

“The bushfire threat in urban areas”, Australasian Science, January/February 2005 Issue
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Counting bushfire-prone address in Australia

“How many bushfire-prone addresses are there in Australia?” Keping Chen and John McAneney have the answer.

In this fire-ravaged continent Australians call home, summer is traditionally signalled with television images of volunteer fire fighters risking their lives to save homes. The recent 2003 Canberra fire with some 500 homes destroyed and four lives lost is only the most recent in a string of such catastrophes.

Assessing the adverse impact of bushfires on our community and environment is an active area of research. Macquarie University’s Risk Frontiers – Natural Hazards Research Centre is looking at the fire risk with its *FireAUS* project. Its particular focus is assessing possible property damage in extreme cases when, for whatever reason, management and control practices fail and fire penetrates the urban boundary. In these relatively rare cases, there is the potential for large numbers of homes to be destroyed as so graphically witnessed in Canberra and in other historical fires such as the 1983 “Ash Wednesday” bushfires (2500 destroyed homes) and 1967 Hobart bushfires (1300 destroyed homes), events that remain etched in the nation’s mythology.

Like much of the Risk Frontiers’ work *FireAUS* has an insurance focus. This is because homeowners need to have confidence that their insurance providers will still be standing when their house is no longer. After all this is why we have insurance. And the insurance companies themselves need to have sufficient reserves to cover claims arising from big events. Recall that in the 1999 Sydney hailstorm, insurers paid out claims worth close on \$2 billion dollars in today’s terms. So an insurance focus; but it is really all about the responsible management of risk and building safer and more resilient communities.

FireAUS began with analyses of the damage experienced in the Canberra suburb of Duffy and losses incurred in the 1994 Sydney fires in adjoining suburbs of Como and Jannali. High-resolution satellite imagery and aerial photographs revealed the critical importance of distance from the bushland edge in determining the likelihood of home destruction. While this is hardly surprising, the statistics and relationships that emerged were both intriguing and useful.

It turns out that in a fire such as those mentioned above a house within 50 metres from bushland faces about a 60 per cent chance of destruction. The danger drops off the further the house is from bushland (Figure 1) with the maximum distance at which property damage occurs varying between fires.

Nonetheless at around 700 metres, other evidence not shown here suggests that your house is pretty safe. And these statistics were confirmed by experience in some of the Hobart and “Ash Wednesday” fires for which we have been able to find data. There would seem to be some useful rules of thumb for town planning here.

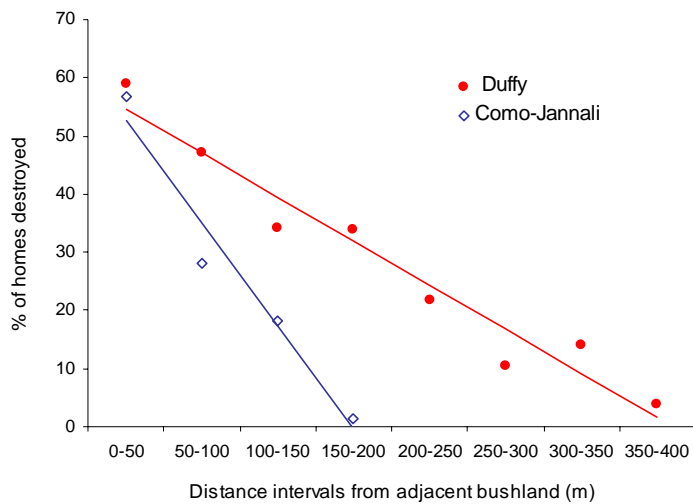


Figure 1. Percentages of homes destroyed at different distance ranges from bushland. The numbers of samples (destroyed homes) for Duffy and Como-Jannali curves are 206 and 76, respectively.

Distance is not the only variable determining the relative bushfire threat to homes, but it is demonstrably the most important and has the virtue of being relatively easy to measure. This is not to ignore the critical role of homeowners in minimising their individual threat through appropriate preparations or even saving their homes by effective interventions. Rather we are looking specifically at the situation when these efforts prove fruitless and/or warning is insufficient. No one we talk to suggests that this circumstance will not happen again.

So let's use distance as a surrogate to help answer a pretty basic but important question: how many properties in Australia are at risk?

Methodology

To answer this question, we need accurate locations of property addresses and maps of the distribution of bushland. For the former, we employed the latest G-NAF (Geocoded National Address File) street address database, which is regarded as Australia's most authoritative geo-located address database. It contains 10.9 million addresses with known locations.

For bushland maps, we first sourced government agencies and publicly available land cover databases. These have major limitations: coarse spatial resolution and many have not been updated recently.

High-resolution imagery is better. The most recent generation of satellite images such as DigitalGlobe's QuickBird imagery has a spatial resolution of the order of 0.6 m. But this is expensive.

More affordable is medium-resolution Landsat 7 ETM+ images and we used these to classify bushfire-prone vegetation - forests and pine plantations. We focused on identifying large areas of continuous bushland, i.e. areas that might allow large fires to develop and, on occasions, get out of control; small, scattered and discontinuous areas of vegetation were eliminated.

Given the locations of all addresses and bushland, the calculation of shortest distance between them is then straightforward. Seven distance ranges were categorised. Group 1 comprises the first row of addresses immediately adjacent to bushland and those up to 50 m beyond the first row. The other six groups are in 50 m intervals out to 700 m, the maximum extent to which we have seen damage. Group 1 lies within about 80 m of the bushland edge and so comprises the most at-risk addresses.

So is the medium-resolution imagery good enough? To test this, a bushfire-prone area in Sydney (Lane Cove National Park and Hornsby) containing a very high proportion of at-risk addresses was chosen as a suitable validation region. Results from the Landsat ETM+ were compared with that from high-resolution QuickBird imagery.

Validation

By comparing cumulative percentages of addresses within each distance group, individual percentages from both types of images were found to be markedly similar. In other words, for estimating the percentages of addresses adjacent to bushland, the medium-resolution imagery was both reliable and cost-effective. Accuracy will increase with the number of addresses and so this should be quite adequate for looking at the proportion of addresses at risk at State or National levels.

Next in a manner analogous to testing for false positives or negatives in a medical procedure, we checked to see whether individual addresses in the validation site were ascribed to the same distance group given either the high- or medium-resolution imagery. For the most vulnerable category, just over two thirds of the 33,700 addresses were grouped identically. However, consistency rates rapidly increase as we combine distance groups. If a zonation of some 200 m was considered adequate for identifying the high-risk zones, then accuracy approaches 90%. This is starting to look pretty good.

In one further test, distance maps were developed for all of the most severely damaged suburbs from major historical fires in Australia. Not surprisingly, all were located in close vicinity to areas of extensive bushland. Suburbs tested include Duffy-Chapman, Como-Jannali, Mt Macedon from the “Ash Wednesday” fires, and Cascades, Old Farm and South Hobart from the 1967 Hobart fires.

Figure 2 shows all Canberra addresses and their distance ranges from adjacent bushland. Startlingly revealed as two of the most bushfire-prone suburbs before the January 2003 Canberra bushfires are the suburbs of Duffy and Chapman. Clearly, this approach has potential to aid emergency planning and changing the perception of the public about bushfire threats.

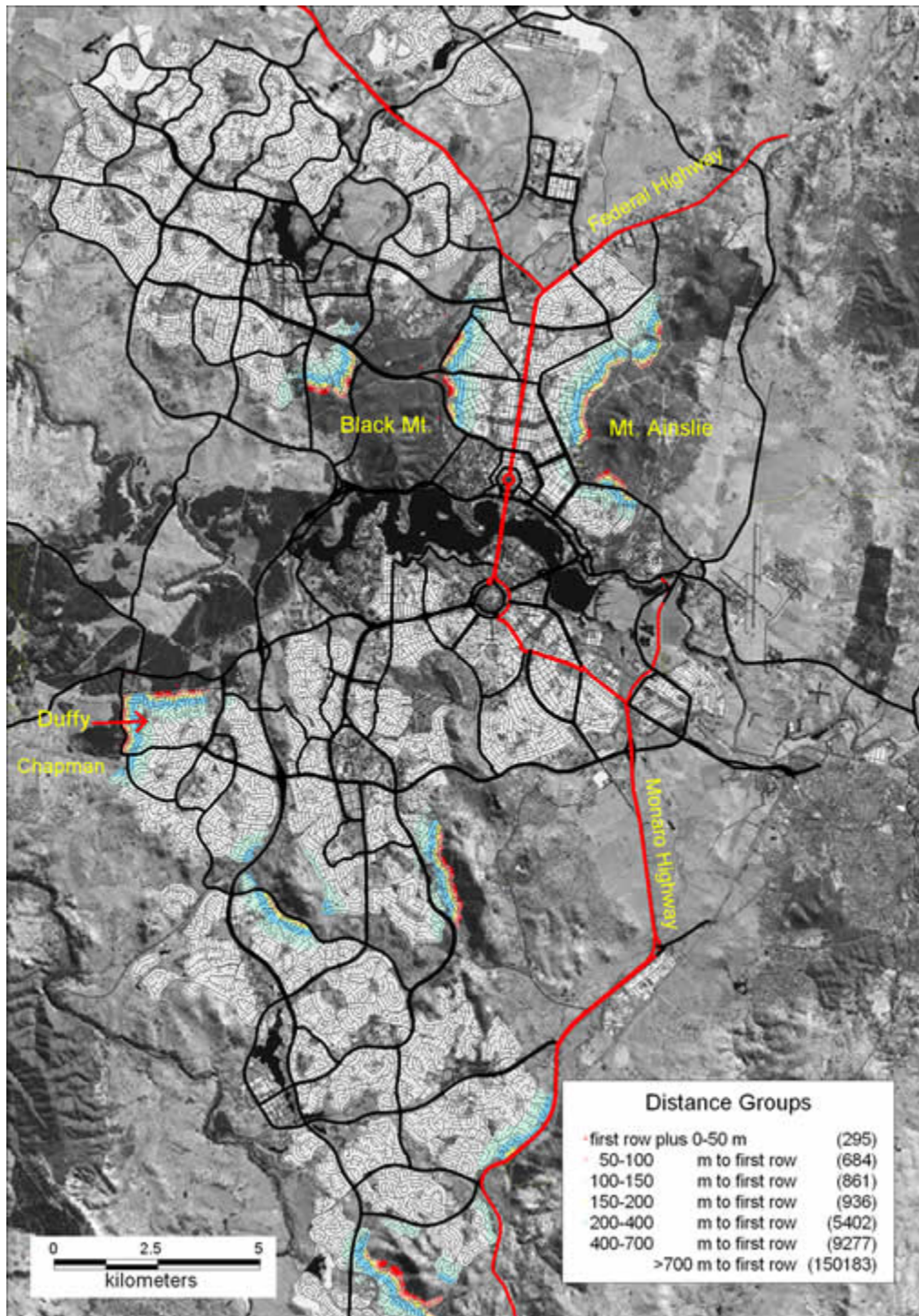


Figure 2. Addresses adjacent to extensive bushland in Canberra, ACT. The numbers in the parentheses in the legend refer to addresses within different distance groups.

Coverage

So with some confidence in the methodology, let's return to our original question: what proportion of properties is threatened by bushfires? To answer this, separation distances between addresses and adjacent bushland were calculated for all addresses in major capital cities and their surrounding areas, with the exception of Darwin. For the 8,161,680 addresses analysed, about 4.1% of addresses are exposed to bushfire risks, being either immediately adjacent or very close to extensive bushland (Group 1); about 500,000 addresses are located with distance Group 2 (first row plus 100 m); and about 80% of all addresses are located beyond 700 m (Figure 3). Further work is in place to see how these percentages vary from one state to another.

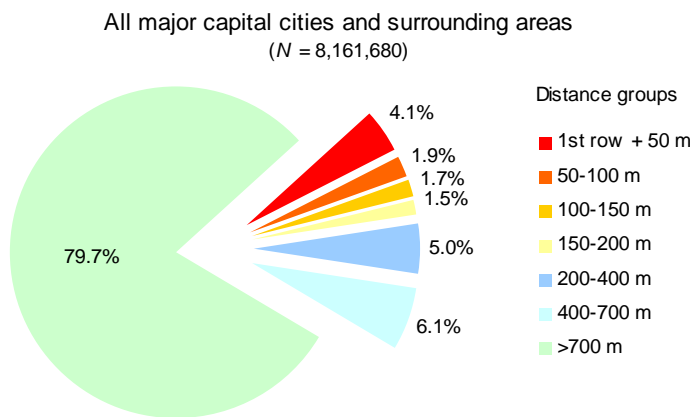


Figure 3. Percentages of addresses falling within different distance ranges from bushland in Australia.

Discussion

As we stressed previously, the separation distance between address and nearby bushland is not the only factor that determines bushfire risk, but is probably the most important and easily quantifiable variable. The results based on distance alone are upper estimations of at-risk addresses. Given that the majority of fires are caused by human activity, predicting their evolution over the landscape is always going to be difficult. Our study takes a somewhat different tack at accounting for at-risk properties at the national scale. Specifically, the *FireAUS* distance database will be useful for

- estimating the percentages of addresses adjacent to bushland at various spatial scales – States, Local Government Areas and insurance statistical zones;
- assisting insurance underwriting;
- serving bushfire prevention planning; and
- educating the public.

This study is already beginning to answer some big questions about the spatial distribution of exposures in relation to neighbouring bushland. While the number of addresses will increase as population grows and the bushland distribution may change in the next few decades, we believe that the overall percentages of addresses adjacent to bushland for the whole country are unlikely to vary significantly.

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