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The adaptive capacity of New Zealand communities to wildfire

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Abstract. When we think of natural disasters in New Zealand, we tend to think of earthquakes or volcanic eruptions. However, a series of events is placing New Zealand communities at greater risk of wildfire. In a case study of a rural New Zealand community that experienced wildfire, process elements such as networks and relationships among locals, development and application of local knowledge and experience, and access to and application of expert knowledge and institutional capacity helped build adaptive capacity for disasters.

Additional keywords: community recovery, community response, resilience, vulnerability.

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Introduction

When we think of natural disasters in New Zealand, we tend to think of earthquakes or volcanic eruptions, not wildland fire. The number and extent of New Zealand wildfires have been low when compared with many countries, and because residents in rural New Zealand do not expect wildfires, they are unlikely to be prepared for the disaster. This lack of awareness and preparedness is of concern to New Zealand emergency managers, who expect the country's wildfire risk to increase in the future.

Emergency managers point to three factors that could expose New Zealand residents to more wildland fires in the future. The first factor is global climate change. Climate change studies predict that the hot, dry weather conditions that support wildfires could become more common in New Zealand, and as a result, more severe fire weather and fire danger are likely in the future (Pearce and Clifford 2008; Pearce *et al.* 2011). The second factor is an expanding rural–urban interface (RUI). Demographers have suggested that, like many other parts of the world, population in the RUI is likely to grow significantly in New Zealand over the next decade (Bayley and Goodyear 2004), placing more people in high fire-risk areas and increasing potential fire ignitions. Finally, Land Information New Zealand (LINZ) is undertaking a review of high-country grazing leases on government land (referred to as land tenure review), with the potential conversion of thousands of hectares of grazing land to conservation and recreation uses (M. Clark, LINZ, pers. comm., 27 May 2011). Some people fear that vegetation previously kept in check by grazing will revert to tall grasses or woody shrubs, increasing fuel loads and fire risk.

The potential for increased fire risk raises questions about the vulnerability of New Zealand communities to wildfire. Research indicates that human vulnerability is influenced not only by exposure to hazards and local biophysical characteristics, but also by social characteristics (Nelson *et al.* 2007; Cutter *et al.* 2008*b*). Vulnerability is reduced in communities that are characterised as resilient, or as having the ability to learn and adapt in response to a disaster event (Adger *et al.* 2005). One vital component of resilient human communities is adaptive capacity. Adaptive capacity refers to the resources, capabilities and actions that can be mobilised to mitigate a community's disaster vulnerability. A community with high adaptive capacity can avoid or reduce risk (Cutter *et al.* 2008*b*), improve their ability to absorb the impacts of an event, and more quickly reorganise to resume necessary functions following a disaster (Norris *et al.* 2008). Many of the actions individuals and communities undertake to reduce wildfire risk – including actions that improve mitigation, preparedness, response and recovery – help build adaptive capacity.

Paveglio *et al.* (2009) suggested a model of community adaptive capacity for wildfire that includes both structural and process elements, with structural elements represented by (1) demographic and socioeconomic characteristics, and process elements by (2) development and application of place-based knowledge and experience, (3) interactions and relationships among locals and (4) access to and application of scientific or technical knowledge. The case for the importance of structural characteristics in determining adaptive capacity has been made by several researchers (Morrow 1999; Cutter *et al.* 2003; Schmidtlein *et al.* 2008; Kulig *et al.* 2011). However, even

proponents of structural characteristics recognise their limitations and suggest that models of adaptive capacity also include local processes that promote community functioning, such as the creation of a community identity, development and use of local knowledge, and advancement of successful public and professional collaborations (Perkins and Long 2002; Pfefferbaum *et al.* 2005; Nelson *et al.* 2007; Cutter *et al.* 2008*a*, 2008*b*; Norris *et al.* 2008; Tierney 2009). The research reviewed below suggests the importance of process elements in adapting to living with wildland fire, and supports the inclusion these elements in the Paveglio *et al.* (2009) model of adaptive capacity.

When analysing factors that contribute to adaptive capacity, it is useful to think about actions that occur or resources that come into play at different times relative to the disaster event. Drabek (1986) recognised four disaster phases – preparedness, response, recovery and mitigation – and used these phases to classify sociological findings from over 200 studies of human response to disasters. McCool *et al.* (2006) used a similar framework to identify human responses to and consequences of wildfire – before, during and after the event.

It is useful to organise the human dimensions of wildfire literature using the McCool *et al.* (2006) disaster phases to understand how process elements in the Paveglio *et al.* (2009) model influence adaptive capacity for wildland fire management. Much of the research addressing what happens before a wildland fire focuses on mitigation and preparedness – actions that support adaptive capacity and resilience (Kulig *et al.* 2011). Social scientists have described and evaluated efforts to improve preparedness in the USA (McCaffrey 2006; Jakes and Nelson 2007; Martin *et al.* 2008), Australia (McGee and Russell 2003; Paton and Wright 2008; Pritchard and Gow 2008; Elsworth *et al.* 2009), Canada (McGee 2005, 2007; Faulkner *et al.* 2009) and New Zealand (Kelly *et al.* 2008; Graham and Langer 2009; Jakes *et al.* 2010). Research on community wildfire protection plans (CWPP) has identified the importance of local and scientific knowledge in helping to define and prioritise adaptations to wildland fire (Jakes *et al.* 2011). Recently, social scientists have pointed out the importance of informal interactions with neighbours and community ties to building a shared understanding of wildfire risk and encouraging property owners to engage in wildfire mitigation activities (Brenkert-Smith 2010; Kyle *et al.* 2010).

Research on the effects of decisions and actions taken during a wildfire covers a range of topics. Evacuation is a common emergency response during a wildfire (Cohn *et al.* 2006), and research has highlighted barriers to effective evacuation and potential alternatives (Cova 2005; Handmer and Tibbits 2005; Carroll and Cohn 2007; Wolshon and Marchive 2007; Paveglio *et al.* 2008; Tibbits *et al.* 2008; Haynes *et al.* 2010; Paveglio *et al.* 2010). Several studies have looked at decisions made by the incident command teams charged with suppressing wildfires. Efforts by command teams to provide residents with up-to-date information during a wildfire have been found to ease resident anxiety and to provide residents with some sense of control (Kumagai *et al.* 2004). However, command teams' apparent inability to effectively incorporate local knowledge and resources in suppression activities has resulted in frustration for the team and local residents (Graham 2003; Kumagai *et al.* 2004; Carroll *et al.* 2005; McCool *et al.* 2006; Elsworth *et al.* 2009; Kulig *et al.* 2009).

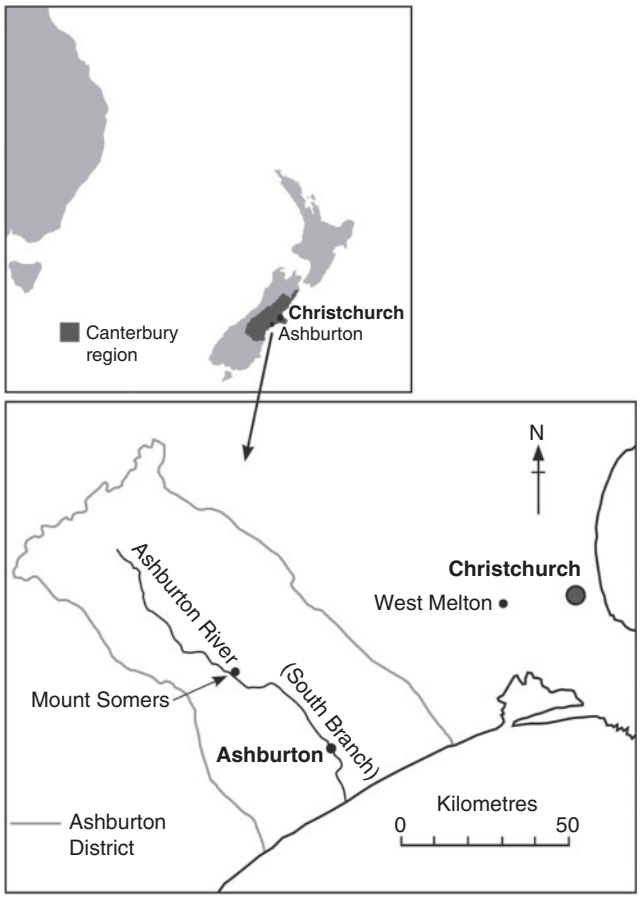

Fig. 1. Mount Somers is located in the Ashburton District in the mid-Canterbury region of the South Island of New Zealand.

Published literature on community response after a fire is not extensive. Burchfield (2007) reviewed research findings related to the psychological and social effects emerging after fire events, and the range of responses from individuals, communities and agencies. The ability of residents to interact following a wildfire was found to support community resilience (Kulig *et al.* 2011). Social networks and community organisations and institutions further facilitated the recovery of individuals and communities (Burns *et al.* 2008; Ganewatta and Handmer 2009; Winkworth *et al.* 2009; Kulig *et al.* 2011).

To begin to answer questions regarding the adaptive capacity of New Zealand communities to wildfire, we studied the 2004 Mount Somers fire, overlaying an event-based temporal framework (McCool *et al.* 2006) on a set of process elements critical to adaptive capacity (Paveglio *et al.* 2009).

Methods

Study area

Mount Somers village is located nearly 110 km south-west of Christchurch, within the Ashburton District in the mid-Canterbury region of the South Island of New Zealand (Fig. 1). The estimated population of the village and surrounding farms is 120, with holiday-makers (seasonal residents) increasing that number primarily during the summer months. Historically a mining

and grazing community, the majority of Mount Somers residents are still involved in farming (Statistics New Zealand 2006). The village is the 'Gateway to the Canterbury Highlands', a marketing designation highlighting the growing importance of recreation to the local economy.

Study event

In the summer of 2003–04, a series of wildfires burned across Canterbury, stretching local and regional fire management resources. On 5 January 2004, a fire described in the media as 'the biggest Canterbury blaze in recent years' (Guardian Today 2004) started near Mount Somers in scrub riverbed vegetation. The fire swept along the South Branch of the Ashburton River for ~6 km. There were several factors that made this fire especially challenging for fire managers including its rapid spread, proximity to farms and infrastructure, forecasts of changing wind direction and potential to extend 44 km south-east to the provincial town of Ashburton.

The local Volunteer Rural Fire Force, with its small team of volunteers, was the first at the scene, but was soon joined by several other Ashburton District Council (ADC) and local volunteer fire forces. They quickly realised that this fire was bigger and more intense than those they had experienced previously and called for assistance. Because the fire started on Crown land within the Department of Conservation's (DOC's) rural fire jurisdiction, a DOC-led regional incident management team with personnel from Rural Fire Authorities (RFAs)[A] across Canterbury took control of the fire. However, as mentioned earlier, local fire resources were stretched that summer, and the next morning, a national incident management team was brought in from outside Canterbury, including some members from the North Island. This was the first time a national incident management team had been formally deployed to manage a wildfire in New Zealand.

With the Mount Somers fire, local farmers, village residents and holiday-makers experienced their first significant wildfire. The fire burned an area of 270 ha, and damaged or destroyed deer fences, boundary fences, equipment, pasture, plantations and shelterbelts. Although a few deer were injured, no stock was lost. Farms and homes were evacuated from the anticipated fire front, but no fatalities or serious injuries occurred to either firefighters or members of the public.

Informational meetings were held for local farmers, in conjunction with the Federated Farmers of New Zealand,[B] and other members of the community during and after the fire event to address what was characterised as poor communication between the incident management team and community, the perception that local knowledge was not used during the fire and the issue of compensation for damage resulting from fire suppression efforts.

Research methods

Because there has been little research addressing the community effects of wildfires in New Zealand, understanding these events required exploratory research using a qualitative inductive approach (Corbin and Strauss 2008; Saldana 2009). Such research may be considered oral history, collecting information based on people's memories of past events. Critics of oral history point to methodological challenges including the reliability of the sources, problems of memory reconstruction, and the relationships between individual and collective memory (Kirby 2008; Kihlstrom 2009). Proponents respond that in trying to understand the meaning of what has happened in the past, the truth is important, but so are the errors people make in remembering events (Stille 2001). The greatest benefit of oral histories may be that they bring forward information that would not necessarily be included in records left by those in authority at the time of the event. This research method therefore brought forward perceptions that were not sought or emphasised in debriefings or formal reviews immediately following the Mount Somers fire.

Table 1. Number of individuals interviewed by category and sex, April–July 2008, Mount Somers, New Zealand

Category	Men	Women	Total
Fire managers	4	0	4
Firefighters	3	0	3
Emergency support officers	4	5	9
Local farmers	9	7	16
Local residents	5	11	16
Total	25	23	48

Study participants were selected using purposeful sampling, with individuals chosen because of their knowledge or experience (Lindlof and Taylor 2002). Participants included local residents, emergency managers, elected officials and representatives of governmental and non-governmental organisations (Table 1). People were interviewed until the authors agreed that emergent themes or responses had stabilised and no new information would be forthcoming from additional interviews.

Data analysis consisted of (1) coding themes emerging from interviews that related to elements of adaptive capacity during different disaster phases; (2) identifying any apparent contradictions in themes within and between interviews; (3) discussing the themes and contradictions with research colleagues and emergency managers in order to standardise themes emerging from the data and (4) selecting the most representative quotations for the remaining themes. This coding strategy provided a systematic way to identify salient themes based on their reoccurrence in the data (Boyatzis 1998; Silverman 2001).

The authors also reviewed newspaper articles, official reports and other memoranda related to the fire. These documents helped to explain some of the findings and to fill in details that were difficult for interviewees to remember 4 years after the fire.

[A]Currently there are 86 RFAs in New Zealand that have the legislated responsibility for rural fire control within four categories of land: Department of Conservation for Crown land; New Zealand Defence Force for fires within the land it manages; Rural Fire District Committees for areas registered with the New Zealand government's official newspaper for fire protection (gazetted areas); and Territorial Authorities for all other rural areas.

[B]Federated Farmers of New Zealand is New Zealand's leading independent rural advocacy organisation, which advocates for farmers and the role of farming in the New Zealand economy. It is referred to as Federated Farmers throughout this paper.

Findings

Major themes emerged from the data that related to the three process characteristics of adaptive capacity identified by Paveglio *et al.* (2009): (1) networks and relationships among locals; (2) local knowledge and experience and (3) expert knowledge and institutional capacity.

Before the fire

Networks and relationships among locals

Networks and relationships critical to building and sustaining adaptive capacity were present in Mount Somers before the fire. Residents displayed confidence that they could handle challenges that were presented to them, owing in part to the strong relationships existing within the community:

> You find that the further away from the main centres [you are], that you have to rely on your neighbours in time of emergency … it's your neighbours who are your first call. [Emergency support officer]

Other place-based challenges, such as the area's severe snowstorms, and how local residents responded to ensure human and animal safety and to keep the community operating normally, were also often cited:

> We helped everybody and everybody helped everybody else. We got the paper through, we got milk, we got everything in. You know, you just went out to help get paths for the elderly … Just step in and do it … [Local resident]

Even people who did not live in Mount Somers, but were familiar with the area, described the closeness of the community:

> But it's that community spirit that brings everybody together. They're very close-knit up there, very close-knit. And once you're in that area, they do treat you like family. [Emergency support officer]

Community networks and relationships in Mount Somers were strong, with community groups centred on the local school, sports clubs, Domain Board, District Citizens Association, the local fire force, church and Federated Farmers. Study participants identified sex differences in the interactions and relationships within the community. The women interviewed felt that they were more likely than the men to admit they needed help, and that they had better support mechanisms in place.

Local knowledge and experience

Participants interviewed indicated that the people in Mount Somers were valued for their knowledge and competence rather than their occupation, land ownership or wealth. As articulated by a local government official, 'If you had skills, and you had abilities, and a good heart, it's all that mattered'.

Local knowledge and experience helped build an awareness of fire risk before the Mount Somers fire. Residents indicated they were more alert to wildfire danger when there were fires burning in other communities, drought conditions had persisted for a long period of time, the fire danger warning signs erected by the ADC showed increased fire risk, and dry north-west föhn winds were blowing, and they changed their behaviour in response to extreme conditions. One teenager interviewed said that when fire danger was high, he did not ride his motorbike for fear of starting a fire in long grass, and farmers prepared by filling their spray tanks with water and mowing grass, including grass along roadways. Farmers expressed concern about the fire risk posed by scrub weeds such as gorse (*Ulex europaeus*) and broom (*Cytisus scoparius*) in the riparian zone and that LINZ was not obligated to control vegetation in this public riverbed (Environment Canterbury 2005).

Community members felt that they had acquired local knowledge relevant to wildfire management over the years by living through droughts and other extreme weather conditions, lighting burn-offs on cropland to remove residues and volunteering in local fire forces.

Expert knowledge and institutional capacity

The DOC and ADC were identified as providing the expert knowledge and institutional capacity necessary for emergency management, augmented by local capacity existing in the Mount Somers rural fire force. At the time of the fire, the Mount Somers force had 10 volunteers, but generally only three volunteers were available for callouts during the work day as the rest of the team was employed outside the immediate area. Local fire forces in nearby townships were ready to assist on Mount Somers callouts. The Mount Somers rural fire force attended ~10–12 fire-related calls per year. Volunteers were proud of their fire force, and the wider community viewed the fire force as dependable.

Non-governmental emergency organisations were in place before the fire that contributed to the emergency preparedness in Canterbury, including international welfare organisations such as the Red Cross and Salvation Army. Victim Support, a voluntary New Zealand organisation, provided practical support and someone to talk to for those affected by disasters. Federated Farmers had established a Rural Support Trust following a 1973 snowstorm to collect donations and provide financial and counselling support for farmers affected by that snowstorm and future disasters.[C] The local branch of the St John Ambulance Service had begun training as part of the regional incident management structure to improve their effectiveness during disasters.

During the fire

Networks and relationships among locals

Mount Somers residents activated networks and drew on relationships during the fire to minimise damage, help their neighbours and support the firefighters. Neighbours of farmers whose land was threatened by the fire helped fight the flames, load valuables into vehicles for evacuation and move stock – engaging in activities familiar from other emergency situations. Women organised and mobilised to provide childcare for volunteers and distribute water and food to firefighters. It was in feeding the firefighters that women felt they were most

[C]The Rural Support Trust evolved into a community organisation called the Mid Canterbury Rural Support Trust. Federated Farmers provide some trustees and administer the Trust.

helpful. Although some were contacted by the Red Cross to help, others just arrived at the village's Memorial Hall (where the incident management team was stationed) offering help:

> [I] rang the office and they said, 'There's a fire in Mount Somers, and it's not looking good.' So I turned the oven on and made scones and buns, and we headed off over there. [Local resident]

Women felt that working together during the fire helped build a sense of community:

> I was going to say [the women were] 'enjoying themselves', but how can you enjoy yourselves when [there's a fire]? But they all pulled together and they all commented on that, how much everybody was pulling together to make the best of a bad situation… [Local resident]

Local knowledge and experience

The perception that the non-local emergency managers devalued local knowledge was common among local residents:

> [Not using local knowledge] was a huge, huge thing. [The locals] said, 'Look, we know this place better than you', and yes, that was a huge complaint, that [the incident management teams] never did use the local knowledge of what was going on and where things were. [Emergency support officer]

The local rural fire force was seen as having critical knowledge that could have reduced the damage caused by the fire and fire suppression efforts, but once the national incident management team took control, local residents felt that the local fire force was marginalised. However, the knowledge and experience of local firefighters allowed them to perform critical tasks during the fire. The fire was believed to have been the result of arson, so local firefighters guarded the ignition site. A member of the local fire force accompanied DOC firefighters on a helicopter overview of the fire, helping them identify potential high-value and high-risk areas. In addition, members of the local fire authorities served as incident controller during the night shift, interpreted weather reports and maintained communication equipment. Several local firefighters provided assistance after the fire was contained, detecting hot spots and ensuring that the fire was extinguished.

Despite the valuable roles played by the local fire force members, it was the perception of residents that if a local team, with knowledge about the community and local properties, had remained in charge, damage from the fire and the fire response operation could have been minimised, that damage was greater than necessary because the team that managed the fire was not from the local area.

Local landowners felt that they should have been allowed to fight the fire on their land. Although Principal Rural Fire Officers have the power to remove people from the scene of a fire, there is an accepted national policy that allows locals to help fight fires and assist with emergency support, but only if they are adequately clothed and trained or can be supervised and integrated into the firefighting structure. Mount Somers fire managers understood that many locals had experience burning their crop residues, but were concerned that locals generally had not worked on a firefighting team or within a larger firefighting structure. Farmers, in particular, became frustrated when what they thought of as their right and responsibility to protect their land was challenged by firefighting officials:

> …a lot of people, they were so frustrated with … being held back by the bureaucrats, the safety side of it … The way it's normally been is that there's some sort of fire and everyone gets in and the fire's out and worry about the problems later… [Local resident]

However, even in their frustration, some locals understood and supported the emergency managers' focus on safety.

Local knowledge was put to use when an agricultural contractor went with firefighters to identify the location of gates, water supplies and other resources and hazards on the south side of the river. Many of the interviewees believed that if the local fire force or DOC firefighters had maintained control of the fire, more local knowledge would have been used.

The local women also had knowledge and experience that allowed them to help emergency managers locate people at risk within the community. During the first hours of the fire, several women helped the police locate homes on a map, the number of people in each home and whether there were disabled or elderly people who would need help during an evacuation.

Expert knowledge and institutional capacity

Firefighting knowledge was initially brought to the Mount Somers fire by local fire forces, then by DOC, and finally by a national incident management team.

Within the incident management structure, the New Zealand police are responsible for evacuating properties threatened by wildfires. During the Mount Somers fire, the Ashburton police handled the evacuation, and members of the force went door-to-door evacuating residents in a limited area. Those who willingly participated in the evacuation appreciated that they were allowed time to move stock and load valuables, including photos, jewellery, favourite toys and pets. Generally, the elderly and families with children were more willing to evacuate than others. However, several local residents indicated that they would not evacuate if faced with a similar situation in the future.

Other local organisations were involved in supporting the fire suppression efforts. The Red Cross and Salvation Army helped organise volunteers and provided menus and provisions for meals served. St John Ambulance Service attended the fire and treated a few minor injuries. A lay minister from the Presbyterian Church was permitted access through roadblocks to provide support and food during the fire.

After the fire

Networks and relationships among locals

The importance of Mount Somers' networks and relationships was especially apparent during fire recovery. The 'happy hour' at the hotel that began during the last big snowstorm continued and provided an opportunity for the locals to share concerns following the fire. The value of these exchanges was described as follows:

> I find that they are very good at talking amongst themselves too, which, of course, is your best way of getting over

> something … They get the hall or the pub and they have their little meetings. They get together and talk about it as a community. [Emergency support officer]

One activity that was frequently mentioned when people talked about how the community recovered was a community barbeque to thank the firefighters involved in the suppression. Some weeks later, one farm family had another barbeque to thank the people who had helped them during the fire, with more than 50 people attending.

Several farmers experienced significant financial losses due to the fire, which made their recovery more problematic – fences had to be repaired, pastures restored, stock relocated and plantations replanted. These costs were not just short-term, but will be felt for many years: '[I lost] 3000 trees for a good retirement … I'll have to carry on working now' [local farmer]. Neighbours helped by providing labour and pasture.

Local knowledge and experience

Experience gained by residents as a result of the Mount Somers fire did not lead to community consensus on potential future wildfire risk or efforts to increase wildfire preparedness. Those who thought that a fire could happen again pointed to the lack of vegetation management along the river and the build-up of fuels. They also believed that in the future, there would be more dry periods and weather conditions that could support a wildfire. Those who thought another wildfire is unlikely generally had faith that people will be careful with fire, and if another fire starts, damage can be limited.

The Mount Somers fire increased locals' awareness of wildfire, and people talked about their surprise at how quickly the fire spread and the damage it caused. Some families identified where they will go and what they will take if they are forced to evacuate in the future. But awareness was not long-lived: '[The fire] made me a wee bit aware of things. You become aware, and that's all right for a while and then you stop thinking about it again' [local resident]. In general, wildfire was not high on the list of Mount Somers' residents' priorities, 'It happened and we got on with our life. No, I don't think much about fire really' [local resident].

Farmers have taken several actions that have increased their preparedness, but those actions were not specifically undertaken in response to the fire. Projects such as building a larger dam to trap more irrigation water, harvesting crop residues rather than burning them and purchasing a larger spray tank all have increased preparedness but were primarily undertaken to improve farm income.

Expert knowledge and institutional capacity

Following the fire, a few local residents participated in debriefings and other meetings, but most people were not aware that these events were being held or their attendance was possible. DOC assigned staff to follow up with farmers who had experienced significant losses, but few of the locals interviewed remembered this interaction.

Insurance coverage was problematic, and generally did not cover the costs of replacing fences or plantations destroyed by the Mount Somers fire. At least one farmer changed insurance companies and increased coverage following the fire. One insurance company that determined their policies did not fully cover all the claims filed by landowners for damages caused by the Mount Somers fire provided additional recovery funds through the Rural Support Trust. These funds were distributed to farmers in proportion to their losses.

Some locals, especially farmers, suffered stress due to the fire and its aftermath. The Support Trust provided a professional counselling service for affected farmers that was well received. The Victim Support staff called locals affected by the fire to monitor how they were recovering and to offer assistance.

Discussion

People interviewed for this study emphasised that Mount Somers is a resilient community:

> You bounce back. And everyone tries to do what they can. That's what this community's about. And that's what the community really does. [Local resident]

Wilkinson (1991) has described a community as an interactional field and states that as long as people interact, the community will persist and develop a collective identity that supports civic action. Carroll *et al.* (2005) pointed out the importance of local agency in determining whether a wildfire results in social conflict or cohesion. Later, Kulig *et al.* (2011, p. 8) talked about resiliency as a process that is 'dependent upon the presence of social cohesion and a sense of community'. The wildfire in Mount Somers provided residents with another opportunity to come together and reinforced their belief that they are self-reliant and capable of meeting challenges.

Research has shown that social networks help people mitigate and prepare for wildfire and give people a sense that they have control over their lives (Winkworth *et al.* 2009). Previous to the Mount Somers fire, networks and relationships among Mount Somers residents had been built to meet a variety of needs – improve the quality of life, aid local families trying to deal with severe illness or death and overcome the challenges of severe snowstorms. Mount Somers networks and relationships were drawn on during the fire to help local landowners threatened by the fire and to assist volunteers, caring organisations and firefighters during and after the fire. Following the fire, networks and relationships helped speed recovery by giving landowners an outlet for articulating their frustration and expressing their thanks, and organising community-based efforts to provide assistance to those affected by the fire. However, these networks did not promote increased preparedness or mitigation activities.

Local knowledge and experience obtained before the Mount Somers fire, especially knowledge and experience linking weather conditions to wildfire, contributed to residents' awareness of wildfire risk. Research indicates that the use of local knowledge during a fire not only informs the firefighting effort, but also builds trust between emergency managers and the community (Liljeblad and Borrie 2006; McCool *et al.* 2006; Elsworth *et al.* 2009). Conversely, when local residents perceive that local knowledge has not been put to good use, it can result in negative feelings that persist years after the fire event (Carroll *et al.* 2011). During the fire, Mount Somers residents were frustrated by what they perceived to be lost opportunities to use local knowledge about threatened structures, crops and

livestock or available resources to fight the fire. The fact that Mount Somers residents continued to talk about what they perceived as a lack of respect for local knowledge and experience 4 years after the fire indicates the importance of this element of adaptive capacity to this community. There was no consensus on whether or how the Mount Somers fire may have added to local knowledge and experience. Immediately after the fire, wildfire awareness increased, but residents' concern waned, replaced by concerns about the availability of water for irrigation and to maintain river flow, the growing number and size of dairy farms in the area, and the ongoing land-tenure review for the high country to the west of Mount Somers.

Expert knowledge critical to Mount Somers wildfire management was found in formal institutions including DOC, ADC and the local fire force. Residents did not recognise a role for these institutions in helping private property owners prepare for wildfire or mitigate wildfire risk. They did hold DOC responsible for managing fuels on land for which they were responsible. Research has shown that firefighting efforts are most effective when local fire forces and local knowledge are integrated into incident management structures and firefighting operations (McCool *et al.* 2006). Although the local fire force did play several important roles in wildfire suppression, the perception persists that they were not adequately utilised:

> A guy from [the national incident management team] took over control, had no idea what Canterbury was like, what a Canterbury braided riverbed is like… He didn't use [the local rural fire force], first thing they should have done is grab [local firefighters] and said, 'What have we got out there?' They didn't use the local knowledge. It was there… [Local resident]

Research has shown that institutions, including non-governmental organisations not usually associated with recovery, can play a role in helping communities prepare for and respond to disaster events (Ganewatta and Handmer 2009; Winkworth *et al.* 2009). Following the Mount Somers fire, institutions identified as bringing the expert knowledge necessary for recovery were not necessarily associated with wildfire, including Federated Farmers and Victim Support.

Conclusions

Global climate change is expected to lengthen the fire season and increase fire occurrence in temperate and boreal regions around the globe, including in New Zealand (Flannigan *et al.* 2009). This means that communities, not only in New Zealand but also in other parts of the world, that have rarely had to address wildfire management will be faced with growing challenges in this area. The success of wildland fire management hinges as much on the acceptance, support, behaviour and cooperation of at-risk communities as on biophysical fire science and technology (also signalled by Daniel *et al.* 2007). Case study research in New Zealand has emphasised that social networks and relationships among locals, local knowledge and experience, and expert knowledge and institutional capacity are vital process elements of the community adaptive capacity model for disasters. Civic action to build adaptive capacity will occur when individuals within communities have common experiences that result in shared perceptions and values. The processes highlighted here as supporting adaptive capacity may be encouraged by policy-makers and emergency managers, but are likely to be most sustainable when they originate from within the community. This is the challenge to strengthen adaptive capacity of communities for the future.

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