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Your vegetation – what you need to know

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Chair

Tonight's program will begin with a presentation from Dr. Kevin Tolhurst.

Kevin Tolhurst

Thanks Malcolm. And thanks everyone for joining again for these webinars because they're really quite important in terms of improving our understanding of the environment we're living in and that understanding leads to much better outcomes and reduction in risk.

I've subtitled this "Vegetation - Bushfire Friend or Foe". Typically, vegetation is seen as something to be got rid of and reduced to maximum extent. Hopefully after tonight you will see that vegetation actually plays a positive as well as a potentially negative role and it's a matter of getting the balance right.

We see vegetation as being fuel but not all fuel is vegetation. And even though all fuel comes from vegetation not all vegetation is fuel. So, here's a couple of pictures from the 2009 fires, the Black Saturday fires, where we had pretty intense fires but we can see there's still vegetation left.

So, the question is then what part of the vegetation is the flammable part that we need to be dealing with and how can we better deal with that to reduce the exposure to bushfire hazards?

Some definitions to start with. Fuel in the first instance is organic material that releases energy through combustion. It's stored chemical energy and the process of combustion basically breaks down that complex organic material into simple inorganic products including heat and water. So, it's really just the reverse process of photosynthesis.

Photosynthesis is the gradual accumulation of energy in a chemical form through sunlight energy, nutrients and moisture from the soil into complex carbohydrates. Combustion just reverses that process, but it reverses what may have taken decades or even centuries to build up, and releases it in minutes.

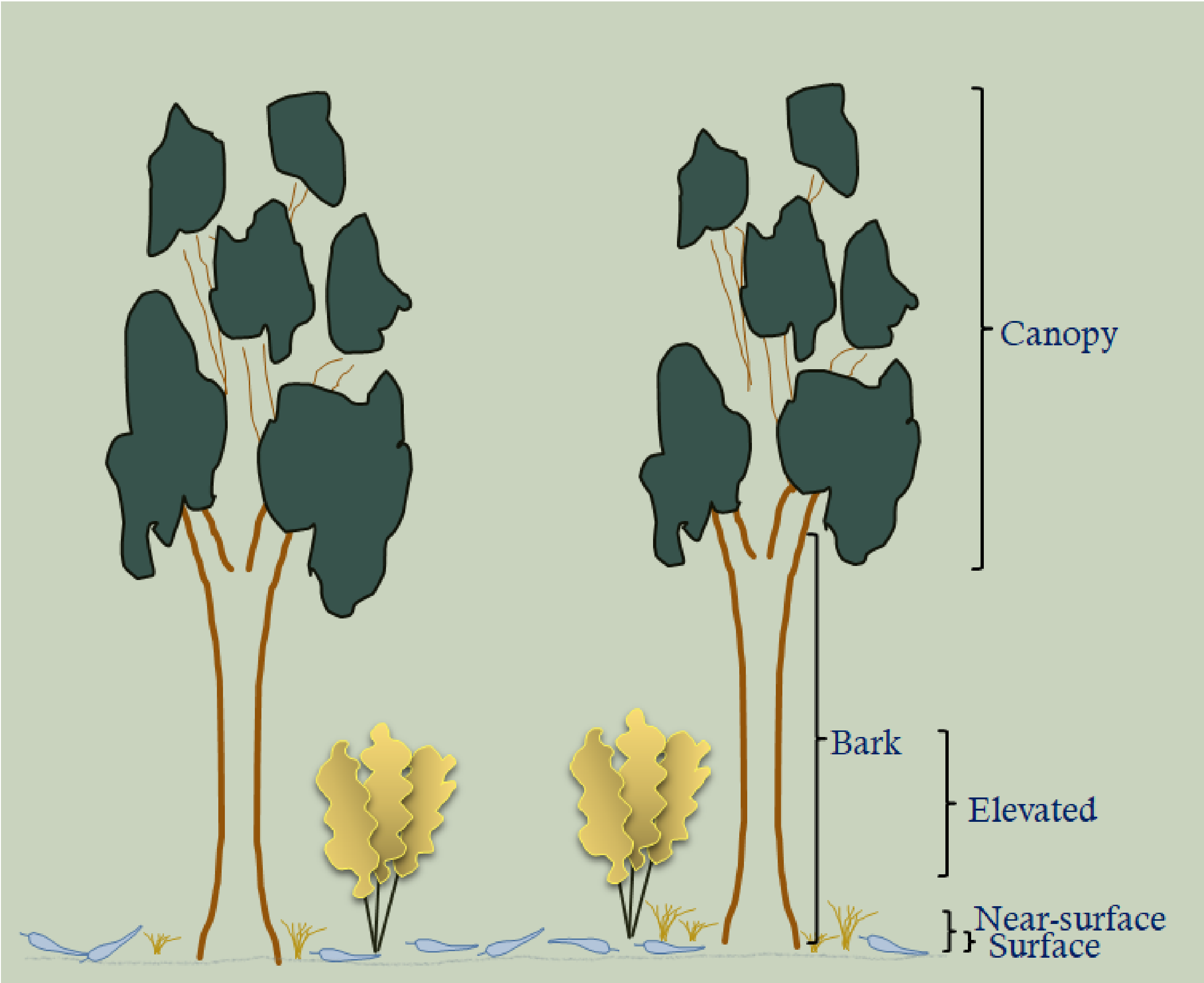
We can talk about the total fuel that might be available under the worst conditions. Part of the fuel can be live or dead vegetative material. But we need to assess what the total fuel is and then see what part of that may be actually burned under particular circumstances.

In prolonged drought a very severe fire basically all the total fuel will be burnt but not all vegetation. But the available fuel may in fact be a smaller component of that under milder conditions. We need to be thinking about fires not just under those really extreme conditions but also under milder conditions as well because they can be just as lethal and destructive at a local level.

Over the years we've developed a better way of looking at fuels. Particularly fine fuels. And what we start off with is the leaf bark and twig material on the ground which we call the surface fuels and they're important because they're largely dead material so they're basically just exchanging moisture between the atmosphere and soil and the fuel themselves and they're fairly continuous across the ground. They're really important in terms of carrying the fire. But we've also got what we also would call near-surface fuel, a more vertical component to this. So, grasses, hedges, held up leaves and bark that might be held up in bushes and so on which is even drier and it burns more readily again. The surface and near-surface fuels are really important in terms of carrying a fire, and the continuity of those two layers is the thing that's really important in terms of carrying a fire.

Then above that we've got elevated fuel. The elevated fuel has some gap between the surface and the main area of fuel itself. And so it's possible to have a low intensity fire burn underneath here without incorporating the elevated fuel. But under more severe conditions the fire that's supported by the surface and near-surface fuels will get the flames into that elevated layer and so the elevated layer becomes incorporated into the flaming zone of the fire. And then we've got the trees and the parts of the trees that we're most interested because we saw in that earlier photograph that a lot of the tree is left behind after the fire. But the bark, particularly the dead bark on the outside of trees, is important in burning but also producing embers to create spot fires. Potentially if the flames connect between the surface, the elevated and the canopy we can have a canopy fire and so there's more energy released from that fuel in the canopy as well.

This is a vertical stratification of fuels that's really important to appreciate. We're looking at that vertical connectivity between the surface and the canopy of the fuels here. And there are things we can do to increase that separation, likewise, there's things we can do at the surface layer to increase that separation. How we assess that. The Overall Fuel Hazard Assessment Guide is a useful way of looking at that. You can downloaded a copy as a PDF file.



Fire spreads through connections, fire is basically a chain reaction where a burning part of the fuel basically creates heat through radiation and convection and pre-heats the neighbouring fuel around it and through that process is a propagation from one area to another and we call that the rate of spread of the fire.

Where we've got continuous fuels that spread is quite easy. But where we start to break that up into patches or create gaps between the fuels then the flames generated by the initial fuel needs to be able to reach over those gaps to the next lot of fuel if this chain reaction is to continue. In a lot of forest situations that's easily achieved.

But embers are also important where we have these islands of fuels because they can jump over, blow over the burning areas into fresh fuel areas and basically extend the fire and keep the chain reaction going that way. Horizontal connectivity is really important, but it can be broken as well by reducing the embers or reducing the continuity of the surface fuel.

Vertical continuity is something which is perhaps easier to see. Basically are relying on flames from the surface and air surface fuels reaching into the elevated and bark fuels. And then the flames from the elevated and bark fuels may reach into the canopy fuels. By creating a separation between those surface and near-surface fuels and the canopy fuels we can reduce the amount of available fuel to a fire even under relatively severe conditions.

In addition large fires are even better at connecting fuels both horizontally and vertically. Within the smoke plume (within the convection column of a fire), the heat transfer is averaged out much better. Preventing a fire from getting large in the first place reduces the amount of fuel that will be available. It's not just a local effect that we might see but also occurs over what I'm talking about, a large fire here, that might be two to four thousand hectares in size. The game changes and we've seen a lot of fires of this nature. The 2009 fires were certainly in this large fire category.

And when we get those large fires the heat from the burning wood material also contributes to the amount of convection, how big that convection column becomes and the connection then with the fuels is increased. It's not just about the fine fuels but it's also about the woody fuel as well.

There are some guides in terms of how we perhaps can differentiate fuels based on their characteristics. Here's an example of a house that was exposed to fire in 2005. And see what looks to be a reasonable defendable space around it. We can see some green area there which was a heavily mown area. But then we've got some vegetation close to the building itself. And here we can see that some of that vegetation that was close to the veranda and to the windows here was sufficient to set fire to the veranda and break the glass on the windows. So here the occupants of this property had thought they've done quite a good job at creating a defendable space around the house, but they wanted garden up close against the house and that really became a major problem in the passage of the fire and it took a lot of effort to defend this house. Obviously it was defended successfully in that the house is still there. The garage was lost. But it did take probably 10 years off the life of the owners in this case.

We need to understand the flammability of fuels. There are three aspects to flammability - the ease of ignition, the ability to sustain burning and the amount of heat that's released in that combustion process.

How can we work out the flammability of fuel in terms of those three attributes? It's related to the fineness of the material: the thickness of the leaf, the twig, the bark material. And what we consider to be fine fuel is dead material less than 6mm in thickness and live material less than 2mm in thickness. The reason for the difference there is that the live fuel has a lot more moisture, so it doesn't burn as readily. Six-millimetre live fuel is more difficult to burn than the equivalent in dead fuel. So the six and the two comparison is an indication of how much more difficult it is to burn live vegetation compared with dead vegetation.

Then there's the degree of connectedness: percentage ground cover, canopy density - the vertical gaps that we see. The degree of connectedness is important and that's something we can manipulate. The chemical composition of the fuels themselves, whether or not there's extractives, (oils, waxes and resins) inherently are part of the chemical composition of the plant material which actually makes them a lot more flammable compared with plants that have a high salt or nutrient content which actually reduces their flammability. Where you have oils, waxes or resins present a plant that might be 1m high might produce flames 4-6m in height whereas without those oils and waxes that flame height would perhaps only be twice the height of the vegetation. So those oils, waxes, resins have a huge impact on the ability to jump across gaps in fuel and therefore the flammability of vegetation.

The dryness, the natural dryness of vegetation. And we need to take into account what happens under drought as well. But the degree of succulence, in a sense if you squeeze or squash leaf material or plant material do you get moisture out of it or not? If you're not getting moisture out of it then it's going to be relatively dry and burn more readily. Whereas if moisture squeezes out then the fire is going to have to dry that moisture out and it's going to be a lot more resistant to burning.

And finally, the fifth point here is the amount of fuel. That determines the total heat output and that's really important as the fire scales up - both duration of heating but also the amount of heat.

So if you look at some examples here. This is a Pencil Cypress. That's got a nice green exterior. We'll say "Okay. Well maybe there's going to be a lot of moisture there so it shouldn't burn very well." But if we actually look inside that Cypress we see there's a lot of retained dead leaf material inside. And given the vertical orientation of this particular tree and the density of it, how it's packed, this tree will burn very readily. When you're assessing the flammability of some of the vegetation it's not just about what you can see on the outside, you need to look on the inside too. It would be nearly impossible to remove all that dead material from a plant such as this. So it's an inappropriate plant to be planting close to your house, as we saw in the Canberra fires, because of this retained dead material.

Here's a hedge out of another plant, happens to be New Zealand Mirror Bush but green exterior, when we look inside there's not that much dead material in there. There's no suspended dead material so this is going to be very hard to burn and the leaves themselves are fairly fleshy, they're fairly low flammability. So, here's a plant that actually would provide a reasonable shield to heat, whether it's radiation or convective heat, and not contribute much to the fire itself.

So not all plants are equal in this sense. And gorse which is notorious in terms of how well it burns. You see when you look inside the gorse plant the dead leaves hang on for two to three years after they've died. And so, there's a lot of dead material in the plant and adding to that it has a resinous component. So, it's a very rich fuel and notoriously a good burner. And our New Zealand friends have actually had a look at some of this, here's a great demonstration of comparing different plants in terms of the flammability.

Dr. Tim Curran (recording)

We measure plant flammability on this device here at Lincoln University which we call our plant barbecue. Now different types of plants will burn to different degrees. And we're going to show you an example of a highly flammable plant and also a low flammability plant.

Simon Whitelock (recording)

So, as you can see this is a great option to plant around you house because it eliminates a lot of the fires. These plants aren't fireproof, but it does reduce the risk and it slows down the spread of a wildfire.

Kevin Tolhurst

What's really important from that video is that all plants will burn but some plants are much more difficult to get to burn than others because of their lower level of flammability

We can use that. If we have a look at some good veg bad veg what we're looking at here is an area in Marysville after the 2009 fires. And you see a house has been destroyed by fire. But there's a lot of vegetation around that house that has only been scorched, it hasn't actively burned. We need to understand what perhaps has gone on here, those plants will have reduced the winds and they will have reduced the number of embers impacting the building, the radiation exposure and the convective heat exposure. But that house has still been lost. And that's due to more the vegetation in the broader landscape that was producing massive number of embers and also how the house was built, maintained and how much fuel there was in close proximity to the house itself.

Vegetation that's good from the point of view of protecting house are things that have high water content or salt content and minimal dead components.

Some of these succulents or semi-succulents fit into the bill. Here in a wet forest where there's high moisture content and a high life-to-dead ratio. But under drought that may in fact dry out. And then there's exotic species like deciduous trees to have high moisture content high mineral content and a high life-to-dead ratio. So not a lot of fuel to actually burn. We need to analyse the plants and the environment they're in to see how flammable they might be.

Here I've got what I've called the Jekyll and Hyde vegetation. In a sense it's quite a moist environment, dense understory. Not that much suspended material in the elevated fuel but there's a lot of fuel on the ground including a lot of woody material. But there is a big separation between the surface fuels and the canopy fuels. You would need fairly significant flames and conditions to burn this forest, and that does occur but perhaps only once in 100 or 200 years.

Over here a Victorian example. We have one in Western Australia. We've basically got the same sort of thing. Big separation between the surface and the tops of these trees. And a lot of moisture retained in the understory. But in drought conditions it can become flammable. There's a trade-off here between retaining moisture but reducing the amount of dead material that would be available during drought conditions.

Here is something that I call perhaps good vegetation from a fire point of view. Very little chance of the fire actually getting into the canopies. Very little surface fuel, on the left is Box-Ironbark Forest and the right it’s Red Gum Forest. The bark is tightly held or alive. There's a poor connection vertically and relatively low level of fuels present and if we look at the horizon to see where flames might need to reach to basically give us a canopy fuel the distance to the flames would might be 100-150m long. The surface fuel is not going to generate flames that long to get it into the canopy.

In a different environment here where we've got the odd scattered tree but a shrubby healthy shrub understory, very flammable vegetation, high level of connectivity both vertically and horizontally and exposure to wind is quite high, so very flammable vegetation.

Similar down on the coast where you’ve got strong vertical and horizontal connectivity. A lot of dead materials in amongst it all.

Going back to another Box-Ironbark sort of situation where we've got a shrubby understory. The distance between the surface and the crown here is reduced but it's probably not reduced to the extent that you would easily get a canopy fire. And the elevated fuel here is basically all live material, there's not much dead material on it so that the elevated fuel would not burn all that readily.

And in this case it looks very verdant. What would it look like under drought conditions? That's the question we've got to ask. In this case it’s largely exotic trees that would have high mineral content so low flammability. So, this would be a relatively safe site. This happens to be in Beechworth. You wouldn't need as tall a flame to reach into the canopy here. But then there isn't the surface fuel to support it so what we've got to look at when we're looking at fuels we can divide fuels or vegetation into three types.

Fuels that will only burn after prolonged exposure to heat and flames, such as succulent plants or plants with high mineral content, there are those plants that will retard fire but under very dry conditions will still burn, so things like wattles and some deciduous trees and shrubs. And then there are other plants which will burn readily like the gorse we just saw in that demonstration. So even under mild conditions they will burn quite readily so many grasses, heaths, eucalypts, conifers fit into that category.

The one and two type vegetation are the ones that we want to promote and the first category are the ones that are going to give us the greatest protection close to the house.

There are a number of guides you can get that help determine what these species look like. Hopefully you've got a better understanding of being able to make that assessment yourself, but these guides exist and I'll give you a list of where you can get these from at the very end. There are useful websites the CSIRO has set up.

And what we need to appreciate is that not all vegetation is adding to the fuel. This is Marysville, look at all the trees with all canopies still on - green canopies. The fuel here was predominantly coming from the surrounding forest and the houses and the fuels immediately around the houses themselves. In fact, the 5% or so of houses that actually survived a lot of them were actually closer to the native bush than they were to the centre of the town.

In summary all fuel is vegetation, it comes from vegetation, but not all vegetation is fuel.

Fuel levels can be significantly reduced without removing all the vegetation, it's just a matter of trying to break up the connections, vertical and horizontal and low flammability fuels reduce the severity of the fire impact by reducing the winds, embers and radiation.

Maintaining the vegetation is important but we've got to make sure that the flames don't connect. And good garden design combined with good maintenance can significantly reduce your bushfire risk.

Thanks very much for your attention.