

Fire Behavior as it Relates to Firefighter Safety: Seven Key Points for Discussion

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Martin E. Alexander, PhD, RPF

... there is one overriding challenge to fire management: that of maintaining full respect for the power of fire and the effects of this power on both wildland environments and the people who live and work in these environments. Barrows (1977)

Introduction

Unfortunately, I could not be in Toronto this week for the 2003 International Wildland Fire Safety Summit. However, I did want to pass along some thoughts that I consider might be relevant to some of the discussions that will no doubt take place during the breakout sessions this week. I have six points I'd like to make here; I've since add a seventh key point. These are presented in no particular order of significance.

Key Point #1: The International Association of Wildland Fire Needs to Consider Broadening the Agenda of the International Wildland Fire Safety Summits to Include the Public at Large

The fatalities associated with the recent California fires and earlier this year in Europe have certainly highlighted the need for a slight realignment of emphasis. The wildland fire community has an enormous amount of technical knowledge about fire behavior that can and should be applied to averting such disasters. Undoubtedly a major issue will be the pros and cons of evacuation vs. "stand and defend" or as Wilson and Ferguson (1984) refer to it as "fight or flee?". This general subject area might even be the focus or theme of the next International Wildland Fire Summit.

As an aside, last year I was asked by Bob Mutch to become involved in future revisions of the "fire" chapter in the book on *Wilderness Medicine: Management of Wilderness and Environmental Emergencies* (Davis and Mutch 2001). A 5th edition is tentatively planned for 2006 (P.S. Auerbach, personal communication).

Key Point #2: Our Understanding of Fire Behavior Dynamics in Insect- and Disease-Killed Forest Stands is Extremely Poor

Our understanding of fire behavior in healthy forest stands is by and large pretty good. While dead and dying forests is not a new issue to the western United States or eastern North America, there appears to be a growing number of these kinds of fuel types in

western Canada and Alaska (e.g., spruce beetle). While we have some general knowledge about fire behavior in stands killed by insects and disease as a result of past incidents, we lack quantitative studies of fire behavior; one exception is the study undertaken in spruce budworm-killed stands by the Canadian Forest Service and the Ontario Ministry of Natural Resources in the late '70s and early '80s (Stocks 1987), which has provided us with a guide to fire behavior in this fuel type (Taylor et al. 1997). This lack of knowledge could unknowingly threaten the safety of wildland firefighters as well as members of the public (Alexander and Stam 2003). More needs to be done. This past year, I was involved in a proposal with others in the Alaskan wildland fire management-research community to study the fire behavior of spruce beetle-killed stands on the Kenai Peninsula of southeastern Alaska that was turned down by the Joint Fire Science Program. I'm pleased to see that Dave Marek of the British Columbia Forest Service took up my suggestion and is here this week to make a presentation dealing with the mountain pine beetle situation in British Columbia.

The International Association of Wildland Fire, and the fire management community at large, needs to support outdoor experimental burning in these "dead forest" fuel types and lobby for financial support to carry out the necessary fire behavior research which is critical to closing the knowledge gaps that exist. An added benefit of these experimental fires would be firefighter safety-related training (Cheney 1994).

Key Point #3: Avoid Placing too Much Reliance on "Trigger Points" and Continue to Stress Fire Behavior Fundamentals and Systematically Assessing Potential Fire Behavior Using Existing Aids & Guides

It's human nature to look for "silver bullets" to help us simplify matters in order to make our jobs easier. While fire behavior rules of thumb (e.g., relative humidity thresholds for a broad geographical region) have been around for many years, there appears to be a growing trend in the wildland fire community to place increasingly greater reliance on the use of "trigger points" (e.g., Greenlee and Greenlee 2003). By trigger points, I mean indicators associated with the onset of a specific type of fire behavior, usually severe or extreme; thus, trigger points have a different meaning than that as defined by Campbell (1998). The temperature/relative humidity "cross-over" concept in Canada is a good example; the use and limitations of "cross-over" have been dealt with by the author in the CD-ROM based training course *Wildland Fire - Safety on the Fireline* (Thorburn et al. 2000).

We need to resist this movement. It seems that even the most experienced fire behavior officers or analysts are subject to this tendency. The value of the "10 Decision Traps" in effective decision making (Russo and Schoemaker 1989) with respect to fire behavior forecasting or prediction has recently been reiterated by Alexander and Thomas (2004). Recall Decision Trap #5 (Shortsighted Shortcuts) - Relying inappropriately on "rules of thumb" such as implicitly trusting the most readily available information or anchoring too much on convenient facts.

Perhaps part of this trend is due to the increasing complexities in our fire behavior prediction systems and models. Certainly, crude but reliable guidelines are needed at the field level (e.g., Alexander and Fogarty 2002); the same holds true for decision support systems (e.g., Beck et al. 2002). Fire behavior researchers need to understand

and appreciate this fact as well as clearly stating the assumptions involved in their models and systems. However, the desire for simplicity has to have a limit, and the onus is on fire operations personnel to still have a firm understanding of the basic principles of fire behavior in order to have the flexibility to make allowances or adjustments as necessary (in other words, they should have the ability to think through a problem).

Key Point #4: The Use of Experienced Judgment in Assessing Fire Behavior Needs to be Supported by More Documentation in the Future

It's been suggested that most wildland firefighters base their expectations of how a fire will behave largely on experience and, to a lesser extent, on fire behavior guides (Burrows 1984). If this is indeed the case, then it's worth reiterating the points made by U.S. Forest Service fire research pioneer Harry T. Gisborne (1948) about experienced judgment: "For what is experienced judgment except opinion based on knowledge acquired by experience? If you have fought forest fires in every different fuel type, under all possible kinds of weather, and if you have remembered exactly what happened in each of these combinations, your experienced judgment is probably very good. But if you have not fought all sizes of fires in all kinds of fuel types under all kinds of weather, then your experience does not include knowledge of all the conditions." Presumably then, case studies can help supplement and thereby strengthen (but never replace) a person's experience level.

Everyone needs to learn more about the fire environments in which they work. Greater emphasis needs to be placed on documentation of fires in order to do this (Alexander 2002a). For more elaboration on the value of wildfire case studies to fire safety, see the recent articles by Alexander and Thomas (2003a, b). Note that *Fire Management Today* is devoting two special issues to wildland fire behavior case studies. The first issue is now available for downloading at http://www.fs.fed.us/fire/fmt/fmt_pdfs/fmt63-3.pdf.

Key Point #5: A Concerted Effort is Needed to Bring the Fire Behavior and Human Behavior Specialists Together in Order to Improve Wildland Fire Safety in the Future

This applies to implications for both fire operations personnel and members of the public. It could be argued that the technical/scientific side of predicting fire behavior has reached a limit and that further major advances, and the greatest gains with respect to improving fire safety from a fire behavior standpoint, will likely be made by how this information is applied by the user (i.e., the human aspect). This includes a wide spectrum from the lay public to the individual firefighter to the fire behavior officer/analyst to the incident commander to the line or resource officer.

I personally believe that it is time that we seek out the assistance of those specialists in the humanities and social sciences. While the "human factors" element has been acknowledged in recent years with respect to firefighter fatalities, it hasn't specifically addressed the issue of fire behavior and fire behavior prediction. We need to understand why we do the things we do. A good start on the psychology of fire behavior forecasting has been made by Dr. Karl Weick (2002) but much remains to be examined and done.

Key Point #6: Initial Attack Dispatch Guidelines Should Reflect the Current State-of-Knowledge Concerning Fire Behavior and Firefighting Resource Productivity/Effectiveness

The importance of fire behavior with respect to fire suppression is widely recognized (Alexander 2000). What is not so widely recognized or appreciated is the fact that if initial attack is based in whole or in part on ground forces, then the type and number of firefighters dispatched to a newly reported fire should have a reasonably good chance of containing the fire at a reasonable size, otherwise their safety is being jeopardized (Alexander 2002b). Audits need to be performed to ensure this is actually the case. And if fuels management is designed to increase fire suppression effectiveness and in turn improve firefighter safety then we need to communicate this point more widely, especially with respect to the wildland-urban interface (Alexander 2003).

A Closing Remark

It is only fitting that the International Association of Wildland Fire is paying tribute at this conference to the wildland firefighters who lost their lives in the line of duty during the 2003 fire season. On February 27, 2003, the wildland fire community lost one of its most staunch supporters when Paul Gleason passed away from cancer. I'd like to think that the greatest tribute we could make to Paul is ensuring that all members of the wildland fire community read the interview he did with Jim Cook and Angela Tom (2003) the day before he died.

Acknowledgment

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Postscript - Key Point #7: We Need to be Cognizant that Fatalities Can and Do Occur on Prescribed Fires

Dave Thomas (Regional Fuels Specialist, USDA Forest Service, Intermountain Region (R-4), Ogden, UT) has reminded me of the fact that burn-overs and entrapments have occurred not only on wildfires but prescribed fires as well (Thomas 1998). There are certainly several well-known examples from the U.S., Canada, New Zealand, and Australia (e.g., the Geraldton PB 3-79 in north-central Ontario). This is an excellent point that should not be overlooked, especially in light of an escalating use of prescribed fire in the western U.S. and perhaps other locations. This could also be another topic for a distinct session at a future International Wildland Fire Safety Summit.

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Marty Alexander is a Senior Fire Behavior Research Officer with Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre, 5320-122 Street, Edmonton, Alberta, Canada T6H 3S5. Telephone: +1 780-435-7346; E-mail: malexand@nrca.gc.ca

The original version of this paper and the associated powerpoint presentation are available for viewing at the International Association of Wildland Fire website: www.iawfonline.org.

Ab adds: Marty is the recipient of the 2003 International Wildland Fire Safety Award. Congratulations.