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A SYSTEMATIC EXPLORATION OF THE POTENTIAL FOR BUSHFIRE RISK MITIGATION WITH PRESCRIBED BURNING

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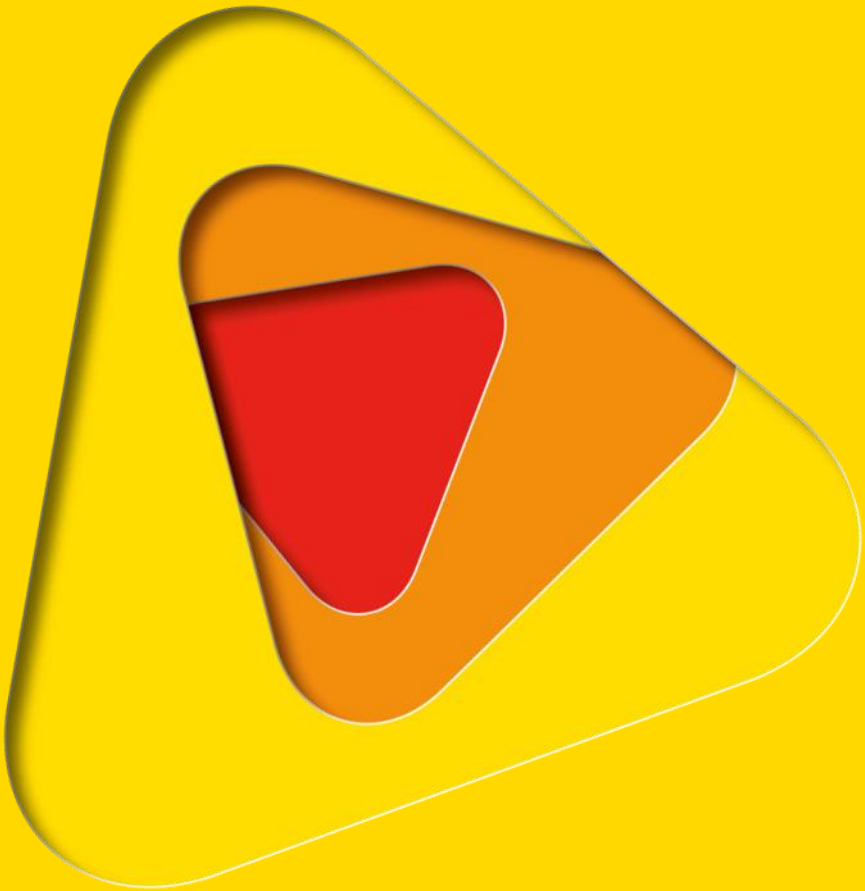

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ABSTRACT

A SYSTEMATIC EXPLORATION OF THE POTENTIAL FOR BUSHFIRE RISK MITIGATION WITH PRESCRIBED BURNING

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Fire regimes vary widely across Australian ecosystems as a function of climate, fuel, terrain and ignition variations. Fundamentally such variation will not only shape the way that prescribed burning can reduce risk to human and environmental assets but also the scope for effective treatment. While many agencies are moving toward planning systems based on risk assessment, knowledge of the best way to use prescribed fire to reduce risk to key values is generally lacking. The BNHCRC Project, "From hectares to tailor-made solutions for prescribed burning", combines simulation and empirical approaches to improve our understanding of how risk to any particular management value will respond to variations in the spatial location and rates of treatment. Here, we present the modelling framework and key results for two landscapes, Tasmania and the Australian Capital Territory. We run a large number of simulations using the PHOENIX RapidFire model, investigating the interaction between fuel treatment and location under various weather scenarios. Key outputs for risk assessment include area burnt, house loss, life loss, roads and powerlines damaged, environmental cost and economic cost. Across both case study landscapes, greater levels of prescribed burning tend to result in reduced wildfire impacts on all risks. However, there is considerable variation in the rate of reduction in risk, including the amount of treatment required to achieve key targets. Further, the particular combination of weather factors underpinning given fire weather conditions (e.g. temperature vs wind driven) can substantially impact the overall level of risk, as well as the response to prescribed burning.

BACKGROUND

Prescribed burning in Australia, currently stands at a cross roads. The 2009 Victorian Bushfires Royal Commission recommended an annual treatment target of 5% of public land in Victoria. Subsequently, concerns have been formally raised (e.g. Bushfires Royal Commission Implementation Monitor 2013 Annual Report) that such an area-based target may not deliver the most effective levels of risk reduction for people and property in Victoria. Concurrently, some other States have adopted such a prescribed burning target, but formal attempts to evaluate its effects on risk to people, property and environmental values across different jurisdictions are lacking. Such extrapolation of the 2009 BFRC recommendation pre-supposes that there is a "one-size fits all" solution to the problem. While many agencies are moving toward planning systems supposedly based on risk assessment, knowledge of the best way to use prescribed fire to reduce risk to key values is generally lacking.

General principles need to be developed about how to apply a risk-based approach across widely varying environments, human communities and combinations of key management values. In essence, the use of prescribed fire for risk mitigation involves understanding how risk to any particular management value will respond to variations in the spatial location and rates of treatment. Managers and policy-makers need to know how these fundamental elements of prescribed burning can be tailor-made to suit the environmental and human context of their local jurisdictions. A variety of fundamental problems need to be overcome in order to deliver effective, tailor-made prescribed burning solutions across different Australian environments.

The Bushfire and Natural Hazards CRC project "From hectares to tailor-made solutions: systems to deliver effective prescribed burning across Australian ecosystems" is designed to address these challenges.

FIRE SPREAD SIMULATIONS

A large number of fire spread simulations were carried out using the PHOENIX RapidFire model. Case study landscapes were selected to sample variation in human and natural systems across southern Australia. Fires were modelled under a range of weather conditions, at 1,000 high probability ignition points per landscape. A range of fuel treatments were investigated: edge vs landscape treatment, and overall treatment levels of 0, 1, 2, 3, 5 10 and 15% p.a. Close to 1,000,000 simulations were carried out in each case study landscape. A full description of the simulations can be found in the 2016-2017 Annual Report.

RISK ESTIMATION

The fire spread simulations were used as input for risk estimation. Wildfire impacts on range of direct and indirect values were calculated, either directly from model output or by using asset loss functions, which relate model outputs to management values. These include area burnt, house loss, life loss, powerline loss, road loss and

area burnt within minimum tolerable fire interval (TFI). A full description of the values and associated loss functions can be found in the 2016-2017 Annual Report.

In order to translate impact estimates into risk estimates, a Bayesian Decision Network model was used which incorporated the relative frequency of weather conditions at each case study landscape, as well as other influences in the network between model outputs and management values (Marcot et al. 2006). This allowed an estimate of the risk reduction afforded by prescribed burning, as well as the relative risk mitigation across different management values, allowing a comparison to be made between them.

RESULTS

The risk estimation was based on the large scale fire behaviour simulations we undertook in case study regions across Southern Australia. Here we present results for two key regions: the ACT (Figure 1) and Tasmania (Figure 2). We found that regardless of weather conditions, prescribed burning tended to decrease impacts on key values such as area burnt, house and life loss, but that the amount of area burnt within minimum TFI increased. Conversely, stronger fire weather conditions were more important in altering impacts on these values than strong increases in treatment rate (e.g. area burnt in Tasmania, Figure 3). Risk did not respond uniformly to treatment, with a greater relative impact in the ACT for some values (area burnt, powerline loss and road loss) and a greater relative impact in Tasmania for others (house loss, life loss). Prescribed burning seemed to have similar effects on the relative increase in area burnt within TFI in each region. In general prescribed burning was not able to achieve a halving of risk for the values studied here in these two regions. This analysis gives us confidence that we are on track to deliver a systematic assessment of the potential to use prescribed burning to achieve wildfire risk mitigation across the varied landscapes of southern Australia.

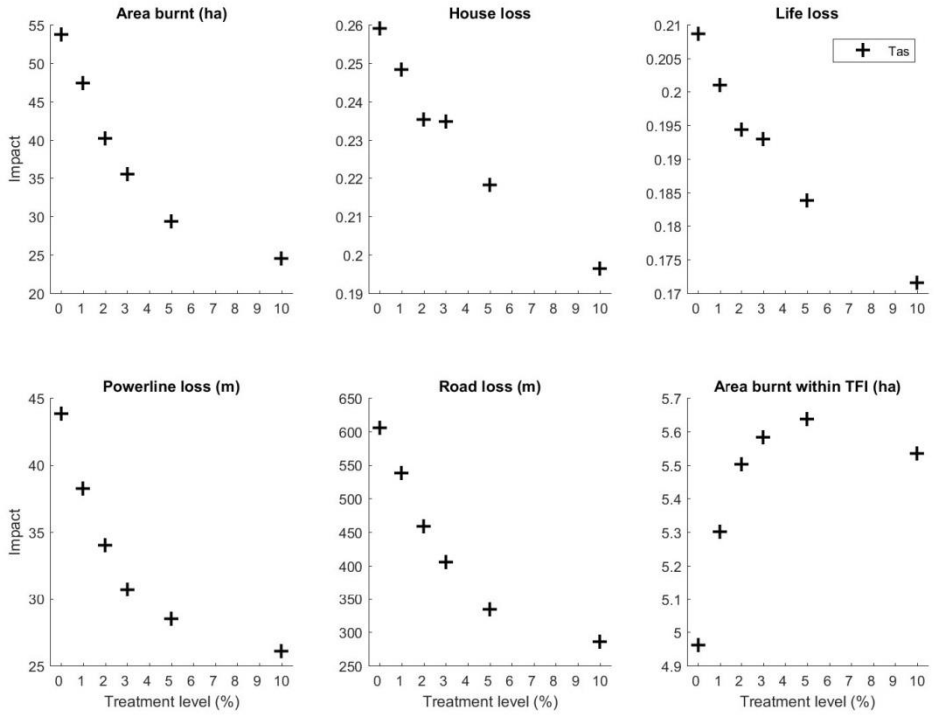

FIGURE 1 EFFECT OF DIFFERENT RATES OF PRESCRIBED BURNING ON SIMULATED WILDFIRE RISK ACROSS KEY MANAGEMENT VALUES IN THE ACT CASE STUDY LANDSCAPE

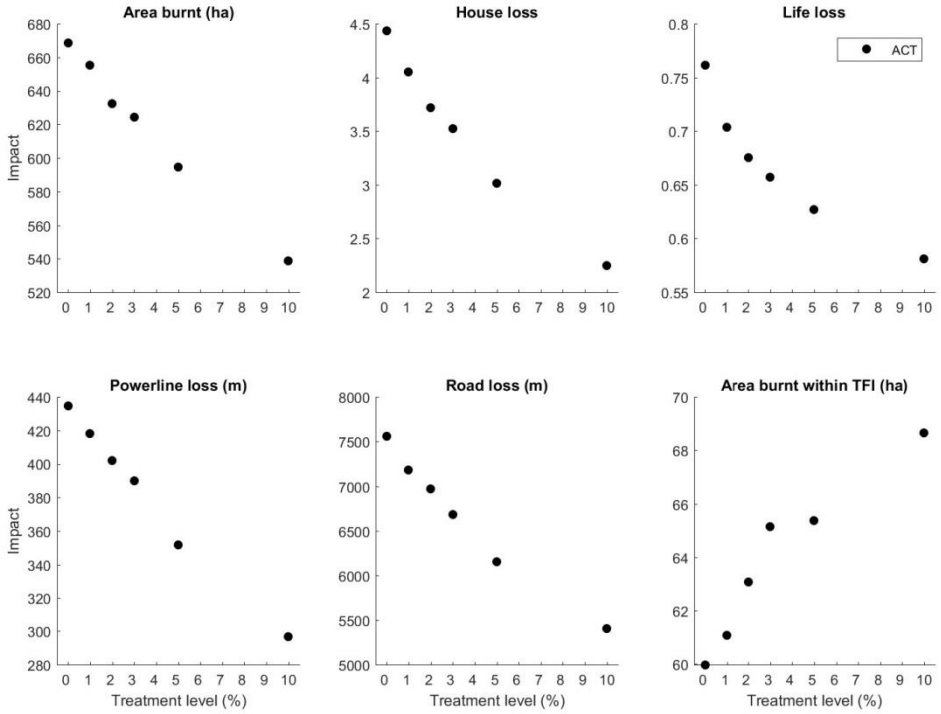

FIGURE 2 EFFECT OF DIFFERENT RATES OF PRESCRIBED BURNING ON SIMULATED WILDFIRE RISK ACROSS KEY MANAGEMENT VALUES IN TASMANIA CASE STUDY LANDSCAPE.

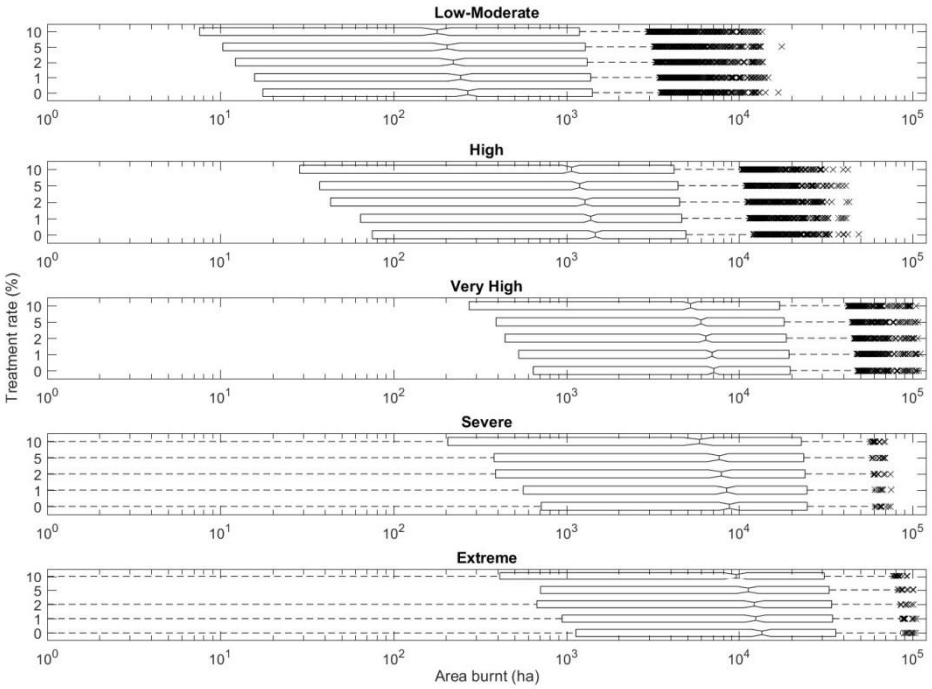

FIGURE 3 EFFECT OF DIFFERENT RATES OF PRESCRIBED BURNING AND DIFFERENT FFDI CATEGORIES ON SIMULATED WILDFIRE IMPACTS ON BURNT AREA IN TASMANIA CASE STUDY LANDSCAPE.

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1 BRCIM, 2013. Implementation Monitor: Annual Report. Bushfires Royal Commission Implementation Monitor.
2 Clarke H, Price O, Boer M, Cirulis B, Penman T, Bradstock R (2017) From hectares to tailor-made solutions for risk mitigation: systems to deliver effective prescribed burning across Australian ecosystems. Bushfire and Natural Hazards CRC, Melbourne