'A review of contemporary Indigenous cultural fire management literature in southeast Australia'

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MAIN TEXT

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Abstract

Indigenous cultural fire management is being recognised and revived across Australia, primarily in the centre and across the north. To explore the benefits of contemporary cultural fire management in southeast Australia and barriers to its revival, we undertook a systematic analysis of the literature. Seventy documented applications of cultural fire management projects were found with the potential for significant upscaling. Over the last decade, eight policies related to Indigenous fire management have been developed by state and territory governments in southeast Australia, with varying levels of implementation. Seventy-eight benefits and 22 barriers were identified in relation to cultural fire management. In the cases where cultural fire management has been successfully reinstated as an ongoing practice, Indigenous leadership, extraordinary relationships, strong agreements and transformational change were identified as drivers of success. For cultural fire management to grow, more funding, policy implementation, long-term commitment, Indigenous control and decision making, mentoring, training and research are required. Several areas of research could facilitate the expansion of cultural fire management and be applied in similar contexts globally, including Africa and the Americas. While Indigenous voices are increasingly represented in the literature, it is imperative that mutually beneficial and respectful partnerships are developed in the cross-cultural interface of landscape fire management.

Introduction

According to Indigenous Lore, Aboriginal people have lived on their ancestral clan estates on 'Country' throughout Australia since the Dreamtime (Dean 1996; Behrendt 2016). Western science has recorded evidence of at least 65,000 years of Aboriginal occupation of Australia (Clarkson *et al.* 2017; McNiven *et al.* 2018). In 1788, Australia was colonised by the British, causing widespread social, cultural, political and environmental disruption, dispossession and denial of rights and recognition for Indigenous people (Rolls 1981; Blomfield 1992; Langton 1998; Harris 2003). The lack of acknowledgement of Indigenous Australian stewardship of the environment was part of the legal justification of *terra nullius* by the British government and the colonial legislatures (Bardsley *et al.* 2019). While the legacy of these injustices prevail in post-colonial Australian society (Department of the Prime Minister and Cabinet 2020), in some areas decolonising processes are being activated and driving an increasing appreciation and reinstatement of Indigenous practices of caring for Country (Baker *et al.* 2001; Hill 2003; Altman and Kerins 2012; Spurway 2018; Neale *et al.* 2019a; Weir and Freeman 2019; Weir *et al.* 2020). Indigenous fire practitioners in northern Australia are considered world leaders in savanna fire management, due to their widespread reinstatement of landscape-scale, Indigenous-led, fire management programs (Lipsett-Moore *et al.* 2018; Moura *et al.* 2019). Savanna burning provides an opportunity for Indigenous Traditional Owners and rangers to use Indigenous knowledge, practice and governance systems to apply fire management on their Country (Russell-Smith *et al.* 2009). This has resulted in social, cultural, environmental and economic benefits for Indigenous landowners (Jackson *et al.* 2017; Ansell and Evans 2019) although some biodiversity and social benefits are debated (Dockery 2010; Martin 2013; Fache and Moizo 2015; Petty *et al.* 2015; Evans and Russell-Smith 2016; Perry *et al.* 2018; Corey *et al.* 2019) .

Indigenous burning practices over thousands of years have shaped extant landscapes and vegetation (Bowman 1998; Enright and Thomas 2008; Gammage 2011). Early literature of Indigenous fire management was dominated by western perspectives and characterised by debates around 'firestick farming' by non-Indigenous academics (mostly anthropologists and archaeologists) such as Jones

(1969), King (1963), Hallam (1975), Horton (1982) and Kohen (1996). This debate was supplemented by studies on the palaeoecology of fire in Australia (Singh *et al.* 1981; Pyne 1991). From the 1990s, Indigenous authorship emerged, such as in Russell-Smith *et al.* (1997), Langton (1998), Yibarbuk *et al.* (2001) and Lehman (2001) as the literature around Indigenous fire management grew (Bowman 1998; Gott 1999; Gott 2002; Bowman 2003; Enright and Thomas 2008; Russell-Smith *et al.* 2009; Gammage 2011). Particularly in the last decade, several Indigenous voices have come to the forefront of the academic literature related to cultural fire management (Robinson *et al.* 2016; Spurway 2018) in McGregor *et al.* (2010), Fitzsimons *et al.* (2012), Pascoe (2014), Zander *et al.* (2014) Prober *et al.* (2016), Maclean *et al.* (2018), Neale *et al.* (2019a), Darug Ngurra *et al.* (2019), Weir and Freeman (2019), McKemey *et al.* (2019a) and McKemey *et al.* (2020).

Despite the impacts of colonisation (Elder 2003) and seemingly overwhelming socio-political and environmental challenges (Spurway 2018), Indigenous cultural burning practices are being revived in southeast Australia. The growing literature describing contemporary Indigenous cultural fire management in southeast Australia comes from a variety of sources. A multi-media review is required to capture the breadth of documented information by Indigenous and non-Indigenous authors from multi-disciplinary perspectives (Mahood *et al.* 2014). Accordingly, we reviewed a broad range of publications, including media articles, podcasts, posters, government documents and websites, in addition to the traditional academic literature.

The unprecedented 'Black Summer' bushfires of 2019–20 in southeast Australia burnt over 10 million ha and affected more than a billion native animals (mammals, birds and reptiles) (Dickman *et al.* 2020; Dickman and McDonald 2020). This resulted in public questioning of existing bushfire management strategies and discussion about alternatives, such as cultural fire management (Firesticks Alliance 2020). In light of increasing public interest in Indigenous cultural fire management and the Indigenous community-driven revival of cultural burning as an applied practice, there is a need to analyse the existing information to inform ongoing development of contemporary cultural fire management in southeast Australia. Therefore, this review aims to: (1) describe the practices,

benefits, barriers and policies relating to contemporary Indigenous cultural fire management in southeast Australia; (2) analyse the literature and evidence to identify gaps in knowledge, practice and policy, and (3) provide recommendations to enhance research and practice related to cultural fire management. We limited our focus to the contemporary literature of the last 20 years (2000–2020). Inferences regarding Indigenous agency in the fire history of southeast Australia, as interpreted from environmental history, are beyond the scope of this paper.

The authors of this paper include Oliver Costello (a Bundjalung Aboriginal man), co-founding Director of the Firesticks Alliance, and five authors who are non-Indigenous scientists, most of whom have worked with Indigenous people for many years.

Definitions

In this paper, the terms 'Aboriginal' and 'Indigenous' are used to describe the First Nations peoples of Australia. We use the term 'cultural burning' to describe the application of fire by Aboriginal peoples and 'cultural fire management' to encompass the broader cultural practices, values, heritage and land management activities that relate to Indigenous use of fire. Cultural fire management can also include the prevention and exclusion of fire. These terms are commonly used in eastern and southern Australia. There are many views of the definition of cultural burning and fire management, which can include perspectives related to cultural responsibility, Lore, history of practice, fire behaviour, roles, caring for country and holistic land management (see text box: *What is cultural burning?*). In other areas of Australia and globally, various terms are used to describe Indigenous fire management and its application, such as Aboriginal or traditional fire management, Aboriginal or Indigenous burning, Indigenous wildfire management, cultural fire and burning of Country. Both the terms 'bushfire' and 'wildfire' are used to describe an unplanned, vegetation fire (Rural and Land Management Group 2012). We define southeast Australia as NSW, ACT, Victoria, South Australia, Tasmania and southern Queensland (spanning the sub-tropic, temperate and grassland climatic zones (Bureau of Meteorology 2001)).

Methods

The academic and grey literature relevant to contemporary cultural fire management in southeast Australia was searched by using keywords ('cultural burning', 'Indigenous fire', 'Aboriginal fire'), themes and regions in databases (Scopus and Google Scholar), citation lists and correspondence with experts. The grey literature related to cultural fire management included government policies, non-government organisation (NGO) documents, media articles, podcasts, websites, conference proceedings, posters and unpublished documents. Media searches were limited to articles containing the keywords and which were relevant to southeast Australia. Sources were publicly available media reports (subscription only media sources were excluded). Articles were found through daily scanning of social media (Twitter and Facebook) during the 2019–20 'Black Summer' bushfires period (September 2019 – February 2020) and internet search engine searches for keywords. Using internet searches and email correspondence we identified government policies related to contemporary cultural fire management in southeast Australia.

The academic literature and media articles were coded *a posteriori* and grouped into themes and sub-themes (Saldaña 2015; Onwuegbuzie *et al.* 2016) (Appendix 1). The frequency of codes for each of the themes and subthemes was determined and calculated as a proportion of the total number of articles. This data was used to compare the focus of media articles (before and during Black Summer bushfires 2019–20) and academic papers.

Drawing from all sources of literature, we compiled a table of case studies of contemporary cultural fire management practices in southeast Australia, including details (where available) of place, Aboriginal group, land tenure type, land area and description of project. The academic literature was analysed to identify the benefits of, and barriers to, Indigenous application of cultural fire management. The benefit categories of Indigenous cultural fire management developed by Maclean *et al.* (2018) were adopted.

What is cultural burning?

Dave Wandin of Wurundjeri Nation, Victoria, explained 'Aboriginals look after their country, because their country has looked after them. The country gave them tools, food, clothing, medicine and shelter. Aboriginal people want to protect the land and keep it safe and strong … The land is sacred to Aboriginal people; it is their job to take care of the land … If we learn how to care for the country it will be happy again … It is really important that Aboriginal people bring back the firestick to look after the land' (Schoof *et al.* 2018).

Shaun Hooper (2019) of Wiradjuri Nation, NSW, explained how Aboriginal people have a responsibility to care for Country: 'This is demonstrated by Aboriginal peoples' continued insistence that they must do cultural burning, it is the cultural expression of knowing who they are and what their responsibilities are in the cosmos. It is Aboriginal people maintaining their cultural practice, maintaining their lore.'

The Firesticks Alliance Indigenous Corporation, which brings together many Aboriginal communities engaged in cultural burning in southeast Australia, used the term cultural burning to describe 'burning practices developed by Aboriginal people to enhance the health of the land and its people. Cultural burning can include burning or prevention of burning for the health of particular plants and animals … or biodiversity in general. It may involve patch burning to create different fire intervals across the landscape or it could be used for fuel and hazard reduction. Fire may be used to gain better access to Country, to clean up important pathways, maintain cultural responsibilities and as part of culture heritage management' (Firesticks Alliance Indigenous Corporation 2019).

Darug Ngurra *et al.* (2019) explained that 'cultural burns are slow moving, physically contained fires which are gentle and generative. Cultural burns have the health of Country as their key motivator', and 'Fire is critical to the health of Darug Country. It provides emotional and physical sustenance; it regenerates seeds, it shapes invasive plant lives, and it imparts vibrant teachings on the humans who co-create it.'

From the perspective of Indigenous people, knowledge about landscape burning is not only about where, when and how to burn; it is also about ensuring that those who light fires are acting under the appropriate authority of the people of that country—that is, people who have the residential and kinship ties that underpin customary connections. For Indigenous people, this is often the single most critical element of fire management (Robinson *et al.* 2016).

Cultural burning is a practice that supports Country. Different people have different considerations about how cultural burns are, or might be, practised, including the involvement of non-Indigenous people and Aboriginal people who are not traditional custodians. The distinct leadership and agenda setting role of traditional custodians as the people of Country who speak for Country is often spoken about as paramount, but not always (Weir and Freeman 2019).

Caring for Country is a broader way of managing and viewing the natural world, it is not just about surviving and providing for family and clan by protecting the land, animals and vegetation in order to maximise peoples' benefits from hunting, fishing and foraging. It is also not just about protecting Country and livelihoods from destructive natural events such as large-scale bushfires. It is all this and more: caring for Country is an end in itself; natural disaster mitigation and livelihoods protection are simply elements of it within an overarching holistic cosmology (Spurway 2018).

Photo caption: Ranger Jimmy Daly at The Willows Boorabee Indigenous Protected Area lights up a cultural burn (photograph: David Milledge)

Results

In total, 137 documents were published between 2000 and March 2020 (Table I). The timeline of

publications according to literature type (Fig. 1) shows a trend of an occasional academic or grey

publication up to 2015, after which total publications increased until 2018, followed by a spike in

publications, particularly media, during the Black Summer bushfires of 2019–20.

Table I: Number of published works identified through literature review

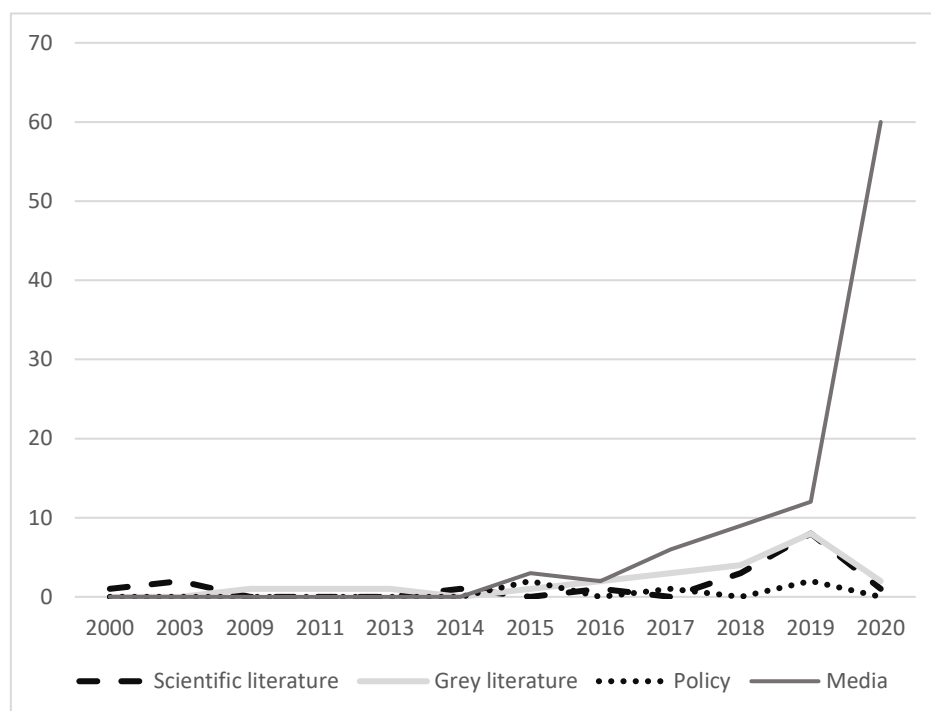| Year	2000	2003	2009	2011	2013	2014	2015	2016	2017	2018	2019	2020	TOTAL
Academic literature	1	2	0	0	0	1	0	1	0	3	8	1	17
Grey literature	0	0	1	1	1	0	1	2	3	4	8	2	23
Policy doc	0	0	0	0	0	0	2	0	1	0	2	0	5
Media	0	0	0	0	0	0	3	2	6	9	12	60	92
TOTAL	1	2	1	1	1	1	6	5	10	15	28	63	137

Fig. 1: Timeline of publications according to literature type related to contemporary cultural fire management in southeast Australia (from 2000 to March 2020)

Cultural burning media focus

The media focused on some common themes both before and during the Black Summer bushfire

crisis (Fig. 2). These common themes included (in decreasing order of coding frequency): the

potential benefits of cultural fire management (environmental, cultural, social and bushfire management); case studies of cultural fire management; providing background (historical context) to cultural fire management, and discussing cultural fire management as a strategy to manage bushfire. Before the Black Summer bushfire crisis there was more focus on: describing partnerships between Indigenous groups, government organisations, NGOs and others; and discussing the revival or reintroduction of cultural fire management. During the bushfire crisis the main focus shifted to the: potential for cultural fire management to improve how fire is managed; destruction caused by bushfires (lives, wildlife/vegetation, homes, infrastructure, general, cultural heritage, trauma/grief); and potential causes of bushfires (climate change, mismanagement, fuel loads).

Focus of media vs academic literature

The most frequently discussed themes, shared by both the media and academic literature (Fig. 3) were: providing a background to Indigenous burning; the cultural and environmental benefits of cultural fire management; examples of the practice of cultural burning; and cultural burning as a management strategy. Beyond this, the academic literature in southeast Australia mainly focussed on: Indigenous rights; respect between Indigenous and non-Indigenous groups; working together; the impacts of colonisation on cultural fire management; and the social benefits of cultural fire management. Other prevalent themes in the media were: the potential for cultural fire management to improve how fire is managed; and to reduce the risk of bushfire. Particularly during the Black Summer bushfire crisis, the media focussed on the causes (blame) and destruction rendered by bushfires. In contrast, academic papers focussed on issues such as identifying research gaps and priorities, and the lack of recognition of Indigenous knowledge. Therefore, the media generally sought to find answers for the causes of the bushfires, while potentially proposing cultural fire management as a panacea to reduce bushfire risk in future. The research articles were more considered and careful in their recommendations regarding cultural fire management (Table II).
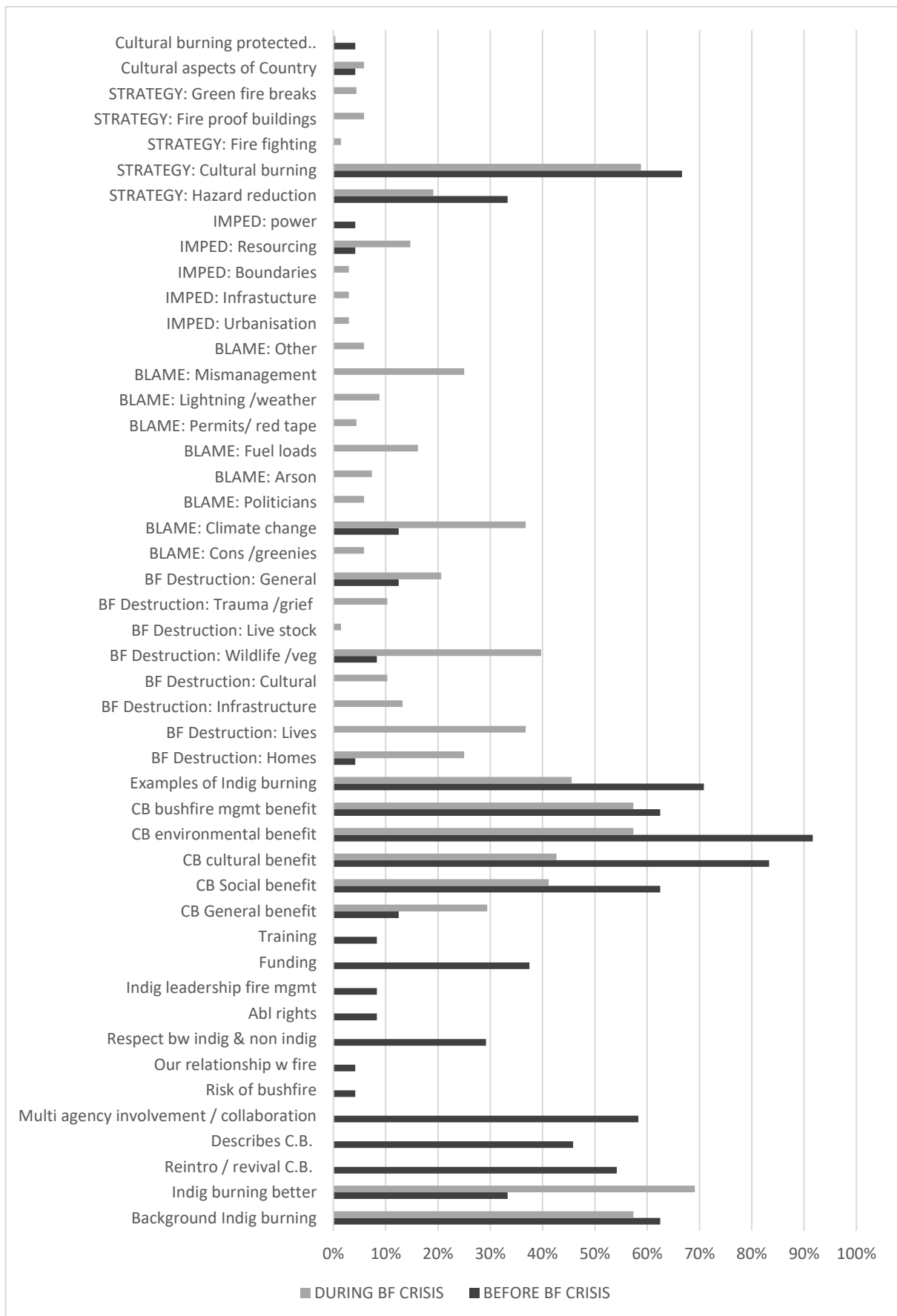
Fig. 2: Proportions of frequencies of sub-themes in cultural fire management media, before and during the Black Summer bushfire crisis 2019/20
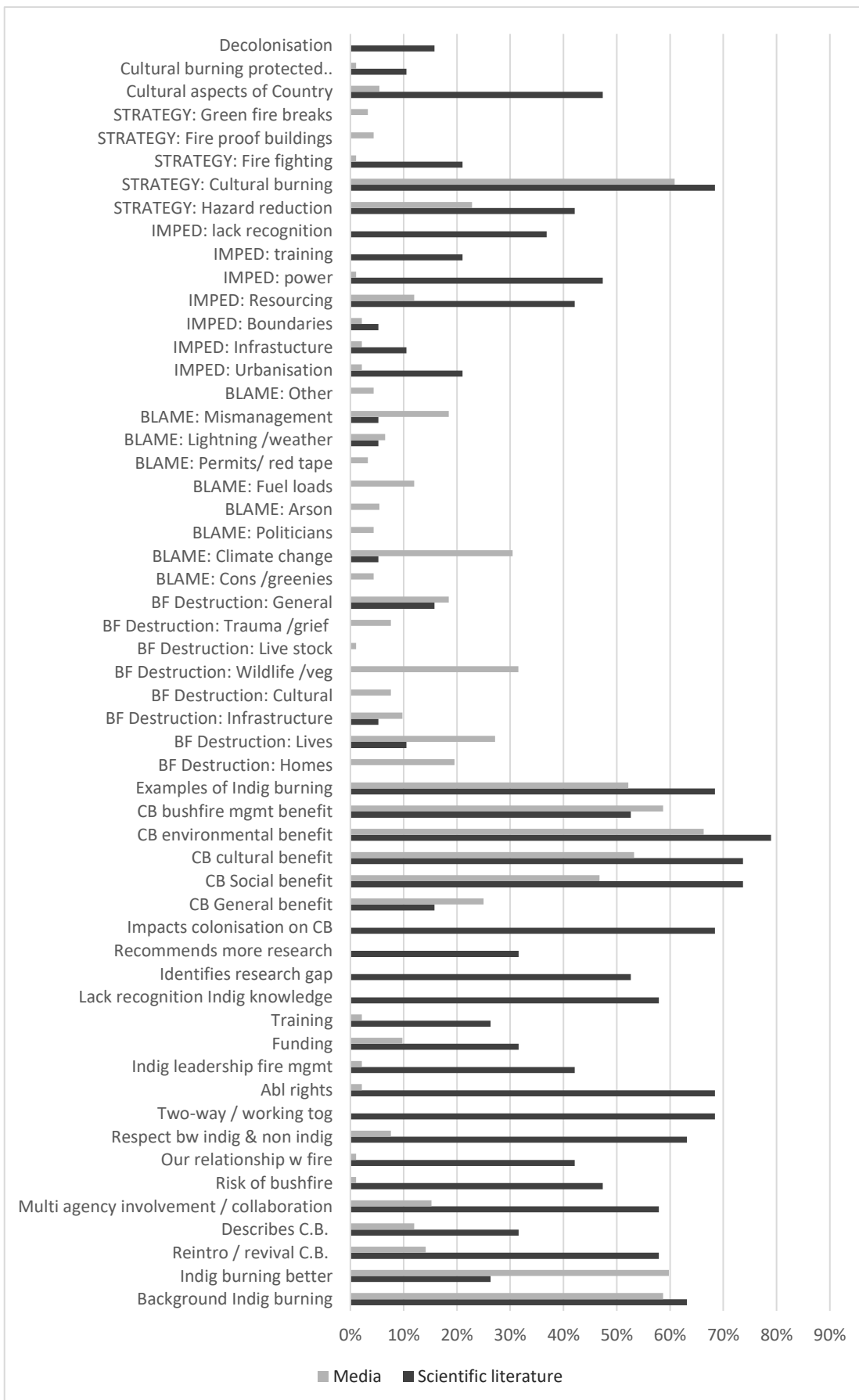
Fig. 3: Proportions of frequencies of sub-themes in cultural fire management media vs academic literature

Table II: Summary of main findings of academic literature on contemporary cultural fire management in southeast Australia

Paper title	Relevant location	Main findings	Reference
Turning Back the Clock: Fire, Biodiversity and Indigenous Community Development in Tasmania	Tasmania	Discusses pre-colonial Aboriginal burning in Tasmania. Describes a case to reintroduce cultural burning into the Tasmanian Wilderness World Heritage Area and trial burns that had been undertaken.	Lehman (2001)
Frameworks to support Indigenous managers: the key to fire futures	Australia-wide	Discusses the shifting paradigms in land and fire management, from the dominant paradigm of the colonial era to a more inclusive paradigm where partnerships between rural communities, government managers, NGO staff, Indigenous peoples and scientists are emerging. The key challenge for researchers and policy makers is in developing new frameworks (legislation, regulation, governance, financial and career support) that enable Indigenous people into a policy-making role that fully respects their rights. Use of dual (Indigenous and non-Indigenous) toolbox for land management.	Hill (2003)
Australia burning: fire ecology, policy and management issues	Australia-wide	Australia cannot be 'fire-proofed' but by using Indigenous fire management as a guide, the impacts of fire may be reduced- although wildfires will not be prevented. Approaches to fire management developed over many millennia by Indigenous Australians must be a major area of future research and associated policy development. Described the importance of western and Indigenous science systems working together in a respectful way.	Cary *et al.* (2003)
The Retention, Revival, and Subjugation of Indigenous Fire Knowledge through Agency Fire Fighting in Eastern Australia and California	New South Wales & Queensland	Explores the potential impact of training and employment with wildfire management agencies on the retention of Indigenous fire knowledge. The paper focuses on the comparative knowledge and experiences of Indigenous Elders, cultural practitioners, and land stewards in connection with 'modern' political constructs of fire. This article emphasises the close link between cross-cultural acceptance, integration of Indigenous and agency fire cultures, and the ways in which knowledge types are shared or withheld. By highlighting how privilege intersects with ethnicity, class, gender and age, this article demonstrates how greater cross-cultural acceptance could aid ongoing debates on how to coexist with wildfire today.	Eriksen and Hankins (2014)
Protocols for Indigenous fire management partnerships	Australia-wide	The review distils key lessons learned from the incorporation and translation of Indigenous knowledge into a range of fire management activities and programs and charts the key methods, processes and protocols for incorporating Indigenous knowledge into environmental management, including fire management. The report described a number of protocols for Indigenous fire management partnerships for application nation-wide and identified research priorities.	Robinson *et al.* (2016)
A national framework to report on the benefits of Indigenous cultural fire management	Australia-wide	This report builds on the efforts of a range of Indigenous fire related activities and partnerships across Australia that support Indigenous groups and enterprises to maintain, learn, build and apply cultural fire knowledge and practices. A number of government programs are developing ways to establish national monitoring and evaluation frameworks to assess the benefits and collate the evidence needed for continued government support for Indigenous cultural fire management activities. Reporting on these benefits between agencies and organisations supporting these efforts can offer vital evidence needed to enable Indigenous cultural fire management, to support enterprises and sustain partnerships. Several chapters of this report are written by Indigenous authors, describing their cultural fire management practices.	Maclean *et al.* (2018)

Southeast Australia Aboriginal fire forum	Southeast Australia	The Southeast Australia Aboriginal Fire Forum 2018 was a landmark event, bringing together Aboriginal and non-indigenous peoples personally invested in expanding the use of cultural burning and supporting the authority of Aboriginal peoples in the management of bushfire in southeast Australia and across the Australian continent more generally. This report identified several key themes that emerged from across the forum: creating knowledge, sharing knowledge, everyone together, and making it genuine.	Smith *et al.* (2018)
Critical reflections on Indigenous peoples' ecological knowledge and disaster risk management in Australia: A rapid evidence review	Australia-wide, with examples from southeast Australia	This paper documents the findings of a rapid evidence review of Australian Indigenous peoples' knowledges and disaster risk management. The evidence base demonstrates the strength of Indigenous peoples' fine-grained and place-based worldviews that integrate natural resource management with strategies to sustain political economies of living off country and the mitigation of extreme events such as disasters. This approach requires a broader purview than currently taken by disaster risk management in Australia and necessitates a robust understanding of Indigenous worldviews if emergency managers want to effectively engage with Indigenous communities.	Spurway (2018)
The natural hazard sector's engagement with Indigenous peoples: a critical review of CANZUS countries	CANZUS countries, with examples from southeast Australia	The article reviews literature on the origins of engagements and key rationales informing natural hazard management agencies' interactions with Indigenous peoples. Incorporating critiques of settler colonialism relevant to the CANZUS context, this review aimed to support established, emerging, and future collaborative engagements by investigating and analysing the literature.	Thomassin *et al.* (2019)
Walking together: a decolonising experiment in bushfire management on Dja Dja Wurrung country	Victoria	Drawing upon a case study of collaborative bushfire management between Dja Dja Wurrung peoples and settler bushfire management agencies on Dja Dja Wurrung country in Victoria, this article argues for an understanding of such collaborations as 'decolonising experiments'. This means paying attention to the open-ended character of collaborative initiatives, whether and how they materially improve the position of Indigenous peoples, as well as whether and how they give rise to new resources and strategies for the creation of other decolonising futures.	Neale *et al.* (2019a)
Indigenous people in the natural hazards management sector: Examining employment data	Southern Australia	This study suggests that Indigenous peoples are statistically under-represented in the natural hazards management sector in southern Australia. Nonetheless, there are signs of increased Indigenous involvement within the natural hazard sector, particularly through collaborative fire management initiatives. The natural hazards management sector should prioritise supporting these engagements as part of their commitment to the resilience of Indigenous peoples and their communities.	Neale *et al.* (2019b)
Cross-Cultural Monitoring of a Cultural Keystone Species Informs Revival of Indigenous Burning of Country in South-Eastern Australia	NSW	This study describes how the Banbai people reintroduced cultural burning at Wattleridge Indigenous Protected Area. Banbai Rangers and non-Indigenous scientists conducted cross-cultural research to investigate the impact of burning on a cultural keystone species, the Short-beaked echidna (*Tachyglossus aculeatus*). The study described a cross-cultural research model whereby Indigenous rangers and non-Indigenous scientists worked together to inform adaptive natural and cultural resource management.	McKemey *et al.* (2019a)

Yanama budyari gumada*: reframing the urban to care as Darug Country in western Sydney*	NSW	This paper makes explicit practices of caring, healing and rejuvenation at Yellomundee Regional Park, Darug Country in western Sydney, through focussing on the return of cultural burns. The Darug principle of yanama budyari gumada, to 'walk with good spirit', embodies and invites new ways of thinking and practising intercultural caring-as-Country in heavily colonised, urban places like Yellomundee. The documentation of the practices has far-reaching implications for NRM and planning, and the importance of geographies of care for unceded urban places.	Darug Ngurra *et al.* (2019)
Seeking knowledge of traditional Indigenous burning practices to inform regional bushfire management	SA	A transdisciplinary review of the current academic knowledge of Indigenous traditional fire management is presented for the Mt Lofty Ranges in South Australia. This review suggests that there is very little formalised, academic knowledge available that could be utilised to inform prescribed burning practices in the region. To learn from traditional Indigenous land management: (a) formal knowledge needs to be generated on past regional burning practices; and (b) understanding needs to be developed as to whether past burning practices could lead to effective hazard management and biodiversity outcomes within contemporary landscapes. Such an integration of Indigenous knowledge for effective environmental management will only be possible if the injustices of past exclusions of the importance of Indigenous biocultural practices are recognised.	Bardsley *et al.* (2019)
Ngulla Firesticks cultural burning	NSW	Describes learnings from the Ngulla Firesticks Cultural Burning Forum.	Robertson (2019)
Fire in the south: a cross continental exchange	ACT	This report documents a trip undertaken across southern Western Australia to exchange knowledge from southeast Australia about cultural burning with traditional owners and fire authorities. Fundamentally, Aboriginal people talked about the importance of understanding fire differently, to reposition it as not just something to fear, but as central to the regeneration of life. At the same time, all were concerned about the growth in catastrophic wildfires, and this intensified the focus on anticipatory land management practices.	Weir and Freeman (2019)
The Theory/Practice of Disaster Justice: Learning from Indigenous Peoples' Fire Management	ACT	Discusses the implications of the fire management experiences of Aboriginal peoples and how this might inform and be informed by the theory/practice of Disaster Justice. The case studies demonstrate the amount of work that is involved for Aboriginal fire managers to navigate and negotiate fire regulation regimes that do not necessarily align with their own governance priorities or their territories. The normative focus of Disaster Justice, the spatial-temporal forces of natural hazards and the community of practice that is fire management are all important opportunities for reframing and redressing along more just lines between natures and peoples.	Weir *et al.* (2020)
*Impacts of Indigenous cultural burning versus wildfire on the threatened Black grevillea (*Grevillea scortechinii *subsp.* sarmentosa*) in southeast Australia*	NSW	This study used cross-cultural monitoring to compare the impact of Indigenous cultural burning with wildfire on the threatened Backwater grevillea. Using BACI experimental design and quantitative methods, the study found that cultural burning had less impact on the grevillea than wildfire, while cultural burning also effectively decreased the fuel load in burnt areas. Interviews with Aboriginal research collaborators and co-authors were used to compare Indigenous methods of caring for Country and cultural burning with western approaches.	McKemey *et al.* (in prep.)

Contemporary cultural fire management practices in southeast Australia

Stories are emerging of Indigenous people setting foot on Country and lighting fires for the first time since Europeans invaded (Kristoff *et al.* 2019) (Table II). From 2014, Banbai people started to reintroduce cultural burns on Wattleridge Indigenous Protected Area in northern NSW (McKemey *et al.* 2019a). In 2014, the Darug people undertook the first cultural burns on their Country near Sydney, since the onset of colonisation (Darug Ngurra *et al.* 2019). In 2017, the Dja Dja Warrung 'walked together' with the Victorian Government to light some of the first Indigenous-led cultural burns on public lands in Victoria (Neale *et al.* 2019a). From the Bunya Mountains in southern Queensland to the midlands of Tasmania, a groundswell of Indigenous cultural fire management is spreading across contemporary landscapes. The literature illustrated that throughout southeast Australia there were many Indigenous communities who were practicing, re-initiating or showing an interest in cultural fire management on their Country (Table III). This has also been evidenced by the amount of interest and large number of participants in the annual *National Indigenous Fire Workshops* (1,500+ participants) and *On Country Workshops* run by the Firesticks Alliance (Maclean *et al.* 2018; Standley 2019; Costello and Standley 2020).

Maclean *et al.* (2018) found that Indigenous people from southeast Australia are re-engaging with cultural fire management practices via diverse and innovative enterprises and partnerships. They reported that cultural fire management is carried out on a mix of land tenures, including Aboriginal land, Indigenous Protected Areas, the Conservation Estate (Government, NGOs), local council or Crown land and private property. The published literature documented 70 cultural burning case studies from southeast Australia (Table III), including 42 projects in NSW, 18 projects in Victoria, 5 projects in Tasmania, 3 projects in Queensland and one project each for ACT and SA. Most of the documented case studies were on public and Aboriginal land, with few examples on private land. The authors are aware of many projects on private land in NSW but these have not been published, therefore cultural burning on private land may be under-represented in these results. Most of the

projects have been implemented in the last decade, except Lehman's (2001) record of an attempt to reintroduce cultural burning in Tasmania.

Few publications quantified the area burnt through cultural burning, so it was difficult to estimate the total area managed through cultural burning in southeast Australia. The closest approximations are for Victoria and NSW. In Victoria, approximately 347 ha of land has been culturally burnt since 2017 (Neale 2020a; Forest Fire Management Victoria and Country Fire Authority 2020). This equates to 0.002% of the total land area of the State of Victoria. In NSW, 42,957 ha of land has been managed to prepare for cultural burning since 2014, which equates to 0.054% of the total land area of the State of NSW. It should be noted that not all areas of these states are fire prone; however, the proportion of land that has been culturally burnt in the last decade is still very small.

Maclean et al. (2018) found that Indigenous cultural fire management was developed and conducted via a suite of partnerships including Indigenous peer to peer partnerships, Indigenous-government partnerships, Indigenous-scientist partnerships and knowledge exchanges. Four drivers of Indigenous fire management practice were described: caring for country; regeneration and protection of native species and managing invasive weed species; fuel reduction to protect important places, species, infrastructure and neighbouring properties; and meaningful employment, related social and economic benefits and outcomes.

Participants at the National Indigenous Fire Workshop 2019 from various organisations and agencies, participating in cultural burning (photograph: Michelle McKemey)

Table III: Summary of case studies identified in the literature (Appendix 2 contains a more detailed summary table)

State & Land Tenure Type	Approximate total known land area (ha)	Place and people	References
NSW			
Public lands	18,960 ha Many burn areas undefined	Yellomundee Regional Park (Shaws Creek Aboriginal Place), Darug Aboriginal community; Henty (Riverina), Wiradjuri; Coastal Themeda Headlands Coffs Harbour, Gumbayngirr; Monaro Plains, Ngarigo traditional custodians; Arakwal National Park Byron Bay, Arakwal/Bundjalung Country; Dorrigo / New England escarpment, Gumbayngirr; Tripalina Reserve Nowra, Yuin; Murrah Flora Reserve Bega Valley, Southern Yuin; Tweed Shire Council area, Madhima Gulgan Community Association; Cumberland Plain, Darug Country; Warre Warren Aboriginal Place, Darkinjung LALC.	Brown (2016a); McGrath (2017); NSW Rural Fire Service (2017); Sleeman (2018); CSIRO *et al.* (2019); Darug Ngurra *et al.* (2019); Kerr (2019); McGrath (2019); Booth (2020); Environment (2020)
Aboriginal lands	Fire planning completed for 23,390ha 457 ha burn area Many burn areas undefined	Rick Farley Reserve, Barkindji, Mutthi Mutthi and Ngyiampaa people; Hunter Valley, 9 Local Aboriginal Land Councils (LALCs) and Traditional Owner groups; Tathra & Bega Valley, Bega LALC; Minyumai IPA, Bandjalang Clan of the Bundjalung Nation; Ngunya Jargoon IPA, Nyangbul Clan of the Bundjalung Nation; The Willows-Boorabee IPA, Ngoorabul Country; Wattleridge and Tarriwa Kurrukun IPAs, Banbai Country; Dorrobbee Grass Reserve, Widjabul/Wiyabul of the broader Bundjalung peoples; Nimbin Rocks and land around Lismore, Ngulingah Aboriginal Land Council Working on Country team; Lismore, Jagun Alliance Aboriginal Corporation; Casino, Casino Boolangle Land Council; Kyogle, Gugin Gudduba Land Council; Jubullum, Wahlabul Country; Eurobodulla, Batemans Bay & Mogo LALCs; Griffith, Griffith LALC; Yass, Onerwal LALC;.	Holmes *et al.* (2009); Tamarind Planning (2017); Maclean *et al.* (2018); Bush (2019); Kerr (2019); McKemey and Wahlabul Nation (2018); McKemey *et al.* (2019b); McKemey *et al.* (2019a); Brown (2020); Environment (2020)
Private lands	150ha Mostly undefined	Bundanon Trust, Yuin Country; Mulgoa, Darug Country; Monaro Plains.	McGrath (2017); Maclean *et al.* (2018); Taylor (2018)
Undefined	Undefined	Muli Muli/Woodenbong area, Githabul Rangers.	Kerr (2019)
NSW TOTAL	**42,957 ha**	**STATE OF NSW LAND AREA = 80,115,000 ha**	**PROPORTION = 0.054%**

VIC			
Public lands	~317	Central western Vic (Bendigo), Dja Dja Wurrung Country; Cohuna - Barapa Iron Punt Track & Flannery NCR Rowlands, Barapa Barapa Country; Dyurrit (Mt Arapiles), Wotjobaluk Country.	Neale *et al.* (2019a); Wales (2019); Forest Fire Management Victoria and Country Fire Authority (2020); Neale (2020a) Skurrie (2020)
Aboriginal lands	Undefined	Teesdale, Wadawurrung Country.	Corangamite CMA (2017); Maclean *et al.* (2018)
Trust/NGO lands	30	Nardoo Hills Reserves, Dja Dja Wurrung Country.	Forest Fire Management Victoria and Country Fire Authority (2020); Neale (2020a)
Private lands	Undefined	Skipton - Mt Emu Creek, Gunditjmara Country; Euroa	Maclean *et al.* (2018); Forest Fire Management Victoria and Country Fire Authority (2020); Neale (2020a)
Undefined	Undefined	Budgerum, Barapa Barapa Country.	Webster (2020)
VIC TOTAL	**347 ha**	**STATE OF VIC LAND AREA = 22,744,400 ha**	**PROPORTION = 0.002%**
ACT			
Public lands	8.7 ha + more undefined	Jerrabomberra Wetlands & other locations, Ngunnawal.	O'Mallon (2018); Guest Author (2019); Weir *et al.* (2020)
ACT TOTAL	**8.7 ha**	**ACT LAND AREA = 235,800 ha**	**PROPORTION = 0.004%**
SA			
Public land	Undefined	Adelaide, Kaurna Country.	Stewart (2020)
SA TOTAL	**Undefined**		
TAS			
Public land	Undefined	Tasmanian Wilderness World Heritage Area, Palawa.	Lehman (2001)
Aboriginal land	Undefined	truwana/ Cape Barren Island, Truwana Rangers; lungtalanana/ Clark Island, Tasmanian Aboriginal Centre; Big Dog Island mutton bird rookery (Bass strait Islands); Preminghana IPA (North west Tasmania); Putalina IPA (Southern Tasmania); Piyura kitina IPA (Southern Tasmania); Trawtha Makuminya Aboriginal Land (Central Highlands); Chapel Island IPA (Bass Strait Islands); Kings Run Aboriginal Land (North West Tasmania).	Whiting (2017); Maclean *et al.* (2018); Costello and Standley (2020)
Private land	Undefined	Ross, Tasmanian Aboriginal Centre.	McIntyre (2018)
TAS TOTAL	**Undefined**		
QLD			
Public land	Undefined	Bunya Mountains, Bunya Mountains Murri Rangers of the Bunya People's Aboriginal Corporation.	Maclean *et al.* (2018); Kerr (2019)
Private land	Undefined	Sunshine Coast, Kabi Kabi Country; Warwick.	Maclean *et al.* (2018); Cannan (2020)
QLD TOTAL	**Undefined**		

Policies

Nationally, the *National Bushfire Management Policy Statement for Forests and Rangelands* promoted Aboriginal use of fire (Forest Fire Management Group 2014). The Australasian Fire and Emergency Services Authorities Council's *National Position on Prescribed Burning* included the key principle of acknowledgement of 'Traditional Owner use of fire in the landscape' (Australasian Fire and Emergency Services Authorities Council 2016). In southeast Australia, community-driven cultural fire management appears to be driving the development of government policies. In the last eight years, eight policies have been developed in NSW, Victoria, Queensland and the Australian Capital Territory (Table IV). *The Victorian Traditional Owner Cultural Fire Strategy* was a landmark document that stated, 'the purpose of the Victorian Traditional Owner Cultural Fire Strategy is to reinvigorate cultural fire through Traditional Owner led practices across all types of Country and land tenure; enabling Traditional Owners to heal Country and fulfil their rights and obligations to care for Country' (The Victorian Traditional Owner Cultural Fire Knowledge Group 2019). In contrast, other states have developed brief operational plans related to Indigenous fire management (Queensland Parks and Wildlife Service 2012), the Tasmanian Parks and Wildlife Service expects to develop a policy in 2020, while South Australia has not produced a specific policy, although the DEW Fire Management Program Statement of Intent includes an acknowledgement and commitment to South Australia's First People (Department for Environment and Water 2019).

The State and Territory policy development in Australia reflects the trend of other settler countries, where there has been a shift over the past four decades from hierarchical military models to more diverse, comprehensive and preventive management strategies for natural hazards (Dovers 1998; Cronstedt 2002; Thomassin *et al.* 2019). While there has been widespread recognition internationally of the important role Indigenous peoples could play in managing hazards on their ancestral lands and waters, Thomassin et al. (2019) concluded that this has yet to significantly transform the sector's policies and practices, and collaborative decision making remains, in general, an aspiration more than a reality. The United Nations acknowledged that while Indigenous rights are

being increasingly recognized, there appears to be an 'Implementation Gap: Much talk, little action' and that globally, more on-ground actions at a local and

national scale are needed (United Nations 2019).

Table IV: Government policies related to contemporary cultural fire management in southeast Australia

Government	Policy	Reference
New South Wales State Government	*NPWS Cultural Fire Management Policy*	Office of Environment and Heritage (2016)
	FR [Fire & Rescue] *NSW Cultural Burning Management Policy*	Fire & Rescue NSW (2017)
	Draft Aboriginal Communities Engagement Strategy NSW	NSW Rural Fire Service (2018)
Australian Capital Territory Government	*ACT Aboriginal Fire Management Plan*	ACT Government (2015)
	Aboriginal Cultural Guidelines for Fuel and Fire Management Operations in the ACT	Williamson (2015)
Victoria State Government	*The Victorian Traditional Owner Cultural Fire Strategy*	The Victorian Traditional Owner Cultural Fire Knowledge Group (2019)
	CFA Koori Inclusion Action Plan (2014-2019), CFA Aboriginal Engagement Guidelines	Country Fire Authority (2015); (Country Fire Authority 2018)
Queensland State Government	*Queensland Parks and Wildlife Service Operational Policy: Fire management partnerships with Traditional Owners on protected areas*	Queensland Parks and Wildlife Service (2012)
Tasmanian Government	The Tasmanian Parks and Wildlife Service is currently developing an Aboriginal Cultural Burning policy. The policy development is in the very early stages and is not expected to be completed until July 2020 or later.	Dwyer (2020)
Council of Australian Governments	*National Bushfire Management Policy Statement for Forests and Rangelands*	Forest Fire Management Group (2014)

Benefits

The academic literature described 78 benefits grouped into seven categories of contemporary cultural fire management in southeast Australia (Table V). The frequency at which benefits were discussed were: cultural (coding frequency = 39), ecological/environmental (29), economic (13), bushfire management (13), political/self-determination (9), social (8), health and wellbeing (5) benefits (total = 116). Of these, 68% of the benefits described had actually been realised, while 39% were potential benefits that may result from cultural fire management. The categories of benefits that had mostly already been realised included cultural, social, health and wellbeing benefits. For ecological/environmental, economic, bushfire management and political benefits, approximately equal numbers of the identified benefits were realised and projected.

Maclean *et al.* (2018) found that Indigenous cultural fire management is a key management activity needed to manage Australia's biodiversity, including threatened species and ecological communities. They noted that the ecological benefits of on-country cultural fire management were plentiful. The latest *Close the Gap Campaign Report* highlighted the benefits of cultural fire management in terms of land management, and the important role cultural burning activities play in passing on local knowledge and connection to land (The Lowitja Institute 2020).

Zander (2018) attempted to assess the economic benefits of Indigenous cultural fire management and found that the total costs per burn ranged between $17,600 and $46,000 and per ha between $53 and $54. However, not many respondents could identify the area burned, or managed in general, and due to a lack of cost data and the intangible nature of the main benefits, they refrained from conducting a benefit-cost analysis.

Table V: Benefits of cultural fire management as described in the literature

Benefit Type	Description	References
Cultural	Intergenerational transfer of cultural knowledge and practice.	Smith *et al.* (2018); Darug Ngurra *et al.* (2019); Robertson (2019); Weir and Freeman (2019); McKemey *et al.* (2019a)
	Increasing awareness of Lore.	Robertson (2019)
	Increasing knowledge and use of Indigenous languages.	McKemey and Patterson (2019); Robertson (2019)
	Ability to undertake cultural practice.	Robertson (2019)
	Protection of cultural diversity.	Hill (2003)
	Revitalisation of culture / enabling Indigenous people to connect with their culture.	Eriksen and Hankins (2014); Maclean *et al.* (2018); McKemey *et al.* (2019a)
	Linking people with natural resource production for food and other cultural practices.	Eriksen and Hankins (2014); Spurway (2018)
	Re-engaging as caretakers of Country.	Eriksen and Hankins (2014); Maclean *et al.* (2018); Darug Ngurra *et al.* (2019); McKemey *et al.* (2019a)
	Facilitating access to Country.	Maclean *et al.* (2018) McKemey *et al.* (2019a); Weir and Freeman (2019)
	Feeling support for meaningful work.	Maclean *et al.* (2018)
	Facilitating cultural knowledge exchange.	Maclean *et al.* (2018)
	Inclusion of cultural burning regimes into fire management plans.	Maclean *et al.* (2018)
	Protection of cultural heritage.	Maclean *et al.* (2018) Robertson (2019)
	Conservation of culturally significant species and ecosystems.	McKemey et al. (2019a)
	Fulfilling cultural responsibilities.	McKemey *et al.* (2019a)
	Rebuilding cultural knowledge.	McKemey *et al.* (2019a)
	Awakening identities.	Darug Ngurra *et al.* (2019)
	Giving back to Country.	Darug Ngurra *et al.* (2019)
	Intercultural learning.	Darug Ngurra *et al.* (2019); McKemey *et al.* (2019a)
	Increasing, refining and developing (cultural and ecological) knowledge.	Spurway (2018)
	Community doing business.	Weir and Freeman (2019)
	Getting away from racism and bigotry.	Weir and Freeman (2019)
	Feeling free and relaxed.	Weir and Freeman (2019)
	Connecting with each other.	Weir and Freeman (2019)

Social	Building of self-esteem, pride and a sense of belonging for local Aboriginal people.	Maclean *et al.* (2018)
	Building social capital when the wider Aboriginal and non-Aboriginal community see rangers successful caring for their country.	Maclean *et al.* (2018)
	The building of knowledge networks and social capital via regional fire workshops.	Maclean *et al.* (2018)
	Increasing feelings of empowerment through Indigenous people leading fire management planning on their land.	Maclean *et al.* (2018)
	Developing and strengthening partnerships between Indigenous and non-Indigenous organisations.	Maclean *et al.* (2018)
	Receiving greater public awareness and increased recognition of the roles of Indigenous fire managers.	Maclean *et al.* (2018)
	Education and training opportunities for non-Indigenous managers to learn about Indigenous cultural fire management.	Maclean *et al.* (2018)
	Understanding the importance of women's fire knowledge.	Spurway (2018)
Economic	Indigenous fire management partnerships and activities have now spread across the country and offer an important opportunity for Indigenous livelihoods and on-country economic enterprises. There is great potential for future enterprise development which would bring many other benefits.	Maclean *et al.* (2018)
	Fire activities create jobs for local Indigenous people that involve work valued by Traditional Owners and rangers.	Robinson et al. (2016)
	Potential savings in weed control, stronger growth in native pastures, carbon abatement and reduction in fire fuel loads.	Maclean *et al.* (2018)
	Economic benefits from the prevention of wildfire as a direct result of sharing cultural burning knowledge with the wider community and the protection of assets, including infrastructure and neighbouring farming properties, from wildfires.	Maclean *et al.* (2018)
	Providing employment and training pathways for young people, and meaningful employment for Indigenous people.	Lehman (2001); Maclean *et al.* (2018); Neale *et al.* (2019a)
	An increase in designated Indigenous positions in government agencies.	Maclean *et al.* (2018)
	More opportunities for Indigenous people to access senior government positions.	Neale *et al.* (2019a)
	Future boosts to the regional economy from improved biodiversity (parks as nice places to visit) resulting from cultural fire management.	Maclean *et al.* (2018)
	Further economic benefits included those that would come from increased employment opportunities for Indigenous land managers (and the flow-on effects for families and communities of increased family income, meaningful employment, connection with country).	Maclean *et al.* (2018)

	In some instances, reduced wildfire fighting costs to government by having place-based remote fire crews.	Maclean *et al.* (2018)
	Indirect economic benefit relates to the cost savings when controlling weeds through Indigenous cultural fire management and the avoided damage that weed incursions do to native ecosystems.	Maclean *et al.* (2018)
Ecological/ environmental	Fire is critical to the health of Country.	Spurway (2018); Darug Ngurra *et al.* (2019)
	Cultural fires regenerate the bush and heals the land, leading to the restoration of healthy environments.	Eriksen and Hankins (2014); Maclean *et al.* (2018); Spurway (2018); Darug Ngurra *et al.* (2019); Kerr (2019)
	Cultural burning used to protect threatened species and their habitat, such as the koala and glossy black cockatoo.	Maclean *et al.* (2018); Robertson (2019)
	Cultural burning's potential use as a tool against the dieback of vegetation.	Robertson (2019)
	Protection of RAMSAR wetlands from the incidence of wildfire.	Maclean *et al.* (2018)
	The benefits of lower intensity cool vs hot burns, and mosaic, patch burns vs hectare wide burns.	Maclean *et al.* (2018); Weir and Freeman (2019)
	Native vegetation management, including native species regeneration from cool burns; managing native woody vegetation and seed banks.	Maclean *et al.* (2018); Darug Ngurra *et al.* (2019)
	Managing exotic weeds with fire (rather than chemicals).	Maclean *et al.* (2018); Darug Ngurra et al. (2019)
	Cultural burns use less chemicals than other burning methods.	Weir and Freeman (2019)
	Managing at a local place-based scale.	Maclean *et al.* (2018); Bardsley *et al.* (2019)
	Cultural burning benefits native fauna and maintains key habitat resources.	McKemey *et al.* (2019a); Spurway (2018); Weir and Freeman (2019)
	Cultural burning achieved a broad range of objectives encompassing conservation and knowledge and capacity development for Indigenous rangers and non-Indigenous scientists.	McKemey *et al.* (2019a)
	Maintaining or improving ecological or biodiversity values.	Lehman (2001); Robinson *et al.* (2016); Bardsley *et al.* (2019)
	Management at the landscape scale.	Robinson *et al.* (2016)
	Cool burns maintain important micro climates in the ecosystem by protecting the canopy and root systems of plants.	Weir and Freeman (2019)
Bushfire management	Cultural burning was adopted for its risk mitigation potential.	Weir *et al.* (2020)
	Cultural burning reduces fuel loads.	McKemey *et al.* (2019a); Robertson (2019); Weir and Freeman (2019)
	Cultural burning protects infrastructure.	Robertson (2019)
	Cultural burning reduces the risk of, and destruction caused by, bushfire.	Lehman (2001); Maclean *et al.* (2018); Spurway (2018); Weir and Freeman (2019); McKemey *et al.* (in prep.)
	'We never feared fire or were worried about being burned out because we had it totally under control' - Noel Butler (Budawang Elder).	Kerr (2019)

	Insights from Indigenous Australian fire management can help inform enhanced fire management practices. Reintroducing fire into some landscapes by drawing on Indigenous knowledge will not prevent wildfires but it may reduce their impact.	Lindenmayer (2003)
	The retention, revival, and integration of the Indigenous fire knowledge can be used to aid ongoing debates on how to coexist with wildfire today. A greater recognition of this traditional understanding of the environment could aid current struggles to manage the growing frequency of devastating wildfires if it is acknowledged by, and incorporated into, the practices of wildfire management agencies.	Eriksen and Hankins (2014)
Health and wellbeing	An Aboriginal fire fighter linked the well-being of the country with her own personal well-being through working with fire in NSW. This sense of well-being is consistent with the findings of the Burgess et al. (2005) study of the health benefits associated with Indigenous burning practices, which included increased physical, mental, and social health.	Eriksen and Hankins (2014); Burgess *et al.* (2005)
	Health and wellbeing benefits related to cultural burning included the alleviation of mental health issues by local Indigenous land managers, an increase in exercise and improved nutrition, psycho-social benefit of getting back on country and importantly spiritual health.	Maclean *et al.* (2018)
	Cultural fire management provides emotional and physical sustenance.	Darug Ngurra *et al.* (2019)
	Many people spoke about how fire management is an opportunity for healing Country, healing themselves, and healing fraught relationships, all at the same time. At many of the meetings diverse people came together to speak about this context, and to find better ways to live and work together.	Weir and Freeman (2019)
Political (self-determination)	Enabling indigenous people into the fire policy-making role in a manner that respects their legal, cultural and human rights provides opportunities for addressing Indigenous economic and social development… contributes to Australian goal of reconciliation… leads to a greater understanding of the nature of relationships between people and country.	Hill (2003)
	The role of fire as an educator is also important for the non-Indigenous participants. The revival of cultural burns signals two-way relationality: 'Yellomundee is now acting how it always has in regards to a place of cultural exchange.' Darug Country is also teaching Landcare groups and Rural Fire Service participants that fire is a non-threatening living entity. Country cares by enabling community participation, a place, and an activity, that provides and nurtures reciprocity.	Darug Ngurra *et al.* (2019)
	Universally, people spoke of the importance of the Recognition and Settlement Agreement in changing how the government agencies – DELWP and PV – related to Dja Dja Wurrung peoples and their corporate group, DDWCAC. According to most, the	Neale *et al.* (2019a)

	agreement provided the conditions-of-possibility for collaboration, particularly through its financial provisions and placing legal obligations on the agencies to consult with DDWCAC on land management issues. As one non-Indigenous manager noted, the agencies had 'engaged' prior to the agreement, but it was only afterwards that they 'really went from informing to inclusion'… The collaboration is materially and structurally redistributing greater control over country into the hands of Aboriginal traditional owners. What is occurring is not decolonisation in the sense of a complete and irreversible transfer of authority, or withdrawal of settler colonial government, but rather the iterative decolonising renovation of the political and practical dominance of settler agencies. These are modest but real gains with nascent and unpredictable effects on those involved. Slowly, resources and authority are less solely on the side of the government and its agencies.	
	Many decades after being displaced from their ancestral lands, the Banbai people have, for the first time, been empowered to reintroduce cultural burning at Wattleridge IPA.	McKemey *et al.* (2019a)
	In 2000 the Parks and Wildlife Service is set to invite our Tasmanian Aboriginal community to participate in the reintroduction of Aboriginal fire regimes in the World Heritage Area. Given the degree of frustration and disappointment which has been felt by Aboriginal people in recent decades over the lagging pace of political change, the ability to manage and protect such a large area of Tasmania has the potential to be an even greater victory than winning legal titles to the small areas handed back in 1995.	Lehman (2001)
	The challenge is not just to bring differing epistemologies together to generate new knowledge, but also to overcome an historical unwillingness to undertake such actions. Truth and reconciliation is vital to facilitate societal healing, but it will also be the key trigger to facilitate openness about past failings to normalise the inclusion of Indigenous biocultural practices in Australian environmental management.	Bardsley *et al.* (2019)
	For Aboriginal and Torres Strait Islander peoples, engagement in disaster risk management potentially has broader implications. The current debates around Indigenous ecological knowledges provide support for arguments for stronger native title and land rights mechanisms that empower Indigenous peoples and guarantee access to country. The growth and sustainability of the Indigenous Estate, the importance of native title, land rights and access to country are important considerations in caring for country and, by definition, disaster risk reduction and Indigenous livelihoods. The lessons learned from Australia's First Peoples is that these issues cannot be separated out, they are part of an integrated whole: caring for country equates with reducing natural disasters and sustaining political economies	Spurway (2018)

	based on lands and waters under Indigenous custodianship. The issues raised in the literature connect to Australian First Peoples' broader struggles for equitable development and basic human rights.	
	Fire management is not simply a technical matter but is about values, and thus it is also political. This includes whose risk mitigation priorities matter, and whose fire management is authorised, funded, and taught. In Australia, this is overlayed with fraught histories of engagement between Indigenous and other people, which Indigenous people have to confront daily.	Weir and Freeman (2019)
	Australia's emerging fire management engagements are important opportunities for positive learning and collaboration, with potential to grow recognition of Indigenous peoples' priorities, as well as to help decolonise relationships between peoples and with nature… In the ACT the government is re-framing its fire management program in response to justice principles, a pathway that is facilitated by assumed synergies with ecological and risk goals; however, a much more comprehensive response is needed to support the authority and governance of the traditional custodians. More than partnerships and contracts, First Nations need to be supported to be First Nations through the sharing of resources and jurisdictional power. This requires the nation state to more comprehensively address the matter of nested sovereignties.	Weir *et al.* (2020)

Barriers

The academic literature described 22 types of barriers to contemporary cultural fire management in southeast Australia (Table VI). The frequency at which barriers were discussed were: lack of recognition (coding frequency = 14), protocols (14), legislation and regulation (8), application of cultural burning (8), power (7), knowledge (6), partnerships and agreements (4), lack of trust (4), ecological understanding (4), resourcing (4), capacity (2), bushfire risk (2), public perceptions (2), training requirements (2), access to land (1), cultural links and protocols (1), altered landscapes (1), fire suppression policies (1), climate change (1), sharing benefits (1), weather (1) and infrastructure (1) barriers (total = 89).

Table VI: Barriers to cultural fire management as described in the literature

Barrier	Examples	References
Lack of recognition of Indigenous knowledge and land management practices	Lack of meaningful recognition of Indigenous knowledge by authorities, scientific community and/or organisations.	Cary *et al.* (2003); Eriksen and Hankins (2014); Darug Ngurra *et al.* (2019); Kerr (2019)
	Conflict between western knowledge systems and Aboriginal cultural learning pathways.	Kerr (2019)
	Lack of support to implement fire using cultural practices rather than western ways.	Kerr (2019)
	Limited appreciation of the benefits of Indigenous peoples' role in fire management.	Hill (2003)
	Different cultural understandings of fire.	Eriksen and Hankins (2014)
	Lack of recognition of the relationship between Indigenous people and fire by settler colonial society and its social, legal and economic structures and institutions.	Robinson *et al.* (2016)
	Unwillingness of agencies and others to engage in Aboriginal perspectives.	Smith *et al.* (2018)
	Reliance on narrow measurements of success (e.g. scientific biodiversity metrics) over other measures valued by Aboriginal peoples.	Smith *et al.* (2018)
	In the past, common practice was to privilege colonial voices and written texts over Indigenous people and their oral histories.	Smith *et al.* (2018)
	Misconceptions regarding the 'disappearance' of Indigenous fire practices.	Robinson *et al.* (2016)
	Treatment of Aboriginal and Torres Strait Islander peoples as unknowing, vulnerable victims in need of external, (usually) non-Indigenous expertise to make them aware of, and adapt to, the dangers of natural disasters… based on the misconception that Aboriginal peoples have lost contact with traditional ecological knowledges and their caring for country strategies that ultimately could help reduce the likelihood of large scale wildfires.	Spurway (2018)
Partnerships and agreements	Conservation agreements are a key mechanism for formally recognising Indigenous fire knowledge and management. However, 'in principle' recognition does not always lead to successful incorporation of fire knowledge or the ongoing empowerment of Indigenous fire knowledge holders and fire managers.	Robinson *et al.* (2016)
	Lack of involvement of government agencies in Indigenous cultural fire management due to disengagement or lack of formal partnerships.	Tamarind Planning (2017)
	Lack of resources to facilitate agency engagement in cultural fire management.	Tamarind Planning (2017)
	There must be a cultural change within government agencies before they can increase engagement in cultural fire management.	Tamarind Planning (2017)
Access to land	Indigenous people were excluded from practicing cultural burning on traditional lands, fire management was undertaken by the authorities.	Kerr (2019)
Lack of cultural links and protocols	There is a need for a process to build the cultural protocols back into areas where cultural links have long been absent. Indigenous cultural governance and authority must be supported, as well as cultural learning pathways.	Kerr (2019)
Training requirements	Government agencies require people involved in fire management to be qualified fire fighters which excludes knowledgeable Elders and children. Government training requirements often distract from cultural burning pathways.	Kerr (2019)
	Relationships between government agencies and Indigenous staff are often perceived to be 'one way'. Indigenous people are required to gain a range of certifications from fire agencies before undertaking cultural burning, but their knowledge is not valued in turn.	Smith *et al.* (2018)

Knowledge	The 'Indigenous toolbox' containing traditional ecological knowledge and customary law is not well represented in fire management. Our challenge is to devise the 'bridging tools' between Indigenous and non-Indigenous toolboxes that would make the integration of information and knowledge from various sources work well.	Whelan (2003)
	While knowledge about Indigenous fire regimes is available for many parts of Australia, in other places the knowledge base has been (and continues to be) eroded.	Lindenmayer (2003)
	There are concerns that some of the Indigenous knowledge needed to burn country 'the right way' is being lost due to 'not being on country'.	Robinson *et al.* (2016)
	It is clear that the integration of actionable knowledge from Indigenous and other traditional sources into natural resource or hazard management remains difficult… The academic knowledge on regional Indigenous burning practices is insufficiently developed to warrant any strong claims to inform possible improvements in hazard and natural resources management.	Bardsley *et al.* (2019)
	There is much flux currently about fire management practices, including: the merits of prescribed burning in terms of protecting life and property; the science about the ecological impacts of hazard reduction burns; and, the role of Indigenous peoples' burning practices. Misunderstandings can derail important conversations because there are such different conceptual traditions and perspectives involved.	Weir and Freeman (2019)
	Traditional fire knowledge is a scarce resource… Some Aboriginal ranger groups had 'lost knowledge' around appropriate burning techniques, skills and experience while other Aboriginal people demonstrated the presence of this knowledge and skill.	Tamarind Planning (2017)
Lack of trust	The mixing of fire cultures often is hindered by a lack of cross-cultural trust.	Eriksen and Hankins (2014)
	Many Indigenous people have a historically-grounded mistrust of academic research and researchers.	Smith *et al.* (2018)
	Relationships between settler governments and Indigenous peoples are characterised by mistrust.	Thomassin *et al.* (2019); Neale *et al.* (2019a)
Power	The legacy of colonial constructs of power based on the oppression of Indigenous peoples and privilege of colonising peoples, leads to lack of access to the land and ability to practice cultural burning.	Eriksen and Hankins (2014)
	Langton (1998) highlights how misrepresentations, tropes and asymmetric power relationships have impeded effective application of Indigenous fire knowledge for decades.	Langton (1998); Robinson *et al.* (2016)
	Control needs to be meaningfully invested in Aboriginal peoples, 'when Aboriginal people are undertaking each step of the burn'.	Smith *et al.* (2018)
	General recognition of the importance of involving Indigenous peoples in natural hazard management strategies and structures has not led to a significant transformation of the sector, nor has it led to the devolution of decision-making power over natural hazards management from government to Indigenous peoples inside or outside the sector.	Thomassin *et al.* (2019)
	Aboriginal leadership is central, but what is also needed is for the government to embrace Aboriginal Australia and our traditional fire management practices… throughout Australia there is much more healing that needs to be done for such intercultural engagement to progress and be more meaningful for Indigenous people, including in material terms.	Weir and Freeman (2019)
	Formalizing cultural fire worked to disempower some Aboriginal participants, in alerting them to the scope and complexity of fire legislation and by formalizing their previously informal/unregulated burning.	Tamarind Planning (2017)
Altered landscapes	Australian landscapes are now substantially modified from those managed by Indigenous Australia- factors like weed invasion can dramatically alter fire regimes and fire impacts on landscapes and ecosystems.	Lindenmayer (2003)

Appropriate protocols for cultural sites and knowledge	Fire management sometimes lacks protocols for access and management of culturally significant sites during burning.	Eriksen and Hankins (2014)
	Lack of protocols for access to, storage of and sharing Indigenous knowledge.	Lindenmayer (2003); Eriksen and Hankins (2014)
	Lack of understanding of how knowledge is transmitted and used. Indigenous knowledge must be passed on by the 'right people to other right people'.	Lindenmayer (2003); Eriksen and Hankins (2014)
	History of exploitation of Indigenous knowledge by non-Indigenous people.	Lindenmayer (2003)
	Indigenous Australians continue to call for unique law and policy to protect Indigenous Australians' traditional knowledge and cultural expressions (Janke, 2003).	Janke (2003); Robinson *et al.* (2016)
	Knowledge of burning is not necessarily seen as something that can or should be shared freely without the responsibilities to country that come with doing it.	Smith *et al.* (2018)
	It is not necessarily appropriate for detailed knowledge about cultural burning to be made freely available to the broader Australian public. This can be a source of tension between Aboriginal and non-indigenous peoples and may lead to conflict surrounding ostensibly well-meaning projects. For example, efforts to establish national repositories of knowledge can be viewed by government agencies as a supportive step in facilitating cultural burning, but may actually be viewed by Aboriginal peoples as extensions of condescending governance approaches or extractive research agendas.	Smith *et al.* (2018)
	It should not be assumed that Indigenous peoples have traditional knowledge ready at hand or that they are willing or able to share it (particularly with the settler state). A fixation on traditional knowledge as the grounds for Indigenous recognition illustrate a key problem of participatory governance more generally, namely their failure to reconfigure power relations.	Lake (2013); Neale *et al.* (2019a)
	It should not be assumed that Indigenous peoples have or would be willing to share Indigenous ecological knowledge/traditional ecological knowledge.	Thomassin *et al.* (2019)
	Non-Indigenous emergency management institutions also need to recognise Indigenous custodianship of knowledge and that sharing said knowledge is not automatic. Indigenous peoples have the right to decide who will access what kinds of knowledge and when. Controlling the content and flow of knowledge is important as knowledge has important cultural, social and spiritual significance and cannot simply be shared with anyone.	Spurway (2018)
Fire suppression policies	Colonial interests in Australia disrupted Indigenous use of fire through the removal of people from their lands and policy prohibition. In place of traditional Indigenous fire knowledge, policies derived from state and federal agencies established around the concept of fire suppression or firefighting have become a societal norm.	Eriksen and Hankins (2014)
Ecological understanding	Ecologists have emphasised that burning practices need to be carefully tailored to the specific features of the ecosystem they are intended to protect. In particular, there is ongoing debate about how certain aspects of fire regimes—such as fire frequency, extent, intensity and seasonality—interact with critical ecosystems and biota.	Robinson *et al.* (2016)
	There is a lack of relevant data about cultural burning and its benefits to biodiversity, risk to human life and property, and other management goals. Data are being collected through agency processes, however, the burns do not have the formal properties of a generic scientific experiment and most estimate it will be 10–20 years before there is a strong basis to speak confidently about ecological outcomes.	Neale *et al.* (2019a)
	There are few data to demonstrate the outcomes of cultural burning in southeast Australia, from both scientific and cultural standpoints.	McKemey *et al.* (2019b)
	Ecological fire is not a widely accepted practice, as some ecologists (and or the broader community) dispute the need for more landscape fire.	Tamarind Planning (2017)

Climate change	Contemporary fire management efforts are primarily driven by the virtual certainty that global warming will increase extreme fire weather and lengthen fire weather seasons, leading to heightened levels of risk. Climate change projections for heightened fire risk have stimulated interest in fuel-reduction burning to mitigate wildfire effects. However, Australian studies have demonstrated that prescribed burning—including approximations of Indigenous practices, such as patch mosaic burning—has very different outcomes in different landscapes. Further ecological and fire-modelling research is needed to better understand the effects of patch mosaic burning on fuel management, and to link management actions directly to asset protection and risks to biodiversity in specific ecosystems.	Robinson *et al.* (2016)
Application of cultural burning techniques	Indigenous Australians inhabited a very diverse range of landscapes, it seems highly unlikely that a single traditional Aboriginal fire regime would have applied continent-wide… Indigenous knowledge is not a toolbox or recipe book to be strictly followed- instead it is an ethos of understanding, respecting and living with the environment, rather than fighting it.	Lindenmayer (2003)
	There exists an attitude that the historic use of fire by Indigenous people does not apply to the environment today due to environmental and demographic changes. It is important to recognize, however, that culture and knowledge are dynamic. From an applied standpoint Indigenous fire knowledge is fluid (e.g., changing with past climatic events), and the ability to read the landscape to know how, when, why, and what to burn comes with proper training.	Eriksen and Hankins (2014)
	Popular approximations of Indigenous fire practices ignore the culturally embedded aspects of these practices that determine the right time for burning; the kinship relationships that determine who can light fires for country; and the knowledge of cultural sites and cultural resources that influence the pathways of fires at a very fine scale.	Robinson *et al.* (2016)
	There is a need to spend time to build the knowledge and capacity needed to burn country appropriately because 'burning with a little bit of knowledge can be a dangerous thing'- Uncle Allan Murray… Important to note, is the need to exercise caution before the scaling 'up and out' of cultural burning practices across the landscape before Aboriginal managers are ready to take the lead. The focus should be on Aboriginal managers building their knowledge, experience and skills in the immediate future.	Maclean *et al.* (2018)
	Indigenous ecological knowledge/traditional ecological knowledge should not be considered a panacea to wildfire management, nor should it be privileged as the grounds for Indigenous peoples' involvement with the natural hazard sector. Today's natural hazard risk context is heightened by contemporary influences such as rapid shifts in climate and land use.	Thomassin *et al.* (2019)
	Aboriginal peoples in southeast Australia have had less opportunity to remain on their ancestral territories, giving them fewer opportunities to maintain the traditional practices and forms of occupation by which settler law recognises Aboriginal land rights.	Neale *et al.* (2019a)
	There are concerns that some communities may 'lose [their] confidence to burn' because of the need to accommodate 'new rules for burning' guided by programs and investors.	Robinson *et al.* (2016)
	In the contemporary Tasmanian context, understanding of Aboriginal burning practices is still poor. Reintroduction of Aboriginal fire regimes may no longer be achievable or desirable, given changes that have occurred in recent times, such as the impact of exotic species and the fragmentation of remnant vegetation types. The level of skill exercised in the timing and control of Aboriginal cultural fires will be difficult to emulate without the redevelopment of an intimate human association with these areas.	Lehman (2001)
Legislation and regulation	Tight, complicated and potentially confusing rules, regulations and legislation.	Tamarind Planning (2017); Maclean *et al.* (2018) Neale *et al.* (2019a) Weir and Freeman (2019)
	State-based fire permits, tenure arrangements and diverse institutions for broad-scale fire mitigation, often impede Indigenous customary fire practices, historically operating at fine-scale in the landscape through extended family groups. Developing balanced, respectful and appropriate measures, protocols, laws and/or policies is crucial to creating solid fire management knowledge partnerships and	Robinson *et al.* (2016)

	knowledge-sharing methods… There is inconsistent translation of legal and policy instruments that support innovative Indigenous fire knowledge translation into programs and practices across the continent.	
	One of the most frequently mentioned barriers to Indigenous fire management was challenges in coordinating the cultural burn with Government agencies.	Zander (2018)
	Overly bureaucratic risk management and regulations that do not account for cultural knowledge and practice.	Smith *et al.* (2018)
	The key challenge for researchers and policy makers is in developing new frameworks (legislation, regulation, governance, financial and career support) that enable Indigenous people into a policy-making role that fully respects their rights.	Hill (2003)
Resources	It is difficult to secure long-term resources for good fire management. Necessary resources include resources for training and employing fire officers, opportunities to share knowledge about good fire management practices with neighbouring groups, and scientific and technical expertise to manage fire for different purposes.	Robinson *et al.* (2016)
	An identified barrier to future collaborations between Aboriginal and non-indigenous peoples for the support of cultural burning included the uneven distribution of funding between government and Aboriginal land managers.	Smith *et al.* (2018)
	Settler governments have repeatedly failed to take Indigenous expertise seriously, and disparities in funding and resources remain clearly evident. Indigenous peoples' governance institutions are typically unfunded, or underfunded, operating within socio-economically disadvantaged communities that bear extensive consultation responsibilities and legal liabilities.	Thomassin *et al.* (2019)
	While government had 'endorsed' the collaboration they had not provided budgetary support, including for employing Dja Dja Wurrung individuals in contract and seasonal bushfire positions. Managers said 'roughly' AUD$800,000 had to be reallocated within DELWP's regional budget over 3 years to fund these positions. Extra funds were also needed to support necessary training and certifications.	Neale *et al.* (2019a)
Sharing benefits	A key challenge that remains in relation to fire management partnerships relates to equitable benefit sharing.	Robinson *et al.* (2016)
Weather	One of the most frequently mentioned barriers to Indigenous fire management was balancing weather windows / conditions.	Zander (2018)
Capacity	Two of the most frequently mentioned barriers to Indigenous fire management were lack of capacity and availability of fire managers and high turn-over rate; and lack of volunteers and participation from community.	Zander (2018)
	There was a need for improved equipment, more advanced training and more frequent experience on fire grounds.	Tamarind Planning (2017)
Bushfire risk	Fire management agencies in southern Australia operate within a context that has significant potential for intense and extreme fires. The period since settler invasion began has involved massive, complex, and ongoing social and ecological changes, one cumulative effect of which dramatic rises in bushfire frequency and intensity. Human migration into peri-urban interfaces is continuing to amplify bushfire's human impacts.	Neale *et al.* (2019a)
	It is important to recognise that classical Indigenous fire regimes cannot, and did not, prevent the extreme wildfires that occur in southern Australia during intense fire weather conditions. Climate change scenarios modelled by CSIRO and others predict that we will experience more extreme events, more often. Our contemporary policy direction must be based on learning to live with the effects of such fires in the environment, as we will not be able to prevent them.	Hill (2003)
Infrastructure	Compared with northern Australia, fire management agencies in southern Australia operate within a context that has a greater number of public and private assets at risk of bushfires.	Neale *et al.* (2019a)
Public perceptions	The results of trial burns have already demonstrated the wisdom of caution. Early burns have already gone out of control – continuing the pattern of destructive firing which has characterised the European experience of wilderness in Tasmania to date. This will alarm nature conservationists and generate resistance to moving away from the defensive fire regimes of recent years.	Lehman (2001)
	There is some optimism from environmentalist groups and scepticism from government employees about the benefits of Aboriginal cultural fire management, which could lead to a potential knowledge controversy.	Neale *et al.* (2019a)

Discussion

Cultural fire management is in the process of being revived in southeast Australia, as our review of the literature demonstrates. The revival has been driven by Indigenous leaders, as well as a broad shift in Australian society. This shift includes a resurgence of Indigenous rights, responsibilities and land ownership, development of policies, and a change in values to respect and take pride in Indigenous culture (Weir *et al.* 2020). The Black Summer bushfire crisis of 2019-20 also drove the public to question Australia's fire management, and to consider alternatives such as Indigenous cultural fire management. The media's coverage displayed brevity and bravery; while the academic literature was cautious and considered. The media may have created expectations that cultural fire management could be a panacea to Australia's fire problems, while the academic literature used evidence-based research to discuss the benefits and barriers to cultural fire management. Both the media and academic literature appeared to display bias. For example, there was a lack of negative or critical news stories about cultural burning, and equally, there was a lack of cultural perspective and research (i.e. how to enhance the cultural practice) in cultural burning academic writing. As expanded on below, many questions remain, which could shape priorities for future research and communication with the broader public, as Indigenous cultural fire management continues to roll out across southeast Australia.

There were 116 instances in the academic literature where the various benefits of cultural fire management were described (Table V). Cultural, social, health and wellbeing benefits had mostly already been realised. For ecological/environmental, economic, bushfire management and political benefits, approximately equal numbers of the identified benefits were realised and projected. This possibly indicates that research participants were able to more easily demonstrate cultural, social and health/wellbeing benefits while the anticipated benefits for other categories are yet to be proven. Different methods may have been used to measure these benefits and, indeed, they could be considered to be different types of challenges. For environmental benefits, it is challenging to quantify the complex changes that take place with burning, and a relatively long time scale is

required to observe ecological changes (Driscoll *et al.* 2010; Lindenmayer *et al.* 2012; Neale *et al.* 2019a). For cultural/social benefits, the challenge lies in isolating the cause and effect. Furthermore, there is a lack of theoretical models to describe socio-cultural change and impacts across the western-Indigenous cultural systems (Satz *et al.* 2013). Consequently, cultural monitoring, evaluation and reporting (MER) is generally under-researched (Wexler 2014).

Furthermore, while many of the benefits of cultural fire management in south eastern Australia have been described qualitatively, few studies took a quantitative approach. Zander (2018) attempted to quantify the economic benefits of Indigenous cultural fire management but found that a lack of data prevented a benefit-cost analysis. McKemey *et al.* (2019a) used cross-cultural science to assess the impact of cultural burning versus hazard reduction burning on the cultural keystone species, the short-beaked echidna. Several studies claimed that cultural burning assisted to protect threatened species, manage weeds and reduce bushfire risk, however these examples did not present empirical evidence to support these claims. A forthcoming paper by McKemey *et al.* (in prep.) compared the impact of Indigenous cultural burning with wildfire on the threatened Backwater grevillea (*Grevillea scortechinii* subsp*. sarmentosa*) in NSW. This research found that cultural burning had less impact than wildfire on the shrub's population and reproduction, whilst also decreasing fuel loads. Maclean *et al.* (2018) developed a national framework to report on the benefits of cultural fire management. This framework sets an agenda for future monitoring projects, to begin to fill the gaps in our shared knowledge across a transdisciplinary range of outcomes.

In regard to economic benefits, the academic literature mainly focused on Indigenous employment and enterprises. The benefits for bushfire management were mentioned but not quantified. Through a brief investigation, we found that the state and territory governments spent more than A$5.5 billion to support fire and emergency services across Australia and New Zealand in 2018/19 and Australia had more than 290,000 personnel and thousands of specialist vehicles, according to the Australasian Fire and Emergency Service Authorities Council (Cox 2019). In 2019, the Federal Government announced an additional A$3.9 billion for an Emergency Response Fund. Each year

'disaster-level' bushfires cost Australia an average of A$77 million (Australian Institute of Criminology 2004). It has been suggested that for every dollar spent on prevention, $22 can be avoided in suppression costs (The Senate Select Committee on Agricultural and Related Industries 2009). The Firesticks Alliance developed an initial $100 million proposal to fund a nationally recognised, accredited cultural fire management training and mentoring program. This proposal was focused on empowering communities in the revival and sharing of cultural knowledge and practice across pilot regions throughout Australia. The aim was to support a cultural landscape approach to improve the health and resilience of Country and communities. This could potentially improve fire regimes to care for cultural and natural values of Country while reducing the incidence, extent and impacts of wildfire over the long term in southeast Australia (Costello and Standley 2020). These types of cultural fire programs could cost a fraction of current expenditure on prevention, mitigation, response and recovery to wildfires. While this is speculative at the current time, cost benefit economic analysis of cultural burning could be undertaken in future for well-documented case studies, similar to other studies that have documented economic values of cultural practices and Indigenous knowledge (for example, see Gray *et al.* 2006 and Blackwell *et al.* 2019).

The literature also lacked detail on the area of land where contemporary cultural fire management was being practiced in southeast Australia (Table III). We were able to develop rough approximations for the ACT, NSW and Victoria, which showed that less than 1% of the total land area of each of these states was being culturally burnt. Cultural burning was mostly documented on public and Aboriginal land. Considering that the majority of Indigenous people live in southern Australia, and they are southern Australia's largest land holders (Weir and Freeman 2019), cultural fire management is an underutilised practice. There were 89 instances in the academic literature where barriers to cultural fire management were described, and we grouped these into 22 categories (Table VI). Many of these impediments were also mentioned by the media (Fig 3). Considering the breadth and significance of these barriers, it is not surprising that cultural fire management has only recently been revived in southeast Australia, and only over a small proportion of land. Many of the

barriers seem insurmountable, and if cultural fire management is to be reinstated more widely, Indigenous fire practitioners have indicated it is likely to take many generations to see the results of landscape-scale cultural fire management.

The numerous Indigenous cultural fire management projects (Table III) are supported by eight relatively recent policies created by state and territory governments of southeast Australia (Table IV). However, they are mostly short-term, small-scale, grass roots projects. In the cases where cultural fire management has been successfully reinstated as an ongoing practice, Indigenous leadership, extraordinary relationships, strong agreements and transformational change seem to be keys to success (Neale *et al.* 2019a). Neale (2020b) stated that in the absence of robust budgets or a clear longer-term commitment by governments, future projects will continue to rely on persuasion, improvisation and intercultural diplomacy. Victorian (The Victorian Traditional Owner Cultural Fire Knowledge Group 2019) and NSW (Office of Environment and Heritage 2016) policies provide examples of ways in which governments are trying to move forward to support Indigenous cultural fire management, but these policies could be restrictive and fall short of providing the drivers and funding needed for cultural fire management to be applied across land tenures, across a broad landscape. In northern Australia, it took the introduction of an entirely new industry, a carbon economy based on savanna burning, to facilitate the reinstatement of Indigenous Traditional Owners as fire managers on their ancestral clan estates (Murphy *et al.* 2015). Neale *et al.* (2019a) found that, for the Dja Dja Warrung people, a Recognition and Settlement Agreement with the Victorian Government and its corresponding financial provisions and legal obligations, along with the leadership and commitment of managers within government agencies, were key factors for the success of the *djandak wi* cultural burning program. With the advantage of being based on Indigenous land, the NCC Firesticks project (NSW) was considered a success due to its innovation: in enabling use of cultural fire, promoting its benefits, bringing Indigenous stakeholders and mainstream agencies together and in establishing pathways for future collaborations (Tamarind Planning 2017). At Rick Farley Reserve (NSW), success resulted from adopting a deeply cultural

framework (Booth 2020; Ridges *et al.* in press). In the ACT, the keys to a successful cultural fire

management program included the critical role of motivated individuals and good relationships, with

the First Nations being supported by government and community to lead the way (Weir and

Freeman 2019). Smith *et al.* (2018) identified some keys to successful and supportive collaborations

as 'a shared emphasis on Aboriginal leadership, joint decision-making and a willingness amongst

non-indigenous partners to give up some of their control and authority'.

Victor Steffensen, Indigenous fire practitioner and leader, outlined his vision for the future

(Steffensen 2020: 213):

'We need to work towards a whole other division of fire managers on the land, looking after country

in all the ways possible, which includes fire as well as other practices. A skilled team of Indigenous

and non-Indigenous people that works with the entire community, agencies and emergency services

to deliver an effective and educational strategy into the future. One that is culturally based and

connects to all the benefits for community.

To do that we need to draw on all of our Aboriginal expertise to train people and start upskilling the

fire managers of the future. To allow indigenous practitioners from all states to bring together their

values and leadership. We need to see three-year training courses of learning out on country to

graduate our Indigenous fire practitioners… we need to start training the trainers, building the

teams, getting people out there on the many different levels. Build from the foundation of

Aboriginal knowledge as the practical knowledge base to work from, and adding the Western

knowledge to support a stronger solution.'

An expansion of cultural fire management could include: Indigenous engagement in fire

management and bushfire recovery though employment, contract services and collaborative fire

management initiatives (Neale *et al.* 2019b); Indigenous mentoring and training programs (Costello

and Standley 2020); empowering local communities to take an active role in decision-making by

building community skills and capacity and providing a greater sense of custodianship; increased

Indigenous involvement in policy and planning; increased recognition of Indigenous knowledge and cultural burning as a treatment strategy on various land tenures (Costello 2019); payments for ecosystem services; research to better understand Australia's fire history and the contemporary application of cultural fire management (as per Bardsley et al. 2019 and Smith *et al.* 2018); and use of cross-cultural knowledge (Indigenous and western science) for fire management (McKemey and Patterson 2019).

Several studies have demonstrated the wide array of benefits which accrue from investing in Indigenous natural resource management (NRM). For example, Social Ventures Australia (2016) concluded that, between the 2009-15 financial years, an investment of $35.2m from Government and a range of third parties in Indigenous NRM, generated social, economic, cultural and environmental outcomes with an adjusted value of $96.5m, which is about $3 return for every $1 invested. While Indigenous Australians have a rights and interests in 40% of Australia's land (Department of Prime Minister and Cabinet 2018), manage 55% of the National Reserve System (Department of Environment and Energy 2019), and are custodians for at least 59.5% of threatened species habitat (Leiper *et al.* 2018), Preece (2019) claims that they receive only 6% of the Federal conservation estate budget. Many Indigenous communities wish to increase their opportunities to care for country (Zander *et al.* 2013) and Zander and Garnett (2011) found that Australians could be willing to pay from $878m to $2b per year for Indigenous people to provide environmental services. This is up to 50 times the amount currently invested by government. In southeast Australia, where small-scale cultural burns have been piloted in many places over the past decade, growing this cultural and NRM practice to the landscape-scale could be considered a priority for investment.

The Bushfires Royal Commission (2020) has provided an opportunity for Indigenous voices to be heard. Of the seven matters identified for inquiry through the Bushfires Royal Commission relating to the Black Summer bushfires of 2019 – 20, an entire matter is devoted to 'any ways in which the traditional land and fire management practices of Indigenous Australians could improve Australia's resilience to natural disasters' (Royal Commission into National Natural Disaster Arrangements 2020).

This is in contrast to past bushfire inquiries, most of which have ignored the experiences, concerns, rights and interests of Indigenous peoples (Williamson *et al.* 2020). Some past bushfire inquiries have considered Indigenous fire management however they concluded that there is very limited scientific information available to inform its effectiveness for bushfire management, or have focussed on past Indigenous burning practices while overlooking the opportunities that exist today (Esplin *et al.* 2003; Environment and Planning Committee 2017; Neale *et al.* 2020). Williamson *et al.* (2020) suggested that the most urgent forum where Indigenous people must have a strong presence is in the context of post-disaster inquiries and commissions, including any co-design of new policies and programs created in response to the disasters. To avoid duplication of findings of previous bushfire inquiries and widen the scope of our understanding of Indigenous fire management, Neale *et al.* (2020) recommended that the Commonwealth Government creates a funding stream specifically to develop Indigenous-led, long-term research projects supportive of new and existing Indigenous fire management initiatives in southern Australia, examining the social, economic and ecological benefits of these initiatives.

Indigenous cultural fire managers are seeking support to produce research that translates and communicates the holistic benefits of cultural fire management. Through a virtual fire circle held in April 2020, 47 participants from a range of Aboriginal communities and organisations and their enabling partners and supporters outlined their research priorities for a submission to the Bushfire Royal Commission and other opportunities (Firesticks Alliance 2020). The research priorities and approaches included: a need to produce peer-reviewed evidence that is written in the best way to communicate with and influence policy makers; a need for greater collaboration with researchers to produce materials that will influence policy change; enabling Indigenous practitioners to properly collaborate so that they are recognised as the experts and authorities of research outcomes; tighter protocols around ethical research practices that foster Indigenous-led research; empowerment of Indigenous research partners to determine the research questions, the nature of research relationships and who should be conducting that research; and, research funding be shared to pay

the research partners who are the experts and knowledge holders. A message that was clearly communicated by participants at the Southeast Australia Aboriginal Fire Forum was that the Indigenous knowledge of cultural fire management does not need to be validated by scientific knowledge (Smith *et al.* 2018). The 'theory of whiteness' suggests that the need for science to validate Indigenous knowledge is a hegemonic process (Owen 2007). Instead, perhaps well-documented case studies that articulate the shared understanding space are needed. Science is one way to generate knowledge for shared understanding, but Aboriginal culture has its own knowledge processes to enable shared understanding (for example, see Ridges *et al.* in press). Any research into Indigenous cultural fire management must take a 'Nothing about us, without us' approach (Ball 2005; The Lowitja Institute 2020). While there is an upward trend in Indigenous voices being represented in the literature, it is imperative that Indigenous leadership, co-development and co-benefits are incorporated into ethical and respectful partnerships in the cross-cultural interface. Beyond this, the frame of reference in which research is conducted must also be reconsidered (for example, see Wright *et al.* 2012). These are transdisciplinary, cross-cultural outcomes that require diverse and innovative research approaches, and could be applied in similar contexts across the globe. For example, Indigenous cultural fire management is increasingly being recognised and applied in post-colonial nation-states such as the Americas (Bilbao *et al.* 2010; Christianson 2014; Mistry *et al.* 2016; Lake *et al.* 2017; Eloy *et al.* 2019) and Africa (Moura *et al.* 2019), although many of these Indigenous communities face similar challenges to those described for southeast Australia (Moura *et al.* 2019; Schmidt and Eloy 2020).

Morgan *et al.* (2020), in their review of the history and future directions of prescribed burning, predicted that Aboriginal involvement in fire management will increase in all jurisdictions of southeast Australia. If Indigenous cultural fire management is to continue to grow in southeast Australia, more funding, devolution of power and Indigenous control is required. Funding for projects, whether from governments, philanthropic organisations or payments for ecosystems and cultural services (as described in Ens 2012), is required to build on the foundations established

through existing cultural fire management projects. An Indigenous Elder at the 2018 National Indigenous Fire Workshop stated that we need 'to take action to heal Country and share knowledge for the survival of all, lest we create our own ecological hell through inaction and bureaucratic paralysis' (Reye *et al.* 2019). Participants of the 2019 National Indigenous Fire Workshop on Yorta Yorta Country called for a 'monumental shift in mindset' to include Indigenous knowledge and burning practices, with potential for 'a stunning reconciliation outcome'.

Conclusion

Our review of the literature indicated that contemporary Indigenous cultural fire management is practiced over a very small proportion of southeast Australia, there are many potential benefits associated with cultural fire management but, at this stage in time, there are significant and widespread barriers to the expansion of cultural fire management practices. Collaborative research could assist through addressing some of the knowledge gaps, such as examining benefits, overcoming barriers, implementing policies and changing paradigms for research, management and cross-cultural relations. It is evident that there is general public interest, widespread media support, policies in place and potential outcomes from the Black Summer bushfire inquiries which could generate the momentum to propel the many grass roots cultural initiatives into longer term, well-resourced, landscape-scale Indigenous cultural fire programs in Australia's southeast. As a community of research, academics may need to provide appropriate support, when invited, for practitioners and policy developers as Indigenous cultural fire management evolves in the post-colonial social-ecological systems of southeast Australia.

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Appendix 1 Themes and subthemes coded from media and academic literature:

- Background to Indigenous burning
- Indigenous burning is better
- Reintroduction / revival cultural fire management
- Describes cultural fire management
- Multi agency involvement / collaboration
- Risk of bushfire
- Our relationship with fire
- Respect between indigenous & non-indigenous people
- Two-way / working together
- Aboriginal rights
- Indigenous leadership in fire management
- Funding
- Training
- Lack of recognition of Indigenous knowledge
- Identifies research gap
- Recommends more research
- Impacts of colonisation on cultural fire management
- Cultural burning (CB) benefits:
    - General benefit
    - Social benefit
    - Cultural benefit
    - Environmental benefit
    - Bushfire management benefit
- Examples of Indigenous burning
- Destruction caused by bushfires (BF Destruction):
    - Homes
    - Lives
    - Infrastructure
    - Cultural
    - Wildlife / vegetation
    - Livestock
    - Trauma /grief
    - General
- Blame (BLAME) for bushfires:
    - Conservationists / greenies
    - Climate change
    - Politicians
    - Arson
    - Fuel loads
    - Permits/ red tape
    - Lightning /weather
    - Mismanagement
    - Other
- Impediments (IMPED) to bushfire management:
    - Urbanisation
    - Infrastructure
    - Boundaries
    - Resourcing
    - Power
    - Training
    - Lack of recognition
- Strategies (STRATEGY) for bushfire management:
    - Hazard reduction
    - Cultural burning
    - Fire fighting
    - Fire proof buildings
    - Green fire breaks
- Cultural aspects of Country
- Cultural burning protected something

- Decolonisation

Appendix 2

Case studies identified in the literature

Place	People	Land Tenure Type	Land area (ha)	Description	Reference
NSW					
Rick Farley Reserve, far south-western NSW.	Mothers Ancestral Guardians Indigenous Corporation; Barkindji, Mutthi Mutthi and Ngyiampaa people; NSW Govt staff; local schools; local land-holders; general public	Crown land and western lands lease. Aboriginal land.	300 ha	Land management at Rick Farley Reserve for restoring Malleefowl habitat using an Aboriginal cultural framework (which includes cultural burning). The aim is to also bring culture back to that landscape. The program has been supported by the Environmental trust, Local Land Services; Department of Education; National Malleefowl Recovery Team. Program is on-going.	Booth (2020)
Yellomundee Regional Park (Shaws Creek Aboriginal Place) NSW	Darug Aboriginal community, NPWS, Greater Sydney Local Land Services, Koori Country Firesticks Aboriginal Corporation, Firesticks Alliance, GBWHI Blue Mountains World Heritage Institute, various universities.	Public lands (dedicated Aboriginal place within NSW National Parks)	485 ha	Multiple Aboriginal Cultural Burns and camp held in Yellomundee Regional Park. Project aims: Aboriginal cultural engagement and knowledge sharing, weed control, habitat restoration.	Darug Ngurra *et al.* (2019); McGrath (2019); Environment (2020)
Hunter Valley, NSW	9 LALCs and TO groups, Firesticks Alliance Hunter LLS	Public & Aboriginal (LALC) lands	>100 ha	The Cultural Burn Mentoring Program will run over the next three years, in partnership with nine Local Aboriginal Land Councils and Traditional Owner groups, Firesticks Alliance Indigenous Corporation and Tocal College. The program is supported through funding from the Australian Government's National Landcare Program, NSW Government's Catchment Action NSW and Department of Education and Training. The program will initially see 22 Aboriginal students complete Conservation and Land Management training, where for the first	Bush (2019); Environment (2020)

				time cultural burning practices have been included as key modules of the training program. Several sites were selected on both public and LALC lands for the initial training, with some cultural burns conducted, and post burning these will be monitored over coming years, and applied with additional burning as needed. Additional sites in the lower Hunter will be included in the program in coming weeks.	
South Coast -Bega Valley	Firesticks Alliance with Indigenous Corporation (Southern Yuin Firesticks)	State forest flora reserve (managed by NPWS)	11,811 ha	*Burning for Healthy Country – Not Hectares*. Aims include: habitat and threatened species protection, Aboriginal cultural engagement and knowledge sharing, reducing fuel loads.	Environment (2020)
Bega Valley, Tathra	Bega LALC Firesticks Alliance	Private land (owned by Bega LALC)		The Bega Local Aboriginal Land Council is the largest private landholder in the Bega Valley, responsible for the management of a vast area of bushland, much of which is on urban fringes. Aboriginal work crews have learnt from Victor Steffensen and other Aboriginal cultural fire practitioners from the Firesticks Alliance community of practice as well as training with the Rural Fire Service. Cultural burning practitioners also work with farmers and other private landowners on using traditional methods as part of their farm and environmental management.	Brown (2020)
Tweed Shire Council area	Madhima Gulgan Community Association	Five different land tenures	Unconfirmed	Cultural burning workshops and practices as part of bush regeneration practices.	Sleeman (2018)
Bundanon Trust	Yuin Country Mudjingaalbaraga Firesticks, Firesticks Alliance, South East LLS	Trust land (total area 1,100ha)	150ha burnt during National Indigenous Fire Workshop 2018	Cultural burning as part of caring for landscape, using Bundanon as a place for research and experiment and fulfilling obligations towards local Aboriginal community.	Maclean *et al.* (2018); Taylor (2018)
Five Ways Travelling Stock Route near Henty NSW (Riverina)	Wiradjuri	Public (Travelling Stock Route)	?	Cultural burning on TSR	NSW Rural Fire Service (2017)

Mulgoa	Darug Country Coordinated by Koori Country Firesticks Aboriginal Corporation, Firesticks Initiative, Mulong Arts	Site managed by Cumberland Land Conservancy	?	2 day cultural burning workshop	McGrath (2017)
NCC Firesticks Project	Northern Rivers and New England Tablelands regions of NSW, including four Indigenous Protected Areas (listed below) and three Local Aboriginal Land Council (LALC) properties	Aboriginal and other land	Fire planning completed for 23,380ha	This project empowered Aboriginal communities to implement fire management programs across 6,680ha of IPA and Aboriginal land and 16,700ha of regionally significant corridors.	Tamarind Planning (2017)
Minyumai IPA	Bandjalang Clan of the Bundjalung Nation	Aboriginal land	Fire planning completed for 2,100 ha as per NCC Firesticks Project	Cultural burning program across IPA.	Kerr (2019)
Ngunya Jargoon IPA	Jali Local Aboriginal Land Council, Nyangbul Clan of the Bundjalung Nation	Aboriginal land	Fire planning completed for 1,114 ha as per NCC Firesticks Project	Cultural burning program across IPA.	Kerr (2019)
The Willows-Boorabee IPA	Glen Innes Local Aboriginal Land Council, Boorabee Aboriginal Corporation	Aboriginal land	Fire planning completed for 2,900 ha as per NCC Firesticks Project	Cultural burning program across IPA.	Holmes *et al.* (2009); McKemey and Ngoorabul Community (2018); Kerr (2019); McKemey *et al.* (2019a)
Wattleridge IPA Tarriwa Kurrukun IPA	Banbai Land Enterprises Incorporated with support from Tamworth Local Aboriginal Land Council	Aboriginal land	Fire planning completed for 480 ha as per NCC Firesticks Project 8 ha burning implemented	Cultural burning program across IPA. Mentoring other Aboriginal groups on cultural burning. Cross-cultural research on process and outcomes of cultural burning. Banbai rangers funded by the Commonwealth Government Working on Country Program.	Maclean *et al.* (2018); McKemey and Banbai Nation (2018); McKemey and Patterson (2018); Kerr (2019); McKemey and Patterson (2019); McKemey *et al.* (2019b)
Dorrobbee Grass Reserve, northern NSW	Widjabul/Wiyabul of the broader Bundjalung peoples	Public Land (Trust) and Aboriginal land	12 ha burn area	*Grassy Cultural Pathways at Dorrobbee Grasslands Reserve*. Cultural burning annually. Project aims: Aboriginal cultural engagement and knowledge sharing,	Kerr (2019) Environment (2020)

	Ngulingah Aboriginal Land Council Working on Country team			threatened species protection, hazard reduction.	
Nimbin Rocks and land around Lismore	Ngulingah Aboriginal Land Council Working on Country team	Aboriginal land	?	Cultural Burn planning for cultural values, threatened species protection, hazard reduction and weed control.	Kerr (2019)
Dobies Bight and Busby's Flat	Casino Boolangle Land Council	Aboriginal land	112 ha	Cultural Burn planning for cultural values, threatened species protection, hazard reduction and weed control.	Kerr (2019)
Helmet range	Gugin Gudduba Land Council	Aboriginal land	?	Cultural Burn planning for cultural values, threatened species protection, hazard reduction and weed control.	Kerr (2019)
Coastal Themeda Headlands, Coffs Harbour	Gumbaynggirr	Public land (NPWS)	?	Protect Aboriginal cultural values; grassland restoration; threatened species protection.	Kerr (2019)
Dorrigo / New England escarpment	Gumbaynggirr and others	Public land (NPWS)	50 ha	Restoring 'Grassy Island' Bio-cultural Landscapes along the Dorrigo/ New England Escarpment. Project aims: protect Aboriginal cultural values; grassland restoration; threatened species protection.	Kerr (2019) Environment (2020)
Muli Muli/Woodenbong area	Githabul Rangers	Public land (State Forest)	?	Tackling lantana and bell miner dieback	Kerr (2019)
Jubullum	Jubullum Local Aboriginal Land Council	Aboriginal land	10 ha	'Cultural Fire Gatherings – Making our way together', a series of local on-country workshops held at Jubullum Local Aboriginal Land Council and facilitated by Firesticks Alliance in partnership with the Northern Tablelands Local Land Service, Banbai Rangers and Jagun Alliance. The aim of the gathering was to "bring together current and aspirational fire projects and consider a regional approach to cultural fire management in north-eastern NSW"	Maclean et al. (2018); McKemey and Wahlabul Nation (2018); Kerr (2019)
Monaro Plains	Rod Mason	Private land	?	Landcare field day to learn about cultural burning	Brown (2016b)
Monaro Plains	Aileen Blackburn, Ngarigo traditional custodian	Public land (Travelling Stock Routes)	?	Trials of traditional burning for recovery after Manna gum dieback	Brown (2016a)
Arakwal National Park, Byron Bay	Arakwal/Bundjalung	Public	<10 ha	Joint management of Arakwal National Park, including cultural burning.	CSIRO et al. (2019)

Mid-north coast	Many Aboriginal groups	To be confirmed	To be confirmed	NSW Koala Strategy: Conservation through community action - Learn from Aboriginal communities on protecting koala habitat. Project aims: Aboriginal cultural engagement and knowledge sharing, capacity building, threatened species protection, collaboration and knowledge sharing.	Environment (2020)
Cumberland Plain	Darug	National park, council and private land	< 6400 ha (7 sites of unknown size)	*Cumberland Plain Restoration Program – Saving the Cumberland Plain Woodland with fire*. Project focus: restoration of endangered ecological community, Aboriginal cultural engagement and knowledge sharing, habitat restoration.	Environment (2020)
South coast- Nowra	Yuin	National park	3.5 ha	*Tripalina Reserve Cultural Burn Project*. Project focus: threatened species protection, hazard reduction, weed control. New project to commence in 2020 called *Djamaga ganji (Good Fire)*	Environment (2020)
South Coast - Eurobodalla	Batemans Bay Local Aboriginal Land Council	Aboriginal land	>50 ha	*Cultural Land Management – Protecting Threatened Flora & Fauna*. Project focus: habitat restoration, Aboriginal cultural engagement and knowledge sharing, threatened species protection, pest management.	Environment (2020)
North Coast - Lismore	Jagun Alliance Aboriginal Corporation	Aboriginal land	>50 ha	*Good Fire on Helmet Grassy Habitats*. Project focus: threatened species protection, habitat restoration, weed management.	Environment (2020)
South Coast - Eurobodulla	Mogo Local Aboriginal Land Council	Aboriginal land	>10 ha	*Grandfathers Gully Land Regeneration and Midden Protection*. Project focus: restoration of cultural site, threatened species protection, habitat restoration.	Environment (2020)
South West -Griffith	Griffith Local Aboriginal Land Council	Aboriginal land	>10 ha	*Mallison Road Restoration and Rehabilitation Project*. Project focus: regeneration, weed management, Aboriginal cultural engagement and knowledge sharing, capacity building.	Environment (2020)
South East - Yass Valley	Onerwal Local Aboriginal Land Corporation	Aboriginal land	>5 ha	*Onerwal LALC Cultural Fire Practices*. Project focus: Aboriginal cultural	Environment (2020)

				engagement and knowledge sharing, habitat restoration.	
North Coast - Dorrigo NP and Gaagal Wanggaan (South Beach) NP	Gumbaynggirr Community	National park	?	*Gumbaynggirr Community Cultural Burn Capacity Development Project*. Project focus: Aboriginal cultural engagement and knowledge sharing, threatened species protection, capacity building.	Environment (2020)
Mangrove Mountain, Central Coast	Darkinjung Local Aboriginal Land Council	Public land	?	*Darkinjung Mirring Women Muree (the fire spirit) Warre Warren Project.* The project will train Aboriginal people (mostly women) in conservation and land management practices through such activities as the use of cultural burning and traditional knowledge sharing between Aboriginal Elders, youth and the community.	Environment (2020)
Batemans Bay region	Batemans Bay Local Aboriginal Land Council	?	?	*Cultural Land Management* – Protecting Threatened Flora & Fauna. The project seeks to protect threatened and vulnerable species and target feral animals under the development of a Land Management Plan. The project will improve habitats through cultural burns, rehabilitating degraded land preventing further loss of habitat and protect the environmental flora and fauna by re-establishing lost traditional practices using fire to heal the country, with proper fore management as an essential part of this process.	Environment (2020)
Tathra	Firestick Alliance Indigenous Corporation (facilitated by Southern Yuin)	Public land (State Forest managed by NPWS)	?	*Burning For Healthy Country - Not Hectares.* This project is to develop a long-term Cultural Burning Program within the Southern Yuin Nation that supports Cultural Burning practice to take place within threatened species habitats and connect community back to country. The project will enable Cultural Burning Crews and Traditional Owners to work together alongside NSW National Parks and Wildlife	Environment (2020)

				Service (NPWS) and Rural Fire Service (RFS) staff within the Murrah Flora Reserve, to improve the health of the local area by protecting, enhancing and supporting threatened species habitats, such as a significant koala population, the long-nosed potoroo, the yellow-bellied glider and the powerful owl, while reducing fuel loads. The project will seek to reduce extreme fuel loads by providing an alternative approach to current Hazard Reduction block burning methods.	
VIC					
Teesdale	Wadawurrung Traditional owners, Wathaurong Aboriginal Cooperative, Aboriginal community	Aboriginal land	?	2 burns at Wurdi Youang & Bakers Lane Reserve Wiyn-Murrup Yangarramela (Fire Spirit Comes Back). Joint Fire Project co-ordinated through the Corangamite Catchment Management Authority, Victoria. This project was developed via a collaborative partnership between the Wathaurung Aboriginal Corporation, the Country Fire Authority (CFA), the Department of Environment, Land, Water & Planning (DELWP), Glenelg Hopkins Catchment Management Authority (GHCMA), Golden Plains Shire Council (GPSC) and Parks Victoria (PV). The stated aim of the multi-partner project was "to assist Wadawurrung people and Aboriginal community of western Victoria to meet their expressed aspirations to practice traditional burning for the health of Country and People".	Corangamite CMA (2017); Maclean *et al.* (2018)
Central western Vic (Bendigo)	Dja Dja Wurrung	Public lands	Size varies from 8 – 153ha per burn	8 fires implemented, 22 more planned on public lands. Agreement between Dja Dja Wurrung Clans Aboriginal Corporation Department of Environment, Land, Water and Planning (DELWP) and Parks Victoria (PV). 'These burns are believed to be	Neale *et al.* (2019a) Wales (2019)

				among the first Aboriginal-led traditional burns on public lands in southeast Australia since the settler invasion began more than 180 years ago.'	
Whipstick - Djandak Wi - Brights Lane	Dja Dja Wurrung people through Dja Dja Wurrung Clans Aboriginal Corporation	Public land, partnership with DELWP	20	This was the first burn in the Djandak Wi program conducted in partnership by Dja Dja Wurrung CAC, DELWP, Parks Vic	Forest Fire Management Victoria and Country Fire Authority (2020); Neale (2020a)
Maryborough - Djandak Wi - Happy Tommy	Dja Dja Wurrung people through Dja Dja Wurrung Clans Aboriginal Corporation	Public land, partnership with DELWP	26.2	Djandak Wi	Forest Fire Management Victoria and Country Fire Authority (2020); Neale (2020a)
Nardoo Hills Reserves	Dja Dja Wurrung people through Dja Dja Wurrung Clans Aboriginal Corporation	Private Conservation Area, partnership with Bush Heritage (NGO)	30	Private burn supported by Bush Heritage and Barapa Land and Water	Forest Fire Management Victoria and Country Fire Authority (2020); Neale (2020a)
Budgerum	Barapa Barapa	Barapa Land & Water	?	Private burn, supported by Dja Dja Wurrung	Webster (2020)
Boort - Little Lake Boort	Dja Dja Wurrung people through Dja Dja Wurrung Clans Aboriginal Corporation	Public land, partnership with DELWP	2.83	Djandak Wi, supported by Barapa Land and Water	Forest Fire Management Victoria and Country Fire Authority (2020); Neale (2020a)
Yerrip - Rock Crossing	Dja Dja Wurrung people through Dja Dja Wurrung Clans Aboriginal Corporation	Public land, partnership with DELWP	1?	Djandak Wi	Forest Fire Management Victoria and Country Fire Authority (2020); Neale (2020a)
Yerrip - Avonmore Bridge	Dja Dja Wurrung people through Dja Dja Wurrung Clans Aboriginal Corporation	Public land, partnership with DELWP	8?	Djandak Wi	Forest Fire Management Victoria and Country Fire Authority (2020); Neale (2020a)
Cohuna - Barapa Iron Punt Track	Barapa Barapa, through Barapa Land and Water	Public land, partnership with DELWP	?	Supported by Barapa Land and Water	Forest Fire Management Victoria and Country Fire Authority (2020); Neale (2020a)
Ngarri - Mt Egbert	Dja Dja Wurrung people through Dja Dja Wurrung Clans Aboriginal Corporation	Public land, partnership with DELWP	7.78	Djandak Wi	Forest Fire Management Victoria and Country Fire Authority (2020); Neale (2020a)
Dyurrit (Mt Arapiles) Walpa /Wanjap (Burn / Fire)	Wotjobaluk, through Barengi Gadjin Land	Public land, partnership with ParksVic	Target area 8ha total with small	Provides an opportunity for Traditional Owners to have access to country where	Forest Fire Management Victoria and Country Fire

	Council + Wotjobaluk elders		burns 0.1 – 1 ha each	caring for our country has been absent for a long time. Traditional owners wish to look after country as their ancestors did for thousands of year and to practice fire techniques in hopes to build capacity and skills on how to read and understand county using fire as the tool. The site is long unburnt with a lot of non-native grasses being the dominant species. Working on a rotation to burn sections at a time to create different age class and mosaic effects across this important country	Authority (2020); Neale (2020a); Skurrie (2020)
Barapa Barapa - Flannery NCR Rowlands	Barapa Barapa, through Dja Dja Wurrung CAC and Barapa Land and Water	Public land, partnership with Forest Fire Management/DELWP	200	Supported by Barapa Land and Water	Forest Fire Management Victoria and Country Fire Authority (2020); Neale (2020a)
Woolshed Swamp Boort	Dja Dja Wurrung people through Dja Dja Wurrung Clans Aboriginal Corporation	Public land, partnership with Forest Fire Management/DELWP	12.39	Djandak Wi, supported by Barapa Land and Water	Forest Fire Management Victoria and Country Fire Authority (2020); Neale (2020a)
Arapiles - Walpa Dyurrita	Wotjobaluk, through Barengi Gadjin Land Council + Wotjobaluk Elders	Public land, partnership with Forest Fire Management/DELWP	9		Forest Fire Management Victoria and Country Fire Authority (2020); Neale (2020a)
Tang Tang Swamp	Dja Dja Wurrung people through Dja Dja Wurrung Clans Aboriginal Corporation	Public land, partnership with Forest Fire Management/DELWP	21.27	Djandak Wi, supported by Barapa Land and Water	Forest Fire Management Victoria and Country Fire Authority (2020); Neale (2020a)
Skipton - Mt Emu Creek	Gunditjmara	Private, in partnership with CFA	?	Cultural burn on the old Mission reserve	Forest Fire Management Victoria and Country Fire Authority (2020); Neale (2020a)
Euroa	Not provided	Private land	?	Euroa Arboretum and the Country Fire Authority supporting Aboriginal cultural fire management on private properties in north east Victoria	Maclean *et al.* (2018)
ACT					
ACT	Ngunnawal	Public lands	?	An ACT government 'cultural burning' program was developed after being	Weir *et al.* (2020)

				suggested by then Senior Aboriginal Ranger, Ngunnawal man Adrian Brown, and supported by managers for its risk mitigation potential as well as being 'the right thing to do'. These cultural burns are listed within the ACT's annual bushfire operational plan alongside 'hazard reduction' and 'ecological' burns. The cultural burns are undertaken on public lands by staff from the ACT Parks and Conservation Service, who are predominantly Aboriginal people from other parts of Australia. Ideally, the traditional custodians identify the priority burn areas and a traditional Ween Bidja (fire boss) lights the fire.	
Jerrabomberra Wetlands	Murrumbung Rangers	Public land (parks)	8.7ha	At Jerrabomberra Wetlands in Fyshwick, Canberra, Wiradjuri man and ACT Parks and Conservation Service, Aboriginal Fire Management Officer, Dean Freeman, oversaw the final scheduled cultural burn for the 2019 calendar year. Like all cultural burns in the ACT, it was planned and managed by a collective of Indigenous people working for ACT Parks known as the Murrumbung Rangers and was lit by a local Ngunnawal elder.	O'Mallon (2018); Guest Author (2019)
SA					
Adelaide	Kaurna people in parthership with City of Adelaide	Public land	?	Trial cultural burn within the City of Adelaide. Council plans to trial and possibly adopt this practice in Autumn 2020 at Mirnu Wirra (aka Golden Wattle / Park 21W), in a western section of the Adelaide Park Lands.	Stewart (2020)
TAS					
truwana/ Cape Barren Island	Truwana Rangers, supported by Aboriginal Land Council of Tasmania	Aboriginal land	?	Fire management project, partnership between Truwana Rangers and Tasmania Fire Service. Federal Government	Whiting (2017); Maclean et al. (2018)

				Indigenous Advancement Strategy and Working on Country program.	
Ross	Tasmanian Aboriginal Centre	Private land	?	Cultural burning through partnership with private landholders, University of Tasmania, NGOs	McIntyre (2018)
lungtalanana/ Clark Island	Tasmanian Aboriginal Centre	Aboriginal land	?	Land management program run by Tasmanian Aboriginal Centre	Maclean *et al.* (2018)
Tasmanian Wilderness World Heritage Area	Palawa, Tasmanian Aboriginal Land Council	Public land	?	Attempt to reintroduce cultural burning in 2000	Lehman (2001)
Tasmania including: - Big Dog Island mutton bird rookery – Bass strait Islands - Preminghana IPA – North west Tasmania - Putalina IPA – Southern Tasmania - Piyura kitina IPA – Southern Tasmania - Cape Barren Island- Bass strait Islands - Trawtha Makuminya Aboriginal Land- Central Highlands - Chapel Island IPA – Bass Strait Islands - Lungtalanana IPA – Bass Strait Islands - Kings Run Aboriginal Land-North West Tasmania	Tasmanian Aboriginal Centre (TAC) and the Aboriginal Land Council of Tasmania	Aboriginal and private lands	The total combined land area of these areas is over 60,000ha	Tasmania Cultural Fire Mentoring Program 2014 – 2023: Fire projects on Aboriginal lands are now in the fifth year of practice and are undertaken on 8 IPA properties owned and managed by the Aboriginal community.	Costello and Standley (2020)
QLD					
Bunya Mountains	Bunya Mountains Murri Rangers of the Bunya People's Aboriginal Corporation	Public land (mostly Russell Park, a conservation reserve in the Bunya Mountains on Western Downs Regional Council managed lands)	?	The purpose of the Murri Rangers' fire management is to protect and maintain the culturally significant Bunya Balds grasslands, heal the country and its people, develop networks and partnerships. Supported through Burnett Mary Regional Group.	Maclean *et al.* (2018); Kerr (2019)
Sunshine Coast	Kabi Kabi people, Bunya Bunya Country Aboriginal Corporation	Private land	?	Cultural burning on private land in partnership with large development company (Stockland)	Cannan (2020)

Warwick	?	Private land?	?	Place-based cultural fire workshops, such as the 'Burning for healthy land' workshop hosted by the Condamine Headwaters Landcare group southeast Queensland, supported by the Condamine Alliance through funding from the National Landcare Program. This workshop brought together Indigenous farmers from the Warwick region with the Bunya Mountain Murri Rangers and Victor Steffensen to "present innovative and challenging ideas for managing land, which make a lot of sense to many local landholders and farmers"	Maclean *et al.* (2018)