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**Critical reflections on Indigenous peoples’
ecological knowledge and disaster risk
management in Australia: A rapid evidence review**

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Abstract

There is an increasing recognition of the social, cultural, political and economic significance of Indigenous peoples’ ethos of caring for country and its potential importance for public policy domains such as disaster risk management. Indigenous peoples’ ecological understandings are increasingly recognised within Australian federal and state policy frameworks, however, very little has been published about the kinds of engagement that have taken place, how they are implemented and whether they work. To better understand the extant evidentiary base, this paper documents the findings of a rapid evidence review of Australian Indigenous peoples’ knowledges and disaster risk management. Although there is very little published in disaster studies on the topic, there is a substantive body of evidence in natural resource management that provides significant lessons for Australian emergency managers. This literature highlights the importance of broadening non-Indigenous framings of natural disasters as discrete events managed separately from broader ecological, social, political and economic issues. 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.

Introduction

Colonisation in Australia proceeded from a developmental paradigm and understanding of nature linked to the imperial ambitions of Great Britain and to processes driving its economic system, capitalism (Adams & Mulligan, 2003). Using this paradigm, nature was conceived by the colonisers as a space separate from human habitation that could be harnessed for exploitation and profitmaking (Adams, 2003; Langton, 2003). Enlightenment rationalities separated human and nonhuman and the British saw geographic areas under the custodianship of Aboriginal and Torres Strait Islander peoples as terra nullius, devoid of human influence and presence. Indigenous peoples, on the other hand, viewed people and nature as integral parts of a whole (Adams and Mulligan, 2003). Unlike the British invaders, Indigenous custodianship of land and water included strategies that focused on sustaining livelihoods for humans that involved a complete, integrated cosmology centred around caring for country (Langton, 2003). Country was primarily valued for country’s sake, not only because of the material gains it could provide regarding hunting, fishing and foraging. This was not an instrumental view of nature but one that respected (and still respects) the inherent, indivisible value and connectedness of peoples, places, lands and waters that precludes narrow western conceptualisations of social and economic life:

Aboriginal peoples' identity is essentially always embedded in land and defined by their relationships to it and other people. The sacred web of connections not only includes kinship relations and relations to the land, but also to nature and all living things. When a controlling ethic, lacking such a collective spiritual basis prevails or is chosen, then the sacred becomes constrained by religious and political imperatives, and the voyage to societal and spiritual hierarchies begins. The logical end point of such a system is a narrow survivalist mentality and perspective on life and on existence itself (Graham, 1999, p.112).

These differences in worldviews underpinned and shaped the ways in which the British Imperium engaged with Australia's First Peoples. This was a fundamental clash of cultural, political, economic, spiritual and epistemological systems that is still being played out in modern Australia as the colonial settler state continues to encroach on the Indigenous Estate. This threatens not only the environmental integrity of areas but also, ironically, undermines Indigenous peoples' livelihoods and economic activities based on country. Of course, Indigenous peoples' understandings of what is deemed 'economic activity' are very different from the Australian state. One is based on collective custodianship of place that integrates strategies within a worldview that minimises the occurrence of events (such as disasters), which threaten the health of country and, as a consequence, peoples' livelihoods (Graham, 1999). The other is based on Western concepts of economic rationalism, business acumen, efficiency, entrepreneurship and individualism aimed at maximising personal benefit.

Despite a colonial legacy that treated Aboriginal and Torres Strait Islander peoples as unknowing savages and nature as an inexhaustible resource, Indigenous peoples' worldviews are increasingly recognised and valued by non-Indigenous institutions and peoples. This trend is evident in the field of disaster risk management in colonial settler states such as Australia, Canada and New Zealand. In non-Indigenous terms, natural disasters emerge out of the intersection of social and natural causes: depending on existing societal processes and structures, natural hazards impact on communities differentially leading to varying levels and types of death, injury and destruction of the built environment (Hilhorst, 2007). Rather than being equalisers, disasters expose socio-economic vulnerabilities:

Far from being occasions in which social inequities are erased, disasters expose and often magnify those inequities ... predisaster inequities express themselves when disasters occur, and patterns of mortality, morbidity, loss, displacement, and recovery are inextricably linked to the social contexts in which disasters occur (Tierney, 2007, p.515).

Large scale disasters impact on the more vulnerable and disadvantaged often with high human costs and in the long and short-term, this means societies, communities and individuals developing strategies and plans to reduce their exposure to the worst consequences of natural disasters. As part of an ongoing attempt to reduce disaster risk, Indigenous peoples' knowledges are currently proposed as part of a broader set of strategies and solutions for the social and economic problems associated with natural disasters. Indeed, Indigenous peoples' ecological ethos fits much better with newer, more critical conceptualisations of disaster that focus on long-term risk reduction through the use of strategies that address underlying social, economic, cultural and ecological vulnerabilities to disasters facing certain communities.

Indigenous peoples' ecological knowledges are now part of international, national and sub-national policy frameworks that advocate for their integration into disaster risk management strategies. At the global level, the *Sendai Framework for Disaster Risk Reduction 2015-2030* states that, 'Indigenous peoples, through their experience and traditional knowledge, provide an important contribution to the development and implementation of plans and mechanisms, including for early warning' (UNISDR, 2015, p. 23). In Australia, a division of the federal Attorney General's Office, Emergency Management Australia, acts as the national focal point for the implementation of the principles set out in the Sendai Framework (EMA, 2017). Each state government in turn coordinates with the federal government through various mechanisms such as the Council of Australian Governments (COAG) and the Australian Government Crisis Coordination Centre (AGCCC) (EMA, 2017). A key Australian policy framework that specifically targets disaster risk reduction strategies for Indigenous peoples is, 'Keeping our mob safe: A national emergency management strategy for remote Indigenous communities' (EMA, 2007). Developed by the Remote Indigenous Communities Advisory Committee (RICAC), the document highlights the inherent strengths of Indigenous peoples' understandings of natural hazards although only in remote and rural peoples. Although focusing on rural and remote communities, the strategy calls for the incorporation of 'the traditional knowledge and experience of local Indigenous Elders and people about the environment, signs indicating weather patterns and potential emergencies, and ceremonies for protection from disasters' (EMA, 2007: 21). In keeping with national policy, Australian states and territories have developed policy frameworks that promote the integration of Indigenous peoples' knowledges in some form into natural disaster risk management.

In order for these engagement processes to work, technocratic, mainstream disaster risk management must avoid the many pitfalls emerging out of a long history of colonisation of Aboriginal and Torres Strait Islander peoples by the Australian settler state. The most obvious of these is the ways in which Indigenous peoples' ecological knowledges are viewed from a purely economic, utilitarian perspective and as quick ways to fill gaps in western science (Berkes, 1993; Mutasa, 2015; Shaw, Uy & Baumwoll, 2008). From this perspective, Aboriginal and Torres Strait Islander knowledges and practices are recognised but only as exploitable resources and history has shown that Indigenous peoples do not always benefit from knowledge exchanges such as this, in fact quite the opposite (Berkes 1993; Langton, 2003; Mutasa, 2015). As utilisable products, Indigenous peoples' knowledges are divorced from their place of production (country) in order to be readily inserted into existing western policy and practice frameworks, policies, toolkits and checklists. This instrumentalist approach to knowledge reflects a long-term colonial expropriation of knowledge where Indigenous peoples' knowledges were taken without permission and used to inform strategies that opened up vast tracts of land, water sources and forests for exploitation by the Australian settler state (Adams, 2003). It also reflects non-Indigenous perceptions of knowledge as universal, detached products that can be owned, copyrighted and sold. However, for Indigenous Australians, knowledge is intimately linked to place, to the custodians of country and knowledge is used to protect and care for country, sustaining both human and non-human, not destroy it while displacing its peoples and expropriating its natural resources.

Experiences of past expropriations of Indigenous peoples' knowledges and practices has eroded trust between Indigenous and non-Indigenous peoples. This highlights the need for mechanisms that ensure Indigenous peoples' ownership and control of their knowledges and practices in any potential engagement with Australian state institutions such as disaster risk management agencies (Agrawal, 2002; Berkes, 1993; Langton, 2003). Indigenous ownership and participation must be an integral and essential precursor to any attempts to collaborate and engage with Aboriginal and Torres Strait Islander peoples. Despite disaster risk management's continual search for a ready-made set of tools that could be applied to any situation, Indigenous peoples' knowledges and practices would require a considerable investment of time and resources for any kind of equitable collaboration to work. This necessitates Australian disaster risk management agencies being prepared to take their time, build trust, set up equitable, participatory working processes if they want to engage with Indigenous peoples. How agencies would go about doing this given current constraints on public funding and the neoliberal push for 'efficiency' in public sector agencies raises interesting problematics.

This begs the question as to what is currently taking place in Australia with regards to Indigenous peoples, natural disasters and emergency service agencies. Calls for the use of Indigenous peoples' knowledges and practices are evident from the numerous examples of initiatives publicised on agency websites. Emergency service agency websites do not explicitly describe what works and how, when describing engagements with Aboriginal and Torres Strait Islander communities. However, agencies demonstrate two key ways they understand the role of Australian Indigenous peoples in disaster risk management. The first is illustrated on the many agency websites that treat 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. A good example of this would be the NSW Rural Fire Service's Bushfire Resilience Project for Aboriginal Communities (BRAC) (Emergency NSW, 2017; NSW RFS, 2011; NSW RFS, 2012). Indigenous peoples' knowledges are not mentioned once in the project document and the project only aims to provide information to "aboriginal communities in fire fuel reduction, fire safety and prevention activities, as well as increasing the community's knowledge of bush fire risk in their local area" (Emergency NSW, 2017). There is no question these initiatives are potentially useful. However, despite meeting with key members of local communities and Land Councils, these initiatives appear to be based on the misconception that Aboriginal peoples in New South Wales have lost contact with traditional ecological knowledges. And calls for "enhanced community resilience and self sufficiency in fire protection" (NSW RFS, 2011, p. 23) seem to ignore the significant ecological understandings and caring for country strategies of NSW Aboriginal peoples that ultimately could help reduce the likelihood of large scale wildfires.

The second way agencies understand engagement demonstrates a more nuanced engagement being applied to integrating Indigenous knowledges into disaster risk reduction. The NSW Forestry Corporation is a good example of a state government agency that is working with Aboriginal communities in bushfire risk reduction. The Corporation is working in collaboration with Coffs Harbour and District Local Aboriginal Land Council (LALC) and local Garby elders on the north coast of New South Wales (Fowler, 2017). A press release published on the Forestry Corporation website provides some basic information, however, a story run by a local magazine provides more useful information about the scope and success of the project, especially from an Aboriginal perspective (Coffs Coast Focus, 2018). Speaking of the success of a burn near Arrawarra on the NSW north coast, local Garby elder, Tony Dodson, explains the significance of the program:

This burn was extremely important, as it taught the different methods of looking after country between today and yesterday's societies. It will hopefully bring a better outcome to managing the bush using traditional and European ways. It's important that we all work together to ensure that the bush is maintained as it was in the past, using fire to look after country and the animals. When wildfire comes through, you can see firsthand the impact that it has on our animals (Coffs Coast Focus, 2018).

Despite these limited insights, there are still many outstanding questions about how disaster risk management programs currently engage with Indigenous peoples especially regarding the uniquely integrated and fine-grained approaches to managing natural disasters and sustaining political economies based on caring for country. It is apparent that there are initiatives taking place across Australia but there is little published on exactly what works, how, when and where (for example see AFAC, 2017; NSW Forestry, 2018; Emergency NSW, 2012; Lake Macquarie, 2011; Office of Environment and Heritage, 2004; Spencer, Christie and Wallace, 2016; SES, 2013; Shire of Broome, 2018). There is an evident need to evaluate what activities and strategies are currently being utilised by emergency service agencies to engage with Australian Indigenous peoples and their knowledges and practices. In order to map out what had been published on this topic, this paper outlines the initial findings of an exploratory rapid evidence review on Indigenous peoples' knowledge, natural disasters and the public policy domain of disaster risk management in Australia. Using Australia as a case study, this paper interrogates the evidence base to improve our knowledge of what evidence exists about how these initiatives have been operationalised at national, state and local levels. The initial aim of the research was to find studies that addressed all three domains, however, as the evidence mapping section of this paper clearly shows, this was modified as the limited scope of the evidentiary base became apparent. As demonstrated in the subsequent review of the evidence base, the key lesson from the evidence base is the need to understand the ways in which 'disaster risk reduction' is integrated into broader strategies that sustain Indigenous livelihoods and political economies through caring for country.

A few quick notes regarding positionality and terminology. The paper takes the viewpoint of non-Indigenous disaster risk management and makes no claim to represent Indigenous peoples' perspectives on natural disasters in Australia. The paper simply reports on what evidence exists in relationship to the topic and draws conclusions related to disaster risk management and public policy. The terms 'emergency management' and 'disaster risk management' are used interchangeably and are considered equivalent. Disaster risk management is the more internationally recognised term, however, many Australian organisations use the term 'emergency management' to describe this public policy domain. The research project aimed to review the literature on the challenges and successes experienced by emergency services agencies of engaging with Aboriginal and Torres Strait peoples and their knowledge of natural disasters in Australia. Knowledges and practices are viewed as intimately interconnected here. Practices and technologies are embodiments of implicit Indigenous understandings about the natural environment and in an iterative loop, knowledges emerge and develop out of peoples' practices (Pottier, Bicker & Sillitoe, 2003). Mosaic burning techniques used by many of the First Peoples of Australia, for example, reflect caring for country strategies and cosmologies underpinning ecological knowledges. However, in an iterative loop, as people burn-off, they also learn, refine and further develop their knowledge base and that in turn shapes future burns.

The paper uses the terms 'Indigenous peoples' knowledges/practices' or 'Indigenous ecological knowledges/practices in preference to 'Indigenous Knowledge' or 'Traditional Ecological Knowledge'. These latter terms are commonly used to describe Indigenous custodianship of ecological knowledge and connectedness to lands and waters. The terms share a lot of conceptual similarities and are attempts to describe the dynamic interaction of knowledges, practices and the natural environment by Indigenous peoples (Berkes 1993; Mutasa, 2015; Shaw, Uy & Baumwoll, 2008). However, both these terms lack an explicit recognition of traditional and current custodianship of knowledge and its inalienable connection to Indigenous peoples, their communities, cultures and societies (Langton, 2003). The terms 'Indigenous peoples' knowledges/practices' or 'Indigenous peoples' ecological knowledges/practices' attempt to recognise this inalienable connection with Indigenous peoples' and their custodianship of ecological knowledges and practices. The terms 'Aboriginal and Torres Strait Islander peoples', 'First Peoples' and 'Indigenous peoples' are used out of necessity given the research aims, however, with the strong caveat that these terms clearly do not reflect the diversity of First Peoples living in Australia.

Methodology

This paper was based on the findings of an exploratory rapid review of the evidence base on Indigenous people's knowledge, natural disasters and emergency management in Australia. The review was carried out between February and August 2017 and aimed to capture a representative set of published research papers on the topic. Specifically, the review originally aimed to document and map existing evidence on Indigenous peoples' knowledges of natural disasters and how these knowledges were being used by Australian emergency management programs. During the course of the review, based on the research emerging from the evidence base, it became clear that the original objectives of the research would not be achieved. As is demonstrated in subsequent sections on mapping the evidence, the focus of the evidence shifted to understanding the connections between Aboriginal and Torres Strait Islander peoples' political economies, natural disasters and caring for country.

An evidence review was chosen because it is an effective way to collect, summarise, appraise and map the key research evidence from relevant bodies of knowledge (Greenhalgh et al, 2004; Petticrew & Roberts, 2006). Unlike systematic reviews that provide a broader purview of the evidence and can take six months to two years to complete, this rapid review aimed to capture a representative set of studies on the topic. The aim, therefore, was to capture a set of studies that characterised the content and trends in the evidence

base (Abrami et al., 2010). This allowed for a preliminary mapping of the key trends and themes in the published literature (Cooper & Hedges, 1994; Petticrew & Roberts, 2006). This exploratory mapping of the evidence provides information about the scope and directions of the literature but also potentially forms the basis for a larger project.

Box 1: Databases searched

1. ProQuest databases:

Applied Social Sciences Index & Abstracts (ASSIA) (1987 – current)

Dissertations & Theses @ University of New South Wales

EconLit (1969 – current)

Humanities Index (1962 – current)

International Bibliography of the Social Sciences (IBSS) (1951 – current)

PAIS Index (1914 – current)

ProQuest Dissertations & Theses Global

Sociological Abstracts (1952 – current)

Worldwide Political Science Abstracts (1975 – current)

2. Informit Australian Public Affairs Full Text (APAFT)

As a first step, a search strategy was designed that aimed to be sensitive enough to capture a substantive, representative set of studies from selected databases without capturing an unmanageable number of irrelevant studies. Based on previous experience of systematic reviews into natural disasters (see Spurway, 2012; Zwi et al, 2013; Hossein et al, 2017), a total of nine ProQuest databases and one database with an Australian focus (Informit APAFT) were selected and systematically searched (see Box 1). Based on the results of preliminary test searches that failed to capture a robust set of studies, it was decided that the search strategy be adapted to capture as large a set of studies as possible. During the main search, the term 'Indigenous knowledge' was removed to make the process as inclusive as possible.

A search string was designed based on the key terms from three conceptual domains: 'natural disasters', 'Indigenous peoples' and 'Australia' (see Box 2). Climate change was included as it is a long-term, slow onset disaster that manifests as increasing numbers of extreme weather events such as bushfires, cyclones and floods (IPCC, 2014). Database thesauri were used to find synonyms for key terms such as 'Indigenous peoples' and 'natural disaster'. Based on previous experience in constructing systematic review search strategies that demonstrated that authors often used the actual type of natural disaster (cyclone, hurricane and typhoon), the search string included a list of common natural disasters. Studies were included from the title and abstract search if they reported on any aspect of Indigenous peoples and natural disasters in post-1788 Australia. Although a set of studies addressing pre-colonial Australia was captured in the initial round, as the research aimed to capture studies investigating the use of Indigenous peoples' knowledges and practices in Australian disaster risk management (i.e. post-invasion), these studies were excluded in the narrative analysis. Studies were in English and books, journal articles, dissertations, conference papers, research reports and working papers were included. During full text review, no limits were set in terms of date of publication or methodology used and, as is common in the social sciences, the searches captured a very methodologically heterogeneous set of studies. Due to time and resource constraints, a comprehensive review of the grey literature was not possible, however, a purposive search of key international, national, state and local government policies and frameworks was carried out to provide contextual background information.

Box 2: Search terms used in ProQuest databases and adapted for Informit APAFT

all("natural disaster" OR "environmental emergency" OR "natural hazard" OR avalanche* OR earthquake* OR fire* OR flood* OR landslide* OR volcan* OR catastrophe* OR cyclone* OR "tidal wave" OR tsunami* OR "coastal hazard*" OR blizzard OR hailstorm OR hail OR storm OR "heat wave" OR heatwave OR landslide OR hurricane OR typhoon OR tornado* OR wildfire OR "wild fire" OR "wildland fire" OR "bush fire" OR bushfire OR "extreme weather event" OR "climate change" OR "global warming")

AND

all(Indigen* OR aborigin* OR ATSI OR "Torres Strait Island*" OR "native race*" OR "native people" OR autochthon*)

AND

Australia

After database searches were completed, papers were assessed for relevance using the inclusion-exclusion criteria based first on their titles and abstracts. After excluding studies that did not fit into the project scope, remaining studies were assessed based on a reading of the full text. In addition to the electronic database search, manual searches of online publications from the *Australian Journal of Emergency Management*, the *Australasian Fire and Emergency Service Authorities Council*, the *Bushfire and Natural Hazard Cooperative Research Centre* were carried out to check for any missing studies. Hand searches showed that all relevant *published_studies* in had been captured during the database searches.

The review used a narrative synthesis approach to summarise and analyse the full text papers. Narrative synthesis has been extensively tested and is considered an appropriate qualitative approach for synthesising a methodologically heterogeneous set of studies such as those found during this review (Mays, Pope & Popay, 2006; Braye & Preston-Shoot, 2007; Arai et al, 2009). Using standard qualitative techniques, papers were coded for key themes and the findings of each paper were summarised and analysed (Coffey & Atkinson, 1996; Harden & Thomas, 2005). During coding and analysis, it became apparent that 'saturation' had been achieved as themes, authors and concepts started to repeat across studies (Mays, Pope & Popay, 2005: 11). Saturation indicated that the set of studies was representative of the body of published research.

A total of 1,313 articles were identified during the preliminary searches in ProQuest and APAFT databases. During screening of the titles and abstracts, 1,139 were excluded based on the inclusion-exclusion criteria. This left 161 studies for inclusion in the final full text review. During full text review, a further 75 studies were excluded because they only investigated pre-invasion Australia, did not investigate natural disasters or Australian Indigenous peoples in any way. Since the evidence base addressing all three domains was so weak, studies that did not investigate 'Indigenous peoples' knowledges' but which address Indigenous peoples and natural disaster were included in the analysis. A total of 86 studies were coded and analysed to better understand emerging themes and concepts. See Figure 1 for more detail on the review process.

Figure 1: Research process flow diagram

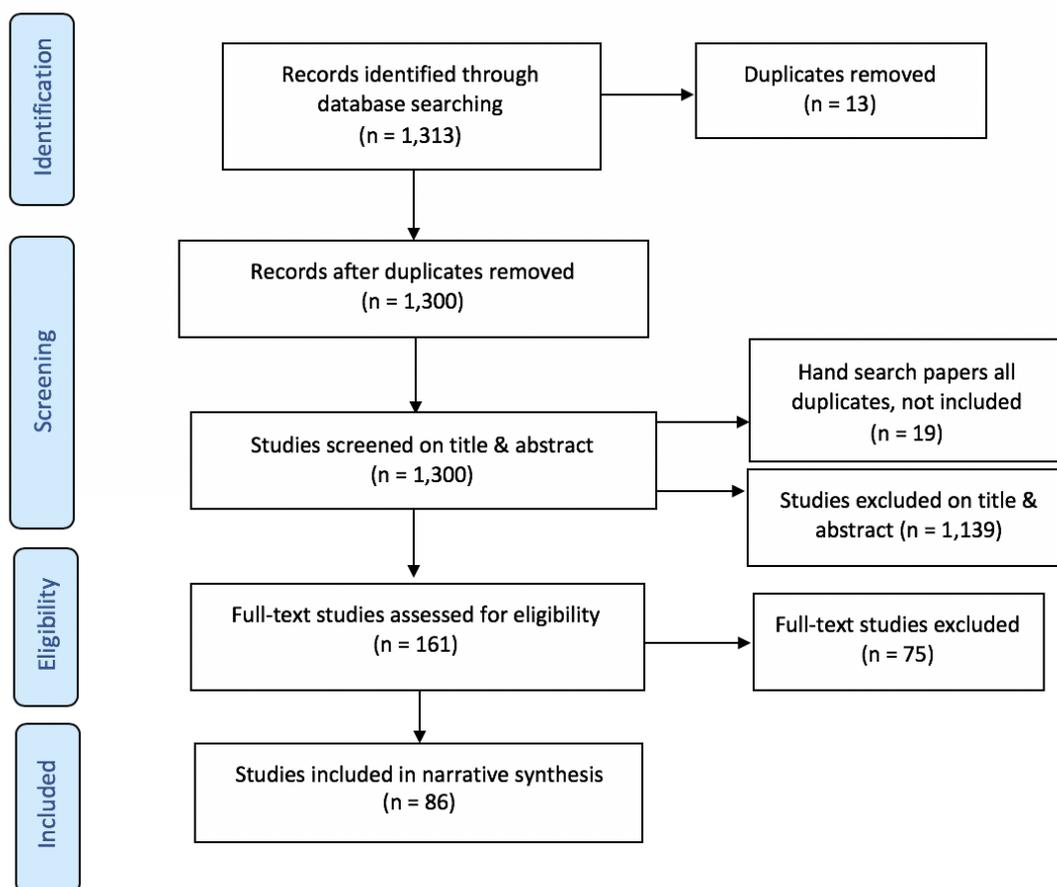


Figure 1: Research process flow diagram

Mapping the evidence

The evidence shows that Aboriginal and Torres Strait Islander peoples' localised, finegrained and interconnected worldviews underpin their approach to natural disasters. Indigenous political and ecological economies based on caring for country support natural disaster 'management', which in turn sustains and enables livelihoods by protecting flora, fauna, lands and waters from degradation and large-scale catastrophes. These are mutually interdependent and inseparable components of Australian Indigenous peoples' ethos of caring for country. The evidence base clearly demonstrates the need for Australian disaster risk management to move beyond narrow conceptualisations that separate out natural disasters as areas of intervention distinct from Indigenous natural resource management and livelihoods strategies. Understanding the wholistic, long-term and integrated approaches of Indigenous peoples can potentially expand and improve disaster risk management approaches in Australia.

The literature showed that 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 within an overarching wholistic cosmology.

The issue of the source and context of knowledge production is also important to consider given the skewed nature of knowledge production, especially in relationship to the level of Indigenous participation and authorship of studies. This is also important given the potential challenges of ownership, collaboration and cooperation within an historical context of appropriation, disengagement and disempowerment for Indigenous peoples in Australia. Strengthening Indigenous engagement with research also makes the evidence base more robust. The level of engagement and participation is shown in the ways in which researchers described interactions with Indigenous participants. Caring for country is localised and place-based, peoples are connected to particular places and places to peoples. Not being able to name or identify the peoples or countries under discussion demonstrates a lack of understanding of Indigenous connectedness to place/country and excluding Indigenous peoples in the design, implementation and publication processes mean that Indigenous voices were potentially sidelined. The evidence base also highlights the importance of native title and land rights regimes. Access to country means that Aboriginal

and Torres Strait Islander peoples could care for country, protect traditional livelihoods and/or develop adapted political economies as well as maintain the health of country and prevent destructive natural disasters. The broader implications related to Indigenous peoples' access to country, native title, land rights, livelihoods and the right to development conclude the discussion.

Australian Indigenous peoples and natural disasters

All three conceptual domains, Indigenous peoples, their knowledge of natural disasters and engagement with Australian emergency management, were rarely studied. The review only found one published study that met and addressed all three criteria (Eriksen & Hankins, 2014). Eriksen and Hankins (2014) investigated Indigenous peoples' engagement with firefighting agencies in New South Wales and Queensland. The paper interrogated the ways in which Indigenous peoples' knowledges engaged with non-Indigenous constructs of fire. The article highlighted the need for disaster risk management agencies to build linkages across cultures and acknowledge Indigenous agency in order to more effectively integrate Indigenous peoples' ecological knowledge of fires:

We believe 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 & Hansen, 2014, p.1300).

The authors maintained that these kinds of initiatives strengthened arguments for Indigenous connection to country and demonstrated the importance of cultural sensitivity for non-Indigenous peoples engaging with Aboriginal and Torres Strait Islander peoples.

This is not to say that Indigenous peoples were not mentioned in other ways in the disaster studies literature, it is just that the connection was not made between Aboriginal and Torres Strait Islander peoples' natural disaster knowledge and disaster risk management. Four studies investigated the ways in which emergency management strategies, procedures and training were delivered to Indigenous communities across Australia, for example (Chhetri et al, 2010; Newman & Smith, 2004; Yates, 1997; Zander et al, 2013). However, none of these papers investigated the use of Indigenous ecological knowledges and did not actively engage with Indigenous peoples as knowledgeable agents. The studies provided information about the provision of information to communities or training of individuals in mainstream non-Indigenous firefighting techniques, first aid or evacuation procedures.

Another two studies looked at Aboriginal and Torres Strait Islander peoples' and natural disaster. One summarised the outcomes of a national fire forum on bushfires and policymaking (Dovers & Lindemayer, 2004) and the other looked at the 'well-honed and robust, traditional counter disaster capabilities' of Indigenous peoples (Skertchley & Skertchley, 2000). Dovers and Lindemayer's paper provides an excellent summary of the key challenges facing fire management programs in Australia and they call for a more integrated approach that accounts for 'Indigenous and non-Indigenous cultures, natural and social sciences, and emergency management and natural resource management' (2004, p.75). Skertchley and Skertchley (2000) provide an overview of Indigenous peoples' ecological knowledges and seasonal calendars from Aboriginal and Torres Strait Islander peoples living in monsoonal Australia. Unfortunately, the former piece of research did not significantly interrogate Indigenous peoples' knowledges in any depth and the latter paper engages with traditional ecological knowledge but does not make the link with disaster risk management.

Although there is a dearth of information on the original three conceptual domains covered by the research aims, a substantive body of evidence was found in research on natural resource management that made strong connections between natural disasters, livelihoods, political economies and caring for country. The natural resource management literature did include limited information on Indigenous peoples and natural disasters, however, as this was not as their primary focus researchers made little mention of disaster risk management. Key intersecting themes around Indigenous peoples' political economies of caring for country and the links to natural disasters emerging out of the natural resource management literature are discussed in a subsequent section of this paper.

Types of natural disaster

Despite the lack of studies focusing on disaster risk management, disasters were mentioned in relationship to caring for country and livelihoods strategies that emerged out of Indigenous political, cultural, social, economic and spiritual worldviews. It is interesting to note the kinds of disaster since the type of disaster determined the type of strategies being employed to care for country. Across all the literature, bushfires and climate change were investigated more than any other natural phenomena in relationship to Indigenous peoples in Australia. The evidence base featured studies of wildfire and the use of fire regimes by Indigenous peoples in Australia, these studies making up a substantive part of the literature (n=52). From non-Indigenous disaster risk and natural resource management perspectives, Indigenous fire regimes were considered to have the most potential:

Despite these challenges, it is clear that major insights into fire management can be gained from examining approaches developed over many millennia by Indigenous Australians... These approaches will vary between vegetation types, landscapes and regions and there will not be a single strategy that can be applied in all places. Indigenous fire management is not a 'recipe book' but rather an ethos of understanding, respecting, and living with the environment" (Dovers, Cary & Lindenmayer, 2004, p.81).

Fire regimes demonstrated the localised, fine grained nature of Indigenous peoples' ecological knowledges and practices that enabled them to thrive in diverse ecological spaces spanning the islands of Torres Strait to the rainforests of northern Queensland and Tasmania to the deserts of central and western Australia. Fire management strategies varied according to geographic location, climate and seasonality with divergent practices across the Australian continent in keeping with the particularities of each given setting. Despite the context specific nature of fire regimes, the research base identified broad commonalities. Hallam (2014) described these regimes as 'sequences of fires, with a range of seasonality, frequency, intensity, extent and local landscape patterning' (p.166). Much of the literature also discussed 'cool burning' techniques that are utilised during the early dry season to "impose patchy, spatio-temporal mosaics of burned and unburned country" (Yibarbuk et al., 2001, p.326). 'Cool burning' was a commonly identified practice used to control the severity of naturally occurring wildfires and this in turn supported and maintained livelihoods such as foraging and hunting as well as sustaining healthy country (Anderson et al, 1998).

Another substantive set of papers (n=25) looked at the impact of climate change and associated secondary hazards such as heatwaves, drought and sea level rise (see Campbell et al. 2008; Green et al., 2015; Green & Minchin, 2014; Hanigan et al. 2008; Johnston et al., 2007; Pearce et al., 2015; Webb et al., 2014; Zander et al., 2013). Intuitively, this makes sense as the impacts of climate change and associated extreme climatological and meteorological events are emerging as key themes in the field of disaster studies (IPCC, 2014). Twenty-four articles dealt with Indigenous peoples and climate change with the evidence base highlighting two key ways in which Indigenous peoples were studied in relationship to climate change. A small set of studies studied Indigenous peoples as the victims of an external force that impacted on their health and wellbeing as they encountered seasonal and meteorological shifts (see Braaf, 1999; Campbell et al., 2008; Cordes-Holland, 2008; Green et al., 2010). However, many of the climate change studies highlighted weaknesses in western epistemologies and the strengths of Aboriginal and Torres Strait Islander peoples' approaches to the natural world. This was most evident when comparing the broad, regional scope of much climate change science compared to the localised, place-based understandings of Indigenous peoples (see Leonard et al, 2013; McNamara and McNamara, 2011; McNamara & Westoby, 2011; Petheram et al., 2010; Stocker et al., 2016; Zander et al., 2013).

Context specific knowledges are important as climate change is expressed in the short-term as extreme weather events, with most of the consequences impacting on affected localities. Place-based local understandings were central to sustaining country and to maintaining critical livelihood strategies. This makes the value of Indigenous peoples' knowledges in interpreting and understanding the natural world more significant as their understandings could potentially provide highly salient information at local levels. In climate change science, non-Indigenous weather and climate science have provided excellent global and regional predictions about changes in the global climate, however, climate science lacks the kind of finely grained local knowledge of natural environments of Indigenous peoples (Berkes, 2009; Mutasa, 2015). Studies demonstrated the ways in which Indigenous peoples' intimate knowledge of country provides locality-specific information about how the changing environment impacted on weather patterns, tracts of land and water as well as vegetation, animals and Indigenous peoples' daily lives. Micro-level knowledges could assist with local preparedness and responses to extreme weather events resulting from a changing climate as well as assist non-Indigenous Australians to maintain livelihoods as climate change increasingly impacts on agriculture, soil health and water supply critical to key economic sectors such as agriculture.

Despite growing interest and research from organisations such as the Commonwealth Scientific and Industrial Research Organisation (CSIRO), other natural disasters had not been investigated to a large degree. Four papers in total investigated Indigenous peoples and floods: one paper investigated floods in Aboriginal cosmology (Morton, 2006), a second paper studied Indigenous peoples living on the floodplains of the Northern Territory (Ligtermoet, 2016) and two more studied Indigenous perspectives from the Murray-Darling river basin in New South Wales and Victoria (Lynch et al., 2013; Lynch et al., 2014). This is despite flooding being one of the most destructive seasonal natural disasters in Australia (Ladds et al., 2017). Another two papers looked at Indigenous peoples and cyclones in Queensland (MacLachlan, 2003) and the Northern Territory (Skertchley & Skertchley, 2000). One paper investigated Indigenous peoples and heatwaves (Webb et al., 2010), drought (Pearce et al., 2010) and what would be termed an 'all hazards' approach (policies and plans to address all types of potential hazards) (Yates, 1997). Many studies also looked at more than one disaster focusing on the primary disaster but also addressing to some degree some of the secondary hazards (e.g. cyclones and flooding or climate change and heatwaves).

Caring for country and 'natural resource management'

No matter what the disaster type, there were strong similarities between the different sets of studies. Papers highlighted the strengths and unique nature of Indigenous peoples' knowledges of the natural environment and the potential importance for current understandings of the more finely grained impacts of disasters at local levels. One of the most important issues for consideration and action by disaster risk management was the ways in which Indigenous peoples envisaged natural disasters as part of a wholistic approach to caring for country. As custodians of the lands and waters, Indigenous peoples care for country as part of an integrated cultural, social, spiritual and pragmatic cosmology. This is a very different approach to that taken by modern disaster risk management, which often applies a much narrower lens to natural disasters.

The substantive body of evidence from natural resource management, with 53 studies (or 62%) investigating Indigenous peoples' caring for country strategies, potentially provides important lessons for disaster risk management¹. Mainstream understandings of disaster risk management that focus on western concepts of discrete, unique extreme weather events are at odds with the integrated approaches taken by Australian Indigenous peoples (for example see Ansell & Koenig, 2011; Berry et al., 2010; Bird et al., 2004; Bird et al., 2015; Bowman et al., 2004; Bowman et al., 2004; Bowman et al. 2007; Butzer and Helgren, 2005; Chisholm, 1994; Clark, 1983; Clark, 2008; Cordes-Holland, 2008; Crowley & Garnett, 2000; Hill & Baird, 2003; Hill, et al., 2001; McIntyre-Tamwoy, et al., 2013; Yibarbuk, 2001; Vigilante & Bowman, 2004).

Caring for country integrated elements that maintained and protected Aboriginal and Torres Strait Islander political economies, reducing the risk of large scale bushfires improved hunting, fishing and foraging activities. Strategies and practices were adapted to country and as diverse as the peoples using them, Indigenous peoples varying strategies to fit with specific topographies, climates, seasons, fauna, flora and places. Some of these practices included mosaics of cool fire regimes that were used to control fuel load and prevent large, hot wildfires, consequently providing benefits to animal life and encouraging vegetation growth and regrowth. First peoples also varied the frequency and timing of burns to regulate fire intensity at a local level and enabled livelihood activities such as hunting and foraging (Gammage, 2011). Hallam (2014) praised these diverse, adaptive approaches to landscape management:

No single regime is optimal for all elements of the biota ...The diversity within the fine-grained patchwork that the Aborigines achieved contrasts with the monotony of large-scale burns ignited by lightning over huge neglected stretches (pp.190-191).

Caring for country and natural resource management would at first appear to be outside the remit of emergency management agencies in Australia, however, this is not necessarily the case. Caring for country in non-Indigenous disaster risk management would broadly fit in with concepts related to 'prevention', 'preparedness', 'mitigation' and 'risk reduction'. Disaster risk management agencies use risk reduction strategies to guide the development and implementation of government policies and frameworks related to natural disasters (UNISDR, 2009). Disaster risk reduction aims to reduce, 'disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events' (UNSIDR, 2009, pp.10-11). Using UNISDR terminology, caring for country includes strategies that have a strong fit with strategies to 'reduce exposure to hazards', albeit with a stronger focus on 'wise management of land and the environment'.

This could be challenging for non-Indigenous disaster risk management to come to terms with. Non-Indigenous emergency services agencies reflect the worldviews and approaches that tend to view natural disasters as isolated extreme weather events that have to be 'managed' and 'controlled' through the application of training, technology and operational planning. As street level policy implementers, disaster risk management agencies tend to focus more on short-term preparedness strategies and response operations (Spurway, 2012; Zwi et al., 2013). Finding the ultimate technological fix is a common theme within disaster risk management agencies and policy frameworks. This clash of worldviews could cause some significant challenges when Indigenous and non-Indigenous peoples try to work together. This is illustrated by an Aboriginal firefighter who describes an interaction with non-Indigenous fire management personnel at a fire management conference in New South Wales:

And that's what it's all about. It's all about life and property and liability. They can't think outside that square to think if we thought about it ecologically and reduced that fuel then there wouldn't be the danger. I think the "R" that's in that acronym [TKRP - Traditional Knowledge Revival Pathways], you know "revival," is really important because when you try and explain this to a white audience, and particularly the white fire management, they want to see it. "Well, where is it? You show me this special formula of Indigenous knowledge that's going to solve everything. Go on, show us now!" It's about reviving. It's about bringing that knowledge back and they're like "We don't have the money and time. We need real solutions now." They're not long-term thinkers (Eriksen & Hankins, 2014, p.1296).

Another issue is that Indigenous and non-Indigenous peoples' approaches to natural resource management and disaster risk reduction often have different aims. Although there was some cross fertilisation of practices, Indigenous peoples burned off for different reasons to non-Indigenous pastoralists, emergency managers or park managers (see Hill, 2001; Lewis, 1989; Murphy & Bowman, 2007; Ockwell, 2008). Many non-Indigenous approaches to managing land and water resources primarily aim at maximising benefits for humans (farming, mining, infrastructure, etc.) from within a worldview that sees nature as separate from human beings. Any benefits for Indigenous peoples, however, are secondary to the needs of country. Burning off is aimed at maintaining the health of country by protecting it from large, destructive fires not necessarily just to make the landscape more amenable to human habitation or create enabling environments for livelihoods. Victor Steffenson from Cape York Aboriginal Development Association highlights the basis for some of these differences:

Farming implies manipulation of the land to meet human ends. Aboriginal Australians, however, do not conceive of people as being separate from nature. Their actions, including burning, are defined by custodial responsibilities to the land as opposed to any potential benefit to people (quoted in Ockwell, 2008, p. 281).

The breadth of Indigenous worldviews and associated political economies incorporate the social, the sacred and concern for both the human and non-human: places, lands, waters, flora and fauna.

For disaster risk management to effectively engage with Indigenous peoples' worldviews and perspectives necessitates approaches that do more than simply providing Aboriginal and Torres Strait Islander communities with training in western knowledge and practices. This means developing a large degree of what could be called knowledge hybridity to learn about, valorise and integrate Indigenous peoples' knowledges in a way that acknowledges their ownership and unique worldviews. Emergency managers would need to seriously engage with Indigenous perspectives in order to effectively develop disaster risk reduction plans and strategies with communities. Differences will need to be discussed, negotiated and resolved if emergency management truly wants any kind of meaningful engagement with Indigenous peoples. This should not be completely alien to emergency managers as there are numerous parallel approaches based on best practices for community-based disaster risk management. A good example of this within the current policy environment is the predominance of concepts such as community resilience, which necessitate an understanding of the inherent strengths, capacities and capabilities of communities including Indigenous ecological knowledges and practices.

Evidentiary legitimacy

Knowledge legitimacy is determined by the sources and contexts within which knowledge is created: who produced, contributed, owned, controlled and benefitted from its production and dissemination. This is especially true for the localised, fine grained ecological knowledges of Australia's First Peoples.

Who is doing the writing is important in the politics of the Third World and African America, and indeed for indigenous peoples; it is even more important in the politics of how these worlds are being represented 'back to' the West (Tuhiwai Smith, 2012, K.L. pp.993-994).

Indigenous participation in, and control of research, are important issues for Indigenous peoples after hundreds of years of colonisation and theft of their knowledges because it determines how Indigenous peoples' knowledges are represented or misrepresented as 'fact' (Langton, 2012; Tuhiwai Smith, 2012). Consequently, it is important to understand the level of involvement of Indigenous peoples in each piece of research and in the evidence base overall in order to assess how legitimate it is.

This raises questions about who authored the papers and to what degree researchers engaged with Indigenous peoples during the research process. Of course, it was difficult to gauge some of this purely from the descriptions provided in the publications captured. However, it was possible to analyse the degree to which Indigenous peoples authored papers; whether researchers interviewed or observed Indigenous participants and whether researchers named and acknowledged research participants as people not just unidentified objects of analysis. Langton (2003) made the case that Indigenous peoples and their understandings are inseparable, closely interconnected and dependent on each other. Consequently, knowing the names of the peoples and the countries they come from and who got a seat at the table could be a good indicator that would help gauge the participation of peoples as well as giving a rough indication of the level of engagement with Aboriginal and Torres Strait Islander peoples by researchers. Although not perfect, these criteria gave some indication as to the degree to which the body of evidence included Indigenous peoples' perspectives and represented their lived experiences and knowledges of natural disasters, living off, and caring for, country.

Unsurprisingly, the evidence base was dominated by non-Indigenous voices. Studies were predominantly written by authors from Australian institutions, with only nine papers overall identifying Aboriginal or Torres Strait Islander authors (Fitzsimmons et al., 2012; Green et al., 2010; Lynch et al., 2013; McGregor et al.,

2010; Prober et al., 2016; Race et al., 2016; Russell-Smith et al. 1997; Stocker et al., 2016; and Yibarbuk et al., 2001). Of the 55 *empirical* papers included in the full text review, the majority (n=42) did directly interview or involve Indigenous custodians in discussions about their practices, knowledge, experiences, perspectives or worldviews. Non-empirical papers such as reviews of the literature, policy and legislation did not necessitate engaging with Indigenous communities of course. However, having Aboriginal and Torres Strait Islander peoples actually participate in interviews and discussions demonstrated more cogency and validity for these studies as their findings at a least emerged out of some kind of direct engagement with Indigenous communities. This reflected critical issues regarding power and ownership by Indigenous peoples' knowledges and their right to fully participate in and control all stages of the process:

Indigenous people shared resources, as well as defending their ownership rights and responsibilities. The general rule, articulated in simple and eloquent terms was and is: 'always ask'... The rule identifies the right of the owners of country to say yes or no; 'always ask' articulates the right and responsibility of owners to make managerial decisions about the use of their own country (Rose, 2005, p.40).

Although many researchers were able to engage with Indigenous peoples and produced a representation of knowledges and practices, another 44 studies did not include Indigenous participants of any kind. Of the empirical papers, 13 studies used scientific proxies to estimate an assumed impact of Indigenous practices on the environment. These proxies included satellite imagery; pollen counts; carbon and nitrogen signatures in soils; fire scars and vegetation types and their distribution (for example see: Bowman & Prior, 2004; Bowman et al., 2007; Braaf, 1999; Chhetri et al., 2010; Franklin, 2008). In effect, these papers did not arguably capture Indigenous peoples' knowledges or practices at all but made conjectures about their knowledges and practices based on remote data collection techniques.

At another level of engagement, studies may have included Indigenous representatives and participants but did not or could not name the groups, nations or peoples who owned the knowledges and practices under investigation. Places, countries and peoples are inseparable for Aboriginal and Torres Strait Islander and knowing the names of peoples allows us to locate the research on country (Graham, 2009). There is a strong argument to be made for the centrality of place and country in any research involving Australian Indigenous peoples: 'Place underpins inquiry in the deepest ontological sense, inasmuch as, from an Indigenous point of view, it is the fundamental existential qualifier: it informs us of *where* we are at any time, thereby at the same time informing us of *who* we are' [emphasis in original] (Graham, 2009, p.75).

Only 27 studies named the Indigenous custodians of country and the evidence base only speaks directly to peoples' knowledges and practices from the nations and peoples of Djelk, Martu, Kunibidji, Kuku-Yalanji, Mirrwoong, Gagadju, Gurig, Mengerrdji, Erre-Wurringak, Yorta Yorta, Walpiri, Bininj, Injinoo, Girringun, Lardil, Erubam Le, Martu, Yolgnu, Ngadju, Gundjeihmi, Nyungar and Gunei (Ansell & Koenig, 2011; Bird, et al., 2004; Bird, et al., 2015; Bowman, et al., 2004; Cordes-Holland, 2008; Hill & Baird, 2003; Hill, et al., 2001; Leonard, et al., 2013; Lewis, 1989; Lewis, 1994; Ligtermoet, 2016; Lynch, et al., 2014; Lynch, et al., 2013; Maclean, 2009; Maddock, 2016; McGregor, et al., 2010; McIntyre-Tamwoy, et al., 2013; McLachlan, 2003; McNamara & McNamara, 2011; McNamara & Westoby, 2011; Parker, 2015; Petheram, et al., 2010; Prober et al., 2016; Russell-Smith, et al., 1997; Stocker et al. 2016; Vaarzon-Morel & Gabrys, 2009; Verran, 2002; Yibarbuk, 2001; Zander et al., 2013). Torres Strait Islanders named in the evidence base were from Poruma, Mer, Saibai and Boigu islands (Green et al., 2010; McNamara & Macnarra, 2011; Macnamarra & Westoby, 2011).

Caring for country integrated locality specific regimes to manage natural resources and sustain Indigenous political economies that fitted within the contingencies of each given place. The evidence base reported on the countries, groups and nations originating predominantly from rural and remote communities located in Queensland, Northern Territory and Western Australia. Victoria, New South Wales, the Australian Capital Territory, South Australia and Tasmania, however, were relatively poorly represented. Studies of Northern Territory Indigenous peoples dominated the evidence base with more than double the number of studies (n=39) investigating their knowledge and practices compared to any other individual state. Seventeen studies were based in Western Australia, 14 in Queensland, six in New South Wales, only two in South Australia and one in Tasmania (ten studies compared more than one state). No studies were conducted in the Australian Capital Territory and there were no studies investigating urban Indigenous peoples' knowledges and natural disasters.

Four studies did investigate urban peoples in Darwin in relationship to health and hospital admissions related to burn-offs and heat related morbidity associated with climate change (Green et al., 2015; Hanigan et al., 2008; Johnston et al., 2007; Webb et al., 2014). And one paper investigated the risk and exposure to house fires of Aboriginal peoples living in peri-urban and rural areas in south east Queensland (Chhetri et al., 2010). However, neither of these papers addressed Indigenous peoples' understandings in any way and could be considered classic examples of Aboriginal peoples being framed as unknowing victims in need of external intervention.

The focus on rural and remote communities reflects issues that predate modern disaster risk management. In Australia, non-Indigenous settlements tended to cluster along the eastern and southern coastlines, leaving the northern and western regions more sparsely inhabited (Langton, 2003; Mulligan, 2003). Although settlement has slowly increased in these locations, there are still areas to the north and west with relatively sparse populations and large tracts of land and water that include the largest areas within the 'Indigenous Estate' (Figgis, 2003). These 'wild' landscapes are perfect for researchers aiming to investigate and observe environmental and natural resource management strategies. However, this is problematic given that the majority of Australian Indigenous peoples live in cities and do not inhabit places covered by the Indigenous Estate (Altman, Buchanan & Larsen, 2007). The focus on remote areas is also likely based on a misconception that urban Indigenous peoples have completely lost contact with country and any associated ecological knowledges and practices even if, like the Gadigal and Bedjigal peoples of Sydney, they are still living on country. As Irish (2017) rightly points out:

On the ground, little appears to remain of the continuing Aboriginal use of Sydney after the arrival of Europeans but evidence has survived in other forms ...It has remained hidden mainly because of a widespread belief that Aboriginal people died out or disappeared from Sydney by the mid-19th century, and that any Aboriginal people in Sydney after this time were either from somewhere else or had lost any cultural attachment to the area (loc. 164-170).

As is so common in many areas of disaster research (see Hossein et al., 2016; Spurway, 2012), studies frequently did not disaggregate data based on gender. Women's ecological knowledges are increasingly recognised as separate albeit integral and equal to men's understandings (Prober et al., 2013). However, only five studies investigated the ecological knowledges of Martu, Kuku-Yalanji and Yolgnu women (Bird, et al., 2004; Hill & Baird, 2003; Parker, 2015; Petheram, et al., 2010; Zander et al., 2013). And, of the nine studies that identified Indigenous authors, only three identified Aboriginal women as co-authors (Lynch et al., 2013; McGregor et al., 2010; Russell-Smith et al. 1997). The importance of understanding women's knowledge is explained by Patsy Nulgit, a Wiltingin woman, "Women's fire knowledge is very different to men's fire knowledge ... it helps country and community in different ways" (CSIRO and NESP NAER, 2016, p.7). The evidence base thus has a significant gap in understanding the particular natural disaster management strategies and political economies maintained by women's unique approaches to caring for country.

Native title, land rights and access to country

It is clear from the evidence base that Indigenous political economies and natural disasters were considered interconnected components of a wider ethos of caring for country. Controlling the occurrence of natural disasters helped sustain livelihood activities such as agricultural, foraging, fishing and hunting practices as well as continuing to sustain healthy country. However, practising these interconnected activities and technologies required ongoing access to and control of country by Australia's First Peoples. A strong argument was made in some studies for the importance of the rights of Aboriginal and Torres Strait Islander peoples to custodianship of, and access to, country (for example see: Bowman et al., 2004; Eriksen & Hankins, 2014; Gammage, 2011; Lewis, 1989; Ligtermoet, 2016; Ockwell, 2008; Petheram et al., 2010; Russell-Smith, 1997; Skertchley & Skertchley, 2000). This custodianship not only ensured environmental protection, natural disaster mitigation and biodiversity but also positively impacted on Indigenous peoples' social, economic, cultural and spiritual wellbeing:

There is substantial evidence of the benefits to Indigenous health and socio-economic outcomes of maintaining strong cultural attachments... A significant way of doing so is engaging with customary activities (Ligtermoet, 2016, p.650).

Federal native title and state land rights legislation does allow some Indigenous peoples access country and the right to continue to practice traditional and adapted forms of natural resource management. However, this is often very limited and the irony of the current policy and legislative environment is that many Indigenous peoples cannot legally engage in livelihoods activities within the Indigenous Estate that could substantially improve their socio-economic status such as commercial wildlife harvesting. This is despite the fact that permits for harvesting turtles or crocodiles, for example, are given out to non-Indigenous commercial enterprises without any benefits accruing to Indigenous custodians (Langton, 2003).

Despite this, the research base showed that access to country enabled Aboriginal and Torres Strait Islander peoples to manage the lands and waters in a way that protected the natural, economic, social and cultural assets underpinning their unique and diverse political economies. In discussing the importance of fire regimes for the Aboriginal peoples of south-western Australia, for example, Hallam (2011) highlighted how essential burning off was as one of the many resource management practices used to sustain economic and livelihood activities:

Aboriginal burns provided protection of assets. Yam tubers and coppices of spearwood would be guarded by a firebreak and swamps would be protected from late summer peat fires as were, no doubt, flammable installations such as wooden fish weirs. Huts would be built in areas already cleared by fire. New growth in burnt areas would ensure the presence of large game on unfenced kangaroo pastures (Hallam, 2011, p.191).

The importance of the Indigenous Estate and caring for country was also emphasised in terms of enhancing environmental integrity. Many studies reported that areas no longer under Indigenous custodianship increasingly showed ill effects including reduced biodiversity, loss of key animal and plant species essential to livelihoods, an increased risk of large scale or catastrophic wildfires and environmental degradation (for example see: Bowman et al., 2007; Brook & Bowman, 2006; Crowley & Garnett, 2000; Lewis, 1989; Lynch et al., 2013; Morgan, Murphy & Bowman, 2007; Petheram et al., 2010; Skertchley & Skertchley, 2000; Yibarbuk et al., 2001). The importance of maintaining Aboriginal and Torres Strait Islander peoples' access to and management of country was deemed essential not only for the control and management of natural disasters but also for environmental management and protection:

A significant component of Australia's biotic web has been shaped by Aboriginal firing practices. Moderate burning on a regular basis decreases the potential for devastatingly large wildfires, increases the richness of plant species and has an important effect on faunal populations (Bird, Bird & Parker, 2004, p. 90).

The evidence showed that maintaining and extending the rights and access of Indigenous peoples to country, whether this be through improved native title, land rights or a constitutionally embedded treaty, could benefit both Indigenous and non-Indigenous peoples living in those areas.

Discussion

From a non-Indigenous disaster risk management perspective, the strength of the evidence base regarding the use of Indigenous peoples' understandings of natural disaster should be one of the most important outcomes of a review such as this one. The evidence base overall, however, was very weak in terms of understanding the use of Indigenous peoples' ecological knowledges by Australian disaster risk management programmes. Although it is evident that there is a lot of work going on at state and local levels, it is difficult to obtain detailed information about what works, who is implementing programmes, exactly how they are being implemented and with what, if any, success. Despite a lack of published material, however, emergency management agencies do have an opportunity to learn from best practices and lessons learned from the natural resource management literature. The natural resource management literature clearly highlights the integrated, holistic nature of Australian First Peoples' ecological, political, social, cultural and economic worldviews. The literature demonstrates the importance of understanding that Indigenous peoples do not view natural disasters as separate from a broader climatic and ecological ethos.

Mitigating against natural disasters such as large-scale bushfires was important for the maintenance and enablement of political economies based on livelihoods such as fishing, foraging and hunting as well as broader socio-economic wellbeing. The political, the economic and the ecological were demonstrated to be part of caring for country and in order to understand the broader ramifications of this worldview, Australian disaster risk management needs to adopt a cultural hybridity. Cultural hybridity enables non-Indigenous people emergency managers to take the perspectives of Indigenous peoples as a starting point rather than demanding that Indigenous peoples adapt to European Australian ways of understanding the natural world (Maclean, 2009; Stocker et al., 2016; Morton, 2006). In effect, this calls for what Stanner (1979) has called "thinking black", trying *not* to impose western understandings on Indigenous ones and, at a minimum, meeting Indigenous peoples half way (Stanner cited in Morton, 2006, p.140).

Engagement and collaboration between Indigenous and non-Indigenous peoples takes place within a space where the consequences of a colonial history of invasion, exploitation and disempowerment are still very much an ongoing social, cultural, economic and ecological catastrophe for Indigenous peoples. Denying access to and rights to care for country impacts on every aspect of Aboriginal and Torres Strait Islander peoples' daily lives. It is important for disaster risk management and emergency services agencies to recognise that any engagement takes place in a context where large power inequities exist that arose out of more than two hundred years of invasion, colonisation and displacement. Agencies need to account for and address these differentials in any engagement strategy they might develop. These are challenges and dangers that non-Indigenous peoples are not normally aware of, but which are very familiar to Indigenous peoples who have learnt from many years of engaging with non-Indigenous peoples and the Australian settler state.

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. As Marcia Langton so eloquently argues:

With their minimal and often inaccurate understanding of indigenous societies, environmental scientists, planners and managers have the potential to cause great harm to native peoples (Langton, 2003, p. 81).

How the disaster risk management community addresses these issues will influence the type of engagement and collaboration possible with Aboriginal and Torres Strait Islander peoples and, ultimately, the success or failure of these programs.

For Aboriginal and Torres Strait Islander peoples this 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 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. This is especially important within the current policy context, which increasingly threatens the environmental integrity of remote and rural areas with large scale development as the Australian settler state looks to expand into and exploit 'frontier territories' many of which lie within the Indigenous Estate (Australian Government, 2014; Australian Government, 2015). As a consequence, an already limited right to access and care for country crucial to the traditional and adapted forms of natural resource management and sustainable livelihood strategies practiced by Aboriginal and Torres Strait Islander peoples who can access their countries is under attack (Altman, 2012; Altman, 2014).

The colonial settler state's expansionary demands place more stress on the integrity of the Indigenous Estate as mining companies, pastoralists and others argue that Indigenous ownership and control of land constrains economic growth and development (Australian Government, 2014). The Australian settler state is currently looking for ways to expand the areas under exploitation and the current Indigenous Estate, once considered to be a "remote periphery" of little interest and low in value (Langton, 2003, p.84). Although touted as solutions to Indigenous poverty and marginalisation with jobs for Indigenous peoples, this expansionist approach threatens existing traditional and adapted Indigenous political economies now (re-)established on those parts of Australia included in the Indigenous Estate. The current political and policy climate also completely marginalises the political, economic and cultural rights of urban Indigenous peoples who have very limited access to country and associated rights to develop or re-establish independent forms of social and economic development. The very narrow economic view of development taken by the Australian state reproduces key elements of colonialism, especially the worldview that sees nature and people as exploitable resources. Certainly, this most recent push to expand further into the Indigenous Estate allows little space for considerations of the rights of Australian Aboriginal and Torres Strait Islander peoples to control, decide upon and achieve their own unique courses of social, economic and cultural 'development' that are centred around caring for country.

Notes

1 This clearly does not represent the entirety of the natural resource management evidence base. The search strategy aimed to capture studies on natural disasters but also by chance captured more papers on natural resource management that proved to be relevant to the research aims.

Appendix: Studies included in narrative analysis

PDF (205kb)

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About the author

Dr Kim Spurway is a Lecturer in Development Studies and Public Policy in the School of Social Sciences at the University of New South Wales. Kim has 13 years' experience working in humanitarian projects in Asia, Africa and the Middle East. After working as a manager of post-conflict humanitarian impact assessments, Kim engaged with critical disaster studies and has worked for ten years' as a lecturer and researcher at the University of New South Wales. Kim has written on several aspects of disasters: disability,

Indigenous peoples and food crises, urbanisation and disasters in the global south and community-based disaster risk management. Kim is interested in critically interrogating the concepts of disaster vulnerability and resilience, the role of situated knowledge and research approaches to systematic reviews and surveys.

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Appendix: Studies included in narrative analysis

AUTHOR, TITLE	DISASTER TYPE	THEME	PEOPLES STUDIED	STATE /TERR	A&TSI PARTICIPANTS?	A&TSI AUTHORS?	INCLUDES IK/TEK?
Alexander, C., et al. (2011). Linking Indigenous and Scientific Knowledge of Climate Change. <i>Bioscience</i> 61 (6): 477-484.	Climate change	Integration IK and science	A&TSI, nationwide	Australia	Yes	No	Yes
Andersen, A. N., et al. (1998). Fire research for conservation management in tropical savannas: Introducing the Kapalga fire experiment. <i>Australian Journal of Ecology</i> 23 (2): 95-110.	Fire	Natural resource management	A&TSI, rural	NT	No	No	No
Ansell, S. & J. Koenig (2011). CyberTracker: An integral management tool used by rangers in the Djelk Indigenous Protected Area, central Arnhem Land, Australia. <i>Ecological Management & Restoration</i> 12 (1): 13-25.	Fire	Natural resource management	Djelk, rural	NT	Yes	No	Yes
Berry, H. L., et al. (2010). Mind, body, spirit: co-benefits for mental health from climate change adaptation and caring for country in remote Aboriginal Australian communities. <i>New South Wales Public Health Bulletin</i> 21 (5-6): 139-145.	Climate change	Natural resource management	A&TSI, rural	Australia	No	No	Yes
Bird, D. W., et al. (2004). Women who hunt with fire: Aboriginal resource use and fire regimes in Australia's Western Desert. <i>Australian Aboriginal Studies</i> 1 .	Fire	Natural resource management	Martu, women, rural	WA	Yes	No	Yes
Bird, R.B., et al. (2015). People, El Nino southern oscillation and fire in Australia: fire regimes and climate controls in hummock grasslands, <i>Phil. Trans. R. Soc.</i> 371 : 1-9.	Fire	Natural resource management	Martu, rural	WA	Yes	No	Yes

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AUTHOR, TITLE	DISASTER TYPE	THEME	PEOPLES STUDIED	STATE /TERR	A&TSI PARTICIPANTS?	A&TSI AUTHORS?	INCLUDES IK/TEK?
Bowman, D. M. & Prior, L. D. (2004). Impact of Aboriginal landscape burning on woody vegetation in Eucalyptus tetrodonta savanna in Arnhem Land, northern Australia. <i>Journal of Biogeography</i> 31 (5): 807-817.	Fire	Natural resource management	A&TSI, rural	NT	No	No	No
Bowman, D. M. J. S., et al. (2007). Seasonal patterns in biomass smoke pollution and the mid 20th-century transition from Aboriginal to European fire management in northern Australia. <i>Global Ecology and Biogeography</i> 16 (2): 246-256.	Fire	Natural resource management	A&TSI, rural	NT	No	No	Yes
Bowman, D. M., et al. (2004). Landscape analysis of Aboriginal fire management in Central Arnhem Land, north Australia. <i>Journal of Biogeography</i> 31 (2): 207-223.	Fire	Natural resource management	Kunibidji, rural	NT	No	No	Yes
Bowman, D. M., et al. (2007). Land management affects grass biomass in the Eucalyptus tetrodonta savannas of monsoonal Australia. <i>Austral Ecology</i> 32 (4): 446-452.	Fire	Natural resource management	A&TSI, rural	NT, WA	No	No	No
Bowman, D., et al. (2001). The 'wilderness effect' and the decline of <i>Callitris intratropica</i> on the Arnhem Land Plateau, northern Australia. <i>Australian Journal of Botany</i> , 49 (5) pp. 665-672, 2001.	Fire	Natural resource management	A&TSI, rural	NT	No	No	No

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AUTHOR, TITLE	DISASTER TYPE	THEME	PEOPLES STUDIED	STATE /TERR	A&TSI PARTICIPANTS?	A&TSI AUTHORS?	INCLUDES IK/TEK?
Bowman, D., et al. (2008). Fire maintains an Acacia aneura shrubland-Triodia grassland mosaic in central Australia. <i>Journal of Arid Environments</i> , 72 (1) pp. 34-47.	Fire	Natural resource management	A&TSI, rural	NT	No	No	No
Braaf, R. R. (1999). Improving impact assessment methods: climate change and the health of indigenous Australians. <i>Global Environmental Change</i> 9 (2): 95-104.	Climate change	Health impacts of climate change	A&TSI, rural	NT	No	No	no
Butzer, K. W. & Helgren D. M. (2005). Livestock, Land Cover, and Environmental History: The Tablelands of New South Wales, Australia, 1820-1920. <i>Annals of the Association of American Geographers</i> 95 (1): 80-111.	Fire	Natural resource management	A&TSI, rural	Australia	No	No	Yes
Campbell, D., et al. (2008). Responding to health impacts of climate change in the Australian desert. <i>Rural and Remote Health</i> 8 (3): 1008.	Climate change	Health impacts of climate change	A&TSI, rural	Australia	No	No	No
Chhetri, P., et al. (2010). Modelling potential socio-economic determinants of building fires in South East Queensland. <i>Geographical research</i> 48 (1): 75-85.	Fire	Disaster risk reduction	A&TSI, urban & rural	Qld	No	No	no
Chisholm, A. H. (1994). <i>Land use choices in a changing world</i> .	Fire	Natural resource management	A&TSI, nationwide	Australia	No	No	no

Appendix: Studies included in narrative analysis

AUTHOR, TITLE	DISASTER TYPE	THEME	PEOPLES STUDIED	STATE /TERR	A&TSI PARTICIPANTS?	A&TSI AUTHORS?	INCLUDES IK/TEK?
Clark, N. (2008). Aboriginal Cosmopolitanism. <i>International Journal of Urban and Regional Research</i> 32 (3): 737-744.	Fire	Natural resource management	A&TSI, nationwide	Australia	No	No	no
Clark, R.L. (1983). Pollen and Charcoal Evidence for the Effects of Aboriginal Burning on the Vegetation of Australia, <i>Archaeology in Oceania</i> 18 (1): 32-37.	Fire	Natural resource management	A&TSI, nationwide	NSW, Qld, Tas	No	No	Yes
Cordes-Holland, O. (2008). "The sinking of the Strait: The Implications of climate change for Torres Strait Islanders' human rights protected by the ICCPR <i>Melbourne Journal of International Law</i> 9 (2): 405-438.	Climate change	Human Rights	Torres Strait Islanders, rural	Torres Strait Islands	No	No	No
Crowley, G. M. & Garnett, S. T. (2000). Changing fire management in the pastoral lands of Cape York Peninsula of Northeast Australia, 1623 to 1996. <i>Australian Geographical studies</i> 38 (1): 10-26.	Fire	Natural resource management	A&TSI, rural	Qld	No	No	Yes
Dovers, C., G. Cary & Lindenmayer, S. (2004). Fire research and policy priorities: insights from the 2003 national fire forum, <i>Australian Journal of Emergency Management</i> 19 (4): 76-84.	Fire	Disaster risk reduction	A&TSI, nationwide	Australia	No	No	No
Eriksen, C. & Hankins, D. L. (2014). The retention, revival, and subjugation of Indigenous fire knowledge through agency fire fighting in eastern Australia and California. <i>Society and Natural Resources</i> 27 (12): 1288-1303.	Fire	Disaster risk reduction	A&TSI, rural	NSW, Qld	Yes	No	Yes

Appendix: Studies included in narrative analysis

AUTHOR, TITLE	DISASTER TYPE	THEME	PEOPLES STUDIED	STATE /TERR	A&TSI PARTICIPANTS?	A&TSI AUTHORS?	INCLUDES IK/TEK?
Fitzsimons, J., et al. (2012). Insights into the biodiversity and social benchmarking components of the Northern Australian fire management and carbon abatement programmes. <i>Ecological Management & Restoration</i> 13 (1): 51-57.	Fire	Natural resource management	A&TSI, rural	QLD, NT, WA	Yes	yes	Yes
Franklin, D. C., et al. (2008). Monitoring contrasting land management in the savanna landscapes of northern Australia. <i>Environmental Management</i> 41 (4): 501-515.	Fire	Natural resource management	A&TSI, rural	nt	No	No	Yes
Gammage, B. (2011). Fire in 1788: the closest ally. <i>Australian Historical Studies</i> 42 (2): 277-288.	Fire	Natural resource management	A&TSI, nationwide	Australia	Yes	No	Yes
Gerrard, E. (2008) Climate change and human rights: Issues and opportunities for Indigenous peoples, <i>Forum: Climate change and human rights</i> 31 (3): 941-952.	Climate change	Human Rights	A&TSI, nationwide	Australia	No	No	Yes
Gott, B. (2005). Aboriginal fire management in south-eastern Australia: Aims and frequency. <i>Journal of Biogeography</i> 32 (7): 1203-1208.	Fire	Natural resource management	A&TSI, rural	Vic	No	No	Yes
Gould, R. A. (1971). Uses and effects of fire among the Western Desert Aborigines of Australia. <i>Mankind</i> 8 (1): 14-24.	Fire	Natural resource management	A&TSI, rural	WA	Yes	No	Yes

Appendix: Studies included in narrative analysis

AUTHOR, TITLE	DISASTER TYPE	THEME	PEOPLES STUDIED	STATE /TERR	A&TSI PARTICIPANTS?	A&TSI AUTHORS?	INCLUDES IK/TEK?
Green, D. & Minchin, L. (2014). Living on climate-changed country: indigenous health, well-being and climate change in remote Australian communities. <i>EcoHealth</i> 11 (2): 263-272.	Climate change	Health impacts of climate change	A&TSI, rural	Australia	No	No	No
Green, D., et al. (2010). Indigenous Australians' knowledge of weather and climate. <i>Climatic Change</i> 100 (2): 337-354.	Climate change	Integration IK and science	A&TSI, nationwide	Torres Strait Islands	Yes	yes	Yes
Green, D., et al. (2015). Differential effects of temperature extremes on hospital admission rates for respiratory disease between Indigenous and Non-Indigenous Australians in the Northern Territory. <i>International Journal of Environmental Research and Public Health</i> 12 (12): 15352.	Climate change	Health impacts of climate change	A&TSI, urban	NT	No	No	No
Hallam, S. J. (1975). <i>Fire and hearth: A study of Aboriginal usage and European usurpation in South-Western Australia</i> , Australian Institute of Aboriginal Studies.	Fire	Natural resource management	A&TSI, nationwide	WA	No	No	Yes
Hanigan, I. C., et al. (2008). Vegetation fire smoke, indigenous status and cardio-respiratory hospital admissions in Darwin, Australia, 1996-2005: A time-series study. <i>Environmental Health</i> 7 : 42.	Fire	Health impacts of smoke inhalation	A&TSI, urban	NT	No	No	No
Havemann, P. (2009) Ignoring the mercury in the climate change barometer: denying indigenous peoples' rights, Australian <i>Indigenous Law Review</i> 13 (1): 2-26.	Climate change	Human Rights	A&TSI, nationwide	Australia	No	No	No

Appendix: Studies included in narrative analysis

AUTHOR, TITLE	DISASTER TYPE	THEME	PEOPLES STUDIED	STATE /TERR	A&TSI PARTICIPANTS?	A&TSI AUTHORS?	INCLUDES IK/TEK?
Hill, R. & Baird, A. (2003). Kuku-Yalanji Rainforest Aboriginal people and carbohydrate resource management in the wet tropics of Queensland, Australia. <i>Human Ecology</i> 31(1): 27-52.	Fire	Natural resource management	Kuku–Yalanji, rural, women	Qld	Yes	No	Yes
Hill, R., et al. (2001). Cattle, mining or fire? The historical causes of recent contractions of open forest in the wet tropics of Queensland through invasion by rainforest. <i>Pacific Conservation Biology</i> 7(3): 185-194.	Fire	Natural resource management	Kuku–Yalanji, rural	Qld	Yes	No	Yes
Johnston, F. H., et al. (2007). Ambient biomass smoke and cardio-respiratory hospital admissions in Darwin, Australia. <i>BMC Public Health</i> 7: 240.	Fire	Health impacts of smoke inhalation	A&TSI, urban	NT	Yes	No	No
Kimber, R. (1983). Black lightning: Aborigines and fire in central Australia and the Western Desert. <i>Archaeology in Oceania</i> 18(1): 38-45.	Fire	Natural resource management	A&TSI, rural	QLD, NT, WA	Yes	No	Yes
Leonard, S., et al. (2013). The role of culture and traditional knowledge in climate change adaptation: Insights from East Kimberley, Australia. <i>Global Environmental Change</i> 23(3): 623-632.	Climate change	Natural resource management	Mirriwoong, rural	WA, NT	Yes	No	Yes
Lewis, H. T. (1989). Ecological and technological knowledge of fire - Aborigines vs. park rangers in Northern Australia. <i>American Anthropologist</i> 91(4): 940-961.	Fire	Natural resource management	Gagadju, rural	NT	Yes	No	Yes

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AUTHOR, TITLE	DISASTER TYPE	THEME	PEOPLES STUDIED	STATE /TERR	A&TSI PARTICIPANTS?	A&TSI AUTHORS?	INCLUDES IK/TEK?
Lewis, H. T. (1994). Management fires vs. corrective fires in northern Australia: An analogue for environmental change. <i>Chemosphere</i> 29 (5): 949-963.	Fire	Natural resource management	Gurig, rural	NT	Yes	No	Yes
Ligtermoet, E. (2016). Maintaining customary harvesting of freshwater resources: sustainable Indigenous livelihoods in the floodplains of northern Australia, <i>Rev Fish Biol Fisheries</i> 26 : 649-678.	Flood	Natural resource management	Mengerddji & Erre-Wurringak, rural	NT	Yes	No	Yes
Lynch, A. H., et al. (2013). The role of the Yorta Yorta people in clarifying the common interest in sustainable management of the Murray-Darling Basin, Australia. <i>Policy Sciences</i> 46 (2): 109-123.	Flood	Natural resource management	Yorta Yorta, rural	NSW, Vic	Yes	yes	Yes
Lynch, A. H., et al. (2014). Policy diffusion in arid Basin water management: A Q method approach in the Murray-Darling Basin, Australia. <i>Regional Environmental Change</i> 14 (4): 1601-1613.	Flood	Natural resource management	Yorta Yorta, rural	NSW, Vic	Yes	No	Yes
Maclean, K. (2009). Re-conceptualising desert landscapes: unpacking historical narratives and contemporary realities for sustainable livelihood development in central Australia. <i>GeoJournal</i> 74 (5): 451-463.	Fire	Natural resource management	Walpiri, rural	NT	Yes	No	Yes
Maclean, K., et al. (2014). Australia's indigenous carbon economy: a national snapshot. <i>Geographical Research</i> 52 (2): 123-132.	Climate change	Emissions trading scheme	A&TSI, nationwide	Australia	No	No	No

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AUTHOR, TITLE	DISASTER TYPE	THEME	PEOPLES STUDIED	STATE /TERR	A&TSI PARTICIPANTS?	A&TSI AUTHORS?	INCLUDES IK/TEK?
Maddock, N. (2016) Managed by us mob: Helping remote northern communities face natural hazards, <i>Australian Journal of Emergency Management</i> , 31(2): 55-57.	fire	Disaster risk reduction	Ngukurr, rural	NT	Yes	No	Yes
McGregor, S., et al. (2010). Indigenous wetland burning: conserving natural and cultural resources in Australia's World Heritage-listed Kakadu National Park. <i>Human Ecology</i> 38(6): 721-729.	Fire	Natural resource management	Bininj, rural	NT	Yes	yes	Yes
McIntyre-Tamwoy, S., et al. (2013). Understanding climate, adapting to change: Indigenous cultural values and climate change impacts in north Queensland. <i>Local Environment</i> 18(1): 91-109.	Climate change	Natural resource management	Injinoo & Giringun, rural	Qld	Yes	No	Yes
McLachlan, E. (2003). Seagulls on the airstrip: Indigenous perspectives on cyclone vulnerability awareness and mitigation strategies for remote communities in the Gulf of Carpentaria. <i>Australian Journal of Emergency Management</i> 18(1): 4-12.	Cyclone	Emissions trading scheme	Lardil, rural	Qld	Yes	No	Yes
McLoughlin, L. C. (1998). Season of burning in the Sydney region: The historical records compared with recent prescribed burning. <i>Australian Journal of Ecology</i> 23(4): 393-404.	Fire	Natural resource management	A&TSI, nationwide	NSW	No	No	No

Appendix: Studies included in narrative analysis

AUTHOR, TITLE	DISASTER TYPE	THEME	PEOPLES STUDIED	STATE /TERR	A&TSI PARTICIPANTS?	A&TSI AUTHORS?	INCLUDES IK/TEK?
McNamara, K. E. & McNamara, J. P. (2011). Using participatory action research to share knowledge of the local environment and climate change: Case study of Erub Island, Torres Strait. <i>Australian Journal of Indigenous Education</i> 40 : 30-39.	Climate change	Natural resource management	Erubam Le, rural	Torres Strait Islands	Yes	No	Yes
McNamara, K. E. & Westoby, R. (2011). Local knowledge and climate change adaptation on Erub Island, Torres Strait. <i>Local Environment</i> 16 (9): 887-901.	Climate change	Natural resource management	Erubam Le, rural	Torres Strait Islands	Yes	No	Yes
Morton, J. (2006). Tiddalik's Travels: The making and remaking of an Aboriginal flood myth. <i>Advances in Ecological Research</i> 39 : 139-158.	Flood	Flood mythology	A&TSI, nationwide	Vic	Yes	No	Yes
Murphy, B. P. & Bowman, D. M. J. S. (2007). The interdependence of fire, grass, kangaroos and Australian Aborigines: a case study from central Arnhem Land, northern Australia. <i>Journal of Biogeography</i> 34 (2): 237-250.	Fire	Natural resource management	A&TSI, rural	NT	No	No	No
Newman, M. & Smith, S.A. (2004). Integration of emergency risk management into West Australian Indigenous communities, <i>The Australian Journal of Emergency Management</i> 19 (1): 10-15.	Fire	Disaster risk reduction	A&TSI, rural	WA	No	No	No

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AUTHOR, TITLE	DISASTER TYPE	THEME	PEOPLES STUDIED	STATE /TERR	A&TSI PARTICIPANTS?	A&TSI AUTHORS?	INCLUDES IK/TEK?
Niall, S., et al. (2013). Climate change and redd+: integrating customary fire-management schemes in east Malaysia and northern Australia. <i>SOJOURN</i> 28 (3): 538-571.	Climate change	Emissions trading scheme	A&TSI, rural	qld, nt, wa	No	No	Yes
Nikolakis, W. et al. (2016). Indigenous communities and climate change: A Recognition, Empowerment and Devolution (RED) framework in the Murray-Darling Basin, Australia, <i>Journal of Water and Climate Change</i> 7 (1): 169-183.	Climate change	Natural resource management	A&TSI, rural	Qld, NSW, SA	Yes	No	Yes
Ockwell, D. G. (2008). 'Opening up' policy to reflexive appraisal: A role for Q Methodology? A case study of fire management in Cape York, Australia. <i>Policy Sciences</i> 41 (4): 263-292.	Fire	Natural resource management	A&TSI, rural	Qld	Yes	No	Yes
Parker, C. H. (2015). <i>On the evolution of human fire use</i> . Ann Arbor: University of Utah. 3727082 : 100.	Fire	Natural resource management	Martu, women, rural	WA, NT	Yes	No	Yes
Pearce, M., et al. (2010). Attitudes to drought in outback communities in South Australia. <i>Geographical Research</i> 48 (4): 359-369.	Drought	Risk perception	A&TSI, rural	SA	Yes	No	Yes
Pearce, M., et al. (2015). Cut from 'Country': The impact of climate change on the mental health of Aboriginal pastoralists. <i>Australasian Journal of Regional Studies</i> 21 (1): 50-79.	Climate change	Health impacts of climate change	A&TSI, rural	Qld	Yes	No	No
Petheram, L., et al. (2010). 'Strange changes': Indigenous perspectives of climate change and adaptation in	Climate change	Climate Change Adaptation	Yolgnu, women, rural	NT	Yes	No	Yes

Appendix: Studies included in narrative analysis

AUTHOR, TITLE	DISASTER TYPE	THEME	PEOPLES STUDIED	STATE /TERR	A&TSI PARTICIPANTS?	A&TSI AUTHORS?	INCLUDES IK/TEK?
NE Arnhem Land (Australia). <i>Global Environmental Change</i> 20 (4): 681-692.							
Prober, S.M. et al. (2016). Ngadju kala: Australian Aboriginal fire knowledge in the Great Western Woodlands, <i>Austral Ecology</i> 41 : 716-732.	Fire	Natural resource management	Ngadju, rural	WA	Yes	yes	Yes
Pyne, S. J. (1991). Fire Down Under. <i>Sciences</i> 31 (2): 39.	Fire	Natural resource management	A&TSI, nationwide	Australia	No	No	Yes
Race, D. et al. (2016). Understanding climate adaptation investments for communities living in desert Australia: experiences of Indigenous communities, <i>Climatic Change</i> 139 : 461-475.	Climate change	Natural resource management	A&TSI, rural	NT	Yes	yes	Yes
Ross, J. & Gerrard , E. (2008). Climate change: Issues facing Indigenous Australians, <i>Indigenous Law Bulletin</i> 7 (8): 7-10.	Climate change	Human Rights	A&TSI, nationwide	Australia	No	No	No
Russell-Smith, J., et al. (1997). Aboriginal resource utilization and fire management practice in western Arnhem Land, monsoonal northern Australia: Notes for prehistory, lessons for the future. <i>Human Ecology</i> 25 (2): 159-196.	Fire	Natural resource management	Gundjeihmi, rural	NT	Yes	yes	Yes
Russell-Smith, J., et al. (2015). Deriving multiple benefits from carbon market-based savanna fire management: An Australian example. <i>PLoS ONE</i> 10 (12).	Fire	Emissions trading scheme	A&TSI, nationwide	NT	Yes	No	No

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AUTHOR, TITLE	DISASTER TYPE	THEME	PEOPLES STUDIED	STATE /TERR	A&TSI PARTICIPANTS?	A&TSI AUTHORS?	INCLUDES IK/TEK?
Skertchly, A. & Skertchly, K. (2000). Traditional Aboriginal knowledge and sustained human survival in the face of severe natural hazards in the Australian monsoon region: some lessons from the past for today and tomorrow. <i>Australian Journal of Emergency Management</i> 14(4): 42-50.	Cyclone	Disaster risk reduction	A&TSI, rural	NT	No	No	Yes
SteWArt, J. et al. (2016). Carbon profiles of remote Australian Indigenous communities: A base for opportunities, <i>Energy Policy</i> 94: 77-88.	Climate change	Emissions trading scheme	A&TSI, rural	NT	Yes	No	No
Stocker, L. et al. (2016). Aboriginal world views and colonisation: implications for coastal sustainability, <i>The International Journal of Justice and Sustainability</i> 21(7): 844-865.	Climate change	Natural resource management	Nyungar, rural	WA	Yes	yes	Yes
Trauernicht, C., et al. (2015). Local and global pyrogeographic evidence that Indigenous fire management creates pyrodiversity. <i>Ecology and Evolution</i> 5(9): 1908-1918.	Fire	natural resource management	A&TSI, rural	nt	No	No	Yes
Trauernicht, C., et al. (2016). Human-imposed, fine-grained patch burning explains the population stability of a fire-sensitive conifer in a frequently burnt northern Australia savanna, <i>Ecosystems</i> 19: 896-909.	Fire	Natural resource management	A&TSI, rural	NT	No	No	No

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AUTHOR, TITLE	DISASTER TYPE	THEME	PEOPLES STUDIED	STATE /TERR	A&TSI PARTICIPANTS?	A&TSI AUTHORS?	INCLUDES IK/TEK?
Vaarzon-Morel, P. & Gabrys, K. (2009). Fire on the horizon: Contemporary Aboriginal burning issues in the Tanami Desert, central Australia. <i>GeoJournal</i> 74 (5): 465-476.	Fire	Natural resource management	Walpiri, rural	NT	Yes	No	Yes
Verran, H. (2002). A postcolonial moment in science studies: Alternative firing regimes of environmental scientists and Aboriginal landowners. <i>Social Studies of Science</i> 32 (5-6): 729-762.	Fire	Integration IK and science	Yolgnu, rural	nt	No	No	Yes
Vigilante, T. (2001). Analysis of explorers' records of aboriginal landscape burning in the Kimberley region of Western Australia. <i>Australian Geographical Studies</i> 39 (2): 135-155.	Fire	Natural resource management	A&TSI, rural	WA	No	No	No
Vigilante, T. & Bowman, D. (2004). Effects of fire history on the structure and floristic composition of woody vegetation around Kalumburu, North Kimberley, Australia: A landscape-scale natural experiment. <i>Australian Journal of Botany</i> 52 (3): 381-404.	Fire	Natural resource management	A&TSI, rural	WA	No	No	No
Vigilante, T., et al. (2004). Contemporary landscape burning patterns in the far North Kimberley region of north-west Australia: human influences and environmental determinants. <i>Journal of Biogeography</i> 31 (8): 1317-1333.	Fire	Natural resource management	A&TSI, rural	wa	No	No	Yes

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AUTHOR, TITLE	DISASTER TYPE	THEME	PEOPLES STUDIED	STATE /TERR	A&TSI PARTICIPANTS?	A&TSI AUTHORS?	INCLUDES IK/TEK?
Webb, L., et al. (2014). Effect of ambient temperature on Australian Northern Territory public hospital admissions for cardiovascular disease among Indigenous and Non-Indigenous populations. <i>International Journal of Environmental Research and Public Health</i> 11 (2): 1942.	Heatwave	Health impacts of climate change	A&TSI, urban	NT	No	No	No
Whitehead, P. J., et al. (2008). The management of climate change through prescribed Savanna burning: Emerging contributions of indigenous people in Northern Australia. <i>Public Administration & Development</i> 28 (5): 374.	Climate change	Emissions trading scheme	A&TSI, rural	NT	No	No	No
Wilman, E. A. (2015). An economic model of Aboriginal fire-stick farming. <i>Australian Journal of Agricultural and Resource Economics</i> 59 (1): 39-60.	Fire	Emissions trading scheme	A&TSI, nationwide	Australia	No	No	No
Yates, J. (1997). Federalism and disaster mitigation in remote Aboriginal communities in Western Australia. <i>Australian Journal of Emergency Management</i> 12 (3): 25-32.	All hazards	Disaster risk reduction	A&TSI, rural	WA	No	No	No
Yibarbuk, D., et al. (2001). Fire ecology and Aboriginal land management in central Arnhem Land, northern Australia: a tradition of ecosystem management. <i>Journal of Biogeography</i> 28 (3): 325-343.	Fire	Natural resource management	Guneij, rural	NT	Yes	yes	Yes

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AUTHOR, TITLE	DISASTER TYPE	THEME	PEOPLES STUDIED	STATE /TERR	A&TSI PARTICIPANTS?	A&TSI AUTHORS?	INCLUDES IK/TEK?
Zander, K. K., et al. (2013). Stay or leave? Potential climate change adaptation strategies among Aboriginal people in coastal communities in northern Australia. <i>Natural Hazards</i> 67(2): 591-609.	Climate change	Climate Change Adaptation	Yolgnu, women, rural	NT	Yes	No	no