Application of fire Suppression Optimisation in Allocating Resources (SOAR)

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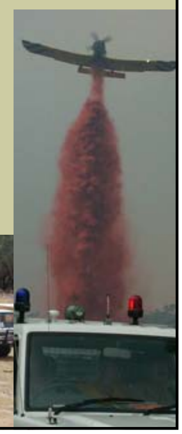
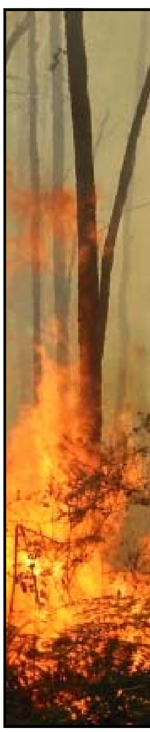
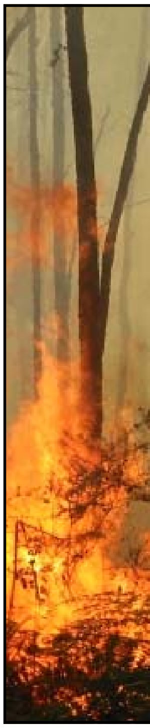




Outline

- Background
  - Aerial suppression
  - Decision support systems
- Suppression research flow
- Inputs
- Research activities
  - Operational data collection
  - Experimental data collection
  - Suppression analysis tools
- Outputs
- Outcomes



Aerial Suppression
more effectively and efficiently

- Bushfires
  - New paradigm carries increased responsibilities and heightened expectations. It almost certainly will increase public expectations of aerial fire fighting ***(fire authorities)*** performance and accountability.
  - Increasing cost of suppressing fires is a pressing concern, requiring careful selection of suppression strategies and efficient application of tactics.
  - Bushfire agencies operate in an environment characterised by great variation in fire activity and its consequences.
  - We need to develop a performance-base system tailored to a local, state and national aerial fire fighting program

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Aerial Suppression
more effectively and efficiently

- ***Effectiveness***- a physical measure of productivity for a desired outcome
- ***Efficiency***- getting the most out a given budget
- We need to define target outcomes and worst case outcomes for each suppression strategy considered:
  - For each outcome we need to:
    - Estimate final fire size
    - Resource damages
    - Suppression costs
    - Probability of that outcome occurring
- **BUT**
  - Logically structured decision analysis protocols are only as good as their inputs and there are uncertainties
  - Expert judgment- subjective assessments on the probability of success

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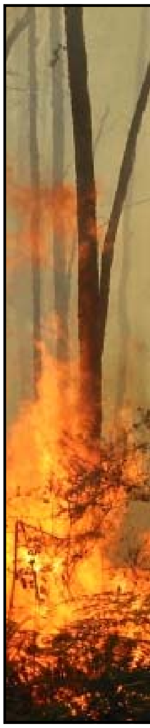

Decision-support systems

for evaluating alternative suppression strategies

- Analytical requirements
  - Identify criteria for evaluating suppression alternatives
  - Develop suppression alternatives
  - Analyze suppression alternatives by evaluating criteria and selecting the alternative that:
    1. Best provides for fire fighter and public safety
    2. Minimises the sum of suppression costs and resource damages
    3. Has an acceptable expected probability of success or failure.

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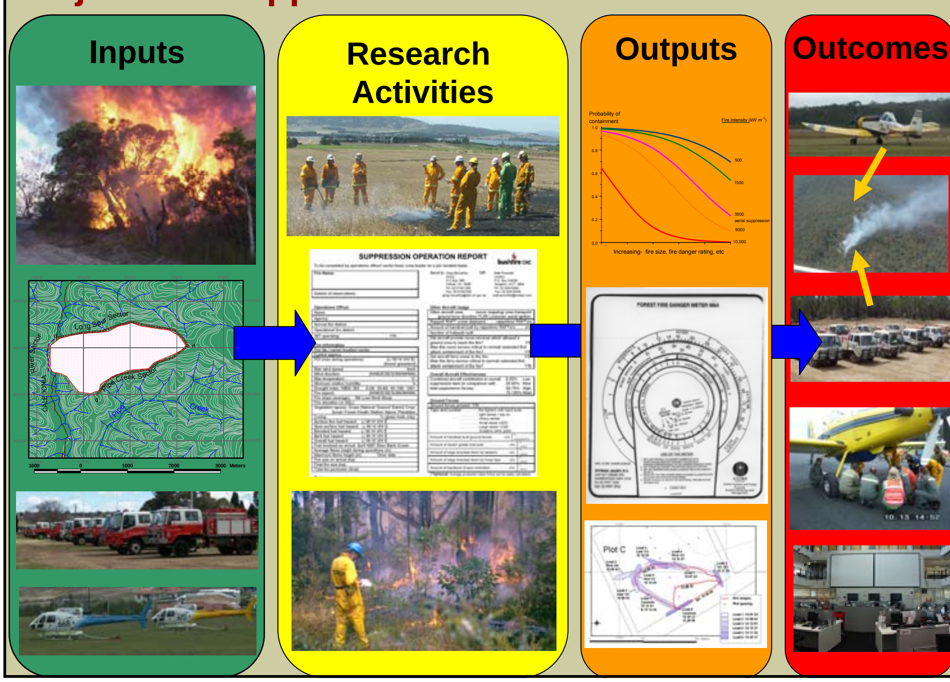
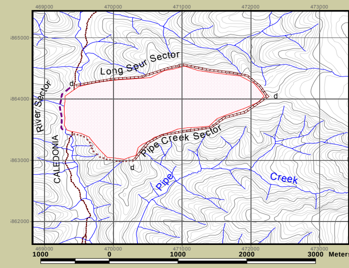
Project A3. Suppression Research Flow



Inputs



- Fire Environment
  - Weather
  - Fuel
  - Topography
- Management Environment
  - eg: land tenure; bush/urban interface; fuel management
- Suppression Resources
  - eg: aircraft; tankers; machinery; ground crews
- Resource Values
  - eg: conservation; primary production; community assets; cultural & heritage values
- Fire History
  - History of ignition and major fires
  - spatial and temporal


Photo: Anthony Knobel

Research Activities

- Operational data:
  - Collected on fire ground
- Experimental data
  - Selected conditions, controlled parameters
- Simulation model
  - Structured assessment of the outcomes and costs associated with alternative budgets and suppression resource mixes.

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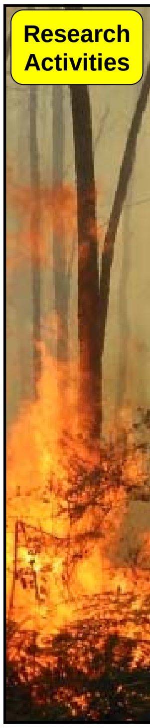
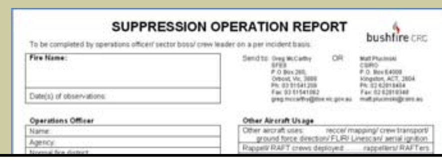


Research Activities

Operational data collection

Collected by operational personnel

- Potentially collect a large amount of data
- Collect data from all states
- Qualitative data (limited application)
  – Limited fuels and fire behaviour information
- Observer bias Two survey forms distributed to fire agencies:
  – Air Attack Supervisor report
  – Suppression operation report
- Supported by supplementary information
  – Maps
  – Reports
  – Photos



SUPPRESSION OPERATION REPORT

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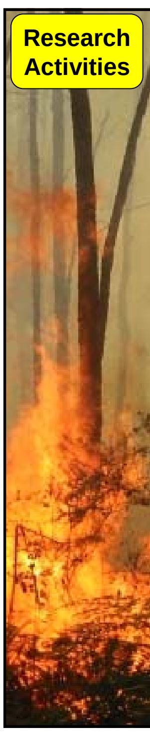
Fire Name:

Date(s) of observations:

Operations Officer

Other Aircraft Usage



Research Activities

Operational data collection

Collected by researchers

- Closely observe and monitor drop zones
  – During fire
    - On ground observations
    - Observations from aircraft
  – Post fire
- Logistical problems
    - Notification
    - Travel
    - Safe access

Photo: Roger "Rabbit" Matthysen

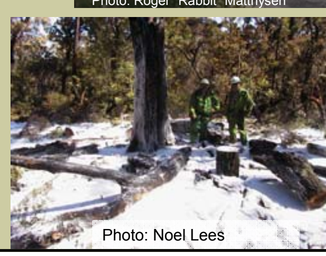
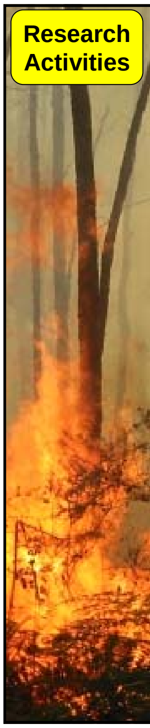


Photo: Noel Lees

Research Activities



Operational data collection

Preliminary trends *(2004/05 season data)*

- First attack is likely to be successful if:
  - – Few fuel layers involved in fire (eg fire in litter, not shrubs)
  - – Quick response (first suppression underway <2.5 hours after detection)
  - – Low flame height (≤1m)
  - – Low - moderate wind speed (<25 km/h)
    - More significant than FDI – due to some fires that burnt under high winds during low drought factors (high elevated fuels)

Research Activities

Data collection

Experimental data collection

- Target conditions
- Comprehensive site assessment
- Detailed & accurate data
- Small amount of high quality data
- Cost & time for preparation
- Dependant on weather and resource availability
- Limited sites & opportunities

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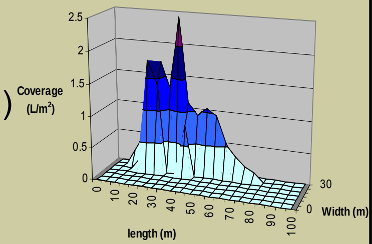
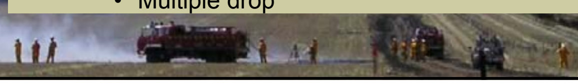
Research Activities

Experimental data collection

2005 Stubble fire suppression experiment Tasmania

- Aim:
  - determine the effects of suppression drops on fire behaviour in stubble fuels
  - develop a field method for further experiments
- Site: Uni of Tasmania farm
  - barley stubble (3 ½ t/ha)
- Medium helicopter (Bell 212)
  - bellytank & bucket
- Components:
  - Drop pattern tests
    - Determine suppressant ground distribution
  - Fire suppression experiments
    - Single drop
    - Multiple drop





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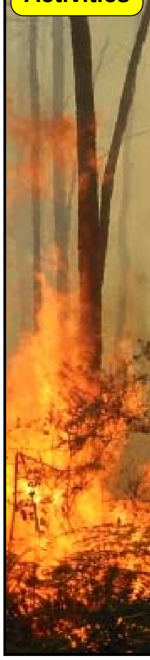
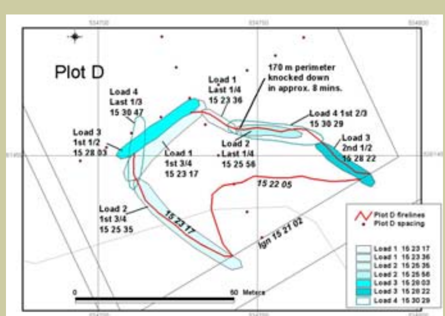
Research Activities

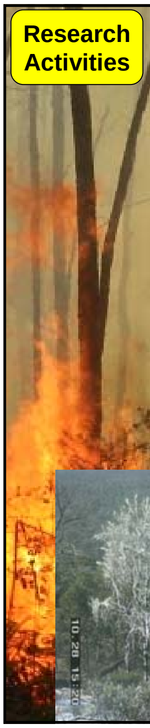
Experimental data collection

Tasmanian experiment 2005



- Helicopter tested works well in moderate conditions, light fuels (3 ½ t/ha), with no canopy
  - Water just as effective as foam in these conditions
  - Unlikely to deploy helicopter in these conditions
- Streamlined experimental methodology
  - Evaluation in heavier fuels and elevated fire danger



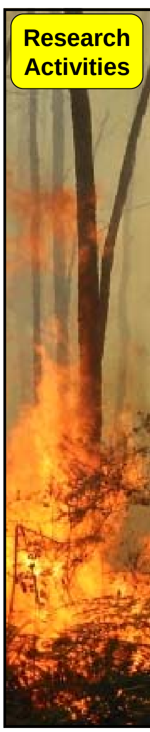


Research Activities

Experimental data collection

Future experiments

- <u>Possible</u> future experimental work
  - Sydney Bioregion
    - In conjunction with other fire experiments (fire behaviour, ecology, smoke, remote sensing)
    - 2006/07 season
    - Type 1 & 2 helicopters
    - Different fuels
  - South Western Australia
    - Single engine air tankers
    - Different suppressant types

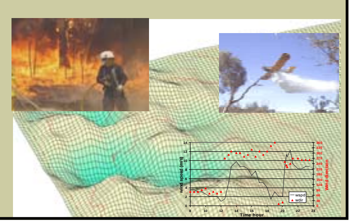


Research Activities

Suppression analysis tools

Simulation models

- **SOAR** - Suppression Optimisation in Allocating Resources
- Structured assessment of resourcing alternatives - resource mixes/ locations
  - Effectiveness - productivity
  - Efficiency - cost effectiveness
- Test optimal resources for changed fire patterns
- Computer based decision support systems to evaluate suppression strategies under different scenarios



Research Activities

Fire suppression scenarios

- **Fire behaviour**
  - Location
  - Fuel type
  - Current and future fire behaviour/ fire weather
  - Fire load (number of fires)
  - Size
  - Fire growth, perimeter
- **Suppression resources**
  - Dispatch rule
  - Type- tankers, crew, aircraft, dozers, etc
  - Availability
  - Constraints
  - Travel time
  - Suppressant type
  - Production rates
  - Cost- standby / operating

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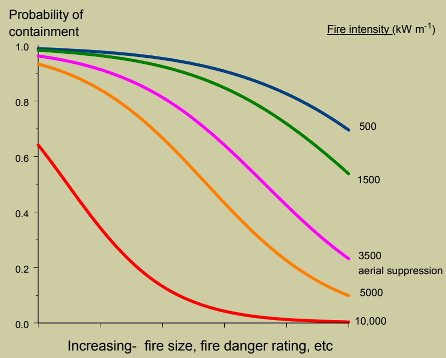
Research Activities

Suppression effectiveness

illustration of suppression effectiveness



- Need to predict fire behaviour in complex environment,
- Ability to model productivity and effectiveness of suppression resources,
- Provide assessments of the probability of fire containment for varied fire size, fire danger ratings, fire intensity.

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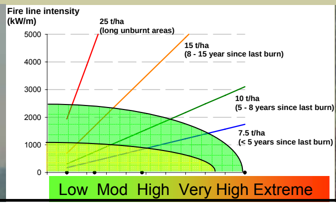
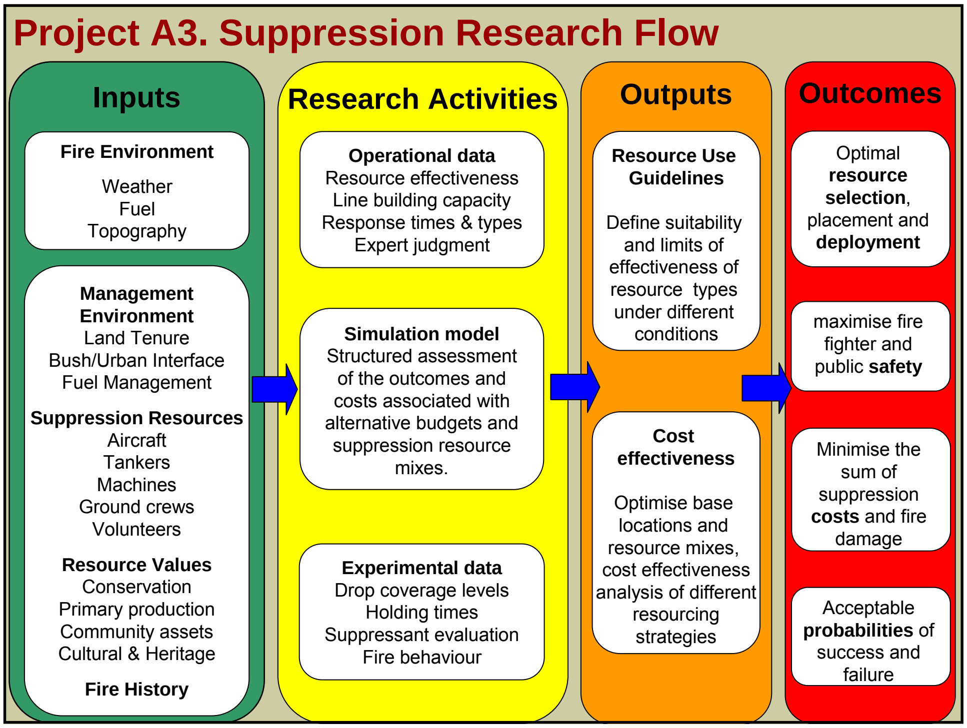
Outputs

- Resource Use Guidelines
  - Define suitability and limits of effectiveness of resource types under different conditions
- Cost effectiveness
  - Optimise base locations and resource mixes, cost effectiveness analysis of different resourcing strategies



Outcomes

- Optimal resource selection, placement and deployment
- maximise fire fighter and public safety
- Minimise the sum of suppression costs and fire damage
- Acceptable probabilities of success and failure


Project A3. Suppression Research Flow
Inputs
Fire Environment
Weather
Fuel
Topography
Management Environment
Land Tenure
Bush/Urban Interface
Fuel Management
Suppression Resources
Aircraft
Tankers
Machines
Ground crews
Volunteers
Resource Values
Conservation
Primary production
Community assets
Cultural & Heritage
Fire History
Research Activities
Operational data
Resource effectiveness
Line building capacity
Response times & types
Expert judgment
Simulation model
Structured assessment of the outcomes and costs associated with alternative budgets and suppression resource mixes.
Experimental data
Drop coverage levels
Holding times
Suppressant evaluation
Fire behaviour
Outputs
Resource Use Guidelines
Define suitability and limits of effectiveness of resource types under different conditions
Cost effectiveness
Optimise base locations and resource mixes, cost effectiveness analysis of different resourcing strategies
Outcomes
Optimal resource selection, placement and deployment
maximise fire fighter and public safety
Minimise the sum of suppression costs and fire damage
Acceptable probabilities of success and failure