

FIRE NOTE

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CLIMATE CHANGE AND ITS IMPACT ON THE MANAGEMENT OF BUSHFIRE

One of the more difficult issues facing those involved in the management of bushfires is assessing the likely impact of climate change on the bushfire threat.

The combination of climate, topography and vegetation in many areas of Australia, and in parts of New Zealand, combine to produce one of the most severe fire environments in the world.

Conversely, fire has been part of most of these environments for millions of years, largely shaping the composition and distribution of the native plants, animals and ecosystems that survive today. Indeed, a significant proportion of Australia's unique biota has become largely dependent on fire and the attendant variety of fire regimes for its continued existence and development.

The possibility that conditions in current bushfire-prone areas may become hotter, drier, and/or windier or that such areas may experience more frequent extreme 'fire weather'

days, must be factored into future planning by fire authorities, land managers and the community.

The fire and land management agencies who are partners in the Bushfire CRC and members of the Australasian Fire and Emergency Service Authorities Council have identified the issue of climate change as one of the most important strategic issues confronting bushfire managers in Australia and New Zealand.

CLIMATE CHANGE AND BUSHFIRE MANAGEMENT

The danger posed from bushfire is directly related to the chances of a fire starting, its subsequent rate of spread, intensity and difficulty of successfully suppressing it. The difficulty of successful bushfire suppression is variously related to the nature and arrangement of the available fuel, the temperature, relative humidity, wind speed and both long and short term drought effects.

From a scientific viewpoint climate change needs to be understood at a both a global and regional level. This is clearly a complex task, and many questions remain.

In a February 2006 report (*Climate change impacts on fire-weather in south-east Australia*), the CSIRO concluded that should the average summer temperature increase then "...there will be an increase in the frequency of very high and extreme fire danger days, especially in inland areas".

The report stated: "The south-east region of Australia is particularly vulnerable to bushfire - along with southern California and southern France it is identified as one of the three most fire-prone areas in the world. It is therefore critical that we prepare for the potential of increased fire risk associated with the hotter and drier years we may experience in the future."

The situation regarding future rainfall levels is less clear at present. Future fire regime scenarios that incorporate increased rainfall

SUMMARY

This FireNote is an update of FireNote Issue 4.

Changes in global climate have the potential to significantly impact on the bushfire threat in Australia and New Zealand.

Predicting the impacts of climate change in specific regions continues to be very complex scientifically.

Current projections suggest that for south-eastern Australia there could be an increase in the frequency of very high and extreme fire danger days, especially in inland areas, and that periods suitable for prescribed burning are likely to move toward winter. In northern Australia, current predictions suggest the frequency of floods and droughts could increase, with some ecosystems becoming more arid.

Lightning strikes might also increase in the north.

Several Bushfire CRC research projects are assisting agencies to understand and prepare for the possibility of future climate change.

More details on the science of climate change can be found in *Fire Note 4*.



result in larger fires, mostly as a consequence of higher fuel load and fuel continuity, which increases fire spread (Cary 2002). Lightning strikes are also predicted to increase in frequency (Goldhamer and Price 1998) for tropical Australia, while the trend for southern Australia remains unclear.

While simulated climate futures vary considerably in their predictions of rainfall, even less can currently be predicted about how current levels of wind speeds, relative humidity and lightning activity may change. Nonetheless, it would seem prudent for relevant agencies to begin planning for a higher frequency of unplanned fires.

In its report to the Council of Australian Governments in March 2004, the *National Inquiry on Bushfire Mitigation and Management* concluded:

“Depending on future international and Australian arrangements for greenhouse mitigation, there may be economic benefits associated with reducing greenhouse gas emissions associated with fire or in sequestering carbon through vegetation sinks. Realising either of these economic benefits would depend on managing the impacts of bushfires.

“In summary, the implications of climate change for bushfires are likely to create substantial economic, social and environmental costs. For these reasons fire and land management agencies are already exploring measures and arrangements that might mitigate the impacts of bushfires under altered climatic regimes and might capitalise on opportunities that mitigation arrangements present. Because of the significance of northern savanna fires to greenhouse emissions and the potential for landowners to benefit from mitigation arrangements, these options have been most fully explored to date in northern Australia.”

BUSHFIRE CRC RESEARCH

The Bushfire CRC is playing a key role in improving understanding of climate change and climate variability and is currently focussing on the following aspects:

- Weather and climate associated with past major fire events.
- A detailed accurate fire weather data set 1957-2007.
- Improved seasonal climate outlooks.
- Composition and health impacts of smoke.
- Links between climate, fuels and the carbon and water cycles, especially in alpine country.
- The impact of climate change for fire management and prescribed burning with more areas being burnt, more regularly.
- The nature and severity of bushfire weather in different regions of Australia under climate change projections.
- Quantifying the economic impact of fire in changing environments.

Several key research projects are looking at the broader long-term consequences of more bushfires under climate change. These include:

- The health and safety of communities and of firefighters in a world of more fire, more smoke and more risk to life and property.
- Educating communities to learn to better live with bushfire.
- Resourcing the increased firefighting effort - finding ways to attract and retain volunteer firefighters.

It is important that we keep in mind that a single major fire event, such as the 2003 or the 2006/7 fires in south-east Australia, can have far greater consequences than small changes in temperature or rainfall over a period of decades. Similarly, year-to-year and seasonal variations can be far greater than the small gradual changes of long-term climate change.

Bushfire CRC research is aiming to assist fire and land management agencies in reducing the frequency and severity of these events.

WEATHER AND CLIMATE

The work in the Bureau of Meteorology’s Research Centre on the weather and climate conditions surrounding major past fire events and Bushfire CRC funded efforts on building an accurate, reliable fire weather data base back to 1957 will assist in managing climate variability for the future.

The Bushfire CRC/Bureau of Meteorology Seasonal Bushfire Assessment workshops that develop a seasonal fire weather outlook have, since 2006, provided a valuable national tool in preparing for fire seasons each year.

One of the major research challenges for the future will be to gain a better understanding of the links between fire as a land management tool and the management of critically important resources such as water and forests.

The Bushfire CRC project *Fire Weather – Fire Danger* is establishing relationships between global circulation anomalies and Australian regional seasonal weather. It is focusing on the number of high hazard episodes as well as ‘mean’ weather behaviour, with a view to assisting fire and land management agencies in their strategic planning.

More work is being done in this area with the development of a spatial fire climatology database for parts of Australia as part of a Bushfire CRC project with the Bureau of Meteorology, Department of Sustainability and Environment Victoria and the Desert Research Institute in the US.



▶ RIGHT: SMOKY WORK AT A BUSHFIRE CRC HIGHFIRE RESEARCH BURN ON THE SNOWY PLAINS, NSW, IN 2007.

◀ COVER IMAGE: SMOKE AND FLAMES AT A BUSHFIRE CRC RESEARCH BURN, SOUTH AUSTRALIA, APRIL 2008



▲ ABOVE: BUSHFIRE CRC RESEARCH IN NEW ZEALAND, JANUARY 2005.

BUSHFIRE SMOKE

At the 'applied science' level, smoke from bushfires, and more particularly smoke from the use of prescribed fire, is increasingly viewed in some quarters as further adding carbon dioxide, and other greenhouse gases to the atmosphere, and as such further contributing to global warming plus a decline in community health.

As with much of the science associated with climate change however, the story is more complex. New vegetation that establishes following a fire is invariably vigorous, growth-wise, generally 'locking up' considerable quantities of carbon. Similarly, any contributions to global warming that might result from prescribed fires must be balanced against the global warming impacts of more frequent and more intense bushfires that will occur in the absence of the strategic use of prescribed fire.

Smoke Composition from Prescribed and Wildfires and Health is better quantifying the contribution of prescribed fires and wildfires to atmospheric particulate matter, classical pollutants, greenhouse gases, photo chemically active gases and ozone-depleting chemicals.

The Bushfire CRC is also tackling the important issue of identifying the key toxic pollutants in bushfire smoke, and providing the tools and techniques to measure, evaluate and control the exposure of fire-fighters and communities to these substances.

FIRE, CARBON AND WATER

Project *HighFire* is helping to better understand the dynamic interactions of climate, fuel, water and carbon in the 'high country' of south-eastern Australia. Using a range of long term ecological research sites, in Victoria, the ACT and New South Wales, researchers are working to quantify the possible impacts of climate change on water and carbon balances, and on fuel production, fuel loads and fuel moisture status, over an extended period of time. The interactions of fire regimes and climate change are presenting land managers of these remote

parks and forests with significant strategic and operational challenges. In particular, the research is seeing how the substantial regrowth after the 2003 and the 2006/7 alpine fires is having an impact on the water yield and the run-off into major urban catchment areas.

Climate changes directly impact fire regimes and associated risks. As a consequence, fire management must change. Risk management now emphasises assessment, measurement and mitigation of risks to a wide range of values, such as, property, and ecosystem services, water, air quality, indigenous values and biodiversity. Bushfire CRC researchers are looking at how this challenges how we assess, quantify and comprehend these risks at large spatial and temporal scales, and asking how climate change will affect risk mitigation.

HEALTH AND SAFETY

Firefighter safety is a high priority for firefighting agencies. Battling fire on public and private property in rural areas and the rural-urban interface areas is at times unsafe and unhealthy. Firefighters are subject to stressful conditions, fatigue and work capacity is affected by the erratic nature of work and rest cycles, and the need for hydration and nutrition.

With the prospect of more fires and longer fire seasons, the ageing population and the physical demands of volunteer firefighting present a significant challenge to fire agencies in improving safety conditions on the fire ground. This research is determining the effects of fitness, stress, fatigue and crew management on the health, safety and wellbeing of firefighters working on bushfire suppression.

FINDING AND RETAINING VOLUNTEERS

The rural fire services rely heavily on volunteers. Ensuring adequate crewing levels for brigades is essential for protecting the environment and communities vulnerable to bushfires. Nationally, there are increasing concerns that while the demand for fire fighting services will increase with climate change, future volunteer numbers

may decline or, at best, stay static in some communities.

In some rural communities economic and demographic factors are resulting in declining and ageing populations. At the same time some new housing developments in previously rural areas are experiencing low levels of community participation in voluntary activities. Structural changes to employment, and social and economic pressures on families are also restricting opportunities for volunteering. The Bushfire CRC's Volunteerism project is providing fire services with information to help strategic planning and policy development concerning volunteer numbers, and is suggesting new ways of recruiting and retaining the volunteer workforce.

LIVING WITH FIRE

As the number of people living and working in places of bushfire risk increases under climate change projections, it follows that more communities are becoming more vulnerable. This demands that residents become more self-sufficient in dealing with that risk.

A range of Bushfire CRC projects are seeking to understand the factors contributing to community resilience and to identify ways to help communities become more resilient in the face of the threat from bushfires. Researchers are seeking to understand what communities need to manage the risk. Central to this research is better understanding what drives human behaviour before, during and after a bushfire, and how communities actually respond to warnings and advice from fire agencies. This research is refining the Stay and Defend or Leave Early policy that is the central component of community bushfire education programs across Australia.

FURTHER RESEARCH

Several other Bushfire CRC projects (such as *Fire Management Business Model*) will assist fire, park and forest management agencies to better prepare for climate related changes to



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fire regimes. The outcomes of Project A4.1 will provide a better understanding of how changes in one aspect of bushfire management can affect other aspects of land and fire management.

The Bushfire CRC is also closely aligned to the fire research projects in the Tropical Savannas CRC. This research is looking at fire and its impacts in the northern parts of Australia.

In considering fire at the landscape level, the likely impact of climate change on the current distribution of flora and fauna is another key issue for further research. Species invariably evolve in ways that enable them to survive in particular climates. Even small changes in climate will see some species unable to continue in some locations. This is likely to be more the case where climate change occurs rapidly and evolutionary adaptation is less achievable.

Similarly, elevated levels of carbon dioxide in the atmosphere may do more than change fire regimes through weather effects. Greater carbon dioxide availability may also lead to changes in plant growth and decomposition rates, thereby changing fuel dynamics. Until the global impacts of climate change become further refined, regional and national consequences for particular ecosystems will remain somewhat elusive.

In the report to the Council of Australian Governments in March 2004, the *National Inquiry on Bushfire Mitigation and Management* concluded:

“Long-term strategic research, planning and investment are necessary if the Australian Government and state and territory governments are to prepare for the changes to bushfire regimes and events that will be caused by climate change.”

AFAC, the Bushfire CRC, and their fire and land management partners remain committed to the need for an on-going strategic response to the possible impacts of climate change on bushfire regimes.

A NEW RESEARCH FOCUS

The Bushfire CRC was established in 2003 for seven years under the Federal Government’s Cooperative Research Centres program. The CRC’s work program was driven by the research requirements for the improvement of policy and practice, as they existed in 2002. The Bushfire CRC is now completing its fifth year and in collaboration with AFAC is focusing on adoption of the outcomes from that research agenda.

Through AFAC the Bushfire CRC has been working with the fire, land management and emergency services sector and researchers to develop an ongoing research capability, building upon the work of the Bushfire CRC. This will be a new CRC bid to be submitted as part of the next round of applications for CRC funding.

The underlying focus for the future CRC work program is based upon the significant drivers

for change, including climate change and demographic movements.

The fire and emergency sector is now formulating new research requirements to address the key issues of the next decade and beyond.

Climate change and drought are expected to have an extensive impact on the emergency response sector, especially as these factors lead to changes in the frequency and duration of bushfires and also impact on water availability for fire fighting.

In the urban environment, the lack of water may lead to a drive to change the way fires are managed; leading managers to ask if there are better ways to extinguish a fire than pouring massive quantities of water on it.

For land managers, climate change may drive ecosystem change resulting in a need to modify fire regimes. Fire in the landscape is already a key element in the management of water resources and climate change will only make this a more important element. Land managers also need to understand the implications and opportunities that a move to a carbon economy may bring.

When combined with other demographic, environmental and political changes it is apparent that existing fire and land management practices at all levels are not sustainable in today’s changing world and we must adapt our practices based on sound evidence.

Fire Note is published by the Bushfire Cooperative Research Centre (Bushfire CRC) and the Australasian Fire and Emergency Service Authorities Council (AFAC).

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Bushfire CRC is a national research centre in the Cooperative Research Centre (CRC) program, formed in partnership with fire and land management agencies in 2003 to undertake end-user focused research.

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AFAC is the peak representative body for fire, emergency services and land management agencies in the Australasia region.