

**Towards a crown fire synthesis:
what would you like to know and what might you be able to contribute?**

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Abstract. Members of the project team associated with the Joint Fire Science Program (JFSP) project JFSP-09-S-03-1 entitled ‘Crown Fire Behavior Characteristics and Prediction in Conifer Forests: A State of Knowledge Synthesis’ are actively seeking help and input from members of the wildland fire community in the form of photo documentation of crown fires and suggestions on the material content of the final written product.

Additional keywords: crown fire behavior, crown fire initiation, crown fire propagation, crown fire rate of spread, crowning.

Introduction

In 2010, the Joint Fire Science Program (JFSP) elected to support a project to undertake a state of knowledge synthesis on the subject of crown fire behavior characteristics and prediction in conifer forests. The project is expected to be completed by October 2012. The purpose of this paper is to provide a summary of background information on the project and at the same time make a formal request of the wildland fire community for their input and assistance.

Background information

The focus of JFSP Project 09-S-03-1 is on synthesizing the currently available information on crown fire behavior related to conifer forests (e.g. onset of crowning, type of crown fire and associated spread rate and fireline intensity) in relation to the wildland fire environment (i.e. fuels, weather and topography). Information on crown fire behavior is available from several scientific peer-review journals, including the seminal articles by Van Wagner (1977, 1993) on crown fire theory and Stocks (1987, 1989) on fire behavior in immature and mature jack pine stands in the *Canadian Journal of Forest Research* as well as the special issue on the International Crown Fire Modelling Experiment (Butler *et al.* 2004a, 2004b; Stocks *et al.* 2004; Taylor *et al.* 2004) plus articles on recently developed and tested models for predicting passive and active crown fire rates of spread (Cruz *et al.* 2005; Alexander and Cruz 2006). Additional articles dealing with crown fire behavior can be found in *Forest Science* (Cruz *et al.* 2004), *International Journal of Wildland Fire* (Cruz *et al.* 2003c, 2006a, 2006b; Cruz and Alexander 2010), *Forestry Chronicle* (Cruz *et al.* 2003b), and *Australian Forestry* (Cruz *et al.* 2008).

Links to a lot of this scientific material on crown fire behavior can be found at the FRAMES website (<http://frames.nbii.gov/>). Pertinent information will also be garnered from other written sources including conference proceedings papers (e.g. Alexander 1988; Agee 1996; Cruz *et al.* 2002, 2003a, 2006c; Alexander *et al.* 2006) and agency publications (e.g. Rothermel 1991; Peterson *et al.* 2005; Cruz and Plucinski 2007; Cronan and Jandt 2008) which typically have undergone at least an ‘in-house’ review. Other information on crown fire behavior is available – much of this has already been located and summarized in theses by members of the project team (Alexander 1998; Cruz 1999, 2004).

Data and information, including video footage (Fig. 1), obtained during wildfire monitoring and documentation by the fire behavior assessment team of the USDA Forest Service’s Adaptive Management Enterprise Services Team (Henson 2005; Vaillant and Fites-Kaufman 2009) will also be examined (<http://www.fs.fed.us/adaptivemanagement/>).



Fig. 1. Time series photos from a fire-proofed video camera taken during the Black Mountain II Fire in Montana in August 2003. Photos courtesy of USDA Forest Service, Adaptive Management Services Enterprise Team.

While the focus is on North American forests, the synthesis is intended to be global in nature and is intended for multiple audiences ranging from the general public to college students to fire and land managers to university professors and other researchers. It’s envisioned that publication of the synthesis will be patterned after the popular Australian book on grass fires by Cheney and Sullivan (2008), accompanied by a multimedia DVD featuring video imagery and other

supporting documentation, and that a special issue of *Fire Management Today* devoted to crown fire behavior will serve to highlight the main conclusions and findings contained in the book.

We need your help and input

In addition to summarizing the existing scientific and technical literature on crown fires, project members are also seeking assistance from individuals in the form of field observations of crown fires and related experiences as well as still pictures (Fig. 2) and video footage. Of course proper credit will given to those are able to contribute photos and imagery.



Fig. 2. A free-burning active crown fire spreading through a lodgepole pine stand (stand height ~20 m) in the boreal forest region of central Alberta in August 1981. Head fire rate of spread and fireline intensity exceeded 15 m min^{-1} and $10\,000 \text{ kW m}^{-1}$, respectively. Note that the ‘wall of flame’ extends well above the top of the tree canopy. Photo by M.E. Alexander.

Finally, we are interested in hearing from you -- the ‘end user’ -- as to your opinions on the subject of crown fires and any specific questions and/or research needs/knowledge gaps that you would like to see addressed in this crown fire synthesis project. This input could take the form of a simple question. For example, several years ago, Sando *et al.* (1970) posed the simple question: ‘What fuel-weather combinations are required to produce a propagating crown fire in northern flatwood forests?’ As well, in a fire ecology survey of land managers and environmental scientists in western North America conducted in the early 70s, several questions were raised that dealt with a number of aspects of crown fire potential (from Taylor *et al.* 1975):

Will fire in a thinned stand tend to stay on the ground as opposed to crowning? What are the effects of various spacings? What spacing inhibits spread of [crown] fire?

Crown fires are quite a threat in the ponderosa pine of the Black Hills. Extreme burning conditions may cause crowning any time of the day or night. Based on slope, what tree spacing would allow full stocking and yet be most desirable for separating tree crowns to preclude crown fire ignition?

How many tons/acre of fuel are required to support a crown fire in ponderosa pine and in mixed conifer forest in the Southwest?

What stand and crown density is required to carry a fire in standing pinon-juniper stands?

We would also appreciate your input in identifying and describing potential fire and fuel management applications of the proposed crown fire synthesis. In short, we want our work to be relevant!

Please feel free to contact any member of the project team regarding information, comments, thoughts or ideas. Note that we have created a 'public neighborhood' entitled 'JFSP Crown Fire Synthesis Project' at *MyFireCommunity.net* developed by the Wildland Fire Lessons Learned Center (<http://www.myfirecommunity.net/Neighborhood.aspx?ID=816>) in order to facilitate the soliciting process.

For the latest developments

In order to keep up to date on the progress of the crown fire synthesis project, periodically visit the project website (<http://www.fs.fed.us/wwetac/projects/alexander.html>). Publications and other products will be posted there and on the JFSP website (<http://www.firescience.gov/>) under Project ID 09-S-03-1.

Acknowledgement

This paper is a contribution of Joint Fire Science Program Project JFSP 09-S-03-1.

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