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# Usage of Cool Burning as a Contributor to Bushfire Mitigation

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## Abstract

This paper considers and describes the cool burning techniques long utilized by Australian Indigenous people as a contributor to bushfire mitigation. Indigenous fire management involves lighting the “cool” fires in selected areas between March and July, in Australia, during the early dry season. The fires burn gradually, reducing fuel loads and creating fire breaks and not all of the area is burnt. Late in the dry season, when the weather is very hot, the method removes fuel for larger fires while maintaining and protecting habitat for mammals, reptiles, insects and birds. The management of Indigenous cultural fire offers an Indigenous viewpoint for wider control of fire and cultural fire management is an opportunity for collaborations to encourage Aboriginal empowerment with public and private sector organisations. Effective cool burning in contemporary prescribed burning activities can be achieved through implementation of good training, strong partnerships, carefully considered on ground practices and appropriate and effective techniques.

## Keywords

Bushfire, Wildfire, Prescribed Burn, Cool Burning, Hazard Reduction, Indigenous, Fire Management, Fire Safety, Greenhouse Gas, Environment, Conservation, Cultural Burn

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## 1. Introduction

Bushfires can have a devastating impact on people’s safety, property and the environment. The primary objective of bushfire mitigation is to alleviate the potential risk to public safety and property, as far as reasonably practicable. Mitigation requires management activities prior to the outbreak of a fire and these include the actions that can be taken by land managers, fire agencies and at-risk

communities to prevent the loss of life and destruction of assets from catastrophic bushfires [1].

Nicholas, and Costa [2] highlight that approximately 23% of the Australian mainland is covered in tropical savanna which is made up of approximately 1.9 million square kilometres of dense grass and scattered trees that stretch across Northern Australia from Broome to Townsville. Hot bushfires sweep over a wide proportion of this area each year during the late dry season causing considerable destruction. Such fires, like natural ecosystems and agriculture, kill everything in their way. Korff [3] quantifies that 3% of Australia's total greenhouse gas emissions are caused by methane and nitrous oxide emissions from savannah hot burning fires.

Fire management techniques known as "cultural burns" or "cool burns" have long been practiced by Australian Indigenous people [4], where for tens of thousands of years, Indigenous Australians have actively managed the Australian savanna using cool burning techniques [2]. Cultural burning is tightly connected to caring for country. It is applied more frequently than hazard reduction burning and is very labor intensive [3]. Control of Indigenous cultural fire or cultural burning represents fire traditions, relationships and awareness that is an integral part of Indigenous governance structures [5]. Cultural burning is a practice not limited to Australia with many Indigenous peoples, for example the Indigenous Peoples of Canada, use the same methodology.

As the forest fuel available determines the amount of heat that could potentially be released in a bushfire, low intensity burns to minimise fuel loading in a forest, or fuel reduction burning, is one aspect that land managers can utilize to minimise fire risk [6]. The Australasian Fire and Emergency Service Authorities Council Limited [7] outlines that evidence suggests that prescribed burning plays an important role in mitigating bushfire risks, including those burning under "extreme" conditions. With Indigenous people using fire in forests, woodlands and grasslands, sophisticated fire management is evident to maintain travel corridors, increase visibility, access and create hunting and gathering areas, cook and promote food plant cultivation [8], and this approach may provide benefit in prescribe burning practices.

Even with the best fire prevention measures, bushfires cannot be eliminated from the landscape and land managers are forced to take steps to minimise the severity of these fires and the harm they cause [1]. Fuel is the only aspect influencing fire behaviour that is subject to human influence and regulation while trying to minimise the impact of bushfires. Reducing combustible content in using approved burning programs is therefore a vital tool of bushfire mitigation.

## 2. Method

An exploratory research method, primarily using semi-systemic literature review, is applied to this study as a method where, as outlined by Snyder [9], a literature review can be broadly described as a more or less systematic way of col-

lecting and synthesizing prior research. Previous research is reviewed and analyzed to describe the research area including describing current prescribed burning practices and cultural burning techniques with a view to discuss how these activities could be integrated. The various roles performed by those responsible for these activities are also considered. The study explores collective evidence to discuss an approach to help mitigate the risks associated with bushfires. The applied approach aims to contribute to current thought for policy and practice to best protect life and assets.

### 3. Discussion

#### 3.1. Prescribed Burning

In rural land management, prescribed burning can be used to define a variety of activities including wide-scale burning of forests, localized burning of hazard mitigation, and disposal of logging slash, crop stubble, weeds, or other unwanted vegetations. Prescribed burning is also referred to as “controlled burning”, “fuel reduction burning”, or “hazard reduction burning”. The Australasian Fire and Emergency Service Authorities Council Limited [7] states that there is debate about the value of controlled burning in enhancing the controllability of burning bushfires under severe conditions of fire threat, where weather tends to be the key driver of fire spread and duration. Although the majority view among fire researchers is that low fuel levels have little impact under these conditions on directly improving bushfire controllability, lower fuel levels can provide indirect benefits by freeing up suppression forces and enhancing incentives for asset security. Furthermore, the mapping of the extent of burning after recent major bushfires has shown that low fuel from previous burning can significantly reduce damage to a range of environmental values under severe conditions, particularly compared to damage in heavier fuel forests [7]. They do also note, however, that there is general consensus that unsustainable fire regimes can harm biodiversity and other environmental and community values, including those resulting from prescribed burning.

McCormick [6] notes that due to the diversity of forests, topography and climates in southern Australia, as well as the different priorities that different land managers have in developing specific burning regimes, fuel reduction burning should not be applied uniformly, in terms of frequency or extent, across Australia. McCormick [6] further notes that:

“In order for fuel reduction burning programs to be effective they need to be designed to be applied to specific vegetation types and implemented by properly trained and resourced staff. Proper assessment of these burns needs to be carried out to show whether the results meet the objectives of the program”.

Prescribed burns can include cool burns as a component of a fuel load reduction program to in turn minimise the risks of bushfires. Morgan *et al.* [10] advise that “Controlled Burns”, “Cool Burns”, “Hazard Reduction Burns”, “Regeneration Burns”, “Slash Burns”, “Fuel Reduction Burns”, “Ecological Burns”, “Habi-

at Burns” and “Backburns” are all forms of prescribed burns. While there are crossovers between prescribed burning and cultural burning, Indigenous cultural burning has a cultural outcome, purpose or significance.

As noted by Morgan, *et al.* [10], “nothing will stop intense bushfires, but prescribed burning will significantly mitigate them”. A primary value of lowering forest fuel levels is that it allows fire-fighters to control most fires with less burnt area more quickly. While reduced fuel levels will not stop the head of an intense fast-moving bushfire, fire behaviour on the fire flanks can be sufficiently mitigated to allow the construction of control lines thus minimising the risk of wide fire flanks becoming head fires as a result of a later change in wind [10]. While fuel hazards can be minimized by mechanical removal and chemical treatment, prescribed burning at landscape scales is the most efficient solution [1].

There are two types of fires at the most general level, namely hot fires that are large, intense and sweep through the land leaving nothing behind and cold fires that “trickle” through the vegetation in the field and burn at relatively low temperatures [11].

### 3.2 Cool Burning Technique

For most non-Indigenous, urban and even agricultural people, fire is viewed as a disruptive force and considered anti-civilization, but in Aboriginal culture, fire has a great symbolic significance, with many myths, memories and dances circulating around the fire [12]. Fire also binds Indigenous communities to the ground, with children as young as four hearing about the country’s healing forces of fire and its symbolic importance in Aboriginal culture.

Indigenous fire management includes “cold” fires in selected areas during the early dry season, gradually and in patches between March and July [13]. The fires burn fuel like detritus, which means that a normal bushfire has less to consume [4]. The cool-burning, knee-high blazes are designed to occur in the landscape continuously. Night and early morning hours are perfect for these fires, because night-time dew allows the fire to cool down and the winds are more likely to be gentle [12]. The fires are closely monitored, ensuring that only the underbrush is burnt. Aboriginal people performing cool fires typically remain in the fire to control it. Further, not only do cool burns clear areas of land, they also ensure that seeds and nutrients are not fried and lost in soil. The heat, which is much cooler than a hazard reduction burn, does not ignite the oil in a tree’s bark [3].

Korff [3] notes that cultural land management cannot simply be added to existing non-Aboriginal fire management practices, such that Aboriginal people need to be involved as they know when to burn, where to burn and how to execute a burn. The scheduling of fire control is important, and needs occur at the right time of year. The country shows to Indigenous experts when it’s necessary to use fire, including measures like when trees heal flowers and native grasses. The best time to cool burn in Australia is the early dry season, from April to July,

when vegetation that developed during the wet season starts drying out. Fuel loads are low and wind patterns and dew support a burn. The burns do not occur when certain seeds or fruits are ripe for harvest. The bushfire threat ends usually in November in the Australian savanna when monsoon rains arrive, and the wet season returns.

The value of timing for fixed cool burns is also discussed by Korff [3]. When burning too early, after the explosion, large, dense shrub grows which can become a large fuel load and is difficult to handle. If burning occurs too late, trees will “explode” during the fire and not much will remain after the fire passes through. These fires emit greater amounts of greenhouse gases than fires in the early season. As such, the most appropriate time depends on the burn area’s ecosystem, since each system has its own identity and needs.

Aboriginal people will read the land in relation to burn locations to decide which areas need fire control. They plan a burn by looking at the various habitats, fields, tonnes of wood, grasses, type of soil and the kinds of ashes that a fire can leave behind [3]. Further, trees tell Aboriginal people about the kind of soil and this tells them what kind of fire is needed. The fire initiated by Aboriginal people traditionally uses a tea tree bark torch as opposed to either a kerosene bark torch with the oil in the bark keeping the torch alive or a drip torch.

As an example of the specific knowledge required to effectively use these techniques, Vigilante and Thornton [14] describe that thickets of spearwood, or Wattan, need a high germination rate to maintain their density. The thickets start losing their dense structure after 10 - 15 years and a hot fire is needed to spur on regeneration and new, thick growth. These areas must be protected against cool fires, as they will simply damage the thicket before an adequate seedbed is established.

These practices do not stop the late season fires, however, may reduce their severity [11]. The use of cultural burning activities should provide Aboriginal people with opportunities to observe or engage in aspects of burn planning, training, preparation, conduct, monitoring or analysis, in a healthy and satisfying manner, for group (low risk) cultural burning [15].

### **3.3. Hazard Reduction Burning**

Hazard reduction burning, sometimes referred to as “hot burning” can be compared to cool burning from a number of different perspectives. The primary objective of hot burning is fuel reduction, as opposed to cool burning focusing on fuel reduction, weed control, healing country, cultural practices, and access to country. The hazard reduction burning process is usually a large-scale operation rather than burning off in small patches. Typography normally determines the ignition points, which are usually multiple, and these can occur aerially, such as by helicopter. The burns are fast and occur at very high temperatures and can occur at any time, irrespective of seasons and plant cycles.

Hot burning can result in significant parts of trees being burnt, often includ-

ing the crown, burning of all vegetation and sometimes loss of some native plant species from the ecosystem [3]. The soil also often becomes baked in this approach resulting in seed damage and loss of nutrients. Regrowth from a hot burn tends to include dominating ferns and trees whereas from a cool burn, native grasses and herbs. Fallen logs are not burned in a cool burn such that animal habitats are preserved. They are, on the other hand, burned in a hot burn. Cool burns are stopped either when they self-extinguish or through a controlled stop where hazard control burns stop at a control or containment line. Cool burns produce light patchy smoke whereas hot burns result in “heavy smoke, red or black sky, pyrocumulus (flammagenitus) clouds, lightening, ashy rains” [3].

Cool burning can be integrated into hazard reduction burning activities. As an example, fire authorities in Australian Capital Territory (ACT) have been working with Aboriginal rangers to identify sacred and significant areas around the area where cultural burning would be appropriate [16]. They then collaborate with the rangers to conduct conventional hazard-reduction burns by lighting and spreading fires in the most important areas without the use of synthetic fuels. As a further example, the Victorian Traditional Owner Cultural Fire Strategy [17] will help provide policy direction and a framework across Victoria’s fire and land management agencies to support Traditional Owners to undertake cultural burning for the range of cultural values entailed in caring for Country [18].

As an important note, hazard reduction burning requires an expert understanding of local weather and fire behaviour, built up over many years [19]. Any prescriptive burn operation should be considered as a high-risk activity and should be conducted by suitably trained persons.

### 3.4. Integrating Cool Burning

There are a number of organisations around Australia working with farmers and aboriginal people and empowering them to work together to share expertise and to maintain the land [20]. This includes Community land management, the Indigenous Land Management Councils, and Landcare organisations.

The Victorian Traditional Owner Cultural Fire Knowledge Group [17] outline a number of guiding principles for the integration of cultural burning. These include:

- Cultural burning is Right Fire, Right Time, Right Way and for the right (cultural) reasons according to Lore.
- Burning is a cultural responsibility. Traditional Owners lead the development and application of fire practice on Country; the responsibilities and authority of Traditional Owners are recognised and respected.
- Cultural fire is living knowledge.
- Monitoring, evaluation and research support cultural objectives and enable adaptive learning.
- Country is managed holistically.
- Cultural Fire is healing.

An imperative aspect of the guiding principles is that cultural burns are used for cultural purposes rather than simply for asset protection. Different Indigenous groups have different burning practices, according to the various landscapes in which they lived and moved through [14]. As advocated by the Victorian Traditional Owner Cultural Fire Strategy, integrating cultural cool burning requires developing situations or explanations of various conditions for undertaking cultural burning, in order to develop systematic processes and practices. It also requires development of scenarios or examples of different conditions for undertaking cultural burning, so procedural pathways and practice can be developed. It also requires the development of scenarios or examples of different conditions to undertake cultural burning, so that it is possible to develop procedural paths and practices. Building bilateral capacity by developing more effective ways of linking modern fire management with traditional burning practices is a further fundamental activity. Understanding the role of science in supporting the re-emergence of a sophisticated and evolving knowledge base that can adapt to climate change and its many challenges is also necessary.

Flore, Burton, Pannell, Kelso and Milne [21] use three different models to investigate the costs and benefits of changing the spatial structure of controlled burns on public property, using Western Australia's south-west as a case study. The study found that the intensification of prescribed burning treatments in the wildland-urban interface contributes to a greater reduction in harm and risk to houses relative to most rural treatments. Nevertheless, given the additional benefits obtained from treatments near homes, it is not the most economically effective technique in most situations. They conclude that controlled burning on public land in the wildland-urban interface produces more net benefits than landscape treatments even under restricted circumstances. Cool burning can be applied within the wildland-urban interface to reduce risk and likewise in a rural setting as an economically effective technique as it can be conducted on a smaller scale than usual prescribed burning approaches.

### 3.5. Effects on Ecosystem

Even when bushfires burn under extreme conditions, lower fuel levels provide a substantial benefit in reducing the severity of fire sufficiently to lessen the impacts on wildlife, soil, water and cultural values as compared to the impacts of the same fire burning through heavy fuel [10].

Small-scale burns can reduce the likelihood of major wildfires in drier conditions at the right time of year and are critical for the protection and regeneration of certain plants and animals [13]. The Watarrka Foundation [12] notes that the process of cool burning can generate patchy habitats preferred by small animals and prevent lightning and wildfires from consuming the land. The cool burning cycle also helps maintain the tree canopy, which is necessary to retain shade in the forest, which protects vulnerable plant species from predators on the ground. The canopy also offers fire-fighting protection for wildlife. Allam [13] notes that different species of animals relate to fire in different ways. Wombats, outlines



Allam, for example, dig burrows to escape, while koalas climb into the canopy.

Lynch, Ross and Carter [8] note that:

“Recognising and valuing Indigenous and non-Indigenous perspectives in a post-colonial approach to environmental management has great promise for addressing everyone’s concern for a sustainable future”.

Lynch, Ross and Carter [8] do note, however, that there are multiple issues to explore in the implementation of cultural burning techniques and delicate, respectful approaches are required to achieving effective cross-cultural, cross-sectoral and cross-institutional engagement with appropriate recognition and maintenance of intellectual property. Further, use of cool burning methods for prescribed burning provide an opportunity to minimise the effects of smoke drift on nearby communities and minimise the potential for escaped burns [1].

#### **4. Conclusions**

In light of our recent catastrophic bushfire season, there has been a national shift in consciousness about land management and bush fire prevention. Fire has always occurred naturally in the Australian environment and as such, it is not possible to prevent bushfires occurring entirely. Measures can, however, be taken to minimise some of the human and environmental costs resulting from bushfires. Integrating Aboriginal fire management practices into bushfire response may contribute to an effective management and risk mitigation strategy. The aspirations of Aboriginal communities to connect and care for Country can be supported by integrating cultural fire practices into fire management. Bushfires mitigation stems from formation of strategic fire management that combines scientific knowledge, modern technology and traditional fire management knowledge and practices. Cultural burning can involve burning or preventing Country burning for the protection of specific plants and animals or biodiversity. This can require patch burning to generate various fire cycles around the landscape or it may be used to reduce fuel and hazard.

Australian agricultural, forestry, rural and fire services sectors, amongst many others, could benefit greatly from development of competency standards around cool burning techniques and these could be integrated into qualifications in these areas. This would result in an emergence of workplace skills that not only contribute to bushfire mitigation in the long term, but also strengthen the health and safety systems and practices in the relevant workplaces and communities.

#### **Conflicts of Interest**

The author declares no conflicts of interest regarding the publication of this paper.

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