Managing Bushfire Risk in a Changing World

Project B.1.2

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Risk is the probability of an adverse outcome. This project attempts to quantify the risks posed by fire in a changing world, where tradeoffs between competing values must be accommodated. Risk quantification is important for fire management, and can vary according to location, ecosystem properties, and perceived values in the landscape. In this study a diversity of ecosystems and values are investigated to determine the types of tradeoffs required for optimal fire management. A paramount aim is to determine how these optimal solutions will be affected by climatic and global change.

Our **research** on managing bushfire risk will be addressed by landscape simulation modelling, statistical analysis of fire occurrence, landscape fire ecology, and modelling of fundamental bushfire processes. These approaches will provide complimentary evidence about the fundamental processes which drive fire regimes and their effects in landscapes. They will provide a quantitative basis for the estimation of risk and the way it is affected by management decisions and climate change.

Central Australia

Sydney Basin

Australian Capital Territory

South West Tasmania

The selection of our **study locations** addresses a fundamental question about whether there is a generic approach to bushfire risk management which is applicable throughout Australia. Alternatively, it may be that solutions need to be tailor-made to suit particular combinations of climate, landscape and management values.

RESEARCH HIGHLIGHTS 2005
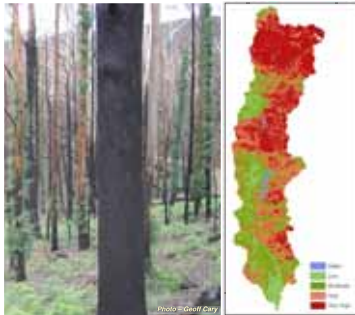
Severely burnt eucalypts in the Cotter River Catchment, ACT

Fire severities in the Cotter Catchment, ACT during the January 2003 Canberra bushfire. (Data supplied by Ecowise International Pty Ltd.)

Southern Tablelands

Simulation Modelling
Preparation of FIRESCAPE for simulating fire management options in the ACT and surrounding region has commenced. Additional vegetation layers are being incorporated, with the implementation of CSIRO's GrassGro model to depict the seasonal and yearly variations in the growth of grasses. Workshops on suppression, spotting, fire spread under extreme weather, and climate are being conducted during the year to optimise the implementation of these in FIRESCAPE. The possibility of simulating the impacts of proposed fire management strategies on unplanned fire is being explored with Environment ACT.

Statistical Analyses
The significance of vegetation, topography, and weather, in explaining spatial patterns of fire severity in the Cotter River Catchment during the 2003 bushfires is currently being explored. (see map above)

Student:
Carola Kuramotto "*Determinants of fire severity in the Cotter River catchment, Canberra region*" (ANU Honours)

Landscape Ecology
An analysis of the response of a sub alpine plant community to varied experimental fire frequency has been completed. *Daviesia mimosoides* exhibited a trend of declining abundance with increasing frequency of fire.
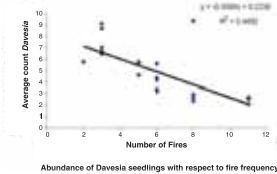
Abundance of Daviesia seedlings with respect to fire frequency

Students:
Christine Kelly "*The effects of fire on the understorey species in a subalpine forest.*" (ANU Honours)

Lindsey Vivian "*The role of fire in determining the boundary between subalpine eucalypt stands*" (ANU Honours)

Phil Zylstra "*Plant species contributions to fire intensity – toward a total fuel model*" (UNSW PhD)

Arid Australia

Simulation Modelling
Landscape simulation modelling of the McDonnell Ranges and Finke Gorge region will identify the sensitivity of the risk of unplanned fires to biodiversity, and values relating to tourism, indigenous, and pastoral issues, with respect to alternate management approaches, the expansion of exotic grasses, and climate change.

With the recent appointment of a Research Assistant (a joint position between the Bushfire and Desert Knowledge CRCs), data collation has commenced. GIS layers are being developed for vegetation, topography, fire histories, and land tenure. Additionally weather data, fire history statistics, fire behaviour algorithms, and ecological responses of vegetation communities to varying fire regimes, is being collected**.**
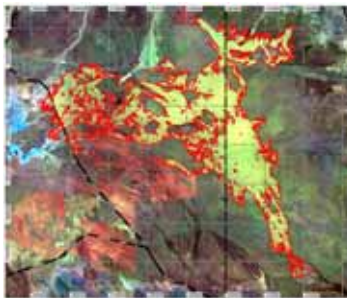
Example of digitising fire history using satellite imagery

Landscape Ecology
Within the arid zone, mulga (*Acacia aneura*) supports a rich bird fauna. Mulga grows in large continuous stands and in patches that are interspersed with other plant communities in an intergrove pattern. Little is known about the way birds respond to the spatial distribution of mulga in the landscape, or the fire-regimes associated with mulga. This joint research project with the Desert Knowledge CRC is investigating the effects of time-since-fire, patch size and the ecotone between fire patches on the bird community of mulga woodlands.

Student:
**Adam Leavesley** "*The response of birds to the fire regimes of mulga woodlands in Central Australia*" (ANU PhD)

Partners:
• NT Parks and Wildlife Service
• NT Bushfire Council
• Desert Knowledge CRC

Photo – Jon Marsden-Smedley

South West Tasmania

Simulation Modelling
Validation and implementation of FIRESCAPE in south west Tasmania is almost complete, with the simulation of alternate management options continuing.

The study area in south west Tasmania (~1.7 million hectares) contains ~27% buttongrass moorlands. This vegetation community is highly flammable, with prescribed burning presently performed in it to reduce the risk of fires spreading to fire sensitive rainforest and alpine species. Simulation modelling over 200 years was performed to ascertain the relationship between the prescribed burning treatment effort and the total area of these species burnt. A proposed planned burning strategy, provided by Tasmanian Parks and Wildlife Service, was also simulated. This proposed treatment included annually burning approximately 3% of the buttongrass in strategically located patches. The proposed treatment was more efficient in protecting fire sensitive vegetation than the hypothetical treatments, as it was statistically similar to annually burning at least 10% buttongrass where patch selection was not focused on value protection.
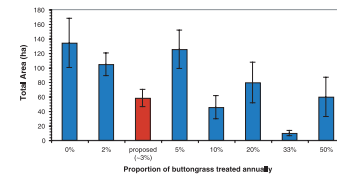
Total area (ha) of fire intolerant vegetation burnt under different management treatments

Simulations indicate an approximate negative exponential relationship between the level of prescribed burning treatment and the area burnt by unplanned fires. This relationship is maintained under a climate change scenario predicted by CSIRO modelling for the year 2070. The anticipated climate has temperatures 2ºC warmer than present, and a decline of 10% in precipitation during spring, summer and autumn, and an increase of 10% in winter (*CSIRO (2001) Climate Change Projections for Australia, CSIRO Climate Change Research Program, www.dar.csiro.au/publications/projections2001.pdf*)**.**

Results indicate that under the predicted climate for 2070, prescribed burning efforts will need to be approximately doubled to maintain similar mean annual areas burnt by unplanned fires. This indicates the system is sensitive to small changes in temperature and precipitation.
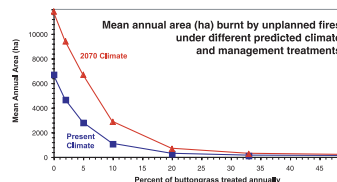

Partner:
Tasmanian Parks and Wildlife Service

Sydney Basin

Simulation Modelling
A crucial issue in the largest urban landscape in Australia is protection of people and their assets. This project will address bushfire risks at the urban interface by exploring differing fire suppression and prevention strategies in landscape simulation modelling. Stakeholder workshops were held in April and May 2005 to discuss bushfire risk management issues in general and the role of this project in particular. Results from this modelling will also yield insight into how air and water quality may be affected by alternative fire management options in the Sydney Basin.

Statistical Analyses
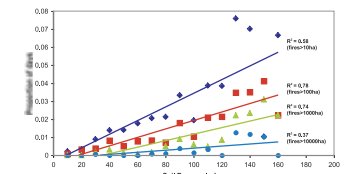
Fires greater than 1000 ha are typically responsible for property destruction in this region. Analyses of fire databases for the Blue Mountains (1960-2003) relates the incidences and sizes of fire to a variety of weather indices (e.g. FDI, SDI), to produce a more comprehensive understanding of the drivers of bushfire risk. The data above show how the chance of fires of a particular size is positively related to the Soil Dryness Index. This relationship provides a simple basis for exploring the consequences of future predicted changes to weather on fire risks to people and property. In a complementary project, fire records are being used to estimate the temporal patterns of fire recurrence with respect to fuel and vegetation patterns. These analyses provide a rare and comprehensive opportunity for validation of simulation modelling.

Student:
Rob de Ligt "*Spatial and temporal controls of unplanned fire ignitions*" (ANU Bushfire CRC Summer Vacation Scholar)

Rob de Ligt "*Determining the risk profile for unplanned fires in the Sydney region.*" (ANU Honours)

Landscape Ecology
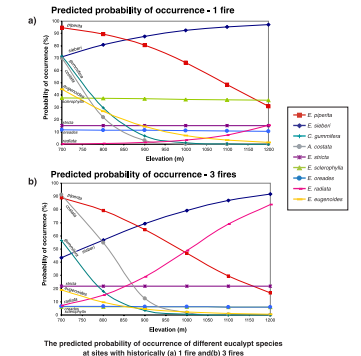
The predicted probability of occurrence of different eucalypt species at sites with historically (a) 1 fire and(b) 3 fires

Management must strive to conserve the high diversity of eucalypt species in the Blue Mountains World Heritage Area, as this is a key value recognised by UNESCO, and the State and Commonwealth Governments. A recently completed project has shown that eucalypt diversity is strongly affected by fire, along with other environmental attributes such as altitude. Patterns of species response (probability of occurrence predicted by logistic regression) vary, with some species (eg *E. oreades* and *E. sclerophylla*) showing a strong sensitivity to fire recurrence, while others (eg *E. piperita* and *E. sieberii*) are relatively insensitive. These patterns complement known life history responses and competitive interactions among species. This study provides a basis for evaluating the relationship between risk and management factors that shape fire regimes.

Student:
Sonya Ku "*Fire and resources: explaining the distribution and coexistence of contrasting life history strategies in Eucalypt forest within the Blue Mountains region of NSW*" (UNSW Honours)

FUTURE OUTCOMES

• Optimal fire management (prescribed burning and suppression) for regional landscape risk mitigation.

• Quantifying 'risk' of fires on perceived values in a diversity of landscapes, and under climate and global change.

• Understanding of relative importance of contributing parameters to fire occurrence, fire behaviour and fire regimes.

Bushfire CRC (Project B.1.2) joint fieldtrip with DesertKnowledge CRC (Desert Fire Project) in Central Australia