The efficacy of Red Flag Warnings in mitigating human-caused wildfires

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Red Flag Warnings (RFWs) are issued by the U.S. National Weather Service to alert management and emergency response agencies of weather conditions that are conducive to extreme wildfire behavior. These conditions generally include some combination of high wind, low relative humidity, high temperature, and dry vegetation. Such circumstances can facilitate rapid expansion of existing wildfires and new ignitions that may be difficult to suppress rapidly. Issuance of RFWs also can increase situational awareness by encouraging the public to exercise extreme caution with any activities that could ignite a wildfire.

MANAGEMENT IMPLICATIONS

- RFWs appeared to reduce the number of ignitions associated with short-term behavioral choices, although the number of human-caused wildfires was higher on RFW days.
- The benefits of RFWs that complement other wildfire mitigation and adaptation efforts increase as wildfire potential escalates.
- The probability of human-caused wildfires becoming large wildfires increased on RFW days, suggesting the value of investment in wildfire prevention on such days.

The U.S. Forest Service maintains the most comprehensive national source of data on wildfire ignitions. Causes of wildfires, when known, are classified as natural or as one of 11 types of human behavior or activity, including but not limited to arson and incendiarism, debris and open burning, fireworks, recreation and ceremony, and power generation, transmission, or distribution. Some of these causes, such as debris and open burning, generally reflect short-term behavioral decisions. Other causes, such as railroad operations and maintenance and smoking, are linked to infrastructure and habitual behavior. Patterns of ignition causes vary seasonally and geographically. Increased understanding about how these causes of ignition relate to the issuance of RFWs increases the ability to mitigate human-caused ignitions.

We assessed whether issuance of RFWs was associated with the number of human-caused wildfires and the probability of an ignition becoming a large wildfire (100 or more acres) across the western United States from 2006 through 2020. This information allowed us to examine the extent to which RFWs may reduce the number of human-caused wildfire ignitions.

Red flag warnings (RFWs) were issued on more than ten days per year across much of the interior western United States, with the greatest number across much of New Mexico and eastern Colorado. By contrast, few RFWs were issued in the coastal Pacific Northwest and areas dominated by irrigated agriculture in California's San Joaquin Valley.

On days with red flag warnings and without lightning, the number of wildfires ignited by most human causes was significantly greater than on similar days without RFWs. For example, the number of wildfires ignited by power systems, smoking, and railroad operations and maintenance were 120%, 65%, and 54% greater on days with RFWs. The number of ignitions that became large (100 or more acres) was 129% greater on RFW days.

The relative increase on RFW days in the number of wildfires caused by short-term behavioral decisions (10%) was lower than the relative increase in the number caused by infrastructure or habitual behavior (36%), suggesting

that RFWs discourage some actions that can lead to ignitions. For example, the number of fires caused by debris and open burning was 10% higher on RFW days than on similar days; across the western United States, 5% of wildfires caused by debris and open burning occurred on RFW days.

Although the number of human-caused fires was higher on RFW days than on similar days without RFWs, the warnings appeared to disproportionately reduce the number of ignitions associated with short-term behavioral choices. As biophysical wildfire potential and the density of people living in wildfire-prone areas increase, so do the benefits of improved wildfire early warning systems, such as RFWs, that complement other wildfire mitigation and adaptation efforts. Given that the probability of a human-caused wildfire becoming a large wildfire increased considerably on RFW days, investments in some types of wildfire prevention may yield an especially high return on such days. RFWs were not explicitly designed for fire prevention, and communication and messaging of such warnings often falls to other federal and state agencies or media outlets. Weather warnings, including RFWs, may not reach everyone at risk if they are not distributed through the diverse channels that people use to access information.

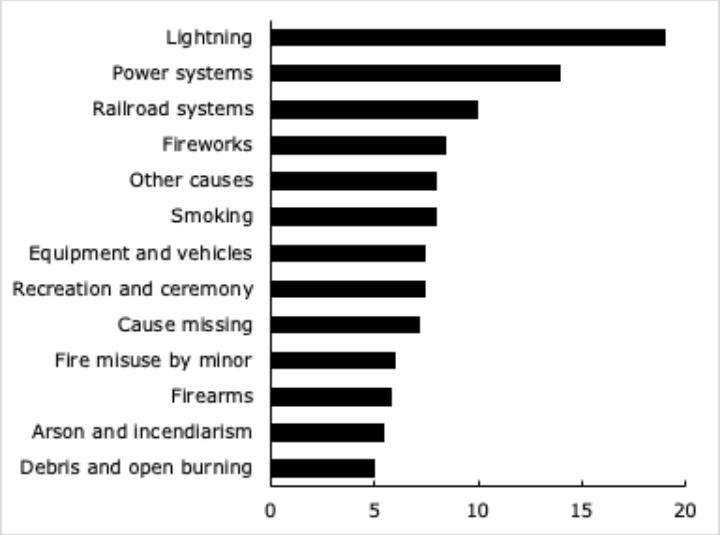

Figure 1. Percentage of wildfires with different causes discovered on days with Red Flag Warnings across the western United States from 2006 through 2020.

Additional Information

This brief is based on the following article:
Abatzoglou, J.T., E. Fleishman, E.L. Williams, D.E. Rupp, J.S. Jenkins, and M. Sadegh. In press. The efficacy of Red Flag Warnings in mitigating human-caused wildfires across the western United States. Journal of Applied Meteorology and Climatology.

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