

## How Much Time Does it Take for a Wildland Firefighter to Reach a Safety Zone?

A field study of fire crews using escape routes provides insights into a key element of firefighter safety.

By Martin E. Alexander, Gregory J. Baxter and Gary R. Dakin

Good question. When fire behavior becomes threatening, wildland firefighters disengage the fire and travel along escape routes to reach safety zones to avoid being entrapped or burned-over. In spite of the fact that the concept of escape routes has been a formally recognized element of wildland firefighter safety for almost 55 years, there is surprisingly little quantitative data or information available on firefighter travel rates using escape routes.

### ALBERTA-BASED STUDY UNDERTAKEN

In 2001 to 2003, the Wildland Fire Operations Research Group of the Forest Engineering Research of Canada or FERIC (now FPInnovations), based out of Hinton, Alberta, undertook a study of the rates of travel on simulated escape routes by individual members of the three types of fire suppression crews used in the province of Alberta.

Travel rates were determined on the basis of individually timed runs over 820-foot (250 metres) courses in six different fuel types/slope situations involving both natural or unimproved and improved routes (i.e., cleared trail and flagged). Runs were made with and without a pack/tool. The pack weighed 15 pounds (6.8 kilograms), and the tool complement consisted of a fire shovel.

A total of 39 firefighters, including three females, of varying ages, heights and weights participated in the project. As expected, travel rates do vary among

and between the type of fire crews, the fuel type/slope steepness, the route condition (i.e., natural or improved) and whether one is carrying a pack and tool or not.

### THE GENERAL RESULTS

On the basis of 360 timed runs, the following conclusions were reached:

- The fastest overall times occurred in the improved-no pack/tool courses, followed by the improved-pack/tool courses, the natural-no pack/tool courses, and finally the natural-pack/tool courses.
- The grass and slash fuel types were the easiest to travel, and the dense spruce type was the hardest; the mature pine fuel type was of intermediate difficulty.
- There was less variation in travel rates among individual crew members on improved routes.
- Traveling uphill dramatically decreases the pace a firefighter is able to achieve.
- Carrying a pack and tool slows down a firefighter's rate of travel regardless of whether on an open, improved route or in a natural, standing timber cover type. Dropping one's pack and tool could allow a firefighter to increase his travel rate by up to 20 percent.
- Firefighters can be expected to move up to 40 percent faster on improved routes. Thus, simply constructing a rudimentary trail (e.g., removing or cutting through large dead-fall) and flagging or marking the route in some manner can decrease the overall time taken to reach a safety zone.
- By using an improved escape route and dropping one's pack and tool, firefighters can travel up to two times faster than if they attempted to travel over an unmarked/unimproved route with their pack and tool. Precious seconds

gained by these actions could mean the difference between life and death on the fireline.

### WAS ANYTHING LEFT IN THE TANK?

The question naturally arises: Could the firefighters that participated in this project have gone any faster? They appeared to have given a maximal effort, and it is unlikely that they could have gone much faster.

A crude way of answering this question, though, is to look at the peak heart rate recording with heart monitors during each run and compare that to the maximal heart rates achieved on the shuttle run test, which is supposedly a maximal test. It was found from these analyses that in every run undertaken, the mean heart rate was within approximately 95 percent (range: 94.0–98 percent) of the maximal heart rate, which was impressive considering the short duration of the individual runs (usually less than 2 minutes). Therefore, it appears that the firefighters used in this project gave a maximal effort during each course run and were, therefore, unlikely to have been able to go much faster than they did.

### VALUE ADDED

While confirming the presumed influence of equipment dropping on travel rates, the FERIC study provided new insights into the dynamics associated with travel over escape routes by wildland firefighters. For example, the study showed the advantages of improving the condition and identification of an escape route on a firefighter's performance level.

Simply carrying out the study increased the awareness and appreciation for the values of escape routes in regards to wildland firefighter safety.

The information generated by the study has refocused attention on the importance of time in relation to fire behavior and firefighter safety. A safety zone isn't much good to firefighters if they aren't able to reach the safety zone before the fire does!

For more information on the study, see [Wildfireworld.org/articles/time-to-reach-a-safety-zone](http://Wildfireworld.org/articles/time-to-reach-a-safety-zone). **W**

*Dr. Marty Alexander is a member of the IAWF Board of Directors and is currently an Adjunct Professor of wildland fire science and management at the University of Alberta in Edmonton. He retired from the Canadian Forest Service in November 2010 after nearly 35 years of service. Greg Baxter is a Senior Researcher and Gary Dakin is an Associate Researcher with the Wildland Fire Operations Research team of FPInnovations in Hinton, Alberta, Canada.*

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**Average sampled travel rates (chains per hour) of the three types of Alberta wildland firefighters for various conditions.**

Crew Type	Fuel Type	% Slope	Pack/Tool		No Pack/Tool		Number of Course Runs
			Natural/Improved		Natural/Improved		
I	Black spruce stand	0	283	501	328	603	12
II	Black spruce stand	0	280	471	298	587	7
III	Black spruce stand	0	254	426	337	513	8
I	Black spruce stand	26	205	- <sup>a</sup>	230	- <sup>a</sup>	8
I	Standing grass	0	400	710	587	799	8
II	Standing grass	0	379	647	465	799	9
III	Standing grass	0	277	457	355	668	8
I	Standing grass	26	- <sup>a</sup>	256	- <sup>a</sup>	307	8
I	Lodgepole pine stand	0	385	582	405	647	7
II	Lodgepole pine stand	0	342	540	426	665	8
I	Conifer logging slash	0	420	677	552	710	7
II	Conifer logging slash	0	370	587	519	734	8

Type 1 Crew = Rappel or Helitack. Type 2 Crew = Contract Firefighters. Type 3 Crew = Emergency Firefighters.  
<sup>a</sup>Combination not sampled.

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