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4th of December, 2003

Mr Stuart Ellis
COAG Inquiry into Bushfire Management and Mitigation
Level 3, MTAA House
39 Brisbane Avenue
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Ack 5/12

Dear Stuart,

Re: Submission to the COAG Inquiry into Bushfire Management and Mitigation

Please find my submission to the COAG Inquiry into Bushfire Management and Mitigation attached. I am confident that its content will contribute significantly to the work being undertaken by you and your colleagues.

For your information, I have noted my academic qualifications, summary of publications and other aspects of my professional practice:

- PhD from the Ecology, Evolution and Systematics Program, The Australian National University (thesis title "Predicting Fire Regimes and their Ecological Effects in Spatially Complex Landscapes").
- Lecturer in Fire Science in the Department of Forestry/School of Resources, Environment and Society at The Australian National University since 1996.
- Senior editor of one fire science and policy book ("Australia Burning: Fire Ecology, Policy and Management Issues" (2003) CSIRO Publishing) and published twelve scientific papers (six refereed), five book chapters (three refereed), and seven conference abstracts on fire science.
- Associate Editor for the International Journal of Wildland Fire since 2001.
- Member of the ACT Bushfire Council since 2002.
- Member of the Bushfire Research Advisory Group advising the Federal Minister for Science since 2003.
- Researcher in Project B.1.2. (Fire regimes and sustainable landscape risk management) of the Bushfire Cooperative Research Centre.
- Member of the International Association of Wildland Fire.

Dr Geoff Cary
Lecturer in Fire Science

Submission to The COAG Inquiry on Bushfire Mitigation and Management

Dr Geoff Cary,
Fire Science Lecturer,
School of Resources, Environment and Society,
The Australian National University

1. Introduction

In Australia, bushfire management and mitigation has largely lacked an appropriate framework for understanding the relative contribution of varying mitigation and suppression strategies to best practice management of bushfire risk. This submission outlines an appropriate framework recently published by Bradstock and Gill (2001) and makes some observations, based on evidence, on one of its components (spread of fire in bushland).

2. An integrated Risk Management Model

Fire management for protection of people and property has no explicit quantitative basis for the evaluation of effects of diverse management approaches on risk (Bradstock, 2003). Bradstock and Gill (2001) and Bradstock (2003) have proposed an integrated risk management model that describes the relationship between the probability of adverse risk to humans and their property (D) and linked probabilities of components of the bushfire problem:

$$D=I.S.E.G.H$$

Where:

- D = probability of an adverse outcome
- I = probability of ignition in the landscape
- S = probability of fire reaching the urban interface
- E = probability of encroachment into the built environment
- G = probability of fire propagation within the built environment
- H = probability of fire propagation within buildings

The model is particularly relevant to the bushland-urban interface where it has been demonstrated, by numerous fire episodes, that people and property are (and will continue to be) most at risk.

Various aspects of bushfire management and mitigation can be attributed to different components of the model. For example, the effectiveness of early initial attack affects I, whereas fire suppression efforts after this initial phase affects S. S may also be affected bythe extent that fuel load have been modified by prescribed burning for fuel reduction. E is affected by the distance built assets are setback from the bushland components of the landscape. G will be affected by selection of species planted in gardens and their arrangement, while H is primarily a function of house design and construction, and occupant behaviour.

The risk of an adverse outcome (D) can only be set to zero if at least one of the components on the right hand side of the Bradstock and Gill model can be set to zero, which is unlikely except perhaps in the case of the most extreme engineering solution. Therefore, it is clear from the Bradstock and Gill model that society has no choice but to accept a certain risk of an adverse outcome, even perhaps given best practice management of the various components of the bushfire risk problem.

Nevertheless, it follows from logic that a low incidence and encroachment of fire from bushland (via prevention and suppression) and a low probability of spread through the urban environment (via town planning and building design) are required for a comprehensive reduction in risk of an adverse outcome (Bradstock (2003).

3. Fire reaching the urban interface (S)

3.1 Effectiveness of mitigation via prescribed burning for fuel reduction

Reduction of fuel loads through the practice of prescribed burning is frequently recommended as a means of reducing the probability of fire spreading across vegetated landscapes and reaching the urban interface, partly by aiding suppression efforts. This is based upon the logic that reducing the amount of fuel will reduce the intensity of ensuing fires, thus increasing the chance of effective suppression.

A thorough review of 138 scientific articles on the effectiveness of prescribed burning in fire hazard reduction (Fernandes & Botelho, 2003) was recently published in the International Journal of Wildland Fire. As stated in the abstract of this review:

> "Wildfire hazard abatement is one of the major reasons to use prescribed burning. Computer simulations, case studies, and analysis of the fire regime in the presence of active prescribed burning programs in forest and shrubland generally indicate that this fuel management tool facilitates fire suppression efforts by reducing the intensity, size and damage of wildfires. However, the conclusions that can be drawn from the above approaches are limited, highlighting the need for more properly designed experiements addressing this question. Fuel accumulation rate frequently limits prescribed burning effectiveness to a short post-treatment period (2-4 years). Optimisation of the spatial pattern of fire application is critical but has been poorly addressed by research, and practical management guidelines are lacking to initiate this. Furthermore, adequate treatment efforts in terms of fire protection are constrained by operational, social and ecological issues. The best results of prescribed fire application are likely to be attained in heterogeneous landscapes and in climates where the likelihood of extreme weather conditions is low. Conclusive statements concerning the hazard-reduction potential of prescribed fire are not easily generalized, and will ultimately depend on the overall efficiency of the entire fire management process."

Unlike Australia, the debate surrounding the role of prescribed burning for fuel reduction and of fire suppression in the Chaparral-dominated landscapes of southern California is rigourous, robust and published in peer-reviewed journals at the highest level (Minnich 1983; Keeley and Fotheringham, 1999; Minnich 2001; Keeley and Fotheringham, 2001). Cary and Bradstock (2003) argue that managers and experts can only speculate on critical levels of fuel-reduction burning required to meet particular management objectives in Australian systems because the relationship between the extent of fuel-reduction burning and the probability of unplanned high intensity fire (Figure 1) is *yet to be detennined* for any system. They presented a range of hypothetical scenarios (Figure 1) that would result in fundamentally different management outcomes given particlar levels of prescribed burning for fuel reduction.

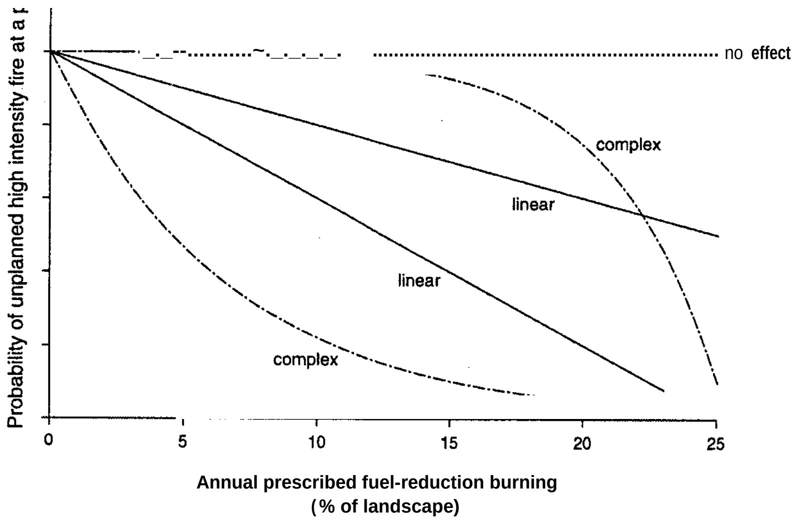

Figure 1. Hypothetical relationships between annual amount of prescribed fuel-reduction burning in a landscape and the probability of unplanned fire (at a point) of sufficient intensity to threaten residential structures at an urban interface of the landscape. Note that these relationships are hypothetical and do not represent results from real landscapes (Source - Cary and Bradstock, 2003).

There have been attempts to resolve this issue for a particular system. For example, an extensive analysis of the contemporary fire regimes in the forests of southwestern Australia (Gill and Moore, 1997), concluded that "since the introduction of prescribed burning to all areas of the Jarrah forest in the 1950s there appears to be little change in the unplanned-fire cycle based on total area of state forests and timber reserves but a widening of the interval if the basis was the protected area." The authors stated that they were unable to establish which basis was more appropriate.

3.1 Effects of mitigation via prescribed burning for fuel reduction

There are economic, ecological and social constraints on the use of prescribed fire for fuel reduction, although the author of this submission is only in a position to comment on ecological constraints. The effect of fire on biota results from the fire regime (Gill, 1975), not individual fire events (Whelan *et* al., 2002). For any species, there are likely to be some fire regimes that are favourable, with the balance representing unfavourable fire regimes (by definition). According to Whelan *et* al., (2002) "The effects of sequences of fires have been most closely examined for obligate-seeder plant species, because it is their life cycle which is likely to be most at risk with increased fire frequency". For example, Whelan *et* al. (2002) cite three studies from the Sydney region (Nieuwenhuis, 1987; Morrison *et* al., 1995; and Cary and Morrison, 1995) that provide evidence for lower cover of obligate seeder species in sites that were frequently burnt compared to rarely burnt sites, and reduced mean richness (number of species) per sample plot in areas characterised by shorter inter-fire intervals. These patterns can be explained by the scheme of vital attributes devised by Noble and Slatyer (1981) that can be used to predict the response of functional groups of plant species to particular sequences of fire events. Therefore, it can be stated with some certainty that there is an ecological impact of increased fire frequency resulting from prescribed burning on some obligate-seeder plant species (at least), and this presents a considerable constraint on the applications of this practice.

4. Overriding factors that change through time

4.1 Climate change

Several of the components of the Bradstock and Gill model (principally I and S) are likely to be affected by changing meteorological conditions associated with a changing climate. For example, various measures of the Forest Fire Danger Index will increase over most of the continent (Beer and Williams, 1995), resulting in markedly shorter intervals between fires in, for example, the Australian Capital Territory region (Cary, 2002). Further, Goldammer and Price (1998) studied how the global distribution of lightning frequency might be affected by a changed climate. They reported that the modelled frequency of lightning increased over all continental areas and doubled over most of Australia for a 2 x $C0_2$ climate simulation (with a 4.2 °C global warming) compared to a 1 x C02 simulation.

4.2 Population growth

According to the Australian Bureau of Statistics the population of Australia will reach 20 million in early December this year (2003). According to Wilson (2003), while the Australian population has grown by 50 per cent over the last 30 years, recoded arsons have increased by 2000 (two thousand percent) per cent. Clearly this impacts on the I component of the Bradstock and Gill model, subsequently impacting on the risk of an adverse outcome (D). Strategies that result in decreased arson, particularly during or before periods of severe weather, will result in a decreased risk of an adverse outcome (D).

Recommendations

It is recommended that The COAG Inquiry on Bushfire Mitigation and Management:

i) adopt the Bradstock and Gill integrated risk management model as an appropriate framework for understanding the relative contribution of varying mitigation and suppression strategies to best practice management of bushfire risk;

ii) recognize that both low incidence and encroachment of fire from bushland (via prevention and suppression) and low probability of spread through the urban environment (via town planning and building design) are required for a comprehensive reduction in risk of an adverse outcome in relation to bushfires;

iii) recognize the contribution, but also the significant limitations, of prescribed fuel-reduction burning for modifying the spread of fires to the bushland-urban interface; and

iv) recognize that increasing population and climate change are likely to result in a greater risk of adverse outcomes with respect to bushfires in Australia, over time.

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