

# The role of research in managing forest and rural fire risk

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## Introduction

### Forest and rural fire research in New Zealand

Research into rural fire behaviour and management in New Zealand is largely carried out by Scion's Rural Fire Research Group, based in Christchurch. A major research focus since the programme's inception in 1992 has been to develop and validate the New Zealand Fire Danger Rating System (NZFDRS). The NZFDRS incorporates effects of the environment (fuels, weather and topography) on fire behaviour and provides a tool for reliable fire management based on sound science. The development and structure of the NZFDRS is described in Fogarty *et al.* (1998) and Anderson (2005, 2006). Other fire research carried out by Scion covers fire climate and weather, social science and firefighter safety and physiology. The research Group is funded by the Foundation for Research, Science and Technology (Contract C04X0403) and a rural fire sector "collaborative" that includes the NZ Fire Service Commission and National Rural Fire Authority, NZ Forest Owners Association, Department of Conservation, NZ Defence Force, Territorial and Local Authorities and Federated Farmers of New Zealand. Research collaborators within New Zealand include NIWA, Landcare Research and the University of Canterbury. New Zealand is also a core member of the Australian Bushfire Cooperative Research Centre (CRC)<sup>2</sup>, a major bushfire research initiative bringing together Australasian fire researchers and practitioners. Scion scientists are actively involved in research projects in close collaboration with their Australian counterparts, focussing on fire behaviour in scrub vegetation (Scion 2008a), grassland fire hazard assessment (Bushfire CRC 2006), and social (community resilience) (Langer 2005) and firefighter safety research (Parker *et al.* 2008).

### Risk management and fire

The management of risk requires a well-planned and organised approach within an agreed framework such as that shown in Figure 1 (Standards Australia and Standards New Zealand 2004). Risk management is not about eliminating risks, but rather identifying risks, deciding how serious they are and taking steps to manage them. If the risk is not tolerable, the risk management process helps determine the best mitigation measure.

Forest and rural fire management in New Zealand follows a risk management approach of identifying,

understanding and assessing rural fire risks, then developing methods to effectively mitigate or reduce those risks. Successful fire management is based around the "4R's" of emergency management, namely Reduction, Readiness, Response and Recovery (Figure 2). The current programme of fire research in New Zealand is also based around these 4Rs, to meet the needs of rural fire management agencies.



Figure 1. Depiction of the risk management process (after Standards Australia and Standards New Zealand 2004).

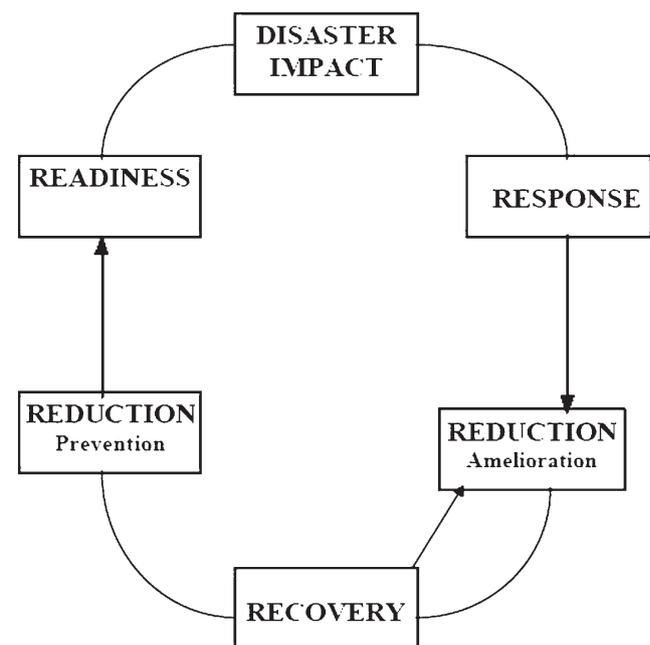


Figure 2. The Emergency Management cycle (after Britton 1994).

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## The “4R’s” of emergency management related to forest and rural fire research

### Reduction

Reduction refers to those activities that reduce the degree of long-term risk (Britton 1998). In a fire management sense, reduction is generally regarded as being ‘fire prevention’, which involves “those activities directed at reducing fire occurrence” (Merrill and Alexander 1987). Fire prevention aims to reduce the number of fires, and therefore area burned, fire suppression expenditure and other damages. Examples of fire reduction activities include: public notification of fire danger; publicity campaigns; setting fire season status (and declaring fire bans); issue of fire permits; activity controls, including restrictions on access and forest operations; and fuels management (firebreaks, roadside vegetation mowing/slashing, etc.). The need for a sound basis for decisions is especially important where fire reduction activities, such as restricting forest harvesting operations and closing recreational areas, can have significant financial and public relations implications.

Research around reduction aims to describe the rural fire hazardscape, by defining the physical and human/social processes contributing to wildfires and quantifying the factors that contribute to wildfire risk in vulnerable areas. Results guide wildfire risk reduction practices to minimise human, economic and environmental losses from wildfires. Current and recent reduction-related research includes:

- Fuels (vegetation) - modelling of fire hazard across the country through quantifying fuel loads (biomass) for major fuel types as inputs into maps and risk analysis tools (Opperman and Coquerel 2005), such as the Wildfire Threat Analysis process (Majorhazi 2006); modelling of fuel moisture relationships (and hence flammability and fire potential) for major fuel types.
- Climate and weather - regional fire climate analyses (Pearce *et al.* 2003); description of the effects of climate variability (Pearce *et al.* 2007); understanding the impacts of future climate change on fire danger across the country (Pearce *et al.* 2005).
- Social - issues around rural fires and insurance (legal context, public and landowner liability); wildfire occurrence (Doherty *et al.* 2008); strategies to mitigate against human-caused wildfires (the predominant cause of wildfires in New Zealand).

### Readiness

Readiness refers to activities that develop operational capabilities for responding to an emergency event (Britton 1998). In fire management terms, readiness activities are carried out in advance of fire occurrence, to ensure that fires are rapidly and effectively suppressed when they occur.

A major research focus is on improving and developing the New Zealand Fire Danger Rating System (NZFDRS) as a decision support tool for warning rural communities of wildfire hazard and improving readiness capability of Rural Fire Authorities. System outputs provide input into a range of fire management activities, including mitigation measures such as fuels management, public education and communication, imposition of fire restrictions and setting resource preparedness levels. Research includes:

- Fire behaviour prediction - developing models that predict the rate of spread and fire intensity for major NZ fuel types (Pearce and Anderson 2008).
- Fire danger rating - accurate assessment of fire danger levels for major fuel types across the country. This includes grassland fire hazard (Anderson *et al.* 2005, Bushfire CRC 2006), evaluating existing moisture codes contained within the NZFDRS, and determining thresholds for fire ignition and development.
- Fire danger warning - understanding the expectations and needs of fire managers in communicating fire danger warnings to communities and the general public, the public’s perception of these communications, and producing recommendations to improve the effectiveness and delivery of these messages (Bones *et al.* 2007, Langer and Chamberlain 2007).

### Response

Response refers to “activities taken immediately before, during or directly after an emergency in an effort to minimise losses and improve recovery” (Britton 1998). In the fire management context, response refers to the ‘fire suppression’ phase. These are the actual firefighting operations most of us are more familiar with, beginning with discovery and continuing until the fire is completely extinguished.

Research is focussed on developing tools and guidelines that promote safe and effective decision-making during wildfire incidents, particularly relating to firefighter and community safety. Knowledge integrated into these tools includes:

- Fire suppression effectiveness - quantifying the productivity and effectiveness of firefighters and other suppression resources, such as machinery (Parker *et al.* 2007).
- Fire behaviour prediction tools - including a paper-based field manual and software package for calculating and predicting fire behaviour (Scion 2008b).
- Fire growth simulation - developing computer-based simulation models for simulating the spread of fires across the landscape to support decision-making (Opperman *et al.* 2006).
- Firefighter health and safety - determining the physiological workload associated with rural firefighting tasks for use in health and safety guidelines (Parker *et al.* 2008).

## Recovery

Recovery refers to the process of returning affected communities to social and economic normality, including immediate, medium and long-term rehabilitation and restoration activities. In fire management, 'fire recovery' applies to rehabilitation of fire-affected individuals, properties and communities, and also to fire-damaged ecosystems. Examples of fire recovery actions include: public welfare; community lifelines (communications and infrastructure); damage assessment (insurance, emergency relief funding); post-fire salvage; site rehabilitation and/or replanting; debriefs and operational reviews (safety, operational learning, research); and investigation and cost recovery.

Research aims to understand community resilience to (and recovery from) wildfire events. This will enable the development of best-practice guidelines to lessen the social impact and improve the recovery process following significant wildfire events. Research projects:

- Case studies and lessons learned from community responses to recent wildfires. Two case studies have focussed on the community impacts from the West Melton and Mt Somers Fires in Canterbury during the summer of 2003/04 (Kelly *et al.* 2008).
- Reviewing local and international approaches to recovery from wildfires and other natural hazards (Langer *et al.* 2007).

## Discussion and conclusions

The programme of rural fire research at Scion covers aspects of all of the 4R's of emergency management. Economic, social and environmental outcomes are achieved through a mixture of fundamental, applied and social science. Through a long-standing and effective partnership with key sector stakeholders, Scion has been able to deliver useful and relevant outcomes for fire managers and firefighters at all levels of management and operations. The rural fire management sector in New Zealand is expected to face increasing challenges, risks and opportunities. These include increased wildfire risk as a result of a changing climate combined with changes in land use and vegetation (biofuel crops, increased forest plantings, spread of new and existing weeds, transfer of pastoral lands to conservation, etc.). Additional risk is presented as more people migrate to peri-urban and rural areas leading to increased community expectations for protection from hazards such as wildfires. Changing demographics such as the ageing population and declining numbers of volunteers compound this issue. Within this context, rural fire research undertaken in New Zealand becomes increasingly necessary to ensure that the rural fire management sector and communities are equipped to deal with the fire management challenges of the future.

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