

Social science research on Indigenous wildfire management in the 21st century and future research needs

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Abstract. This article reviews social science research on Indigenous wildfire management in Australia, Canada and the United States after the year 2000 and explores future research needs in the field. In these three countries, social science research exploring contemporary Indigenous wildfire management has been limited although there have been interesting findings about how Indigenous culture and knowledge influences fire management. Research with Indigenous communities may be limited not because of a lack of interest by social scientists, but rather by obstacles to doing research with Indigenous communities, such as ethical and time concerns. Research needs on Indigenous wildfire management are presented, centred on the four pillars of emergency management (preparedness, mitigation, response and recovery).

Additional keywords: Aboriginal, Australia, Canada, culture, Native American, mitigation, USA.

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Introduction

Despite fairly extensive knowledge on traditional burning practices (Huffman 2013), little is known about how wildfire is currently managed in Indigenous communities worldwide (Carroll *et al.* 2004; Huntington *et al.* 2006; Carroll *et al.* 2010). Indigenous communities are frequently at high risk from wildfire because they are often situated in isolated, remote locations in landscapes prone to fire. Indigenous populations are increasing rapidly compared with the general population. For example, between 1996 and 2006 the population of Aboriginal people in Canada grew by 45%, nearly six times faster than the non-Aboriginal growth rate (Statistics Canada 2008). As well, research has shown that climate change will increase the frequency of large wildfires, putting Indigenous communities who depend upon forests for both cultural and subsistence purposes at further risk (Voggeser *et al.* 2013). Indigenous communities often face a range of socio-economic issues of increasing complexity and severity in some communities, making fire management a lower priority. Social science research with Indigenous populations on fire management can help to inform policy in the face of global changes such as climate change, biodiversity loss and economic change. The objectives of this insight article are (1) to review existing social science literature published after 2000 on contemporary wildfire management in Indigenous communities

in Canada, Australia and the United States and (2) to identify future research needs.

Indigenous^A cultures around the world vary tremendously in traditions, language and beliefs. However, one thing they have had in common was the use of fire for landscape modification to support a subsistence lifestyle (for examples, see Lewis 1988a; Huffman 2013). From burning of savannas to facilitate hunting using the stars and constellations as a guide in Brazil (de Melo and Saito 2013), to burning tropical wet-dry grasslands to aid the growth of the 'green pick' needed for livestock in Africa (Kull and Laris 2009), burning around campsites to clear vegetation where snakes may be hiding in Australia (Lewis 1989) and burning in early spring in the Canadian boreal forest to extend the growing season (Lewis 1982)^B, Indigenous people have used fire for a multitude of resource objectives. There is a major distinction between wildfire and fire resulting from the burning practices of Indigenous people. Wildfires can be natural or caused by humans and generally occur in the summer months or at other times when vegetation is dry and conducive to burning out of control. In contrast, traditional burns are controlled and generally take place during low risk conditions, such as the early spring or late fall. These burns are started by people with knowledge and experience of fire behaviour and control and are carried out to achieve certain objectives.

^AIndigenous peoples refers to original peoples internationally who have experienced colonisation. It is a term that emerged in the 1970s from the American Indian Movement and the Canadian Indian Brotherhood (Smith 1999).

^BPhysical fire science research has shown that fire can have an effect on the thermal stability of both continuous and discontinuous permafrost (Hinzman *et al.* 2003; Jafarov *et al.* 2013). Fire that burns the organic layer of the soil can lead to accelerated thawing in a relatively short period of time (Jafarov *et al.* 2013).

Much of the knowledge of traditional burning has been collected through ethnographic research, typically by anthropologists. This research documents historical reasons for traditional burning practices as well as techniques and knowledge of the practices (for examples, see Lewis 1982; Arno 1983; Reid 1987; Gottesfeld 1994; Clark and Royall 1995; Crowley and Garnett 2000; Dey and Guyette 2000; Kimmerer and Lake 2001; Stewart 2002; Russell-Smith *et al.* 2003; Bird *et al.* 2005; Bowman *et al.* 2007). Rationales included promoting pastures, creating habitat for game animals, minimising pests and providing protection from out-of-control wildfires (Lewis 1983, 1988a, 1988b; Williams 2002; Carroll *et al.* 2004; McDaniel *et al.* 2005; Huntington *et al.* 2006; Oetelaar and Oetelaar 2007).

However, the use of fire changed significantly after colonisation, in some countries more than others. Colonisers worldwide noted the prevalence of fires in the new territories they were exploring (Pyne 1995, 2007; Pyne 2012; G. A. Oetelaar and D. J. Oetelaar, unpubl. data, 2008). The colonial worldview was that fires were destructive to the timber supply and dangerous to communities (Pyne 2007). Therefore, fires were suppressed and the deliberate starting of fires was outlawed (Murphy 1985; Timbrook *et al.* 1993; Murphy *et al.* 2007). However, the colonisers view of fire and the forests was largely one dimensional. Nancy Turner states it best: 'It is ironic that the landscapes so appreciated by the early explorers and colonists actually were created by the very fires they feared and disliked' (Turner 1999, p. 194). As early as 1956, geographer Carl Sauer noted the dangers of fire suppression stating, 'the longer the accumulation, the greater the fire hazard and the more severe the fire when it results' (Sauer 1956, p. 56)

Social science research on contemporary (since 2000) Indigenous wildfire management in Canada, Australia and the USA

This section focuses on social science literature published about contemporary (post-2000) wildfire management in Indigenous communities in Canada, Australia and the United States of America (USA). This paper focuses on these countries because of their similarities: (1) in all three countries, there is a large body of social science research on wildfire management in non-Indigenous communities; (2) Indigenous people in all three countries underwent 'similar' experiences after colonisation, with burning practices being widely outlawed and (3) all three countries currently have similar wildfire management policies, with a large amount of resources devoted to fire suppression. However, it is important to note that social science research on contemporary wildfire management by Indigenous peoples has been conducted in other countries where fire suppression has not occurred at the same level as in Canada, Australia and the USA (for example, see Laris 2002; Mathews 2005; McDaniel *et al.* 2005; Mistry *et al.* 2005; Kull and Laris 2009; Shaffer 2010; de Melo and Saito 2013; Sletto and Rodriguez 2013).

Canada

Aboriginal people have been burning in the forests and on the prairies of Canada for millennia with the goal of managing vegetation to support their subsistence lifestyle (Ferguson 1979; Oetelaar and Oetelaar 2007; Pyne 2007). It is estimated that the practice of traditional burning in Alberta dates back

~8500 years (Lewis 1982, 1983; Holehouse 2001; Oetelaar and Oetelaar 2007). Pyne (2007) remarks that Aboriginal peoples 'sought to replace fires of chance with fires of choice' (p. 23).

Aboriginal peoples were often blamed for starting high-hazard wildfires. However, John Macoun of the Geological Survey of Canada (1882, as quoted in Holt 1998, pp. 21–22) felt that Aboriginal people did not deserve the blame. According to Macoun:

There is a penalty of \$200 for starting a prairie fire, and as the informer gets half the money, the Indians [First Nations] and Halfbreeds [Métis] are constantly on the alert during the dangerous season, to pounce on any delinquent. Many people blame the Indians for setting the prairie on fire, but my experience leads me to lay blame on white men, especially the young bloods who go shooting in the fall. A stump of a cigar dropped on the prairie is much more dangerous than an Indian fire.

In Canada, as in many other countries, burning was outlawed and replaced with a centralised system that aimed to suppress all forest fires (Lewis 1978). The first known record of a fire suppression campaign by a government in Canada was in 1610 in Newfoundland, where it was declared that 'No person shall set fire in the woods' (Apsey 2003, p. 758). This colonial view significantly influenced Aboriginal burning practices and perception of fire in Canada.

Approximately 80% of the Aboriginal communities in Canada are located in forests prone to wildfire. Despite the potential risk, social science research on wildland fire management in Aboriginal communities has been scarce. Before 2000, most studies were conducted in northern Alberta (Lewis 1977; Ferguson 1979; Lewis 1982, 1988a, 1988b; Newton 1995; Epp *et al.* 1998; G. A. Oetelaar and D. J. Oetelaar, unpubl. data, 2008). The fire management situation in many Aboriginal communities is complex, primarily because jurisdiction for wildfire management lies with the provinces and territories, but the majority of Aboriginal people and communities are under federal jurisdiction because of treaty agreements. The federal government maintains fire management agreements with each province or territory to provide fire management resources to Aboriginal communities, most of which clearly outline suppression activities and reimbursement. However, it is not always clear who is the party responsible for wildfire risk reduction and post-fire activities.

A community-based research study on contemporary (2006–2011) fire management with Peavine Métis Settlement in northern Alberta found that all participants had experienced wildfires in one way or another (Christianson 2011). Some traditional burning knowledge still existed in the community amongst Elders; however, the larger influence on wildfire management in the community was firefighting experience (Christianson 2011; Christianson *et al.* 2013). A large proportion of the men and some women had been employed as firefighters by the provincial wildfire management branch. This experience made them cautious of burning for hazard abatement on their settlement for fear that a fire would burn out of control. The firefighters were much more likely to support vegetation management, such as thinning. Importantly, participants thought the current state of the forest was unhealthy because it was overgrown. This is in contrast to studies in non-Aboriginal

communities, in which some participants wanted to protect the current state of forests surrounding their homes (Nelson *et al.* 2005; Cohn *et al.* 2007). Another important factor that affected wildfire management at Peavine was land and home ownership (Christianson *et al.* 2012). On Métis settlements in Alberta, one can hold title to a property, but the settlement owns all land and homes in the community. Wildfire management on individual properties, therefore, was often viewed as a settlement responsibility. Participants also stressed the importance of making communal decisions and using collective action for problem solving. Other factors found to influence wildfire management included local leadership (and distrust of outsiders), economics and community capacity (Christianson *et al.* 2012).

Lewis (2013) examined the resurgence of burning practices by Aboriginal people in Lytton First Nation after a change in burning policy in wildfire management in British Columbia. He found that although fire use occurs in Lytton the scope has decreased, both in size and application. Although burning continues to follow traditional rationales, debris control and hazard abatement have become the main reasons for burning and traditional burning objectives (such as improving foodstuffs) have become less common.

Miller and Davidson-Hunt (2010) examined the role of fire in the Anishinaabe culture in north-western Ontario through interviews and field trips with Elders. The Elders considered fire to be a living sentient being. They discussed three sources for their knowledge: (1) the use of fire in domestic activities, (2) the use of fire as a means to manipulate vegetation and (3) employment as professional firefighters (Dunning 1959, as described in Miller and Davidson-Hunt 2010). Burning in the community had been stopped by the province in the 1950s, and the last large controlled burn (of a marsh) occurred in 1996. However, burning is still conducted in the spring to remove dead grass around homes. The Elders were knowledgeable about fire behaviour being linked to weather, topography, soil type and fuel conditions. They also spoke of how forests recovered after a fire. Miller and Davidson-Hunt (2010) concluded that '... fire management has a moral dimension. Currently [the provincial wildfire management agency] directs management decisions for both forests and forest fires following political, technical, and scientific guidelines in which the moral guidelines for fire management offered by residents of Pikangikum may find little traction' (p. 412).

Australia

Perhaps the most documented examples of historical Aboriginal burning practices are from Australia, where Aboriginal people burned to enhance hunting and plant resources (Lewis 1989; Crowley and Garnett 2000; Russell-Smith *et al.* 2003; Whitehead *et al.* 2003; Bird *et al.* 2005; Gott 2005; Huffman 2013). This type of burning has been conducted by Aboriginal people for 35 000 to 40 000 years (Lewis 1989). However, there is still debate as to whether burning was ecologically beneficial (see Verran 2002 for a discussion). Fire activity in northern Australia had actually increased during the transition from Aboriginal to European land management regimes (Bowman *et al.* 2007), but Australia quickly moved to a fire management policy of suppression because of several large and damaging fires. Current laws regarding wildfires in many parts of the

country do not recognise traditional Aboriginal practices of prescribed burning (Preece 2007); however, the Bushfires Northern Territory agency of the Northern Territory government is currently developing a bushfires management strategy that continues to incorporate Aboriginal burning practices on traditional lands (Northern Territory Government Department of Land Resource Management 2012). A recent physical science study comparing fire management during European and Aboriginal tenures in northern Australia found significant differences between when burning was conducted (during European tenures burning occurred earlier in the dry season), resulting ecosystems (weeds were more frequent during European tenures; feral animals were more plentiful during Aboriginal tenures) and resulting fire regimes (more intermediate during Aboriginal tenures) (Franklin *et al.* 2008). However, it has been difficult for fire managers and scientists to understand the ritualised approach to burning practices of Aboriginal people (Verran 2002).

Monaghan (2004) examined socio-political influences on fire management in two remote Aboriginal communities in northern Australia. He found that wildfire mitigation was an important part of life for Aboriginal people. Aboriginal participants regarded wildfire in the dry season to be the main hazard in their region. In these communities, Aboriginal residents conducted various mitigation activities, such as firebreaks, fencing and vegetation management, around their communities, outstations and camping areas. Monaghan (2004) also found that Aboriginal residents were more accepting of wildfire risk and had more trust in the capacity of their community (including the Council, the police and the state emergency services) to deal with wildfire than non-Aboriginal people in the community. Monaghan (2004) found that the socio-political context of each community, particularly the presence of local kinship networks, increased the development and implementation of wildfire risk management. Most members of both communities felt that intervention from outside agencies was not required for wildfire management because the issue was dealt with adequately by their community.

A second community-based study was conducted in 2005 with Aboriginal people in the southern Tanami, located in the Northern Territory (north-west of Alice Springs), using interviews and participant observation (Gabrys and Vaarzon-Morel 2009). The research focussed on 'finding out why, how, when and where Aboriginal people burn, and who is doing the burning' and also 'sought to determine Aboriginal perceptions of fire issues and conflicts (if any), local interest in livelihoods in relation to fire, and current fire knowledge and use of tradition-derived fire practices in the contemporary context' (p. 88). A key finding of this study was that although significant changes to the lifestyles of Aboriginal people had occurred over the last decades, a decline in fire knowledge or use did not occur; however, there were differences in knowledge retention based on age, sex, life experience and history of land use. It was generally thought that fire was a way to look after the land. Numerous factors influenced decisions about burning, including environmental (i.e. time of day and year, fuel load, wind direction and speed, and temperature) and social concerns (i.e. traditional ownership and effects on hunting and gathering). Aboriginal participants noted that restricted road access to certain areas influenced their ability to burn regularly and that

they received mixed messages about fire from agencies and neighbours. The researchers noted many of the concerns of Aboriginal participants about fire were similar to the concerns of their non-Aboriginal neighbours, fire managers and scientists, including the risks of out-of-control fire on certain areas with cultural, economic or social values. Aboriginal participants also noted they lacked firefighting equipment to extinguish out-of-control fires. Participants were interested in increasing their involvement in fire-related activities, particularly in knowledge transfer or employment opportunities.

United States of America

The land that constitutes the USA has been managed extensively by Indigenous peoples for tens of thousands of years, including the use of fire (Arno 1983; Lewis 1983, 1988b; MacCleery 1994; Dickason 2002; Dods 2002; Stewart 2002; Williams 2002; Murphy *et al.* 2007). A summary of Indigenous burning practices across North America was written by Stewart (2002), who is considered to be one of the first to recognise the influence of Indigenous burning practices on 'natural landscapes'. Reasons for burning by Native Americans included, but were not limited to, burning to facilitate hunting, crop management, improving growth and yields, fireproofing areas, insect collection, pest management, warfare and signalling, economic extortion, clearing areas for travel, felling trees, clearing riparian areas and ceremonies (Loscheider 1977; Phillips 1983; Stewart 2002; Williams 2002). As in Canada and Australia, in the USA the loss of fire in the landscape can be directly linked to the removal of Native Americans from their traditional lands and following policies of fire suppression (Gruell 1983; Kimmerer and Lake 2001; Rasmussen 2005; Murphy *et al.* 2007; Yazzie 2007). However, some Native American tribes are making a concerted effort to bring fire back to their traditional territories (Terence 2012).

Two studies in the USA used surveys to compare Native Americans with the general population. Winter and Cvetkovich (2007) compared ethnic groups and found that Native Americans were more concerned about wildfire and had a higher self-assessed level of knowledge of wildfire than other ethnic groups in the region. Native Americans had the lowest trust in wildfire managers and were divided as to whether some fires should be allowed to burn and only structures protected or whether all fires should be extinguished. Another study in Montana examined willingness to pay for prescribed burning and mechanical fuel reduction (González-Cabán *et al.* 2007). Results showed that support for prescribed burning was similar for Native Americans and the general population, but Native Americans showed a higher level of support for mechanical fuel reduction programs.

Four studies of Native Americans were conducted in the Pacific North-west using interviews, focus groups and participant observation (Carroll *et al.* 2004; Weisshaupt *et al.* 2007; Watson *et al.* 2009; Carroll *et al.* 2010). The first focussed on fire risk perception and the use of fire as a management tool amongst non-industrial private and tribal forest landowners in Washington State. Carroll *et al.* (2004) found tribal landowners spoke about the land in terms of hundreds or thousands of years of land ownership. They also found that tribal members spoke about insects, disease and uncontrolled wildfire as threats

to the forest but also emphasised the lack of periodic fire as a threat. Tribal members were highly supportive of prescribed burning, particularly to improve wildlife habitat, and were generally accepting of smoke as part of rural life. The second study was conducted with the Nez Perce tribe on their contemporary views of wildfire management (Carroll *et al.* 2010). Findings showed that the cultural significance of fire remained in the community, and there was some knowledge of using fire as a management tool. However, many in the community were employed as firefighters, resulting in a 'hybridisation of knowledge and practices from a traditional culture with those from the now-dominant culture' (Carroll *et al.* 2010, p. 75). The third study of residents in the northern Inland West of Washington State, including members of the Colville Confederated, Spokane and Kalispel Tribes, examined what residents think is needed to reduce wildfire risk and who should bear the responsibility for mitigation (Weisshaupt *et al.* 2007). The Native Americans had more experience with fire management than other residents and emphasised that current forests are overgrown with heavy fuels. Most said they had burned on their own property; they felt that defensible space around a home was important and that responsibility and financial obligation for reducing fire risk belonged to the homeowner. As the authors noted,

The natives who, it seems, accepted both natural and human-caused fires as a part of life, understood the preemptive measures needed to protect oneself from the threat of a wildland fire. The idea of mitigating personal fire risk was strongest with the tribal groups. [Weisshaupt *et al.* 2007, p. 184]

The fourth study, with residents of the Flathead Indian Reservation in Montana, described and mapped values within an area that could potentially be affected by fuel treatments and fire management (Watson *et al.* 2009). Five layers of values were delineated: (1) protection of the wilderness, (2) wildlife and water quality, (3) recreation and scenic values, (4) access and functional attachments and (5) personal and cultural meanings. Participants were aware that the buffer zone was overgrown and there was risk of fire. It was found that protection of wilderness was mapped with the greatest uniformity and, although wildfire was widely recognised as a threat, logging was also commonly listed.

Another study in the Pacific Northwest used surveys and interviews to examine economic opportunities involving fire management amongst 31 tribes (Rasmussen 2005; Rasmussen *et al.* 2007). The researchers found tribes were already involved in several fire management activities (including seasonal firefighting and fuels reduction) and were interested in expanding their fire management programs but were concerned about constraints including the seasonality of work and cost of equipment and training programs. Opportunities associated with biomass utilisation and non-timber forest products were mentioned; however, each had numerous constraints and concerns mentioned by participants. Rasmussen *et al.* (2007) also noted that although fire was not used by the tribes to the same extent it has been historically, some tribes were using or planning to use burning on small to medium scale projects.

In the American South-west, Native Americans were found to have a strong desire to manage their own burning programs

for economic benefits and to be involved in management decisions about prescribed burning (Raish *et al.* 2005). In Alaska, Ray *et al.* (2012) found Koyukon participants from Galena and Huslia reported that recent severe wildfires dramatically affected subsistence practices (including resources and access) and perceived more wildfire-induced hardships than benefits. Participants also indicated that landscape flammability was higher because of warmer temperatures and forest overgrowth. Ray *et al.* (2012) found participants felt that the negative effects of using wildfire as a management tool would outweigh the positives. Another study of the Koyukon in Huslia, Alaska (Huntington *et al.* 2006, Natcher *et al.* 2007^c) found that participants had a unique worldview of fire and the 'context in which fire is viewed has an important influence on perceptions of fire's impact and significance' (Huntington *et al.* 2006, p. 5). Participants were frustrated that they were not able to collaborate in decisions about fire on federal lands that had an effect on their livelihoods. A unique finding from this study was that the Koyukon considered fire to be destructive and had no knowledge of using fire for landscape management (Natcher *et al.* 2007). As the authors note, 'these findings call into question the commonly held view that native peoples of North America pervasively and near universally modified landscapes through the use of fire' (Natcher *et al.* 2007, p. 1).

In 2010, a workshop was held in Montana with seven tribal Elders and 20 Native and non-Native scientists, resource managers and academics to discuss how to integrate Native American knowledge and stewardship practices with western science aimed at addressing contemporary wildfire challenges, including forest health (Mason *et al.* 2012). Elders at the workshop noted burning had been an important part of life for their people but was stopped by 'white people' who are now realising the consequences of this decision and are coming to Native Americans to ask what could be done. The Elders realised the irony of this but were eager to help and share knowledge in a respectful and reciprocal manner. However, they noted sharing of knowledge would not be straightforward because of differences in terminology and preferences for communication. As well, tribes tend to burn for different outcomes than do fire managers, such as improving hunting grounds. One Native American graduate student, also a fire manager for his reservation, spoke about how they had developed a fuels program to return fire to the landscape. Tribal foresters at the workshop discussed the importance of protecting cultural values including places of spiritual significance, traditional foodstuffs, access to wood, certain wildlife habitats, medicines and others.

Discussion

The small number of social science studies in Canada ($n = 3$), Australia ($n = 2$) and the USA ($n = 11$) since 2000 may not be related to a lack of interest in contemporary wildfire management in Indigenous communities, but rather related to obstacles to doing research with Indigenous communities. Many Indigenous communities have developed strict ethical guidelines for researchers who want to conduct research in their community because of a history of inappropriate and insensitive research

being conducted 'on' Indigenous people (Smith 1999). These ethical guidelines often call for collaboration by using community-based or participatory research where the community is involved in all aspects of the research, including setting the research goals and objectives, primarily to address issues of power (Grenier 1998; Schnarch 2004; Canadian Institutes of Health CIHR 2007). These approaches assume that individuals can reflect on their own experiences, have their own priorities and questions, as well as skills and concerns that contribute to the research process (Smith 1999). This involves a strong relationship between the community and the researcher. However, relationships can take a long time to establish and funding to support travel to and from communities for this endeavour can be difficult to find. Non-Indigenous researchers may also be concerned about offending community members because of a lack of awareness of local customs. As well, qualitative research methods have also been found to be appropriate for studies with Aboriginal communities but can be time-consuming compared with using quantitative methods, such as survey research.

Although considered time-consuming and intensive, community or participatory-based research with Indigenous communities can be incredibly rewarding for the community, researcher and associated agencies. It gives the community its own voice to conduct research on what matters to them, and they can be active players in using the results to improve wildfire management. This type of research can lead to the development of trusting relationships that enable future research, as well as facilitate on-the-ground activities with wildfire management agencies (Mason *et al.* 2012).

There are also fundamental differences between worldviews that can make research difficult between westernised scientists and Indigenous peoples (Huntington *et al.* 2006; Ermine 2007). Often, it is difficult for one group to understand the other's worldview, which may complicate research and subsequent fire management. It is also sometimes difficult for a westernised social scientist to present an accurate description and analysis of Indigenous fire management because of these differences in worldview, which can even influence the context of words (Huntington *et al.* 2006). For example, Verran (2002) observed a workshop in Australia in 1996 where scientists came together to receive instruction about and observe a firing of a particular site. She found that 'westernised' scientists and fire managers were confused by the burning practices of the Aboriginal people leading the workshop because they appeared at times to be random and 'spur of the moment'. She found that burning by Aboriginal people was a ritualised process, and generalisations could be made between firing and prescribed burning that would be useful for fire managers and Aboriginal people that could facilitate shared understanding and mutual respect.

Research needs

The research needs identified here are centred on wildfire management and emergency management themes with the mutual goals of reducing the risks to Indigenous peoples and communities associated with wildfires. A summary of potential research questions is presented in Table 1.

^cThis study also examines the Gwich'in of Alaska, but because the research with the Gwich'in was conducted before 2000, the results are not included here.

Table 1. Potential research questions based on the four pillars of emergency management

| | Potential research questions |
|--------------|--|
| Preparedness | <ul style="list-style-type: none"> • Do Indigenous communities have the human capacity to develop the emergency plans required by many emergency management agencies? • Are Indigenous communities adequately prepared to deal with a wildfire event? • How knowledgeable are Indigenous children about wildfire risk? • How does the wildfire preparedness of an Indigenous community compare with a non-Indigenous community? • How do other social issues in Indigenous communities affect capacity or resources for wildfire preparedness? |
| Mitigation | <ul style="list-style-type: none"> • How do Indigenous communities currently mitigate wildfire risk? • What knowledge do generations other than Elders have about historic burning practices? • How are fire management agencies and Indigenous communities working together to implement prescribed burning? How do they handle differing intentions, outcomes or values? • Are the skills, training or resources needed to implement wildfire mitigation (such as burning or mechanical thinning) available in Indigenous communities? • How are issues such as climate and landscape change affecting mitigation strategies? • How do other social issues in Indigenous communities affect the capacity or resources for wildfire mitigation? • What are the positive and negative economic implications for Indigenous communities to implement wildfire mitigation? • How do home and land ownership in Indigenous communities affect the mitigation activities conducted? • Are programs like FireWise and FireSmart transferrable to Indigenous populations? |
| Response | <ul style="list-style-type: none"> • Are Indigenous communities adequately equipped to respond to a wildfire event affecting their community? • Do wildfire management plans for the area incorporate the appropriate tangible and intangible cultural resources? • What are the wildfire evacuation experiences of Indigenous peoples? • What are some of the challenges faced by Indigenous communities during a wildfire event that are different from those faced by non-Indigenous communities? • How do Chiefs and other community leaders make decisions during a wildfire event? |
| Recovery | <ul style="list-style-type: none"> • How do Indigenous communities cope after being affected by a wildfire event? • How do Indigenous communities recover financially from a wildfire event? • How does experiencing a wildfire evacuation affect Indigenous peoples in the long-term? |

Preparedness

Little is known about how prepared Indigenous communities are to handle a wildfire event. The term preparedness is the first phase in the emergency management cycle and is used to evaluate how prepared a community is to handle an emergency event. [Bonde \(2011\)](#) assessed the disaster preparedness of Dog Creek reserve in British Columbia and found that the reserve lagged behind other non-Aboriginal communities in preparedness. In the USA, many Native American reservations have Community Wildfire Protection Plans (CWPPs). These plans seek to increase the community's preparedness for wildfire by implementing planning efforts and mitigation activities, such as mechanical fuels reduction or prescribed burning. A useful guide for many communities is the *Tribal Wildfire Resource Guide*, which presents information about tribal and federal policy, federal wildland fire management planning, tribal wildfire plans and opportunities for economic development through fire management activities ([Resource Innovations 2006](#); [Rasmussen et al. 2007](#)). However, more research is needed to find out how wildfire events are specifically prepared for and whether additional resources may be required by communities.

Mitigation

Mitigation is the second phase of the emergency management cycle and is used to describe actions taken to reduce the risk of a hazard event affecting a community or a person.

Burning practices

Most of the social science research conducted on contemporary wildfire management in Indigenous communities in Canada, Australia and the USA has focussed on two topics: (1) the incorporation of historical burning practices into contemporary wildfire management and (2) support for and acceptance of prescribed burning programs. Unfortunately, a major consequence of enforced fire suppression has been the loss of knowledge on Indigenous burning practices ([Huffman 2013](#)). As early as the 1970s, Lewis stated that the few participants with firsthand knowledge of burning practices were Elders ([Lewis 1978](#)). In southern British Columbia, many Elders who recalled historical burning only observed the practices because they were too young to participate ([Turner 1999](#)). Therefore, it can be surmised that much of the knowledge surrounding burning practices has been lost to time^D. This is why works by researchers such as Lewis, Stewart and Anderson

^DThere is still knowledge of historical burning practices as documented in recent research studies, mostly carried out by the Elders ([Carroll et al. 2010](#); [Mason et al. 2012](#); [Christianson et al. 2013](#); [Lewis 2013](#)). However, the extent of this knowledge is much less than it would have been 100 years ago when burning was conducted frequently.

are so vital and why historical burning practices should continue to be documented as long as the knowledge still exists.

As found in recent social science research, many Indigenous communities either have reinstated or are interested in beginning to return fire to the landscape. In Canada, Australia and the USA, historical burning practices cannot simply be documented and immediately adopted into contemporary wildfire management practices. There are other factors that influence the relevance of historical burning practices to contemporary fire management.

Relevance of historical burning practices to contemporary fire management.

As most researchers agree, the climate is changing worldwide. New plant species may grow and thrive in areas where they have not previously and where knowledge of burning is limited to more traditional species. In Canada, it is predicted that climate change will likely increase the annual area burned, fire severity and length of fire season in some areas (Flannigan *et al.* 2006, 2013). In the USA, it is predicted that climate change will affect Native American tribes differently than the larger non-Indigenous society because of the integration of tribal economies and cultural identities in the natural world (Cordalis and Suagee 2008). For traditional Indigenous burners, the time to start burns is generally decided by cues from the environment, based on traditional ecological knowledge (Huffman 2013). However, climate change may cause these fire regimes to change (Voggesser *et al.* 2013). For example, in Brazil, the positions of the constellations have been linked to the seasons by the Indigenous people, the position of the stars are then used to determine when to burn or not burn (de Melo and Saito 2013). However, climate change may shift the start and end of the seasons, affecting the linkages between suitable burning conditions and the position of the stars.

Landscape change has also influenced the relevance of traditional burning practices to contemporary fire management. For example, in Canada's boreal forest, seismic and pipeline rights-of-way, well sites and roads have cut what used to be a continuous forest, with natural meadows and sloughs, into a patchwork of forests often separated by grass. This will likely change the historical fire behaviour in these areas, because cured grass can spread fire quickly. One reason that Aboriginal people practised burning in northern Alberta was for the maintenance of trails to move through the forest, long before the current fragmentation of the forest. It is likely that landscape changes have also occurred in other areas that have been traditionally burned by Indigenous peoples.

The presence of invasive species may also influence the relevance of historical burning practices. Research on the relationship between fire and invasive vegetation species in the temperate and boreal coniferous forests of North America has found that not only does fire influence invasive species, but invasive species have also been found to influence fire and fire regimes (Harrod and Reichard 2002; Brooks *et al.* 2004). This may have important consequences for Indigenous burning practices. As stated previously, burning was conducted in northern Alberta for specific purposes. An area may have been burned to allow for the expansion of a meadow for the purpose of attracting moose and other ungulates to the area. However, invasive species may invade the site, affecting the fire hazard

and preventing the growth of wanted vegetation. An example is the European sow-thistle (*Sonchus arvensis*), a plant native to western Asia and Europe and accidentally introduced to North America as a contaminant in seeds, which has been found to invade burn sites in Saskatchewan (Peltzer *et al.* 2000).

As stated previously, Indigenous people have burned for many different reasons and for many different outcomes (Huffman 2013). It is likely that the desired outcomes from historical burning are different to outcomes needed by Aboriginal peoples today, who may not need to create trails or improve meadows because of a decreased reliance on hunting for subsistence. In Africa, fires have multiple useful outcomes, so simply using a single classification as to why an area was burned is difficult (Kull and Laris 2009). Intentions behind burning have been found to be different for local communities in Mozambique and protected area management (Shaffer 2010). However, it is likely that managers' intentions for burning are primarily related to forest and ecosystem health, as well as risk management, and not as diverse as the intentions of Indigenous burners (Rasmussen *et al.* 2007).

Contemporary social issues also influence the relevance of historical burning practices to contemporary fire management. Public opinion on prescribed burning is varied. Many are against burning because of the risk of fire becoming out of control and because of significant health concerns over smoke. Many Indigenous communities also struggle with other contemporary social issues, such as drug and alcohol abuse, unemployment and infrastructure problems. This means that mitigating wildfire risk may not be considered a priority in many Indigenous communities, even though fire management may offer economic opportunities for Indigenous people and communities (Rasmussen 2005; Rasmussen *et al.* 2007; Christianson 2011; Christianson *et al.* 2012).

Therefore, the integration of Indigenous burning practices into contemporary society is not straightforward (Mason *et al.* 2012). Some tribal communities in the USA have been working to bring back prescribed burning to their traditional lands. One example is Hoopa Valley Indian Reservation in North-west California, where the community has treated 200 acres using a combination of mechanical thinning and prescribed burning (Salberg 2005). Some Native American individuals or communities have also restarted burning on tribal allotments on a smaller scale, although some plans have been met with bureaucratic roadblocks (Terence 2012). However, as the examples above show, more social science research on how Indigenous communities and wildfire managers are integrating the remaining knowledge of traditional burning methods with contemporary fire management practices would be very useful.

Other mitigation activities.

There has been little research conducted on how other wildfire mitigation practices, such as thinning, are perceived and supported by Indigenous people. At Peavine Métis Settlement in Canada, participants were very supportive of the thinning program in the community because many came from a firefighting background (Christianson *et al.* 2013), and the thinning created local jobs for community members (Christianson *et al.* 2012). But little is known about how other Indigenous communities perceive this popular practice of vegetation management.

It is also unknown whether contemporary wildfire mitigation programs are accepted in Indigenous communities, particularly in communities that are on reserves or reservations with communal ownership. Can programs such as FireWise and Fire-Smart, which were developed for non-Aboriginal communities, be applied to Aboriginal communities? For example, in Canada, if a person living on a reserve wants to reduce the wildfire risk to their home, the process is not straightforward because they do not own the home. A member of a First Nation first needs permission to make modifications to their home if they would like the First Nation to cover costs. If the member covers the cost themselves, they do not receive any benefit in equity for the changes. As well, a member of a First Nation cannot insure their home or improvements, only the contents. The First Nation is responsible for insuring all buildings, but many choose not to buy insurance because of high policy prices and high deductibles (up to 80%) resulting from the remote, isolated location of many reserves. Therefore, there is little financial benefit for individual First Nation members to make structural changes to their homes. We understand very little about how current structural wildfire mitigation recommendations are perceived in Indigenous communities or how mitigation policies and programs might be adapted to meet the unique circumstances of Indigenous communities.

Response

Many Indigenous communities are threatened by wildfire each year, but little is known about how these communities respond to a fire. Response is the third phase of the emergency management cycle and describes actions taken to resolve or contain an emergency event. One primary difference in wildfire response between wildfire managers and Indigenous peoples is how one would classify 'values at risk'. Whereas wildfire managers may look at structures, infrastructure and natural resources, an Indigenous person may include archaeological sites, trap lines and traditional hunting areas as values at risk. The US Wildland Fire Decision Support System (WFDSS) (http://wfdss.usgs.gov/wfdss/WFDSS_Home.shtml, accessed 22 January 2014) is the primary federal fire agency planning tool for identifying and evaluating values at risk. The WFDSS includes two value layers: (1) natural resources (i.e. critical habitats and range allotments) and (2) infrastructure (i.e. oil and gas leases, federal buildings, building clusters and communication towers) (Noonan-Wright *et al.* 2011). Lake (2011) has documented how in California, the USDA Forest Service, a wildfire management agency, has been making an effort to involve Native American tribes in protecting cultural heritage sites during wildfire response. There has also been movement in the US to include both tangible and intangible cultural resources in fire management planning (Welch 2012). More research is needed in this area, particularly on values at risk for contemporary Indigenous communities and how these values can be incorporated into response plans (Watson *et al.* 2009).

There are many other factors that could be examined in regard to response to wildfires, including decision-making, firefighting response, response to evacuation alerts and orders, and individual experiences of community members. In Canada, an Aboriginal Wildfire Evacuation partnership has been established comprising two universities, ten provincial and federal

agencies, and six First Nations communities. The goal of this partnership is to document the wildfire evacuation experiences of Aboriginal people and to improve wildfire evacuations of Aboriginal communities. Similar research in the US would also be useful in order to compare and recommend best practices for the wildfire response of Indigenous communities.

Recovery

If little is known about how Indigenous communities respond to wildfire, even less is known about how Indigenous people and communities recover after being affected by a wildfire event. Recovery is the fourth phase in the emergency management cycle and includes actions taken to rebuild, restore, cope and heal after an emergency event. In Canada, First Nations have charged that they received very little support during or after a wildfire event compared with non-Aboriginal communities. This is reiterated in a statement by National Chief Shawn A-in-chut Atleo:

Too many of our people are already vulnerable and when disasters or emergencies strike, we are hit hardest. The reality is that First Nation citizens and communities are affected by these emergency events to a greater extent because of remoteness, lack of critical security infrastructure, resources, and capacity. We need action on a number of fronts, including efforts by all governments to work with First Nations on effective coordination and delivery of emergency services on the short and long term. I am calling for immediate action by the federal government. [Assembly of First Nations 2011, p. 1]

The recovery costs after being affected by a wildfire can also be extreme. For example, over 1000 residents of Whitefish Lake (Atikameg) First Nation were evacuated for almost 3 weeks because of a wildfire threat in 2011. No buildings were lost, but the water treatment plant and sewage plant were severely damaged. In 2013, this First Nation is still feeling the financial effects of the evacuation that cost the community ~CA\$1 million, of which they have only been able to recoup approximately half from disaster assistance programs (T. Auger, unpubl. data, 2013). Research is needed to understand how contemporary Indigenous communities cope with and recover from wildfire events.

Conclusion

Despite the risk to Indigenous communities from wildfire, few social science research projects worked with Indigenous communities to examine contemporary wildfire management. This is likely not because of a lack of interest amongst social scientists regarding contemporary fire management in Indigenous communities, but rather because of added difficulties in working with Indigenous communities due to differences in worldview, ethical requirements and the added time often needed to build relationships. However, there must be recognition that Indigenous communities have different values, concerns and knowledge bases than non-Aboriginal communities with regard to fire management. As well, social, economic and climatic changes may affect Indigenous peoples and communities more severely than the general population. Therefore, although relationship building and research with Indigenous communities takes time, it is vital that fire social scientists increase their engagement with Indigenous communities.

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