



## Your last resort options

Chair: Malcolm Hackett OAM

Presenter: Dr Jim McLennan

### Chair

Before Black Saturday my plan was to defend the house and sheds full of machinery with plenty of water and several well positioned pumps. I thought my fire preparations were pretty good. And although I knew there was some weaknesses I naively believed the water setup would conquer the shortfalls. We hadn't really talked about what to do if the house caught fire because that wasn't part of the plan. Because we weren't close to any bush or undergrowth we did have a sense that it would be safe outside once the fire front had passed. And this proved to be true.

When the fire did come I realized to my horror that I couldn't leave the house to defend the sheds. And although they'd caught fire slowly I had to let them burn - tractors, motorcycles, tools and machinery all up in flames.

When the water failed that was the end of the plan. Not much of a plan and no options after the first major failure. Lesson one, there's a good chance that when the fire does come it'll be different to what you imagine so it might be best to imagine lots of scenarios and get a critical friend to help you test them out.

After our water failed the house caught fire pretty quickly and we left for the shelter of our cars. My ute had a fire in the tray so when I drove it away from the sheds and the house to a burned open space where I could put it out. Diana didn't follow me because during our escape she had left her handbag containing the car key inside the house.

When I got back to her car the house and the sheds were roaring. The radiant heat was enough to melt the plastic trim on the car and to blister Diana's ear and neck as she changed vehicles. But the point of that story is that although the temperature of radiant heat was high enough to melt plastic Diana had been safe inside her car. I look forward to hearing more from our presenters and our panellists about these last resort options.

Dr. Jim McLennan from Latrobe University will begin with a presentation. Welcome Jim and I'll hand over to you.

### Jim McLennan

Thanks very much Malcolm. Two things to begin. First in my opinion, prompt evacuation to a safe location via a safe route should always be the first household survival action you consider planning and preparing for. But, and forgive the crudity, in a bushfire sometimes shit happens. And that's especially so in the early stages of a bushfire when everything can be confusion and chaos and warning information may be lacking or just plain wrong.

What I want to try and do tonight is to help you better understand the nature of what you could face if things do go wrong.

Number two, I'm going to talk about death and dying in bushfires. If you feel uncomfortable it's quite okay to simply leave the meeting. If you do experience distress help is always available from Lifeline.

There are two aspects of death versus surviving during a bushfire threat, the physical one involving physics, chemistry, and human physiology and the human one involving thinking, emotions, and behaviour. Now I'm going to be concentrating tonight on the physical aspect.

The human aspect is certainly important, but it really deserves a session of its own and in fact in last year's webinar session number three (<https://bushfireresilience.org.au/webinar-recordings/2021-webinar-3/>) was devoted to looking at the human aspects. So that's available for you to go and watch.

Bushfires are all about heat. Keep that in mind. Pretty much all bushfire related deaths and injuries result directly or indirectly from the heat generated in a bushfire and the products of that heat.

There are three that concern us particularly - superheated air, smoke and burning embers.

How hot are bushfires? Well, bloody hot. On the slide is an indicator of just how hot after a bushfire has gone through an area or a property. You find deformed and melted objects and damaged materials and they together give you a pretty good idea of the kinds of temperatures that are involved in a burning fire.

Remember, water boils at 100 degrees and most of your electric ovens will get to about 250°C. So we find collapsed and sometimes distorted metal buildings and structures and that's because structural steel begins to lose its load bearing strength at about 425°C. And about half its strength is gone at 650°C. Aluminium melts at 660°C, we often find burnt cars with pools of aluminium under them where the head melted. Brass melts at 930°C, copper at about 1083°C and your window melts around about 1400°C. So those are the temperatures with which we're dealing.

To understand the most common ways that bushfires kill you just go back to your old primary school science class. You can experience heat through three transmission methods - conduction through solid stuff like metal, convection of hot stuff like air, and radiation of heat energy through air.

Now what we have here is a summary of the most frequent causes of bushfire related deaths, generally, over a long period of time in Australia. Two causes dominate. First, superheated air being inhaled and damaging your airways so that you're deprived of oxygen. Second, radiant heat impacting on your body on skin through clothes so that your core body temperature rises above about 43°C or more and then major organs like brain, heart and lungs simply cease to function.

Now these are important to realize. First they explain why most, not all, but most bushfire related deaths occur at a distance from the flames. Second, this means that the immediate agents of death are kind of invisible - radiation and superheated air. In general, fewer bushfire deaths are due to burns from flame impingement. Mostly radiant heat or superheated air kills first. Quite a way behind radiant heat and superheated air in third place comes traumatic injuries resulting from motor vehicle accidents. Poor visibility due to smoke and embers is often a contributing factor. And finally, people have perished because they remain sheltering in basement cellar type rooms when their house caught fire and they died of carbon monoxide poisoning.

Air temperatures downwind from a bushfire are routinely hot enough to scorch leaves. That takes about 290°C. Or to ignite them, they ignite at about 300 degrees, just think of putting your head in your electric oven at 250°C.

This convective heat from bushfire superheated air is deadly. The air being pushed ahead of a bushfire by the wind and accelerated by the fire itself and on an upward slope will be superheated. Inhalation of air above about 370°C is likely to prove fatal. That will be due to anoxia resulting from damage to your trachea (windpipe).

Let's now move to radiant heat. It's the truly invisible killer. You can't see it. In the past most of you will have used or at least seen in a motel these old bar radiators. They're generally rated at 1000 Watts. That's one kilowatt okay? Keep that in mind.

Now here are some of the radiant heat energies that different kinds of fires produce. if we just take a representative day, temperature above 30 °C, relative humidity below 20, wind speeds all above 20- 30km/h and there's been very dry conditions.

Grass fires will generate radiant heat intensities of about 2,000kW/m<sup>2</sup>. Scrub fires they'll generate a radiant heat intensity of about 4,000 kW /m<sup>2</sup>. Woodland fires up to 30,000 and mature eucalypt pine and forest fires they will generate radiant heat intensities of above 100,000 kW /m<sup>2</sup>.

Compare those with radiant heat intensities in the thousands of kilowatts with this summary of some of the kinds of tolerances that we human beings have.

For a radiant heat impinging on you up to about 1kW/m<sup>2</sup> it'll be okay though you might have to take your sweater off. Once the radiant heat impacting on you gets to about 5kW/m<sup>2</sup> you'll get second degree skin burns, severe burns after about 30 seconds. At a radiant heat intensity of 12kW/m<sup>2</sup> death will occur after several minutes due to hyperthermia when your core body temperature rises above about 43 °C. And remember normal body temperature is 36-37 °C. And at a radiant heat intensity impacting you of 38kW/m<sup>2</sup> almost instant death due to hyperthermia.

That's important to bear in mind in relation to say moving from your house which has caught fire on the way to your bunker or other shelter or shelter options.

Now, having familiarized ourselves very quickly with the ways in which bushfires kill us, how are we able to maybe not die in a bushfire threat to life situation? Well, we've got a lot of information from interviewing the 496 survivors who were interviewed after the 2009 Black Saturday fires. Of those we're particularly interested in 47 folk who survived severe to extreme levels of threat to their life.

In a broad generalization almost did so because they kept their heads despite their dangerous situation. In particular, they controlled the fear and anxiety that they were experiencing mostly by survival related self-talk. Things like "I must stay lying down behind this shed no matter how hot and smoky it gets." And they maintained their focus on the threat and how they had to respond adaptively. That is, they weren't hypnotized or paralysed by the flames they looked for a shed to shelter behind.

Now in trying to work out how to survive first of all remember distance is your friend. Radiant heat energy intensity decreases very rapidly with distance. So get away as far as you can from the flames.

However superheated air can travel far with the high wind speeds generated by an intense bushfire and that's especially a problem if the fire is being blown towards you uphill. Arguably the worst situation to be in is being on foot, in the open, uphill from the fire with the wind pushing the fire uphill towards you.

If you can't safely get a long way from the fire, and we're talking about distances further away than 200m, the fundamental principle for survival in a bushfire threat to life situation is to have a non-flammable barrier between you and the fire so that you're protected from both the impact of radiant heat on your body and inhalation of superheated air. Examples of such barriers that people have used to survive include metal Colourbond fences, brick walls, metal sheds, a house, a car, a culvert, a ditch, and a depression in the ground.

If you're sheltering outside your house in desperate circumstances lie down. Usually there's a layer of relatively cooler air close to the ground, there's also usually less danger from windblown embers. A house can be both a life saver and a death trap. If you're sheltering from the radiant heat and the superheated air in a room, it should (a) let you see the fire situation outside and (b) give you a means of escape to the outside on the downwind side of the house. When the fire begins to burn the house you've got to get out. If necessary, crawl to whatever shelter is available away from the heat of the burning house.

Now in relation to cars. On Black Saturday about 150 people saved themselves by sheltering in their cars on sports ovals. Gallipoli Park Marysville, Kinglake West, Kinglake Central, and Callignee. If you like, the cars functioned as mobile fire shelters.

At Gallipoli Park the cars not only protected the occupants from radiant heat and superheated air but also from an ember storm.

Kinglake West occupants actually had to keep their engines running and they twice had to move vehicles away from igniting vegetation.

The CFA website has quite detailed information about last resort shelter in your car. One of the key features is just get as low on the floor as you possibly can to escape radiant heat.

In most situations you will need to protect your airways from hot air. Keep your face close to the ground if you're in a desperate situation like that. If available use a damp cloth to cover your nose and mouth. As a last resort use any clothing items you've got, breathe through your sleeve if that's all that's there. It's not recommended that you wet your clothing. The reason is simply that radiant heat impacting on wet clothing can be conducted to your skin resulting in scalding.

Well, I've tried to be as clear as I can about how bushfires can kill, but I want to conclude by emphasizing that survival is possible under the most extreme circumstances by protecting yourself against inhaling superheated air and the impact of radiant heat using whatever protection is available.

I'm going to read an extract from an interview I conducted with a survivor of the Black Saturday fires. Now this interview took place on the destroyed property about a week or so after the Black Saturday fires. The interviewee was a man in his 30s, he was visiting his elderly uncle who owned the property the man's left arm was heavily bandaged. They'd seen the smoke from the fire to the northwest and decided to evacuate. They were loading the car when the fire swept up the west face of the ridge on which the property stood and engulfed the car and here's what happened next.

"We rushed back into the house and sheltered, then the inside wall caught fire so it was time to get out the back and away from the fire and it was very hot. There was a wall of flame across the front of the property. We stood behind this empty concrete water tank here and then all those trees were catching fire. That's about the time I thought we were not going to make it. So basically I knocked us both to the ground and I began to drag my uncle who was in a pretty bad way downhill from the burning house. We crawled down the eastern slope trying to get away from the heat. This was the only option we had because everything was on fire, we just had to get down that hill. But then we hit the barbed wire fence and I thought this is it. But we kept crawling down the hill beside the fence till we hit the corner where all we could do was just lie in this ditch here while everything burned around us. After what seemed forever the fires died down, then the neighbour drove down on the other side of the fence to see what had happened to us. He cut the fence and took us to the hospital."

Now I looked carefully and the ditch that he'd described was actually a shallow depression which I estimated to be no more than about 10 or 12 centimetres deep.

I've covered a lot of material in a short time. Here's some follow up reading, it will be available on the website. And by way of conclusion, I fervently hope that none of you ever have to make use of the things that I've presented. Good luck.

### **Chair**

Thanks Jim. That was a sobering presentation, it's one of the clearest and most concise descriptions of what's involved that I've ever heard so thank you very much.

Jim you mentioned about stress and anxiety. Diana leaving her handbag behind after things had been gathered together all in one place and the desire to flight mode kicks in and you're out the door and have forgotten the key and I'm imagining that sort of anxiety occurs to lots of people.

### **Jim McLennan**

Yes indeed. Being very anxious and justifiably frightened has a number of effects which make it more difficult for us. In fact, one of these effects is anxiety interferes with memory. One of the folks that I interviewed following fires in Western Australia explained to me that he and his partner had quite an elaborate sprinkler system set up and when the fire came through so rapidly all he thought of was leaping into the car and driving away and he actually forgot to switch on the sprinkler system and they lost the house.

### **Chair**

The other thing that occurred to me there we've had a new car in the last couple of years and one of the features of it is it won't let anyone in unless you're carrying the key. Cars of some years ago if they were unlocked you could get in. We'll have to make a different plan for our current vehicle, very annoying.

### **Jim McLennan**

A related problem can be garages with automatically opening and closing doors. If you lose power to the house as often is the case you've then got the problem of opening them manually.