

Prescribed Burn Windows Under Future Climatic Conditions



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Introduction

Conducting more prescribed burns is recognized as one of the critical solutions for reducing wildfire hazard and improving forest health in California. Prescribed fires must occur within specific meteorological conditions known as burn windows, where the range of conditions is designed to keep the fire within its intended boundaries and to produce desired fire effects. However, burn windows can be infrequent and brief, requiring practitioners to be nimble. Predicting when burn windows will likely occur can help practitioners across landowner types prepare to be opportunistic. This need is even more important with a changing climate, as traditional burn windows may shift in timing and duration.

Here, we review two studies that have assessed seasonality and duration of burn windows: A California-focused study on trends in historic burn windows (Bajinath-Rodino et al. 2022) and a Western US-focused study on recent trends and potential future changes (Swain et al. 2023). This brief will focus on the California-specific finding from Swain et al. (2023).

Methods & Results

First, Bajinath-Rodino et al. (2022) described the seasonality of prescribed fires, using records from existing databases (CALFIRE, PFIRS, and MTBS) to assess the seasonal trends in prescribed fire occurrence and burn efficiency since 1948 in California. Efficiency refers to the number of acres burned per fire, i.e., larger fires are more efficient than smaller ones. They found that most (40%) prescribed burns occurred in the fall (September, October, November), followed by winter (December, January, February), spring (March, April, May), and summer (June, July, August). Even though spring burns were less common than fall burns, their efficiency was similar to that of fall burns.

Bajinath-Rodino et al. (2022) also used meteorological data to project when burn windows in California were likely to occur in the future. A second study from Swain et al. (2023) conducted a similar projection at a broader scale, with slightly different methods. Bajinath-Rodino et al. (2022) used data from gridMet and vegetation data from Landfire to simulate seasonal trends in burn window availability from 1984 to 2019, and Swain et al. (2023) used Landfire and gridMet in conjunction with the CMIP5 RCP4.5 climate projection to track past burn windows (1981-2020) and predict future trends (2021-2060). Both papers found that prescribed burn windows have been abundant in winter and spring. However, despite the abundance of burn windows and the lack of permitting requirements in both spring and winter, only about half of Rx burns occur in these six months. Together, the studies suggest that winter and spring burn windows are being underutilized.

Both studies found that during winters, there has been widespread burn window availability across southern California. Spring offers an abundance of burn windows in Northern and Central California and along the Southern California coast. Fall offers an abundance of burn windows in the Central Valley and along the Southern California coast. Summer offers an abundance of burn windows along the coast of California and across most of the Sierra Nevada range.

Concerningly, both studies found trends of widespread decrease in burn window availability. Using climate modeling, Swain et al. (2023) found that over the next few decades, there will be a gradual loss of burn windows across all seasons, but to a greater extent in winter and spring. This aligns with the trends found in Bajinath-Rodino et al. (2022) based on

MANAGEMENT IMPLICATIONS

- Spring and winter both offer numerous prescribed burn windows but have been historically underutilized.
- Spring prescribed fires have a similar burn efficiency (acres per burn) to fall prescribed fires.
- Spring and winter burns also have an added benefit of reducing fuel loads immediately prior to the wildfire season.
- Drier, warmer future climatic conditions will likely open more burn windows earlier in the season in wetter, cooler forested areas.

actual past climate data. Rather than discourage the use of prescribed fire, however, the results suggest a shifting of the seasonality of practice. Through applying this and presumably future studies, land managers and agencies can better predict, prepare for, and utilize future burn windows under changing conditions. There may be a gradual loss of winter burn opportunities in Southern California, the Southern Sierras, and the Central Coast. But winter burns will still be an option in the Central Valley. There will be a decline in spring burn windows in Southern and Central California. But spring burn opportunities across the Sierra Nevada range may increase. A possible regional tradeoff is a slight decrease in burn window availability across southern and central California, but still opportunities in the Northern Sierras and near Humboldt County. The summer months will likely see a decrease in windows along the Southern California coast, in Northern California, and across the Sierra Nevada, but they will not disappear.

By separately modeling spatial changes in the number of days that maximum temperature, wind speed, and relative humidity are in prescription and comparing it to the spatial changes in the number of burn windows, Baijnath-Rodino et al. (2022) determined that relative humidity was the meteorological condition most correlated with changes in burn window availability. Swain et al. (2023) used a similar method to model how 100-hour and 1000-hour fuel moisture (FM) constraints affected future burn window availability. They found that large-diameter FM posed a strong constraint on burn window availability in forested areas. This resulted in 40 to 80 fewer days of burn window availability per year. They also found that this effect was the strongest in wet forested regions and was likely the result of the two-side nature of burn windows, i.e., too high of FM or too low of FM can push a region out of prescription. FM, being

the main driver of changes in burn window availability is notable for two reasons. First, as climate change produces increasingly warmer and drier conditions across much of California, there is a window of opportunity to treat previously climate-limited forests (i.e., an abundance of fuels, but too wet to burn) before lower FM in conjunction with high fuel loading pushes them back out of prescription. Second, lower FM may increase the ability to conduct spring burns and treat fuels in wetter areas like the Sierra Nevada before the primary wildfire season occurs.

Discussion & Conclusion

While fall and summer align with what is thought to be the historical fire regime of California, climate change, fire suppression, and mega-fires are rapidly altering the seasonal component of fire regimes. Integrating the studies suggests that the Spring season presents reliable burn windows across many vegetation types while having high burn efficiency. Burning in the spring also has the added benefit of reducing fuel loads immediately before the wildfire season. Warmer, drier future climatic conditions open more burn windows earlier in the spring in wetter, cooler forested areas and likely will result in more spring windows in Northern California and the Sierra Nevada. Practitioners may adjust their plans to be more prepared for these spring windows and to mitigate the seasonal-specific challenges (i.e. planning for mop-up or conducting maintenance burns). Lastly, winter presents many opportunities for safely burning in the grassland and shrubland ecosystems of Southern California and the Central Valley. Just as wildfires have become year-round, so have opportunities to conduct prescribed fires when seasonal and spatial considerations such as those presented in these studies are considered.

Additional Information

This brief is based on the following articles:

Baijnath-Rodino, J. A., Li, S., Martinez, A., Kumar, M., Quinn-Davidson, L. N., York, R. A. and Banerjee, T., Historical Seasonal Changes in Prescribed Burn Windows in California, *Science of The Total Environment*, vol. 836, p. 155723, August 25, 2022. DOI: 10.1016/j.scitotenv.2022.155723

Swain, D. L., Abatzoglou, J. T., Kolden, C., Shive, K., Kalashnikov, D. A., Singh, D. and Smith, E., Climate Change Is Narrowing and Shifting Prescribed Fire Windows in Western United States, *Communications Earth & Environment*, vol. 4, no. 1, p. 340, October 3, 2023. DOI: 10.1038/s43247-023-00993-1

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