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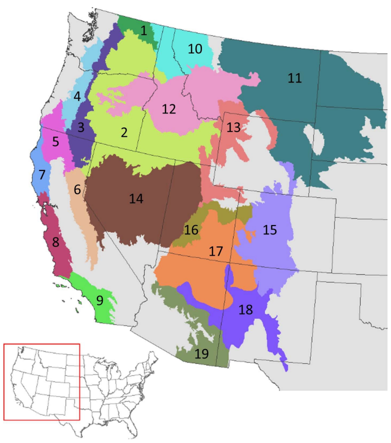
High-severity fire: Evaluating its key drivers and mapping its probability across western U.S. forests



Keywords: fire behavior prediction; Ecoregions

Background & Management Issues: Research to date pertaining to the key drivers of high-severity fire has been either comprehensive in ecological scope but geographically limited, or geographically broad but lacking important environmental components. Some studies have evaluated a more inclusive set of environmental drivers but were often conducted at disparate temporal and spatial scales, ranging from those of individual fires (Thompson et al. 2007, Harris and Taylor 2015) to landscapes with 50–100 fires (Fang et al. 2015, Birch et al. 2015), thereby making broader-scale generalizations challenging. Differences in methodology among these studies also complicate interpretation. An evaluation using consistent data and methods across the broad geographic range of forested landscapes of the western United States will allow for an improved understanding of the most influential factors driving fire severity and will provide forest managers with highly relevant information for planning and mitigation purposes.

Project Objectives:
In this study, we assessed a comprehensive suite of potential drivers of high-severity fire using a consistent, repeatable approach that was not only geographically extensive but also predictive in nature.
Our overarching objectives were three-fold:

- First, we aimed to identify the most influential factors driving high-severity fire for each ecoregion in the western United States.
- Second, we designed a quantitative framework such that the model predictions for each ecoregion can be updated annually using recent (e.g. 2016) satellite imagery and implemented to evaluate the probability of high-severity fire (were a fire to occur) under a range of potential weather scenarios.
- Third, we incorporated the capability for model predictions to assess and monitor the effectiveness of fuel treatments in changing the probability of high severity fire.

Project Description:

Our evaluation included explanatory variables representing live fuel, topography, climate, and fire weather. The models we developed have the potential to support fire and fuel management (cf Hessburg et al. 2007) because several of the explanatory variables are dynamic (i.e. varying on daily to annual time scales), such as those representing live fuel and daily fire weather. Consequently, raster maps representing predictions of high-severity fire (cf Holden et al. 2009) can be updated annual and under different weather scenarios to assess for example, the potential for high-severity fire in an upcoming fire season. Such products may facilitate the development of more adaptive strategies for addressing the contemporary challenges of wildland fire management.

Results:

Although there was substantial variation across ecoregions, live fuel was the most important variable group, with an average relative influence of 53.1% among ecoregions; this ranged from 5.1% (California North Coast) to 99.0% (Utah—Wyoming Rockies). Fire weather was the second most influential variable group (22.9% average), ranging from 0% (California Central Coast and Utah –Wyoming Rockies) to 66.2% (California North Coast). Climate was the third most influential variable group (13.7% average) and topography the least influential (10.3% average).

Our results show that fuel is the most important driver of high-severity fire in forested regions of the western United States, followed by fire weather, climate (i.e. 30 year normals), and topography. Our results are supported by the findings of past research but also contrast with several previous studies and provide important new insights regarding the drivers of high-severity fire. Our study is also a substantial step forward by providing a modeling framework that enables the prediction for high-severity fire while incorporating fuel and fire weather inputs. In particular, this framework involves the inclusion of fuel and fire weather inputs as dynamic variables (i.e. those that change over time) and gives us the ability to produce maps depicting the probability of high severity fire, were a fire to occur, over entire ecoregions. This framework also provides the means to evaluate changes in the probability of high-severity fire due to fuel treatments.

Management Implications:

- An evaluation using consistent data and methods across the broad geographic range of forested landscapes of the western United States will allow for an improved understanding of the most influential factors driving fire severity and will provide forest managers with highly relevant information for planning and mitigation purposes.

Publications / Products:

High-severity fire: Evaluating its key drivers and mapping its probability across western US forests
Parks, Sean A. ; Holsinger, Lisa M. ; Panunto, Matthew H. ; Jolly, William M. ; Dobrowski, Solomon Z. ; Dillon, Gregory K. , 2018

For additional information…

Sean A. Parks- *Research Ecologist*
Address: 790 East Beckwith Avenue, Missoula, MT 59801-4421
sean_parks@fs.fed.us

Lisa M. Holsinger- *Ecologist*
Address: 790 East Beckwith Avenue,Missoula, MT 59801-4421
lisamholsinger@fs.fed.us

This summary prepared by M Snyder 04/2018.