



# SOUTHERN Fire Exchange

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## Wildfire Ignitions: State of the Science in the Southeast

*Alan Long and Jeffrey Prestemon*

### INTRODUCTION

Wildfire ignitions are caused by lightning or a variety of human-related activities. While lightning is the most prevalent ignition source across much of the western United States, human-caused ignitions start the majority of fires in the South and nationwide. The frequency of natural and human-caused wildfires varies significantly according to different biophysical, social, and fire management and prevention factors. Understanding local and regional ignition sources is a critical element in fire management, prevention, and policy. Thus, an early focus in the National Cohesive Wildland Fire Management Strategy process was to evaluate the state of the science regarding how ignitions are produced, their predictability, and how prevention efforts can affect their occurrence. The results of that extensive review and analysis of national and international literature were released in 2013 in a General Technical Report (GTR) from the U.S. Forest Service Southern Research Station<sup>1</sup>. This fact sheet extracts key findings from the GTR relevant to wildfire ignitions in the southern United States and to relationships between prevention activities and human-caused ignitions. More specifically, we focus on recent trends in different ignition causes, predictors of fire cause, and prevention activity effectiveness.

### IGNITION CAUSE TRENDS AND PREDICTORS

Generally, the four most common human-related ignition sources on public lands in the U.S. have been arson (incendiary), escaped debris burns, campfires, and equipment. Important biophysical variables associated with these causes have been daily weather conditions (including winds), fuel moisture, fire behavior indices (synthesizers of weather and fuel factors), and duration



The majority of wildfires in the Southeast, such as this fire in Horry County, South Carolina, start from human-caused ignitions. Photo by South Carolina Forestry Commission.



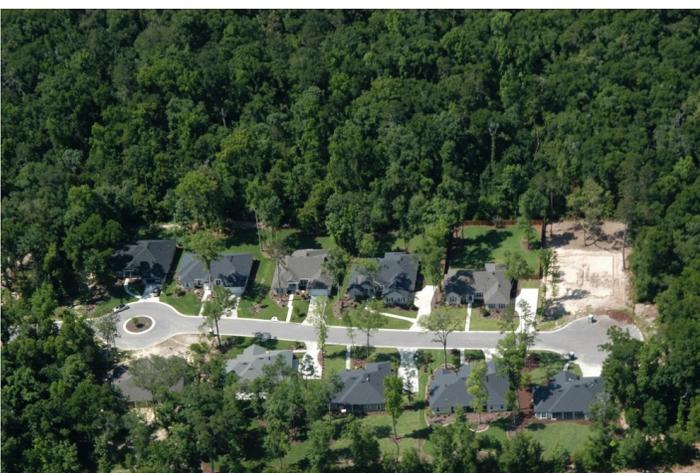
Campfires are one of the most common human-related wildfire ignition sources. Photo by Annie Oxart.

<sup>1</sup>Prestemon, J. P., T. J. Hawbaker, M. Bowden, J. Carpenter, M.T. Brooks, K.L. Abt, R. Sutphen, and S. Scranton. 2013. Wildfire Ignitions: A Review of the Science and Recommendations for Empirical Modeling. GTR SRS-171. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station, 20 p. Available online at <http://www.treesearch.fs.fed.us/pubs/42766>.

of an immediately preceding precipitation event. As expected, ignition frequency in many studies increased with warmer, drier, windier conditions. Vegetation type, fuel load, and topography have also been associated with ignition frequency, probably through interactions with the weather and climate variables.

Although less intuitive, different social and cultural factors that influence ignition sources are perhaps equally important as modifiers of ignition frequency. Several studies have related increases in law enforcement to decreasing trends in arson fires, with so far only limited evidence of an impact on other human-related fire causes. On the other hand, a number of social factors are positively linked with increasing ignition likelihood: increases in population density, transportation corridors, and presence of industrial and recreational vehicles in wildlands. Vegetative fuel connectivity appears to be an important qualifier in these relationships, which generally display an inverse-U distribution. That is, ignitions increase with human and infrastructure density up to a point but then decrease as fuels become increasingly disconnected. In a similar manner, weekends and holidays often lead to spikes in human-caused ignitions, while ignitions from escaped debris burning or arson increase in certain seasons. Somewhat less predictable, but representing periodic important sources of arson ignitions, are social factors such as poor economic conditions or land-use changes that may lead to a disgruntled populace. Research has demonstrated that such ignitions may cluster spatially and temporally, often due to serial or copycat behavior of arsonists.

Several interesting trends in previously important ignition causes have emerged over the last 20 to 30 years.



Studies have shown that wildfire ignitions increase with human and infrastructure density to a certain point but then decrease as fuels become increasingly disconnected. Photo by Larry Korhnak.

Fires started by cigarettes are much less common today, with a 90 percent reduction in this ignition source since the early 1970s. Possible reasons for this reduction include lower smoking rates and cigarette consumption, improved wildfire investigation capabilities, and new ‘banding’ technology in cigarettes that reduces their smoldering time if discarded. Railway and accidental fires from other equipment have similarly declined, perhaps as the result of improved spark arrestors and an increase in compliance with regulations regarding their use. Arson fires have also shown a decline over the past 20 to 30 years, possibly due to stricter judicial sentences and greater efforts to identify, arrest and prosecute suspected arsonists. Similarly, the culturally accepted practice of “fire setting” (still classified as incendiary) that was common prior to the mid-1900s, also appears to have declined in recent decades, perhaps because of much wider use of prescribed burning for natural resource management.

## EFFECTIVENESS OF PREVENTION ACTIVITIES AND FUELS MANAGEMENT

Interacting with social and cultural wildfire ignition trends are the beneficial impacts that likely result from agency and municipal wildfire prevention activities. Although such programs have been conducted for many years, and substantial anecdotal evidence and agency reports might support prevention effectiveness, there are very few scientific studies that document those results. Several studies in Florida have suggested an inverse relationship exists between the spatial extent of authorized prescribed burning and certain unintentional human-caused ignitions. Overall, however, research has yet to provide a comprehensive understanding of the relationship between fuel treatment programs



Few assessments of public education programs, such as mass media campaigns and community outreach events, have been published. Photo by Jan Amen.

and wildfire ignitions. In addition, relatively few quantitative assessments of the impacts of public wildfire mitigation and education programs have been published. Several studies in Florida indicated that there was an inverse relationship between the number of certain types of human-caused wildfire ignitions and the number of wildfire prevention educational efforts. Public service announcements, presentations, brochures, and hazard assessments were identified to be some of the most effective activities, especially when conducted just prior to and during the main wildfire season. In addition, there has been some evidence to suggest that prescribed burn authorization systems with education and enforcement components may help reduce escapes. The authors concluded that quantitative assessments of wildfire prevention and education programs have been “hampered by a lack of accurate and complete reporting of prevention activities.” They strongly recommend more data collection and archiving to facilitate future assessments of the impacts of prevention activities.



Studies in Florida indicated that there was an inverse relationship between the number of certain types of human-caused wildfire ignitions and the number of wildfire prevention educational efforts. Photo by Florida Forest Service.

## MODELING WILDFIRE IGNITIONS

A major focus of Prestemon et. al.’s GTR is to summarize past attempts at predicting ignitions based on biophysical, social, fire management, and prevention factors. The authors conclude with 15 recommendations for future modeling of ignition occurrence and impacts of prevention activities. They suggest that predictive models for ignitions be built separately for natural, accidental, and arson causes, and that the models use variables or proxy measures to represent factors that can be intentionally manipulated by managers, such as budgets for different types of prevention activities. Fire managers in the South that are interested in developing a clearer understanding of ignition causes and trends in their area will benefit from studying the authors’ conceptual model of wildfire ignitions and their accompanying list of recommendations.

## SUMMARY

- Ignition sources such as cigarettes, railways and other equipment, and arson have been trending down as wildfire causes for 20 to 30 years.
- Prevention efforts appear to be effective in reducing fire starts, but improved evaluation and reporting of prevention activities and impacts will clarify those observations.
- Public service announcements, presentations, brochures, and hazard assessments are effective prevention activities, especially when conducted just prior to and during wildfire events.
- Predictive models should be built separately for different ignition causes, and allow managers to manipulate specific variables that they can influence.

### Authors

Alan Long, Southern Fire Exchange, Tall Timbers Research Station and Land Conservancy  
Jeffrey Prestemon, Southern Research Station, United States Forest Service

For more information on the Southern Fire Exchange,  
visit [www.southernfireexchange.org](http://www.southernfireexchange.org) or email [sfe@ifas.ufl.edu](mailto:sfe@ifas.ufl.edu).



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