

Successive bushfires have significantly affected the lives, wellbeing and livelihoods of communities living within or near fire-prone forests and rangelands. Drought (made worse by climate change) and bushfire have also negatively affected the health and productivity of these ecosystems. Climate change will further increase bushfire risk and stress on human and natural communities.

Reducing the occurrence, severity and impact of bushfires, and enhancing the resilience of our natural ecosystems by managing fire in our forests and rangelands are core objectives of bushfire management. Local and regional actions contribute to the broader outcomes across the entire landscape. These outcomes need to reflect community values and expectations including:

- community protection
- the conservation of natural biodiversity (plant and animal species, habitat)
- the production of water, carbon, and timber
- the provision of tourism and recreation opportunities.

Developments in science and technology supporting fire behaviour modelling, fuel monitoring and weather prediction have led to significant improvements in the ability to provide predictive services support to communities, emergency services, land management agencies and business.

Predictive services is a key contributor to:

- effective mitigation activities, such as fuel reduction burns
- community warning and information activities, such as issuing fire danger ratings
- response activities, such as fire behaviour analysis and issuing of emergency warnings and information.

Ensuring the availability of accurate input data, such as weather observations and fuel loads, is essential to the utility of any predictive modelling approach. The data covers an expanse greater than the entire land area of Australia and consequently accurate, affordable and timely technologies are required to gather this information if modelling approaches are to be effective.

Throughout 2015-2017, emergency service agencies around Australia participated in workshops hosted by the Bushfire and Natural Hazards CRC to consider the major issues in natural hazards emergency management.

This publication on bushfire summarises the outcomes of two of these workshops and poses questions as a guide for a national research agenda in natural hazard emergency management.

Land management agencies operate in the highly urbanised and politicised environment. The community has a range of beliefs concerning land management and it does not necessarily share an understanding of, and support for, management activities such as the use of prescribed fire with land management agencies. Community engagement is essential to ensure that the community understands risk and risk reduction activities carried out by land management agencies and are able to use community information programs.

- **What are the expectations of the community from land management agencies, and how should those expectations be addressed?**
- **How can information that inherently contains uncertainty be best provided to the community, and how can the community make best use of that information?**
- **Are there ramifications for the providers of the information if the information is misinterpreted by the community and bad things happen as a result?**
- **How do we provide confidence to decision-makers and the community in a world of uncertainty?**

Better understanding of the economic costs of disasters and their risks, and the risk-reducing benefits of treatments can build a more convincing case that improves the likelihood of risk treatments being resourced and implemented.

- **How can we quantify the long-term benefit of mitigation investments across different hazards?**
- **How can emergency events and climate change be used as an opportunity**
 - o **to further develop and expand the emergency management narrative when there is a heightened level of interest, to government, business and community, to prepare for and mitigate disasters?**
 - o **to build mitigation activity directly into recovery processes?**
- **How does investment in changing behaviour at different levels, including political, government agency, business, community and individual support improving disaster resilience?**

KEEPING PACE WITH TECHNOLOGY

Technologies supporting the provision of predictive services are advancing rapidly, and predictive services must evolve rapidly itself to absorb and exploit those advances. These include:

- remote sensor systems for data collection, such as satellite, manned and unmanned aerial vehicles, permanent land based systems
- supercomputer facilities for processing of data and advanced model computation
- platforms for communicating information to control centres, field personnel and the community.

At the same time, the body of research available for enhancing predictive services capabilities continues to grow, and this is likely to accelerate as greater amounts of data become publically available.

- **How can a nationally consistent predictive services capability be delivered and maintained?**
- **How can technology as a tool contribute to community and emergency management effectiveness and efficiency?**
- **How can predictive service capabilities be used to drive organisational change and improvement, and how should that be managed?**
- **How do we assimilate rapidly evolving technology and a growing body of research and translate this knowledge into operational practices?**

There is a growing demand from community and government for an advanced, reliable and accurate bushfire predictive services capability. These services are valuable over a range of timescales and a variety of purposes including:

- years–in support of long-term emergency services and land management planning
- months–through seasonal outlooks that assist fire authorities to make strategic decisions on resource planning and prescribed fire management for the upcoming fire season
- weeks and days–to support warnings to the community and businesses, decision-making on total fire bans, and potentially response to large-scale fires
- days and hours–to support operational response to running fires.

As demand for information grows, expectations will also grow, in terms of accuracy, availability to community, and ensuring that it is clearly and appropriately communicated to all potential users.

- **What are the appropriate measures of accuracy for bushfire predictive services and what level of accuracy is needed for different purposes?**
- **What are the expectations of the community from bushfire predictive services, and how should those expectations be addressed?**
- **How can we validate fire behaviour models when there is a limited, albeit growing, archive of data collected during the most dangerous and extreme conditions?**
- **Are our fire behaviour models good enough?**

Predictive services must inherently deal with uncertainty from a number of sources, including:

- How accurate and precise is the data?
- How good are the models? How much variability is there in climate and weather?

An important approach to dealing with this uncertainty is the use of ensemble forecasting. Ensemble forecasting relies on performing repeated model runs using slightly different conditions for each run, within the expected range of variation that the input data might be expected to exhibit. Ensemble forecasting can also be applied through the use of multiple models that might be applicable to a given situation. The output of the approach can, for instance be a map highlighting the probability that a fire front reaches a particular point within a given length of time, or the likelihood that a severe fire will start tomorrow and destroy a certain number of homes. Ideally, the actual circumstances fall within the spread of the ensemble forecast.

- **How can information that inherently contains uncertainty be best provided to the community, and how can the community make best use of that information?**
- **How can information that inherently contains uncertainty be best provided to emergency management organisations, and how can they make best use of that information?**
- **Are there ramifications for the providers of the information if the information is misinterpreted by the community and bad things happen as a result?**
- **How do we provide confidence to decision-makers and community in a world of uncertainty?**



National research priorities for natural hazards emergency management

What are the most significant natural hazard emergency management issues Australia faces over the next 10 years?

This was the question posed to emergency service agencies around Australia in a series of workshops hosted by the Bushfire and Natural Hazards CRC from 2015-2017.

This publication is an outcome of one of these workshops and part of a broader national research agenda in natural hazards emergency management being developed by the CRC.

The workshops provided an exploration of major issues that would benefit from the support of research at a national level. There was no attempt to solve any of the issues or problems raised nor was there any discussion on the details of specific research projects. The participants discussed the issues they believed were relevant to the specific topic under discussion, the relative importance of the issues and the reasons underpinning their relative importance.

This series of publications summarises the outcomes of the workshops conducted so far – more will take place in 2017. They provide a guide for future research activities by identifying national priorities across major themes. The workshop outcomes have also influenced the evolving research agenda of the CRC.

This statement has been developed with the assistance of the Australasian Fire and Emergency Service Authorities Council (AFAC) Predictive Services Group, the Forest Fire Management Group and the Rural and Land Management Group, which hosted workshops with key natural hazard stakeholders in Melbourne and by video conference in all other Australian states on 27 April 2016 and 5 May 2016 respectively.



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