

OPERATIONS RESEARCH (OR) TO SUPPORT BUSHFIRE MANAGEMENT

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Research Advisory Forum 25 October 2011







"Operations Research (OR) is the use of analytical techniques such as mathematical modelling to analyse complex interactions between people, resources and the environment to aid decision-making and the design and operation of systems."

(Altay and Green 2006)

OPERATIONS RESEARCH (OR)



OR methods successfully applied in a range of industries:

- Transportation
- Health Care
- Mining
- Finance
- Aviation
- Telecommunications

RESEARCH QUESTIONS



• Defining challenges of bushfire management?

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- Applicable OR methods?
- Current state of knowledge OR use in wildfire management?

LITERATURE REVIEW



- Comprehensive review wildfire OR work 1961-81 (Martell 1982)
- Elements updated in 1998 (Martell et al. 1998)
- No detailed reviews of wildfire OR since 1998
- Our work addressing this significant gap

LITERATURE REVIEW



- Range of OR methods presented
- Ability to address defining challenges of bushfire management:
 - o complexity
 - multiple conflicting objectives
 - o uncertainty
- Examples and case studies wildfire/disaster OR literature

COMPLEXITY



• Mathematical Programming (Optimisation)

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- Problem Structuring Methods (Soft OR)
- System Dynamics
- Hyper-projects

MULTIPLE CONFLICTING OBJECTIVES

This .



- Multi-objective Optimisation
- Goal Programming

UNCERTAINTY



- Simulation
- Stochastic Programming

This .

- Robust Optimisation
- Fuzzy Models

LITERATURE REVIEW



Elements of this work presented at:

- Wildland Fire Canada Conference 2010
- Australia and New Zealand Industrial and Applied Mathematics Conference 2011

Paper based on this work accepted for publication:

 Minas JP, Hearne JW, Handmer JW A review of operations research (OR) methods applicable to wildfire management. International Journal of Wildland Fire, in press (WF10129).

RESEARCH QUESTIONS



- Pressing problem faced by bushfire managers?
- Suitable OR methods to tackle this problem?

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• Gaps in literature?

RESEARCH QUESTIONS



- Pressing problem faced by bushfire managers?
- Suitable OR methods to tackle this problem?

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• Gaps in literature?



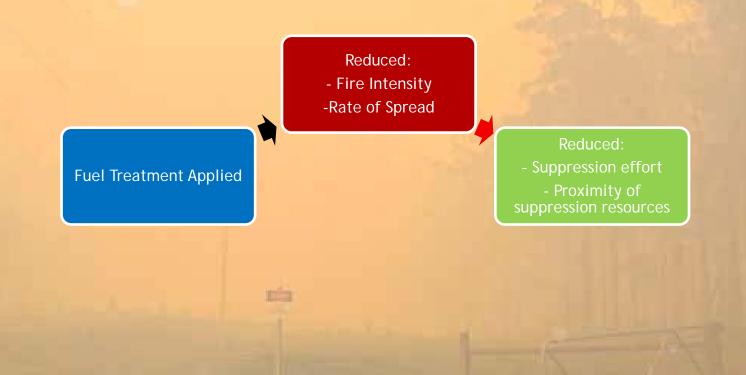
Bushfire management - complex mix of interrelated components:

- o fuel management
- o fire prevention
- o fire detection
- suppression preparedness

Previous OR models treat these in isolation from one another

NEED FOR AN INTEGRATED APPROACH

Interrelation between fuel treatment and suppression programs



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INTEGRATED MODEL



- Integrated optimisation model
- Scope developed in consultation with end user (DSE)
- Collaboration with Fire Management Systems Lab (U of T)
- First optimisation model to include both:
 - fuel management decisions
 - suppression preparedness decisions
- Model presented in a general form
- Tested on a series of hypothetical test landscapes

INTEGRATED MODEL



Elements of this work presented at:

- Australia and New Zealand Industrial and Applied Mathematics Conference 2011
- Conference for the International Federations of Operational Research Societies 2011
- Bushfire CRC and AFAC Annual Conference Science Day 2011

Paper based on this work to be submitted to Annals of Operations Research - special volume on OR in forestry

Minas JP, Hearne JW, Martell DL An integrated optimisation model for fuel management and suppression preparedness planning

FUTURE WORK



Further model testing with real landscape data

Explore model extensions:

- multi-period (approximate dynamic programming)
- fire weather uncertainty (stochastic programming)
- multiple objectives (multi-objective optimisation)

REFERENCES

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Minas JP, Hearne JW, Handmer JW A review of operations research (OR) methods applicable to wildfire management. International Journal of Wildland Fire, in press (WF10129).





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