BUILT TO BURN

California's Wildlands Developments Are Playing With Fire

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Satellite image of the 2018 Camp Fire near Paradise, California / NASA.

BUILT TO BURN:

California's Wildlands Developments Are Playing With Fire

Bold Land-use Reforms Needed Now to Ensure Safer, Sustainable Future

A report by the Center for Biological Diversity:
Tiffany Yap, DEnv/PhD, Senior Scientist
J.P. Rose, Staff Attorney
Peter Broderick, Staff Attorney
Aruna Prabhala, Urban Wildlands Program Director, Senior Attorney

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Cover photo: Aftermath of the 2017 Tubbs Fire in the Coffey Park neighborhood of Santa Rosa, California / Bay Area Media Masters, CC-BY

Guenoc Valley area, where the 2020 LNU Complex Fire burned through / Drew Bird Photography

EXECUTIVE SUMMARY

Wildfires have occurred on California's landscapes for millennia. They're a natural and necessary process for many of California's ecosystems. But some of the recent fires have been exceptionally harmful to communities.

Since 2015 almost 200 people in the state have been killed in wildfires, more than 50,000 structures have burned down, hundreds of thousands have had to evacuate their homes and endure power outages, and millions have been exposed to unhealthy levels of smoke and air pollution. Meanwhile costs for fire suppression and damages have skyrocketed.

Policymakers must reckon with California's wildfire history and acknowledge that reckless land-use policies are increasing wildfire risk and putting more people in harm's way. Legislation that prioritizes the following proactive measures is needed immediately:

- Stop building new homes in highly fire-prone wildlands;
- Retrofit existing homes with high fire risk.

Where we place homes influences fire risk. Almost all contemporary wildfires in California, 95-97%, are caused by human sources such as power lines, car sparks and electrical equipment. Building new developments in highly fire-prone wildlands increases unintentional ignitions and places more people in danger.

Hotter, drier and windier conditions due to climate change make the landscape more conducive to wildfire ignitions and spread.

Most destruction to human communities from fire has been caused by wind-driven, human-ignited fires in highly fire-prone shrubland habitats. More than 2 million homes have high fire risk, and local governments

continue to approve new construction in highly fire-prone wildlands. Such reckless sprawl development endangers all Californians.

Elected officials and planners need to consider the state's complex fire history and fire ecology to implement smarter land use that protects people and native biodiversity. Many of California's ecosystems have adaptations to survive and thrive with wildfires. But long-term fire resilience is varied depending on the habitat type and fire regime (i.e., the frequency, intensity, severity, spatial complexity and seasonality of fire over time). Changes to fire regimes threaten human communities as well as native habitats and wildlife.

Increased human ignitions due to sprawl development in highly fire-prone native shrublands are harmful to people and biodiversity. Native shrubland habitats, like chaparral and sage scrub, are adapted to high severity wildfires at relatively infrequent intervals ranging between 30 to 130 years or more. But increased fire frequency in these habitats is causing type conversion to non-native grasses and forbs that burn more easily throughout more of the year. This altered fire regime endangers human communities and the unique biodiversity those habitats support.

If California policymakers continue to expand development into highly fire-prone wildlands and dismiss the need for home hardening in high fire-risk areas, then more destructive fires will ignite and more structures will burn. More people will be killed by fires and have extended exposure to hazardous smoke. More firefighters and first responders will be put at risk. Some biodiversity and unique ecosystems will be lost. Fire suppression and recovery costs will continue to rise.

We must change these destructive land-use policies and prepare our communities to safely coexist with wildfire.

CALIFORNIANS FACING UNPRECEDENTED WILDFIRE IMPACTS

Wildfires have occurred on California's landscapes for millennia. Lightning strikes and indigenous burning drove fire regimes that varied by habitat, frequency, size, extent and seasonality (Kimmerer and Lake 2001; Stephens et al. 2007; Anderson 2018).

Approximately 4.4 to 11.9 million acres of land are estimated to have burned in California every year prior to European colonization due to lightning-caused fires and cultural burning (Stephens et al. 2007). But in the past 200 years, California's highly diverse habitats and their historical fire regimes have been disrupted (Stephens and Sugihara 2018). The impacts on human communities due to these changes have now become clear.

Pyrocumulus cloud from the 2020 Ranch 2 Fire near Azusa, California / Russ Allison Loar, Flickr CC-BY-ND

Recent fires have been exceptionally destructive to California communities (Figure 1a). Based on fire records from the past 100 years, fires have become deadlier and more destructive, and large fires are occurring at an increasing rate (Stephens and Sugihara 2018). Seventeen of the 20 largest wildfires, 18 of the 20 most destructive wildfires, and 11 of the 20 deadliest wildfires have occurred after 2003 (Cal Fire 2020a, 2020b, 2020c).

Meanwhile the cost of fire suppression and damages in areas managed by the California Department of Forestry and Fire (Cal Fire) has skyrocketed to more than $23 billion during the 2015-2018 fire seasons (Figure 1b). After adjusting for inflation, this is more than double the wildfire cost for the previous 26 years of records combined. These harmful trends will continue unless policymakers reckon with the reckless land-use policies that put our communities in harm's way.

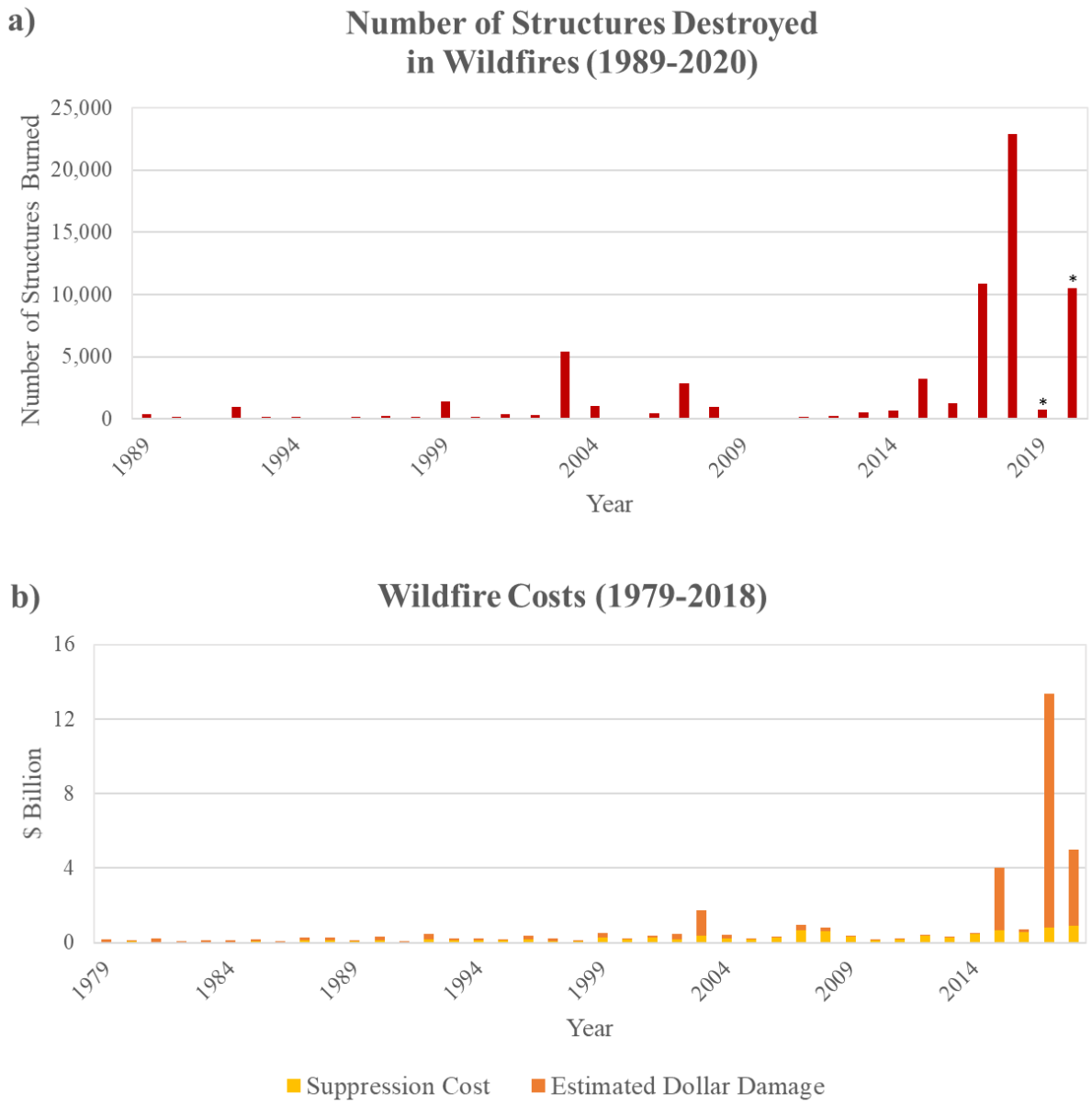


Figure 1. *Wildfire destruction and costs over time. (a) Number of structures destroyed from 1989 to 2020 (*2019 and 2020 statistics are not finalized) and (b) Cal Fire wildfire-suppression and damage costs from 1979 to 2018, adjusted for inflation. Data source: Cal Fire (https://www.fire.ca.gov/stats-events/).*

Owl soars over fire / U.S. Fish and Wildlife Service

SPRAWL DISRUPTS FIRE REGIMES AND MAKES WILDLIFE MORE VULNERABLE TO FIRE

Wildfires are a natural and necessary process in many of California's ecosystems, providing essential habitat for numerous species. For example, woodpeckers and many other animals of the Sierra Nevada rely on wildfire to create the dead trees, shrubs and post-fire vegetation within which these animals find the food they need to survive (e.g., Bond et al. 2009; Campos and Burnett 2015; Taillie et al. 2018; Blakey et al. 2019; Stillman et al. 2019). The critical role of wildfire in Sierra Nevada forests has been dramatically disrupted, however, by development, logging and fire suppression. As a result, these forests have a deficit of wildfire, meaning there's much less fire in these forests than there was historically — prior to 1800, an estimated 20 to 53 times more forest area burned each year in California than in recent decades (Stephens et al. 2007).

Researchers therefore recommend that more wildfires be allowed to burn each year in the backcountry, instead of being suppressed, in order to allow Sierra Nevada forests to rejuvenate and support the region's exceptional biodiversity. Continued sprawl development in these landscapes is an expanding impediment to efforts to restore natural fire regimes at any level.

California's shrubland habitats, on the other hand, such as chaparral and sage scrub, are experiencing a very different relationship with fire. These ecosystems are adapted to high-severity wildfires at relatively infrequent intervals ranging from 30 to 130 years or more (Keeley and Fotheringham 2001; Stephens et al. 2007; Keeley and Syphard 2018; Baker and Halsey 2020), but increased fire frequency from human ignition sources due to sprawl development is now causing these shrubland habitats to receive too much fire. This altered fire regime is the primary driver of habitat degradation and loss of biodiversity in these ecosystems (Keeley 2005) and leads to conversion of these important habitats to non-native grasses and forbs that burn more easily throughout more of the year, thereby compounding the problem of too much fire (Keeley 2005; Syphard et al. 2009; Balch et al. 2013; Sugihara et al. 2018; Syphard et al. 2019). Any additional sprawl development in these highly fire-prone habitats further undermines efforts to restore natural fire regimes and reduce human ignitions in these areas.

In addition to disrupting fire regimes, human activities have also put many of California's wild animals at risk of extinction. As a result, fire can sometimes have harmful consequences to endangered species that now only exist in very small, isolated populations due to massive habitat loss and fragmentation from sprawl development combined with other threats.

For example, two mountain lion deaths in the Santa Monica Mountains were attributed in part to the 2018 Woolsey Fire (Figure 2). Although mountain lions are highly mobile and generally able to move away from wildfires, these lions were unable to escape to safety because they were boxed in by roads and development. Such deaths can further destabilize the small mountain lion population that's already facing numerous other threats, including low genetic diversity, vehicle strikes and rodenticide poisoning, and make them more vulnerable to local extinction (Benson et al. 2016; Benson et al. 2019).

Similarly, researchers fear, post-fire landslides after the 2020 Bobcat Fire could be the end for remnant populations of sensitive species in the San Gabriel mountains that have been hard hit by sprawl development combined with disease, non-native predators and other threats, including Santa Ana suckers, unarmored threespine stickleback fish, speckled dace, arroyo chub, mountain yellow-legged frogs and western pond turtles (Figure 2) (Sahagun 2020). While historically these species would have been able to recolonize from neighboring populations after the loss of individuals or populations to fire impacts, that ability is now limited by the species' current small and fragmented population structure. Continued alteration of historical fire regimes due to sprawl development will further endanger those remnant populations.

Figure 2. *The burned paws of P-64, an adult male mountain lion whose death was attributed to the 2018 Woolsey Fire (left), and a mountain yellow-legged frog, whose remnant populations in the San Gabriel Mountains are threatened by post-fire landslides in the wake of the 2020 Bobcat Fire (right). Photo credits: National Park Service and U.S. Geological Survey (Adam Backlin).*

POOR LAND-USE PLANNING FUELS MORE DESTRUCTIVE FIRES

Reckless land-use planning is causing fires to be more destructive. Development in highly fire-prone areas increases unintentional ignitions, places more people at risk, and destroys native shrubland habitats that support high levels of biodiversity. Almost all contemporary wildfires in California (95-97%) are caused by humans in the wildland urban interface (Syphard et al. 2007; Balch et al. 2017; Radeloff et al. 2018; Syphard and Keeley 2020).

For example, the 2019 Kincade Fire, 2018 Camp and Woolsey fires, and 2017 Tubbs and Thomas fires were sparked by powerlines or electrical equipment. And although many of the 2020 fires were sparked by a lightning storm, the Apple Fire was caused by sparks from a vehicle, the El Dorado Fire was caused by pyrotechnics at a gender-reveal celebration, the Blue Ridge Fire was likely caused by a house fire, and electrical equipment is suspected to have ignited the Silverado and Zogg fires.

More than a million homes were built in the wildland-urban interface between 1990 and 2010 (Radeloff et al. 2018), and more than 2 million homes are located in high fire-risk areas (Verisk 2020). Such development in California's highly fire-prone wildlands is increasing wildfire frequency while placing more people in harm's way.

Recent fires highlight this issue: 15 of the 20 most destructive California wildfires have occurred in the past five years (Cal Fire 2020b). If current land-use practices continue, scientists estimate, 640,000 to 1.2 million new homes will be built in the state's highest wildfire-risk areas by 2050 (Mann et al. 2014), which will only worsen the devastating trend.

The contrast between the 1964 Hanly Fire and 2017 Tubbs Fire offers a poignant example of how expanding development in highly fire-prone areas increases fire risk. Both fires were caused by people: It's believed that the Hanly Fire was started by a hunter either discarding a cigarette or burning debris, while the Tubbs Fire was caused by faulty electrical equipment on private property.

These fires had similar footprints (Figure 2), yet the Tubbs Fire burned more than 5,500 structures and killed at least 22 people, while the 1964 Hanly Fire only burned about 100 structures and killed no one. From 1964 to 2017 the population of nearby Santa Rosa grew from 30,000 to 170,000 people — sprawl development had extended farther into fire-prone wildlands and put more people at fire risk (Figure 3) (Keeley and Syphard 2019).

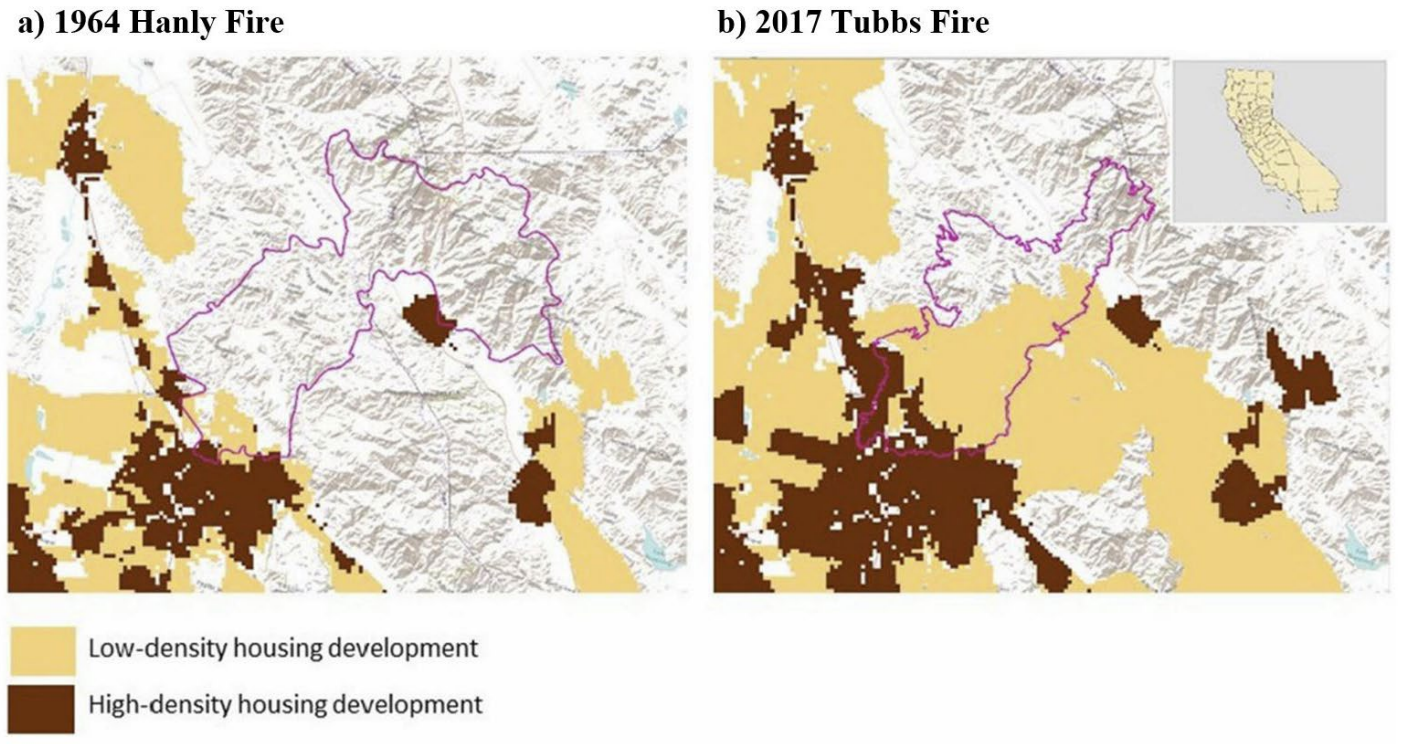
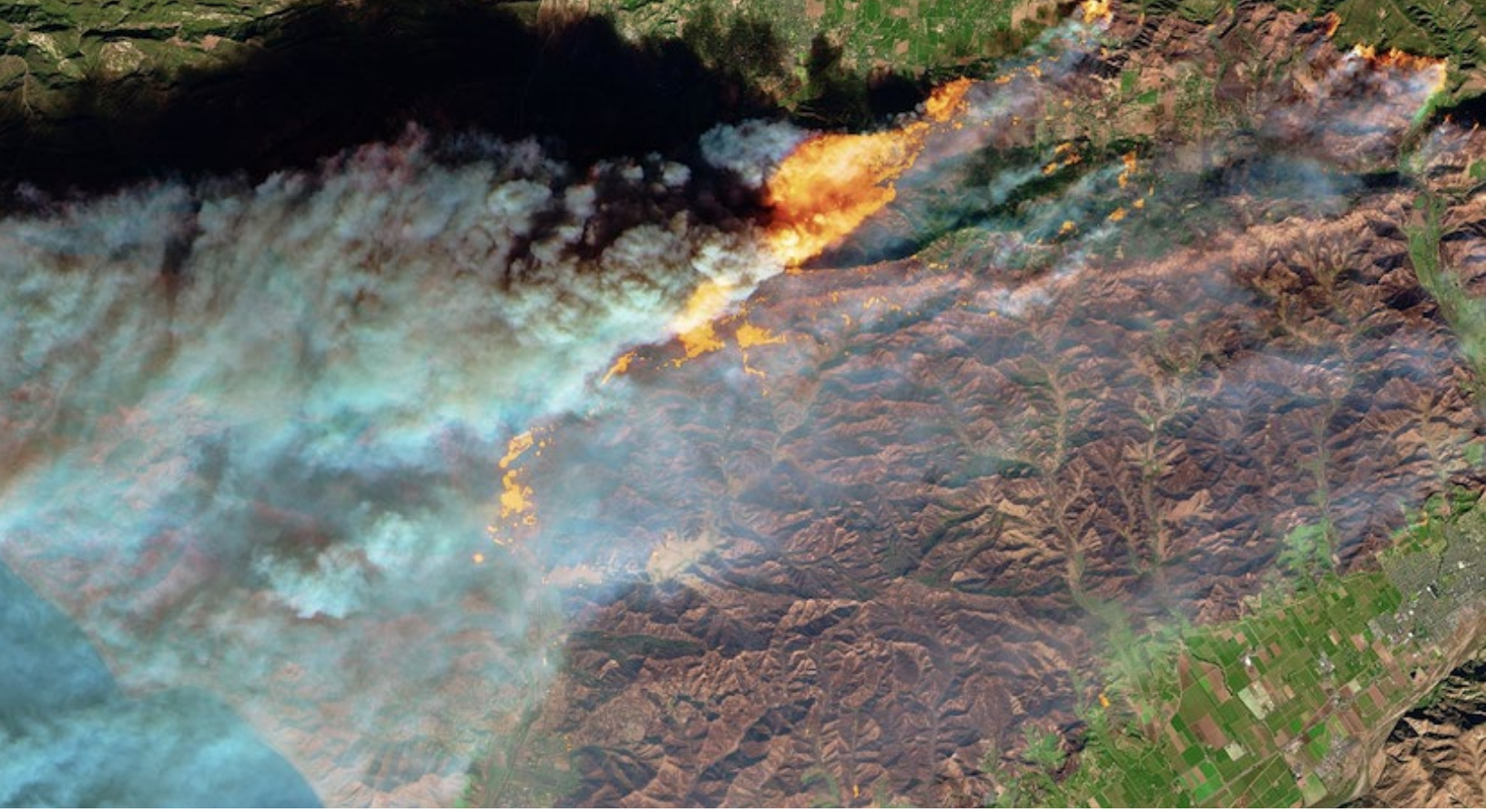


Figure 3. *A tale of two fires: the 1964 Hanly Fire (a) and the 2017 Tubbs Fire (b). Despite the simliar fire footprints (shown with the purple line), the Hanly Fire caused no deaths, and only about 100 structures were destroyed, while the Tubbs Fire killed 22 people and destroyed more than 5,500 structures. Note the extension of housing development within the fire footprint after the Hanly Fire (Keeley and Syphard 2019).*

Most destruction to human communities from fire has been caused by human-ignited fires in mixed shrubland habitats (Syphard 2020). Native shrublands like chaparral and sage scrub are highly diverse and adapted to high-intensity, relatively infrequent fires.



The 2017 Thomas Fire near the city of Ventura, California / European Space Agency

Placing developments in these highly fire-prone habitats ultimately increases fire threat over time. Continued sprawl is causing more frequent fires, which convert shrublands to non-native grasses that ignite more easily throughout more of the year. This perpetuates a dangerous cycle that increases wildfire ignitions, extends the fire season, and eliminates native shrubland habitats and biodiversity.

Wind is another important factor in wildfire risk. Foehn winds, referred to as the Santa Ana winds in the south and the Diablo or North winds in the north, commonly occur in the fall. These are dry, warm, strong winds that can spread fires dangerously fast. Winds were clocked at 40 to 95 miles per hour during the 2020 wildfire season. Wind-driven fires can cover 25,000 acres in one to two days as embers are blown ahead of the fires and toward adjacent fuels like flammable vegetation and/or structures (Syphard et al. 2011).

The 2018 Hill Fire in Ventura County spread three miles in 15 minutes (County of Los Angeles 2019). The speed at which these wind-driven fires can spread may overwhelm and outpace even the most experienced and capable agencies (County of Los Angeles 2019). And in some cases, high winds in developed areas may play a role in initiating wildfires. The 2018 Woolsey Fire, which killed three people and burned more than 1,600 structures, was sparked by powerlines that were knocked down by strong winds.

In addition, progressively hotter, drier and windier conditions due to climate change are making it easier for wildfires to ignite and spread. The number of days with extreme fire weather conditions in California has doubled since 1980, and further climate change will amplify that trend (Goss et al. 2020).

It's time for California to acknowledge that land use influences wildfire risk. Placing more homes in highly fire-prone areas increases the chances of causing larger and more destructive wildfires (Keeley and Syphard 2019; Syphard and Keeley 2020).

POLICYMAKERS CONTINUE APPROVING SPRAWL DEVELOPMENT IN HIGHLY FIRE-PRONE AREAS

Local officials continue to approve sprawl projects in high-wildfire zones. For example, in December 2018 the Los Angeles County Board of Supervisors approved the 19,000-home Centennial development in high and very high fire-hazard severity zones on the remote northern edge of the county (Agrawal 2018a). Between 1964 and 2015, Cal Fire documented 31 wildfires larger than 100 acres within five miles of the 12,000-acre development site, including four within the project's boundaries (Figure 4a) (Agrawal 2018b).

Similarly, in April 2019 the board approved the 3,150-home Northlake development, which sits in a very high fire-hazard severity zone. Multiple fires have burned the Northlake project footprint over the last few years (Figure 4b). Both projects were approved by a 4-1 vote, with Supervisor Sheila Kuehl casting the lone opposition vote.

a) Centennial Development **b) Northlake Development**

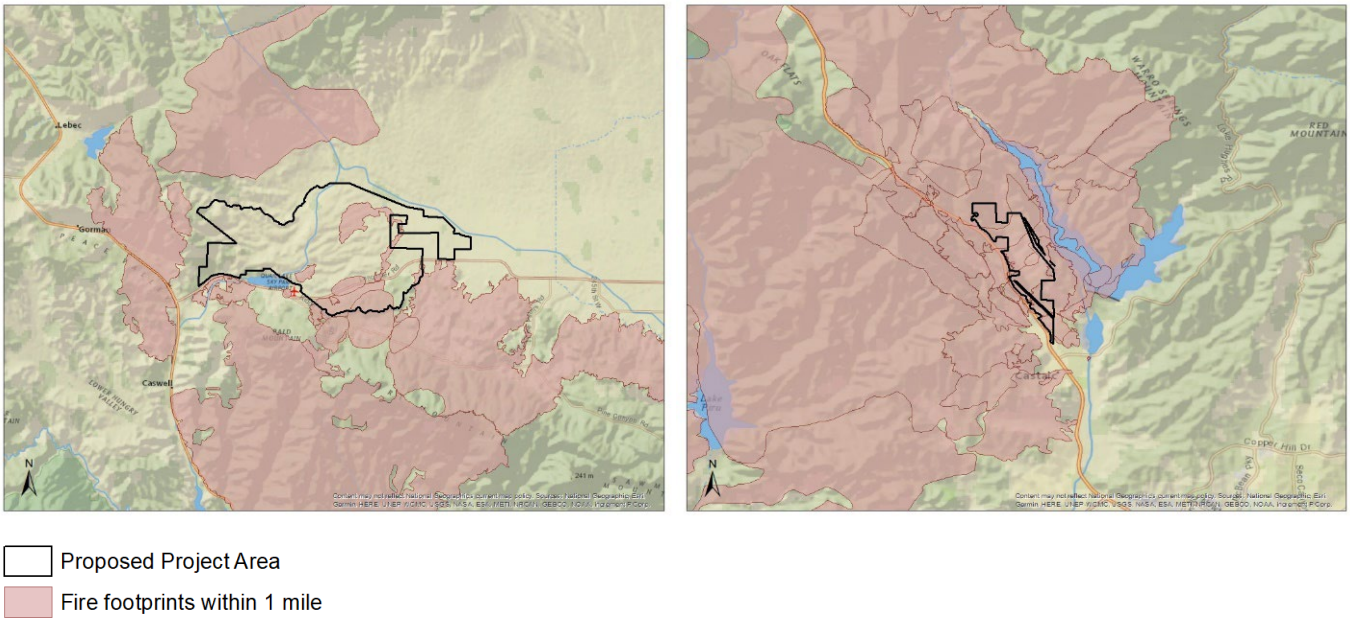


Figure 4: *Wildfire burned areas in and near the recently approved development projects of Centennial (a) and Northlake (b). Black outlines indicate development areas, and red indicates previously burned areas.*

This is a trend that's likely to continue throughout the greater Los Angeles region. The Southern California Association of Government's Regional Transportation Plan, which covers Imperial, Los Angeles, Orange, Riverside, San Bernardino and Ventura counties and was approved in September 2020, estimates that an additional 154,300 housing units will be built in very high fire-hazard zones by 2045 (SCAG 2020).

San Diego County has similarly persisted in authorizing new sprawl development in rural, highly fire-prone areas of the county. In 2018 the county approved the 2,000-unit Newland Sierra project, which would have been constructed on 2,000 acres in a very high wildfire-hazard zone. Voters repealed the county's approval by referendum in March 2020, in part due to fire concerns. Also in 2018 the county approved the fire-prone Harmony Grove South and Valiano projects, with approximately 800 combined housing units. A judge halted these projects in 2020 after finding that San Diego county hadn't adequately addressed the safety and evacuation of potential new residents.

In 2019 and 2020, San Diego County approved two more new development projects (Otay Village 14 and Otay Village 13, respectively) with over 3,000 housing units on a combined 3,000 acres in the ecologically sensitive Otay region. The project sites have been burned in several separate fires over the past two decades. In a letter to the county urging it not to approve the Otay Village 13 project, the California attorney general cited "the increased risk of wildfire that the Project will create."

Los Angeles and San Diego counties were named the top two counties in the state with the highest number of housing units located in high wildfire-risk areas (Verisk 2020). Together these counties and their local governments have recently approved the construction of more than 30,000 homes for almost 100,000 people in highly fire-prone areas (Table 1).

Table 1. *Approved development projects located in highly fire-prone areas in Los Angeles and San Diego counties. Number of people were estimated using 2019 U.S. Census data.*

County/Local Government	Approved Housing Project (Year Approved)	Number of Housing Units	Number of People	Status
Los Angeles	Centennial (2018)	19,333	57,806	Lawsuit is ongoing
Los Angeles	Northlake (2019)	3,150	9,419	Project blocked after successful litigation
San Diego	Newland Sierra (2018)	2,135	6,127	Project blocked after a successful referendum
San Diego	Harmony Grove South (2018)	453	1,300	Project blocked after successful litigation
San Diego	Valiano (2018)	326	936	Project blocked after successful litigation
San Diego	Otay Village 14 (2019)	1,119	3,212	Lawsuit is ongoing
San Diego	Otay Village 13 (2020)	1,938	5,562	Lawsuit is ongoing
City of Santee	Fanita Ranch	2,949	8,464	Lawsuit is ongoing
Total		**31,403**	**92,826**	

The problem of runaway development in risky areas is not confined to Southern California. For example, in 2020 Lake County approved a massive new luxury residential and resort project on 16,000 acres in the Guenoc Valley, northwest of Sacramento, over the objections of fire experts and the attorney general, who cited concerns about the project's risks to public safety. At the time the county was considering the project, the site had experienced at least five fires since 2006. Less than two months after the county's approval the site burned yet again in the 2020 LNU Complex Fire.

WILDFIRE IMPACTS DISPROPORTIONATELY AFFECT LOW-INCOME, MINORITY COMMUNITIES

Impacts of wildfire disproportionately affect vulnerable communities with less adaptive capacity to respond to and recover from hazards like wildfire. Low-income and minority communities, especially Native American, Black, Latinx and Southeast Asian communities, are the most marginalized groups when wildfires occur (Davies et al. 2018).

Past environmental hazards have shown that those in at-risk populations (e.g., low-income, elderly, disabled, non-English-speaking, homeless) often have limited resources for disaster planning and preparedness (Richards 2019). Vulnerable groups also have fewer resources to have cars to evacuate, buy fire insurance, implement defensible space around their homes, or rebuild, and they have less access to disaster relief during recovery (Fothergill and Peak 2004; Morris 2018; Harnett 2018; Davis 2018; Richards 2019).

The 2020 Apple Fire north of Beaumont, California / Brody Hessin, CC-BY

In addition, emergency services often miss at-risk individuals when disasters happen because of limited capacity or language constraints (Richards 2019). For example, evacuation warnings are often not conveyed to disadvantaged communities (Davies et al. 2018). In the aftermath of wildfires and other environmental disasters, news stories have repeatedly documented the lack of multilingual evacuation warnings leaving non-English speakers in danger. (Gerety 2015; Axelrod 2017; Banse 2018; Richards 2019). Survivors are left without resources to cope with the death of loved ones, physical injuries and emotional trauma from the chaos that wildfires have inflicted on their communities.

Health impacts from wildfires, particularly increased air pollution from fine particulates ($PM_{2.5}$) in smoke, also disproportionately affect vulnerable populations, including low-income communities, people of color, children, the elderly and people with pre-existing medical conditions (Künzli et al. 2006; Delfino et al. 2009; Reid et al. 2016; Hutchinson et al. 2018; Jones et al. 2020).

Increased $PM_{2.5}$ levels during wildfire events have been associated with increased respiratory and cardiovascular emergency room visits and hospitalizations, which were disproportionately higher for low socioeconomic status communities and people of color (Reid et al. 2016; Liu et al. 2017; Hutchinson et al. 2018; Jones et al. 2020). Similarly, asthma admissions were found to have increased by 34% due to smoke exposure from the 2003 wildfires in Southern California, with elderly and child age groups being the most affected (Künzli et al. 2006).

Farmworkers, who are majority people of color, often have less access to healthcare due to immigration or economic status. They are more vulnerable to the health impacts of poor air quality due to increased exposure to air pollution as they work. Yet farmworkers often have to continue working while fires burn, and smoke fills the air, or risk not getting paid (Herrera 2018; Parshley 2018; Kardas-Nelson et al. 2020).

Unprecedented California wildfires are increasing negative health impacts within and beyond its borders. A recent study found that wildfire smoke now accounts for up to 50% of ambient fine particle pollution in the western United States (Burke et al. 2021). Land-use planning must improve now.

The 2018 Camp Fire near Paradise, California / U.S. Department of Agriculture

CALIFORNIA CAN FORGE A SAFER FUTURE

Policymakers must reckon with California's wildfire history and acknowledge that reckless land-use policies are increasing wildfire risk and putting more people in harm's way. The combination of sprawl development in highly fire-prone wildlands and altered fire regimes endangers communities.

Legislation that prioritizes the following proactive measures is needed immediately:

- Stop building new homes in highly fire-prone areas;
- Retrofit existing homes with high fire risk.

Stop Building New Homes in Highly Fire-prone Wildlands

The science is clear. Placing more homes and people in highly fire-prone areas leads to more human-caused ignitions and puts more people in danger. California should prohibit new development in high fire-risk areas to keep people safe and protect its rich biodiversity.

Californians broadly support this approach — 3 out of 4 want to restrict housing developments in wildfire-prone areas, according to a 2019 poll (Dillon 2019). Yet local governments like Los Angeles and San Diego counties continue to push for sprawl development in such areas.

Developers claim that compliance with building codes written in 2008 will make their developments fire safe. This is misleading and produces a false sense of security.

While some measures can reduce fire risk, they do not make structures or communities fireproof. In an analysis that included more than 40,000 structures exposed to wildfire between 2013 and 2018 in California, many "fire-safe" structures were destroyed (Syphard and Keeley 2019). And although an analysis conducted in the aftermath of the 2017 Camp Fire showed that new building codes improved home survival, with 51% of homes built to code undamaged compared to 18% of homes built prior to 2008, about half of the homes built to fire-safety codes were still destroyed in the blaze (Kasler and Reese 2019).

The best way to limit fire risk is to avoid building homes in highly fire-prone wildlands.

The 2009 Station Fire in La Crescenta, California / Anthony Citrano, CC-BY-NC-ND

Retrofit Existing Homes With High Fire Risk

Although there are steps that can be taken to reduce risk, they do not guarantee safety from fire. Limiting new development in highly fire-prone areas is critical to reducing risk. But for homes already in high fire-risk areas, home-hardening is important to minimize the chances of human ignitions and fire spread.

It is estimated that more than 2 million homes are located in high fire-risk areas (Verisk 2020). Investing resources primarily in fire suppression without adequately addressing the human-related cause of the fires will not reduce wildfire losses (Stephens et al. 2009). State funds must be equitably distributed to retrofit existing communities in fire-prone areas to reduce the chances of unintentional ignitions and minimize spread should a fire ignite.

Retrofits should include ember-resistant vents, fire-resistant roofs and irrigated defensible space immediately adjacent to (i.e., within 100 feet of) structures. Although such features do not make homes fireproof, they have been shown to improve the chances of structure survival in fires (Syphard et al. 2014; Syphard et al. 2017). External sprinklers with an independent water source could reduce structures' flammability when fires occur (California Chaparral Institute 2018). Rooftop solar and clean energy microgrids could reduce fire risk from utilities' infrastructure during extreme weather (Roth 2019).

The state must also engage, prepare and train homeowners to harden their homes, reduce the risk of fire ignitions and spread, and be ready to safely defend their homes or evacuate early when needed (Stephens et al. 2009). As communities rebuild from recent wildfire destruction, now is the time to instill a culture of coexistence with wildfire.

California policymakers can help our state meet this crucial challenge. Strong land use policies that consider the state's diverse fire history and ecology will help improve our relationship with wildfire and ensure a safer and healthier future for both humans and wildlife.

REFERENCES CITED

Agrawal, N. (2018a, December 4). LA County considers building a new city where fire hazard is high. Is Tejon Ranch worht the risk? Los Angeles Times.

Agrawal, N. (2018b, December 11). Supervisors OK 19,000-home development at Tejon Ranch. Los Angeles Times.

Anderson, K. (2018). The Use of Fire by Native Americans in California. In J. W. Van Wagtendonk, N. G. Sugihara, S. L. Stephens, A. E. Thode, K. E. Shaffer, & J. A. Fites-Kaufman (Eds.), Fire in California's Ecosystems.

Axelrod, J. (2017, December 13). California Wildfires Spark Issues of Bilingual Emergency Communications. American City and County.

Baker, B., & Halsey, R. W. (2020). California Chaparral and Woodlands. Reference Module in Earth Systems and Environmental Sciences, 1–12.

Balch, J. K., Bradley, B. A., Abatzoglou, J. T., Nagy, R. C., Fusco, E. J., & Mahood, A. L. (2017). Human-started wildfires expand the fire niche across the United States. Proceedings of the National Academy of Sciences, 114(11), 2946–2951.

Balch, J. K., Bradley, B. A., D'Antonio, C. M., & Gómez-Dans, J. (2013). Introduced annual grass increases regional fire activity across the arid western USA (1980-2009). Global Change Biology, 19, 173–183.

Banse, T. (2018, April 20). How Do You Say 'Evacuate' in Tagalog? In a Disaster, English Isn't Always Enough. Northwest Public Broadcasting.

Benson, J. F., Mahoney, P. J., Sikich, J. A., Serieys, L. E. K., Pollinger, J. P., Ernest, H. B., & Riley, S. P. D. (2016). Interactions between demography, genetics, and landscape connectivity increase extinction probability for a small population of large carnivores in a major metropolitan area. Proceedings of the Royal Society B: Biological Sciences, 283(1837), 20160957.

Benson, J. F., Mahoney, P. J., Vickers, T. W., Sikich, J. A., Beier, P., Riley, S. P. D., … Boyce, W. M. (2019). Extinction vortex dynamics of top predators isolated by urbanization. Ecological Applications, 29(3), e01868.

Blakey, R. V., Webb, E. B., Kesler, D. C., Siegel, R. B., Corcoran, D., & Johnson, M. (2019). Bats in a changing landscape: Linking occupancy and traits of a diverse montane bat community to fire regime. Ecology and Evolution, 9, 5324–5337.

Bond, M. L., Lee, D. E., Siegel, R. B., & Ward, J. P. (2009). Habitat use and selection by California spotted owls in a postfire landscape. Journal of Wildlife Management, 73(7), 1116–1124.

Burke, M., Driscoll, A., Xue, J., Heft-Neal, S., Burney, J., & Wara, M. (2021). The changing risk and burden of wildfire in the United States. Proceedings of the National Academy of Sciences, 118(2), e2011048118.

California Department of Forestry and Fire Protection (Cal Fire). (2020a). Top 20 Deadliest California Wildfires.

California Department of Forestry and Fire Protection (Cal Fire). (2020b). Top 20 Largest California Wildfires.

California Department of Forestry and Fire Protection (Cal Fire). (2020c). Top 20 Most Destructive California Wildfires.

California Chaparral Institute. (2018). Independent external sprinklers to protect your home during a wildfire.

Campos, B. R., & Burnett, R. D. (2015). Avian Monitoring of the Storrie and Chips Fire Areas 2014 Report.

County of Los Angeles. (2019). After Action Review of the Woolsey Fire. After Action Review of the Woolsey Fire.

Davies, I. P., Haugo, R. D., Robertson, J. C., & Levin, P. S. (2018). The unequal vulnerability of communities of color to wildfire. PLoS ONE, 13(11), 1–15.

Davis, M. (2018, December 5). A tale of two wildfires: devastation highlights California's stark divide. The Guardian.

Delfino, R. J., Brummel, S., Wu, J., Stern, H., Ostro, B., Lipsett, M., … Gillen, D. L. (2009). The relationship of respiratory and cardiovascular hospital admissions to the southern California wildfires of 2003. Occupational and Environmental Medicine, 66(3), 189–197.

Dillon, L. (2019, June 18). More homes in wildfire zones? High number of Californians say no , poll says. LA

Times.
Fothergill, A., & Peak, L. A. (2004). Poverty and disasters in the United States: A review of recent sociological findings. Natural Hazards, 34, 89–110.
Gerety, R. M. (2015, September 1). Farm Workers in Wildfire Areas Aren't Always Aware of Evacuation Plans. National Public Radio Morning Edition.
Goss, M., Swain, D. L., Abatzoglou, J. T., Sarhadi, A., Kolden, C. A., Williams, A. P., & Diffenbaugh, N. S. (2020). Climate change is increasing the likelihood of extreme autumn wildfire conditions across California. Environmental Research Letters, 15.
Harnett, S. (2018, September 19). Low-Income Communities Struggle to Recover After a Wildfire. KQED.
Herrera, J. (2018, November 14). As Wildire Smoke Fills the Air, Farmworkers Continue to Labor in the Fields. Pacific Standard.
Hutchinson, J. A., Vargo, J., Milet, M., French, N. H. F., Billmire, M., Johnson, J., & Hoshiko, S. (2018). The San Diego 2007 wildfires and Medi-Cal emergency department presentations, inpatient hospitalizations, and outpatient visits: An observational study of smoke exposure periods and a bidirectional case-crossover analysis. PLoS Medicine, 15(7), e1002601.
Jones, C. G., Rappold, A. G., Vargo, J., Cascio, W. E., Kharrazi, M., McNally, B., & Hoshiko, S. (2020). Out-of-Hospital Cardiac Arrests and Wildfire-Related Particulate Matter During 2015-2017 California Wildfires. Journal of the American Heart Association, 9(8), e014125.
Kardas-Nelson, M., Alvarenga, J., & Tuirán, R. A. (2020, October 6). Farmworkers forced to put harvest over health during wildfires. Investigate West.
Kasler, D., & Reese, P. (2019, April 11). The weakest link: Why your house may burn while your neighbor's survives the next wildfire. Sacramento Bee.
Keeley, J. E. (2005). Fire as a threat to biodiversity in fire-type shrublands. Planning for biodiversity: bringing research and management together. USDA Forest Service General Technical Report PSW-GTR-195.
Keeley, J. E., & Fotheringham, C. J. (2001). Historic fire regime in southern California shrublands. Conservation Biology, 15(6), 1536–1548.
Keeley, J. E., & Syphard, A. D. (2018). South Coast Bioregion. In Fire in California's Ecosystems (pp. 319–351). Berkeley, CA: University of California Press.
Keeley, J. E., & Syphard, A. D. (2019). Twenty-first century California, USA, wildfires: fuel-dominated vs. wind-dominated fires. Fire Ecology, 15(24).
Kimmerer, R. W., & Lake, F. K. (2001). The role of indigenous burning in land management. Journal of Forestry, 99(11), 36–41.
Künzli, N., Avol, E., Wu, J., Gauderman, W. J., Rappaport, E., Millstein, J., … Peters, J. M. (2006). Health effects of the 2003 Southern California wildfires on children. American Journal of Respiratory and Critical Care Medicine, 174, 1221–1228.
Liu, J. C., Wilson, A., Mickley, L. J., Ebisu, K., Sulprizio, M. P., Wang, Y., … Bell, M. L. (2017). Who among the elderly is most vulnerable to exposure to and health risks of fine particulate matter from wildfire smoke? American Journal of Epidemiology, 186(6), 730–735.
Mann, M. L., Berck, P., Moritz, M. A., Batllori, E., Baldwin, J. G., Gately, C. K., & Cameron, D. R. (2014). Modeling residential development in California from 2000 to 2050: Integrating wildfire risk, wildland and agricultural encroachment. Land Use Policy, 41, 438–452.
Morris, B. (2018, April 23). How the Ultra-Wealthy are Making Themselves Immune to Natural Disasters.
Parshley, L. (2018, December 7). The Lingering Effects of Wildfires Will Disproportionately Hurt People of Color. Vice, pp. 1–11.
Radeloff, V. C., Helmers, D. P., Kramer, H. A., Mockrin, M. H., Alexandre, P. M., Bar-Massada, A., … Stewart, S. I. (2018). Rapid growth of the US wildland-urban interface raises wildfire risk. Proceedings of the National Academy of Sciences, 115(13), 3314–3319.
Reid, C. E., Jerrett, M., Tager, I. B., Petersen, M. L., Mann, J. K., & Balmes, J. R. (2016). Differential respiratory health effects from the 2008 northern California wildfires: A spatiotemporal approach. Environmental Research, 150, 227–235.

Richards, R. (2019, July 25). After the Fire: Vulnerable Communities Respond and Rebuild. Center for American Progress.
Roth, S. (2019, March 14). California's wildfire threat could be an opportunity for clean- energy microgrids - Los Angeles Times. Los Angeles Times.
Sahagun, L. (2020, November 1). Rescue operations underway in the San Gabriel Mountains for rare species marooned by wildfire. Los Angeles Times.
Southern California Association of Governments (SCAG). (2020). Certified Final Connect SoCal Program Environmental Impact Report.
Stephens, S. L., Adams, M. A., Handmer, J., Kearns, F. R., Leicester, B., Leonard, J., & Moritz, M. A. (2009). Urban-wildland fires: How California and other regions of the US can learn from Australia. Environmental Research Letters, 4, 014010.
Stephens, S. L., Martin, R. E., & Clinton, N. E. (2007). Prehistoric fire area and emissions from California's forests, woodlands, shrublands, and grasslands. Forest Ecology and Management, 251(3), 205–216.
Stephens, S. L., & Sugihara, N. G. (2018). Fire Management and Policy since European Settlement. In J. W. Van Wagtendonk, N. G. Sugihara, S. L. Stephens, A. E. Thode, K. E. Shaffer, & J. A. Fites-Kaufman (Eds.), Fire in California's Ecosystems. UC Berkeley.
Stillman, A. N., Siegel, R. B., Wilkerson, R. L., Johnson, M., & Tingley, M. W. (2019). Age-dependent habitat relationships of a burned forest specialist emphasise the role of pyrodiversity in fire management. Journal of Applied Ecology, 56(4), 880–890.
Sugihara, N. G., Van Wagtendonk, J. W., Fites-Kaufman, J., Shaffer, K., & Thode, A. E. (2018). The Future of Fire in California's Ecosystems. In Fire in California's Ecosystems (pp. 538–544).
Syphard, A. D. (2020). A Conversation About Fire Resliency. Sierra Club Redwood Chapter Presentation.
Syphard, A. D., Brennan, T. J., & Keeley, J. E. (2014). The role of defensible space for residential structure protection during wildfires. International Journal of Wildland Fire, 23(8), 1165–1175.
Syphard, A. D., Brennan, T. J., & Keeley, J. E. (2017). The importance of building construction materials relative to other factors affecting structure survival during wildfire. International Journal of Disaster Risk Reduction, 21, 140–147.
Syphard, A. D., Brennan, T. J., & Keeley, J. E. (2019). Drivers of chaparral type conversion to herbaceous vegetation in coastal Southern California. Diversity and Distributions, 25, 90–101.
Syphard, A. D., & Keeley, J. E. (2019). Factors associated with structure loss in the 2013–2018 California wildfires. Fire, 2(3), 49.
Syphard, A. D., & Keeley, J. E. (2020). Why are so many structures burning in California. Fremontia, 47(2), 28–35.
Syphard, A. D., Keeley, J. E., & Brennan, T. J. (2011). Comparing the role of fuel breaks across southern California national forests. Forest Ecology and Management, 261(11), 2038–2048.
Syphard, A. D., Radeloff, V. C., Hawbaker, T. J., & Stewart, S. I. (2009). Conservation threats due to human-caused increases in fire frequency in mediterranean-climate ecosystems. Conservation Biology, 23(3), 758–769.
Syphard, A. D., Radeloff, V. C., Keeley, J. E., Hawbaker, T. J., Clayton, M. K., Stewart, S. I., … Hammer, R. B. (2007). Human influence on California fire regimes. Ecological Society of America, 17(5), 1388–1402.
Taillie, P. J., Burnett, R. D., Roberts, L. J., Campos, B. R., Peterson, M. N., & Moorman, C. E. (2018). Interacting and non-linear avian responses to mixed-severity wildfire and time since fire. Ecosphere, 9(6).
Verisk. (2020). FireLine State Risk Report – California.