CALIFORNIA FIRE SCIENCE CONSORTIUM

Research Brief for Resource Managers

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The 2020 fire season: an eye-opener but not a fluke

Safford, Hugh D., Alison K. Paulson, Zachary L. Steel, Derek J. N. Young, and Rebecca B. Wayman. 2022. "The 2020 California Fire Season: A Year like No Other, a Return to the Past or a Harbinger of the Future?" Global Ecology and Biogeography
https://onlinelibrary.wiley.com/doi/10.1111/geb.13498

2020 was a landmark year for wildfire in California. Patterns of wildfire and wildfire impacts reflected decades of forest and fire management, climate change, and socio-economic trends. At the same time, the 2020 season was punctuated by unusual stressors like subtropical lightning storms. This paper summarizes important outcomes of the 2020 fire year in California and discusses what we can learn from them.

Relatively few fires accounted for the vast majority of area burned in 2020—a pattern common to other recent years. 24 fires (out of 9,917) accounted for 90 percent of area burned, and a further 51 fires accounted for 7 percent. These fires (hereafter "large fires") were largely ignited by lightning, especially during a mass lightning event in mid-August. This pattern contrasts with many other recent large fires, which have been largely human-ignited.

Several factors likely contributed to the spread of the largest fires, including:

- **Weather**: The vast majority of the largest fires co-occurred with at least one National Weather Service "red flag" day in the fires' early stages, indicating high temperatures and/or winds, and low humidity.
- **Low fuel moisture**: Fine fuel moistures (derived from the RAWS network) were very low, particularly during the first five days of the wildfires.
- **Interactions between fire history, vegetation and weather**. In much of the conifer forest base, areas that had burned ≤10-12 years previous to 2020 were much less likely to burn in 2020, with some exceptions driven by extreme weather conditions. In chaparral and sage scrub ecosystems, time since burn tended to be less influential. Nonetheless, under normal summer weather (absence of Santa Ana winds) the extent of chaparral burning in 2022 also showed fuel-age dependence.

Management Implications

- 2020 was a record year for wildfires in recent history, though the area burned was close to estimates of pre-suppression burning. We should expect more of these types of fire seasons in the future.
- Much of the burning was destructive rather than restorative and impacts to humans were severe.
- In forested California, managers should focus on reducing fire severity rather than fire area; this is best done via prefire fuel management. More emphasis should also be placed on postfire restoration.
- Patterns of fire severity differed substantially among 2020 fires, though time-since-last-fire, dryness, and wind speed were all generally associated with higher-severity fire.

Area burned alone is not a sufficient metric for understanding the ecological impact of wildfire. In fact, the area burned in 2020 (~1.7 million acres) came closer to estimates of the amount of area burned in a typical year prior to Euro-American colonization (~1.8 million acres; Stephens et al. 2007) than any prior year in the historical record.

A more meaningful metric of impact is the degree of vegetation or environmental change, or "fire severity." Many of the fires that burned in 2020 resulted in a large degree of vegetation change ("high severity"). In some ecosystems this is to be expected. Shrub-dominated chaparral ecosystems have low-lying, relatively continuous vegetation and therefore tend to experience a large amount of "top-kill" (dead aboveground biomass), though they can generally recover quickly via resprouting and re-seeding. The 2020 fires reflected this tendency towards high-severity effects: 70 percent of the burned low-elevation chaparral and 50 percent of the montane chaparral ecosystems burned at high severity.

But even vegetation types adapted to lower-severity fire experienced a greater amount of high-severity fire in 2020. Yellow pine, mixed conifer, and red fir forests experienced 43-76 percent more high-severity fire than the average over previous decades and about 300-600 percent more than in pre-suppression reference conditions. Forest recovery across 100,000s of acres will be severely impacted by the scale and severity of the 2020 fires.

The researchers found several factors that could help explain fire severity patterns across the 38 largest 2020 wildfires. The most important variables were time since last fire (TSLF), which is correlated with higher fuel loadings; vapor pressure deficit (a measure of dryness); and wind speeds. 1000-hr fuel moisture (a measure of longer-term dryness) and prefire tree mortality were important in only a handful of fires.

The importance of the different variables varied substantially between fires and within fires. For example, the severity patterns for some fires — and some pixels within fires — were strongly associated with wind speed, and for other fires (and areas) they were hardly affected by wind speed. Altogether, the variability among and within fires suggests that while there are some major drivers of fire severity, the specific fire effects will be influenced by local environmental conditions and weather patterns.

In addition to ecological effects, the 2020 wildfires also created a tremendous amount of human suffering, economic losses, and other socio-economic impacts. The article includes a wide variety of data related to these effects (see summary below) . The degree of these losses surpasses the historical averages and even recent years, though economic losses have been trending upwards since 2015.

As described in the article, the 2020 fire season was an eye-opener, but it was not a fluke. Many of the trends described in the article will continue to impact California in future fire seasons. The authors conclude with a plea to focus less on reactive fire suppression and more on proactive strategies like prefire forest management and ecosystem restoration.

Suggestions for further reading

- Stephens, S.L., et al., 2022. Mass fire behavior created by extensive tree mortality… *Forest Ecology and Management*, *518*, p.120258.
- Safford, H.D., et al., 2021. Fire ecology of the North American Mediterranean-Climate Zone. In *Fire Ecology and Management: Past, Present, and Future of US Forested Ecosystems*. Springer, Cham, Switz.
- Safford, H.D. and Stevens, J.T., 2017. Natural range of variation for yellow pine and mixed-conifer... *Gen. Tech. Rep. PSW-GTR-256. Albany, CA: USDA Forest Service, Pacific Southwest Research Station.*

Note: this brief focuses on trends, but the journal article also includes information about individual fires >10,000 ha, including:
- Fire size, size, cause, start and containment dates, fuel moisture conditions
- The socio-economic impact (structures destroyed, lives lost, suppression cost, smoke impacts),
- Vegetation within the fire perimeters,
- Fire history (% burned in the last 10/15/20/30 years, area-weighted years since the last fire, and the area-weighted presettlement fire return interval departure (how current fire frequencies differ from frequencies prior to Euro-American colonization).