blackouts are also a concern for the state. Beyond the inconvenience of being unable to use some of your electronics, some people rely on refrigeration of medicines or electricity for their oxygen tanks. Losing power can mean life or death for some, particularly those unable to afford a generator. Costs to upgrade the grid would be balanced out by funds saved from reducing the risk of the most severe wildfire impacts. Additionally, the investment in microgrids and diversified renewables would also help build grid stability (Roberts, 2019). In the most high-risk areas, additional precautions will be needed to be taken such as the building underground lines. These lines completely reduce wildfire risk yet are susceptible to earthquakes

and animals and are exorbitantly expensive (Roberts, 2019), yet may be the only option if wildfire severity continues to persist.

Liability & Insurance

Many barriers currently exist preventing fire practitioners and landowners from getting fire on the ground safely and during optimal conditions. California currently does not offer insurance for fire practitioners (Miller et al., 2020, p. 1), other than for state agencies that perform burns such as CAL FIRE and the BIA. This prevents experienced cultural burners such as Forest Service ecologist Frank Lake from performing small burns on his own property (Mann, 2020). Risk of financial ruin in the unlikely event of a prescribed burn causing unintended damage, understandably dissuades many from learning how to safely perform burns (Clark et al., 2021).

In areas such as the southeastern United States, prescribed burns are viewed as a more common occurrence and people are only found liable if pure negligence is proven (National Interagency Fire Center, 2019). Adopting this mindset and policy in California would help widen the pool of those trained in safe, prescribed burns. In 2018, Assembly Bill 2585, insurance for fire practitioners was put forth yet rejected. Reexamining this bill, as Newsom's fire action plan goes into effect would also help with encouraging more to learn about prescribed burns and potentially use them on their own properties.

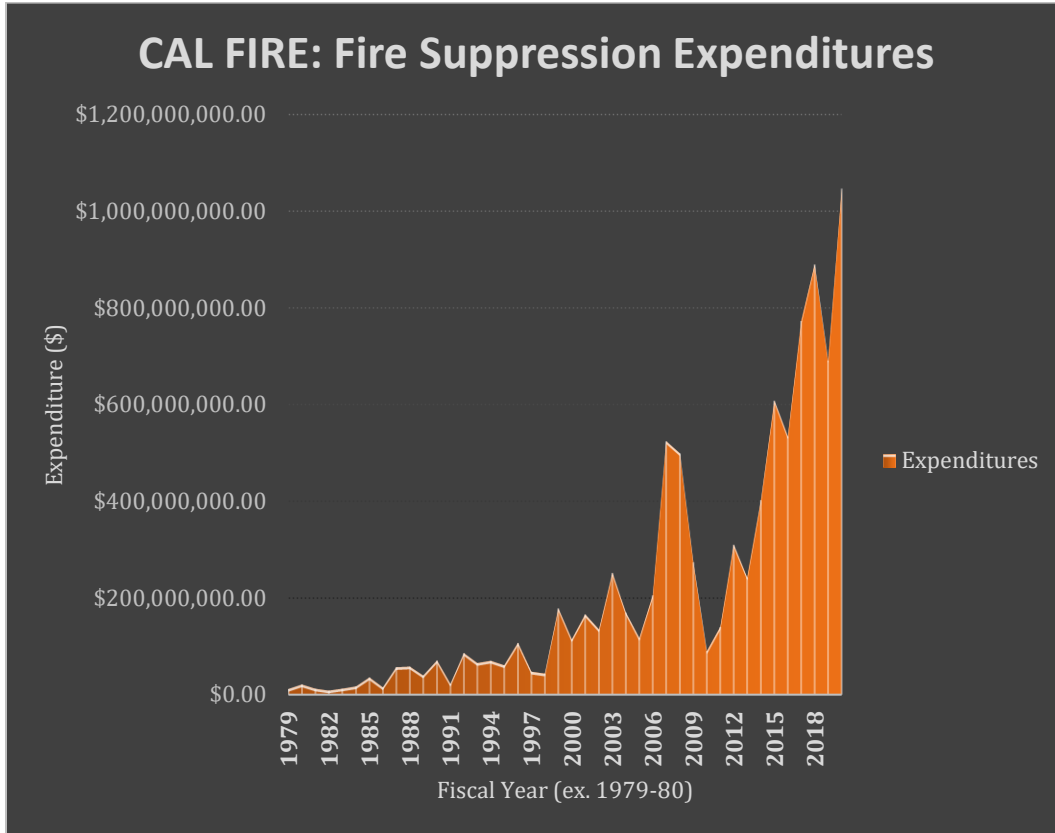
PROPOSED SOLUTIONS

Recognition of Tribal Sovereignty and TEK

In accordance with the Newsom administration’s pledge of increased co-management of forested areas, particularly regarding cultural burns, full autonomy to carry out burns should be returned to Tribal Nations who have historically practiced cultural burns. With expanded training in safe burns, particularly for Indigenous peoples, greater sovereignty could help expand burns much quicker to reach the goals set forth of 500,000 acres intentionally burned per year by 2025 (Newsom et al., 2021). Efforts toward educating the public on safe fire should also be expanded to reduce political opposition. In the countless cities that have hosted TRES trainings, many formerly apprehensive residents, now know how to identify “good burn days” (Terence, 2016). Providing access to insurance for cultural fire practitioners will also remove additional barriers to getting “good fire” (Clark et al., 2021) on the ground. This can be accomplished via bills such as AB 2585.

To address transmission line failures, hardening of the lines will be needed to prevent further devastating blazes. Some techniques include increasing powerline height and the removal of vegetation. For the highest-risk areas, impact assessments will need to be examined for animal and earthquake risks, should underground lines be needed. By paying the high cost to upgrade the system now, we can get better returns in the future due to higher reliability against blackouts, as well as from savings as wildfire suppression and damages costs decrease. Figure 5 depicts California’s current expenditure for fire suppression- note over the last 40 years, California has spent over \$9.2 Billion dollars, and over \$1 Billion dollars this past year (CAL FIRE, 2020).

Figure 5: CAL FIRE: Fire Suppression Expenditures



(Data sourced from CAL FIRE, 2020)

WUI can also be addressed via incentives or subsidies to help move those in high-risk areas out. By moving people out of these dangerous areas, we can prevent further loss of life and damage to property. Steps should also be taken to halt new development in these areas, with insurance companies being more honest about the risks associated with these unincorporated locations.

CONCLUSION

Governor Newsom and California are making great strides in finally addressing the state's wildfires. Yet efforts toward reframing resident's views on fire along with continued work toward fulfilling the promise of co-management are needed to reach these high goals of 500,000 acres burned per year by 2025. Additionally, consideration for transmission line upgrades, and the dangers associated with the expansion of the WUI will need addressing. Climate change impacts will continue regardless, and by addressing this issue now, we can ensure fire impacts do not continue to worsen and protect lives and honor those who have always been here. To gain the best climate outcomes, TEK and Indigenous leadership should be supported and encouraged.

ADDITIONAL PHOTOS BY KILIII YÜYAN

“Training”



“Home Ground” – Klamath River



“Tradition” – Elizabeth Azzuz, Cultural Fire Management Council opens TREX
with a prayer, Yurok Lands 2019.



“Resources Return” -bear grass and acorns.



REFERENCES

A.B. 2585, 2018 Bicameral. 2018 Reg. Sess. (Cal. 2018).

https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB2585

Anderson, M. K. (2005). *Tending the wild: Native American knowledge and the management of California's natural resources*. University of California Press.

<http://ebookcentral.proquest.com/lib/ucsd/detail.action?docID=239718>

Andrews, E. (2019, Nov. 7). What do firefighting chemicals do to a forest? *Grist*.

<https://grist.org/article/what-do-firefighting-chemicals-do-to-a-forest/>

Bailey, J., & Quinn-Davidson, L. (2019, Nov. 7). Fire training exchange expand controlled burns. *The Nature Conservancy*. [https://www.nature.org/en-us/what-we-do/our-priorities/protect-water-and-](https://www.nature.org/en-us/what-we-do/our-priorities/protect-water-and-land/land-and-water-stories/fire-training-exchanges-expand-controlled-burns/)

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Banrie. (2013, Sep. 30). Managing ammonia in fish ponds. *The Fish Site*.

<https://thefishsite.com/articles/managing-ammonia-in-fish-ponds>

Beck, A. (2020, Jan. 13). To help Australia, look to Aboriginal fire management. *yes! Magazine*.

<https://www.yesmagazine.org/environment/2020/01/13/australia-fires-aboriginal-land-management>

Blakemore, E. (2020, Dec. 4). California's little-known genocide. *History.com*.

<https://www.history.com/news/californias-little-known-genocide>

Boyd-Barrett, C. (2019, Feb. 8). People of Color and the Poor Disproportionately Exposed to Air Pollution, Study Finds. *California Health Report*.

<https://www.calhealthreport.org/2019/02/08/people-of-color-and-the-poor-disproportionately-exposed-to-air-pollution-study-finds/>

- Buono, P. (2020, Nov. 2). Quiet Fire. *The Nature Conservancy*. <https://www.nature.org/en-us/magazine/magazine-articles/indigenous-controlled-burns-california/>
- Burnett, P. (1851, Jan. 6). *State of the State Address*. The Governors' Gallery. https://governors.library.ca.gov/addresses/s_01-Burnett2.html
- Cahill, J. F. (2018, Oct. 18). Fire and food in Karuk and Yurok communities. *North Coast Journal*. <https://www.northcoastjournal.com/NewsBlog/archives/2018/10/18/fire-and-food-in-karuk-and-yurok-communities>
- CAL FIRE. (2017). Informational report for State Responsibility Area Fire Prevention Fee. *California Department of Forestry and Fire Protection, Fiscal Year 2016-2017*. <https://www.fire.ca.gov/media/8146/report-for-sra-fire-prevention-fee-fy16-17.pdf>
- CAL FIRE. (2020, Sep.). Emergency Fund Fire Suppression Expenditures. *CAL FIRE*. <https://www.fire.ca.gov/media/px51naaw/suppressioncostsonepage1.pdf>
- CAL FIRE. (2021). Current year statistics. *California Department of Forestry and Fire Protection*. <https://www.fire.ca.gov/stats-events/>
- CA Air Resources Board. (2021). Prescribed burning. CA.gov. <https://ww2.arb.ca.gov/our-work/programs/prescribed-burning/about>
- CA Public Utilities Commission. (2021). Public safety power shutoff (PSPS)/ de-energization. Public Safety Power Shutoff. cpuc.ca.gov/psps/
- Clark, S.A., Miller, A., & Hankins, D. (2021). Good Fire. *Karuk Tribe*, 1(1), 1, 13. https://karuktribeclimatechangeprojects.files.wordpress.com/2021/03/karuk-prescribed-fire-rpt_final-1.pdf

- Cordero, A. (2018, Nov. 17). We cannot choose a life without fire. *Wishtoyo Chumash Foundation*.
<https://www.wishtoyo.org/wishtoyo-chumash-foundation/2018/11/17/we-cannot-choose-a-life-without-fire>
- Daly, H. (2012). "American Indian freedom controversy:" Political and social activism by Southern California Mission Indians, 1934-1958. *UCLA Electronic Theses and Dissertations*, 1, 25, 62.
<https://escholarship.org/uc/item/07k8h1xg>
- Davis, J. B., Dibble, D. L., & Phillips, C. B. (1961, Apr.). Firefighting chemicals... new weapons for the fire suppression crew. *U.S. Forest Service*.
https://www.fs.fed.us/psw/publications/documents/psw_misc057/psw_misc057.pdf
- Devis, J., & Lieberman, S. (Executive Producers). (2017). *Tending the Wild* [TV series]. KCET.
<https://www.kcet.org/shows/tending-the-wild/episodes/tending-the-wild>
- Environmental Protection Agency. (2021, Apr. 6). Basic Information on PFAS. *United States EPA*.
<https://www.epa.gov/pfas/basic-information-pfas>
- Forest History Society. (n.d.). U.S. Forest Service fire suppression. *Forest History Society*.
<https://foresthistor.org/research-explore/us-forest-service-history/policy-and-law/fire-u-s-forest-service/u-s-forest-service-fire-suppression/>
- Gilmer, H. (2019, Apr 5). Mitigating wildfire risk with transmission technology. *T&D World*.
<https://www.tdworld.com/vegetation-management/article/20972441/mitigating-wildfire-risk-with-transmission-technology>
- Howard University Law Library. (2018). The Allotment and Assimilation Era (1887-1934). *Howard University Law Library*. <https://library.law.howard.edu/civilrightshistory/indigenous/allotment>
- Indiana Division of Fish & Wildlife. (2005, Mar.). Prescribed Burning. *Indiana Division of Fish & Wildlife*, 2. <https://www.in.gov/dnr/fish-and-wildlife/files/HMFSPrescribedBurn.pdf>

Isaacs-Thomas, I. (2020, Sep. 14). California's catastrophic wildfires in 3 charts. *PBS*.

<https://www.pbs.org/newshour/science/californias-catastrophic-wildfires-in-3-charts>

Karp, J., & Mahaffey, E. (2020, Oct. 16). PFAS in Firefighting Foam Has Contaminated Water Resources on Military Bases and in Surrounding Communities. *JDSUPRA*.

<https://www.jdsupra.com/legalnews/pfas-in-firefighting-foam-has-54726/>

Kricheff, J. (2009). Metal concentrations in native Yupik foodstuffs from St. Lawrence Island, Alaska. *University at Albany, State University of New York*.

http://www.atmos.albany.edu/geology/theses/Kricheff_MSthesis.pdf

Lewis, J. (2011, Oct. 8). October 8, 1871: Peshtigo, Wisconsin, is Consumed by Fire. *Forest History Society*. <https://foresthistor.org/october-8-1871-peshtigo-wisconsin-is-consumed-by-fire/>

Li, S., & Banerjee, T. (2021, Apr. 22). Spatial and temporal pattern of wildfires in California from 2000 to 2019. *Scientific Reports*, 11(8779), 17. 10.1038/s41598-021-88131-9

Madley, B. (2016, May 24). *An American Genocide*. (Yale University Press). Quoted in Wolf, J. (2017, Aug. 15). Revealing the history of genocide against California's Native Americans. *UCLA Newsroom* <https://newsroom.ucla.edu/stories/revealing-the-history-of-genocide-against-californias-native-americans>

Mann, C. (2020, Dec. 17). 'There's good fire and bad fire.' An Indigenous practice may be key to preventing wildfires. *National Geographic*.

<https://www.nationalgeographic.com/history/article/good-fire-bad-fire-indigenous-practice-may-key-preventing-wildfires>

Manning, S. S. (2016, Jun. 27). Manning: Following Forced Removal, Tribes Return to Boise Valley.

Indian Country Today. <https://indiancountrytoday.com/archive/manning-following-forced-removal-tribes-return-to-boise-valley>

- Massasoit Community College Library. (2017). *Peshtigo fire: Introduction*. Massasoit Community College. <https://library.massasoit.edu/americanfires/peshtigo>
- Micalizio, C.-S. (2020, Apr. 6). May 28, 1830 CE: Indian Removal Act. *National Geographic*. <https://www.nationalgeographic.org/thisday/may28/indian-removal-act/>
- Mickey, S. H. (2020, Aug. 6). Wormwood: Its history and use. *Edible Alaska*. <https://ediblealaska.ediblecommunities.com/food-thought/wormwood-its-history-and-use>
- Miller, R. K., Field, C. B., & Mach, K. J. (2020, Feb.). Barriers and enablers for prescribed burns for wildfire management in California. *Nature Sustainability*, 3(101-109), 1. 10.1038/s41893-019-0451-7
- National Ground Water Association. (2017). PFAS top 10 facts. *NGWA*. <https://www.ngwa.org/docs/default-source/default-document-library/pfas/pfastop-10.pdf>
- National Interagency Fire Center (Director). (2019). *Native Fire* [Film]. <https://www.youtube.com/watch?v=RUPXtKeOHu0&t=770s>
- Native American Netroots. (2010, Apr. 20). The Removal of the Flathead Indians. *Native American Netroot*. <http://nativeamericannetroots.net/diary/472>
- Native Americans in Philanthropy. (2021). 1851 Indian Appropriations Act provides funds to move western tribes onto reservations. *Native Americans in Philanthropy*. <https://nativephilanthropy.candid.org/events/1851-indian-appropriations-act-provides-funds-to-move-western-tribes-onto-reservations/>
- Native Voices. (n.d.). 1953: Congress seeks to abolish tribes, relocate American Indians. *U.S. National Library of Medicine*. 1953: <https://www.nlm.nih.gov/nativevoices/timeline/488.html>

Newsom, G., Crowfoot, W., Blumenfeld, J., & Porter, T. (2021, Jan.). California's wildfire and forest resilience action plan. Forest Management Task Force.

<https://fmtf.fire.ca.gov/media/cjwfpckz/californiawildfireandforestresilienceactionplan.pdf>

Office of Governor Gavin Newsom. (2021, Apr. 13). Governor Newsom Signs Landmark \$536 Million Wildfire Package Accelerating Projects to Protect High-Risk Communities. CA.gov.

<https://www.gov.ca.gov/2021/04/13/governor-newsom-signs-landmark-536-million-wildfire-package-accelerating-projects-to-protect-high-risk-communities/>

Onion, A., Sullivan, M., & Mullen, M. (2018, Aug. 21). Chicago fire of 1871. *History.com*.

<https://www.history.com/topics/19th-century/great-chicago-fire>

Onion, A., Sullivan, M., & Mullen, M. (2019, May 18). Indian reservations. *History.com*.

<https://www.history.com/topics/native-american-history/indian-reservations>

Ott, J. (2014, Dec. 7). Seattle Board of Trustees passes ordinance, calling for removal of Indians from the town, on February 7, 1865. *HistoryLink.org*. <https://www.historylink.org/File/10979>

Phillips, A. (2020, Aug. 30). California lawmakers vote to phase out toxic firefighting foam. *Los Angeles Times*. <https://www.latimes.com/environment/story/2020-08-30/california-lawmakers-vote-to-phase-out-toxic-firefighting-foam>

Raish, C., Gonzalez-Caban, A., & Condie, C. J. (2005). The importance of traditional fire use and management practices for contemporary land managers in the American Southwest. *Elsevier, Environmental Hazards*(6), 115.

https://www.fs.fed.us/rm/pubs_other/rmrs_2005_raish_c001.pdf

Rinkevich, S., Greenwood, K., Leonetti, C., & U.S. Fish and Wildland Service. (2011, Feb.). Traditional Ecological Knowledge. U.S. Fish & Wildland Service.

<https://www.fws.gov/nativeamerican/pdf/tek-fact-sheet.pdf>

- Robbins, M. (2016, Jun 28). What TREX has meant to one fire adapted culture. *Fire Adapted Communities Learning Network*. <https://fireadaptednetwork.org/what-trex-has-meant-to-one-fire-adapted-culture/>
- Roberts, D. (2019, Oct. 22). 3 key solutions to California's wildfire safety blackout mess. *Vox*. <https://www.vox.com/energy-and-environment/2019/10/22/20916820/california-wildfire-climate-change-blackout-insurance-pge>
- Roos, D. (2020, Sep. 18). Native Americans used fire to protect and cultivate land. *History.com*. <https://www.history.com/news/native-american-wildfires>
- Sommer, L. (2020, Aug 24). To manage wildfire, California looks to what tribes have known all along. *npr*. <https://www.npr.org/2020/08/24/899422710/to-manage-wildfire-california-looks-to-what-tribes-have-known-all-along>
- Stanley, P., Rowntree, J., Beede, D., DeLonge, M., & Hamm, M. (2018). Impacts of soil carbon sequestration on life cycle greenhouse gas emissions in Midwestern USA beef finishing systems. *Agricultural Systems*, 162(May 2018), 249. <https://www.sciencedirect.com/science/article/pii/S0308521X17310338#>
- Stephens, S. L., Martin, R. E., & Clinton, N. E. (2007, Jun. 6). Prehistoric fire area and emissions from California's forests, woodlands, shrublands, and grasslands. *Science Direct, Forest Ecology and Management*(251), 205-216. <https://nature.berkeley.edu/stephenslab/wp-content/uploads/2015/04/Stephens-et-al.-CA-fire-area-FEM-2007.pdf>
- Terence, M. (2016, Nov. 3). Unleashing the TREX. *North Coast Journal*. <https://www.northcoastjournal.com/humboldt/unleashing-the-trex/Content?oid=4132514>

Treuer, D. (2021, Apr. 12). Return the National Parks to the tribes. *The Atlantic*.

<https://www.theatlantic.com/magazine/archive/2021/05/return-the-national-parks-to-the-tribes/618395/>

UCLA American Indian Center. (n.d.). XIV. Status and Needs of Unrecognized and Terminated California Indian Tribes. *UCLA American Indian Center*.

<https://www.aisc.ucla.edu/ca/Tribes14.htm>

U.S. Forest Service. (1998, Jul. 9). Wildland Fire Chemical Products Toxicity and Environmental Concerns General Information. *U.S. Forest Service*.

<https://www.fs.fed.us/rm/fire/documents/envissu.pdf>

Wehner, M.F., Arnold, J.R., Knutson, T., Kunkel, K.E., & LeGrande, A.N. (2017). Chapter 8: Droughts, floods, and wildfire. In D.J. Wuebbles, D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, & T.K. Maycock (Eds.), *Climate Science Special Report: Fourth National Climate Assessment* (Vol. 1, pp. 231-256). U.S. Global Change Research Program. 10.7930/J0CJ8BNN

Yüyan, K. (2020, Nov. 2). Caretaking [photograph]. *The Nature Conservancy*.

<https://www.nature.org/en-us/magazine/magazine-articles/indigenous-controlled-burns-california/>

Yüyan, K. (2020, Nov. 2). Good fire [photograph]. *The Nature Conservancy*. [https://www.nature.org/en-](https://www.nature.org/en-us/magazine/magazine-articles/indigenous-controlled-burns-california/)

[us/magazine/magazine-articles/indigenous-controlled-burns-california/](https://www.nature.org/en-us/magazine/magazine-articles/indigenous-controlled-burns-california/)

Yüyan, K. (2020, Nov. 2). Home Ground [photograph]. *The Nature Conservancy*.

<https://www.nature.org/en-us/magazine/magazine-articles/indigenous-controlled-burns-california/>

Yüyan, K. (2020, Nov. 2). Resources Return [photograph]. *The Nature Conservancy*.

<https://www.nature.org/en-us/magazine/magazine-articles/indigenous-controlled-burns-california/>

Yüyan, K. (2020, Nov. 2). Tradition [photograph]. *The Nature Conservancy*. [https://www.nature.org/en-](https://www.nature.org/en-us/magazine/magazine-articles/indigenous-controlled-burns-california/)

[us/magazine/magazine-articles/indigenous-controlled-burns-california/](https://www.nature.org/en-us/magazine/magazine-articles/indigenous-controlled-burns-california/)

Yüyan, K. (2020, Nov. 2). Training [photograph]. *The Nature Conservancy*. [https://www.nature.org/en-](https://www.nature.org/en-us/magazine/magazine-articles/indigenous-controlled-burns-california/)

[us/magazine/magazine-articles/indigenous-controlled-burns-california/](https://www.nature.org/en-us/magazine/magazine-articles/indigenous-controlled-burns-california/)