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Implementation of wildfire risk management by local governments in Alberta, Canada

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This study examined the implementation of wildfire mitigation by local governments in Alberta, Canada. Written surveys and telephone interviews with participants in 18 municipalities were combined with additional in-person interviews within two of these municipalities. Many participating local governments were completing emergency preparedness plans, infrastructure measures, education, wildfire hazard assessments on public and private land, and vegetation management. Few were implementing land-use planning and structural mitigation measures on local government buildings. Factors that influenced implementation of wildfire mitigation measures included issue advocates, communication with internal and external stakeholders, financial and human resources, support from higher levels of government, and biophysical and demographic characteristics. Recommendations for encouraging the implementation of wildfire mitigation by local governments are provided.

Keywords: wildfire; local government; wildfire mitigation; hazard mitigation; Alberta; Canada

1. Introduction

The risk from wildfire is becoming an increasing concern across much of Canada as more people move into wildfire prone areas and the frequency and severity of wildfires are predicted to increase in some areas (Flannigan *et al*. 2005, Peter *et al*. 2006). In 1999, Partners in Protection, an Alberta based non-government organization, developed the first edition of *FireSmart: Protecting your community from wildfire* (Partners in Protection 1999, 2003), which aimed to provide provincial, territorial and local governments and homeowners with advice about how to mitigate wildfire risks. This manual, now in its second edition, has subsequently been adopted by provincial and territorial governments across the country.

In Canada, both provincial and local governments play key roles in wildfire mitigation. Within Alberta, the provincial government department Alberta Sustainable Resource Development is responsible for all Crown land that is within the Forest Protection Area (see Figure 1). Management activities by Alberta Sustainable

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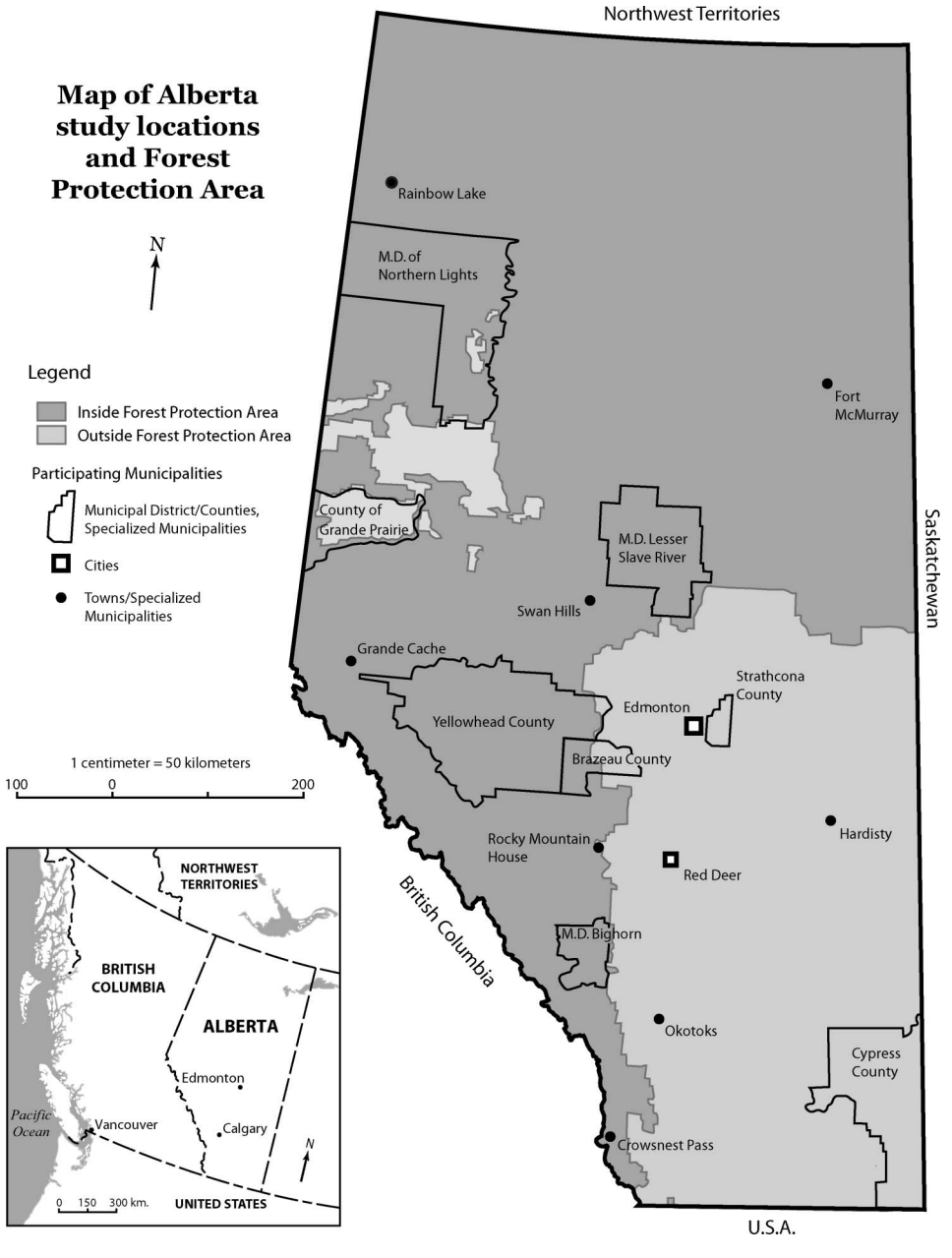

Figure 1. Map of Alberta study locations and forest protection area. Reproduced with the permission of Alberla Sustainable Resource Development 2007.

Resource Development include fuel modifications on provincial Crown lands bordering communities in the Forest Protection Area, education initiatives aimed at local governments and private land owners in the Forest Protection Area, and technical and financial assistance for local governments in the Forest Protection Area to develop and implement wildfire mitigation plans. Alberta Sustainable Resource Development has also helped local governments outside the Forest

Protection Area with wildfire hazard assessments and wildfire preparedness plans, and has provided education materials. Local governments have responsibility for emergency management within their jurisdiction, including the development and implementation of local emergency plans. With respect to wildfire mitigation, local governments can develop wildfire management plans, as well as implement risk reduction measures such as vegetation management in municipal parks and other local government owned or managed land, land-use planning measures (e.g. zoning), and public education programs. Thus, local governments have an important and unique role to play in managing the wildfire risk within their communities.

Few studies have examined the implementation of wildfire mitigation by local governments. Plevel (1997) found that few local governments in the US had implemented policies specific to wildland urban interface fires. More recently, Reams *et al*. (2005) examined how US Federal government vegetation management programs were being implemented by both state and local governments. They found that a range of programs were being carried out by local governments under the US Department of Agriculture Forest Service National Wildfire programs, including education, wildfire hazard assessments and mapping, financial and other support, mandatory defensible space, and development and zoning standards. However, in Australia, Hughes and Mercer (2009) found that a Wildfire Management Overlay land-use planning tool developed by the State of Victoria was not being widely implemented by local governments. It is unclear to what extent Canadian local governments are implementing wildfire mitigation.

The existing wildfire and broader hazards literature provides insights into factors that may influence implementation of wildfire mitigation. Research indicates that local governments will need to be aware of the local wildfire risk (Plevel 1997). This awareness may be enhanced after a recent fire experience (Plevel 1997, Tierney *et al*. 2001). Olsen *et al*. (1998) found that a 'window of opportunity' opens following a hazard event when government can more easily implement related policy and management initiatives. This may also be the case with wildfires. Public support will probably enhance local governments' ability to implement wildfire mitigation, particularly programs that aim to reduce wildfire risks on private properties (Reams *et al*. 2005). Internal and external funding and other resources will also be important. Wildfire mitigation measures must compete with the other demands and responsibilities of local governments (Prater and Lindell 2000, Shrubsole 2000). Steelman *et al*. (2004) found that funding by federal and state governments in the US exerted a great deal of influence on programs implemented at the local level. Reams *et al*. (2005) similarly found that inadequate funding was a major barrier to implementation of wildfire mitigation programs (also see Ballart and Riba 2002, Cottrell 2005). Finally, cross-jurisdictional collaboration will also be needed (Kartez and Lindell 1990, Plevel 1997), given that provincial and local governments in Alberta and elsewhere in Canada are both involved in wildfire mitigation.

This paper presents the results of a study that examined how local governments in the province of Alberta, Canada, are implementing wildfire mitigation measures recommended by Partners in Protection and provincial/territorial governments. We aimed to obtain insights into *which* wildfire mitigation measures are being implemented, as well as *how* they are being implemented. We also wanted to understand *why* local governments were or were not implementing recommended wildfire mitigation measures. As indicated in the existing literature, were awareness of the wildfire risk, public support, funding and cross-jurisdictional collaboration

also the main factors influencing implementation of wildfire mitigation by local governments in Canada? Based on these findings, we make recommendations that could encourage the implementation of wildfire mitigation by local governments.

2. Methods

Eighteen municipalities in the province of Alberta, Canada, were selected for inclusion in this study: Municipal District of Bighorn, Brazeau County, County of Grande Prairie, Municipal District of Lesser Slave River, Municipal District of Northern Lights, Yellowhead County, Cypress County, Fort McMurray, Strathcona County, City of Edmonton, City of Red Deer, Town of Crowsnest Pass, Town of Grande Cache, Town of Hardisty, Town of Okotoks, Town of Rainbow Lake, Town of Rocky Mountain House and Town of Swan Hills. These municipalities were selected to represent a variety of natural regions, primary industries and population sizes (Table 1). All participating local governments had some experience with wildfires within the last 20 years that affected people's health, structures and/or infrastructure.

Data collection occurred in two phases from May to December 2006. In phase one, we invited the fire chief, mayor or reeve (rural municipalities are governed by a reeve instead of a mayor), and land-use planner to participate in a written survey and a telephone interview. These participants were selected because they were most likely to be involved in and influence wildfire management within their municipality. In some cases, however, the deputy fire chief replaced the fire chief and municipal officials (councillors, chief administrative officers, directors of disasters services and emergency services) replaced the mayor/reeve or land-use planner. We had 38 respondents to the survey from all 18 municipalities. The respondents included 16 fire chiefs or deputy fire chiefs, six mayors or reeves, seven land-use planners and nine other municipal officials.

The written survey collected data on the municipality's wildfire history and the wildfire mitigation measures that each municipality was implementing or planning to implement. Participants were provided with a list of activities recommended by Partners in Protection (2003): Education, wildfire hazard assessments, vegetation management, structural measures (e.g. using fire resistant building materials for municipal buildings), infrastructure measures (e.g. road widths to facilitate emergency vehicle access), land-use planning restrictions on the use and development of land, and emergency preparedness plans. The surveys were sent and returned by email or fax. Once the survey was returned, a follow-up semi-structured telephone interview lasting approximately 1 hour was conducted with survey respondents to obtain information about how the measures were being implemented and factors influencing implementation.

In the second phase of data collection, two municipalities were selected as case studies to further explore the process of implementing wildfire mitigation measures and the factors that influenced implementation. Municipality 'A' was selected because it had implemented a significant number of wildfire mitigation measures. Municipality 'B' was selected because it had experienced opposition to some elements of its program. Data were collected via semi-structured in-person interviews with municipal and provincial government officials, business and industry representatives, residents and members of environmental groups. Sixteen people participated in the interviews, including six from municipality 'A' and 10 from

Table 1. Characteristics of municipalities.

Municipality	Municipality type[1]	Population (2006)[2]	Natural bioregions[3]	Principal industry[4]
Bighorn	Municipal District	1264	Rocky Mountains/ Foothills	Oil & Gas, Forestry, Mining, Hydro-electric, Tourism
Brazeau	County	7040	Foothills/Boreal Forest	Oil & Gas, Forestry, Agriculture, Tourism
Crowsnest Pass	Town	5749	Rocky Mountains	Oil & Gas, Forestry, Tourism
Cypress	County	6729	Grassland	Oil & Gas, Agriculture, Military
Edmonton	City	730,372	Parkland	Manufacturing, Tourism
Fort McMurray	Specialized	51,496	Boreal Forest	Oil and Gas, Forestry, Mining
Grande Cache	Town	3783	Rocky Mountains	Oil & Gas, Forestry, Mining
Grande Prairie	County	17,970	Boreal Forest	Oil & Gas, Forestry, Agriculture, Tourism
Hardisty	Town	760	Parkland	Oil & Gas, Agriculture, Tourism
Lesser Slave River	Municipal District	2820	Boreal Forest/ Foothills	Oil & Gas, Forestry, Agriculture, Tourism
Northern Lights	Municipal District	3772	Boreal Forest/ Foothills	Oil & Gas, Forestry, Agriculture, Tourism
Okotoks	Town	17,145	Grassland	Manufacturing, Construction
Rainbow Lake	Town	965	Boreal Forest	Oil & Gas, Forestry
Red Deer	City	82,772	Parkland	Manufacturing, Tourism
Rocky Mountain House	Town	6874	Boreal Forest/ Foothills	Oil & Gas, Forestry, Agriculture, Tourism
Strathcona	Specialized	82,511	Parkland	Oil Refineries, Agriculture
Swan Hills	Town	1645	Foothills	Oil & Gas, Forestry, Hazardous Waste Plant
Yellowhead	County	10,045	Foothills	Oil & Gas, Forestry, Mining, Agriculture, Tourism

Notes: [1]Definitions:
City=an urban municipality with a mayor and a population >10,000.
Town=an urban municipality with a mayor and a population between 100 –10,000.
Municipal District/County=rural municipalities, governed by a reeve.
Specialized municipality=encompass both urban and rural areas, and therefore have a mayor and reeve.
All municipality types perform similar functions throughout their jurisdiction.
Adapted from: [2]Statistics Canada (2007), [3]Heritage Community Foundation (2005), [4]Alberta First (2006).

municipality 'B'. The interviews lasted approximately 1 hour, and took place at the interviewee's workplace.

Results from the written survey in phase one were entered into a Microsoft Excel© spreadsheet and tabulated. Interviews were transcribed verbatim and reviewed for accuracy. The interview data were analyzed thematically using the qualitative data analysis software program NVIVO 7.0©. Data analysis began by identifying major themes in the data that were identified in the literature prior to data collection. We then identified additional themes that emerged from our data.

3. Implementation of recommended wildfire mitigation measures

Table 2 presents the seven recommended wildfire mitigation measures that were being implemented to varying degrees by the 18 participating municipalities. At one end of the spectrum, two participating municipalities were implementing all seven recommended wildfire mitigation measures and four participating municipalities were implementing all except one measure. At the other, one municipality was completing only one measure. Most participating municipalities fell in the middle, and were implementing between three and five of the seven recommended measures.

The only measure that was completed by all municipalities was an emergency preparedness plan, which is mandatory under provincial legislation. In most cases the plan was generic in nature and designed to address all types of emergencies. Ten of the 18 participating municipalities' emergency plans identified wildfires as a potential hazard and nine plans identified high wildfire risk areas. Seven plans identified evacuation routes that could be used by residents in the event of a wildfire. Participants in five of these seven municipalities indicated that they had informed residents of this evacuation route.

Seventeen of the 18 participating municipalities had completed recommended infrastructure measures. Fourteen had an adequate water supply for fighting wildfires and adequate road widths for emergency vehicles. In most cases these measures were undertaken for reasons other than wildfire mitigation, such as ensuring roads were wide enough to be used by large vehicles and an adequate water supply for structural firefighting.

Education programs were implemented by 16 of the 18 municipalities. In 15 municipalities, information about the wildfire risk and wildfire mitigation measures that need to be undertaken by the municipality was provided to municipal officials (such as the mayor or reeve, councillors, land-use planners and other municipal government department heads). This information was provided by fire chiefs or deputy fire chiefs, land-use planners, councillors, chief administrative officers and directors of disaster or emergency services. Information was also provided to external stakeholders (residents, local businesses and industry) about wildfire risks and mitigation measures that can be undertaken on private property Fifteen participating municipalities were implementing education programs aimed at residents, seven were targeting local businesses, and six were providing information to local industry (e.g. forestry, oil and gas). In a few instances, respondents noted that information was only disseminated when requested, instead of taking a more proactive approach.

A range of tools was used to disseminate information to residents and other external stakeholders, however, most involved one-way communication. Pamphlets were the most popular education tool used by 16 of the 18 municipalities. The most

Table 2. Wildfire mitigation activities completed by participating local governments in Alberta, Canada.

Municipality	Emergency preparedness plans	Infrastructure measures	Education	Wildfire hazard assessments	Vegetation management	Land-use planning	Structural measures on government buildings
1	X	X	X	X	X	X	X
2	X	X	X	X	X		
3	X	X	X	X	X	X	
4	X	X			X		
5	X	X	X			X	X
6	X	X					
7	X	X	X	X		X	
8	X	X	X	X	X	X	X
9	X	X	X		X		
10	X	X	X	X			
11	X	X	X	X	X		
12	X	X	X		X		
13	X	X	X				
14	X		X	X			
15	X	X	X	X	X		X
16	X	X	X	X	X	X	
17	X	X	X	X	X	X	
18	X	X	X	X	X		
Total activities completed	18	17	16	12	12	7	4

common pamphlet distributed by municipalities was the 'FireSmart Homeowners Manual' (Alberta Sustainable Resource Development undated) created by Partners in Protection, which was provided to them by Alberta Sustainable Resource Development. This pamphlet includes information for homeowners on where wildfires can occur, how to complete a wildfire hazard assessment on their property, and mitigation measures homeowners can implement to reduce the risk to their property. Open houses were also a popular way to try to educate residents (used by 13 of the municipalities). Open houses could be an opportunity for two-way communication, however interview participants reported that open houses were generally not well attended. As one participant noted: "...We've had open houses, advertised them heavily, and had one, like one person would show up".

Seven out of our 18 municipalities used newsletters to remind residents about the wildfire threat and mitigation measures that they can undertake on their properties. Our research participants generally felt that these were an effective way to provide information to residents. In the words of one participant:

> ... We have a newsletter, and we send it out to all ratepayers, so everybody that is on our tax roll, so everybody is getting it ... Also we can put articles [about wildfires] in our newsletter and this goes to all of our residents and so we do that almost every year, we put something in about wildfires, sometimes twice a year depending on what the risk is like.

Six out of the 18 participating municipalities were using newspaper ads at the beginning of wildfire season to remind local residents about the risk of wildfires and fire bans. Six municipalities were also using exhibits at trade shows and radio ads as part of their education programs. Three municipalities reported holding government sponsored community events such as municipal breakfasts and street events to inform members of the public about wildfires and mitigation measures. Three municipalities sent members of the fire department door-to-door to speak to residents about the results of a wildfire hazard assessment completed on their property, or to inform residents about vegetation management that was planned near their property. Other education tools that were used by a few participating municipalities included website notices about wildfires, fire bans and mitigation measures that homeowners can complete on their property (2), workshops about wildfire risks and mitigation measures that can be adopted by residents (2), presentations at local schools (2), television ads (2), displays in malls or community centres (1) and resident participation in wildfire evacuation exercises (1).

A majority of municipal fire chiefs, land-use planners and chief administrators said that they and their departments distributed information about wildfires and what homeowners could do to help protect their house in the event of a wildfire. Provincial government (Alberta Sustainable Resource Development) officials often provided municipalities with education materials and/or assisted with education programs, particularly for communities inside the Forest Protection Area. Fire departments, some land-use planning departments and chief administrative officers were involved in the two-way communication methods. Fire department staff was involved in the door-to-door hazard assessments, and land-use planners spoke to homeowners when they came into the municipal planning department to obtain a building permit. Many participating municipal officials expressed an interest in completing more two-way communication techniques within their

municipality, but had not done so because they lacked resources (funding, time and personnel).

Twelve of the municipalities had completed wildfire hazard assessments. Eleven had completed wildfire hazard assessments on private property within their municipality. In most cases, these assessments involved staff from fire, disaster services or emergency services departments completing a home and site hazard assessment form and providing the homeowner with information on how to mitigate the wildfire risk on their property. Eight had completed the assessments on municipal public land, or had worked with the provincial fire management agency to complete wildfire hazard assessments on provincial land within the municipality or on provincial land surrounding towns. Eleven of the 12 participating municipal governments who were completing wildfire hazard assessments were also completing vegetation management. Wildfire hazard assessments were completed first to identify high-risk areas and then vegetation management was completed in these areas to reduce the identified risk.

Many participating municipal governments were completing vegetation management, which is not surprising because vegetation (fuels) management is widely accepted as being essential to protect communities in the event of wildfire (Dombeck *et al*. 2004). Twelve of the 18 participating municipal governments were clearing and pruning vegetation within their municipality. Eight municipalities had created a fireguard around their community. Three municipalities were assisting residents (by providing funding, labour and expertise) with thinning, pruning and clearing vegetation from their property, and 10 were providing residents with assistance to dispose of vegetation that they removed from their property. Two municipalities had replaced existing vegetation with more fire resistant species.

Land-use planning and structural measures were less popular. Only seven of the 18 participating local governments had completed land-use planning measures to reduce wildfire risks. Five were ensuring access routes and water supplies in the development of new subdivisions or updating existing routes, and three were introducing building codes requiring the use of fire-resistant building materials on new houses. None of the municipalities were restricting development in high wildfire risk areas. Participating municipalities' low adoption of land-use planning measures to mitigate wildfire risks is consistent with other studies that have found land-use planning measures for hazard mitigation to be highly political, and therefore often not used by local governments (Prater and Lindell 2000). Dombeck *et al*. (2004) also found that few local governments in the Western US have used land-use planning measures to mitigate wildfire risks.

Finally, only four municipal governments had implemented structural measures on municipal government buildings such as fire resistant roofs or siding. This finding is important since research has shown that allowing residents to view a demonstration property could encourage them to implement mitigation measures on their own property (Sturtevant and McCaffrey 2006). Thus, it appears that many municipal governments are not yet leading by example to encourage homeowners to implement measures to reduce the flammability of their homes.

4. The wildfire mitigation implementation process

Our interview results provided insights into *how* municipalities were implementing recommended wildfire mitigation measures (Figure 2). We found that municipalities

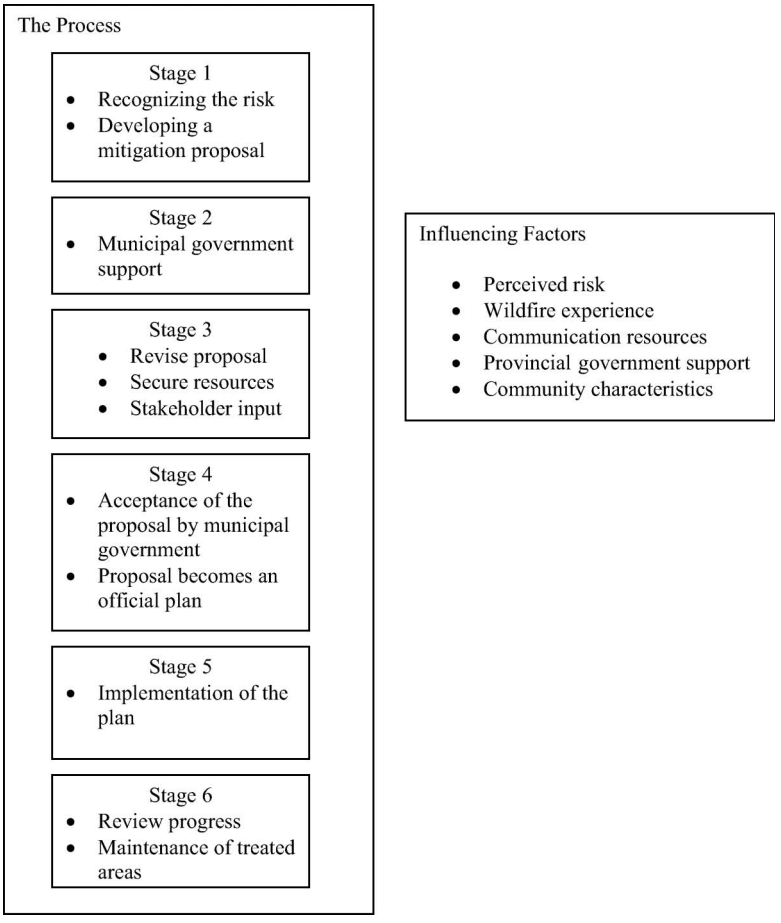

Figure 2. The municipal wildfire mitigation process and influencing factors.

were following a six stage process, however, not all municipalities had implemented all of the steps. First, one or more municipal officials aware of the wildfire risk developed a wildfire mitigation proposal. This first step was often initiated by the fire chief or deputy fire chief, or by the chief administrative officer or councillor. All participating municipal governments had reached this first stage. The wildfire mitigation proposal identified the roles and responsibilities of municipal officials in the event of a wildfire, high wildfire risk areas in the municipality, and activities to reduce the risk. These proposals either focused on a specific high-risk area within the municipality or encompassed the entire municipality.

The second stage involved gaining internal municipal government support for the wildfire mitigation proposal, which involved the person(s) from the first stage tabling the proposal at the council to gain support and resources, and communicating with other municipal departments (e.g. the planning office and parks department) to build support for the proposal. All participating municipal governments had completed this stage. However, participating municipalities differed in the degree of support received from the council and other municipal departments.

Next, the proposal was revised and initial support was sought from external stakeholders by the initiator(s) in Stage 1, sometimes with the support of the chief administrative officer. The proposal was revised to reflect input from other municipal officials, as well as availability of resources. Gaining initial support from external stakeholders (e.g. residents, environmental groups, businesses and industries) first involved acknowledgement that such support was needed. Support was then obtained by communicating with stakeholders to increase their awareness of wildfires and potential impacts, and what measures could be implemented to reduce the threat from wildfire. We found that the majority of participating municipal governments were revising their proposal, but only a few were seeking support from external stakeholders. Some municipal governments that did not acknowledge and gain support from external stakeholders experienced significant opposition when they tried to implement vegetation management measures.

The fourth stage involved ongoing consultations with all potentially affected stakeholders about the wildfire mitigation proposal. Information was provided to stakeholders about the proposal, their input was sought, and the proposal was revised accordingly. We found that only a few of the participating municipal governments conducted ongoing consultations with stakeholders. In these cases, fire chiefs, chief administrators and councillors communicated with stakeholders, and planning and parks officials were often involved if proposed mitigation measures related to their area of responsibility. At the end of this stage, the proposal was accepted by the council. Those municipal governments that did not engage stakeholders in the early stages of plan development were more likely to experience public resistance when they attempted to implement their plan. In one case, a municipality began vegetation management on public land that was adjacent to a residential area. The municipality did not involve residents before the work started and the residents raised concerns that eventually resulted in halting the work.

Stage five involved implementing the wildfire mitigation plan. All participating municipal governments had implemented at least one wildfire mitigation measure within their municipality. Plan implementation usually involved the co-operation and coordination of several municipal departments. The sixth stage consisted of an annual review of progress, assessment and maintenance of the completed wildfire mitigation measures. A few of our participating municipal governments had reached the final stage in this process, while most were still working through the process.

5. Factors influencing implementation of wildfire mitigation

Implementation of recommended wildfire mitigation was found to be affected by several factors (Figure 2): perception of risk, wildfire experience, communication of information, access to sufficient resources, local and provincial government support, and geographic characteristics of the communities.

5.1. Perception of risk

We found that a high perceived risk of wildfire was essential. All participants from fire departments and other emergency services indicated that their municipality was at high risk from wildfires. Other participating municipal officials had various perceptions about the wildfire risk; some knew there was a risk but were not aware of the degree of risk, while a few were not even aware that their municipality could be

affected by a wildfire. Not surprisingly, those participants that initiated the wildfire management implementation process believed that there was a high wildfire risk. These participants also sought internal support for wildfire management, and were involved in communication with external stakeholders later in the implementation process.

Participants working in rural municipal districts and counties tended to perceive a higher risk than those working in cities and towns because the majority of municipal districts and counties were heavily vegetated. Participants also tended to perceive a high risk when their municipality had done little to implement wildfire mitigation measures, and when they felt that local residents were unaware and had not implemented mitigation measures to protect their property. These higher risk perceptions led to an overall awareness that wildfire mitigation needed to be completed, which usually led to the implementation of management measures.

In addition to perceiving a threat from wildfire, believing that wildfire mitigation measures would be effective in reducing the impacts from wildfire was also essential. All participants stated that the impacts of wildfires were possible to control by implementing wildfire mitigation measures although this depended on the size of the fire. As one participant said:

> Up to a certain level, yes … A large one [wildfire], no. I don't think anybody can be all that prepared for it [a large wildfire] though.

5.2. Wildfire experience

Most participants had direct experience with wildfire as a resident, a fire fighter or other type of first responder. However, eight participants, including one deputy fire chief, one chief administrator, one mayor and five land-use planners did not have direct experience with wildfires. This experience influenced the implementation process. Those participants who initiated the wildfire mitigation process within their municipality had first-hand experience with wildfire. These participants with wildfire experience also assisted their municipal government in communicating with the council, other departments and the public about wildfires and the wildfire mitigation measures. These municipal participants were able to provide a first-hand, credible description of what could happen to their municipality if a wildfire occurred.

Participants without wildfire experience or formal training related to wildfire mitigation felt that their lack of experience made it difficult for them to help their municipal government implement wildfire mitigation measures. One land-use planner stated that his lack of knowledge and experience hindered his ability to communicate to local residents about mitigation measures that could be implemented on their property:

> I am struggling a bit with that because coming to this County was my first encounter working so closely and so consciously towards emergency plans and fire hazards … it wasn't part of my training when I became a planner, and I've been in the planning profession for [several] years. The previous municipality where I worked never put that [wildfires] as a high priority.

5.3. Communication

Communication within the municipal government, as well as communication with external stakeholders, was vital to implementation of the wildfire mitigation process.

Communication with other municipal government employees and the council increased their awareness of why wildfire mitigation measures were needed, which was crucial for obtaining support and resources needed to implement wildfire mitigation. Communication with external stakeholders aimed to increase awareness of the wildfire risk and therefore encourage support for the municipality to implement wildfire mitigation measures, and also encourage stakeholders to mitigate wildfire risks on their own property. Stakeholders were also informed about the wildfire mitigation plan, and their feedback was sought and incorporated into the plan. It was also important to keep stakeholders informed during the implementation stage to remind them when and where activities such as fuel modification would be carried out.

Several participants commented that their municipal government was distributing to residents information about wildfire risks and mitigation measures that residents can complete on their property, but they did not know how much of the information was understood or implemented by residents. One participant said:

> Because going to a trade show and handing out pamphlets only does so much, right ... They [residents] may look at the pictures. The odd person may even read it, but I mean that type of communication and education is low. You know, it's not very good.

5.4. Resources

Having adequate resources to implement wildfire mitigation plans was fundamental to successful implementation. Two-thirds of the participating municipalities had access to funding through the provincial FireSmart Community Grant Program. This program provides funding for projects such as preparation of wildfire preparedness plans, vegetation management, public education, and inter-agency co-operation and cross-training for communities within the Forest Protection Area (Figure 1) (Government of Alberta 2008). Some participants cited the provincial grant program as fundamental to developing and implementing their mitigation plan. Communities outside of the forested areas of the province were eligible for provincial financial assistance under the Municipal Wildfire Assistance Program, which is administered by the provincial government's Department of Municipal Affairs. However, none of the participating municipalities that were eligible were aware of this program and were instead relying solely on internal municipal government funding. Regardless of the source of funding, most participants said that their municipality did not have sufficient funds to implement all of the wildfire mitigation measures in their plan. Importantly, municipal governments that relied on only internal municipal government funding struggled to implement wildfire mitigation measures because they had to compete with other local government priorities for funding.

In many cases, participants also identified a lack of human resources to implement their plan. A lack of personnel dedicated solely to wildfire mitigation, a reliance on volunteers, and lack of expertise were cited as human resource issues. In most participating municipalities the implementation of the plan was an additional activity assigned to current staff workloads. Only five participating municipal governments had trained staff whose job it was to ensure that the municipality was prepared for a wildfire. Volunteers staffed the majority of fire departments included in this study, and all fire chiefs and deputy fire chiefs identified a lack of time and personnel in their department to implement wildfire mitigation measures. In some

cases, the fire chief and deputy fire chief were volunteers, and reported that they were unable to attend some meetings about implementing wildfire mitigation measures in their municipality.

5.5. *Local and provincial government support*

Support from other municipal government staff and council members was crucial throughout the wildfire mitigation implementation process, from gaining initial support for the wildfire mitigation proposal, securing funding, to implementation of the wildfire mitigation plan. Participants spoke about receiving varied levels of support from within their municipality and from their council members. In participating municipalities, all fire chiefs and chief administrative officers supported the implementation of wildfire mitigation. Councils in the majority of participating municipalities were supportive. In the words of one participant:

> ... The fact that the Councils ... ever since I've been here have been very proactive, and supportive of the initiatives [implementing wildfire mitigation]. And you know, if you go to them with a valid reason, you know, they don't turn it down.

Several planning departments were involved in implementing wildfire mitigation; however, many were not. A land-use planner in one participating municipality said that their land-use planners were not equipped to implement wildfire mitigation measures. In a few participating municipal governments, the parks departments were actively involved in implementing wildfire mitigation by completing vegetation management and wildfire hazard assessments on public land. One participating land-use planner spoke about the benefits of being involved in wildfire mitigation:

> In fact, I think it's better from a development standpoint ... There is better communication, as far as you know what we want from a fire protection standpoint, and what they need to know from a development standpoint.

Support from the provincial government had an important influence on the implementation of wildfire mitigation. Alberta Sustainable Resource Development (SRD) provided assistance with wildfire mitigation, particularly to municipalities located within the province's Forest Protection Area. In most cases, the person who initiated the wildfire mitigation process in their municipality communicated with SRD staff to obtain advice and information to help with the development of the municipal wildfire proposal. SRD staff also provided valuable assistance with communication, particularly with the public. SRD collaborated with Partners in Protection to develop the Homeowners' FireSmart Manual (Alberta Sustainable Resource Development, undated), which was used by most participating municipalities to inform residents about wildfire risks and mitigation measures that residents can complete on their own property. The provincial government also assisted with other public communication. In the words of one participant:

> ... Because Forestry [the provincial government] does have a dedicated communication/public relations person, ... they're ... initiating a lot of them [open houses], and then when we can go, we'll provide manpower or support at their functions. But really, they're the ones heading ... that charge, just because they have the resources.

The provincial government's Firesmart Communities Grant Program provides funding for both education and vegetation management. SRD also assisted

municipalities within the Forest Protection Area by completing vegetation management on Crown land that surrounded various communities, to assist in reducing the wildfire threat.

5.6. *Biophysical context*

The biophysical characteristics of the municipalities affected municipal governments' ability to implement some wildfire mitigation measures. For example, valleys and slopes within several municipalities hindered completion of vegetation management because personnel and equipment could not work effectively and safely on steep slopes. In such cases, municipalities were either faced with hiring specialized equipment and crews or leaving the areas untreated. Many participants also identified a municipality's size as a constraint to implementing wildfire mitigation. Participants from municipalities that covered a large area, such as municipal districts and counties, expressed concern that they struggled to have enough resources to implement wildfire mitigation. These larger municipalities typically included several communities within their boundaries, each of which required wildfire management. Municipalities located in isolated, remote areas of the province were aware that their municipality could be significantly affected by a wildfire, but could not rely on receiving timely outside assistance in the event of a wildfire, and in some cases there was only one access road to the community. As a result, participants in these municipalities recognized that they had to be self-reliant and implement wildfire mitigation measures well before a wildfire occurred.

In addition to the biophysical characteristics of municipalities, many participants also commented on the population growth in their municipality due to growth in the oil and gas sector. This left many municipalities struggling to communicate with the increasing number of newcomers, and put pressure on scarce resources needed to implement wildfire risk reduction. As one participant said:

> Because of the rapid growth in our communities, I don't think we can keep up with the informing, so I think there is a liability there. We do try our best, but with the numbers of people moving into the municipality it is getting tougher and tougher to make people aware.

6. Discussion and conclusions

The results of our study indicate that local governments readily complete recommended wildfire mitigation measures that are mandatory (emergency preparedness plans) or required for reasons other than wildfire mitigation (infrastructure measures). Our findings that education programs aimed at the public and other stakeholders, vegetation management and hazard assessments were popular amongst participating local governments are in line with the findings of Reams *et al.*'s (2005) study in the US, and also reflects the availability of provincial government funding for education and vegetation management in Alberta under the FireSmart Communities Grant Program and education materials and expertise by provincial government staff. However, local governments in Alberta do not appear to be implementing land-use planning measures for wildfire mitigation. This finding is in line with research that has found that local governments often do not use land-use planning for mitigation of wildfires (Dombeck *et al.* 2004) and other hazards (Berke *et al.* 1996, Burby 1998, Prater and Lindell 2000, Burby 2006). King (2008)

concluded that planners in Australia still regard hazard mitigation as a low priority. Our findings indicate that the same may be true in Alberta. Our finding that few local governments were implementing wildfire mitigation measures on local government property is interesting, since local governments advise homeowners to implement recommended measures on their own properties, thus many local governments are clearly not setting an example through their own actions and are therefore missing an opportunity to set a normative standard for mitigation (Faulkner *et al*. 2009).

The results of our study confirm the importance of an issue advocate in the implementation of wildfire mitigation measures by local government (Prater and Lindell 2000, Jakes *et al*. 2003, Eggleston and Knob 2004, Lang *et al*. 2006). We found that this person perceived a high wildfire risk, believed that mitigation would be effective and had first hand fire experience. This person is crucial in bringing wildfire mitigation onto the local government agenda, ensures that it stays there, and mobilizes support. In their examination of the politics of hazard mitigation, Prater and Lindell (2000) note that this person may be an elected official or someone within government who has a long-term interest in an issue. In our case, this person was usually the fire chief or deputy fire chief, but in some instances this person was the chief administrative officer or a councillor.

In addition to this individual, our results also clearly show that in order to implement wildfire mitigation, local governments need to collaborate with and obtain support from stakeholders, both inside and outside local government (also see Prater and Lindell 2000), as well as across jurisdictions. Our finding that few participating local governments were implementing land-use planning measures for wildfire mitigation makes sense given that few land-use planners were involved in the wildfire mitigation process, particularly at or before the plan development stage. This is unfortunate because land-use planners can play a key role in advocating for and implementing mitigation measures, including education of homeowners and builders (Burby 1998, Mileti 1999, Stevens *et al*. 2008). A lack of public support due to insufficient communication delayed vegetation management in one municipality, and may have influenced council support in others. Our findings support the importance of communication with the public and other stakeholders as an essential step towards implementation of wildfire mitigation plans (also see Mileti 1999, Pearce 2003).

The results of this study confirm that financial resources are important for the implementation of wildfire mitigation measures. Adequate financial and/or human resources were crucial in order for participating local governments to implement their mitigation plans. Importantly, many participating municipal governments relied on provincial government funding, particularly for their implementation of communication with residents, hazard assessments and vegetation management. However, some participating local governments were able to obtain internal funds when they were able to justify the need against other competing local government demands (also see Prater and Lindell 2000, Shrubsole 2000, McEntire and Myers 2004).

Our study results also shed light on the influence of higher levels of government on the implementation of hazard mitigation by local governments. We found that provincial government support was crucial throughout the wildfire mitigation implementation process, from developing an initial plan, provision of education materials for the public and other stakeholders and providing resources (funding, equipment) to local governments. Our findings are in line with those of Ivey *et al*.

(2004), who found that senior government commitment and support for local agencies affected the capacity of local government to adapt to climate change impacts, and Steelman *et al*. (2004) who found that US federal and state agencies policies, provision of financial resources and programmatic decisions influence community response to wildfire.

Finally, our findings indicate that a municipality's biophysical characteristics, including terrain, size and isolation, can also negatively or positively influence the implementation of recommended wildfire mitigation measures. For example, a significant increase in population, which occurred in several municipalities in our study, may make it difficult to implement public education and mitigation measures requiring public support. On the other hand, the remoteness of municipalities may lead to the realization that outside assistance may not arrive in time to save a community and thus, municipalities have to be self-reliant in the event of a wildfire.

Based on our findings, we make the following recommendations that could encourage implementation of wildfire mitigation by local governments. Those responsible for wildfire mitigation within local government should collaborate with a wide range of stakeholders both inside and outside local government. In particular, our findings indicate that land-use planners need to be better integrated into the wildfire mitigation process in order to facilitate the implementation of land-use planning tools and public education for wildfire mitigation. Land-use planning measures are important tools for the implementation of sustainable hazard mitigation (Mileti 1999). In addition, land-use planners interact daily with developers and homeowners, and they would be an excellent source of information for those interested in wildfire mitigation on private property. Communication with the public and other external stakeholders as part of an education program will help garner public support, which will also help in obtaining council support and resources. Importantly, extensive communication has been found to lead to a high level of public trust in agencies (Fleeger and Becker 2008), which has been associated with public support for wildfire management (Winter *et al*. 2006).

In addition to extensive communication, local governments should take advantage of windows of opportunity (Kingdon 1984) in order to assist them to obtain support and resources (Prater and Lindell 2000). They should also implement recommended measures on city property in order to provide a demonstration to residents about how to implement recommended mitigation measures. Providing residents with information about recommended mitigation measures is often not enough to cause a change in behaviour (McCaffrey 2004, Monroe *et al*. 2006), and providing a demonstration property would provide additional encouragement (Sturtevant and McCaffrey 2006).

Finally, we recommend continuation of higher government support of local government implementation of wildfire mitigation efforts. Such support should emphasize capacity building within local governments. Provincial government support also encourages the implementation of all wildfire mitigation measures that may be implemented by local governments.

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