



Stay Cool: There are Ways to Avoid an Entrapment

By Mark Matthews
WINTER 2008

April, 2009—Canadian Interagency Forest Fire Center member agencies do not carry fire shelters, and in 2005 fire officials in British Columbia suspended their use in that province. Rather than spend money for a new generation of shelters—which they say provide “no apparent benefit to life safety or risk reduction”—officials in British Columbia and other Canadian provinces focus on keeping their firefighters out of harm’s way.

“Safety includes prevention—I cannot emphasize this enough,” wrote Brad Hartley, Safety Officer in Victoria, B. C., in a July 2005 memo announcing the decommissioning of fire shelters. “I cannot recall a single case where a fire entrapment fatality could not have been easily prevented... Your Protection Branch will support any decision for anyone exercising their right to pull back to safety!” Still, the nature of fire remains unpredictable. Staying out of harm’s way may be the best advice—but what if fate and the elements don’t cooperate? Dr. Marty Alexander, a Senior Fire Behavior Research Officer with the Canadian Forestry Service, based in Edmonton, Alberta, wants to make sure firefighters and others are prepared for the worst—especially those who don’t carry fire shelters. “The danger of being entrapped or burned over and possibly killed or seriously injured by a wildfire is very real threat for people living, working or visiting rural areas subject to wildfires,” he says.

Fire can spread at the rate of 100 meters a minute in forested areas, and up to twenty times that rate in grasslands. No human can outrun a wind-driven fire for very long. Alexander knows; he’s looked over the statistics and studied specific cases of entrapments from the western U.S. to Portugal to Australia.



Steep slope-escape route-that the crew used in attempts to reach the rock reef (top right corner of photo). Photo credit: NIFC

“There have also been many well publicized cases or incidents where attempting to initially out pace and then ultimately outrun an advancing flame front have ended in tragedy,” Alexander says. He cites the Pepper Hill (1938), Mann Gulch (1949), Rattlesnake (1953), Inaja (1956), Loop (1966), and South Canyon (1994) fires as examples where firefighters lost the race with advancing flames. Civilians have also died while trying to outrun flames; four young hikers perished in the Blue Mountains of New South Wales, Australia, in 1957 as well as three civilians who volunteered to join the fireline near the community of São Domingos in the district of Sandtarém, Portugal, in 1995.

Alexander has also undertaken simulations of firefighter rates of advance in relation to spreading wildfires. A person running up a 26 percent slope from a fire spreading 60 meters per minute is likely to fall to exhaustion or be knocked down by the radiant heat within six to seven-and-a-half minutes if not sooner

As Alexander points out, “If the distance between the fire and safe area is short, the fire’s advance slow, the path to the safe area easily traversed, and the person able-bodied, then selection of this survival option is appropriate”.

Another option of escaping an entrapment, Alexander says, is to light an escape fire—as Wagner Dodge did at Mann Gulch. Dodge had enough time to start a fire on the steep grassy south-facing slope of the gulch and wait for it to burn off enough fuel so that he could lie down in the ashes before the main fire struck. Unfortunately, he was unable to convince the rest of his crew to follow him into the black.

Investigations party photo taken from bottom of Mann Gulch looking north toward Dodge’s escape fire. Photo credit: NIFC



However, the escape fire doesn’t present a universal mode of escape, as Alexander points out. “This option only works well in a grassy area and when there is sufficient time to burn out a safety area. It does not work well in forested locations because of the generally heavier fuel conditions, which in turn lead to prolonged smoldering combustion.”

Alexander has identified other options for firefighters caught out in the open. Rather than run he suggests hunkering down in a protected spot. Large rocks or depressions in the ground—such as deep tire ruts—can deflect radiant and convective heat. In 1949 Joe Sylvia initially survived the Mann Gulch fire when he fell behind a table sized rock, but died in the hospital the next day. Root cellars and caves or mine shafts provide even better shelter, although “it is important to vacate into the open at the earliest opportunity due to potential problems associated with accumulations of smoke and carbon monoxide,” Alexander says. Vehicles also offer good shelter. Although vehicles can also ignite, they sometimes lend enough time until the main flame front passes.

When attempting to survive a fire by hunkering down Alexander stresses the “importance of staying as flat as possible with one’s nose and mouth pressed down into the ground.” A prone position minimizes the radiation profile. Also, cooler, denser air usually sits at ground level.

But after a fire passes, the opposite may be true. The air temperature near the ground becomes hotter than the air above it after the flames pass. “So if someone is sheltering from radiation at ground level, they need to stand up as soon as possible after the fire passes to breathe cool, fresh air,” says Phil Cheney, an Australian bushfire research specialist. “This is most apparent in grass fires where air at ground level is hot and smoky for several minutes whereas at 2 m. it is cool and breathable within 10-15 seconds of the flames passing.”

Rockslides may also offer shelter during entrapments, as Robert Sallee and Walter Rumsey discovered in Mann Gulch. However, Alexander cautions that “there have also been instances where these apparently safe, fuel-free areas contained enough combustible materials to cause injury or death.”

Whenever seeking shelter during an entrapment use clothing to protect exposed skin. But be aware that synthetic materials, even the materials in underwear, can quickly ignite or melt. Alexander points to the 1983 Ash Wednesday fires in Victoria, Australia, where flames killed two individuals who had covered themselves with a synthetic blanket while two others covered by a wet woolen blanket--and lying right next to them-- survived the burn-over.

Natural bodies of water can protect one from heat and flames, but they present their own safety problems. Firefighters have been known to drown while seeking refuge in lakes with a sudden drop off, and some have become hypothermic while immersed too long in cold water.

Some entrapped firefighters over the years have turned to the last resort of racing through an advancing flame wall to reach the burned out area. Although more than a handful have survived using this tactic the experts suggest sticking with the other alternatives—especially when flames range more than 1.5 m. in height or depth. “It has been suggested that a person could theoretically survive passing through flames 3 m. high and 37 m. in depth and still survive,” Alexander says. “It is presumed that the person would be immersed in flames for less than 7.5 seconds and would require ideal running conditions (e.g., good footing, no obstructions) and be properly clothed to withstand the direct flame contact. While it’s reasonable to expect a person to be able to hold his/her breath for this long, the very notion of attempting such a drastic feat seems unimaginable. Nevertheless, it is worth noting that firefighters have lived, albeit while suffering severe burns as result, by running through high-intensity flame fronts. “

To summarize, Alexander stresses four basic strategies to follow when facing an entrapment:

Select an area that would not burn--the bigger the better--or failing that, one with the least amount of combustible material and that offers the best microclimate (e.g., depression in the ground).

Use every means possible to protect oneself from radiant and convective heat emitted by the flames (e.g., boulders, rock outcrops, large downed logs, trees, snags, etc.).

Protect airways from heat at all costs and minimize smoke exposure.

Remain as calm as possible.

Although Alexander agrees that safety training should focus on avoiding entrapments he thinks safety officials would be “remiss not to include the material on survival options.”

Alexander urges all firefighters who have experienced a “close call” or “near miss” during a wildland fire to report the encounters to researchers like him. Read more about entrapments in the book *Wilderness Medicine*.

He also wants to remind everyone that “sometimes safety is very close by – don’t overlook the obvious.”

Mark Matthews is author of "Smokejumping on the Western Fireline: Conscientious Objectors during World War II," and "A Great Day to Fight Fire: Mann Gulch, 1949." Contact Mark Matthews:

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