New Zealand Rural Fire Research Workshop 2010

8 - 9 December 2010

Sudima Hotel, Christchurch Airport

PROCEEDINGS

"PROMOTING RESEARCH ADOPTION"

Scion, in conjunction with the Rural Fire Research Advisory Committee, hosted the third Rural Fire Research Workshop in Christchurch on the 8th and 9th of December 2010. The focus of the workshop was on promoting the adoption of fire research outcomes. The programme included discussion of opportunities for adoption of rural fire research under the four themes reduction, readiness, response and recovery.

The aims were to:

- Present the latest progress in rural fire research in New Zealand.
- Provide examples of research implementation by fire agencies.
- Ensure that research outcomes are embraced by fire managers.
- Ensure that the needs and priorities of fire managers are being satisfied by the Scion Rural Fire Research programme.
- Encourage fire managers to actively participate in the direction and scope of research activities within the Scion Rural Fire Research programme.

Day 1, Wednesday 8 December (0930 – 1800 hrs)

Opening & Welcome (1000 – 1120)
Chair: Richard Parker, Scion

Welcome. Murray Dudfield (NRFA and Chair of RFRAC)

Scion Update. Brian Richardson (Scion)

Keynote speaker:
Disaster research for mitigation and preparation -The 2009 Victorian bushfires.
Jim McLennan (La Trobe University/ Bushfire CRC)

Jim's presentation began with an overview of the disastrous 7 February 2009 Victorian bushfires. It then described the research response of Australasian fire and emergency services agencies, and associated organizations, as coordinated by the Bushfire CRC. A summary of the 'big picture' findings by the Bushfires Research Task Force for the 2009 Victorian Bushfires Royal Commission and supplementary findings concerning survival under extreme bushfire conditions were covered.

RESILIENCE & RECOVERY (1120 - 1230)
Chair: Douglas Marshall (Local Government rep, Selwyn District Council)

Resilience of the Mt. Somers community prior to, during and following the wildfire of January 2004. Lisa Langer (Scion)

Lisa discussed the findings from a study made of the rural community of Mt. Somers that experienced a wildfire on 5 January 2004. The study found that the interactions and relationships community residents had experienced prior to the fire helped the community deal with the wildfire. They displayed confidence that they could handle challenges that were presented to them, due in part to their location in the landscape and sense of community. Networks and relationships need to be developed to build adaptive capacity for natural disasters in the future.

Rural Community Recovery: some perspectives from natural hazards research.
Tom Wilson (University of Canterbury, Geological Sciences)

Rural and isolated communities face unique challenges when compared with urban communities for managing catastrophic natural events. During natural disasters rural communities may experience: geographic, resource and social isolation; greater lifeline fragility; low priority for lifeline restoration; reluctance to evacuate, and a greater perception of resilience than urban communities. Using examples from large snow storms, drought, volcanic eruptions, and earthquakes from New Zealand and overseas we will highlight issues and challenges faced by rural communities when preparing for, responding, and recovering from natural disasters.

REDUCTION (1330 - 1500)
Chair: Mark Boere (New Zealand Fire Service)

Assessing the general public's perception of rural fire danger communications.
Sophie Hide (Scion)

Sophie presented findings from a research project that determined the understanding of rural fire danger messages in New Zealand. The enquiry was undertaken to establish awareness, understanding of, and expected responses to warnings and messages, and knowledge and perception of publicity initiatives. Recommendations of the findings will help improve future rural fire danger communication methods.

Mitigating the risk of human caused wildfires: key findings from a Scion study of key Canterbury stakeholders.
Mary Hart (Scion Contractor)

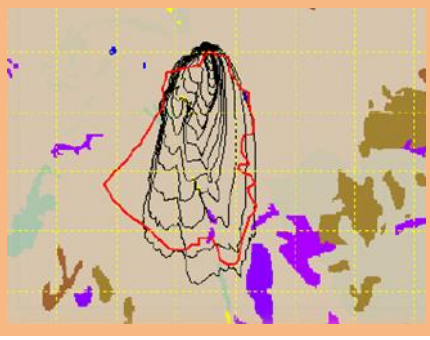
Mary described the results from a study investigating methods for mitigating human caused wildfires for adoption by both national agencies and individuals. Methods presently used internationally and in New Zealand are highlighted for arson, maliciously lit fires, and accidental fires including escapes from fires lit for recreational purposes, fires originating in the rural-urban interface, and escaped land management fires.

Fewer wildfires in Northland - the role of research in social change.
Sioux Campbell (DOC, Northland)

The Department of Conservation is leading a community relations and social change programme in Northland to help reduce the number of wildfires and build greater community ownership. Social research is a key component of this challenging and evolving campaign.

READINESS (1530 - 1700)
Chair: Mike Owen, New Zealand Defence Force

The latest in fire behaviour tools. Veronica Clifford (Scion)



Veronica presented the latest in fire behaviour tools developed by the rural fire research team. These include: the *Manual for Predicting Fire Behaviour*, the *Fire Behaviour Toolkit*, the *Guide to New Zealand Fuels, grassland curing assessment using satellite imagery* and the fire growth simulation software *Prometheus*.

Use of fire behaviour tools in planning. Dave Hunt (DOC, National)

The Department of Conservation is responsible for the management of over 30% of NZ land. It has a number of statutory and sound business practices it must follow. These include mitigation of environmental degradation, loss of habitat and biodiversity. It is required to provide soundly-based outcome measures using accurate and efficient data collection. Three processes have been identified, *Wildfire Threat Analysis*, *Fire Behaviour Simulation Modelling*, and *Fire Management Planning* to support DOC's fire management activities. The current and planned use of these was described.

Strategic Tactical Fire Management Planning (STFMP) - Multi-Agency Approach.
Heather Wakelin (DOC, Canterbury)

The new standard for Assessing Fire Hazards, set by the NRFA, requires all Rural Fire Authorities to meet a set of requirements and document them in their fire plan. The Department of Conservation is leading an approach to meeting this standard, involving multiple Rural Fire Authorities in Canterbury. This Strategic Tactical Fire Management Planning approach is in draft form, and once finalised, will include a Guideline and Template for fire planning use.

Day 2, Thursday 9 December (0830 – 1530 hrs)

READINESS (0830 - 1000)
Chair: Dave Hunt (Department of Conservation)

Ignition thresholds for grass and gorse fuels and management applications.
Heather Wakelin (Scion)

Two recently completed studies have investigated the relationships between fuel moisture and fire ignition and spread in grass and gorse fuels. Heather described these studies, and potential uses of the guidelines produced from them to support fire management decision-making.

User guide to the NZFDRS.
Grant Pearce (Scion)

A project is currently underway to develop a User Guide to the New Zealand Fire Danger Rating System (NZFDRS). This User Guide aims to provide an overview of the background and status of NZ's adoption and modification of the Canadian fire danger rating system, as well as worked examples on the use of the fire danger rating outputs to develop "trigger points" and other decision-support aids for fire management. Grant outlined progress to date on production of the User Guide, including several of the proposed worked application examples.

The behaviour of the Haines Index for the 2009/10 New Zealand fire season.
Colin Simpson (University of Canterbury)

The Haines Index was originally developed to give fire management agencies in the US a tool for predicting the potential for development of large wildland fires. Through the use of a mesoscale atmospheric model, WRF, the behaviour of the Haines Index during the 2009/10 New Zealand fire season has been investigated. From this investigation, the potential for operational utility of the Haines Index for New Zealand was discussed.

RESPONSE (1030 - 1230)
Chair: Glen Mackie (New Zealand Forest Owners Association)

Firefighter workload/productivity.
Richard Parker (Scion)

Richard presented the results of data collected at real fires to measure the workload and fire suppression productivity of rural firefighters. Developments in sensor technology and data handling methods were also discussed. Carbon monoxide exposure of rural firefighters was measured in the last fire season and the results presented and the implications examined.

Bushfire CRC aerial suppression research.
Matt Plucinski (CSIRO/Bushfire CRC)

This presentation discussed the research undertaken in the Bushfire Cooperative Research Centre's project A3.1 "*Evaluation of aerial suppression techniques and guidelines*". The project had three major research components: a strategic level operations study; wildfire suppression case studies; and field experiments. Outputs from the project including initial attack success models, a deployment decision tool and a drop assessment guide were presented, along with the recent evaluation of a large air tanker.

NZ resource productivity/effectiveness - use and needs.
Kevin Ihaka (Forest Protection Services)

Kevin discussed the current status and needs for information on resource productivity and effectiveness of NZ fire suppression resources. This included highlighting what research has been done previously, particularly relating to aerial suppression productivity and effectiveness, and what additional data and research is required.

RESEARCH ADOPTION (1330 - 1515)
Chair: Grant Pearce, Scion

End user group discussion sessions

Four groups will be rotated through 4 topics **addressing research adoption in NZ:**

1) What research can be implemented? (based on what has been presented, or is available from NZ or overseas)
2) What are the barriers to implementation of research by end-users?
3) How can the research programme assist in the uptake of the research? (i.e. technology transfer activities)
4) What other research could be done to address end-user needs? (i.e. to support uptake of existing research findings, or new research to address other needs)

Workshop Closing. Murray Dudfield (NRFA and Chair of RFRAC)

Support from the following organisations through contributions to speaker travel,
social function sponsorship and workshop logistical arrangements were greatly appreciated.

NATIONAL RURAL FIRE AUTHORITY
bushfire CRC
NEW ZEALAND FOREST OWNERS ASSOCIATION INC
Department of Conservation
Te Papa Atawbai

NZ Rural Fire Research Workshop

December 8-9, 2010

Outline

- Scion and the CRI reforms
- Fire research at Scion
- Programme Performance
- Priorities for 2011

Scion

- New Zealand Forest Research Institute Ltd, a Crown Research Institute (CRI)
- ~350 staff: **Rotorua**, Chch, Akl, Wellington
- Science reforms:
  - Re-definition of CRI purpose and scope
  - Success measured by benefit to NZ
  - Board is responsible for delivering benefit
  - Core purpose funding
  - Fire in contestable funding pool

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Scion' s Core Purpose

- SCP: drive innovation and growth from New Zealand's forestry, wood product and wood derived materials and other biomaterial sectors, to create economic value and contribute to beneficial environmental and social outcomes for New Zealand
- Outcomes:
  - forestry biosecurity and risk management and mitigation

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Board review process

- Reviewing Scion's overall strategy
- Process of engagement with stakeholders
- Opportunity for fire stakeholders to engage with process
- Outcome will be Statement of Corporate intent i.e. definition of research priorities

Scion Rural Fire Research Group: Purpose

- Develop the science and technology needed to protect life and property and manage fire in the landscape
- Themes:
  - enhance firefighter safety
  - better understand fire behaviour
  - allow for safe & effective use of fire as a land management tool
  - deploy effective suppression resources
  - manage fire in different landscapes

History and capability

- Forest fire research undertaken by NZ Forest Service at FRI during 1970s
- Programme re-established in 1992, after 15 year lapse
- Based at Scion, Christchurch
- ~4.0 staff (FTE's), expertise in:
  - fire behaviour/science
  - fuel dynamics
  - climatology
  - ergonomics
  - social science
- Broader capabilities of Scion e.g. carbon, remote sensing, economics

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Research team

- Richard Parker – new Project Leader, firefighter health, fitness & productivity
- Grant Pearce – scientist, weather/climate, fire behaviour, fire danger rating
- Veronica Clifford – research officer, fuels & fire behaviour, tech transfer
- Lisa Langer – social science, community resilience & recovery
- Contract/seasonal staff as required
- Recruitment?

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FRST contract performance (2004 – 2010)

- External review of rural fire research programme, 2009
  - obtained overall "Excellent" rating
  - very strong end-user relationships

  But:
  - lack of science publications
  - need for links with CDEM sector
- Achievement recognised by Minister of Internal Affairs in speech to 2009 annual FRFANZ Conference
  - NZ fire science considered "world class"
- 2010 FRST contract classification
  - Scion's top performing programme

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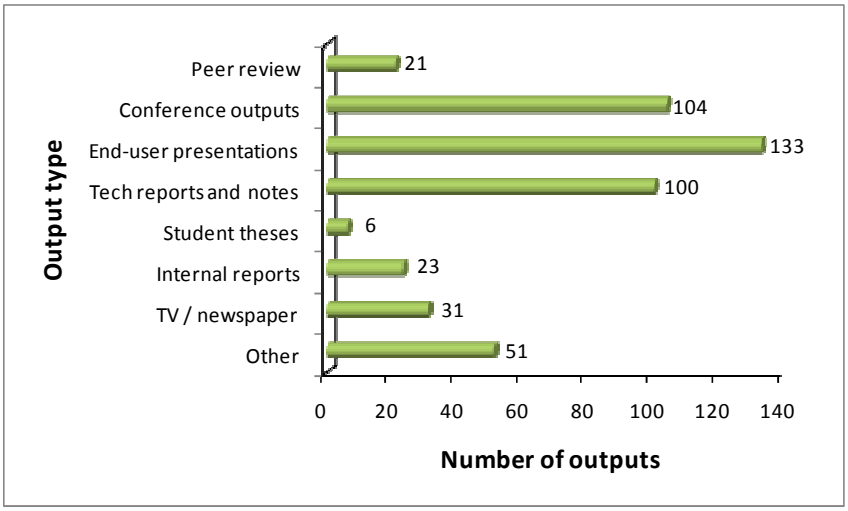
FRST contract outputs (2004 – 2010)



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Why is the programme highly rated?

- Strong constructive partnership with stakeholders (RFRAC)
- Effective governance by stakeholders
- Clear strategy focused on outcomes agreed by all parties
- Committed science team
- Excellent collaboration within Scion, NZ and internationally

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Important research collaborations

- Whole of Scion participation
- NZ: University of Canterbury, Landcare Research, NIWA, MetService
- Australian Bushfire Cooperative Research Centre:
  - NZ is full member (M Dudfield on Board)
  - Critical that NZ researchers actively participate to ensure relevance of activities to NZ
- US Forest Service (social, fire simulation modelling, firefighter fitness/ ergonomics)
- Canadian Forest Service (fire danger rating, fire simulation modelling)

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Priorities for 2010/11

- Although current funding rolled over for 2 years, agree new 6 year research strategy and research programme
- Continue to engage with FRST / MSI to be well positioned for new bid and increased funding
- Participate in development of Scion's Statement of Corporate Intent
- Keep up the good work!

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Disaster Research For Mitigation and Preparation – The 2009 Victorian Bushfires

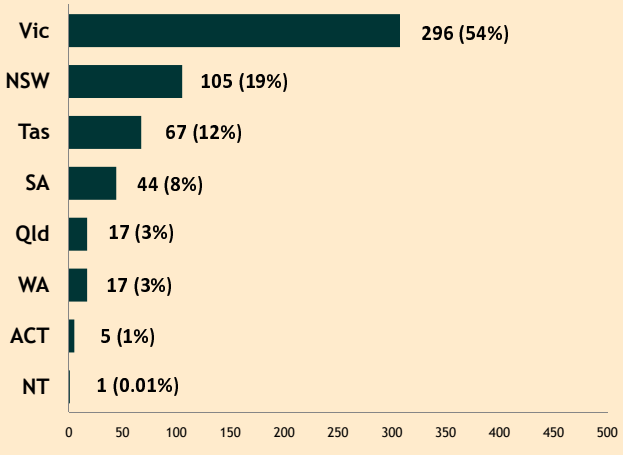
Jim McLennan
School of Psychological Science, La Trobe University; & Bushfire CRC Researcher

I am grateful to Lyndsey Wright, Research Manager Bushfire Cooperative Research Centre, for her assistance in preparing in this presentation. I was a member of the Bushfires Research Taskforce and participated in data analysis and preparation of several of the reports arising. However, the views I express in this presentation are mine, and do not necessarily reflect the views of any of the agencies and organisations associated with the Taskforce.

Australia's "Gang of Four" Top Natural Hazards

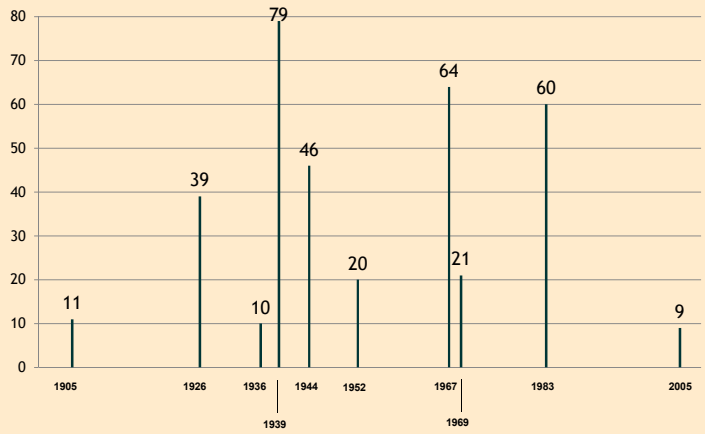
1. Tropical Cyclones
2. Severe Storms
3. Floods
4. Bushfires (wildfires)
   ---least costly in $, most deadly in lives

552 civilian bushfire deaths across Australia, 1900 – 2008: Most in the South-East



[Source: Haynes et al, 2008]

Civilian Deaths in Major Fires/seasons 1900-2008



10 fires/seasons accounted for 359/552 = 65% of deaths

[Source: Haynes et al, 2008]

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Community Decision Making Under Stress

Herald Sun

Friday, February 6, 2009

'Worst ever' fire risk threatens Vic

The Victorian Premier John Brumby says tomorrow's weather forecast poses the greatest fire danger in the state's history and people should be prepared.

"Tomorrow we're going to have unbelievably high temperatures and we're also going to have unbelievably high winds," he said. We've gone through now a couple of months across the state where there's been basically no rain since mid-December. We've got a state that is just tinder dry".

Fire authorities say conditions are the driest they have been since the Ash Wednesday Bushfires in 1983.

7th February 2009: Black Saturday

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Aftermath: more than 2,000 homes destroyed

© BUSHFIRE CRC LTD 2008

Aftermath: 173 deaths

A major research response initiative

1. Saturday 7 February: Fires occur
2. Monday 9 February: Lead researchers and industry leaders meet; interstate research teams despatched
3. Thursday 11 February: First research teams go to fire-affected communities

(Murrindindi Fire still burning)

Task

Focus: The collection of time-critical data that could be destroyed through the passage of time or the impact of weather.

Three Key Research Areas:

1. Fire behaviour
2. Buildings, and land use planning
3. Human behaviour & community safety

---"integrated studies"

Initially 6, ultimately 8, fire complexes

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Community Decision Making Under Stress

Managing the research response

1. Crews in the field over 8 weeks – up to 50 researchers at any given time.
2. Buildings and Human Behaviour researchers combined: crew = 2 X buildings + 1 h-b. Fire behaviour teams independent.
3. ICS basis:

   field: Sector Commander; Crew Leader

   HQ: IC; Operations; Planning: Logistics

Task Force crews – Strathewen Sector

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Community Decision Making Under Stress

Issues & Constraints

1. Time pressures.
2. Legal & ethical requirements.
3. The 2009 Victorian Bushfires Royal Commission began working 16 February.
4. Agency liaison and in-kind financial and resources contributions
5. Safety – physical and psychological
6. Data management & integrity
7. Analysis and reporting

Multi-disciplinary researcher crews

Data

--A total of more 1,800 person-days generated:

1. Building features/vegetation profiles of more than 2,000 properties (survived, damaged, destroyed); together with:
2. Fire-behaviour indicators (leaf-freeze, crowning, scorching, impact damage).
3. Approximately 600 interviews with survivors, recorded digitally and transcribed.
4. More than 21,000 photographs.

Subsequently:

1. A mail survey of approximately 6,000 residences in the fire-affected communities (Dr Joshua Whittaker - RMIT).

2. An investigation of the circumstances associated with the 171 deaths caused directly by the 7 February fires (Professor John Handmer-RMIT; Dr Saffron O'Neil – University of Melbourne; Mr Damien Killalea – Tasmania Fire Service)

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Research 'products' to date:

1. Interim Report – Human Behaviour & Community Safety.
2. Final Report – Fire Behaviour, Building and Land Use Planning, Human Behaviour & Community Safety, Integrated Studies of Selected Communities (Strathewen, Pine Ridge Road Kinglake West, Reserve Road Kinglake, Marysville).
3. Final Report – Household Mail Survey.
4. Final Report – Review of Fatalities.
5. Report – Use of Informal Places of Shelter and Last Resort on 7 February 2009.
6. Report – "Deep Survival" on Black Saturday.

"Big Picture Learnings" from the research endeavour

1. Fire behaviour under Black Saturday conditions is qualitatively different in many ways from that of "normal bushfires".
2. House survivability under Black Saturday fire conditions is much more problematic than under "normal" bushfire attack—by an order of magnitude.
3. Despite major efforts by fire agencies and local governments, community bushfire safety endeavours proved to have been, at best, only modestly effective overall.

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Community Decision Making Under Stress

"Big Picture Learnings" ABOUT the research endeavour (from a researcher's perspective)

1. It was hugely resource-intensive, and the effort had to be sustained over a period of 3 months. For agencies, the BCRC, AFAC, and other participating organisations, other work suffered.
2. Time pressures were such that there was little opportunity for planning and proactivity: mostly it was catch-up, patch-up, react, make-do.
3. For the human behaviour and community safety aspect, there were not enough people available with training and experience in effective interviewing in the field.

Key human behaviour and community safety learnings (1).

1. A disconnect between fire weather danger warnings and perceived need for decisions and actions.
2. A low level of understanding of the specifics of building vulnerability to severe ember attack.
3. A low-level of understanding of potential weak links in most plans to defend, need for fall-back options.
4. Uncertainty is the enemy of survival-enhancing decision making: misleading information is worse than NO information---example: the naming of fires by location of origin.
5. Households living in residential streets, are as at-risk as those in isolated dwellings.

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Community Decision Making Under Stress

Key human behaviour and community safety learnings (2).

6. Leaving on a day of predicted high/extreme/catastrophic fire danger weather is “costly” for many.
7. A low level of understanding of the **specifics** of the threats to life posed by a bushfire.
8. There may be superficial agreement among family members about a fire plan, but conflict can emerge under imminent bushfire threat.
9. A vehicle, under the right circumstances, saves lives.
10. Risk is neither random nor evenly spread: the elderly, disabled/impaired/ill, isolated, visitors, new arrivals and children, are more likely to die in a bushfire.

"Research Adoption" A Contrarian View!

Major risk? Collision between the adoption and how people actually think and act. The need for 'trade-offs'.

Illustration: The strange case of the Munich taxi drivers: 'risk homeostasis', pushing the envelope, transfer of responsibility.

1. The "Catastrophic" level of fire risk? (Possibility: Extreme and High will be more likely to be ignored).
2. High-technology personalised warning systems? (Possibility: Many will come to rely on these and be less vigilant).

Resilience of Mt. Somers community prior to, during and following the wildfire of January 2004

E.R. (Lisa) Langer and Pam Jakes

Content

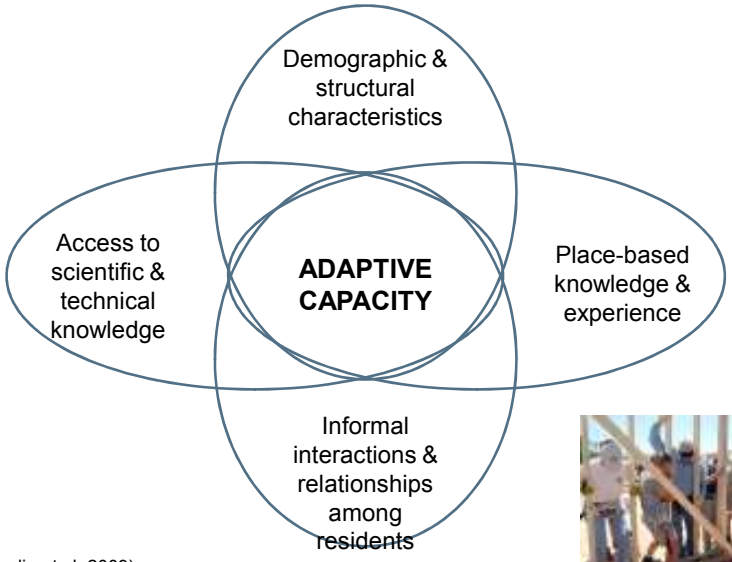
- Australian, US, Canadian research
- Events-based framework
- Mt. Somers case study
- Comparisons with West Melton
- Lessons learned to increase resilience.

Australian and US research

- Vulnerability of communities influenced by:
  - exposure to hazard events
  - biophysical characteristics
  - social characteristics.
- Communities can minimise vulnerability by building resilience.
- Resilient communities – ability to adapt to hazards and move beyond pre-fire condition.

⇨ Adaptive capacity.

Adaptive capacity: function of 4 elements

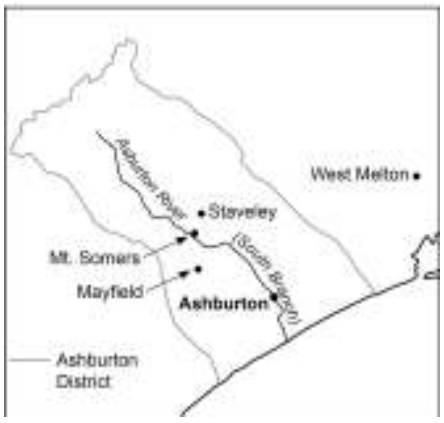


(Paveglio et al. 2009)

Case study research

- Mt. Somers, remote rural community
- Focus on social characteristics that may affect resilience
- Compare rural findings with a more urban community - West Melton, rural-urban interface
- Lay groundwork for partnership between local residents, firefighters and emergency managers, and government to increase community resilience.

Mt. Somers fire, 4 January 2004



- 6 km riverbed scrub
- Arson?
- DoC jurisdiction
- Volunteer fire brigades
- North Island CIMS team
- Burned 270 ha, fences, equipment, pasture, plantations and shelter belts
- Evacuations/affected community.

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Events based framework

- **Before – community preparedness**
  - Physical – vegetation mgmt / defensible space
  - Social – planning, CWPPs, relationships/networks and education.
- **During - response**
  - Key decisions made during event can affect community outcomes and relations
  - Evacuation / 'prepare, stay & defend or go early'.
- **After - recovery**
  - Post-fire stresses – influenced by economic and social conditions
  - Social networks and community organisations can facilitate recovery.

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Qualitative study: personal interviews

Category	Men	Women	Total
Fire managers	4	-	4
Firefighters	3	-	3
Support officers	4	5	9
Local farmers	9	7	16
Local residents	5	11	16
Total	25	23	48

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Data analysis

- Analytical analysis - explanations of impact of wildfire
- Thematic analysis – identify similar experiences
  - Code patterns
  - Identify contradictions
  - Standardise themes.

- Newspaper reports
- Official reports
- DoC memos.

Before the fire: Sense of community

- Confident community – can handle challenges
- Come together to assist others
- Value abilities rather than position
- Close community

You find that the further away from the main centres [you are], that you have to rely on your neighbours in time of emergency… it's your neighbours who are your first call. [Support officer]

We helped everybody and everybody helped everybody else. [Local resident]

They're very close-knit up there, very close-knit. [Fire manager]

Before the fire: gender differences

- Women
  - More likely to admit needed help
  - Better support mechanisms/outlets
- Men
  - 'Happy hour' at pub
- Mt. Somers District Citizens' Association
  - developed annual plan and raised funds for village
  - managed grazing and plantation.

Fire awareness and knowledge

Recognise when danger high and change their behaviour…

Institutional capacity

- Local fire brigade – 10 volunteers
(3 available for working day call outs)

- Emergency organisations
  - Red Cross
  - Salvation Army
  - Victim support
  - St John Ambulance
  - District Council
  - NZ Police
  - Federated Farmers – Ashburton Emergency Relief Trust.

During the fire: use of local resources

- Local brigade first to respond but not integrated effectively into DoC or CIMS teams

They weren't allowed [to help]. That was bad. Because, I mean, all over the years we've had a fire unit here. [Local resident]

They didn't use the local knowledge. It was there… [Local farmer]

But manned ignition site (suspected arson)
Assisted in initial helicopter overview
Role of IC some nights
Helped maintain communication equipment.

During the fire: emergency support

- Local organisations provided support
  - Red Cross fed firefighters
  - Salvation Army provided menus an
  - St Johns treated minor injuries
  - Parish visitor provided support
- Women – located homes on maps and community needs
  - baked, distributed food and water, and fought the fire.

[I] rang the office and they said, 'There's a fire in Mt. Somers, and it's not looking good.' So I turned the oven on and made scones and buns, and we headed off over there. [Local resident]

Evacuation

- Some evacuated willingly
- Others assisted in moving households
- Lacked info; thought more sensitivity required
- Some farmers wanted to remain and fight the fire, refused evacuation and were threatened with arrest:

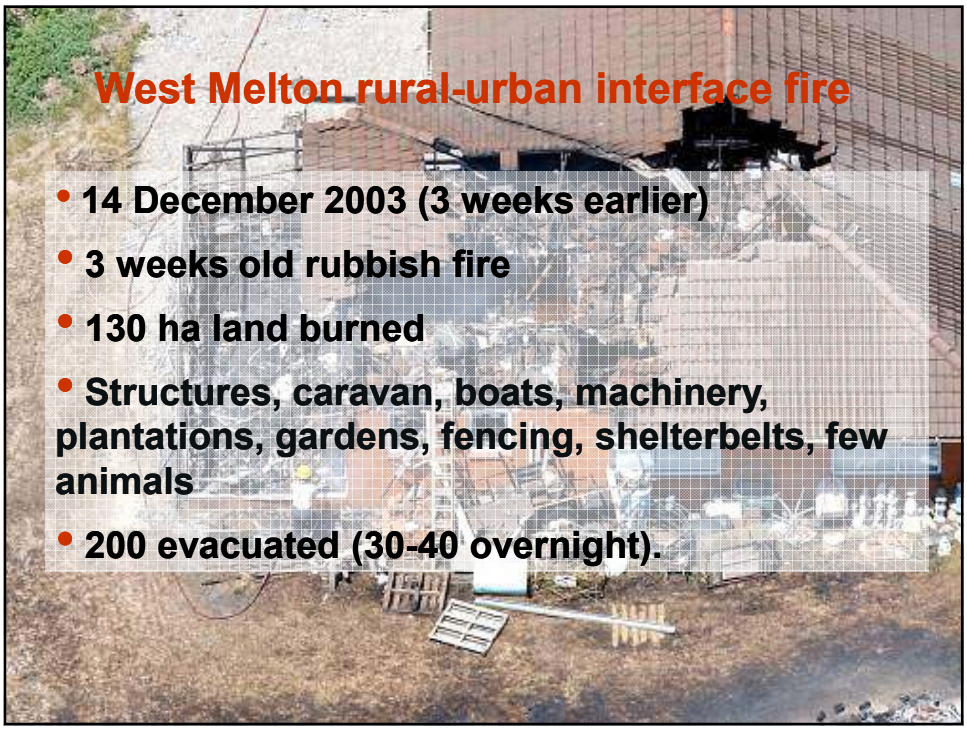
… you will not order a farmer off his own land. I mean, that goes totally against the grain. And that was hugely frustrating. And that really angered farmers… [Local farmer]

… there were a lot of people that were visibly upset because we were evacuating and everything… they probably didn't understand the psychological aspect of the upset people. [Local resident]

After the fire: Recovery

- Stay connected and exchange information
  - ‘Happy hour’ in pub
  - Community barbecue to thank firefighters
  - Farmer’s barbecue to thank community helpers
- Financial loss – some long-term
  - neighbours provided labour and maintenance
  - insurance payouts incl. recovery fund distributed by Federated Farmers.
- Stress
  - Federated Farmers counselling
  - Victim support assistance.

Mt. Somers: Land tenure review - increased fire risk



West Melton rural fire risk…

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Old lifestylers > 15-20 years

- More rural experience
- Correct local knowledge
- Take responsibility—more prepared.

New lifestylers < 15-20 years

- Risk assessment based on urban experience
- Depend on authorities
- Relatively unprepared.

Jakes, Kelly & Langer 2010

West Melton: new lifestylers

- Viewed emergency management as District Council responsibility
- Did not actively seek technical knowledge
- Expected urban level service
- More dependent on officials to manage hazard risk
- Limited interaction with neighbours
- Significant networks based in Christchurch

We were prepared for a civil defence emergency, what to do, in that we had a meeting point, but not for fire. We had long grass, we were way unprepared, and the experience of having a fire has now made us very aware.

[New lifestyler]



West Melton old lifestylers and Mt. Somers

- Expect to look after themselves
- Described themselves as self-reliant
- Had acquired knowledge they thought was necessary through experience
- Life-long experience rather than science knowledge from experts – seen as critical to addressing risk and limiting damage
- Felt should have been allowed to stay and defend.


Mt. Somers – support each other

- Helped feed stock/ moved stock during snowstorm
- Assisted family following accident
- Raised money for village park
- Supported rugby team.

Mt. Somers community- self-reliance

- Moved stock
- Fed firefighters
- Housed evacuated
- Tried to help neighbours fight fire
- Provided pasture
- Reinforced belief self-reliant and capable of meeting challenges.

West Melton fire

- Highlighted new lifestylers and old lifestylers differences in community
- Fire did little to build bridges between different community groups.

Communities as part of the solution…

The success of wildland fire management hinges as much on the acceptance, support, behaviour, and cooperation of at-risk communities and individuals and the general public as on biophysical fire science the technology. [People, Fire and Forests 2007]

- Communities could play an important role in fire planning in NZ
- Residents, Council, fire managers, businesses and community groups could tackle rural fire risk management challenge collaboratively.

Lessons learned to increase resilience

- Help community plan for rural fires/natural disasters
- Share knowledge - communicate with the community before and during the event
- Involve property owners before and during the event
- Tackle rural fire risk management challenge collaboratively
- Involve the community in planning.

⇨ Can result in increased community resilience and improved recovery.

Acknowledgments

- Foundation for Research, Science and Technology Contract C04X0403
- NZ Rural fire sector
- USDA Forest Service
- Bushfire CRC
- Mt. Somers community.


MT SOMERS VILLAGE
RECREATION - HISTORY
SCENIC WALKWAYS
AMENITIES

Rural Community Recovery from Natural Hazards
Making the Link...
Rural Fire Research Workshop: 8 December 2010

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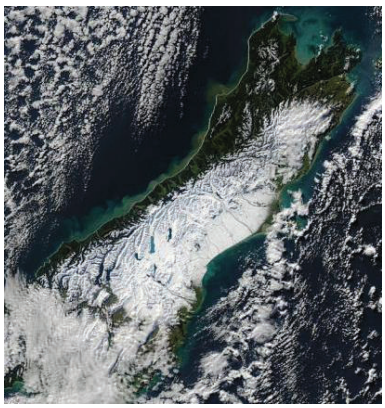
With contributions from **Lisa Langer** (Scion), **Julia Becker** (GNS), **Zach Whitman** (UC) and **Ros Houghton** (Women's Refuge)



Rural Communities & Disasters
Challenges for emergency management

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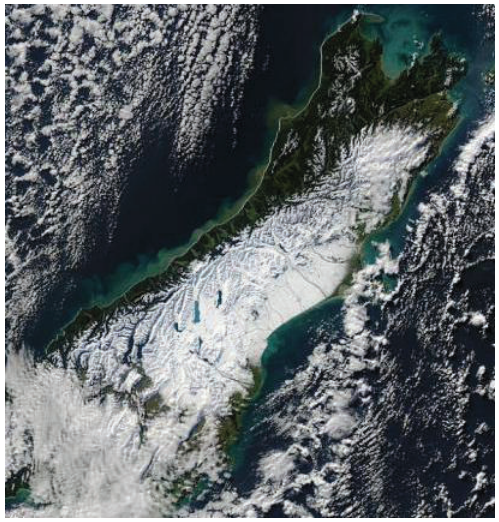
Rural Communities...assumptions?

- Strong social networks
- Greater preparedness
- High rates of volunteerism
- High adaptive capacity

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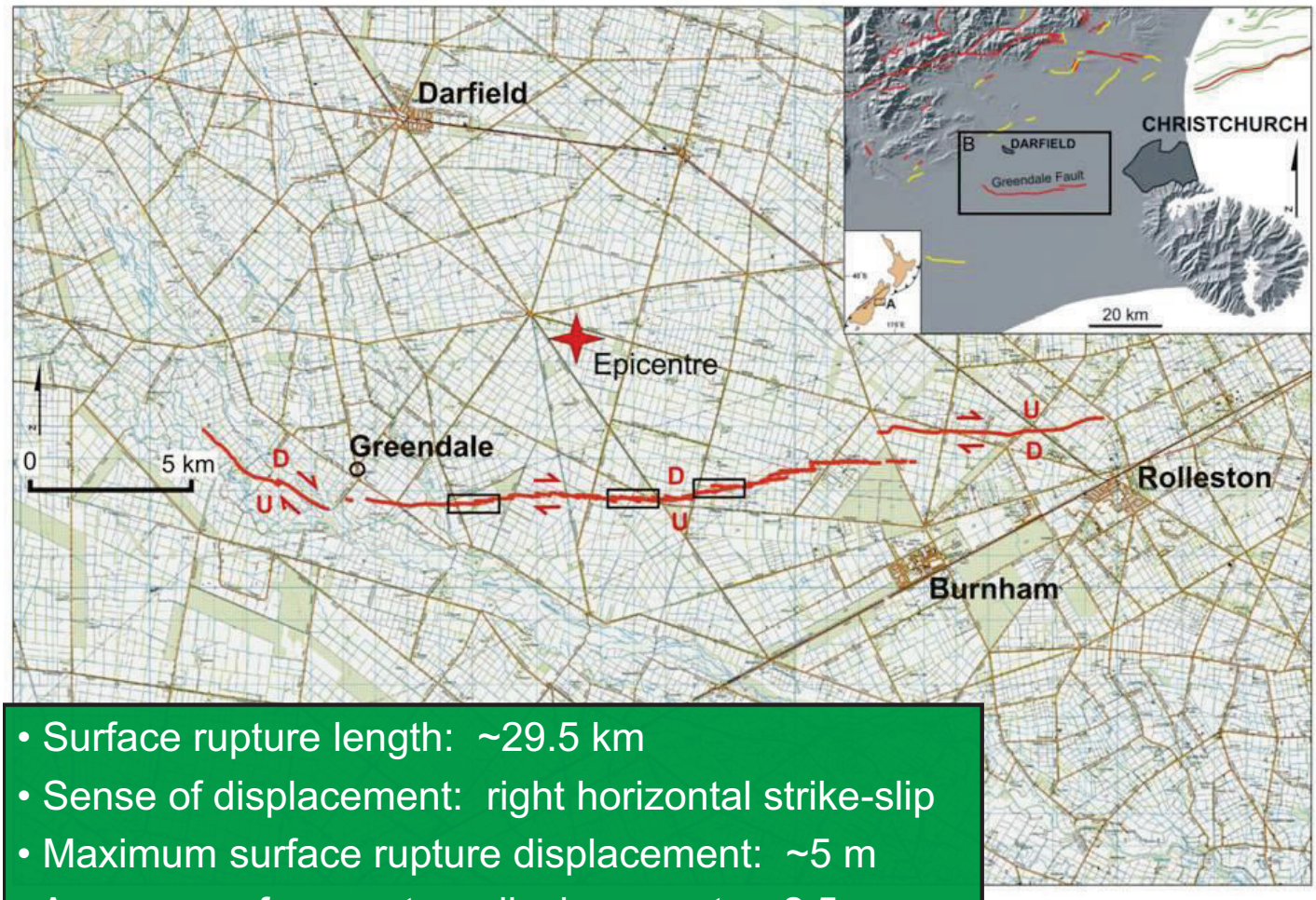
Vulnerabilities

- Greater perception of resilience than urban communities…
- Geographic, resource and social isolation
- Greater exposure to lifeline disruption
- Lower priority for lifeline restoration
- Reducing rates of volunteerism
- Greater reluctance to evacuate



- Surface rupture length: ~29.5 km
- Sense of displacement: right horizontal strike-slip
- Maximum surface rupture displacement: ~5 m
- Average surface rupture displacement: ~2.5 m

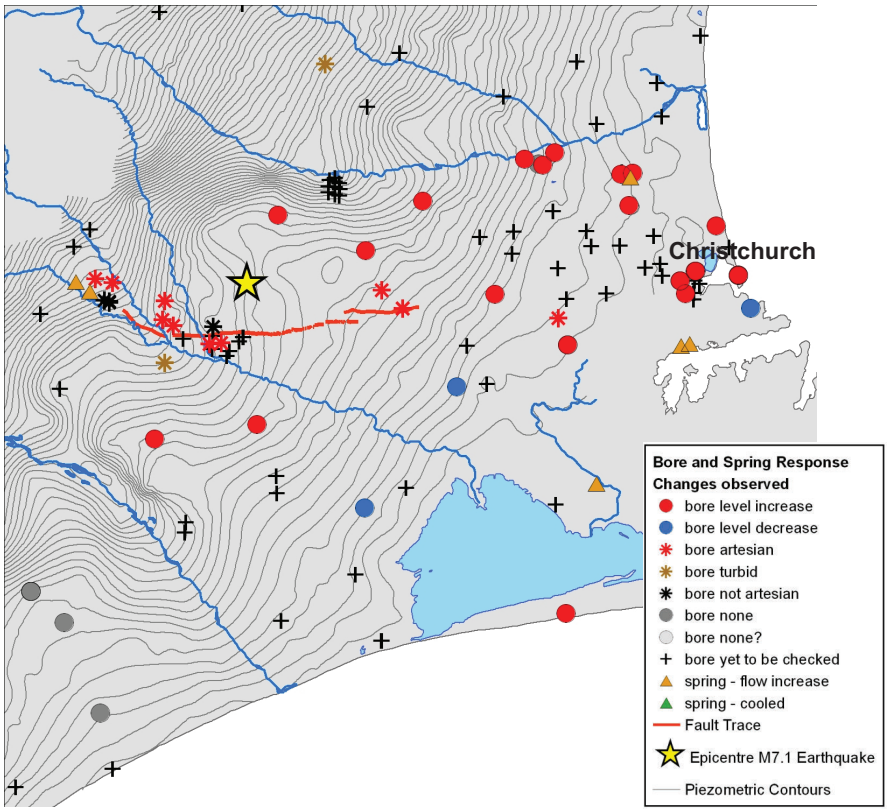

Photo: Simon Cox


Photo: David Barrell

Photo: David Barrell

Photo: Dougal Townsend

Groundwater response



- **Irrigation bores went artesian near Greendale fault (+40 m). New springs & increased flow.**
- **Near instantaneous step-changes, mostly level increases < 4 m (red), with few decreases (blue).**
- **Gradual recession back to pre-earthquake levels, or to a sustained change in level.**

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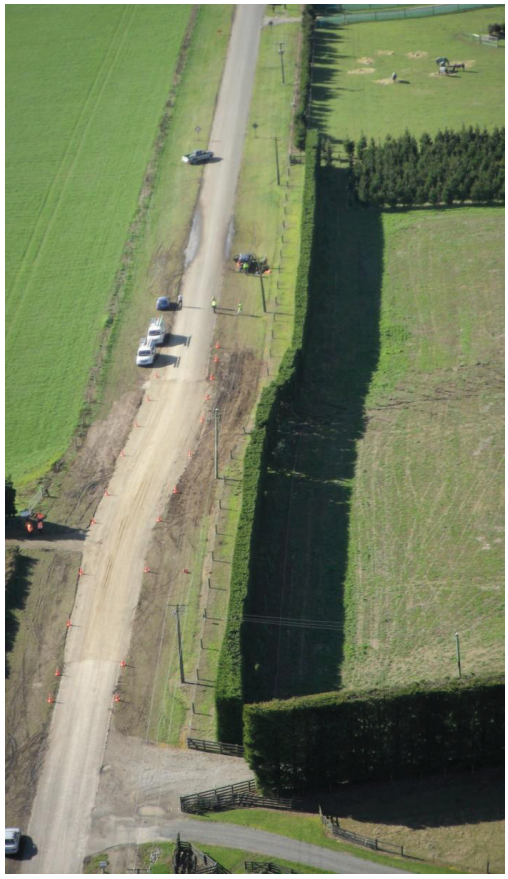
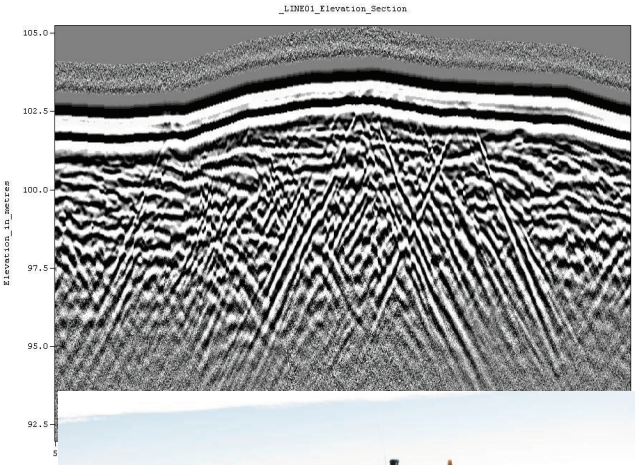
Current Situation - 1



- Rapid assembly of the Rural Recovery Group
  - Selwyn DC took lead for rural Canterbury recovery
  - Allan Baird – Rural Recovery Coordinator appointed
  - MAF, Federated Farmers, North Canterbury Rural Support Trust
  - Various agri-businesses – including Irrigation NZ
- Strong response
  - Dairy sheds
  - Water supplies (domestic, livestock, irrigation)
  - Farm infrastructure (silos, farms sheds, etc.)
  - Fences
  - **Homestead**
  - Concerns about reaching the "lifestylers"

Current Situation - 2



- Recovery effort focused on:
  - **Groundwater supplies**
  - Insurance
  - *Fault scarp and liquefaction remediation*
  - Living in a goldfish bowl
- Very low rates of contact to the RRG.
  - Very busy time of year
  - Utilised farm agents (close personal relationships = recognizing stress)
- **The grass is still growing...**
- Generally: this is an opportunity to capture the lessons for other rural communities

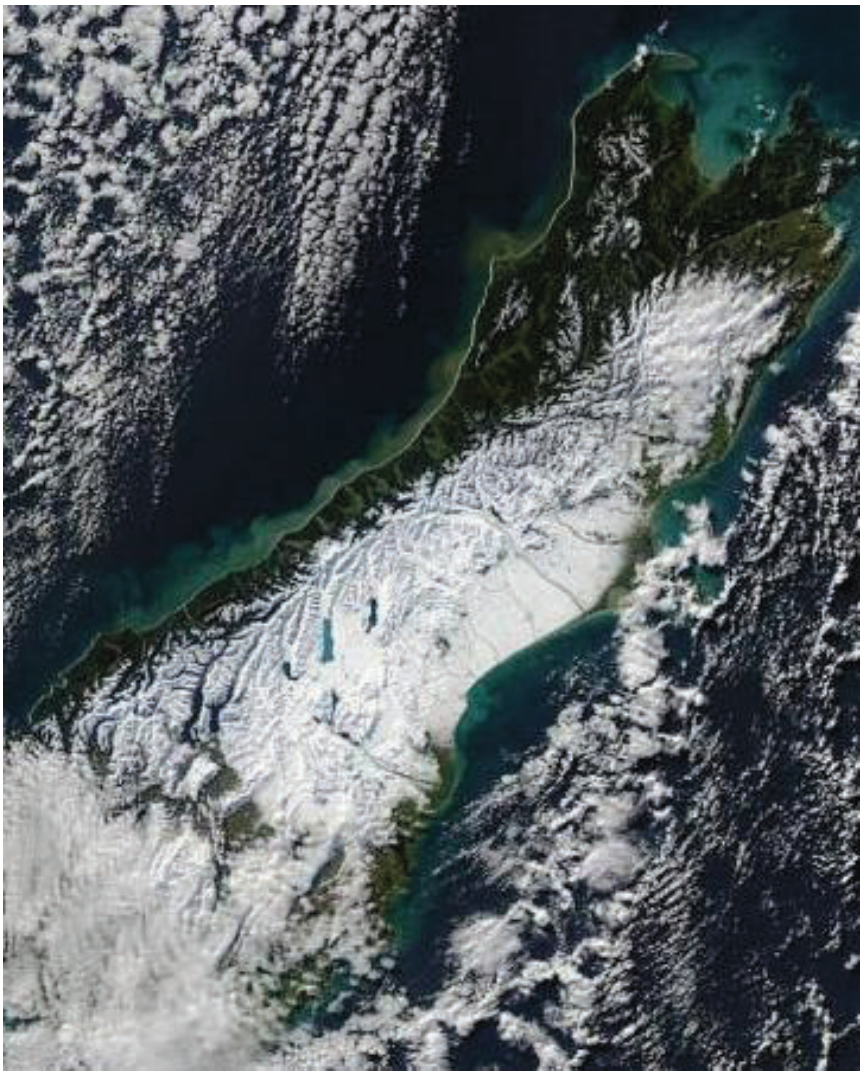
  - Zach Whitman, PhD student (UC)

Current Situation - 3

- Lifestyle owners
- Different vulnerability
- Reduced access to equipment and capital for land rehabilitation
- Connection to the rest of the community?

2006 Canterbury Snowstorm

- **Snowstorms are a common hazard in Canterbury**
- **Major snows 1945, 1967, 1973, 1992, 1996, 2002, 2006**



Widespread impact caused major disruption to infrastructure networks

- **>20,000 households lost power for up to 3 weeks**
- **>10,000 households lost telecommunications**
- **Rural community badly impacted:** heavy snow in areas unaccustomed and poorly prepared

Isolation

- **Couldn't go anywhere:** roads were blocked and <u>significant work commitments on the farm</u>
  - Farm is the home...so it is difficult to leave. Difficult to **trust** someone else to relieve you for several days
- **Relationships were stressed**
- **But inability to call social support networks (friends and relatives) significantly compounded feeling of isolation**
- **Loss of telecommunications was a much greater issue than the power being out...**

It was essential impact assessment continued throughout the event, particularly for social welfare agencies

The situation evolved as people's needs changed

- hundreds of households without power for weeks
- farms at the bottom of restoration priorities
- working long hours in difficult conditions
- relationships became increasingly stressed...

RURAL FAMILIES & DISASTERS
STORIES FROM CANTERBURY, ICELAND & PATAGONIA
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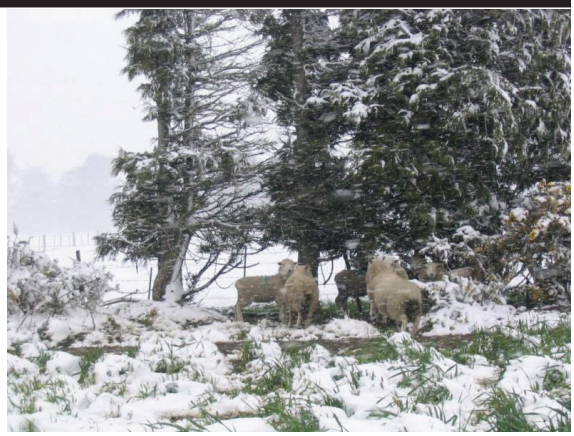
Impact on the Rural Household

- Males initially adopted a 'she'll-be-right' attitude
- Females were much more in-tune with the reality of the struggling household
- Usually most took up offers of assistance – important for councillors, welfare agency and CDEM staff to recognise this



Impact on the Rural Household

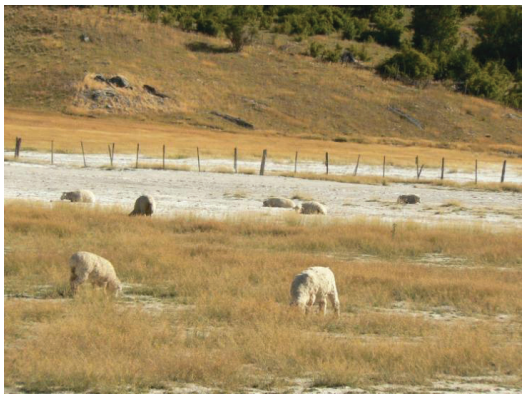
- Social isolation of the male
  - Rural Support Trusts
  - Stock and station agents
  - Neighbours and friends
  - *Old rural bachelor*
- Social Isolation of the female
  - Telecommunications essential
  - Rural Women NZ
- Woolshed/technology transfer days (45/46 families in a district)

What about people who didn't attend these?

DROUGHT (gives context to the current EQ recovery...)

- Social impact was much more significant at the human level.
  - For the last 20 years sheep and beef farms have rarely made a profit
  - Low incomes with few reserves
- No one really took an interest. Farmers felt totally ignored by the media and authorities. *Problems of Chch overshadowing rural issues...*
- Stress – farmers **isolated** themselves. Couldn't work so hard...
- MAF sponsored help centres – many didn't access them.
- **Australia:** increase in on **farm accidents** and **suicides:** still occurring 12-24 months after drought and fires
  - Couldn't send the kids to private schools...
  - **Suicide is logical *("not going to do something silly are you...")***

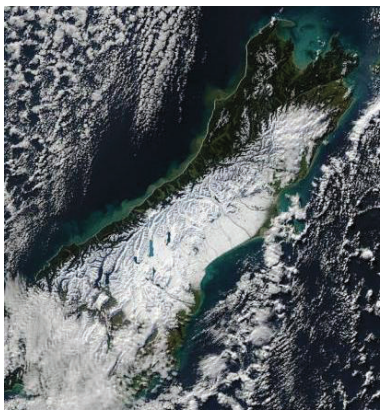
DROUGHT



- Role of the farm advisor was important – close personal relationships.
- Patterns were identical to impacts of removal of farm subsidies in the 1980's. **Halving of incomes might be the common theme....???**
- "Hollowing out" of rural NZ – there is less infrastructure in place to pull communities together and to meet.
  - The local dairy, or bank, or pub, church, or rugby/netball club.
  - Marae were effective in the North Island (first time many had been onto one...)

Final Thoughts - 1

- Farms with most infrastructure and development initially have the most to lose initially (disrupted services). But once restored, they have the **right tools** and typically exhibit the best long-term recovery performance (economically and socially)
- Isolation is important for both male and female family members, especially the old rural bachelors
  - Infrastructure
  - Social
- Urban/Rural interface

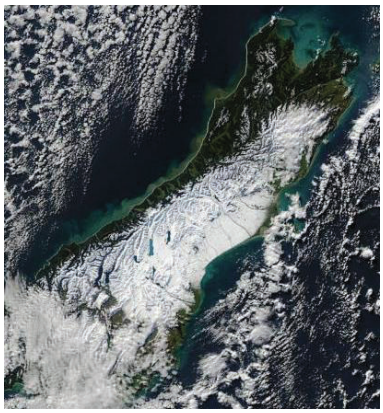


Final Thoughts - 2

- Rural Community is not homogenous. Most diverse they have ever been...
  - Dairy farmers are probably cash-rich **("have the money to go on holiday...")**
  - Sheep/Beer and Arable are not.
  - Lifestylers...

- Rural Support Trusts: Focus where there are **pre-existing problems**

- Convince farmers that it will **benefit their partner or kids** – then action occurs



MODERN EMERGENCY MANAGEMENT
RECENT DISASTERS AND FUTURE CHALLENGES

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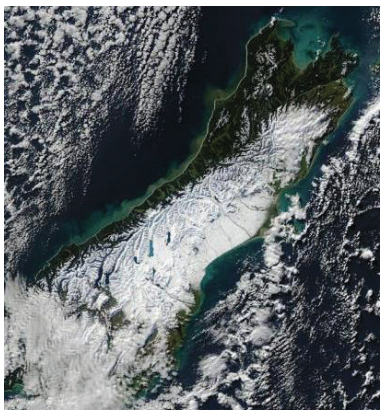
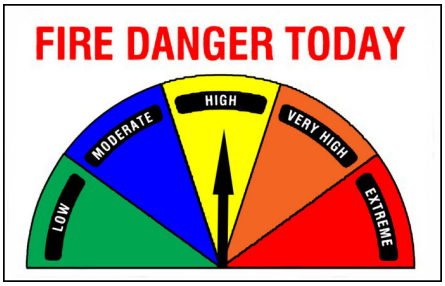
QUESTIONS??



Assessment of the general public's perception of rural fire danger communications



- Sophie Hide
- David Tappin
- Lisa Langer
- Stuart Anderson

This work was completed with funding from the Foundation for Research, Science and Technology (FRST) and the rural fire sector (through members of the Rural Fire Research Advisory Committee).

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Background research (1)

The public survey finalises a 5 year research programme. Previous work commenced with:

- Literature review of rural fire danger warnings (NZ)

Concerns questioned:

1. The value fire danger classes in influencing positive behaviour change amongst the public
2. The ability of the media campaign to identify and encourage the behaviour changes

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Background research (2)

- Followed by interviews with Rural Fire Authority Managers

Concerns questioned:

- Adequacy of the fire danger sign - its location; perceived meaning, accuracy and relevance; and ease of understanding
- Consistency of knowledge of fire danger, and behaviour expected under different levels of fire danger
- Variability in knowledge and perception of publicity initiatives

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Data collection methods

- Questionnaire survey in Northland and Canterbury
  - 10 questions exploring the concerns identified by RFA managers
  - pilot study at Whangarei A&P show (12 people)
  - varied locations, 10 – 15 minutes / person + ice-cream!
  - 106 interviews Northland & Canterbury (≥ 16 years)

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Interviewee profile

- Mix of rural residents, NZ and overseas visitors

	Age group (years)												Gender			
	16-24		25-34		35-44		45-54		55-64		65+		F		M	
	N	C	N	C	N	C	N	C	N	C	N	C	N	C	N	C
	9	6	9	11	11	5	17	11	13	12	6	8	40	24	25	29
All	15		20		16		28		25		14		64		54	

- Experience of rural fire

Experience of rural fire	N	C	All
None at all	36	24	60
Awareness (family involved or involvement as a near neighbour, called services, training), but no personal experience of fire	7	13	20
Involved in controlled fire	8	4	12
Involved in out of control fire	14	12	26

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Findings

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The sign itself (1)

- Poor perception of sign currency

  47 (40%) people do not know or do not think that the information is current

- Lack of behaviour change guidance

  Many (n=78) acknowledged that the sign identified fire danger or risk level BUT only a third of participants (n=40) reported that this also alerted them to a need to change their behaviour .

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The sign itself (2)

- Intrinsic difficulties in understanding the sign

  Concerns about interpretation difficulties, such as visual ability, colour vision, English language skills or literacy

- Poor perception of relevance

  24 felt that the signs were directed at specific groups (e.g. campers, smokers) or “deviants” (such as those throwing cigarette buts out of car windows), rather than to themselves

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Knowledge and interpretation
- Key concerns about fire ratings (1)

- Poor perception of meaning attributable to each rating
  - 'see' arrow position at the ratings 'low' and 'extreme' (and to a lesser extent 'high') and / or
  - 'see' arrow movement across the scale, rather than its specific position

What do each of the different ratings mean?											
Danger / hazard / risk level											
Low	All	Moderate	All	High	All	Very High	All	Extreme	All	General	All
Low danger/ risk	43	Could be a bit risky / be careful / potential danger	7	Chance of / bit risky / be aware	15	Bit too risky / great possibility	7	Hazardous / very dangerous / trouble / double risk of low	33	Low to high risk (dependi-ng on arrow)	36

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- Varied perception of rating meaning
  - indicator of risk / hazard (most common), prevailing weather conditions, likelihood of out of control fire
  - some contradiction for the 3 central ratings

What do each of the different ratings mean?									
Uncertainty									
Low	All	Moderate	All	High	All	Very High	All	Extreme	All
No answer / unsure	42	No answer / unsure	94	No answer / unsure	83	No answer / unsure	92	No answer / unsure	48

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Knowledge and interpretation (2)
- Translating fire danger ratings into behaviour change

- Fire danger warning sign ratings infrequently perceived as means to guide behaviour change.
  - variation in responses between behaviour change by rating, or by increased fire danger

- Fire risk activities variably understood, but inconsistent knowledge among the public
  - Many described themselves as being risk aware
  - good ideas proposed for mitigating fire risk, but not necessarily linked with a fire rating
  - isolated statements about reducing use (sometimes in specific locations) of machinery or equipment that generate heat or sparks

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Would you change your behaviour for each rating?

High	All	Very High	All	Extreme	All	General	All
More aware	4					More aware	14
More care	5	More care	5	More care	9	More careful. Light fewer fires (esp. If camping)	23
		Tell others off	1	Tell others off	1	Tell others off	5
Fire ok (with rain)	3	No fire/ incinerator/coal (maybe gas?)	13	No fire	16	No fire	4
No fire	9					Depends on the season	6
		Get permit	1	Get permit	2	Get permit	3
Stop using equipment (chainsaw)	1	Stop using equipment (chainsaw) / drive 4wd on long grass / going into forest	3	Stop using equipment (chainsaw) / drive 4wd on long grass / going into forest	3	Stop certain activities (mowing lawn, travel, burning rubbish, throwing cig butts away, rotary slasher)	5
Total	22	Total	23	Total	31	No change as- no risk behaviour	35
No answer	98	No answer	96	No answer	88	No answer	N/A

- Low – no response except 9 who would still light a fire
- Moderate – no response except 5 who would still light a fire

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Are there any activities that you would stop doing if fire danger went up?	N	C	All[1]
1 Less a-d[2]	2	4	6
2 Change behaviour (be more careful)	7	9	16
3 Avoid …			
3a - fireworks	6	1	7
3b - camping/forest walk	2	1	3
3c - bush/camp/any fire lighting	23	9	32
3d - BBQ	6	9	15
3e - rubbish burning	7	2	9
3f - leaving house	-	1	1
3g - welding	-	2	2
3h - burning off	-	1	1
3i - indoor fire	-	1	1
3j - machinery use / driving over scrub	-	8	8
4 No change as no risky behaviour	14	21	35

[1] Some people gave multiple examples
[2] (a) Bonfire on the beach, (b) Campfire in the bush, (c) Fire on private rural property, (d) Use of fire works

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Knowledge and interpretation (3) – fire season information

- Limited understanding of fire permit requirements

  - this system was rarely associated with fire danger warning sign communication

  - relatively few followed the publicity (radio / paper) alerting the public to the need to have a fire permit

  - responses for the understanding of ‘open’ fire season were good, but with mixed responses for ‘restricted’ and ‘prohibited’ fire seasons

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What do the terms 'open', 'restricted' and 'prohibited' fire season mean?

'Open'	All	'Restricted'	C	N	All[1]	'Prohibited'	All[1]
Don't know	6	Don't know	-	11	11	Don't know	14
Fire ok	84	No fire	-	4	4	No fire	81
Winter	3	Be careful	1	3	4	Summertime /certain times of year	2
Need a permit	3	Certain times only	4	5	9	Extreme	1
Low risk	2	Certain places only	12	8	20	Be careful	1
Low/mod	1	Permit required	15	18	33		
		Spring/autumn	-	1	1		
		Certain fires only	6	6	12		
		Certain conditions only	12	4	16		
		High / very high	1	-	1		
		With supervision of experienced person	-	2	2		

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Publicity initiatives

- <u>TV and radio were the most memorable and preferred media</u>
  - no widespread knowledge of alternative modes
  - only ~ ½ respondents reported awareness of such publicity
- <u>The message of the 'Bernie' campaign was known by only half the participants</u>
  - message = alert to fire danger, risk level or 'keep it green', BUT fewer reported that the message directed a need to change behaviour

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Recommendations (1)

1. Define and publicise the range of risk factors for fire

2. Provide guidance on expected behaviour and link this to the relative fire risk conveyed in fire danger signage and communication

3. Initiate efforts to clarify and simplify information relating to fire danger (and incorporate guidance for recommended behaviour change)

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Recommendations (2)

4. The 'fire danger warning sign' and 'fire season' systems operate in parallel. Explore the possibility of developing and integrating the two separate methods into a single sign 'graphic'

5. Improve the sign technology, maintenance and placement locations

6. Develop the media campaign to target specific groups and provide guidance on behaviour change

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Mitigation of Human Caused Wildfires

Mary Hart

Scion contract

Aims and content

- To produce evidence-based recommendations to reduce the incidence of human caused wildfire in New Zealand
- Three types of wildfire causes:
  - Arson and malicious fires;
  - Accidents (visitors and tourists)
  - Land owners: lifestylers / farmers

Wildfire: any uncontrolled, non-structural fire burning in a grass, scrub, bush or forested area.

Methodology

Comprehensive literature review

•2 Focus groups (Federated Farmers and RRFC)
•7 stakeholder interviews

Common themes

•Recommendations
•Report
•FTTN

Arson and maliciously set fires

Context

- Fire rarely attributed to arson; major problem
- Certain times and places riskier

What helps

- Improving knowledge
- Modelling and mapping;
- Multi agency working
- The public
- Education and intervention

Recommendations

- More mapping and profiling
- Education
- More multi agency work
- Consistent reporting
- Better data collection
- Research and best practice

Accidents: visitors and tourists

- ***Context***
- Little research
- Serious risk
- Public's lack of understanding and knowledge
- Continuum of public's behaviour

What helps?

- Education
- Information campaigns
- Information
- Restrictions
- Public Informants

Recommendations

- Improving information
- Email alerts to schools
- Target overseas visitors
- Further restrictions

Carelessness and Negligence: Lifestylers

- ***Context***
- Growth of RUI
- Newcomers have less understanding of fire
- 3 types of ignorance identified

- ***What helps***
- Practical changes
- Information and education
- Permit regulations

- ***Recommendations***
- More information outlets
- Council planners: fire awareness
- Personalised contact
- Multi agency working

Carelessness and Negligence: Farmers

- ***Context***
- Most common known cause of wildfire in NZ
- Maintain the privilege
- Tiny proportion
- 3 reasons for escapes
- Particular issues in high country

- ***What helps***
- Information
- Permit requirements
- Prosecutions, cost recovery

- ***Recommendations***
- Investigate prescribed burns in high country
- Targeted campaign

In conclusion

- Human caused fire serious problem
- Suggestions from literature and qualitative study
- Important for agencies to keep updated with research to enable risk reduction

Less wildfires in Northland!

A community relations and public engagement programme

2007-2010

Sioux Campbell, Northland Conservancy
Carla Wilson, EveBay Research

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Uniquely Northland!

- Waitangi, Zane Grey, kauri trees, Poor Knights Islands, Cape Reinga …and …
- The second most deprived region in NZ on the depravation scale;
- Big gaps between rich and poor;
- Isolated communities;
- By national average, less educated, less likely to have professional occupations, earn less and have less access to telecommunications systems …

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And too many arson and careless wildfires!

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Confronting the issue/s

- Originally contracted as a consultant to develop the programme – now part-time staff;
- Conscious of the multi-agency nature of rural firefighting, but not necessarily collaborative effort in community relations approaches;
- Need to "sell" a change programme and achieve buy-in across Northland;
- Aware of low existing knowledge base about motivation etc

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Brief background

- First time a documented, planned strategic approach had been taken;
- Lead by Department of Conservation, with support from the NZ Fire Service and growing contributions to specific aspects from members of the Northland regional rural fire committee;
- Growing interest in our approach from other parts of NZ.

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Goal and objectives

The incidence and severity of wildfires in Northland is reduced. People understand the consequences of wildfires and participate in preventing them.

Several SMART objectives are aligned with this goal – some of these need re-writing with three years' programme experience behind us. The latter objectives, relating to understanding and participation, are where work most needs to be progressed.

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The value of research

- Little obviously available at the time of developing the programme;
- Used relevant overseas material and the knowledge and experiences of local people involved in rural fire management;
- Work within the programme revealed research sources and opportunities;
- New path for DOC – not an area which had been targetted for social research before;
- Developed new alliances with researchers such as Lisa (SCION);
- Started discovering other recent research such as into FAIP efficacy;
- Opportunities to participate in others' research.

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Researching what?

- Overseas information provided some common motivators for arson but – PR and public engagement theory raise the importance of local relevance in finding lasting local outcomes;
- We wanted to find out (a) why people in Northland deliberately light wildfires (b) why other people are careless about wildfires and (c) what might be most effective in supporting change.

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Meantime -

- FRST and Rural Fire Research Advisory Committee's research into fire danger communications;
- Questions about communication method efficacy included Northland NZFS annual monitor;
- Feedback from schools via our contract advocate, DOC staff and other management agency representatives;
- Regular discussion and inclusion at NRRFC meetings;
- 2007-2008 FAIP assessments (Sparking Up and Old Flame) - University of Auckland;
- Anecdotal feedback on messaging effectiveness;
- Carla's phase one and pending phase two research commissioned by DOC Northland .

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Why start wildfires?

- Arrogant, idiots or just unlucky?
- Reasons for wildfires
- Barriers to reducing wildfires
- Possible future approaches

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The experiences of people who carelessly start wildfires

"We need to get out the message that there are consequences for your actions on property, life, your bank balance, stress and family. If you could get someone to say 'this happened to me' it would be very powerful".

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Other aspects

- Develop Northland-specific resources – bi-lingual fact sheets, radio advertising, schools kit and DVD, DOC blog (see DOC website www.doc.govt.nz/region/threats/fire);
- Distribute and promote the resources;
- Employ a wildfires reduction advocate to work with schools in target communities;
- Listen to communities to seek feedback;
- Talk to landowners and residents in target communities;
- **Be strong** in using key messages – show we mean the consequences. Media exposure during fires is a good opportunity;
- Use RMA opportunities to improve infrastructure on fire prevention (defensible space, water access etc);
- Active engagement with the suite of wildfire management agencies in the region – gain consistency of messaging and approaches;
- Seeking greater engagement from the police.

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Constraints and bonuses

- Money
- Staff time
- Working collaboratively can be both…
- Conservator's influence
- Influence of other PRFAs
- From DOC perspective – reduction in 1k fire margins

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What next?

- Finding out more about "why" will help us tailor approaches more accurately;
- Ongoing, sustained effort required in target communities;
- Importance of consequences **being understood and felt**, consistently;
- Importance of treating this as a serious social, not just environmental, issue.

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Fire Behaviour Tools

Veronica Clifford
Scion Rural Fire Research

www.scionresearch.com/fire

Overview

Latest tools for fire behaviour prediction:

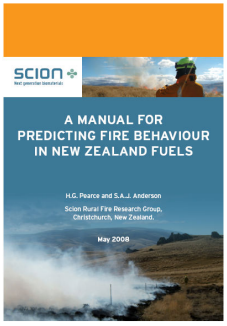
1. Manual for Predicting Fire Behaviour
2. NZ Fire Behaviour Toolkit
3. Photoguide to NZ fuels
4. Prometheus
5. Satellite Imagery for grassland curing

Here's your chance to have a say….

SCION
Next generation biomaterials

A Manual for predicting fire behaviour

- Intended for predicting fire behaviour in NZ fuel types
- A well explained easy to use guide
- Consists of sections related to fuel and fire behaviour characteristics
- Durable binder, A5 sized and bright orange
- Purchase at Scion $45 + postage



Manual consists of tables

SECTION E. Equilibrium Rate of Spread (ROS) and Fire Intensity Class on flat terrain

Care should be taken when selecting the most appropriate fuel type for Rate of Spread (ROS) determination. This should be the dominant fuel that is contributing to fire spread. For example, in an immature pine stand with a dominant scrub understorey, the scrub fuel type is likely to provide more accurate estimates of fire behaviour.

Models for estimating the equilibrium or steady-state rate of fire spread on flat ground (usually of the head fire) currently exist for the following New Zealand fuel types:

In addition to equilibrium rate of spread (ROS), the following tables (and subsequent sections) also indicate likely fire intensity based on the appropriate available fuel load information for each fuel type. These intensity estimates have been colour-coded using the following classes:

INTENSITY CLASS

<10 kW/m
10-500 kW/m
500-2000 kW/m
2000-4000 kW/m
>4000 kW/m

Equilibrium Rate of Spread (ROS) on flat terrain – Mature Pine Plantations

ISI	Mature Pine Plantations, ages 11-20 and 20+ BUI											
	10	20	30	40	50	60	70	80	90	100	110	120
	Rate of Spread (m/h)											
0.5	0	0	0	0	0	0	0	0	0	0	0	0
1.0	0	1	1	1	1	1	1	1	1	1	1	1
1.5	1	2	2	2	2	3	3	3	3	3	3	3
2.0	2	4	5	5	6	6	6	6	6	6	6	6
2.5	4	7	9	10	10	11	11	11	11	11	12	12
3	7	12	14	16	17	17	18	18	18	19	19	19
4	15	25	31	33	35	37	38	38	39	40	40	40
5	25	44	53	58	62	64	66	67	68	69	70	70
6	39	68	82	90	96	99	102	104	105	107	108	109
7	56	97	117	129	136	141	145	148	150	152	154	155
8	75	130	157	172	182	189	194	198	201	204	206	207
9	95	167	201	220	233	242	248	253	257	261	263	265
10	118	206	248	272	288	299	307	313	318	322	325	328
12	166	290	349	383	405	420	432	440	447	453	458	461
14	216	377	454	499	527	547	562	573	582	589	595	600
16	266	464	559	614	649	673	691	705	716	725	733	739
18	314	548	660	724	766	795	816	833	846	856	865	872
20	359	627	755	829	876	910	934	953	968	980	990	998
25	456	797	960	1054	1114	1157	1188	1212	1231	1246	1259	1269
30	531	927	1117	1226	1296	1345	1381	1409	1431	1449	1464	1476
35	585	1022	1231	1351	1428	1482	1522	1553	1577	1597	1613	1627
40	623	1089	1311	1439	1522	1579	1622	1654	1680	1701	1719	1733
45	650	1135	1367	1500	1586	1647	1691	1725	1752	1774	1792	1807
50	668	1167	1405	1542	1631	1693	1738	1773	1801	1823	1842	1858
55	680	1189	1432	1571	1661	1724	1771	1806	1834	1857	1876	1892
60	689	1203	1449	1590	1682	1745	1792	1828	1857	188 0	1899	1915
65	694	1213	1461	1604	1696	1760	1807	1844	1872	1896	1915	1931
70	698	1220	1469	1612	1705	1769	1817	1854	1883	1906	1926	1942

Equilibrium rate of spread (and indicative fire intensity classes) for surface fires only, based on Canadian FBP System Fuel Type C-6, Conifer Plantation.

The **Pine Plantation model** has been developed for use in mature radiata pine stands of age 20+ years. However, it can also be used to derive the rate of spread component for immature pine plantations of age 11-20. It could also be used with some caution for mature stands of other conifer species (e.g., other pines or Douglas-fir).

Rule of thumb: As a general indication, crowning is likely to occur in a mature pine stand pruned to 6 m once the fire intensity exceeds 4000 kW/m. Broader guidance on the likelihood of crown fire initiation can be obtained in Section H (see page H-1).

Future ahead

- Version 2
  - AFL & ROS tables updated for scrub and grass
  - Those who have V1 manuals will be sent new pages to replace
  - Available soon in new year
- Discussion
  - This is not a replacement of the green handbook *although the tables in here could be updated also!*
  - Before V2 is printed, what would you like to see included or changed?

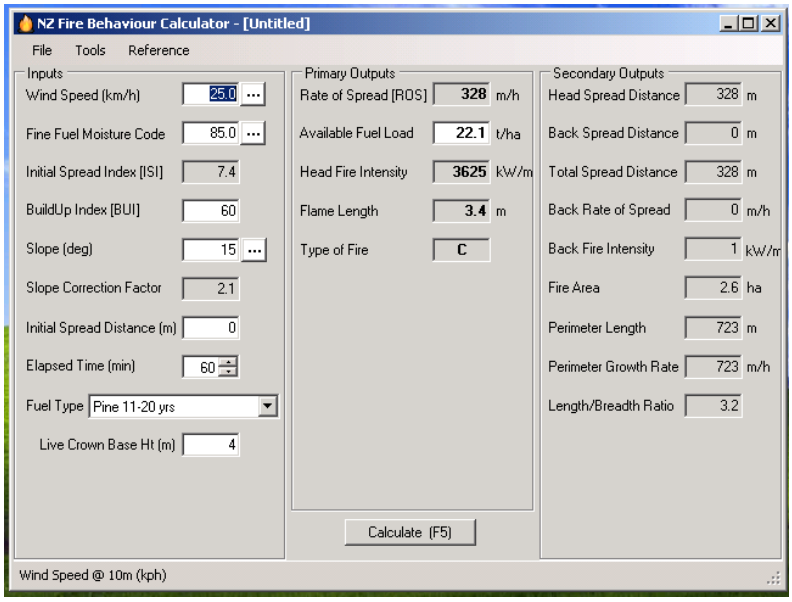
NZ Fire Behaviour Toolkit

- Designed for quick and easy calculations
- Currently used on a desktop or laptop
- Future use on handheld devices

•This is available for download (free of charge)
www.scionresearch.com/fire

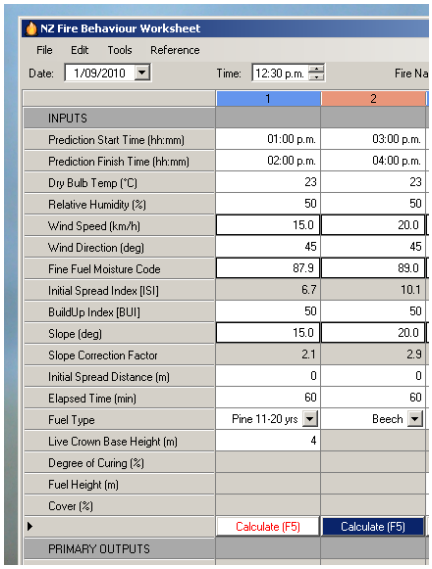
Calculator function

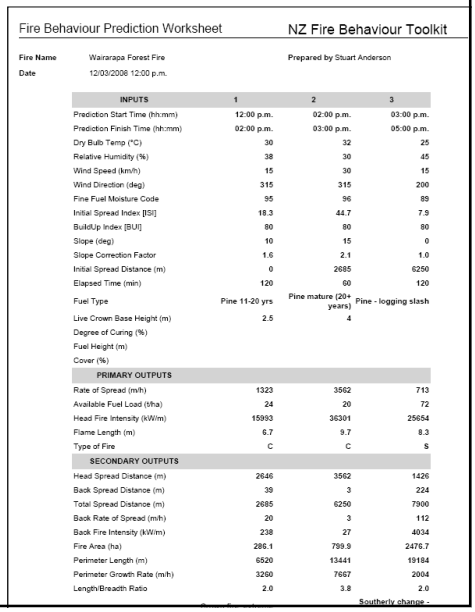
- Quick what if scenario



Worksheet function

- Detailed predictions, compare best & worst case



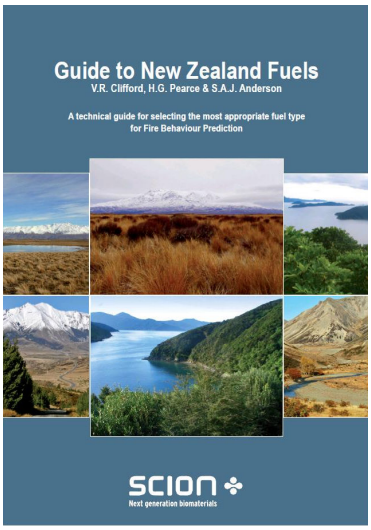


Future ahead

- Version 2
  - Updated with new ROS and AFL models
  - Printer error fixed (currently only those with adobe writers can make pdf's)
  - Available soon in new year
- Discussion
  - what is missing/what do you want included, such as:
    - Resource productivity function
    - FWI forecast 3 days ahead function
    - Basic calculator as an application on smart phones/hand held devices

Guide to New Zealand Fuels

- Select the most appropriate fire behaviour models
- Use with fire behaviour toolkit and manual
- Available as a stand alone book and an insert
- Available soon in new year



Immature Pine, age 11-20 years

Description

Immature pine aged 11 to 20 years is represented by areas of immature pine plantations with a closed canopy. Tree heights are in the order of 10 – 20 m, depending on the stand age, stocking and site productivity. Tree crowns overlap, and while there may still be scrub understorey present, this will generally reduce over time due to shading by the canopy. By the age of 20 years, scrub fuels may have disappeared altogether.

The forestry regime being managed for will also determine stand characteristics and therefore resulting fuel loads and fire behaviour. For example, framing grade timber stands will feature heavier and later thinning, with ladder fuels being present for longer than in similar aged board regime stands. Similarly, unmanaged pulpwood stands will have more ladder fuels, and a greater likelihood of crown fire occurrence.

The primary carrier of surface fire is the pine litter layer with some slash residue. High levels of understorey slash from pruning and thinning activities may decompose slowly, contributing to a build up of near-surface fuels. The presence of scrub fuels in these stands can act as ladder fuels, enabling torching or crowning to take place. Crown fires can initiate with ladder fuels and be supported by a closed canopy under moderately windy conditions.

15 year old pine stand. Canopy not fully closed, presence of scrub and slash residue on forest floor.
Location: Bottle Lake Forest.

Close up of 15 year old pine stand forest floor.
Location: Bottle Lake Forest.

16 year old pine stand. Canopy not fully closed, presence of scrub and slash residue on forest floor.
Location: Bottle Lake Forest.

Landscape view of pine stand.
Location: Gowan Lea Forest, Whitecliffs, Canterbury. Photo courtesy of Selwyn Plantation Board.

Fire Behaviour

Fuel loads and rate of spread models for immature pine aged 11 to 20 years are based on modifications of models for other coniferous forests derived from expert opinion. The rate of spread model assumes that pine litter and other surface fuels are the primary carriers of fire.

Available fuel loads (Figure 7a) are calculated from the **Immature Pine age 11-20 model** using the Buildup Index (BUI) (page D-3 of the Field Manual). Fuel loads are moderate compared to other pine models and can reach up to 26 t/ha.

Rate of fire spread (Figure 7b) is usually calculated from the **Mature pine plantations model** using the Initial Spread Index (ISI) and Buildup Index (BUI) (page E-2 of the Field Manual). A scrub rate of spread model can be used if scrub fuels are present and is the primary carrier of fire. Relatively low rates of spread are usually predicted, and reach 1940 m/h (1.9 km/h).

A spreading fire requires a relatively higher ISI than most other forest models due to the effect of the closed canopy on reducing the wind speed acting on a surface fire beneath the canopy. Moderate to extreme fire intensities are possible, especially with the occurrence of torching and crowning where ladder fuels are present.

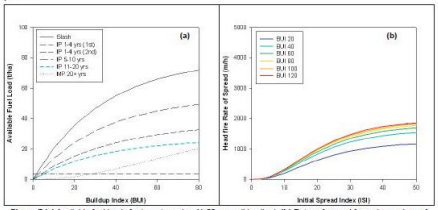


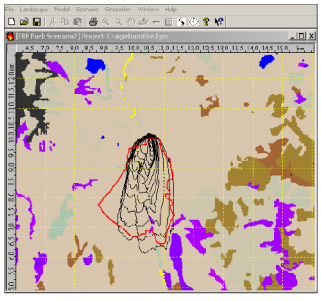
Figure 7 (a) Available fuel loads for immature pine 11-20 years (blue line); **(b)** Rates of spread for various values of the Buildup Index (BUI).

Future ahead

- Version 1
  - Available soon, released with V2 of Manual and toolkit in early new year
- Discussion
  - what is missing/what do you want included, such as:
    - Make this into a poster guide
    - Pine plantations look too clean – try North Island
    - Include a NZ grass curing guide similar to CFA
    - Other fuel types included i.e. rose hip, coastal grasses

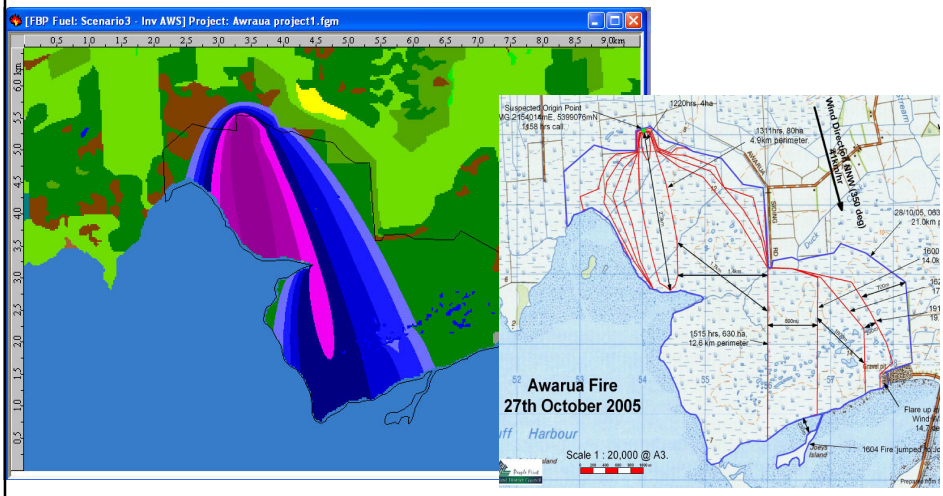
Fire Growth Simulation

- Project funded and supported by DOC
- Canadian tool *Prometheus* modified
- Software that simulates growth of fires across landscape
- It has been validated
- It can be used for:
  - Pre-planning
  - Operationally
  - Post-fire assessment



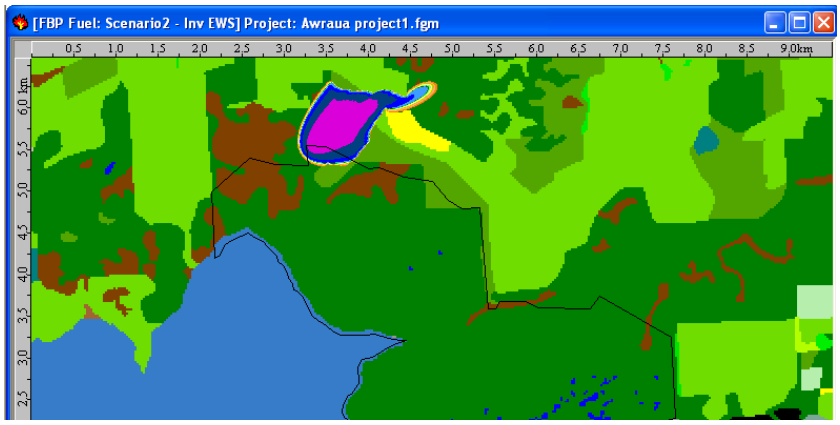
Example

- validation fire. simulated historical fire well



Example

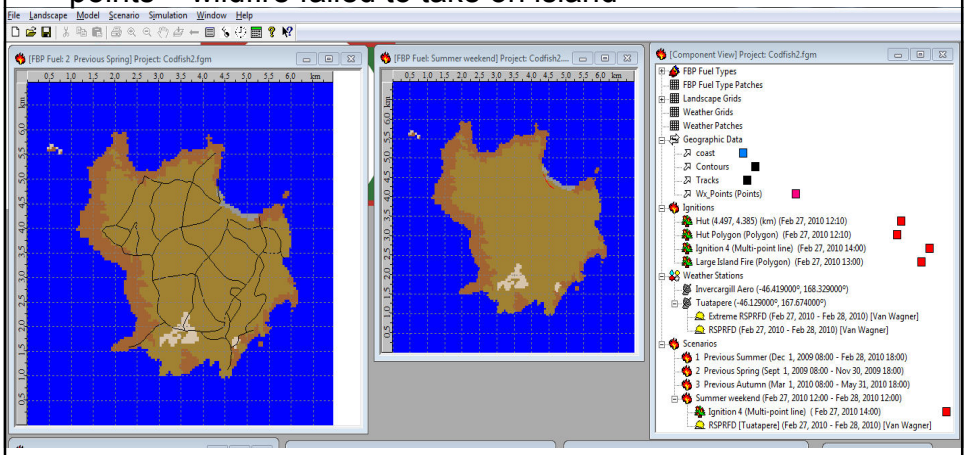
when it doesn't get it right
– value of reliable/right weather info



Example

pre-planning – likelihood of ignition on Codfish

- using 'Normal' to Extreme weather, and various ignition points = wildfire failed to take on island

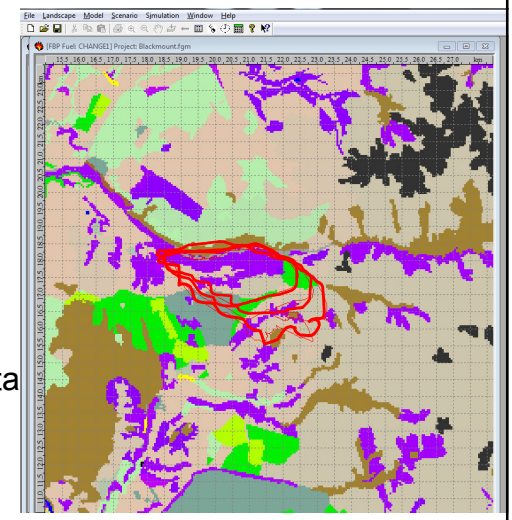


Slide provided by A. Buddle from SRFA

Example

Operationally - SRFA Rural Fire training exercise 2010 at Blackmount Forest

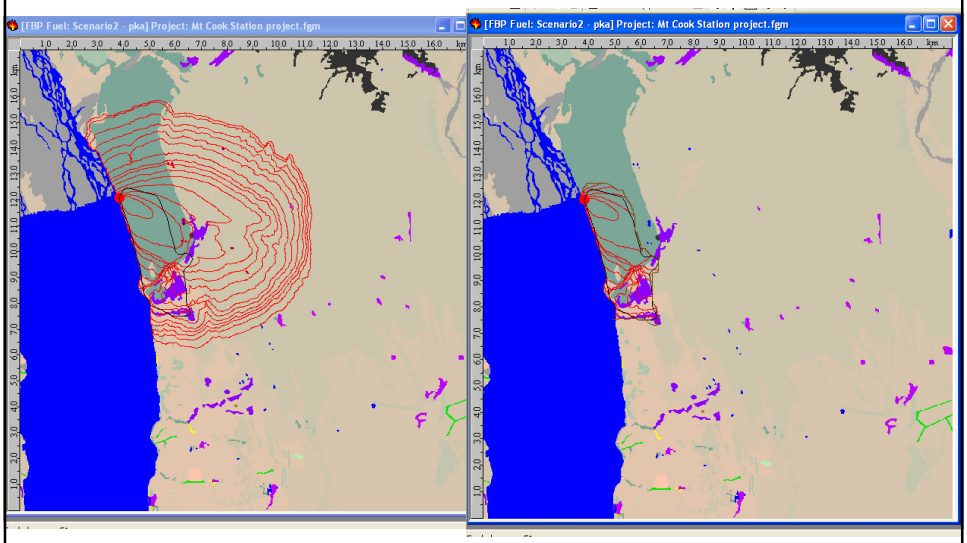
- Verdict:
  - Able to run 'real time' in operational scenario
  - Faster than green or orange manual
- Main issues
  - Documentation
  - Preparation of some data ahead of fire season



Slide provided by A. Buddle from SRFA

Examples

- Post fire investigation – values saved vs cost of suppression



16hrs Without suppression

With suppression

Future ahead

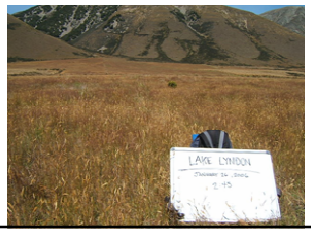
- Software available to trained operators
- Aimed at technical experts, not operational fire managers
  - GIS/Mapping, FBO/Situation in IMTs, and fire strategic planners (e.g. WTA)
  - Computing and GIS skills, fire behaviour understanding necessary
- Summary report available in new year
- NZ user guide available in new year

Discussion

- Current *Prometheus* users could share with others how they're using it.

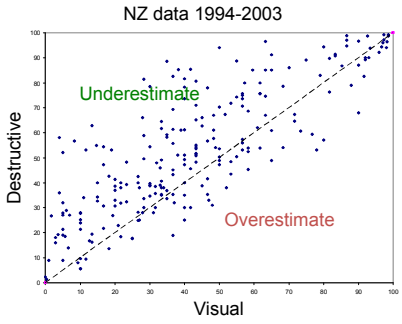
Grassland curing assessment

- aim to develop better methods to assess current and predicted levels of curing in grasslands
- grass “curing” refers to seasonal die-off of annual and perennial grasses
- key input into fire behaviour models and fire danger rating systems



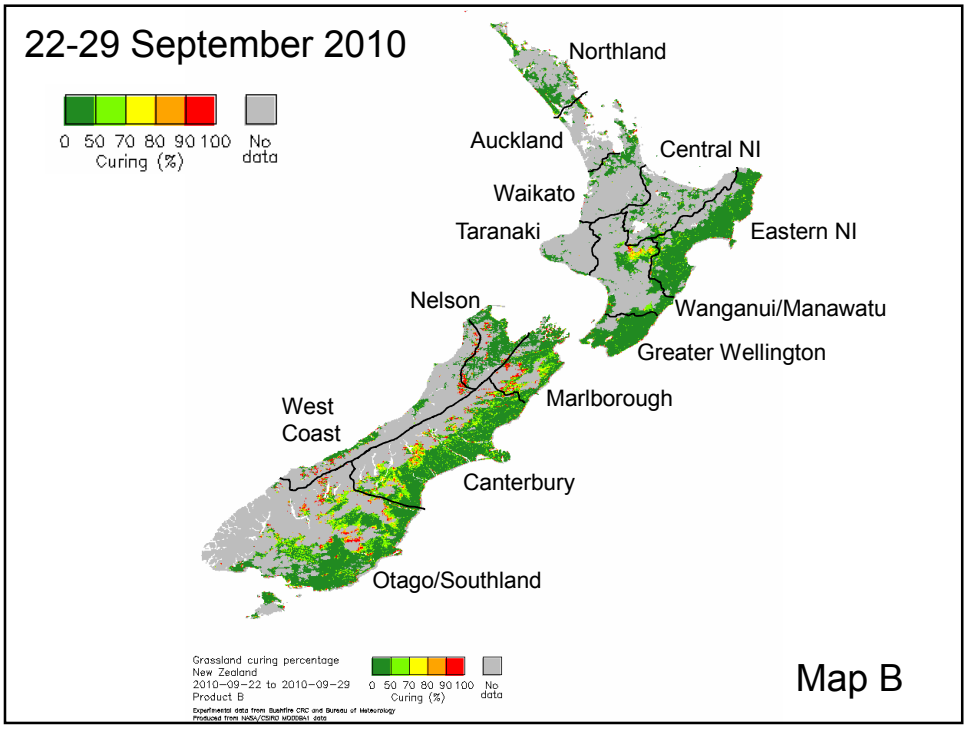
Visual assessment

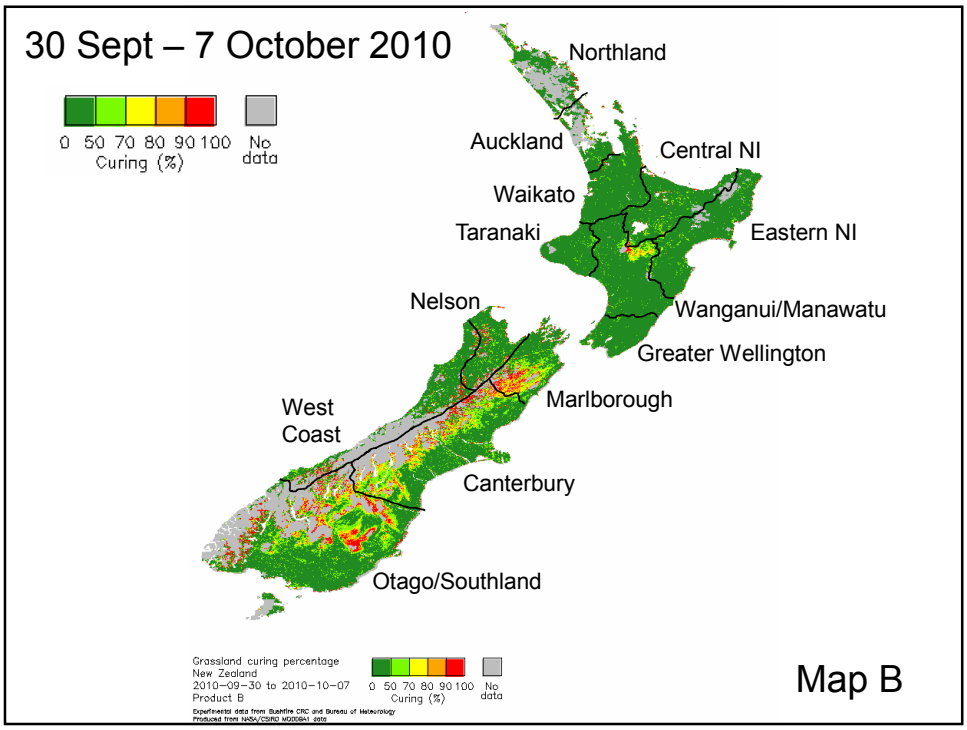
- often inaccurate – subjective, difficult & infrequent
- tendency to underestimate
- Need for a NZ grass curing guide?

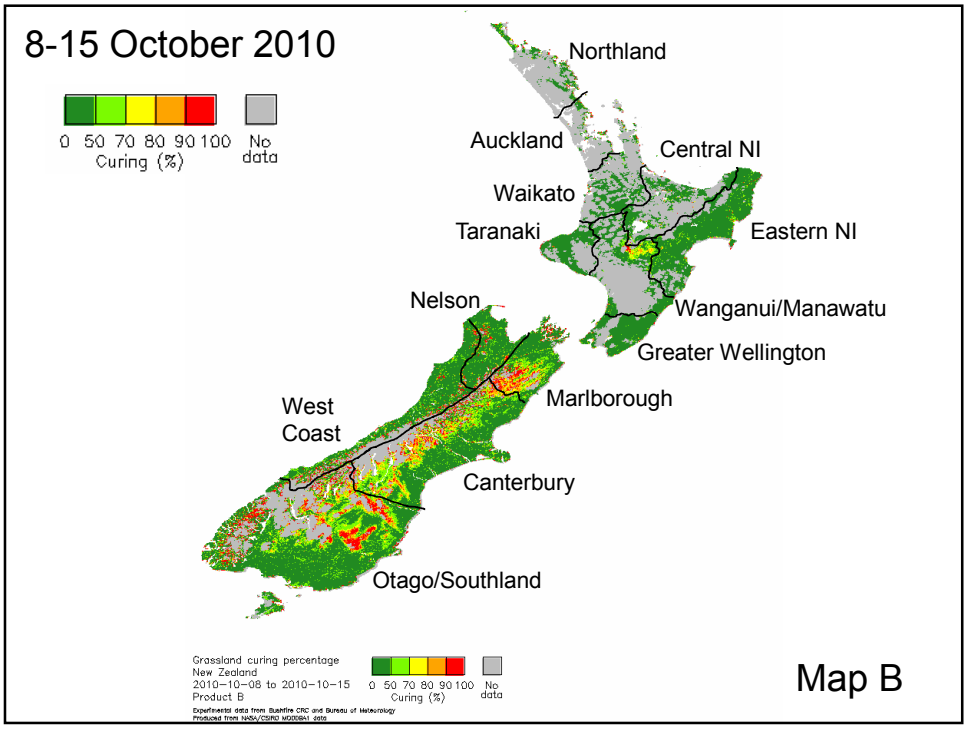


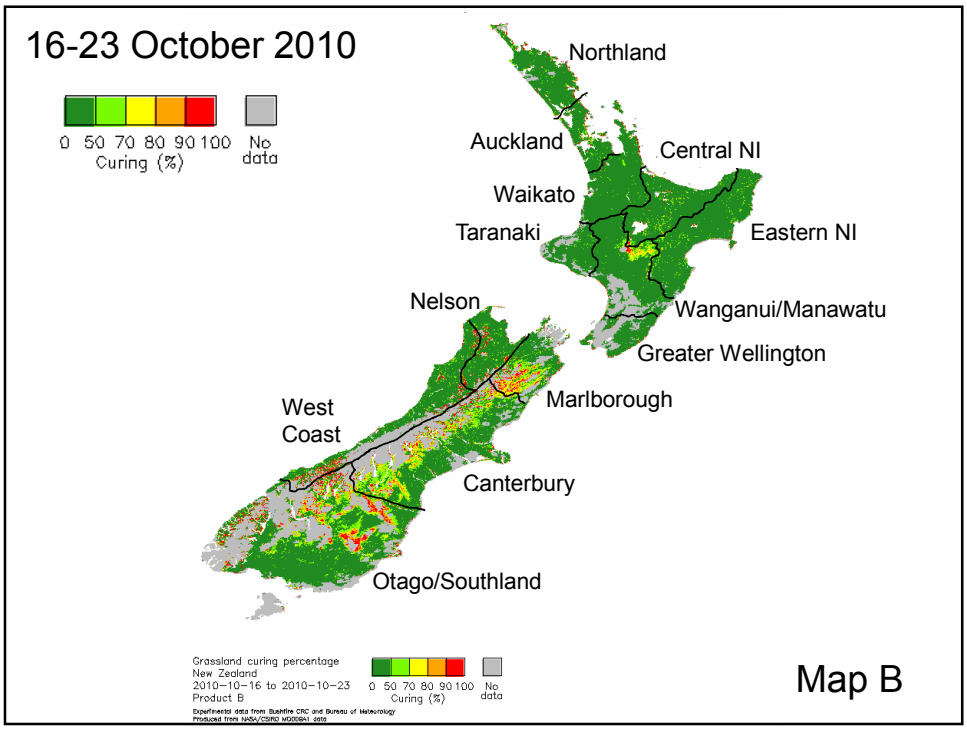
NZ pilot trial using Satellite images

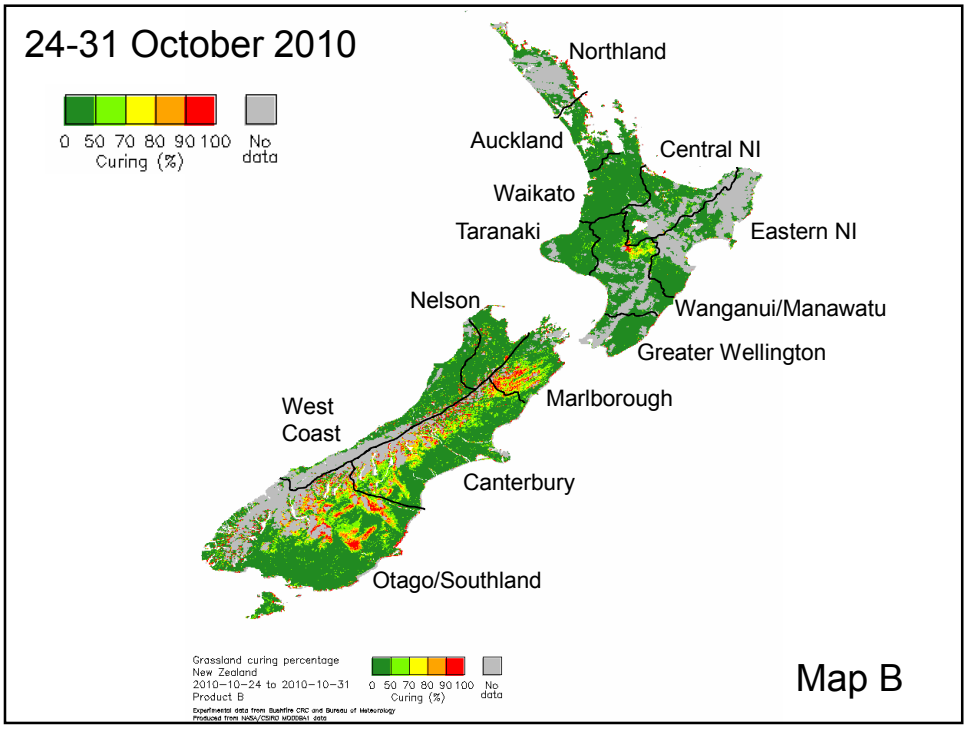
- Conducted end of 2009/10 summer
  - Rank four maps provided by Aust BoM
  - To determine best product for NZ
- Repeat the same process but for entire season (September 2010 – April 2011)
  - Rank two maps (B & C)
  - To determine best product

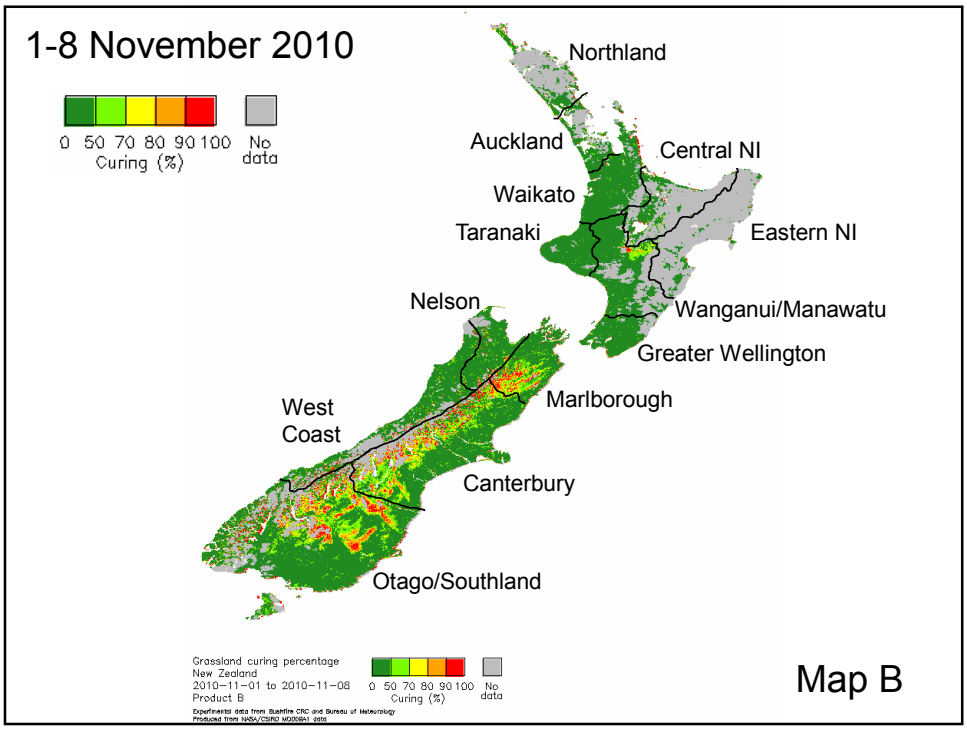



30 Sept – 7 October 2010
0 50 70 80 90 100
Curing (%)
No data
Northland
Auckland
Central NI
Waikato
Taranaki
Eastern NI
Nelson
Wanganui/Manawatu
Greater Wellington
Marlborough
West Coast
Canterbury
Otago/Southland
Grassland curing percentage
New Zealand
2010-09-30 to 2010-10-07
Product B
Map B


8-15 October 2010
0 50 70 80 90 100
Curing (%)
No data
Northland
Auckland
Central NI
Waikato
Taranaki
Eastern NI
Nelson
Wanganui/Manawatu
Greater Wellington
Marlborough
West Coast
Canterbury
Otago/Southland
Grassland curing percentage
New Zealand
2010-10-08 to 2010-10-15
Product B
Map B


16-23 October 2010
0 50 70 80 90 100
Curing (%)
No data
Northland
Auckland
Central NI
Waikato
Taranaki
Eastern NI
Nelson
Wanganui/Manawatu
Greater Wellington
Marlborough
West Coast
Canterbury
Otago/Southland
Grassland curing percentage
New Zealand
2010-10-16 to 2010-10-23
Product B
0 50 70 80 90 100
Curing (%)
No data
Map B


24-31 October 2010
0 50 70 80 90 100
Curing (%)
No data
Northland
Auckland
Central NI
Waikato
Taranaki
Eastern NI
Nelson
Wanganui/Manawatu
Greater Wellington
Marlborough
West Coast
Canterbury
Otago/Southland
Grassland curing percentage
New Zealand
2010-10-24 to 2010-10-31
Product B
0 50 70 80 90 100
Curing (%)
No data
Map B


1-8 November 2010
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Curing (%)
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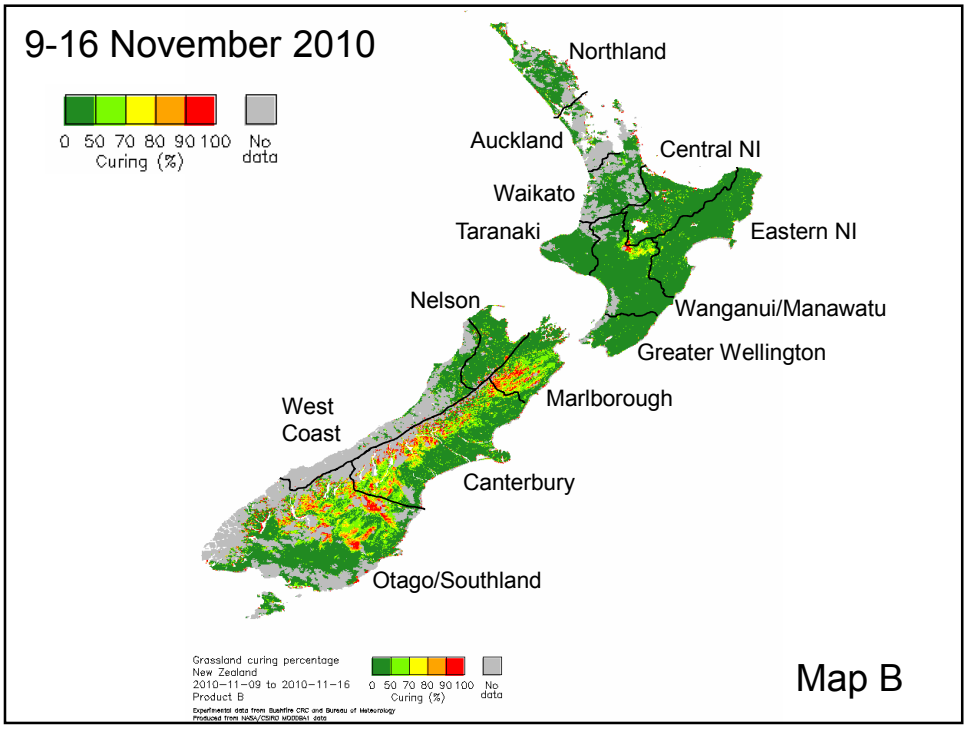
Central NI
Waikato
Taranaki
Eastern NI
Nelson
Wanganui/Manawatu
Greater Wellington
Marlborough
West Coast
Canterbury
Otago/Southland
Grassland curing percentage
New Zealand
2010-11-01 to 2010-11-08
Product B
0 50 70 80 90 100
Curing (%)
No data
Map B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Curing (%)
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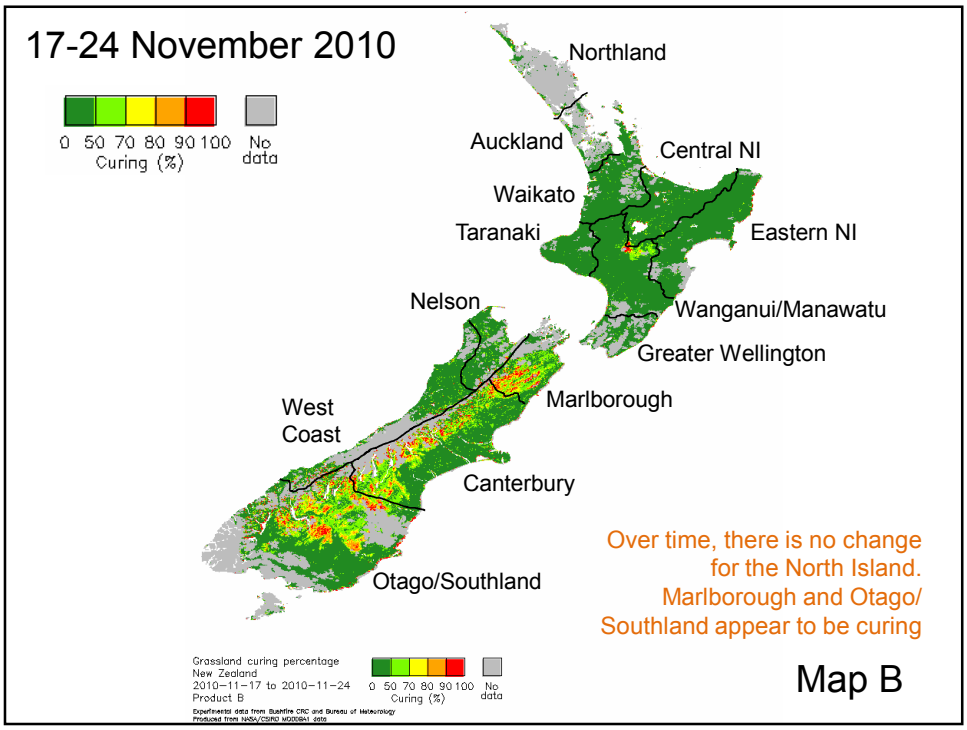
Central NI
Waikato
Taranaki
Eastern NI
Nelson
Wanganui/Manawatu
Greater Wellington
Marlborough
West Coast
Canterbury
Otago/Southland
Grassland curing percentage
New Zealand
2010-11-09 to 2010-11-16
Product B
0 50 70 80 90 100
Curing (%)
No data
Map B


17-24 November 2010
0 50 70 80 90 100
Curing (%)
No data
Northland
Auckland
Central NI
Waikato
Taranaki
Eastern NI
Nelson
Wanganui/Manawatu
Greater Wellington
Marlborough
West Coast
Canterbury
Otago/Southland
Over time, there is no change for the North Island. Marlborough and Otago/ Southland appear to be curing
Grassland curing percentage
New Zealand
2010-11-17 to 2010-11-24
Product B
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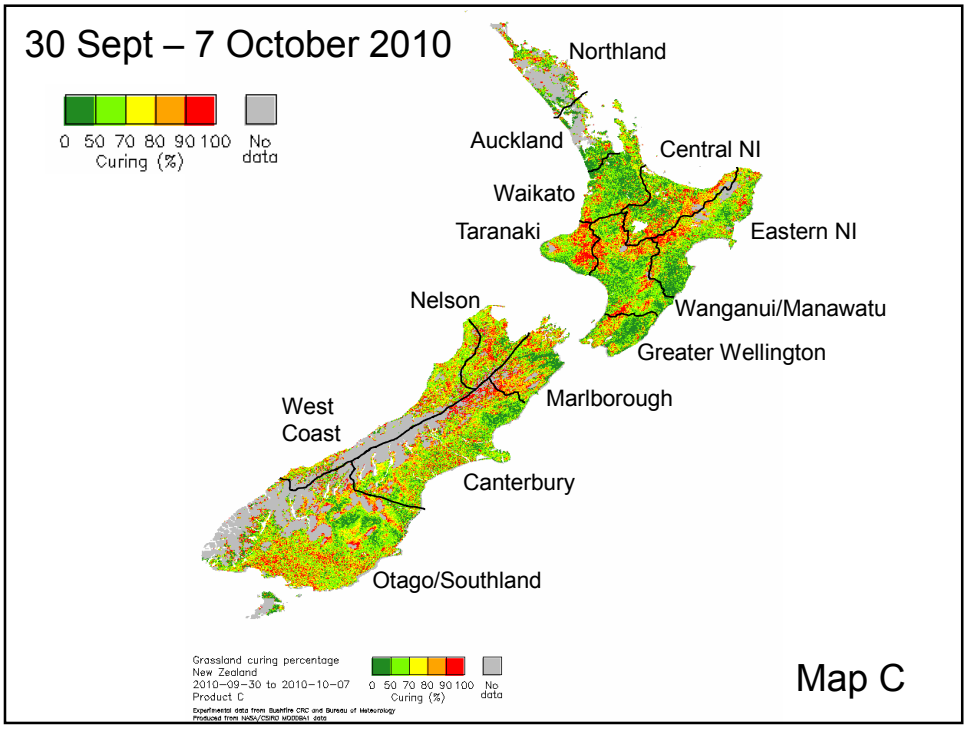
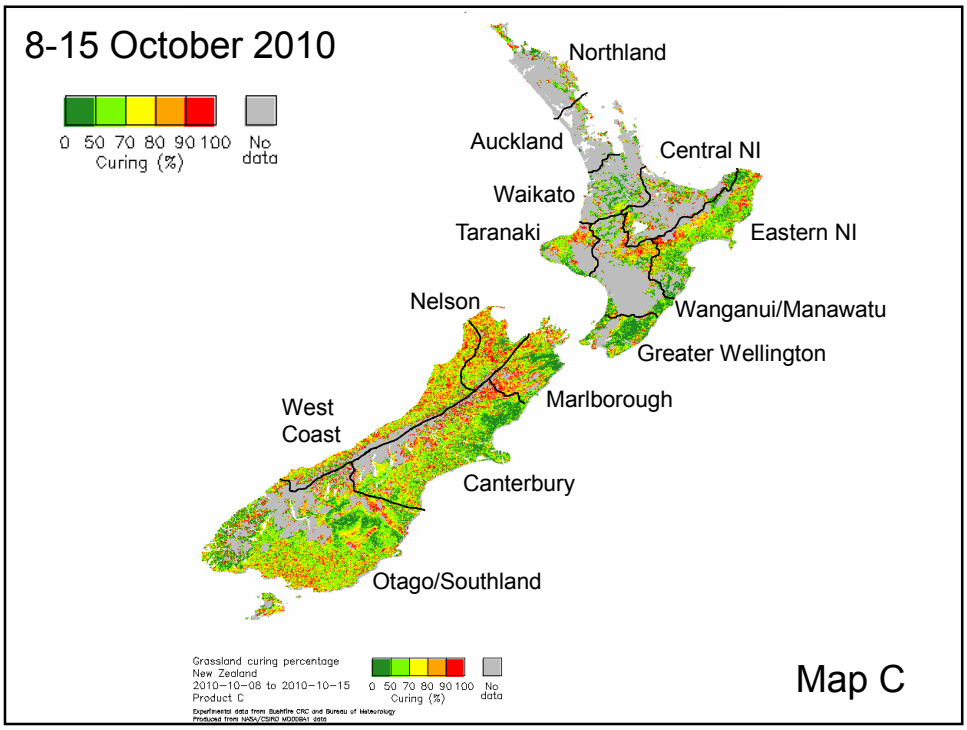
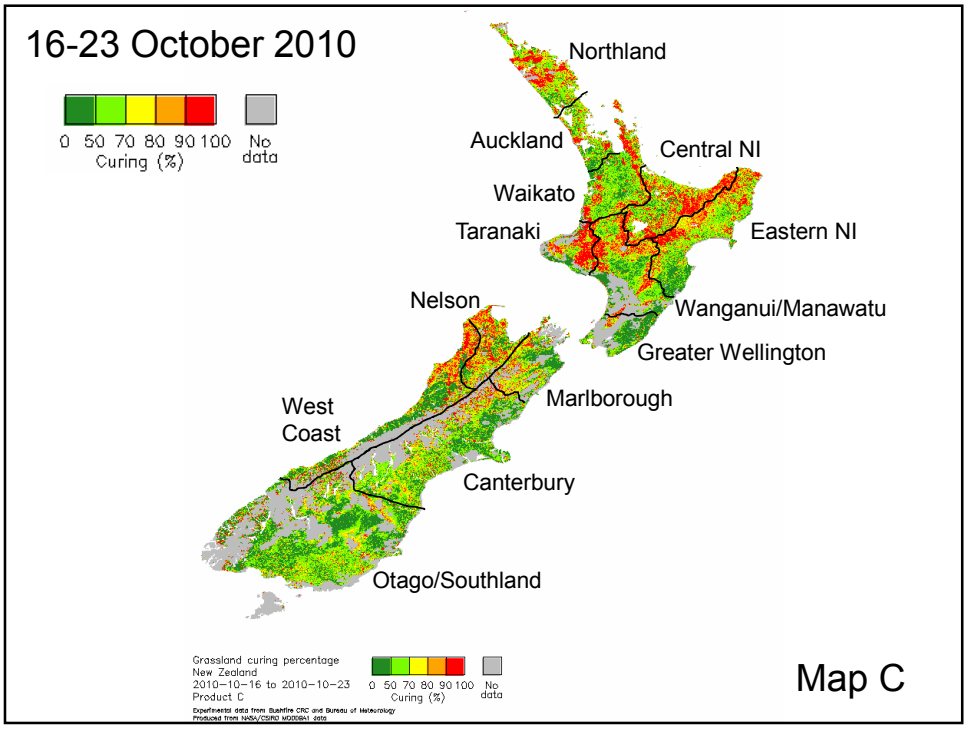
Curing (%)
No data
Map B


30 Sept – 7 October 2010
0 50 70 80 90 100
Curing (%)
No data
Northland
Auckland
Central NI
Waikato
Taranaki
Eastern NI
Nelson
Wanganui/Manawatu
Greater Wellington
Marlborough
West Coast
Canterbury
Otago/Southland
Grassland curing percentage
New Zealand
2010-09-30 to 2010-10-07
Product C
0 50 70 80 90 100
Curing (%)
No data
Map C


8-15 October 2010
0 50 70 80 90 100
Curing (%)
No data
Northland
Auckland
Central NI
Waikato
Taranaki
Eastern NI
Nelson
Wanganui/Manawatu
Greater Wellington
Marlborough
West Coast
Canterbury
Otago/Southland
Grassland curing percentage
New Zealand
2010-10-08 to 2010-10-15
Product C
0 50 70 80 90 100
Curing (%)
No data
Map C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Northland
Auckland
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Waikato
Taranaki
Eastern NI
Nelson
Wanganui/Manawatu
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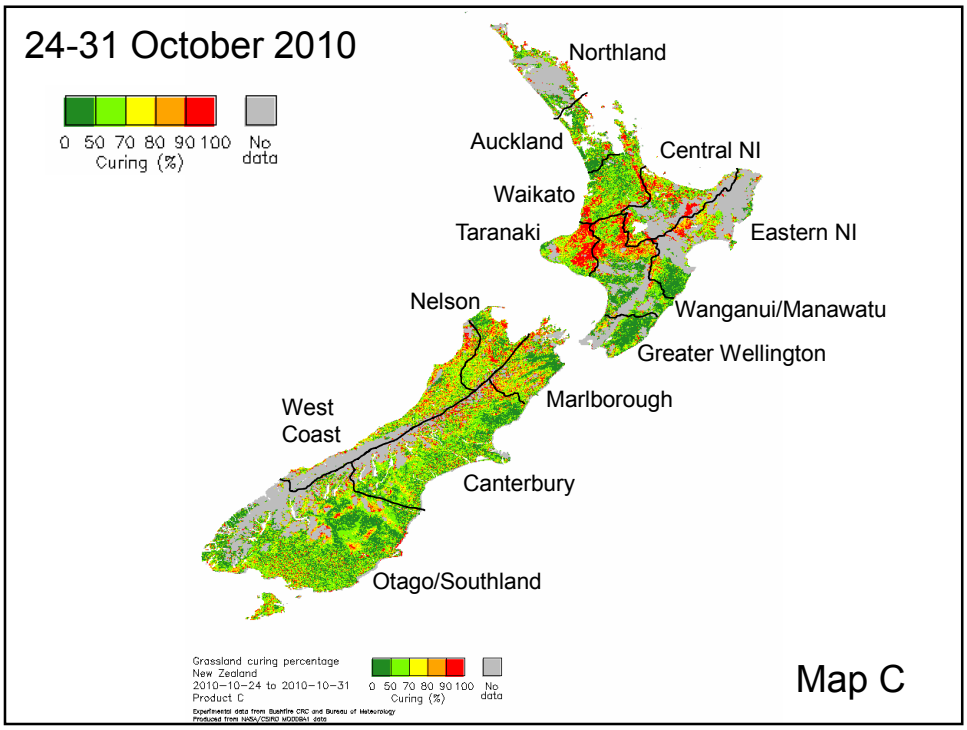
Marlborough
West Coast
Canterbury
Otago/Southland
Grassland curing percentage
New Zealand
2010-10-16 to 2010-10-23
Product C
0 50 70 80 90 100
Curing (%)
No data
Map C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Curing (%)
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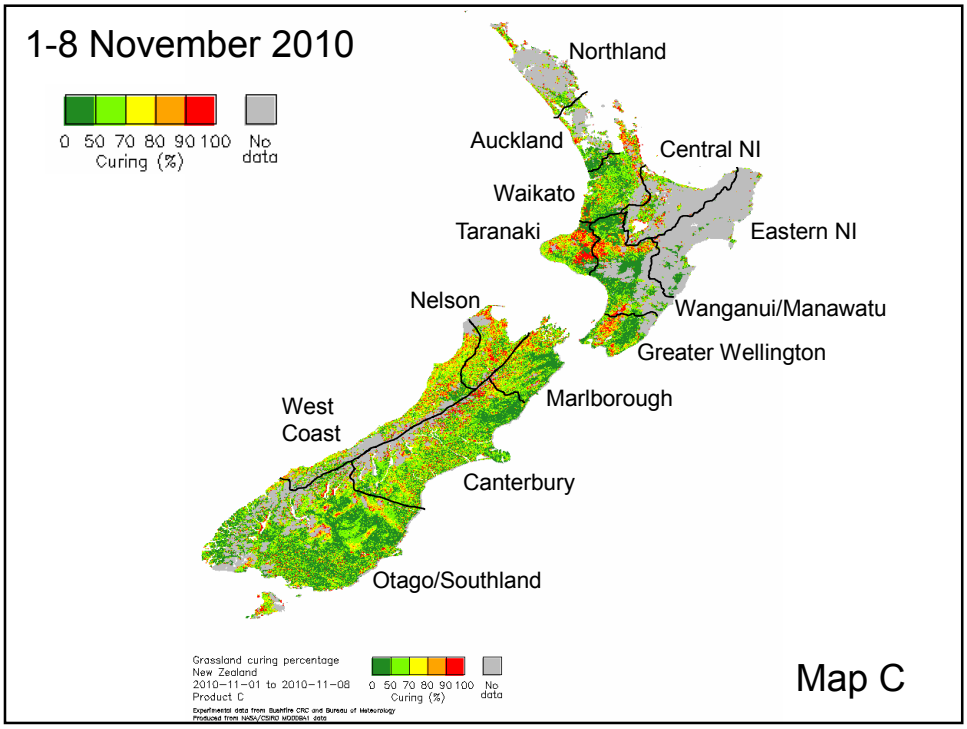
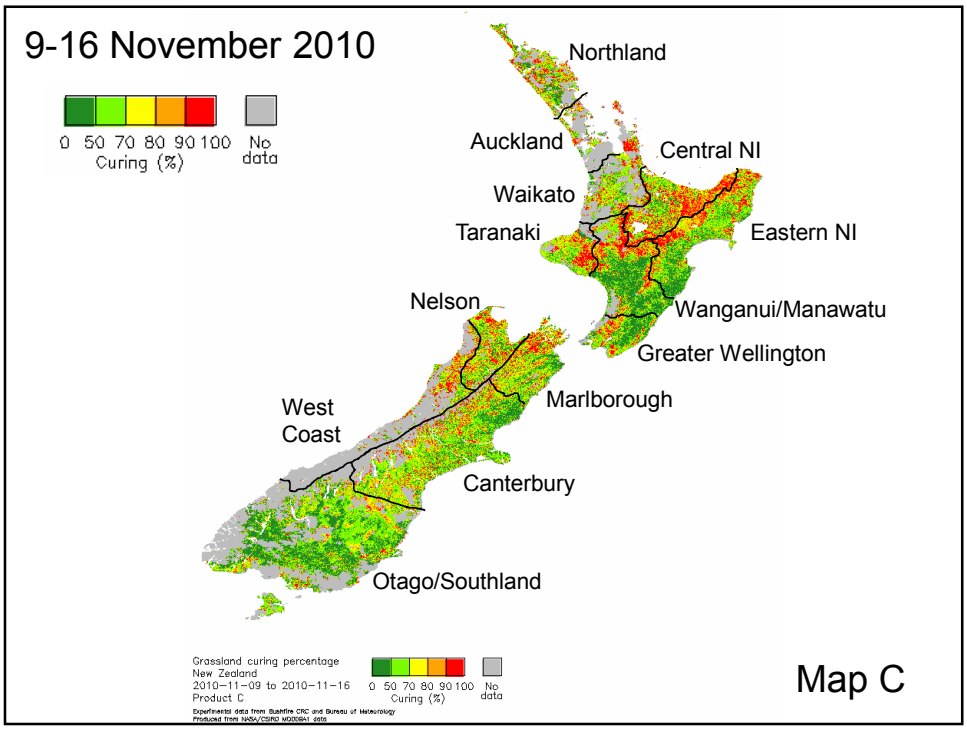
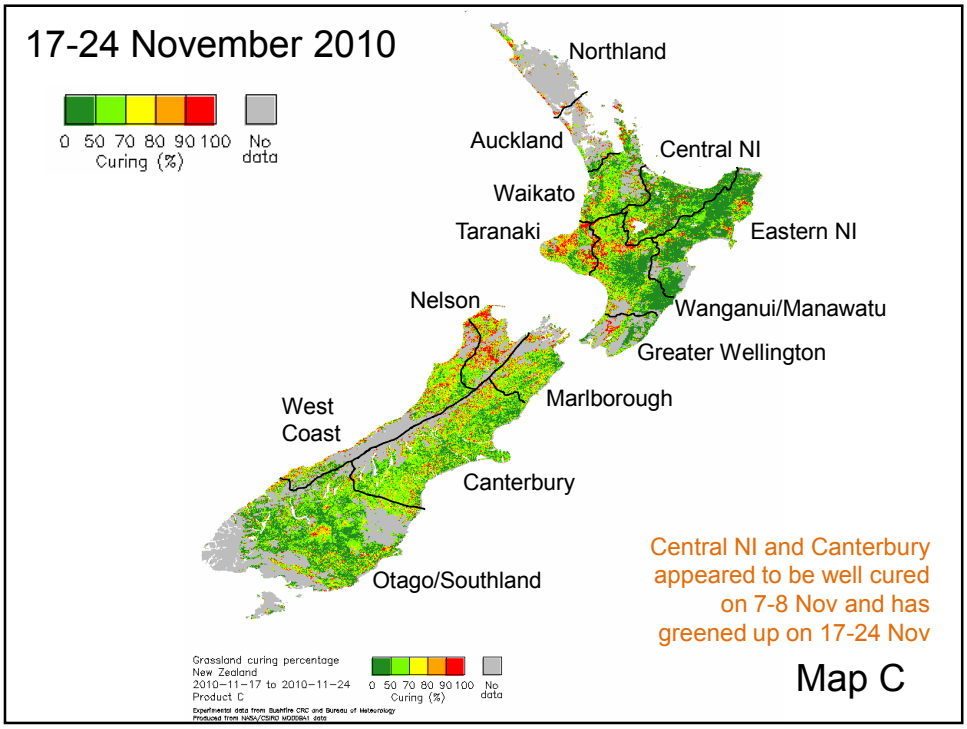
Central NI
Waikato
Taranaki
Eastern NI
Nelson
Wanganui/Manawatu
Greater Wellington
Marlborough
West Coast
Canterbury
Otago/Southland
Grassland curing percentage
New Zealand
2010-10-24 to 2010-10-31
Product C
0 50 70 80 90 100
Curing (%)
No data
Map C


1-8 November 2010
0 50 70 80 90 100
Curing (%)
No data
Northland
Auckland
Central NI
Waikato
Taranaki
Eastern NI
Nelson
Wanganui/Manawatu
Greater Wellington
Marlborough
West Coast
Canterbury
Otago/Southland
Grassland curing percentage
New Zealand
2010-11-01 to 2010-11-08
Product C
0 50 70 80 90 100
Curing (%)
No data
Map C


9-16 November 2010
0 50 70 80 90 100
Curing (%)
No data
Northland
Auckland
Central NI
Waikato
Taranaki
Eastern NI
Nelson
Wanganui/Manawatu
Greater Wellington
Marlborough
West Coast
Canterbury
Otago/Southland
Grassland curing percentage
New Zealand
2010-11-09 to 2010-11-16
Product C
Experimental data from Bushfire CRC and Bureau of Meteorology
Produced from NASA/CSIRO MODIS1 data
0 50 70 80 90 100
Curing (%)
No data
Map C


17-24 November 2010
0 50 70 80 90 100
Curing (%)
No data
Northland
Auckland
Central NI
Waikato
Taranaki
Eastern NI
Nelson
Wanganui/Manawatu
Greater Wellington
Marlborough
West Coast
Canterbury
Otago/Southland
Central NI and Canterbury appeared to be well cured on 7-8 Nov and has greened up on 17-24 Nov
Grassland curing percentage
New Zealand
2010-11-17 to 2010-11-24
Product C
Experimental data from Bushfire CRC and Bureau of Meteorology
Produced from NASA/CSIRO MODIS1 data
0 50 70 80 90 100
Curing (%)
No data
Map C

Future ahead

- Continuing with full season trial
- Explore implementation options (provider, coord. agency)
  - Web based instead of email alerts

Discussion:

- More enduser feedback please!
  - Paul Baker and Mike Grant in the lead
- Limitations: clouds, non-grassland cover, resolution 500m)

Summary

Latest tools for fire behaviour prediction:

1. Manual for Predicting Fire Behaviour
2. NZ Fire Behaviour Toolkit
3. Photoguide to NZ fuels
4. Prometheus
5. Satellite Imagery for grassland curing

Tools training workshops & IFB refreshers

- Nelson & Alexandra
- Christchurch x2

Use of Fire Behaviour Tools in Planning

A Department of Conservation National Overview

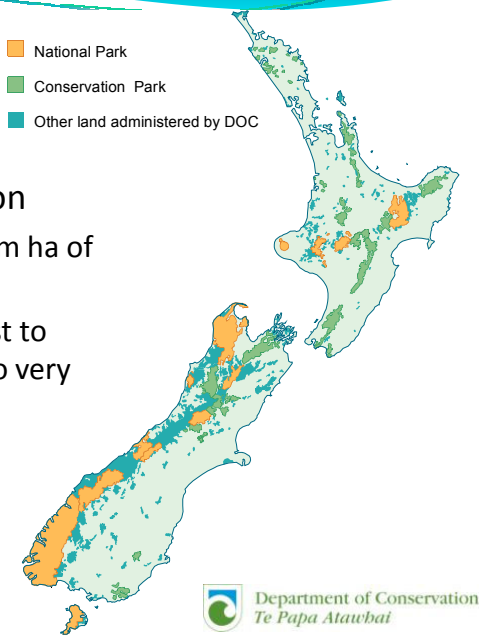
NZ Rural Fire Research Workshop
8-9 December 2010

Dave Hunt
Deputy National Fire Co-ordinator

DOCDM-677102

Department of Conservation
Te Papa Atawbai

Context



Department of Conservation

- Manages ≈ 30% of NZ (8.5m ha of land)
- Range of ecosystems (coast to mountain tops, very wet to very dry)

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Context

Key drivers

- environmental degradation
- loss of habitat & biodiversity
- ecosystem services are finite
- soundly-based outcome measures
- accurate & efficient data collection (NHMS)

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Context

Department of Conservation Fire Management costs (average/year of last 3 years)

Reduction	$2m
Readiness	$2.2m
Response	$2.4m
Recovery	$0.8m
Total	$7.2m

Needs & Current work

Require

- robust measure of biodiversity enhancement
- change in focus from “loss” to “protection” from $ spent

Current work

- Wildfire Threat Analysis
- fire behaviour simulation modelling
- fire management planning in Canterbury

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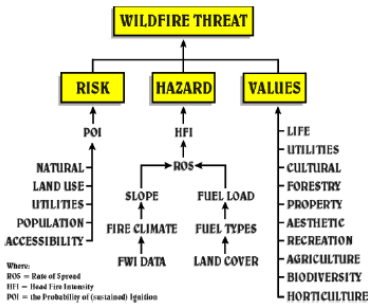
Wildfire Threat Analysis - National

Conservancies working on WTA

- East Coast - Bay of Plenty
- Tongariro-Taupo (part)
- Wellington (part)
- Canterbury
- Otago (almost completed)
- Northland (just starting)



Needs

- specific data sets e.g. improved fuel type and fuel load maps
- standard approach to WTA

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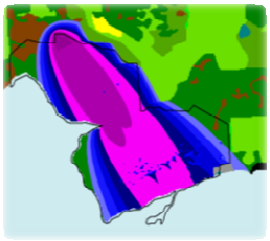
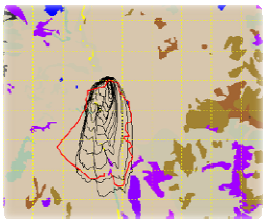
Fire Behaviour Simulation Models

Using simulation models as decision-support tools.

- aiding development of suppression strategies;
- planning tool prior to & during fire events;
- post-fire assessment tool

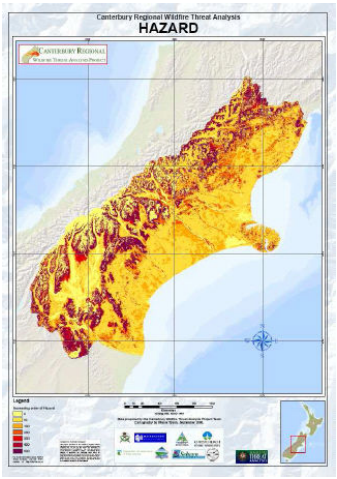
Process started - *Prometheus* Fire Growth Simulation Modelling course July 2010





Fire Management Planning in Canterbury Conservancy

- Updating the WTA
- Strategic and Tactical Fire Management Planning (STFMP) Project (underway)
  - provide an up to date "decision support tool" to plan and mitigate against fire on the landscape



Fire Management Planning in Canterbury Conservancy cont.

- Utilises a range of resources to prepare plans:
  - the Department's Natural Heritage & Monitoring System
  - WTA
  - NZ Fire Danger Rating System
  - key stakeholders &
  - *Prometheus*

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The End

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Strategic Tactical Fire Management Planning (STFMP) – Multi-Agency Approach

Presentation by Heather Wakelin
Project led by the Department of Conservation

Outline

- Justification and Objective
- Risk Assessment
- STFMP Process
- Draft Plan Areas for Canterbury
- Use of Prometheus
- Conclusion

Justification and Objective

- NRFA Standard – Assessing Fire Hazards

  Key Requirements
  - WTA and map ✓
  - If WTA ≥ 601 → risk assessment following AS/NZS ISO 31000
  - Risk must be identified, analysed, evaluated, and treated
  - Register of Building Risk Assessment must be established (NZFS)

Risk Assessment (AS/NZS ISO 31000)

- Risk Management – Principles and Guidelines
- Framework for analysis
- Protecting Values
- Establishing Communication/Consultation
- Defining Risk

  Likelihood x Consequence

STFMP - Definitions

Strategic

- allows long-term vision and goals to be established and realised

Tactical

- turns strategy into reality and is usually tightly integrated with annual budget processes

STFMP

Project initiated in 2006

Originally DOC only

A draft guideline and template has been developed which includes multiple agencies

Improvements to Fire Management

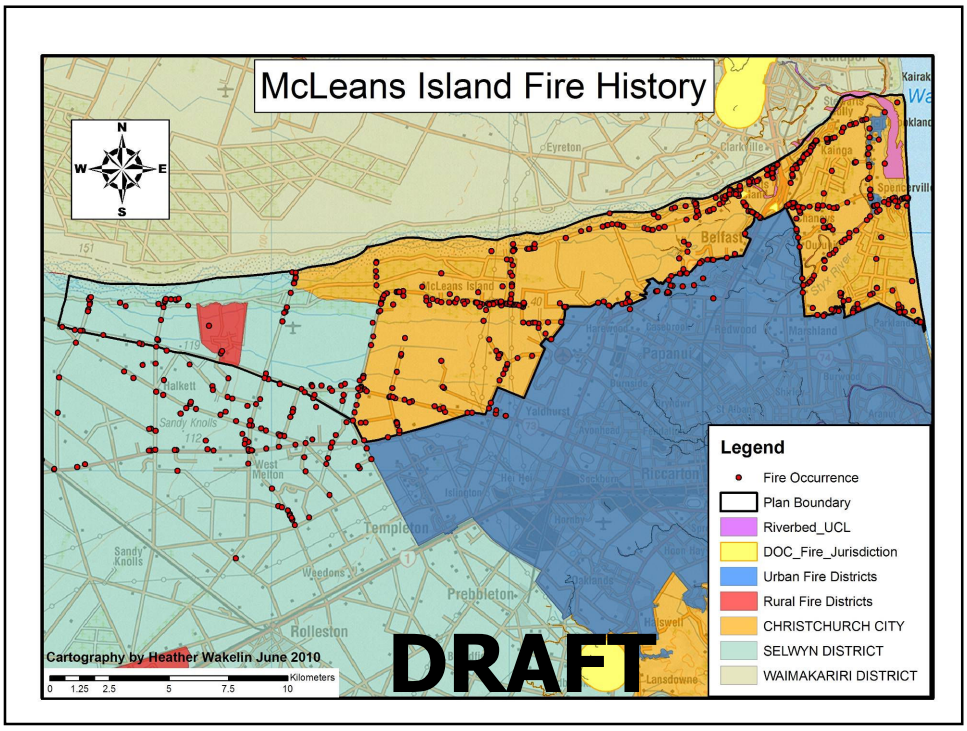
Fire reduction

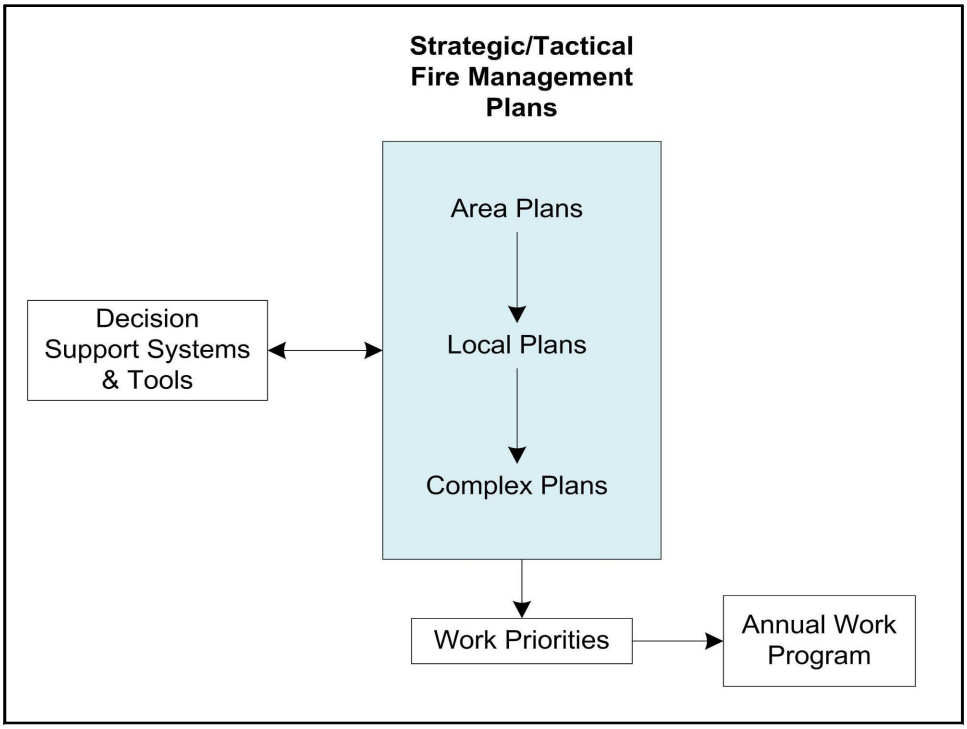
Values and risks → improved collaboration

- Focusing fire management activities in most appropriate places
- Standardised format → consistency for prioritising
- Access to the best available information in a GIS-format (ARC READER)

What does the STFMP process involve?

- Creating plans for land areas managed by RFAs → determining mitigation actions based on **PRIORITY**
- Information gathering
- WTA Summary and Local Knowledge
- Identifying management constraints
- Partitioning land into similar priority groups


McLeans Island Fire History
N
W
E
S
Legend
Fire Occurrence
Plan Boundary
Riverbed_UCL
DOC_Fire_Jurisdiction
Urban Fire Districts
Rural Fire Districts
CHRISTCHURCH CITY
SELWYN DISTRICT
WAIMAKARIRI DISTRICT
Cartography by Heather Wakelin June 2010
Kilometers
0 1.25 2.5 5 7.5 10
DRAFT


Strategic/Tactical Fire Management Plans
Area Plans
Local Plans
Complex Plans
Decision Support Systems & Tools
Work Priorities
Annual Work Program

STFMP – Local Plans and Complex Plans

- WTA Reclassification Tool

+

- Local Knowledge

Local Plans

1. LOW PRIORITY
2. MEDIUM PRIORITY
3. HIGH PRIORITY
4. VERY HIGH PRIORITY

Complex Plans

1. Life
2. Property Values
3. Biodiversity
4. Historic Values
5. Iwi Values
6. Rec Values
7. Ecosystem Services
8. Economic/Utility
9. Other
10. RFA

STFMP – Mitigation Actions

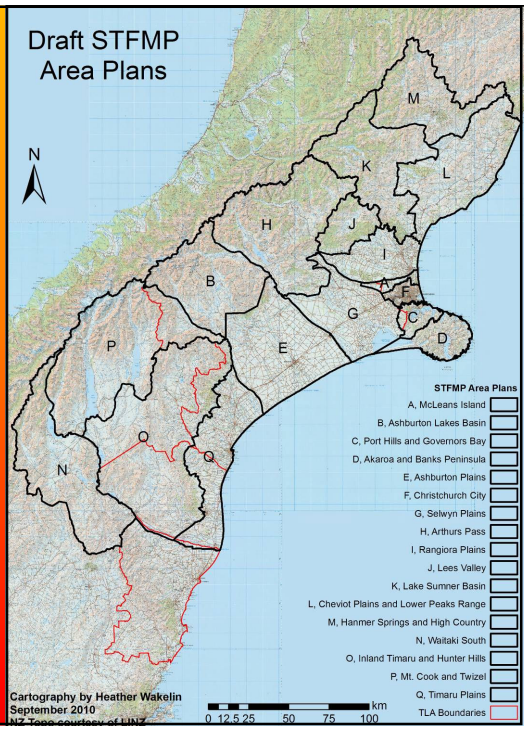
- 4R's of Emergency Management

Specifications

- General (Area Plan)
- Priority (Local Plan)
- Specifiction (Complex Plan)

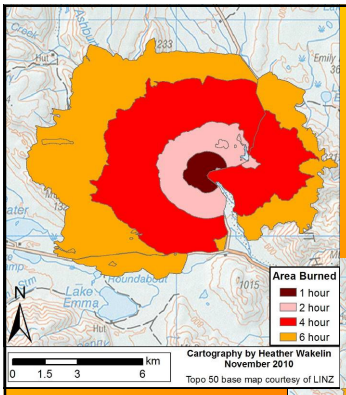
Criteria for Area Plan Boundaries

- Natural topographic features
- TLA boundaries
- Rural Fire Authority fire restriction lines
- Include small communities
- Size is determined based on complexity of values and risks in the area



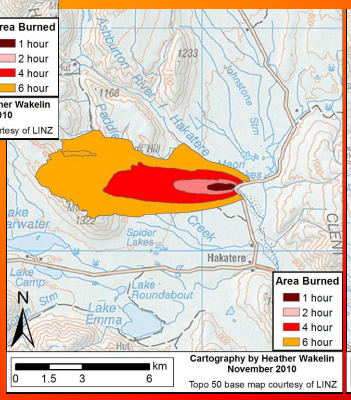
Prometheus

Very High/Extreme Grassland Fire Danger

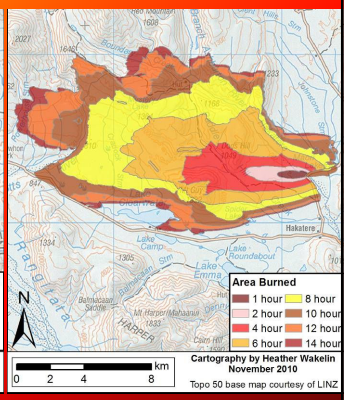


Very High - No wind

Grassland Curing = 85% for these Scenarios



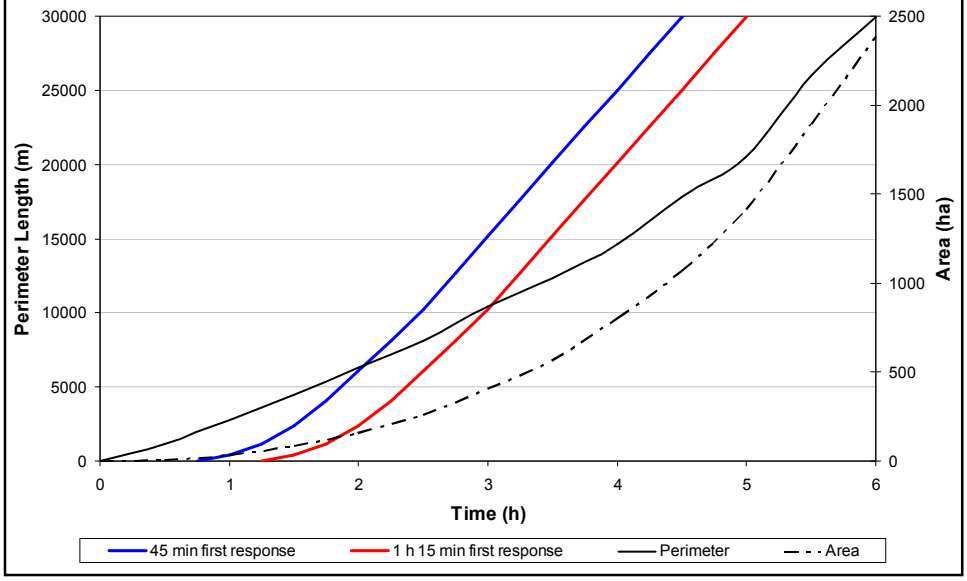
Very High - Wind 15 km/h



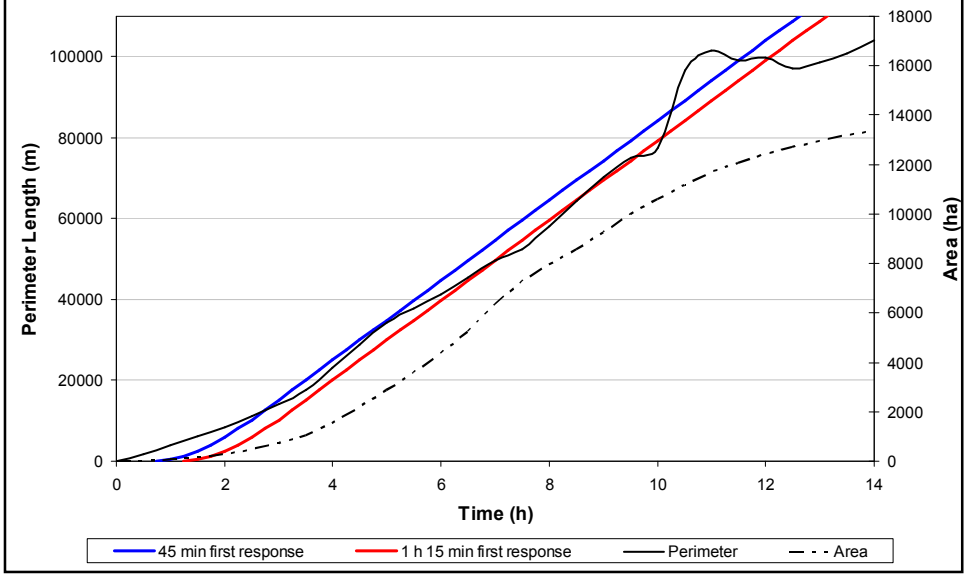
Extreme (diurnal) – 14 hours
Wind 15 km/h

DRAFT

Predetermined Response – Very High Fire Danger (Plan MC_B) **DRAFT**



Predetermined Response – Extreme (diurnal) Fire Danger (Plan MC_B) **DRAFT**



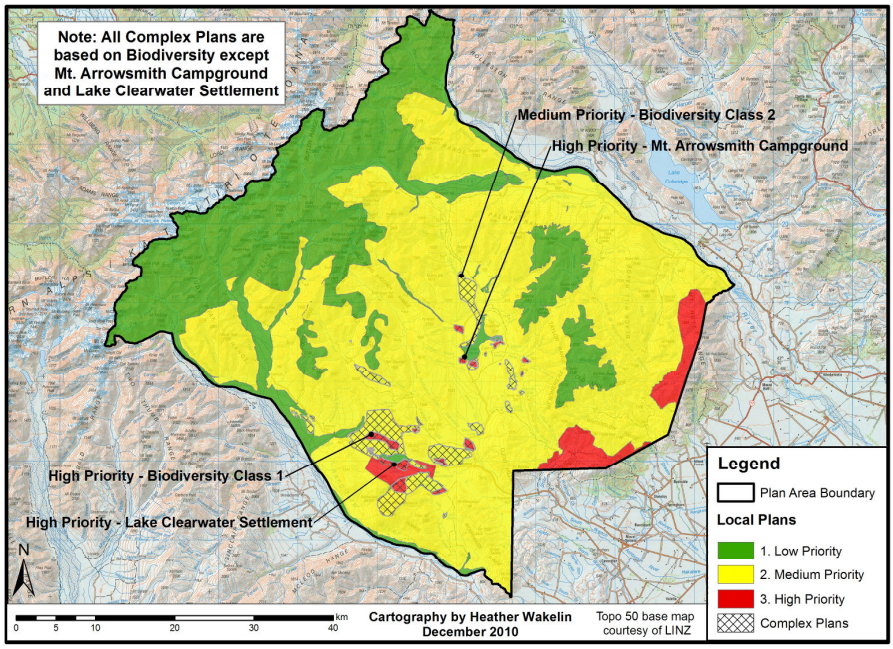
Predetermined Response objectives and actions DRAFT

Ashburton Basin (Responding via Ashburton Gorge Road)

Medium and High Priority Local Plans

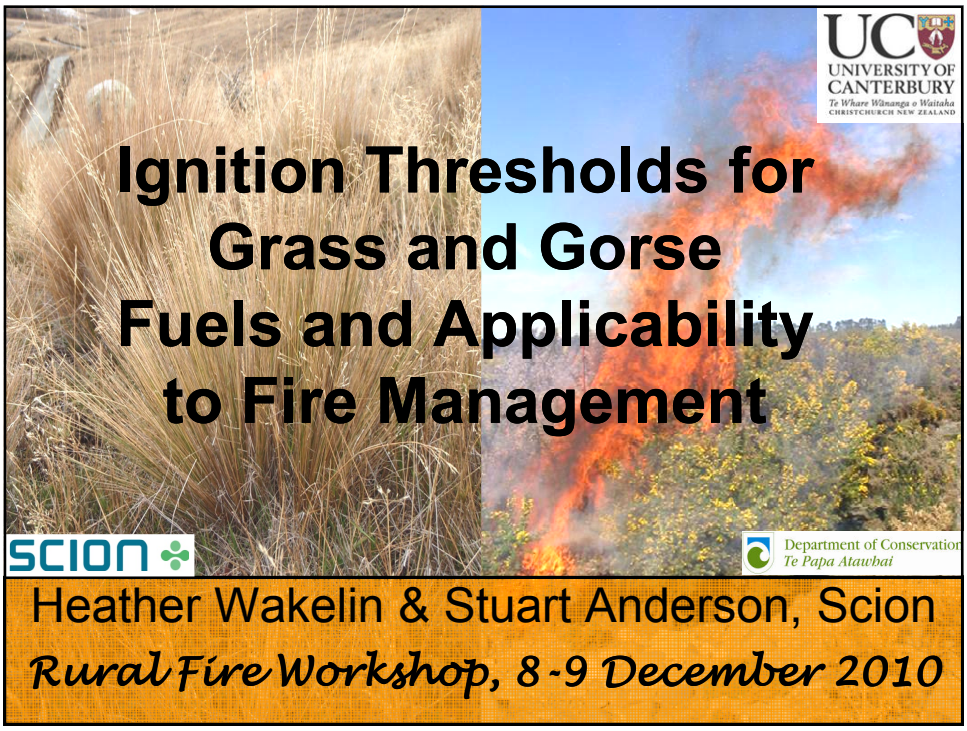
Grassland Fire Danger	Objective	Plan of Action		
		Resources	Location	Approximate Arrival Time*
Low or Moderate	To contain the fire to < 5 ha within 2.5 hours.	1 ground crew (3 pax) 1 ground crew (4 pax)	ADC Mt. Somers NZFS Methven	45 min 1 h 15 min
	Standby Requirements	1 helicopter	Mt. Hutt	
High	To contain the fire to < 50 ha within 2.5 hours.	1 ground crew (4 pax) 1 helicopter 1 ground crew (4 pax) 1 ground crew (4 pax) 1 helicopter 1 ground crew (4 pax) 1 filling crew 1 ground crew (6 pax)	ADC Mt. Somers Mt. Hutt ADC Mayfield ADC Alford Forest Mt. Hutt NZFS Methven NZFS Methven ADC Ash Rural	45 min 45 min 1 h 1 h 1 h 1 h 15 min 1 h 15 min 1 h 30 min
		Other Resources: RFO (Initial Attack IC) - with backup smoke chaser if from DOC, Air Support Supervisor, Operations Manager, Logistics Manager and 2 support personnel, Command Unit, 100 litres foam		
	Standby Requirements	1 helicopter 1 fixed wing Bulk foam retardant supplies	Rakaia Gorge Methven	N/A
Very High or Extreme	To contain the fire within the first 12 hour operational period.	1 ground crew (4 pax) 1 helicopter 1 helicopter 1 ground crew (4 pax) 1 ground crew (4 pax) 1 helicopter 1 fixed wing 2 filling crews 1 ground crew (4 pax) 1 ground crew (4 pax) 2 helicopters 1 helicopter 1 filling crew 1 ground crew (6 pax) 1 ground crew (4 pax) 1 ground crew (4 pax) 1 ground crew (4 pax) 1 fixed wing 1 filling crew 1 ground crew (4 pax) 2 ground crews (8 pax) 1 fixed wing 1 ground crew (4 pax) 1 ground crew (4 pax) 2 ground crews (8 pax) 2 ground crews (8 pax)	ADC Mt. Somers Mt. Hutt Upper Rakaia ADC Mayfield ADC Alford Forest Mt. Hutt Methven NZFS Methven ADC Rakaia Gorge ADC Laureston Christchurch Hokitika NZFS Ashburton ADC Ash Rural SCRFD Peel Forest ADC Hinds ADC Willowby Twizel SDC Colleridge ADC Pendarves ADC Rakaia Waikari DOC Geraldine DOC Geraldine DOC Rangiora DOC Christchurch	45 min 45 min 45 min 1 h 1 h 1 h 1 h 1 h 15 min 1 h 15 min 1 h 15 min 1 h 15 min 1 h 15 min 1 h 30 min 1 h 30 min 1 h 30 min 1 h 30 min 1 h 30 min 1 h 45 min 1 h 45 min 1 h 45 min 1 h 45 min 2 h 2 h 30 min 2 h 30 min 2 h 30 min
		Other Resources: Full Regional Incident Management Team (fully kitted), Northern and Southern Retardant Units, ICP adequate site with power, phone and assembly area, Fire Depot Maintenance Services, 300 litres foam		
	Standby Consideration	Full National Incident Management Team (fully kitted)		

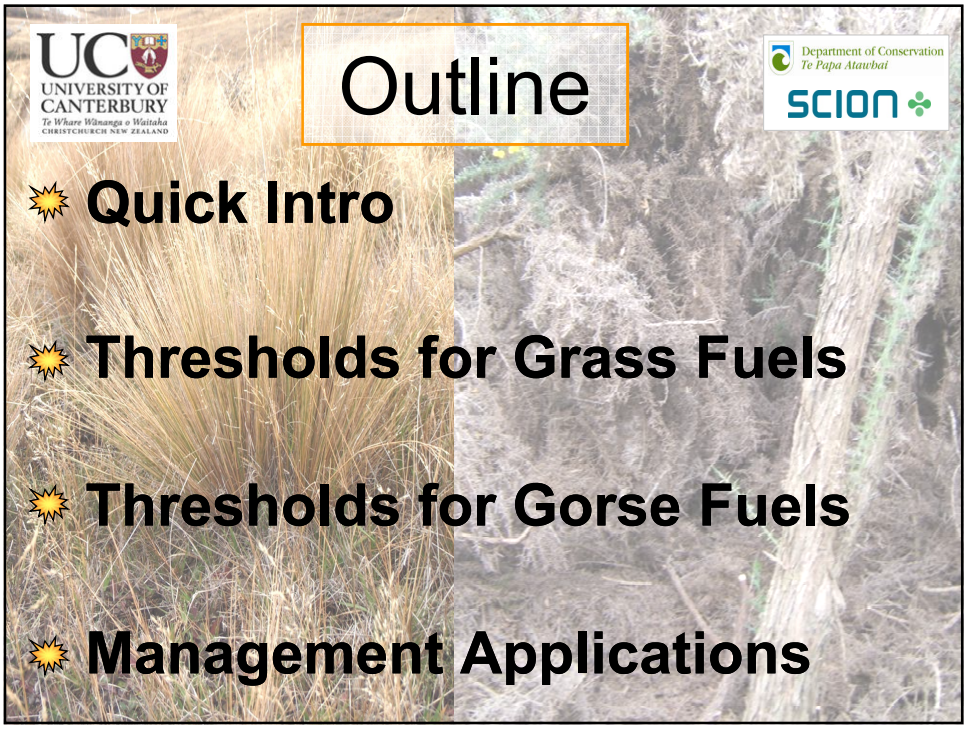
Local and Complex Plans DRAFT



Conclusion

- The STFMP process **WILL** meet the NRFA standard and **WILL** follow the AS/NZS ISO 31000 of Risk Assessment
- Multi-agency approach ensures collaboration between RFAs
- Allows for variable management actions and budgets
- Establishes and maintains good communication between RFAs and stakeholders within plan areas


UC
UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND
Ignition Thresholds for Grass and Gorse Fuels and Applicability to Fire Management
SCION
Department of Conservation
Te Papa Atawbai
Heather Wakelin & Stuart Anderson, Scion
Rural Fire Workshop, 8-9 December 2010


UC
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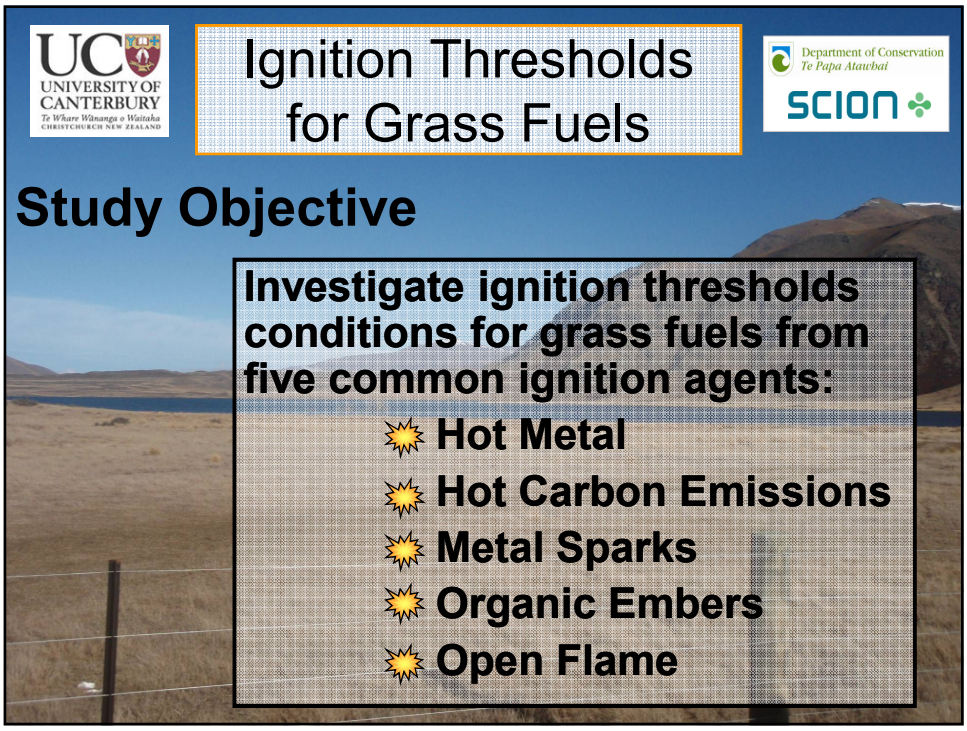
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND
Outline
Department of Conservation
Te Papa Atawbai
SCION
Quick Intro
Thresholds for Grass Fuels
Thresholds for Gorse Fuels
Management Applications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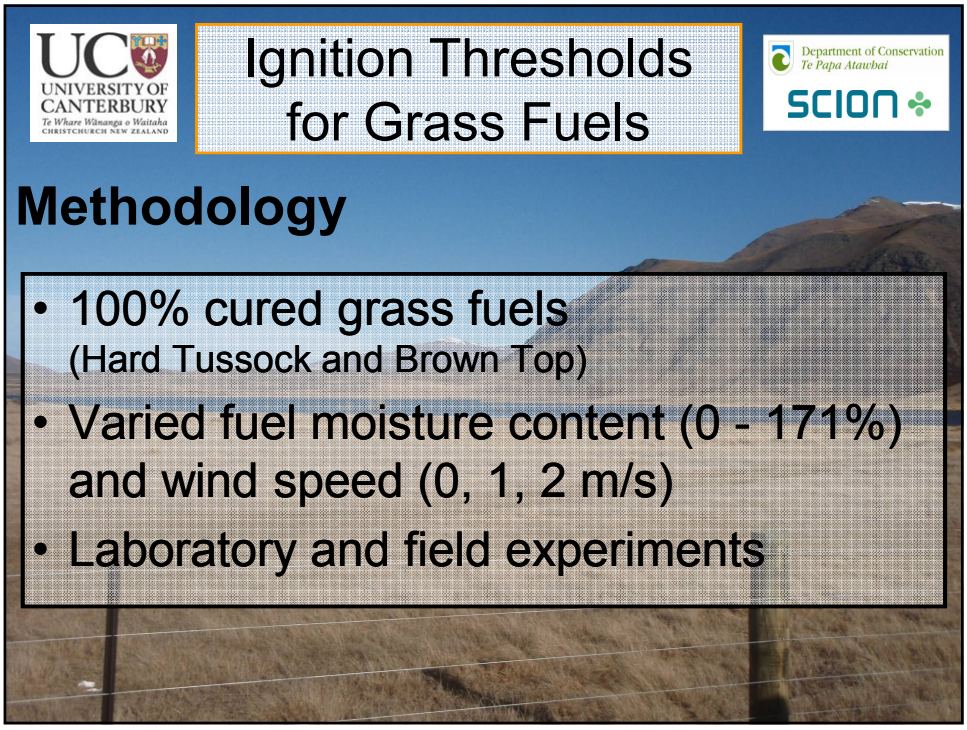
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND
Ignition Thresholds for Grass Fuels
Department of Conservation
Te Papa Atawbai
SCION
Study Objective
Investigate ignition thresholds conditions for grass fuels from five common ignition agents:
Hot Metal
Hot Carbon Emissions
Metal Sparks
Organic Embers
Open Flame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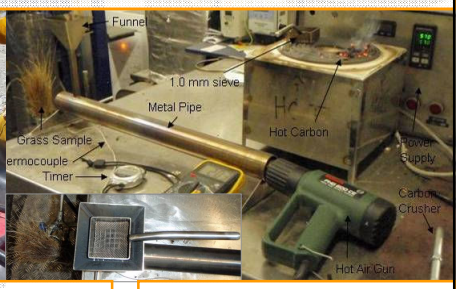
CHRISTCHURCH NEW ZEALAND
Ignition Thresholds for Grass Fuels
Department of Conservation
Te Papa Atawbai
SCION
Methodology
100% cured grass fuels
(Hard Tussock and Brown Top)
Varied fuel moisture content (0 - 171%) and wind speed (0, 1, 2 m/s)
Laboratory and field experiments

Hot Metal

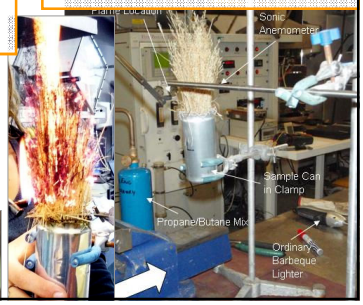
Hot Carbon Emissions



Metal Sparks

Organic Embers

Open Flame



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Ignition Thresholds for Grass Fuels

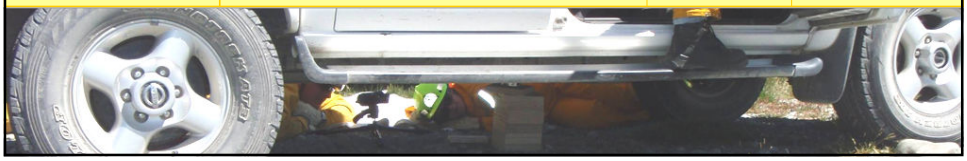
Department of Conservation
Te Papa Atawbai

SCION

Results

Thresholds for a 50% probability of ignition

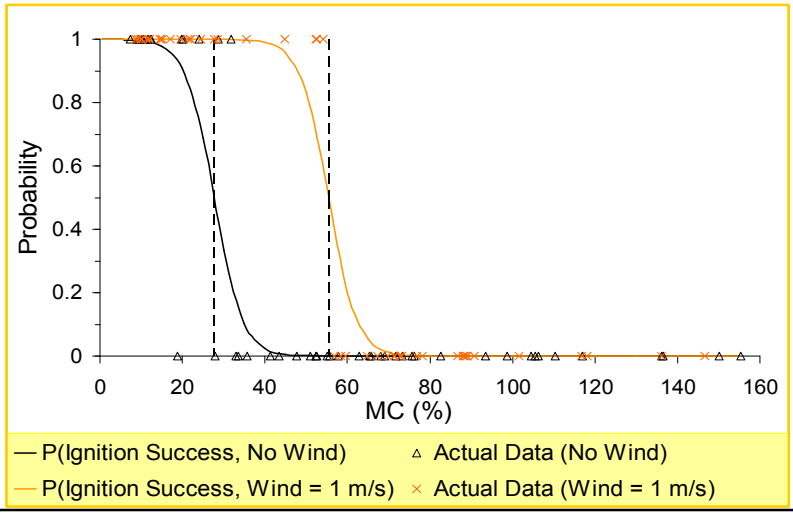
Ignition Source	Scenario	Ignition Threshold	
		FFMC	°C or MC
Hot Metal	Vertical Hot Plate, Wind = 2 ms^{-1}, MC = 1%	**100**	**398°C**
	Vertical Hot Plate, Wind = 1 ms^{-1}, MC = 1%	**100**	**421°C**
	Horizontal Hot Plate, Wind = 2 ms^{-1}, MC = 1%	**100**	**429°C**
	Horizontal Hot Plate, Wind = 1 ms^{-1}, MC = 1%	**100**	**452°C**
Carbon Emissions	N/A	**52**	**65% MC**
Metal Sparks	N/A	**69**	**37% MC**
Open Flame	No wind	**75**	**28% MC**
	Wind = 1 ms^{-1}	**57**	**55% MC**



Ignition Thresholds for Grass Fuels

Results

Open Flame Model



Ignition Thresholds for Gorse Fuels

Study Objective

- **Understand and model fuel moisture relationships in dead gorse**
- **Investigate threshold conditions for fire development (ignition and fire spread) in gorse fuels**

Ignition Thresholds for Gorse Fuels

Methodology

- **Daily and hourly fuel moisture sampling of gorse fuel layers**
- **Fire ignition tests (not spread)**
  - **cigarette lighter, individual bushes**
- **Fire spread tests (ignition and sustained spread)**
  - **drip torch, contiguous gorse**

Ignition Thresholds for Gorse Fuels

Results

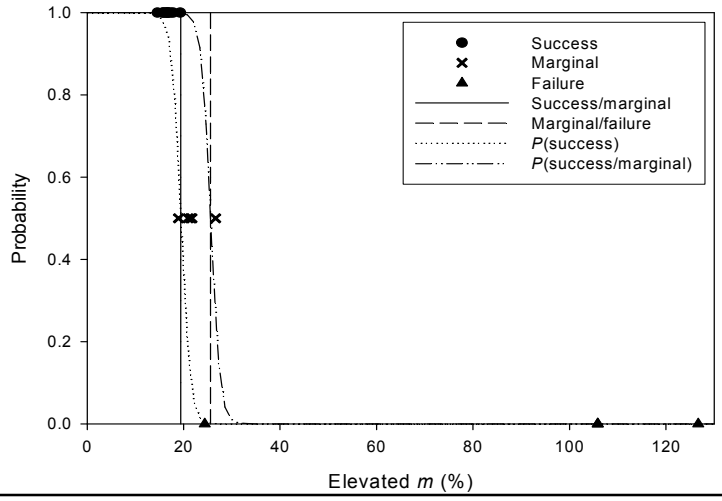
Ignition thresholds for fire development in terms of a 50% probability of ignition

Elevated *m* (%)	FFMC	Ignition	Fire Spread
> 36%	< 69.5	NO	NO
30 – 36%	69.5 – 73.9	MARGINAL	NO
26 – 30%	74.0 – 77.0	YES	NO
19 – 26%	77.0 – 82.7	YES	MARGINAL
< 19%	> 82.7	YES	YES

Ignition Thresholds for Gorse Fuels

Results

Ignition & Spread Model



Management Applications

Grass Fuels

Open Flame Example

FFMC	MC	Probability of Ignition	
		No Wind	Wind = 1 m/s
100	1%	1.00	1.00
96	5%	1.00	1.00
91	10%	0.99	1.00
86	15%	0.98	1.00
82	20%	0.91	1.00
78	25%	0.69	1.00
74	30%	0.34	1.00
70	35%	0.10	1.00
67	40%	0.03	0.99
63	45%	0.01	0.96
60	50%	0.00	0.83
57	55%	0.00	0.53
55	60%	0.00	0.20
52	65%	0.00	0.05
49	70%	0.00	0.01
47	75%	0.00	0.00

Management Applications

Grass Fuels

- access restrictions or closures
- education
- restriction or prohibition of use of open flame or spark hazardous activities

Gorse Fuels

- permit issue
- burning prescription

References

Wakelin, H. M., Anderson, S. A. J., Cochrane, C. H., & Teeling, A. M. (2010). Ignition thresholds in grassland fuels and management applications for public conservation land in Canterbury. Scion Rural Fire Research Group, Christchurch. Fire Technology Transfer Note 39 (June 2010). 12 p.

Scion. (2009). Thresholds for fire development in gorse. Scion, Rural Fire Research Group, Christchurch. *Rural Fire Research Update* 6 (December 2009). 4 p.

User Guide to the NZFDRS

Grant Pearce & Heather Wakelin

Rural Fire Research Workshop 2010

Development of a User Guide to the NZFDRS

Overview:

- aims and objectives
- contents and structure
- applications examples
- proposed format
- progress to date

Objective

To develop a "User Guide" to the New Zealand Fire Danger Rating System (NZFDRS), containing:

- background to and present status of the NZFDRS
- guidelines and worked examples on use of the NZFDRS to develop decision-support aids
  - best practice guides
  - locally relevant "trigger points"

Outcomes

A "one stop" guide to use of the NZFDRS, that will result in:

- improved understanding of the NZFDRS and potential applications
- greater uptake and operational use of scientific knowledge by fire managers
- improved standards of fire management through more consistent application of the NZFDRS

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Development

- Project initiated and end-user project team established Aug. 2008
- Input sought on needs, content and format for the User Guide
- Existing application examples obtained
- Priorities for application development agreed
- Development of Guide commenced late 2009, and ongoing since

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User Guide structure

- **Overview & Background section**
  - development history of NZFDRS
  - current NZFDRS structure and basis
- **Applications section**
  - operational application guides
  - listing of information sources
  - worked examples
- Appendices
  - bibliography of NZFDRS literature
  - copies of relevant publications

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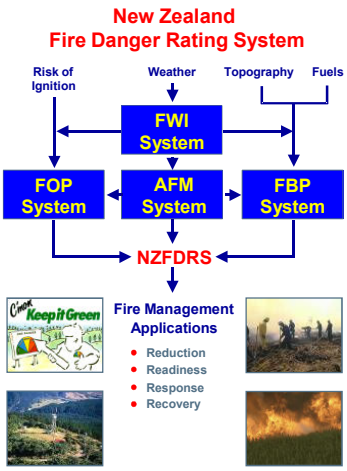
Background section

1. Introduction
2. Background to the NZFDRS
   - 2.1 History of development
   - 2.2 Current structure
     - 2.2.1 FWI System
       - Fire weather monitoring
       - Fire weather forecasting
     - 2.2.2 FBP System
     - 2.2.3 Fire danger class criteria
   - 2.3 Other NZFDRS components
     - 2.3.1 Accessory Fuel Moisture (AFM) subsystem
     - 2.3.2 Fire Occurrence Prediction (FOP) System



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Applications section

- Practical fire management activities across the '4 Rs' (Reduction, Readiness, Response and Recovery) with introductory description of each
- Useful data and tools

Input	Data Sources	Availability
Weather/climate	weather station archives	Rural Fire Authorities (e.g. DOC, forestry companies)
	fire weather data	FWSYS (www.nrfa.org.nz) RuralNet fire weather archive (https://portal.fire.org.nz/FireNet/)
	fire climatology	Pearce et al. (2003) report (www.scionresearch.com/fire)
	climate records	NIWA National Climate Database, CliFlo (http://cliflo.niwa.co.nz/)
	rainfall data	Regional Councils
	forecast weather & FWI	MetService MetConnect (http://www.metconnect.co.nz/)
Fuels/Vegetation	topographic maps	Terralink (www.terralink.co.nz)
	aerial photographs	Terralink (www.terralink.co.nz) GoogleMaps
	forest inventory maps	forestry companies MAF
	Land Cover Database (LCDB 1 & 2)	Terralink (www.terralink.co.nz)

Applications worked examples

Reduction:
- trigger points for Restricted and Prohibited Fire Seasons
- guidelines for operation of fire danger signs
- public access controls (e.g. island closure)
- activity restriction triggers (e.g. spark hazards)
- permit conditions associated with crop stubble burning
- permit issue/requirements for gorse scrub burning

Readiness:
- guidelines for FWI codes and indices – threshold values/ranges
- readiness levels – stand-by requirements (based on FWIs)
- initial attack guidelines – based on predicted fire danger/fire behaviour

Response:
- trigger points for community warnings and/or evacuations
- backwards FWI determination (from fire behaviour)

Recovery:
- wildfire documentation case study preparation (lessons learned, fire behaviour)

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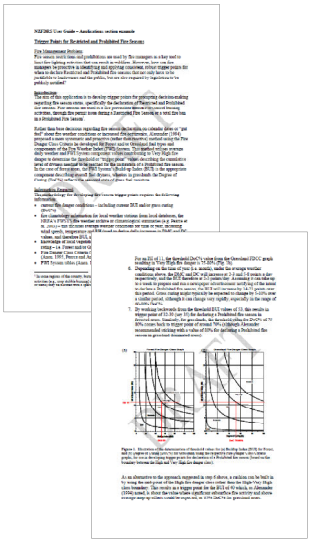
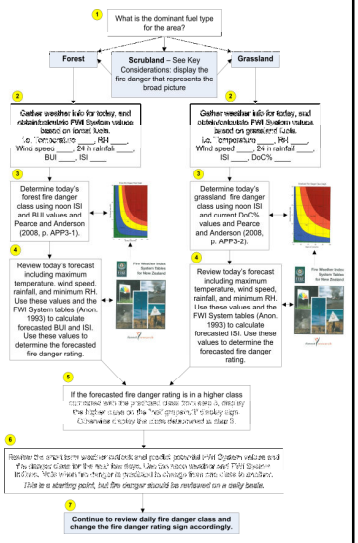
Worked examples

- Fire management problem statement
- Overview of application
- Summary of information required
- Fire management objective
- Methodology
  - step-by-step process for developing local versions



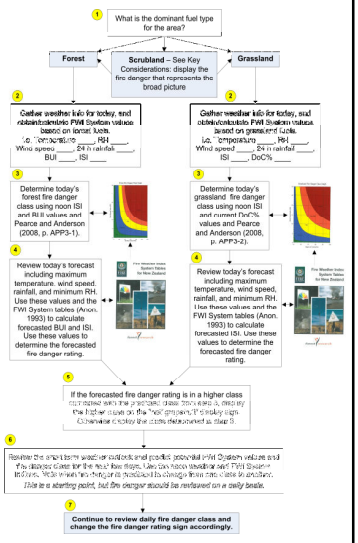
Worked examples

- Fire management problem statement
- Overview of application
- Summary of information required
- Fire management objective
- Methodology
  - step-by-step process
  - flow chart of process



Worked examples

- Fire management problem statement
- Overview of application
- Summary of information required
- Fire management objective
- Methodology
  - step-by-step process
  - flow chart of process
- Worked example
- Key considerations



Intended as stand-alone document

- includes relevant tables/graphs + references

Progress to date

- Introduction / Background section drafted
- Applications section drafted
- Worked examples being finalised for:
  - fire season status triggers, fire danger sign operation, access controls, grass activity restriction triggers, permit issue guides for crop stubble & gorse
  - evacuation triggers, backwards FWI (+ IA guides)
- Peer review by project end-user group
- Publication by Apr/May 2011
- Intended as living document, additional applications/ worked examples to be added over time
- Tech transfer needs?

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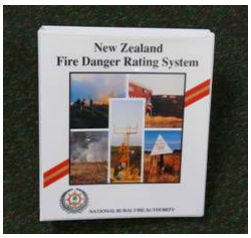
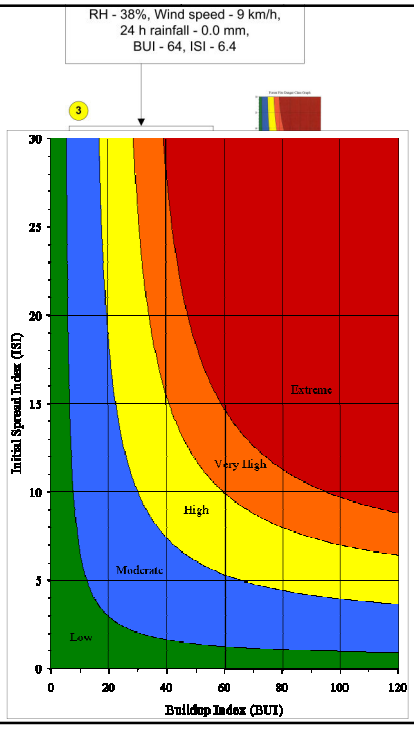
Proposed format(s)

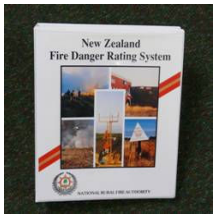
- Hard-copy paper version (binder)
- Web-based electronic version





Summary

- **Comprehensive "User Guide" to NZFDRS:**
  - background and present status of the NZFDRS
  - guides and worked examples to developing decision aids



- **Use will result in:**
  - improved understanding of NZFDRS and its applications
  - greater uptake and operational use of scientific knowledge
  - more consistent application

The Behaviour of the Haines Index for the 2009/10 New Zealand Fire Season

Presented by Colin Simpson, University of Canterbury

bushfire CRC

UC UNIVERSITY OF CANTERBURY

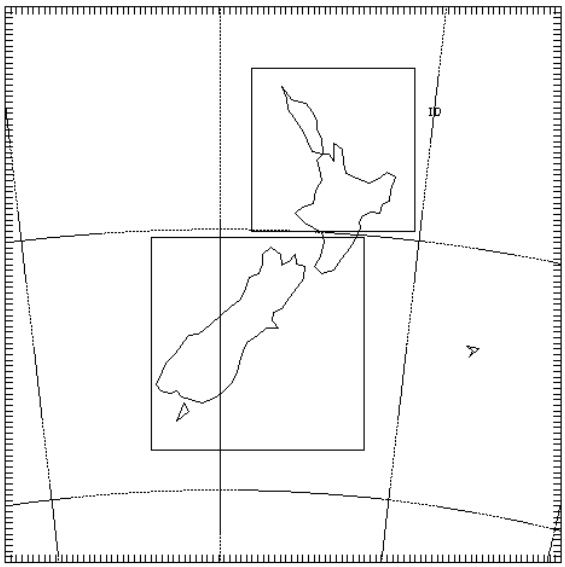
Research Questions

- Does the Haines Index (HI) provide additional value to existing indices already used in NZ?
- What is the behaviour of the HI in NZ?
- Which variant of the HI is best suited to NZ?
- Does the HI distinguish extreme fire weather days?
- What is the typical persistance time of a HI forecast?

Experimental Setup

- Retrospective analysis of the 2009/10 NZ fire season
- NWP model called WRF (v3.2)
- Model run from 01/10/2009 to 30/04/2010
  - April 2010 results not yet included
- Nudged every six hours using:
  - NCEP FNL Operational Model Global Analyses Files
- Three domains:
  - Parent Domain: 24km resolution, whole of NZ
  - “North Island” Domain: 8km resolution
  - “South Island” Domain: 8km resolution
  - Two-way interactive nesting
- Model grids, not station points

Model Domains



Background on Haines Index

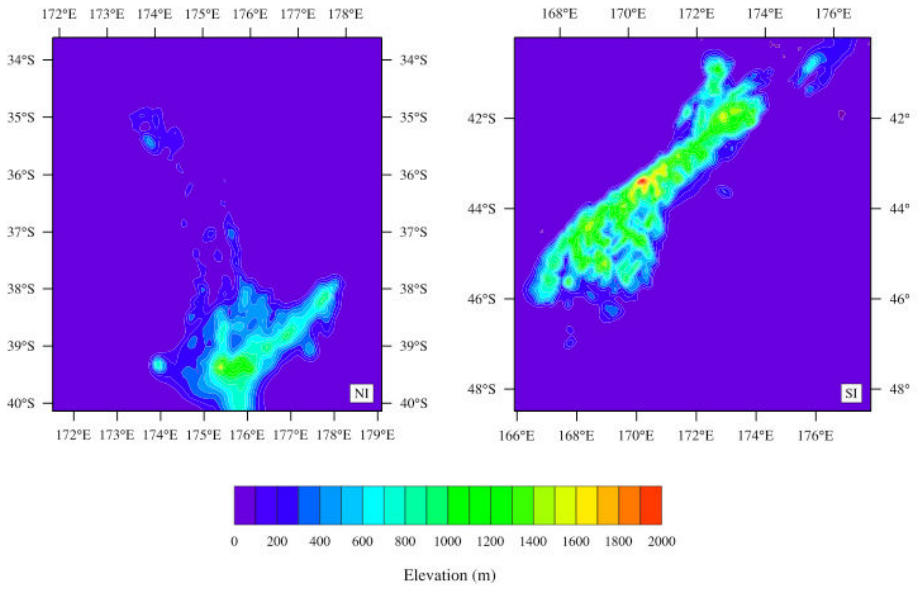
- Developed for operational use in the USA
- Measure of atmospheric stability and moisture
  - best suited for convection driven fires
- Easily derived from NWP model output
- Severe wildfires often coincide with high Haines Index
- Three variants: low, mid and high elevations

Low Elevation Haines Index

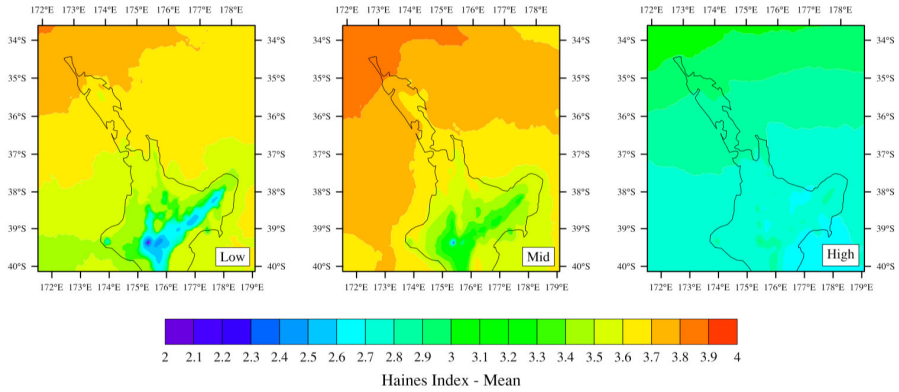
(A)	$T\,(950\,mb) - T\,(850\,mb)$	Value of A
	less than $4\,K$	1
	4 to $8\,K$	2
	greater than $8\,K$	3
(B)	$T\,(850\,mb) - T_{dew}\,(850\,mb)$	Value of B
	less than $6\,K$	1
	6 to $10\,K$	2
	greater than $10\,K$	3

$H = A + B$	Potential for Large Fires
2 or 3	very low
4	low
5	moderate
6	high

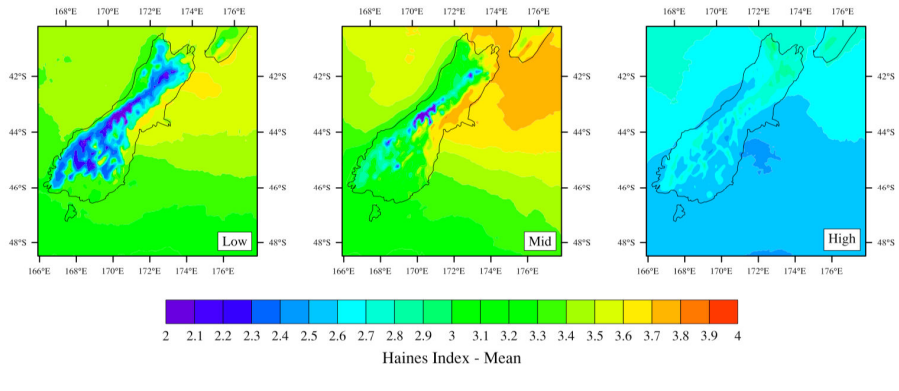
Model Topography



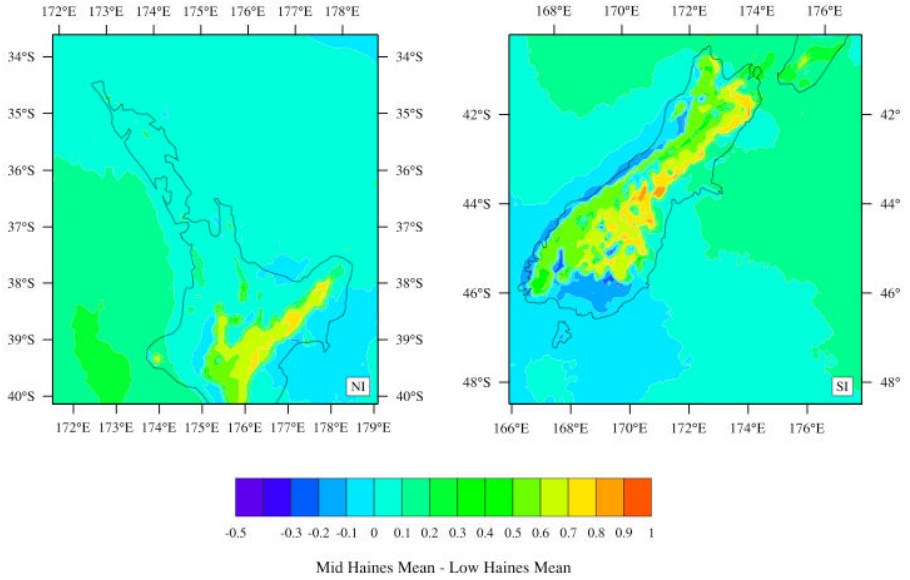
Mean - North Island



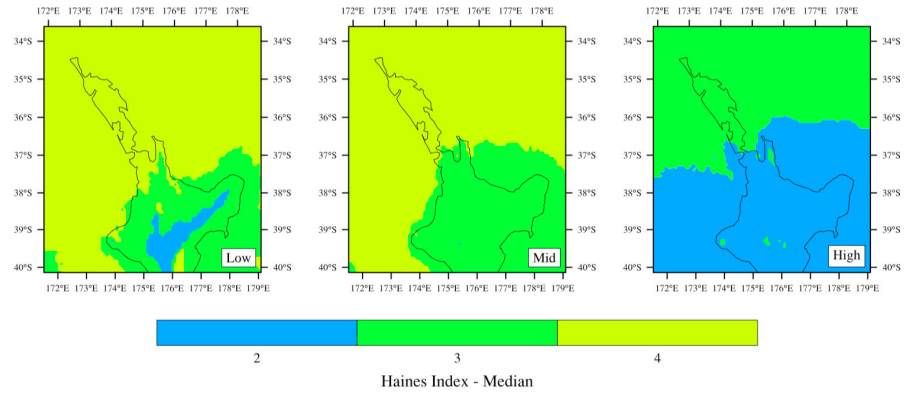
Mean - South Island



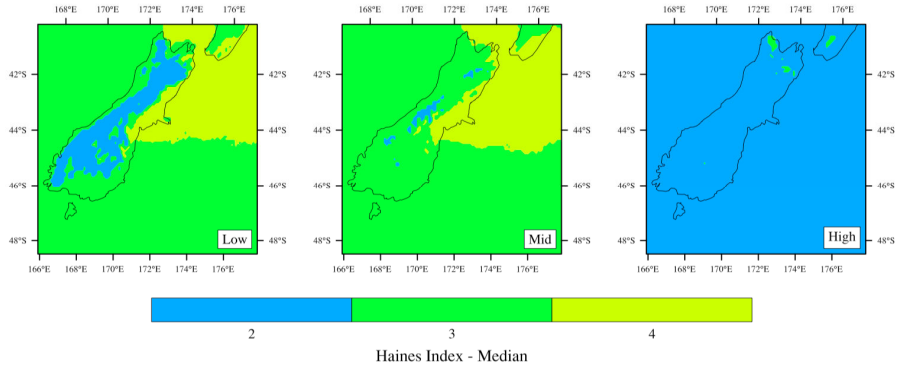
Difference in Mid and Low Means



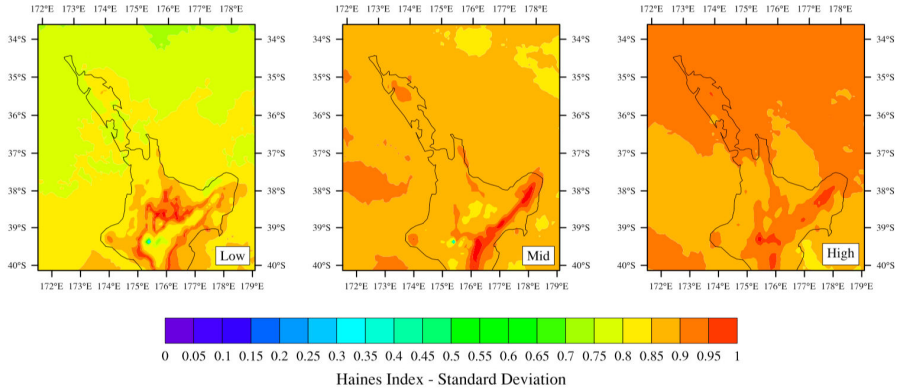
Median - North Island



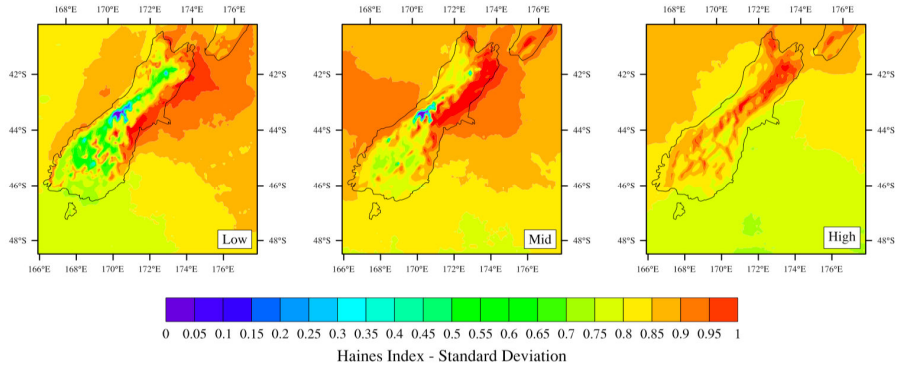
Median - South Island



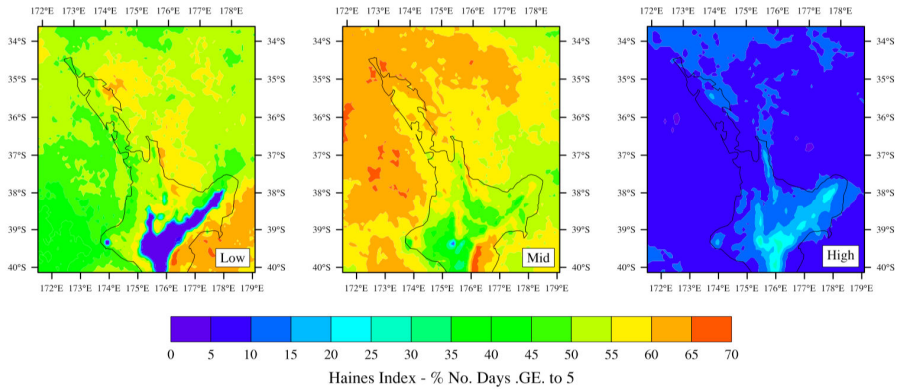
Standard Deviation - North Island



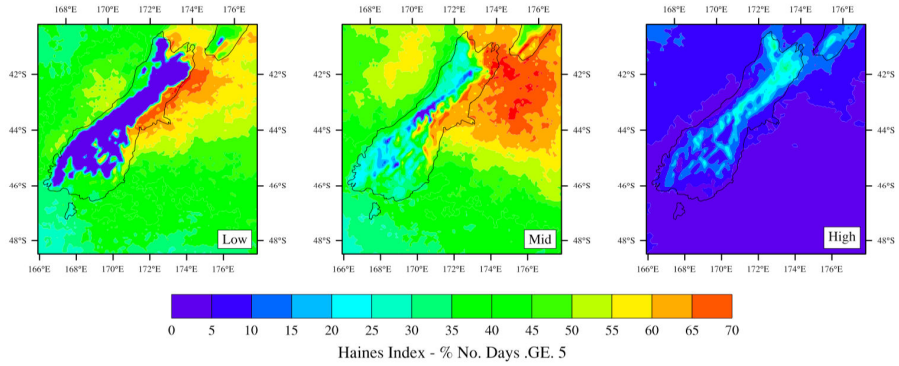
Standard Deviation - South Island



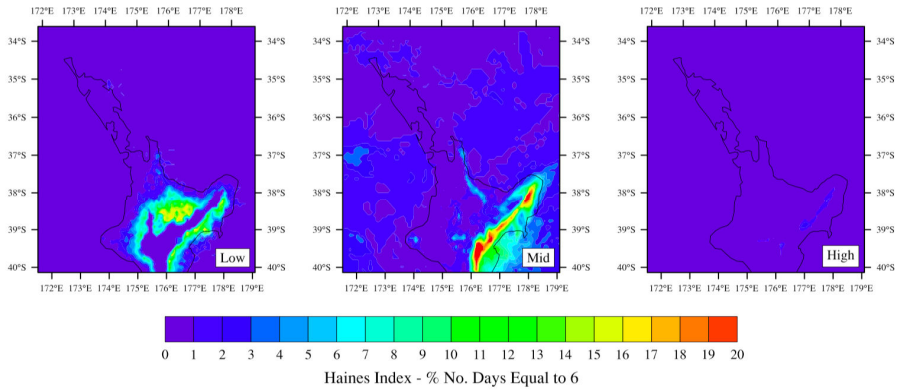
Frequency 5/6 - North Island



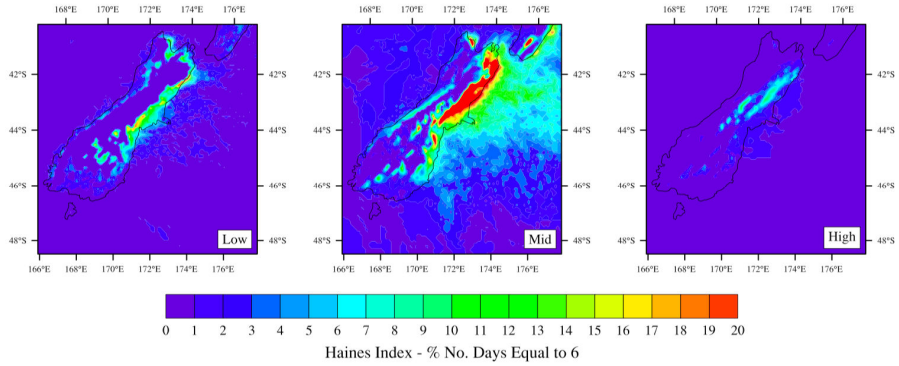
Frequency 5/6 - South Island



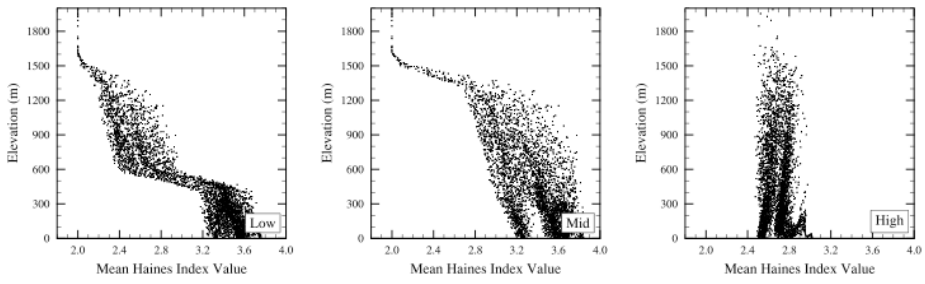
Frequency 6 - North Island



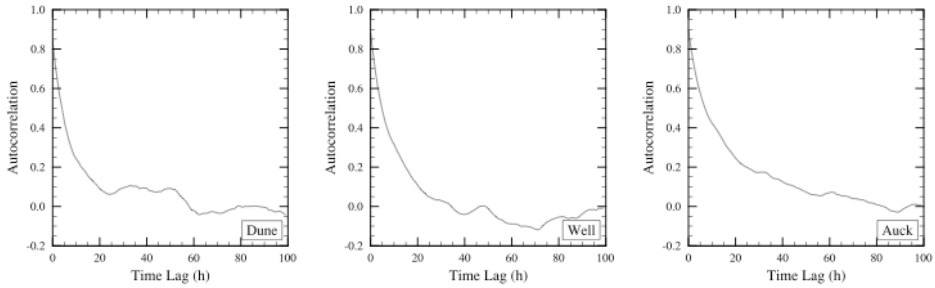
Frequency 6 - South Island



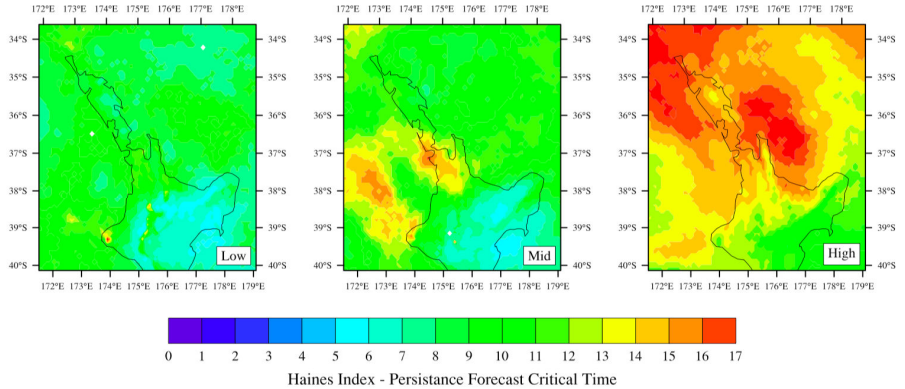
Elevation vs Mean HI



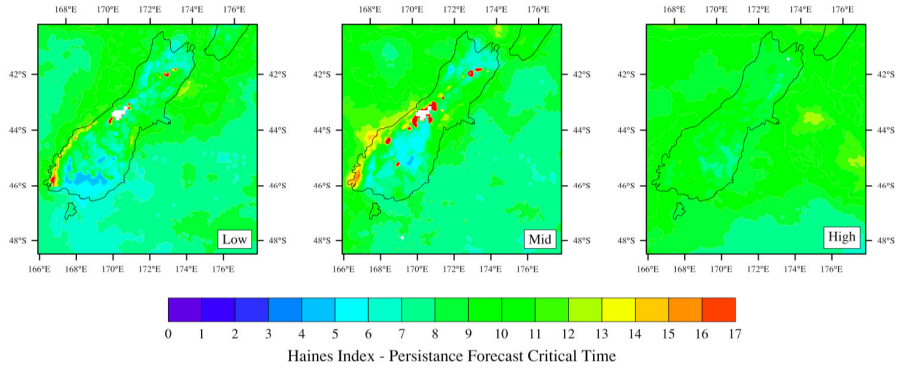
Autocorrelations



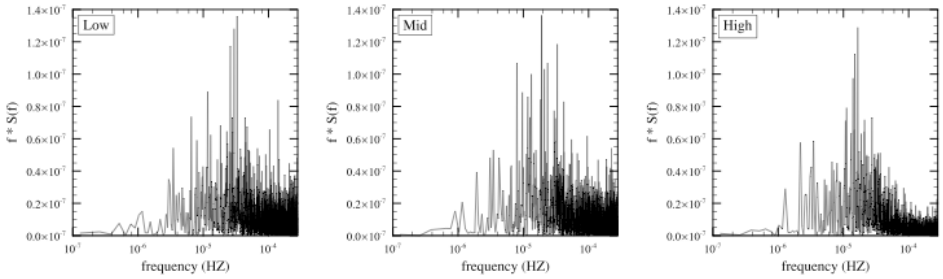
Persistance Forecasting - NI



Persistance Forecasting - SI



Diurnal Signal, Dunedin



Conclusions

- Low HI: unsuitable for elevations > 400m
- Mid HI: unsuitable for elevations > 1300m
- Mid elevation variant best suited for use in NZ
  - Small difference in mean values for Mid/Low
- Regional variations in HI values
  - Highest values on lee side of mountain ranges
- Up to 20% of fire season days have maximum HI=6
- Diurnal signal is present higher values during daytime
- Forecast persistance of HI typically 8-12 hours

Future Work

- Relate HI behaviour to known fire events across NZ
- Similar analysis with Fire Weather Index
- Relation to between Haines Index and Fire Weather Index
- Verification of model output using observational data
- Case studies of extreme fire weather days
- Detection of seasonal signals in index values

Rural Firefighter Workload & Productivity

Richard Parker

Acknowledgements

- The firefighters who generously gave their time and expertise
- The New Zealand Fire Service Commission Contestable Research Fund
- The New Zealand Rural Fire Authority
- The New Zealand Accident Compensation Corporation
- The Foundation for Research, Science & Technology
- My colleagues

Project Objectives

- Measure actual physiological workload and productivity
- Real fires
- Measure the terrain
- Relate to fitness and productivity requirements

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Background

- Difficult and dangerous to collect data
- Rural fire fighting
  - unplanned event
- Relied on wearable technology

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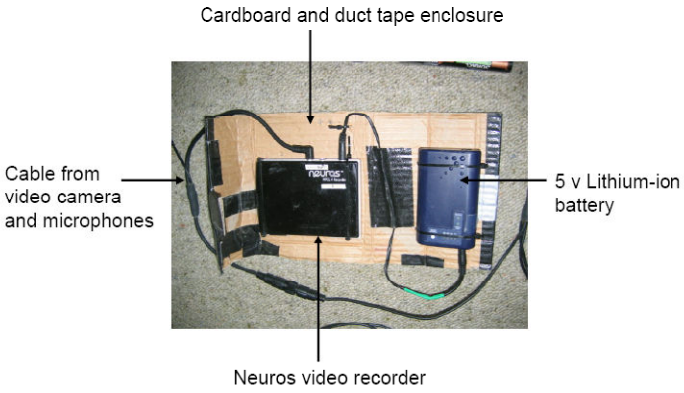
Cardboard & duct tape technology



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Data collection ensemble for rural firefighters

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Modified helmet

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Field studies

- NOT simulations or exercises
- Real people
- Operational demands
- Laboratory quality data

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Physiological workload

- Measured by heart rate
- Physical cost of a task
- Quantitative measure

Carbon monoxide (CO)

- Product of combustion
- Colourless, odourless gas
- Binds to haemoglobin – reduces work capacity

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Data sets

- Prescribed burns
  - Understand practical problems
  - Not too demanding
- Wild fires
  - Opportunistic
  - Difficult to capture
- Mopping up
  - Frequently performed activity

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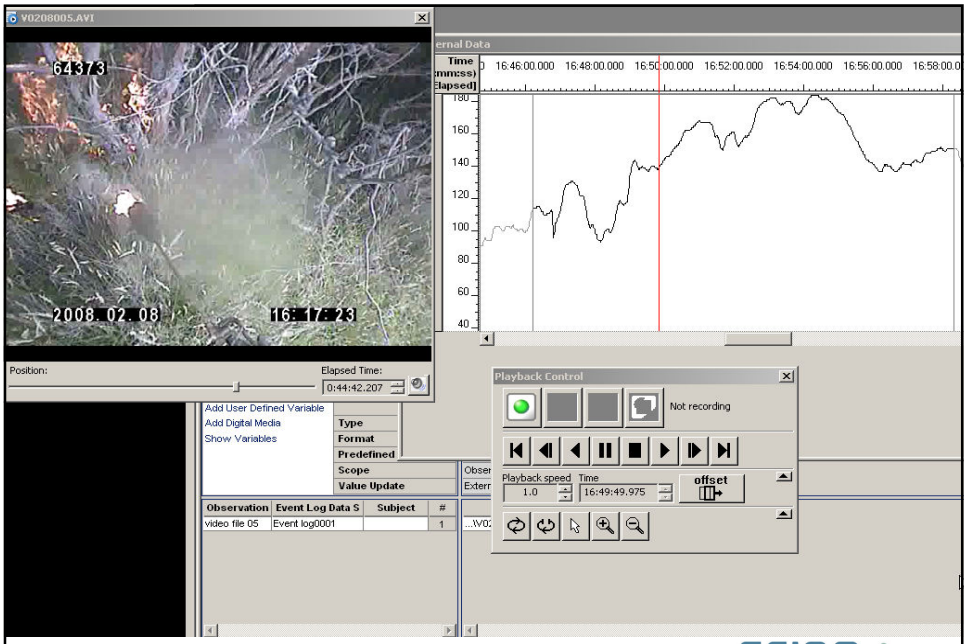
Results – Prescribed burns



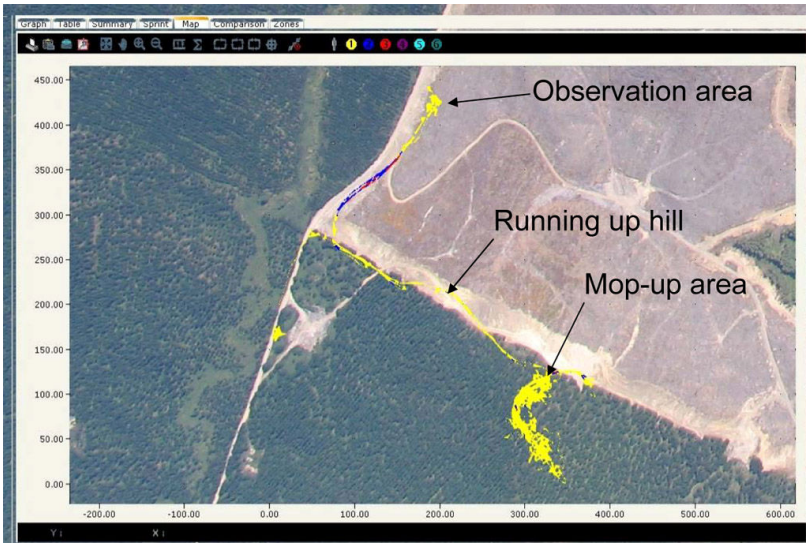
View from camera on helmet and recording of flamethrower's heart rate

Prescribed burns

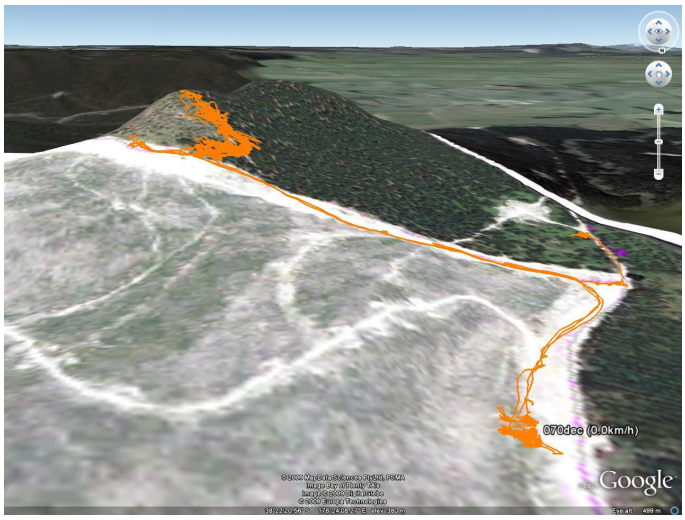
- High workload tasks moving fire gear around
  - but a lot of watching the fire
- But provided a testing ground for methods

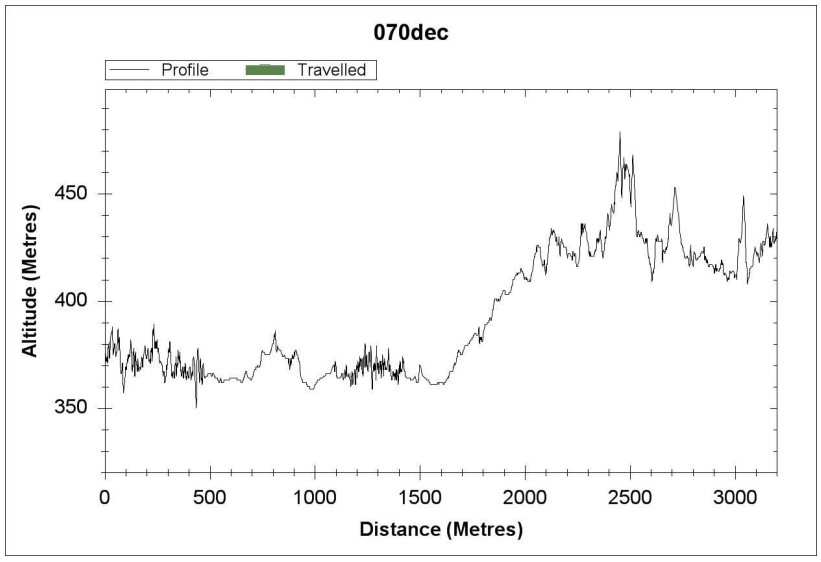
Results – Wild fires

- No photographs
- Video screen shots



Fire location





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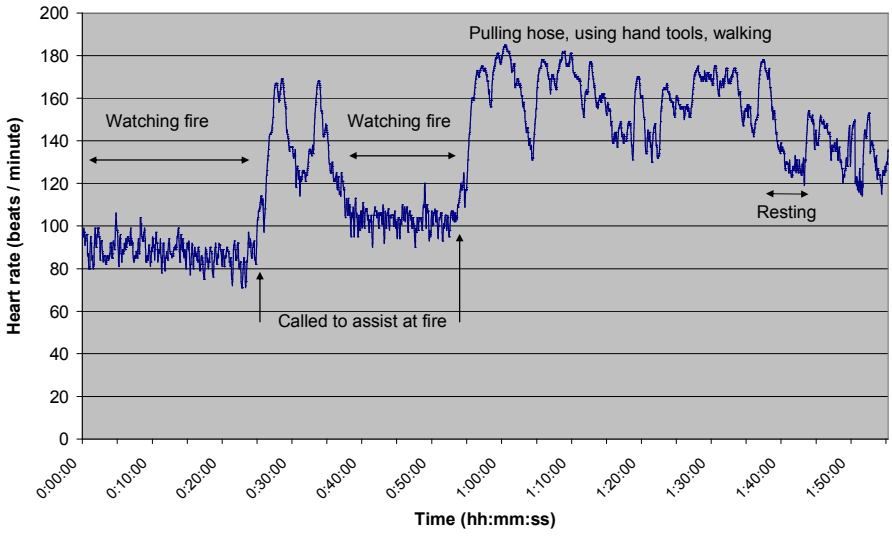

Fire on steep terrain

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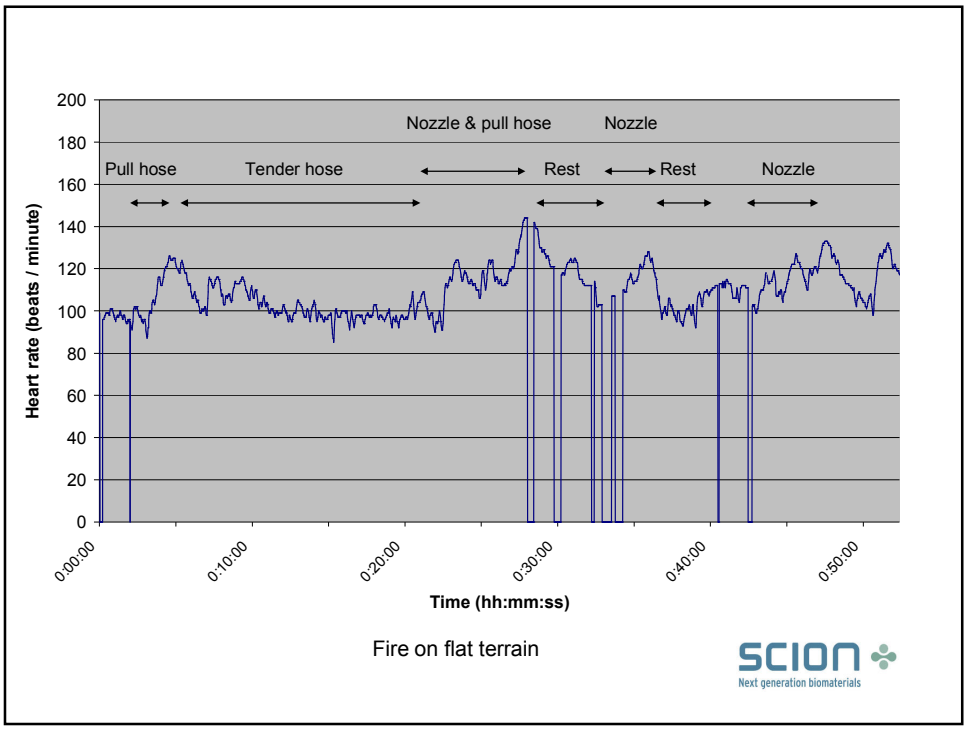
Raw video & audio

Results – Mopping up



Fire on flat terrain

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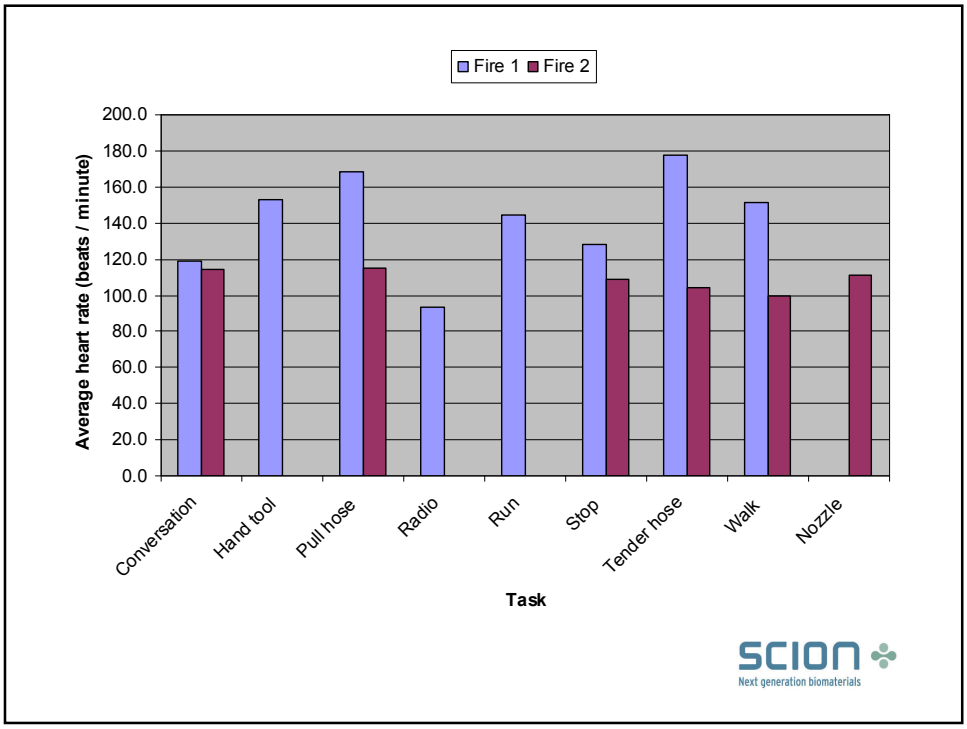

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Carbon monoxide

- Exposure limits
  - 30 ppm for 8 hour day
  - 200 ppm for 15 minutes
  - 400+ ppm to be avoided
  - 800 ppm seizures & coma
- Linked to concentration of other pollutants
  - Benzene, formaldehyde, particles
- No studies linking detailed work activity with exposure

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Mopping up

- Highest CO around pump – 300 ppm
- Smouldering stumps and roots – 50 ppm

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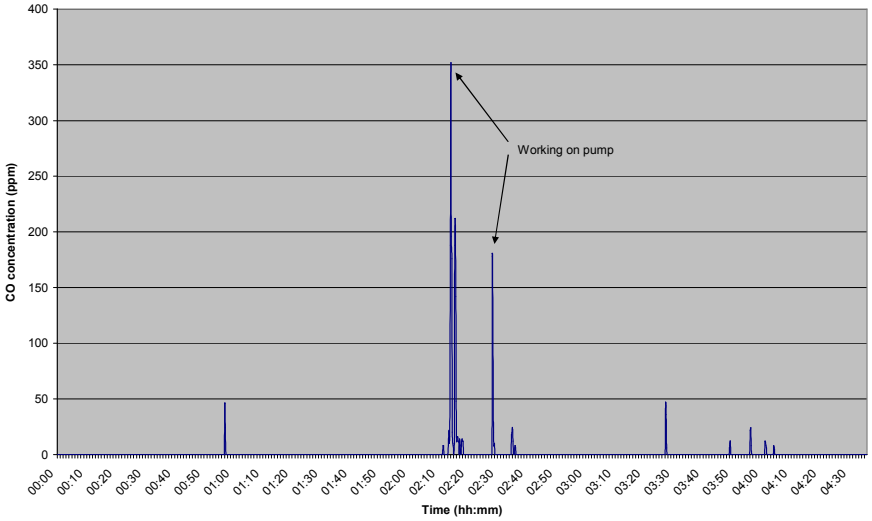

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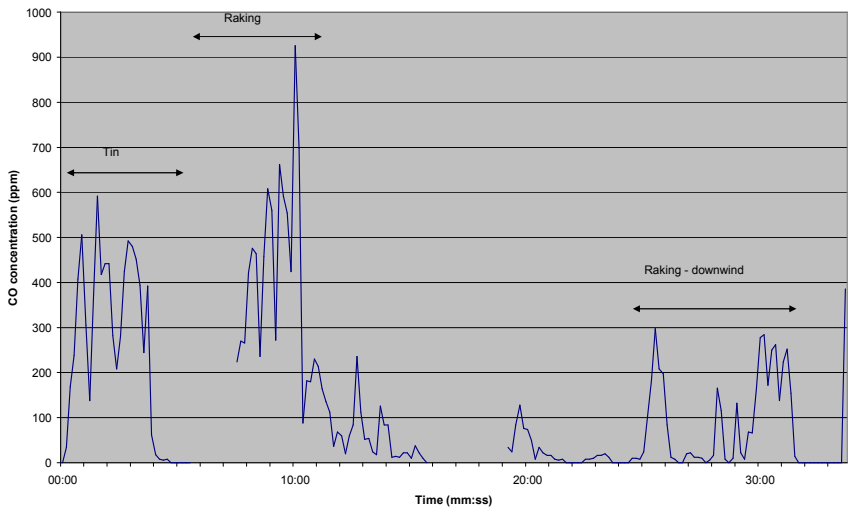
Hay barn fire

- High short duration CO concentration
  - Peak 900 ppm
  - Periods 400 – 600 ppm



Recommendations

- Respirators not practical – can result in excessive CO exposure
- Train fire fighters on smoke hazards
- Use planning and tactics to reduce smoke exposure
- Use CO dosimeters to assess smoke exposure

Reflective Interview

- Auto confrontation
  - explain events while watching video of their own work
- Head mounted video
  - immersive, not an actor in the scene

Video with firefighter commentary

Comparison - who is at the fire

Task analysis

- Only know the helmet camera wearer

Reflective interview

- Three person crew, two are women who have not been to a real fire before
- All work for DOC
- Two other people handling the hose work for a forest company crew
- The two crews don't know each other
- Another DOC Crew Boss appears but is actually working with a second DOC crew

Comparison - why events are occurring

Task analysis	Reflective interview
•No understanding of why events are occurring	•Getting slack in hose so it can be pulled further up the hill •Removing kinks in the hose so water flows well •Ensuring hose not on hot ground where it could burn •Not all crews have radios but DOC do •Breathing hard because of exertion and adrenaline •May need a second 'dam' and pump to get water higher up the hill •Trying to put another hose on the line to get water higher •Hose may be blocked with a kink

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Reflective interview

- Removes chaos from the video record
- Allows understanding of risks and risk management
- Provides authentic training material

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Conclusion

- These studies have highlighted the value of, and need for, fire research that occurs at real fires
- More data collection and detailed analysis
- Develop workload & productivity guidelines

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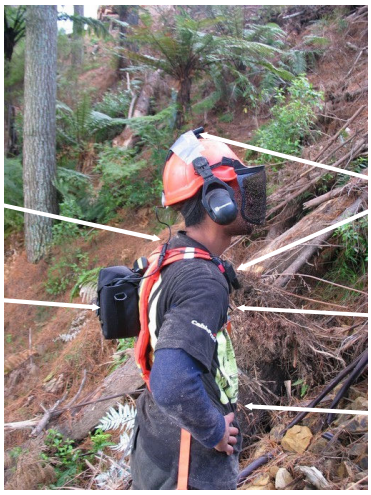
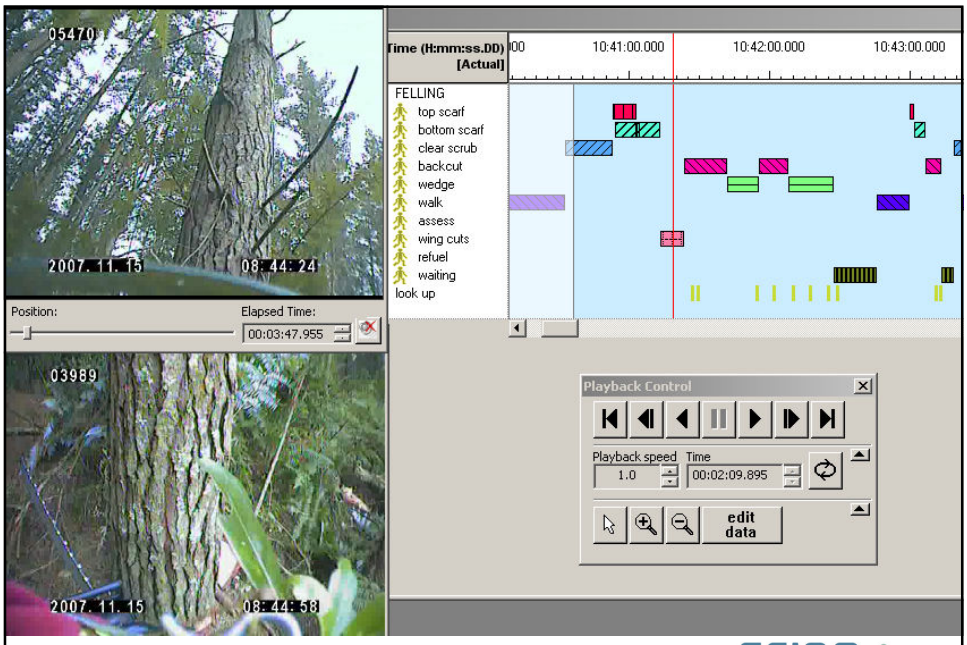
Case Study – Tree felling

- Work poorly understood
- Dangerous for the researcher
- Fatigue of researcher
- Disruption of work
  - Faller caring for welfare of researcher
  - Faller taking breaks to chat

Methods – Tree Felling



Data collection ensemble for tree fallers



Felling and using a wedge

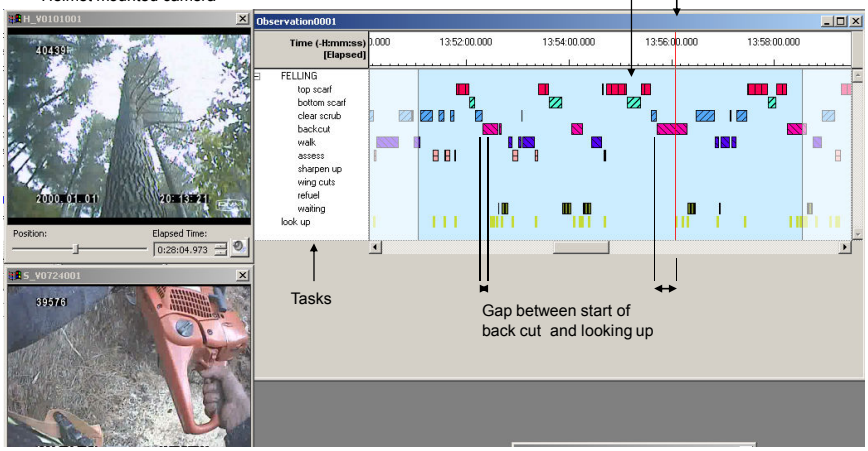
SCION
Next generation biomaterials

Less experienced Faller

Helmet mounted camera

Top scarf recut

Red line indicates position of video



Shoulder mounted camera

SCION
Next generation biomaterials

Results

Experienced tree fallers:

- twice as productive as novices
  - take longer to insert first cut
  - all other cuts faster
  - do not have to rework cuts
- generate less hazards
  - did not fell into standing trees
  - control the direction trees fall

SCION
Next generation biomaterials

bushfire CRC

Aerial Suppression Research

Matt Plucinski
CSIRO Ecosystem Sciences and CSIRO Climate Adaptation Flagship, ACT

CRC AUSTRALIA

National Research FLAGSHIPS Climate Adaptation

CSIRO

Outline

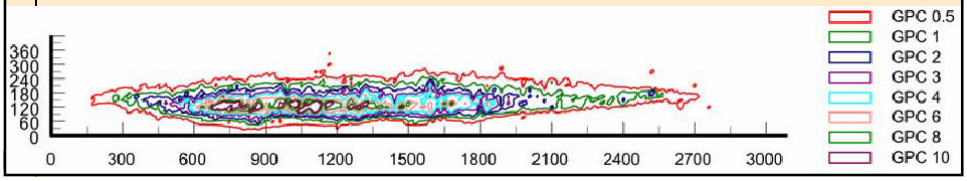
bushfire CRC

CSIRO

Aerial suppression effectiveness
Historical perspective

bushfire CRC CSIRO

- Retardant testing
- Delivery systems
- Drop pattern testing
- Safety
- Productivity



Aerial suppression effectiveness
Historical perspective

bushfire CRC CSIRO

Project Aquarius - CSIRO (Loane and Gould 1986)

- Aerial suppression drops are about as effective as experience ground crews with bull dozers and tankers in stopping fire progression
- Fire intensity exceeds 3,000 kW/m where fuel loads are high, fire bombing is ineffective in stopping the forward spread of fires
- Still has a role in high intensity fires in conjunction with ground forces, in delay fire spread, dealing with spot fires, or property protection

Bushfire CRC (A3.1)

Suppression effectiveness project

"Evaluation of suppression techniques and guidelines (aerial and ground resources)"

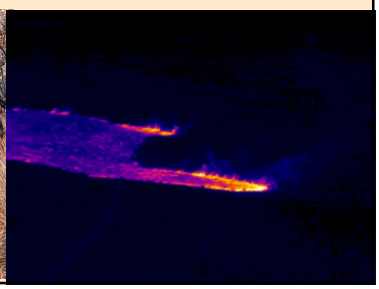
- **Aim:** optimise the effectiveness and efficiency of aircraft use in conjunction with ground suppression during fire fighting operations

Bushfire CRC Suppression Project

Main methods

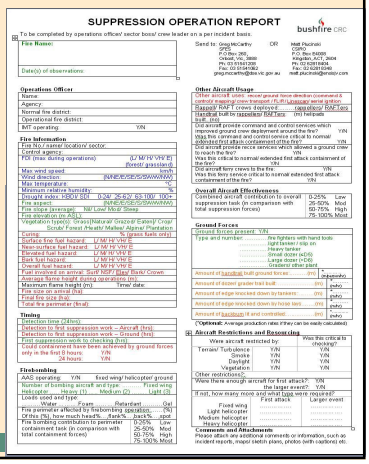
- Operational Research
  - Fire incident database (Surveying operations personnel)
  - Wildfire suppression case studies
- Experimental Research


SUPPRESSION OPERATION REPORT



Operations study

- Determine factors important for initial attack success
  - Collect incident data from operational personnel
- Data collection survey forms
  - Collect a large amount of data
  - Low cost
- Data from >800 fires
  - (~500 useful)


SUPPRESSION OPERATION REPORT

Operations study

bushfire CRC CSIRO

Initial attack success model

(Success = containment in 8 hours)

Important predictors for initial attack success are:

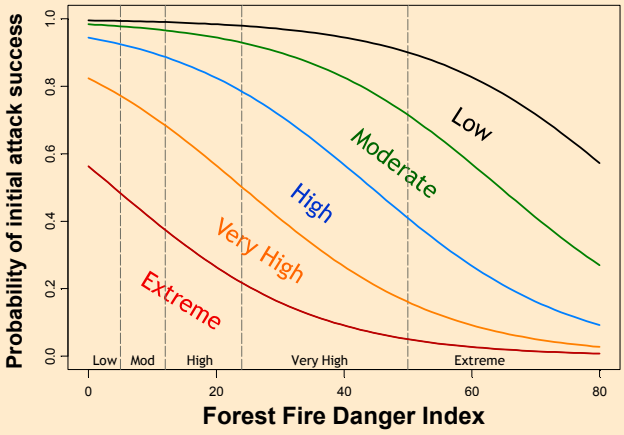
- Response timing (detection to initial attack)
- Weather (fire danger index or wind speed)
- Fuel (hazard score/ curing)
- Fire size at initial attack

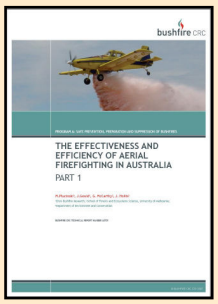
Operations study

bushfire CRC CSIRO

Initial attack success model (original)

Probability of initial attack success with
Overall fuel hazard and Forest Fire Danger Index





Overall Fuel Hazard
- Low
- Moderate
- High
- Very High
- Extreme

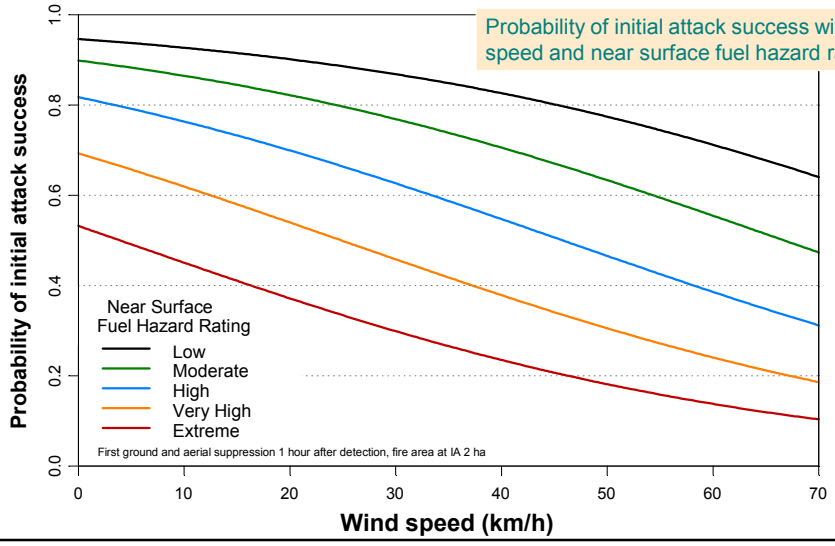
(Area burning on arrival 1 ha, 1 hour to first aerial suppression)

Operations study

bushfire CRC CSIRO

Initial attack success model (refined)

Probability of initial attack success with wind speed and near surface fuel hazard rating



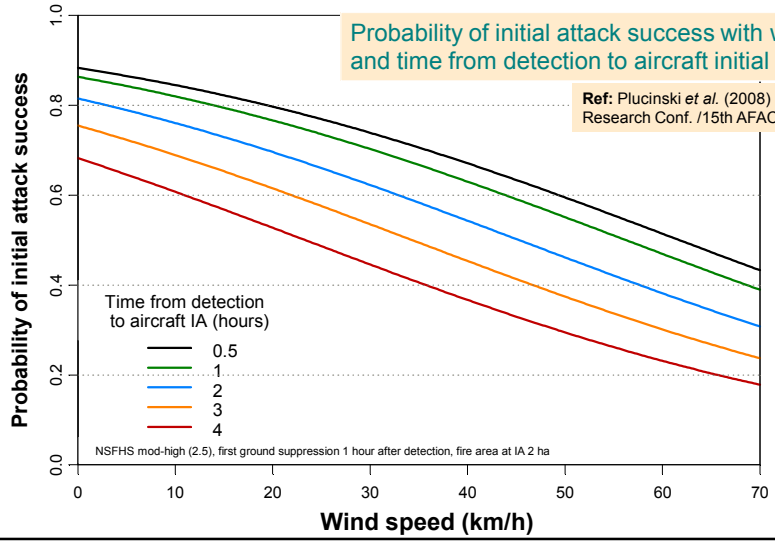
Operations study

bushfire CRC CSIRO

Initial attack success model (refined)

Probability of initial attack success with wind speed and time from detection to aircraft initial attack

Ref: Plucinski *et al.* (2008) Int. Bushfire Research Conf. /15th AFAC conf., Adelaide



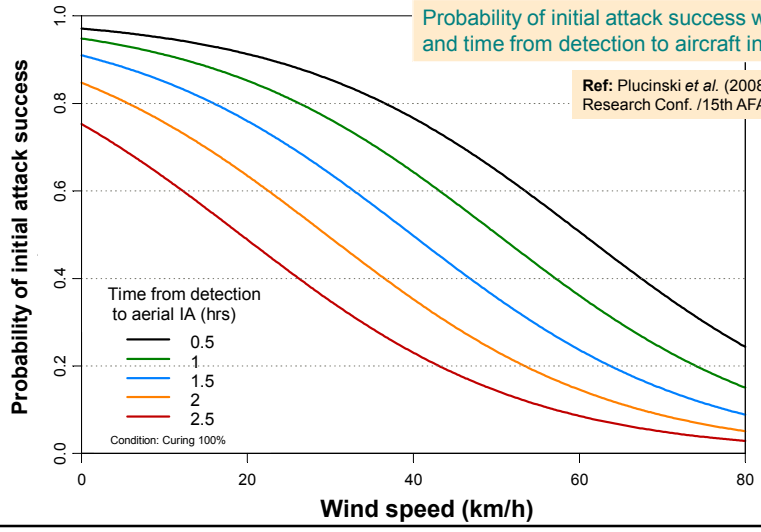
Operations study

bushfire CRC CSIRO

Initial attack success model (grasslands)

Probability of initial attack success with wind speed and time from detection to aircraft initial attack

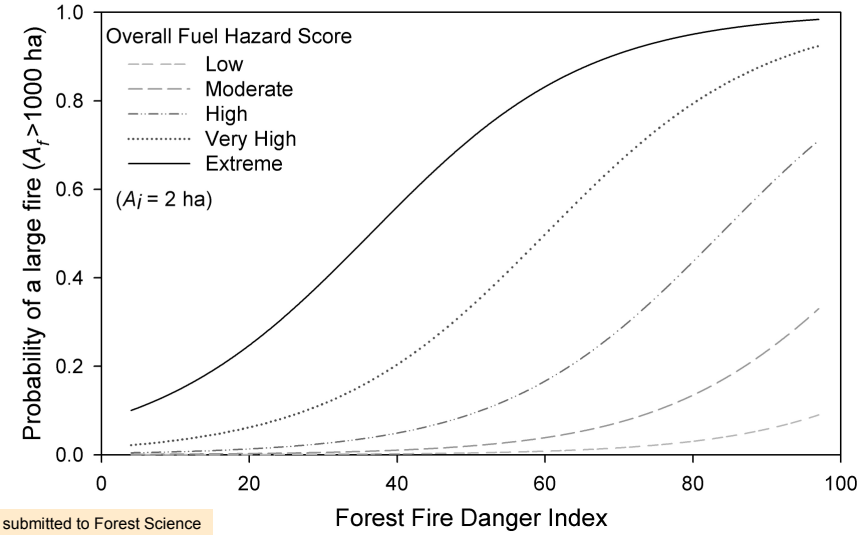
Ref: Plucinski *et al.* (2008) Int. Bushfire Research Conf. /15th AFAC conf., Adelaide



Operations study

bushfire CRC CSIRO

Probability of a large fire (>1000 ha)



Ref: submitted to Forest Science

Operations study

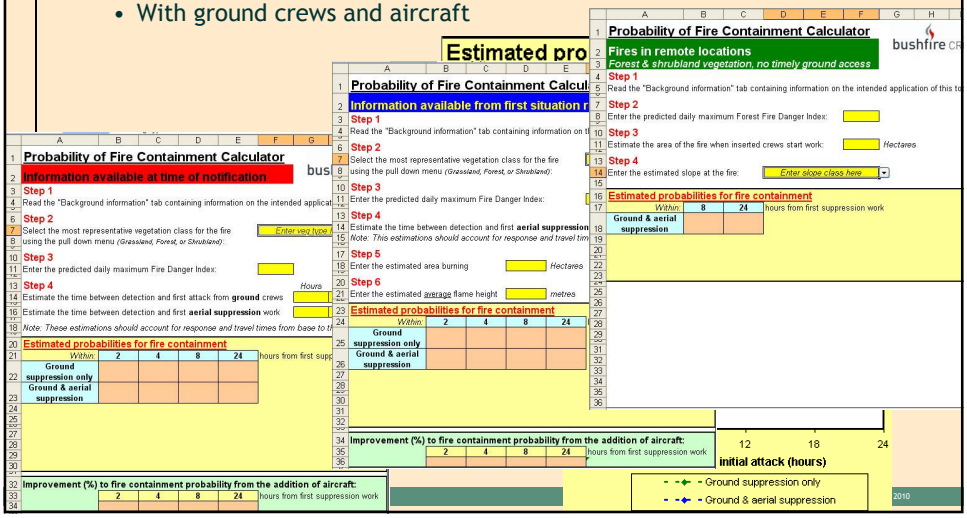
Identifying conditions when aircraft reduce fire containment time

- Conditions are more challenging due to weather, fuel, ground response times and area burning at initial attack
- Remote locations (slow ground response)

- Fire containment calculator
  - Predict if aerial suppression will reduce fire containment time
    - Prevent deployments when not really needed or beneficial
    - Make the decision quickly

Fire containment calculator

- What is the chance of containing a fire within *x* hours?
  - With ground crews only
  - With ground crews and aircraft



Fire containment calculator

- **Deployment decision process:**

1. Assess practicality – are aircraft an option? *yes*
2. Assess probability of success
3. Consider community impact

} *yes to 1 (or both)*

4. Tasking/ integration *yes*
5. Address sustainability issues *yes*
6. Document decision *yes*

Deploy

Operations study

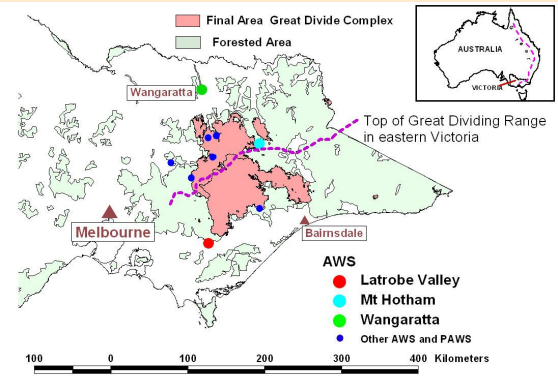
- Unique dataset (in Australia)
- Similar datasets collected over longer periods can be used for
  - Ongoing assessment of suppression performance
  - Development of operational guides
  - Evaluation of medium and long term strategies
  - e.g.
    - Cumming (2005) used 30 years of data to investigate the impact of a changed management strategy on IA success
    - Arienti *et al.* (2006) investigated the effects of fire cause, timing fuel, accessibility and response on IA and detection failures
- Key data fields related to suppression effectiveness should be collected in fire history data bases

Case studies

- Multiple ignition events
  - e.g. Great Divide Complex of fires (Vic 2006/07)
- Wildfire case studies
  - e.g. Billo road pine fire (NSW 2006)
- Drops on fire ground

Case studies

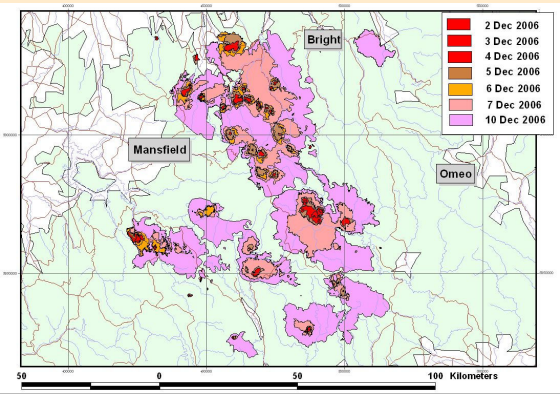
- Great Divide Complex of fires (Vic, Dec 2006)
  - Study of resourcing & containment of the first 10 days of a large multiple ignition (66) event
  - Investigate effects of resource numbers & slope on containment
  - Predict required resources for containment in 10 day window



Ref: McCarthy et al., submitted to *Aust. For.*

Case studies

- Great Divide Complex of fires (Vic, Dec 2006)
  - Resourcing depended on distance to nearest road or track, slope, elevation and fuel hazard
  - Containment success depended on fire perimeter, slope and fuel hazard
  - Too many fires to contain in window with all available resources



Ref: McCarthy et al., submitted to *Aust. For.*

Case studies

Billo Road fire (Tumut NSW, Dec 2006)

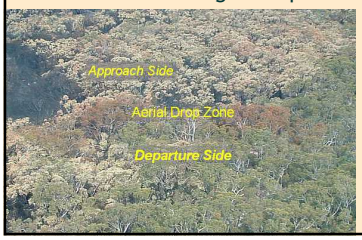
- Large (11,000 ha) high intensity pine fire
- Case study report - Fire behaviour and suppression
- Suppression study findings:
  - Suppression options severely limited by fire behaviour in pine forests and slash areas
  - Aircraft were most effectively employed in the detection and rapid attack of spot fires
  - Field officers with local knowledge played important roles in prioritising and implementing suppression strategies which minimised the impact of the fire on plantation assets

Case studies

bushfire CRC CSIRO

Drops on fire ground

- Analysis of aircraft tracking data
  - Productivity
  - Flight characteristics
- Ground evaluation
  - Effect of suppression drops on fire
    - Comparing pre, during, and post drop/ fire behaviour
    - On ground & airborne observations and measurements
    - Logistical problems – notification/ travel/ safe access



Case studies

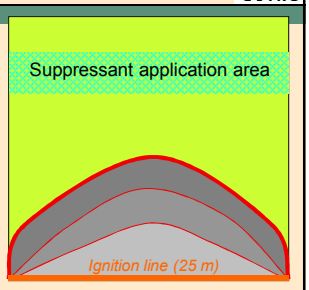
bushfire CRC CSIRO

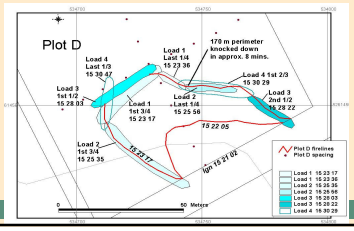
Drops on fire ground

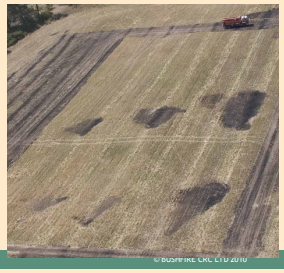
- Ground evaluation – *data trends*
  - Drops that **held** were more likely to:
    - Have rapid ground support;
    - Have less tree canopy;
    - Occur during lower fire danger ratings; and
    - Occur in lower fuel areas

Field experiments

- Why:
  - Detailed & accurate data
  - Comprehensive site assessment
  - Target conditions
  - Plan procedure
- But:
  - Dependant on weather and resource availability
  - Limited by sites & opportunities
  - Costly







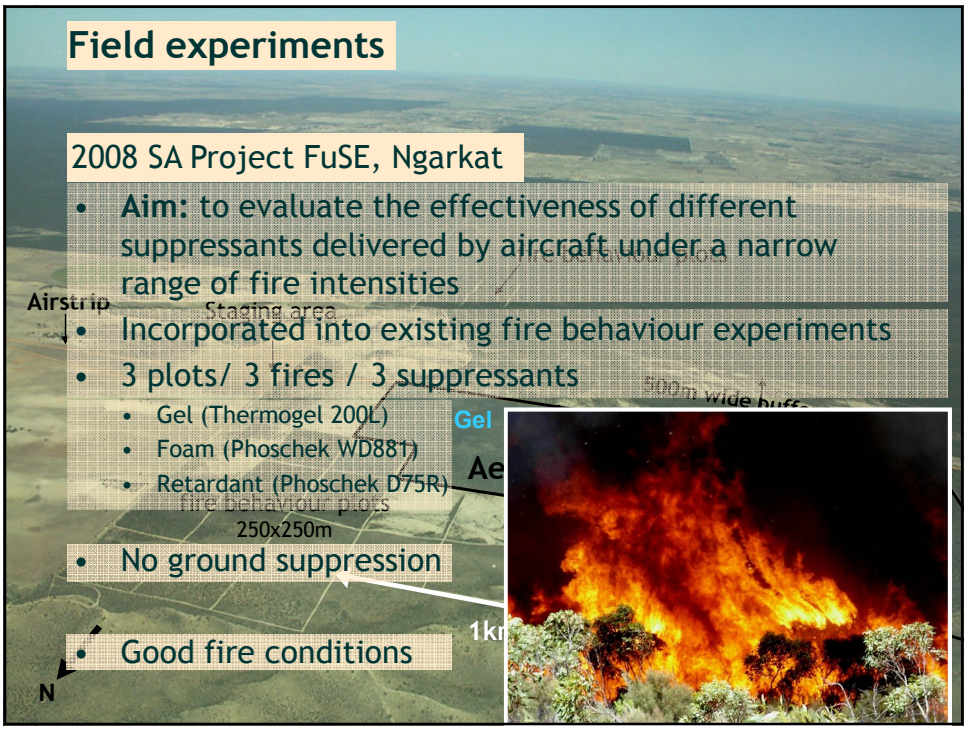
Field experiments

- Non-events
- 2004 Tumbarumba (NSW)
- 2005 Tasmania
- 2006 ACT Summer students
- 2008 SA Project FuSE, Ngarkat

Field experiments

2008 SA Project FuSE, Ngarkat

- **Aim:** to evaluate the effectiveness of different suppressants delivered by aircraft under a narrow range of fire intensities
- Incorporated into existing fire behaviour experiments
- 3 plots/ 3 fires / 3 suppressants
  - Gel (Thermogel 200L)
  - Foam (Phoschek WD881)
  - Retardant (Phoschek D75R)
- No ground suppression
- Good fire conditions



Field experiments

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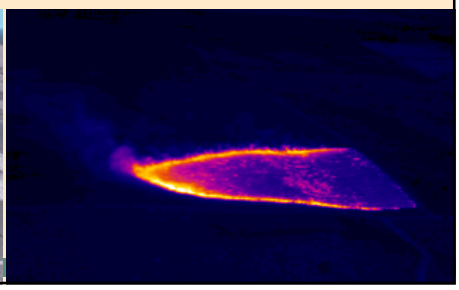
2008 SA Project FuSE, Ngarkat In-fire camera footage

Field experiments

2008 SA Project FuSE, Ngarkat

- Not enough replication for fair comparison of suppressants
- Other results:
  - Confirm importance of tactics/ drop accuracy/ spotting /line construction and perimeter growth rates
  - Use of airborne Infrared camera



Field exp's/ Ngarkat/ Output

Drop Assessment Guide

- **Purpose:** outline key criteria for assessing aerial suppression drops to assist in the effective use of fire fighting aircraft
- **Main considerations**
  - Placement
    - Is it on target, anchored/ linked?
  - Coverage
    - Coating of surface fuels
    - Depth, gaps - consistency
  - Effects on fire behaviour
    - Reduction in intensity
    - Does the result meet the objective?
    - Holding time


FIRE NOTE

ASSESSING AERIAL SUPPRESSION DROP EFFECTIVENESS

Field exp's/ Ngarkat/ Output

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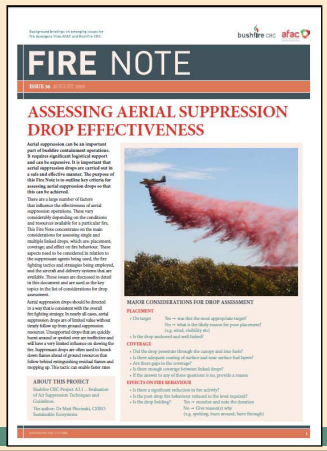
Drop Assessment Guide

- **Mechanisms for drops breaching**
  - Spotting
    - Fire behaviour threshold
  - Fire burning around
    - Placement
    - Line building/ turnaround time
  - Fire burning through drops
    - Coverage
      - Depth
      - Shadowing
      - Durability of suppressant
  - *Lack of ground support*


FIRE NOTE

ASSESSING AERIAL SUPPRESSION DROP EFFECTIVENESS

Field exp's/ Ngarkat/ Drop placement

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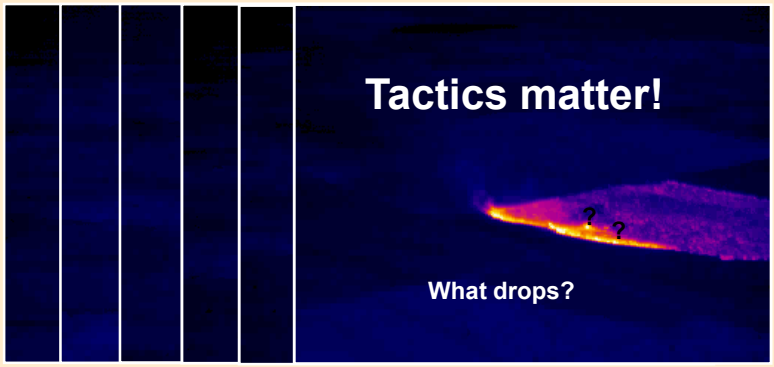
- The single most important factor determining the success of aerial suppression drops



Field exp's/ Ngarkat/ Coverage level

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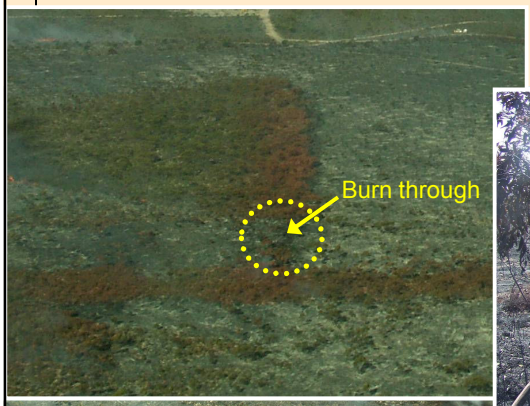
CSIRO

- Retardant line held head and flank fire (initially)
- However.....
- Fire breached the retardant line in an area of weak coverage



Field exp's/ Ngarkat/ Effect on fire behaviour

CSIRO

- Comparison of pre and post drop fire behaviour

Field exp's/ Ngarkat/ Effect on fire behaviour

- Monitoring drops with infrared analysis

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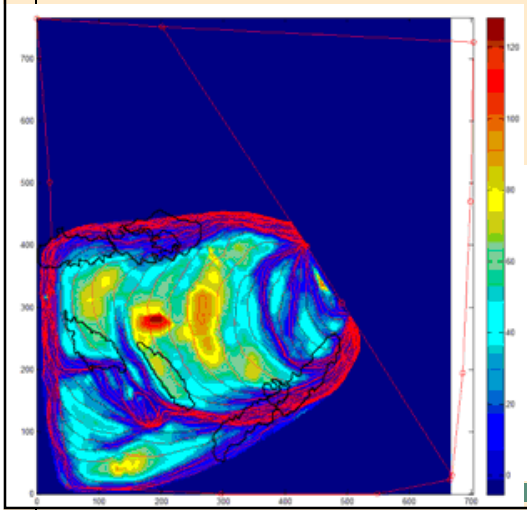
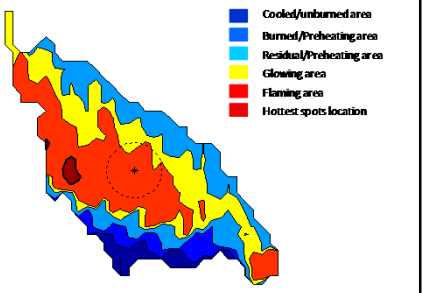
UNIVERSITAT POLITÈCNICA
DE CATALUNYA





Bushfire CRC Suppression Project

Key messages from project

- Aerial suppression drops cannot fully extinguish wildfires without the support of ground suppression
- Aerial suppression is best suited to initial attack
  - *"small fires are easier to put out than big ones"*
- Initial attack success affected by:
  - ✓ Response timing (detection to initial attack)
  - Weather (fire danger index or wind speed)
  - ✓ Fuel (hazard score/ curing)
  - ➢ *Fire size at initial attack*

Bushfire CRC Suppression Project

Key messages from project

- Tactics are more important than suppressants
  - Drops can only ever be as good as the tactics allow
  - Drop assessment can be useful for improving operations
- The mechanisms for breaching of drops are:
  - Spotting
  - Fire burning around
  - Fire burning through drops

Acknowledgements

- *A3.1 Research team:* Jim Gould (CSIRO), Greg McCarthy (Uni of Melb/ DSE), Jen Hollis (DEC WA)
- Operational staff and volunteers from all Aust. & NZ fire agencies who provided data, advice and support
- Project FuSE/ Ngarkat:

Government of South Australia
Department for Environment and Heritage

CFS

Department of Sustainability and Environment

DC-10 Air tanker Evaluation

bushfire CRC CSIRO

- DC-10 Air tanker
  - 45,400 L capacity (12,000 gal)
  - Drop height 200 ft min (60 m) above ground/ canopy
  - Drop speed 150 knots (278 km/h)

- Contracted to Victorian Government Jan-Mar 2010
  - "operational trial"

DC-10 Air tanker Evaluation

bushfire CRC CSIRO

VLAT evaluation

Evaluation of effectiveness

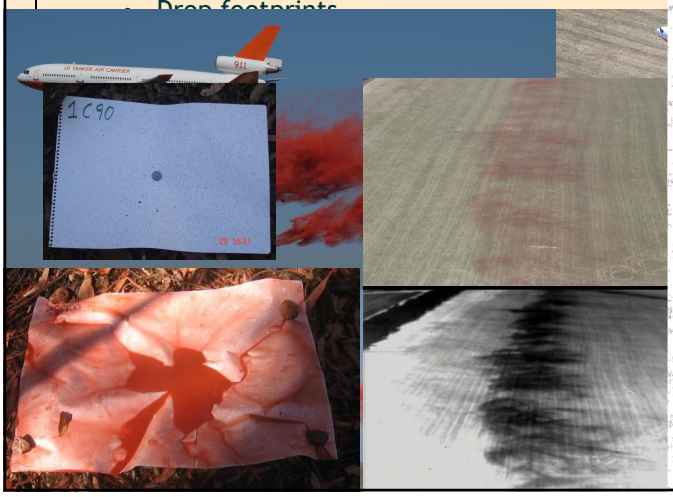
- Aims:
  1. Quantify drop characteristics
  2. Determine if there are ground safety issues
  3. Determine the effect of drops on fire behaviour

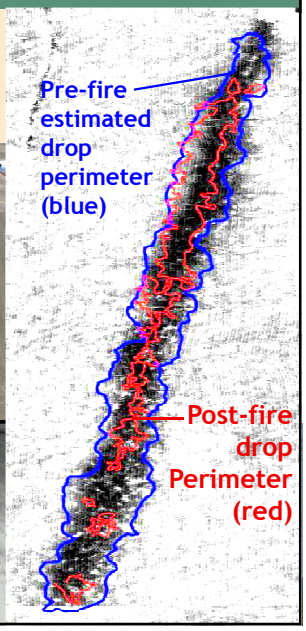
DC-10 Air tanker Evaluation

bushfire CRC CSIRO

VLAT evaluation

1. Quantify drop characteristics
   - Retardant cloud
   - Drop footprints





DC-10 Air tanker Evaluation

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VLAT evaluation

2. Determine if there are ground safety issues

DC-10 Air tanker Evaluation

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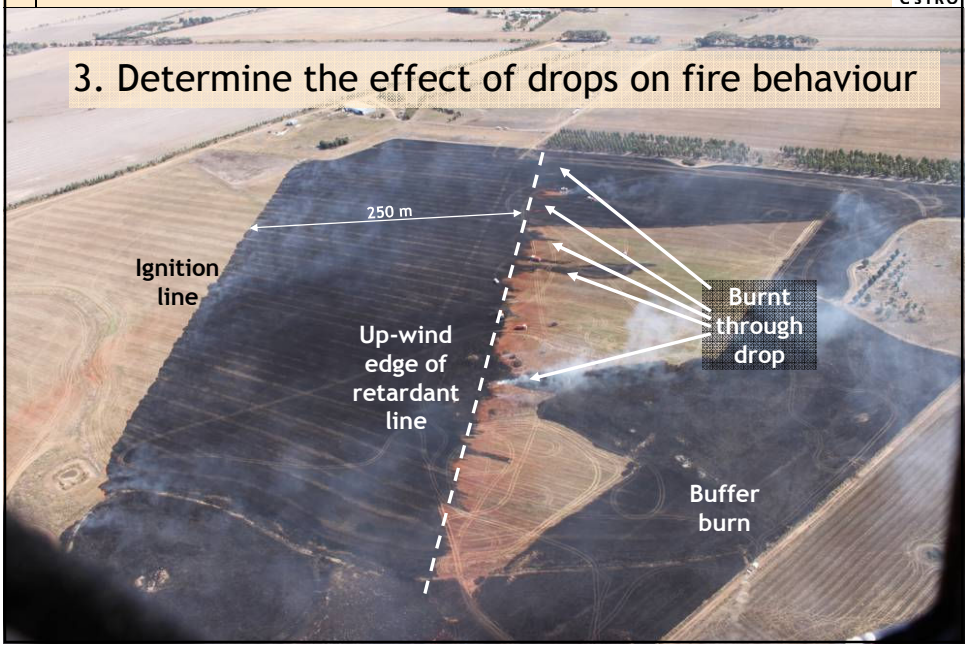
3. Determine the effect of drops on fire behaviour



DC-10 Air tanker Evaluation

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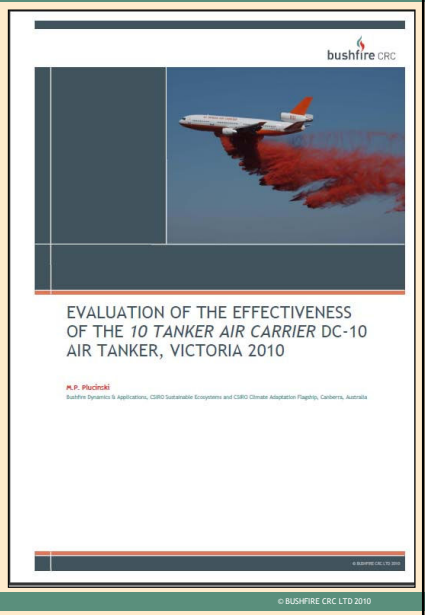
More info – report available:

www.bushfirecrc.com



NZ Resource Productivity/Effectiveness

Use and Needs

Kevin Ihaka

Requirements for Research Based Operational Guidelines

- Crew productivity.
- Machinery productivity.
- Aircraft operations.
- Chemical/Water firebreak effectiveness

Kevin Ihaka

Crew Productivity

- Need a range of models unique to NZ fuels topography and practices
- Effectiveness across a range of situations.
  - Fuels and Soils
  - Weather
  - Techniques
    - Water under pressure
    - Hand cut lines
- Interaction with other activities
  - Burning out/chemicals etc

Kevin Ihaka

Machinery Productivity

- Currently simple models available, all overseas based, adapted to NZ conditions.
- Effectiveness
  - Is big really better? – initial attack dozers?
  - Machine combinations, dozer – excavator/harvester etc.
- Safety and technique:
  - Support systems for operators, training, off-siders etc.
  - Techniques to assist later operations.
- Interaction with other activities
  - Burning out etc.

Kevin Ihaka

Aerial Operations
Where are we now?

- Highest cost resource, not always managed well.
- Often left to pilot judgment.
- If it doesn't work – we need more!
- "Heli–mopping" common.
- Last research 1998, much has changed:
  - Aircraft types and size, lift capacity.
  - Bucket types, more collapsibles – Bambi etc.
  - More use of foam – losing operational knowledge of long term retardants.
- Most previous research simulated, not field validated

Kevin Ihaka

Where to Now – Air ops

- Quantification of the influence of height and speed of aircraft, wind speed and direction, foam percentage and bucket design/setting on foam types and expansion ratios on aerial drops.
- Quantification of the necessary depth and type of water-based firebreak required to hold fires in different fuel, weather, and fire danger conditions
- *Quantification of the necessary depth and type of chemical-based firebreak required to hold fires in different fuel, weather, and fire danger conditions.*
- Validation of interception rates from overseas data for New Zealand's forest fuels and to estimate rates for other New Zealand vegetation types.
- Development and testing of guidelines on bucket design, flight characteristics and mixing rates so that pilots can produce various types of water-based firebreak as required.
- Evaluation of what pilots/aircraft actually do at wildfires is necessary to benchmark current aircraft operations.

Kevin Ihaka

How do we get there? Air Ops

- Use available data from manufacturers/others.
- Collect air ops data from real fires
- Use technology, ongoing basis. Cameras, GPS etc
- More time and money on evaluating the data, less on flying.
- Create guidelines to include more emphasis on operation technique.
- Evaluate new technology and chemicals, break down entry barriers to new technology.

Kevin Ihaka

Ground crews and Machinery

- Use technology to collect real fire data over long time periods.
- Research interaction between different operations/techniques eg.
  - Crew follow up air ops,
  - Burn out from machine line,
  - Machine combinations etc.
- Useable guides for common scenarios, integrate into training.

Kevin Ihaka

Research Adoption Group Discussion session

Rural Fire Research Workshop 2010

2010 Research Workshop

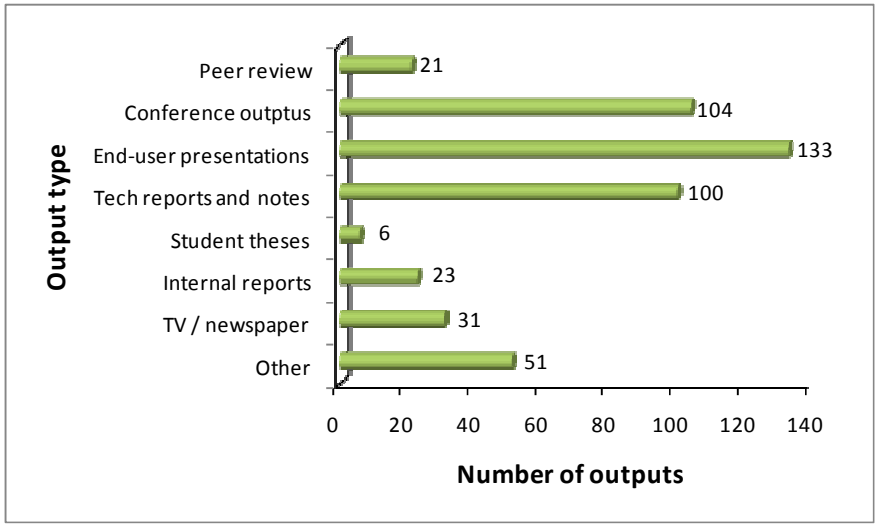
Reduction
Fire danger communication
Mitigation of human caused wildfires
Fire prevention strategy/community interaction

Readiness
Fire behaviour tools
NZ fire growth simulation model
Use of fire behaviour tools in planning
Ignition thresholds for grass and gorse
User Guide to the NZFDRS

Response
Firefighter workload/productivity
Bushfire CRC aerial suppression research
NZ productivity/effectiveness info - use and needs

Recovery
Bushfire CRC resilience/recovery research
NZ wildfire recovery case studies
Natural Hazards resilience/recovery research

Fire research outputs 2004 – 2010



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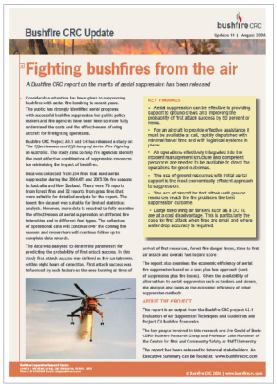
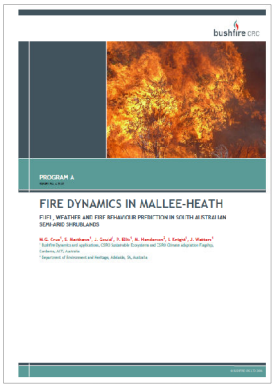
Other applicable research

bushfire CRC





Promoting Research Adoption

Four groups rotate through 4 topics:

1) **What research can be implemented? (based on that presented, or available from NZ/overseas)**
2) **What are the barriers to implementation of research by end-users?**
3) **How can the research programme assist in the uptake of the research? (i.e. tech transfer)**
4) **What other research could be done to address end-user needs? (i.e. to support uptake of existing research findings, or new research to address other needs).**

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Research Adoption discussion groups (13:30 – 15:15)

13:40 – 14:40

- Divide into four groups to rotate through each of the 4 discussion topics (15 min. at each)
- Facilitator and notetaker/spokesperson for each topic remain at that topic/question throughout.

14:45 – 15:15

- Spokesperson for each topic will report combined discussion findings back to full workshop (5 min. each)

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