Understanding, developing and sharing knowledge
about fire in Victoria, Australia

Fire and adaptive management

report no. 77

Cover photograph: Fire learning network in conversation, April 2010

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By Simone Blair, Claire Campbell, Andrew A. G. Wilson and Matt Campbell

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Summary

Knowledge and learning are discussed daily in large organisations, such as the Department of Sustainability and Environment (DSE). Most of the time we do not reflect on what is meant by knowledge, even though many of DSE's most difficult problems require knowledge and understanding to resolve.

This report articulates a model of knowledge, one in which knowledge:

- is social
- is dependent on context
- is a process
- has a physical and emotional basis.

Approaching knowledge in these ways represents a profound, and perhaps uncomfortable, shift for DSE (as it would for many organisations). Even so, approaching old problems in new ways should be tried. Trying new ways of addressing old problems and creating new knowledge in the process is the basis of managing adaptively – an approach that DSE is taking as part of Living with Fire, Victoria's Bushfire Strategy. Knowledge is the 'currency' that flows through the adaptive management cycle of 'learn, do and review'. It is necessary, therefore, to come to grips with what is meant by knowledge, as this is crucial when implementing an adaptive management framework.

The report draws on insights from the social sciences and psychology and discusses how knowledge can be understood as our continually updating mental model of the world. Our mental models are based on our experiences and social relationships, and so, the report argues, we must pay much more attention to these aspects of learning contexts. Finally, the report describes a number of techniques and processes – informed by the knowledge model – that can be employed to facilitate group learning and knowledge sharing.

As knowledge is the currency of all workplaces, the model of knowledge proposed here, and the ways of working that logically flow from it, can be used to improve our ability to learn from others and share our knowledge with others. The focus of this report is knowledge about fire.

Acknowledgements

This report is the result of action research. In 2008–09, while piloting a strategic conversations approach to knowledge sharing, we learnt a lot and confirmed a lot about how knowledge of land and fire management emerges in practice.

Simone Blair

Simone is an anthropologist who taught and undertook social research at the University of Melbourne. She has worked with Victorian commercial fishing communities to explore how they learn about, understand, use and pass on knowledge about the marine environment; and how their values and social relationships affect these processes of learning and intergenerational knowledge transfer.

The common thread in all her work is an interest in the different ways groups of people come to know, value, care about and use the natural environment. These differences, in life ways, culture and ways of knowing, offer insights into how we can all better live in and adapt to our world.

Claire Campbell

Claire is a clinical psychologist and has worked in the community development field for the last ten years. In that time, she has developed processes, tools, approaches and mechanisms to empower communities to respond to the issues they are facing (e.g. HIV/AIDS in Africa or the Asia Pacific), or the issues of loss and grief encountered after a natural disaster (e.g. the 2004 tsunami and 2005 earthquake in Pakistan).

Claire spent a number of years as the lead researcher in a cross-cultural participatory action-research project evaluating the impact of HIV/AIDS prevention approaches implemented by the Salvation Army. The research was undertaken in eight countries – Kenya, Zambia, Malawi, Uganda, PNG, Indonesia, India and Sri Lanka – and the learnings shared with other organisations.

Claire believes that all people have the capacity to respond to the issues facing them in their own context. Further, dynamic change is possible, irrespective of culture or issue, by systematically applying core concepts related to building relationships through ongoing conversations.

Andrew Wilson

Andrew is a forester by training and has worked for DSE (and the departments that it succeeds) since 1987. He has worked in the functional areas of fire management, whole-of-department information management, geological survey and corporate IT. Before joining DSE, he worked with CSIRO's National Bushfire Research Unit in Canberra, and the Rural Fire Research Centre in Melbourne. His masters degree researched the survival of people and houses at Mount Macedon following the devastating Ash Wednesday fires of 1983. That research is the basis of the "so-called" 'Wilson house survival meter'.

Common threads that run through Andrew's work include making practical sense of complexity, and linking disparate people and concepts together to release the benefits of them working as a whole.

Matt Campbell

Matt Campbell is a public health professional and has worked on HIV-related community development initiatives in the Asia/Pacific region and southern Africa. His focus has been building community connectedness through strengths-based approaches, which recognise the inherent capacity of all individuals to respond to the concerns in their lives. Matt is passionate about discovering how social and environmental contexts affect communities – initially, across cultures and now through DSE Land and Fire Management.

Matt believes ongoing learning from local knowledge and experience is the greatest catalyst for generating sustained behaviour change. In his experience, genuine relationships enable all people to participate in this process.

The events of Black Saturday were a dramatic reminder that Victorians live in a fire-prone environment. The fires caused unprecedented trauma, loss of life and livelihoods, and destruction of property, water catchments and other values. Mostly, these losses are irreplaceable. However, as we grieve, we can at least find some meaning by striving to learn from this event and sharing that knowledge with others.

Before we can learn, it is important to discover what people understand about fire and how those understandings influence what they do. We've each observed how understandings differ widely, with animated debates on tree clearing, bunkers, rebuilding and many other issues. Because of these differences in understanding, agreeing on ways forward is likely to be difficult.

An important consideration for any organisation that strives to learn from experience, develop new knowledge, incorporate local knowledge and share knowledge with others is to have a working understanding of what knowledge actually is.
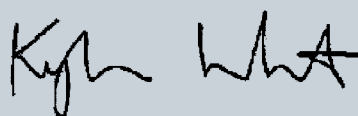
This report addresses a critical need at a critical time. It carefully explores our basic assumptions about the nature of knowledge itself. It suggests practical ways for DSE staff and people within the community to work differently to improve knowledge sharing and, ultimately, learning.

Shortly before the fires the Victorian Government launched an important initiative called Living with Fire: Victoria's Bushfire Strategy. The initiative identified six strategic directions:

• managing the land with fire

• building community capacity to live with fire

• enhanced response and recovery

• workforce/volunteer capability

• planning for protection

• risk and adaptive management.

This report is the result of work that began in 2006, which focused on adaptive management and addressed some of the hard questions about how our values and beliefs affect what we know about our environment and each other. Ultimately, it is these understandings that profoundly influence how we learn from our actions.

I recommend the report to all DSE staff and members of the community with a serious interest in grappling with one of the key influences on positive fire outcomes – our knowledge. If we understand ourselves better, we will be more able to share what we know and learn from others. Moreover, during this process we will develop a mutual understanding that will lead to better fire outcomes for fire agencies and the communities they work alongside.

Kylie White
Executive Director, Land and Fire Management
Department of Sustainability and Environment

Bushfires have a profound effect in Victoria. They can be both disastrous and beneficial to socio-ecological systems and affect these systems in ways we do not fully understand.

To temper fires' effects on the environment, communities and individuals, DSE actively uses and suppresses fire. The causes and effects of both bushfire and planned burning, however, span decades and long distances, are much contested, infinitely nuanced and not well understood. Further, the socio-ecological system that DSE works within, and, to some extent, manages, keeps changing: more houses are built, people move and change their views, the landscape changes and so to does the climate.

There are many ways that organisations and societies respond to changes in socio-ecological systems. Some ignore change and carry on doing what they have been doing (past societies, such as the Easter Islanders, come to mind), others respond by trying something new and the remainder try multiple ways of doing something new and assess which worked best – an approach often called 'adaptive management' (e.g. Holling 1978; Walters & Holling 1990).

Adaptive management puts discipline into the 'learning cycle' (see Fig 1) and enables managers to learn faster as they study alternative courses of action simultaneously. We may apply it to socio-ecological systems (such as people living with a forest), or less preferably to natural and social systems separately. By managing adaptively, rather than by haphazard interventions, we expect to continually build on our knowledge and to remain responsive to change. Even so, our best efforts to address the gaps in our knowledge – perhaps like greyhounds chasing the mechanical hare – help but ultimately never truly succeed. We may never 'catch the hare', but we can come closer. We'll need to keep striving, of course – and we'll need to better understand the race itself, and how best to run.

The benefits of adaptive management still leave some critical questions unanswered – what is knowledge, who has the knowledge, who needs it, who decides who needs it, how does the knowledge transfer between them and can knowledge really be transferred?

These are social questions about how we relate with one another, organise ourselves and collectively know, learn and decide.

People make sense of social and ecological changes by drawing on their own knowledge, experiences and networks (Paton 2006; Hoffman & Oliver-Smith 2002; Strauss & Orlove 2003). Sometimes, their conclusions about what happened, why it happened and how to respond differ widely. These different perspectives often inhibit knowledge-sharing and promote lack of understanding and conflict (King 2005; Raish et al. 2007; Soeterboek 2008; Trigger 1999; Whittaker & Mercer 2004). They can also degrade a community's resilience – an important quality in their ability to anticipate, respond to and recover quickly from changes in their ecological and social surrounds. Paradoxically, however, the diverse perspectives that make up a community may be a great source of resilience.

This report has the ambitious aim of improving cohesion, resilience and decision making within the complex social system of the Victorian community, including the staff of organisations such as DSE. A model of what knowledge is and how people create, share and act on it is proposed. It seeks to complement rather than replace existing management practices. While it focuses on knowledge in the context of land and fire management, this model can apply to issues of knowledge, knowledge sharing and learning in many different contexts.

The report is presented in three sections: (1) the proposed model, its effects and ways of testing it; (2) the underlying concepts, rationale, literature and theory; and (3) methods and tools to use to help people develop an understanding of, and responsiveness to, the socio-ecological context in which they live.

The environment and the society in which we live are always changing. To become more responsive to these shifts, DSE's new fire-management policy will be even more deliberate about learning and working within an adaptive-management framework (State of Victoria 2008).

Adaptive management is an approach to the management of socio-ecological systems that treats all management interventions[1] as experiments (Holling 1978; Walters and Holling 1990; Waltner-Toews, Kay & Lister 2008). Rather than learning haphazardly by trial and error, an adaptive organisation learns in a systematic way as it deliberately tries new ways of doing things and learns from the effects of those actions.

As it is unlikely that one person alone can change the working of the system, an important consideration for adaptive managers is how new and current knowledge flows from one person to another, or from one organisation to another. For adaptive management to be realised in practice, managers must consider how new and current knowledge can be shared across communities, including organisations. By focusing on knowledge and knowledge sharing, DSE can enable all of us to act 'to the best of our abilities' in our spheres of responsibility, our backyards, our region and so on.

This report's support for an adaptive-management approach is twofold:

1. If we approach knowledge in a particular way we predict that learning outcomes will be significantly better – the hypothesis about knowledge

2. In developing this hypothesis, the report contributes to understanding new ways of helping the flow of knowledge within organisations and the community, and between the community and organisation.

We revisit our understanding of the system to check for accuracy and refine it if required.

Example

What is adaptive management?

To begin with, there is a system and it is in a particular state (e.g. the atmospheric system, which creates weather patterns that are somewhat predictable). We can predict the outcomes of various management options on the system, based on our existing understanding of the system and uncertainty.

Then we use our predictions to select and plan for a particular management action, while considering other influencing factors.

We act by carrying out the planned management action, which may lead to a change in the state of a system (e.g. from mature vegetation to juvenile vegetation; from antagonism between people to understanding and acceptance).

We monitor or observe events and changes to the state of the system and then learn by interpreting those observations and gaining knowledge from this interpretation.

Notes

1   Non-intervention is also a management action.
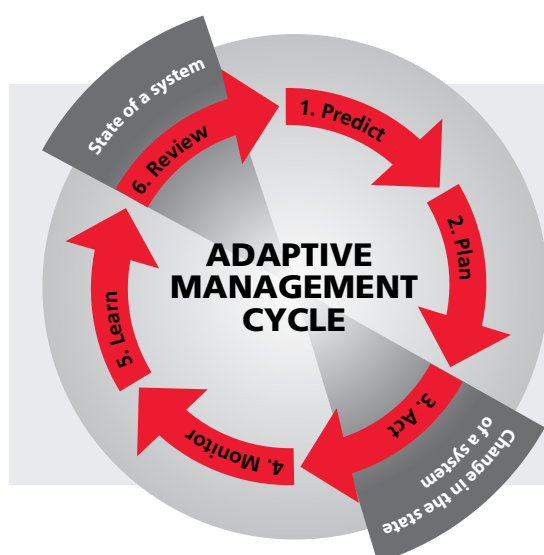
Figure 1. An adaptive management cycle. This cycle shows the actions required to achieve adaptive management.

One of the main benefits of adaptive management is that the organisation can learn as it works. It is not limited to research, which has long completion times, and it incorporates knowledge that has been generated beyond academia. This approach allows an organisation to adapt to changes in its external socio-ecological environment more rapidly (Holling 1978; Walters and Holling 1990).

Adaptive management, the flow of knowledge and resilience

Increasing community or social resilience is a key aim of *Living with Fire Victoria's Bushfire Strategy* (State of Victoria 2008). Some key traits of a resilient community are its interconnectedness and ability to share its knowledge and resources (Olsson et al. 2004; Goldstein 2008; Norris et al. 2008). Connectivity enables a community to better anticipate, respond to and recover from changes in its ecological and social surrounds, that is, it can adapt. When applied to social systems, an adaptive management approach seeks to support and enhance these characteristics. Since connectivity is a key quality of resilient systems, working to create and improve relationships between people, groups and communities and support knowledge flow between them increases adaptability and resilience (Holling & Meffe 1996; Olsson et al. 2004; Goldstein 2008; Norris et al. 2008).

Community resilience can be developed by fostering connectivity and relationships through which knowledge can flow at a variety of scales and between scales. For example:

- **Individual** – reflection on personal views and beliefs
- **Group/community/ organisational** – sharing knowledge and experience with others and in the process creating new knowledge (e.g. through strategic conversation – for a case study see Blair, Campbell & Campbell 2010).
- **Network/regional/global** – transfer of knowledge between social groups or networks (e.g. through a learning network, for case study discussion see Campbell, Blair & Wilson 2010).

Conflict inhibits knowledge flow

People value, care about, use, and interact with the environment or landscape in different ways. In addition, people make sense of social and ecological changes by drawing on their own knowledge, experiences and networks. Sometimes, in the process, very different conclusions are drawn about what happened, why it happened and what should be done about it. These differences in perspective can lead to conflict and misunderstandings within a community, and between communities and organisations. Conflict can inhibit knowledge-sharing processes and is the antithesis of social resilience.

In general, DSE has worked with conflicts through community engagement initiatives that focus on outcomes (i.e. decision making and consensus). The community's involvement may be limited to being informed about the project, while sometimes a community is given a degree of decision-making power (e.g. community engagement for the Fire Operations Plan (FOPs)).

The aim of making a decision can be detrimental to learning, however. While the decision-making approach certainly motivates people who want their views to be heard and adopted, it also raises expectations and may create or entrench divisions between different groups within a community. The approach also assumes that people know enough about a situation to make an informed decision in a short period of time.

It is worth keeping in mind, however, that the diversity of human experiences and responses can lead to conflict but can also be the wellspring of new knowledge and learning.

A knowledge development aim

The findings of this report form the basis of an approach (developed here and in other documents, such as Campbell, Blair & Wilson 2010; Campbell, Campbell and Blair, forthcoming) that has quite a different aim – to increase our capacity to live with fire by creating opportunities for all of us in the community and organisation to share knowledge about fire in trust-rich settings. This approach complements decision-making approaches because it increases everyone's capacity to participate constructively in decision-making processes. However, to enhance knowledge flow and become more adaptive, we first need to understand what knowledge actually is and how it is created, acted on and shared between people.

A new knowledge model

Land and fire managers sometimes treat 'knowledge' about fire as if it were an object that can easily be transferred between people and remain unchanged. As a consequence, they predict that people's beliefs and behaviours will change (in the way they intend) simply by this transfer of information.

Taking the 'knowledge as object' approach often leads to poor knowledge sharing within an organisation or community; between a community and organisation; and between an organisation and its research partner/s. This is most clearly evidenced in the community where there are widespread misunderstandings (and disinterest) about bushfire and planned fire. Further, there are 'blockages' to sharing new approaches and findings about fire within our own organisation – DSE. Issues such as these suggest that our current model of knowledge is inadequate.

We therefore propose an alternative model of knowledge[2], which is described below. This model provides ways for fire managers to work to promote knowledge creation and sharing within Victoria. We also outline predicted outcomes, followed by ways of testing whether those outcomes have occurred.

The model is underpinned by a theory of learning and cognition known as 'social learning theory;' which has been championed by researchers such as Etienne Wagner, Jean Lave and Edwin Hutchins (see for example, Chaiklin & Lave 1993; Hutchins 1995; Lave and Wenger 1991; Wenger, McDermott & Snyder 2002). Social learning theory posits that the acquisition of new knowledge [i.e. learning] is context driven, participatory and inextricably tied to social processes of relationship and identity formation.

The model

We propose a fourfold model – that knowledge:

• is always social

• is more than just facts (i.e. context is critical)

• exists in process

• is developed through different modes of being (e.g. physical, emotional and visual).

Always social

Knowledge is never pure or free from human interpretation. It is people who generate, challenge and change it (this also pertains to scientific knowledge e.g. Kuhn 1959). We are all implicitly aware of this, often questioning the source of any new information – "who told you?" or "who did you hear this from?". We recognise that knowledge can never be entirely separated from its human creators – facts, data, information, knowledge and wisdom have authors. These authors are only human and, by virtue of their background (e.g. family, cultural, political, economic and education), they will conceive and represent knowledge in different ways.

In practice, we all understand this and so we question the social origin or source of knowledge in order to assess its reliability and applicability to *our* context. The social origin of knowledge is why trust between knowledge sharers is so important (Paton 2008). For example, no matter how accurate my knowledge is, if you do not trust me it is unlikely that you will take on board what I tell you.

Notes

2   The question, "what is knowledge?" has troubled people for at least 2000 years. This concern forms an entire sub-field in philosophy – epistemology. The model proposed here draws from this field of enquiry in a simplified way.

More than facts

We often differentiate between facts or information and knowledge. In doing so, we imply that we must know something about the fact's context for it to become knowledge; if we do not, it cannot become knowledge. Without some context we simply do not know where the fact fits. For example, information may show that fire at intervals of more than two years reduces the cover of a particular plant species. Without knowing anything else, however, we do not know what the implications of this are for our own lives and may find it difficult to act on the information.

To really understand what the information means we need to know something about the different contexts involved. Some of these contexts are outlined below.

Environmental	Is the plant rare locally?
Social	Who collected the data? How? Is there any bias? Who cares about the answers to these questions and why? Who doesn't care and why?
Political	What are the ways in which people can act on these facts? Would the answer to this question change if I lived in a democracy as compared to a dictatorship?
Personal	Why do I care about the answers to these questions?

This way of thinking about knowledge is related to 'systems thinking', which states that all things are interconnected and that knowledge about any one situation or phenomenon comes from greater understanding about how it is connected to and influenced by other phenomena (see also Bateson 1972; Checkland 1981; Midgley 2003).

When we create learning settings that do not allow people to explore context, we prevent learners from connecting facts to their own knowledge and lives.

Exists in process

Knowledge comes into existence as we talk, read, observe, drive, laugh, touch … as we act and do. We should, therefore, think of it as a process and not an object. This report uses the word 'knowledge', but, it would be more accurate to use the verb 'knowing' – a doing or process word[3]. Clearly, our language has influenced how we see the world and this is one reason why we come to think of knowing as having a product – knowledge – that we can pass around.

Knowledge exists in the relationship between us and other people, or us and objects, and so on. We have to read a book (i.e. interact with it) or interact with a website before it becomes knowledge. Acquiring knowledge through reading is also a process – a process of interpretation. We can ask ourselves – if a book remains unread, is it knowledge? Arguably, though, reading is less interactive than conversation because the book itself cannot respond to the reader[4].

When we develop learning settings where learners are passive and expected to receive knowledge as if it were a package – just sitting in the audience, for example – far less interaction and, thus, learning takes place.

Knowledge is developed through different modes of being

Knowledge has a physical and emotional basis because we are all, inescapably, physical and emotional beings. What we know comes to us through our different senses and is heightened or diminished by our emotions and the emotions of others. For example, we learn about food as we taste, smell and see it. We may need to see, hear and smell a bushfire before we begin to understand the theory of fire behaviour. Or we may only really understand the danger and behaviour of bushfire through drama, art or poetry. To understand something, human beings need to learn about it in a variety of ways.

Creating learning settings that engage people physically and in positive emotional ways is more likely to lead to learning.

Notes

3 Basic neurobiology supports what many philosophers have posited for thousands of years – knowledge is really an activity or process. That is, it is only when our neural pathways are activated, one neuron firing and affecting the other and so on, that we can say we know something.

4 Universities can also treat knowledge as an object. It is common for universities to equate the production of journal articles – which are objects – as knowledge transfer.

Hang on, aren't books and websites knowledge?

The written word is an excellent way to share and retain what societies have learned. We can call the written word a 'knowledge object'. This report is a knowledge object. We enjoy a longstanding culture of knowledge objects – especially of written words. Through letters, books, websites, scientific articles and other printed materials, literate societies have been able to 'capture' what has been learned over many generations. These knowledge objects underpin many civilisations.

Knowledge objects harbour a number of problems, however. The first is that we have to interact with a book or website to transform the words into knowledge. Reports often just sit on the shelf and so no knowledge is ever created from them.

The second problem is that knowledge objects assume a huge overlap between the author's world and the world of the reader. They assume a common language between the author and reader, an ability to read to a certain standard, and also aspects such as a shared social and cultural background (including values, beliefs, social norms and even experiences). This means that a reader interprets words according to what they value, what they think is important and what they think relates to them. An author has little control over this interpretive process.

When we assume that all we need to do is get people to read our words for them to do what we want, we really run into trouble because people must interpret words *before* knowledge is created. For example, when we read a report, the author cannot rewrite the document to better accommodate what we, as the reader, do and do not know, what we value or what our aims are. As a reader, we cannot ask the author questions or tell them what we really care about. Authors and readers cannot figure out together how what the author is saying relates to what the reader cares about.

To a large extent, written words are interpreted in the way their author intended. This is because, in general, we share histories, environmental context and value systems e.g. Australian, urban, Anglo-Saxon, educated, believe in democracy and the rule of law. But as soon as the knowledge object strays outside a zone of commonality, the ability of knowledge objects to illuminate the world around us falters. This can happen easily, as the example below shows.

DRINK!

Example

A simple knowledge object

Imagine seeing this sign, which is a very simple knowledge object.

What do you think it means?

Our first response to the sign may be to ask, "*where* is the sign?" This is a question about context. Our interpretation would differ depending on whether we see this sign in a desert or in a bar. Knowing where the sign is situated may give us a clue as to its author and his or her intent.

If it is in the desert it might be reminding us to drink. Or it might be notifying us that we are at a location where water is available.

Depending on our perceived circumstances (e.g. if we feel thirsty or not), we may or may not take any notice of the sign. We may also change our interpretation of the sign depending on our relationship to the perceived author. For instance, if we think the local government erected the sign, and we think they're pretty hopeless, we would probably dismiss the sign.

If, on the other hand, the sign is situated outside a bar we may understand it to be an invitation to drink an alcoholic beverage. If we are Muslim we might react to this sign very differently compared to if we are not.

A very simple knowledge object can be interpreted in many different ways, depending on the person and the situation. Some authors may want to add more detail to more fully explain something but this may not automatically overcome issues of interpretation.

By working in these ways, we predict that people (including ourselves) will begin to change in observable ways. They will:

- develop systems thinking
- change the way they view their own knowledge
- begin to understand the views of others
- be more likely to accept the views of others (including organisations)
- think less individualistically
- begin to hold an understanding of the world that comes closer to 'reality'
- share new knowledge with others
- add to the development of community resilience.

Based on the model of knowledge proposed, we can hypothesise that some processes, ways of working and settings will be more conducive to developing knowledge and understanding about fire than others. These ways of working apply whether we meet with one person over coffee or hold a meeting with fifty people.

To better share our knowledge and learn from others we should work to:

Ways of working	Aspect(s) of knowledge model
Develop learning settings that build trusting relationships	Social
Allow people to explore the context of facts	Context
Allow people to begin with contexts that are important to them	Social Context
Develop settings that are compelling, interesting and engaging	Process Modes of being
Develop learning settings that expose people to different ways of developing knowledge	Process Modes of being
Develop knowledge and understanding	Context
Enhance learning opportunities rather than change people	Social Context
Find ways that promote independence and critical thinking	Social
Look for good in people	Social
Find ways that recognise the subjectivity of knowledge	Social

Ways of working

The following table describes in more detail ways of working that incorporate the model of knowledge proposed here. The ways of working always involve people – knowledge is social, it comes from people and is changed by them. To work with knowledge means to work with people.

Many of these ways of working are not new and we may have an intuitive sense that they are the way we should work. Sometimes, though, these ways of working are regarded as optional, nice to do or the fluffy alternative we would do if we had more time. If we are serious about sharing and developing our knowledge we should consider these approaches as the first option.

Table 1. Ways of working that incorporate our knowledge model

Way of working	
Work to develop learning settings that build relationships	People will only incorporate new knowledge into their lives when they trust its source. They want to know: *who* is telling me this? The best and fastest way to answer this is to meet someone face-to-face and to develop a relationship with them. • Do provide learning settings where participants can develop trusting relationships with one another (given they are sharing knowledge with each other). • Do develop settings where listening to, and learning from, others is valued. • Do develop learning settings where participants including presenters have the space to converse with one another and develop rapport. • Do develop learning settings where people are able to show themselves to others as a whole person e.g. settings where they can talk about what motivates them, why they care, what experiences influence their thoughts. • Do enable people to experience and accompany others in their work, home or local environment. • Do develop settings where free/informal socialising is part of the process. • Don't develop settings where social interaction is prohibitive or difficult.
Work in ways that look for good in people	When we expect the worst from people we tend to behave towards them in ways that are condescending and defensive. Understandably, as a result, they usually behave towards us in negative ways. • Have faith in people to behave towards you and others as one human being to another. • Have faith that other people will and can censor behaviour that they find unacceptable. • Have faith that all people have the capacity to empathise, think beyond themselves and care about others.
Work in ways that recognise the subjectivity of knowledge	The scientific method is a method that can lead us closer to an understanding of our world but as human beings we will always be limited from having absolute objectivity. • Don't present ideas of knowledge as if it they are the absolute truth. • Do discuss knowledge as being comparatively *more* or *less* representative of reality.
Work in ways that allow and encourage people to explore the context of facts	The potential scope of discussion about any particular fact is limitless. Approaches that do not limit the contextual scope of a discussion are likely to lead to increased levels of understanding, interest and participation. • Do develop learning settings where listening is valued. • Do develop learning settings that allow people to discuss fire in terms of social, environmental, historical and technical context i.e. settings that allow holistic conversation. • Do foster contexts where participants can ask questions of each other. • Do ask open-ended questions of participants. • Don't just give people facts but provide them with space to explore the context of those facts. • Don't rely solely on written documents i.e. knowledge objects or passive teaching/training.

Work in ways that promote independence and critical thinking	The physical arrangement between people (e.g. seats), what we wear and how we speak all send messages to people about what we think of their capacity to think and how we want to relate to them. If we want people to develop critical thinking skills and independence of thought (in relation to their own opinions as well as others) then it is important to treat them as intelligent equals.
	• Do treat people as equals.
	• Do arrange seats in non-hierarchical ways.
	• Be aware of the effect of uniforms and badges on others.
Work in ways that allow people to begin with contexts that are important to them	Fire affects our lives in different ways. It is often the way that fire impacts on things we value that interests us and motivates us to learn – rather than fire *per* se.
	• Do ask open-ended questions.
	• Do let participants shape the agenda.
Work to develop settings that are compelling, interesting and engaging	Knowledge exists in process. To transform data into knowledge people need to interact with the data. If data are presented in unpalatable ways then people will not be motivated to engage with them. If they don't engage with the data, it has no effect on their lives.
	• Do create settings that allow for interaction – with others and the environment.
	• Do create settings that are humorous, non-judgmental and feel safe – that in some way make it easier for people to become involved in the process.
	• Don't embarrass people or put them on the spot.
	• Don't rely heavily on passive learning techniques (i.e. telling people what to know).
	• Don't rely too heavily on knowledge products or objects.
Work to develop learning settings that expose people to different modes of developing knowledge	Our minds, bodies and emotions are deeply interconnected. What we know is affected by how these systems interconnect. Some people prefer to learn at an emotional level, others a bodily level. Learning settings that engage people at all these levels will be more effective and engage more people.
	• Do develop learning settings that engage the senses and emotions, as well as the intellect.
	• Use multiple techniques at once.
	• Don't rely on just talking, reading or doing.
Work to develop knowledge and understanding, including your own	Aiming to develop knowledge may be an ambiguous goal, compared to that of making a decision, but it is also one on which most people can agree.
	• Do be clear to introduce the goal of a learning setting as *learning.*
	• Do listen to others and be prepared to learn.
	• Do make it clear that the outcomes of learning are changes to personal, group and community behaviour and outlook rather than policy change.
	• Do make it clear that it is fine for someone not to participate.
	• Listen to others' experience and be prepared to learn. Listen to and understand their point of view. You can decide later whether you agree. If you disagree immediately then the sharing will stop.
	• Don't set out to change people's minds.
Work to enhance learning opportunities rather than change people	Think of your role as one of creating opportunities for people to share what they know and learn from others.
	• Do remember that you are also a learner and can be changed by working with others.
	• Don't set out to change people – or allow others to do this. It is likely that they will take offence and resist.

Predicted changes

By working in at least some of the ways outlined, a number of changes in the ways that people relate to one another – in our organisation and in our community – are predicted. As these relationships change (as people share experiences with one another and speak about what is important to them), it is predicted that knowledge around land and fire management issues will also change and develop. Some of the changes predicted are outlined in table 2.

Table 2. Predicted changes in relationships and knowledge

By working in these ways we expect to see	
Development of systems thinking	People can develop their systems thinking skills when they are provided with a setting where they can explore and connect phenomena. Changes to expect are: • people will find connections between different phenomena and events. • people will be able to connect social phenomena to environmental phenomena, and vice versa.
Changes in the way people view their own knowledge	Through developing personal relationships, empathy and understanding, people will come to realise that different opinions about the world almost always stem from different life experiences, rather than from wilful ignorance or disregard for others. Changes to expect are: • heightened awareness of the way that different life experiences lead to different ways of understanding fire. • heightened awareness of the multiple ways in which those around us interpret and act on information. • greater appreciation of the points of view of others. • greater acceptance that the views of others are equally legitimate. • more attenuation in outspoken minority views, as all views are subjected to the scrutiny of peers. • an awareness that no one person's knowledge is absolute.
People more likely to accept the views of others, including organisations	In settings where people develop authentic relationships, participants can establish a sense of the source and trustworthiness of what they are hearing and reading. When this happens they are: • more likely to listen to what is being said. • more likely to accept what is being said and incorporate it into their lives. • more likely to pass on that knowledge to others. • more likely to become agents of change themselves.

People thinking less individualistically	People care about what is closest to them – local places, personal issues. Their outlook can only grow beyond personal interests if they are exposed to the concerns of others. Expect people to: • begin to think beyond the personal to the collective. • begin to think beyond the local to the regional. • consider the well-being of others. • consider the well-being of classes of animals or plants rather than the ones that live closest to them.
People's understandings of the world overlap more and come closer to 'reality'	In creating learning settings that enable people to contextualise information, everyone has the opportunity to develop a more encompassing view of the world. We expect: • people will develop a more complex understanding of the socioecological system of Victoria. • as people develop a more complex understanding of the world, that understanding begins to approach 'reality'. As this occurs views that were once different begin to coincide.
People begin to take on new knowledge and share it with others	By creating learning settings where people can explore what is meaningful to them with people they trust, we expect: • people to incorporate that new knowledge into their lives. • people to then share that knowledge with others.
Community becomes more resilient	Understanding the environment in which we live helps people anticipate and respond to environmental change. And understanding the community in which we live helps people to connect with others and seek help and knowledge in times of need. Signs of community resilience are: • relationships are 'deployed' during emergencies and, in realms beyond fire. • parties that were in conflict are relating to one another and working with one another more. • people are better equipped to critically assess knowledge sources and relate it to their own circumstances. • people know who to turn to in their community to seek advice or take action. • people take responsibility for their own contribution to social and ecological problems, instead of blaming others • the community identifies the vulnerable and neighbours help neighbours.

Testing the predictions

The model predicts that as a person becomes more aware of context his or her perspective widens and begins to overlap with the perspectives of others. In other words, the model predicts that as a person's perspective widens by interacting with different people, his or her capacity to trust, appreciate, empathise with, and understand and accept the views of others (including organisational staff) grows.

In testing the adequacy of the model, the basic question we ask is "what changed?" We use the idea of change, rather than outcome, to stress that learning, trust building and relationships are never complete.

This is a question of qualitative change and is subjective e.g. your trust in another person cannot be measured in any absolute way. Your ability to put botanical facts into context cannot be measured in an absolute way either. We must look for more than just change in the quantity or accuracy of facts about fire. We look for changes

in the ability to integrate those facts and relate them to the wider world (i.e. context), and changes in the way people relate to one another i.e. their capacity to share knowledge.

Qualitative change can be appraised using a wide variety of methods derived from psychology and the social sciences. In some cases, qualitative changes can be ascertained using quantitative indicators – for example, the number of people attending a meeting is a rough *indication* that people are learning something.

Appreciative inquiry and participant observation, derived from the social sciences, are two simple yet powerful ways of testing our predictions.

Appreciative inquiry

Appreciative inquiry is a way of deliberately engaging participants to share stories of positive change (Cooperrider & Avital 2004; Lewis, Passmore & Cantore 2008). Stories are elicited by asking open-ended questions (formally – in open-ended interviews, or informally – in the course of the process, see May 1997), which explore how being involved in the process has changed their life/way of relating/practices etc. This method has many benefits, such as:

- revealing processes and changes that could not have been predicted, imagined or discovered by project coordinators alone
- identifying and validating what changes are meaningful to participants (as opposed to the organisation)
- less likely to make people feel like they are being tested.

Participant observation

We can also use direct observation, by participants and ourselves, to identify change (Dewalt et al. 1998; May 1997). Those who are *engaged* in the process (i.e. those who are participating) observe and reflect on change in themselves and others. In this approach, 'outsiders' are not regarded as good observers because they have not been involved and cannot assess what meaningful change would look like.

The person who has initiated the learning process is also regarded as a participant. If he or she is changing, this means he or she is responding to changes in others and therefore learning too.

Example

Observing and appreciating change: a self-assessment

An adapted version of a group self-assessment tool is shown in the following table (for further discussion of self assessment tools see Collison & Parcell, 2004). The example given below is a guide only. It should be adapted to suit a local context, i.e. participants' understandings of where they want to be and what the criteria should be for assessing their progress. This can be achieved through tools such as *Building the Dream,* where a collective vision for living with fire is articulated.

The group that is self-assessing may also wish to clarify the definitions of the 'levels' they are assessing themselves against. The levels should act as a scale from 1 (a basic awareness that the practice is important) to 5 (the practice is fully integrated into our lifestyles).

There is no specific number of practices that should be assessed. However, it is important to elicit enough practices so the group feels that if all the practices were carried out they would be living positively with fire.

Facilitating self-assessments can vary depending on the context and demographic profile of the group. It may be possible to provide an empty framework that the group fills out, or it could even be acted out physically by taking steps to indicate the levels and the differences in opinion.
The most important part of the process is the conversation that takes place as people reach agreement. This is an opportunity to open up issues of concern to the group and explore why differences in opinion, knowledge and understanding exist.

A degree of consensus is important. If one member of a group self-assessment feels the real level is 3 and the majority feel it is 4, this should be explored. A 'majority rules' approach doesn't work; nor does calculating a median score based on individual experiences. Generally, if one person's experience keeps them at a lower level, then the score for the whole group is that lower level score. This helps participants recognise that they need to own their ability to 'live with fire' *collectively.*

Self-assessment is a way for people to observe and measure their own change. As such, there is no right or wrong result, and the tool can be revisited as necessary to demonstrate growth or regression in a group's ability to live with fire. In turn, it can be used to inform decision making and prioritise actions.

Table 3. An indicative self-assessment for 'Living with Fire' – an assessment that communities can adapt to assess their capacity to live with fire risk

Practice / Level	Level 1: We are aware	Level 2: We know how	Level 3: We sometimes do this	Level 4: We routinely do this	Level 5: This is a deliberate part of our lifestyle
Acknowledgement & recognition	We are aware that Victoria is a fire-prone environment.	We know we live in a fire-prone environment and are affected.	Living in a fire-prone environment affects some of the decisions we make.	We know the risks of living in a fire-prone environment and routinely factor this into our decision making.	We integrate our knowledge of living in a fire-prone environment into our daily decision making and seek opportunities to learn and share with others.
Inclusion	We know it is important to include different people in understanding how to live with fire.	We have mechanisms in place for sharing knowledge and experience.	We often seek out the input of others. We value learning from varied local knowledge and experience.	We regularly ensure that everyone who is affected by fire is included in community preparation and response.	We share the responsibility for living with fire and act collectively for community preparedness and response.
Preparedness	We know a fire plan is important.	We have thought about what our fire plan would involve.	We have a thorough fire plan and understand how to enact it.	We review our fire plan when prompted by a fire event or new information.	We review and adapt our fire plan as part of our lifestyle. We consistently seek new knowledge and understanding about how to be best prepared.
Systems thinking	We are aware that different understanding of fire exists.	We appreciate that when people have different views to our own it is because their understanding comes from a different context.	We place our own experiences of living with fire in the context of the differing experiences around us.	We regularly make time to seek views other than our own for learning and understanding. This is a deliberate practice to expand our knowledge of where we are in the landscape.	We view our existence in the context of multiple interacting systems. We seek learning and understanding instead of consensus or compromise.

Level Practice	Level 1: We are aware	Level 2: We know how	Level 3: We sometimes do this	Level 4: We routinely do this	Level 5: This is a deliberate part of our lifestyle
Mobilising resources & networks	We are dependent on external resources and information in order to live with fire.	We know that some resources and knowledge exist within our own community.	We sometimes acknowledge what resources we have. We have some idea of the resources and responsibilities beyond our community.	We regularly seek ways to mobilise our own resources and support our local knowledge. We have a reasonable idea about what resources we can expect in an emergency and whose responsibility they are.	We are living with fire. We possess the necessary local resources and knowledge and have a clear understanding of what we can expect from others beyond the community, we have networks that extend beyond the town that provide us with resources and knowledge.
Measuring change & adapting our response	We are aware of the importance of recognising change and adapting as a result.	We employ some methods of measuring our change but don't yet adapt accordingly.	We have experience of adapting and occasionally reflect on the improvement.	We systematically self-measure and adapt accordingly. We can demonstrate measured change.	We adapt to meet implied change for the future and measure as we go.
Learning & transfer	We want to learn and share with others.	We adopt good practice from outside.	We sometimes share our knowledge and experience to observe lessons from our actions.	We regularly share and reflect on our learning and observe its impact on others.	We consistently learn how to live better with fire and seek opportunities to transfer knowledge and practice to others.

Indicators of change

The best way to observe whether change has taken place is to look for behavioural differences in others and ourselves. We ask "what is being done differently". Some of the changes that we can look for (that relate to fire) are listed on the next page. Both participant observation and appreciative inquiry look for changes in the areas listed on the next page (the list in not exhaustive). These changes come about as a result of the process behaving towards people in the ways listed above. They are process outcomes.

Table 4. Qualitative indicators of change

Observed indicators of change	Examples of possible change	
	From	**To**
The language people use to talk about the subject matter. *How did people's way of talking change?*	• Fire as a monster, • using technical jargon • something the government deals with	• Something that they can learn to live with • Something that is natural. • Something that we can all learn about.
The level of emotion people hold towards the subject matter. *How emotive were people when they spoke?*	"We have to meet our burning targets regardless of cost!" "you people just barbeque the native animals!"	"Planned burning is one aspect of land management" "I am really worried that planned burns harm animals"
The way people talk about themselves. *Do they describe their interest in fire or what motivates them in a different way from when they began the learning process? To what extent do they see themselves as dependent or empowered?*	"I want to know what you're doing about roadside vegetation" "Why hasn't the government given us generators and sprinklers?"	"I'd like to help others clean-up around their block" "I'd like to find out more about how to plant my garden to encourage native animals and keep fuel down".
The way people talk about each other. *Are people using 'them' and 'us' language? Does this change?*	"They're just stupid, they'll never learn!" "You lot don't understand"	"we're all in this together" "We all need to take some responsibility"
The way people act. *To what extent are they taking constructive action in their communities? Are they working with others or against them?*	People are taking action only with regard to themselves.	People are showing they care about others too.
The way people speak to each other. *How much are they listening to others? To what extent are they using dogmatic or rhetorical ways of speaking?*	"I think that you need to work harder" "What is the world coming to?"	"What do you think is happening here?" "what do other people think about our town?"
Skill level. *To what extent have they developed practical skills that improve their ability to learn*	• Wondering about how fire is affecting the bush. • Wondering about how to protect home.	• Joining a friends group and beginning flora monitoring activities. • Actively seeking information from CFA and DSE website.
Appreciative inquiry. *Are they seeking and appreciating stories of change from those around them?*	• Talking about what I'm learning about fire.	• Actively asking others what they are learning, how they've changed and why. • Looking to others to learn more
The development of facilitation skills. *Are they taking on the role of facilitator themselves?*	• Using new knowledge in own life	• Sharing new knowledge with others. • Opening-up opportunities for others to learn. • Building new relationships with others

Table 4b. Quantitative indicators of change

Quantitative indicators of change	
Attendance at meetings	Attendance shows motivation and interest, in the latter stages, a sense of achievement – that something worthwhile is taking place. Remember, in these settings, there is no obvious direct personal benefit so people are coming because they want to.
People offering to help	People who offer to help – even in small ways – are signalling that they are getting something out of the process. People offering to help is a sign of resilience – of ownership and confidence in their skills and knowledge.
Length of time people stay to 'chat'	When people extend the time spent with each other this is an indicator of motivation and interest. It is also a sign of growing social resilience, especially in cases where the participants did not previously know one another.
Practicing facilitators	People voluntarily establishing 'knowledge sharing' processes and acting as facilitators. This is a very high level of achievement and the ultimate goal of a sustainable knowledge sharing process.

Recording change

A simple way to observe and record change is to keep a learning journal of the interactions you have with people and what you observe. This can be done after each conversation or engagement with a group or individual. In recording observations of yourself and others you have an ethical obligation to ensure that that material is only used as a way of understanding how that process is changing yourself and others. Material or data like this should not be publicly available. The self-assessment process discussed earlier (Table 3) also generates a record of change again this material is owned by the group and should be used in accordance with its wishes.

Example

Facilitator's learning journal

One simple way to observe and record change is to write a journal after each conversation, encounter or meeting with an individual or group. A learning journal simply records what was expected, what actually took place and what was learned. It can be used to record changes in the behavioural variables, listed above, and record what was learned, and how you and others changed through the process (see Blair, Campbell & Campbell 2010 for example).

In the previous section we discussed some of the qualities of knowledge – that it is social, more than facts, a process and has a physical and emotional basis. In this section we discuss how our knowledge develops and changes by introducing the concept of mental models[5].

Understanding knowledge through mental models

Mental models are 'presupposed, taken-for-granted models of the world … [that] play an enormous role in [a person's] understanding of [the] world and their behaviour in it' (Quinn & Holland 1987:4). Mental models, then, are our accumulated knowledge (see Paolisso 2002; Resilience Alliance 2007, see also for discussion of mental models and risk perception, Bostrom, Fischhoff & Morgan 1992; Paton [forthcoming]).

The world around us is complex and vast. Yet, from our first moments of life, we begin to draw a model or map[6] of this complex world in our mind – a mental model. We piece together the model by following and listening to those around us, by developing associations, and by learning cause and effect relationships from experience.

Right from our first moments our knowledge is created through social interactions.

As children we have very simple mental models of the world. We start to piece together our mental models by asking those around us questions, such as how come, what is that and why. As we grow older and interact with the world and the people around us, our mental models become more complex

Notes

5   Mental models are also known as 'cultural models'. When anthropologists talk of culture they mean the knowledge or mental models that people acquire that are characteristic of a particular society, time and place.

6   The mental model way of thinking about knowledge is probably very close to reality. Neuroscience has shown that learning takes place as some neural pathways or networks become stronger than others. These map-like networks reflect – in a way we don't currently understand - relationships in the real world (see for example Eldeman & Tononi 2000). Importantly, it is only when our neurons are firing that we are living and thinking suggesting again that knowledge is a process not an object.

or change. In time, experience fills in some of the gaps, confirms much of what we have been told, and overturns some of the poorer models.

Our mental models guide us through the world and provide us with a map of how we should expect the world to respond when we act in a particular way. These models help us to decide on a course of action, to predict what might happen next and to explain to others what is happening. They can even help us know how to feel about a particular situation. For example, each of us has a mental map of the way the weather works. This model might be quite different to that of a meteorologist. Each of our non-scientific models, however, can still help us to decide whether to put on a coat when we walk out the door e.g. if it is cold now it is likely to remain cold for the rest of the day.

Some of our most important knowledge is knowledge about how to behave towards others in different contexts e.g. when to say please and thank you, when to smile and how to stand when speaking to others. Our ability to do these things and get along with others can affect our ability to attain more esoteric knowledge. To illustrate, if we cannot get along with others in a way that is appropriate to our society it is likely we will have difficulty learning at school.

Another form of knowledge is embodied or tacit knowledge. Our mental model of how to operate a chainsaw, ride a bike or make a perfect soufflé with no recipe are examples of this kind of knowledge. This knowledge is hard to put into words and is often experienced as instinct or gut feeling. It is knowledge that we have learned from experience or from others, nonetheless.

Mental models are like the scaffolding formed by all our previous experiences. This scaffolding is constantly updating as we interact with, and learn more about, the world. As we interact, our models are either validated or invalidated

and forever changing. The whole of this dynamic system can be understood as knowledge. The dynamic nature of our knowledge or mental models is why thinking about knowledge as a process – as knowing – is a more accurate description than thinking about knowledge as an object.

Our mental models help us to categorise, organise and, importantly, make predictions about reality. Mental models, then, are our working knowledge of the world. Our models are never complete and it is beyond any one person to comprehend the entire world.

Mental models guide us (often without our realising it) on such things as:

- how we should behave towards others
- the origins of the universe (e.g. God, the Big Bang Theory)
- the proper relationship between human beings and nature.

Mental models of this kind are often categorised as beliefs, morals or value systems.

Two sources of knowledge

Our mental models emerge from two interrelating sources:

- direct experience
- other people.

When our mental models develop or change, whether from direct experience or from what others tell us, this is *learning.*

Direct experience

Direct experience fundamentally shapes what we know, although each of us has different experiences. What we experience in our lives is usually a result of our social, cultural, economic and geographic context. My experiences – what I do, how I do it, where I do it and so on – fundamentally shape my mental model of the world.

As discussed below, our experience of the world is *always* framed by, or part of, our values and beliefs mental model of the world.

Other people

Other people also inform our mental models. This is why it is so important to consider social relationships when working with knowledge. Anything written, spoken, mimed etc can be considered knowledge that has been authored by another person.

There are two different kinds of mental model that we get from other people:

- factual
- values and beliefs.

A factual mental model is one that we can verify through experience (this includes the most elaborate method of verification, such as the scientific method). For example, our mother may tell us that the fire is hot. We can verify this by touching the fire (but it is better to take it on good faith, in this instance).

A values and beliefs mental model is a system of ideas that describe what is fundamentally important to us. We rarely articulate this knowledge but it sits in the back of our minds framing all that we do. This kind of knowledge 'relates to the way that [we] interpret [factual] knowledge and [integrate that knowledge with] ... more or less coherent cosmologies' (Kalland 2000:326). For example, I may value all human life and therefore believe that all people are created equal. This mental model informs my behaviour towards other people. I cannot empirically prove my values or beliefs, however.

Factual mental models are like the pieces of a puzzle, whereas our values and beliefs are like our working hypotheses about what the whole puzzle *should* look like. Factual mental models are always embedded in belief and values mental models (refer Figures 2, 3 and 4). Values and beliefs mental models have the following attributes:

- We attain our beliefs and values structures from people around us, but we cannot verify them through experience (even the scientific method).
- Factual and experiential knowledge are always embedded in mental models of what is important to us, what is right, what is normal etc. Thus, how people interpret experience or empirical data depends on their views, e.g. of the fundamental relationship between humans and their environment (for further examples see Milton 1996; Thompson Ellis & Wildavski 1990) or how we should act towards others.
- Knowledge derived from values and beliefs is often expressed through statements, such as humans have dominion over the earth, humans should control nature or God is kind. These mental models are not verifiable and are often considered a matter of faith.

Figure 2. A factual mental model sits within a values and beliefs mental model.

Figure 3. The same factual mental model sits within a different values and beliefs mental model

In the outer (blue) mental model of Figure 3, humans and nature can bring about change in the environment. In the outer (blue) mental model of Figure 2, it is believed that only natural processes should bring about change in the environment. People who view the world as part of the blue mental model of Figure 2 do not believe that human beings should deliberately interfere in natural systems – although both Figure 1 and Figure 2 agree that fire removes scrub and regenerates grass.

People with the outer mental model in Figure 2 are often very uncomfortable with planned burning, even though they would agree that it regenerates flora species – the verifiable inner (grey) mental model.
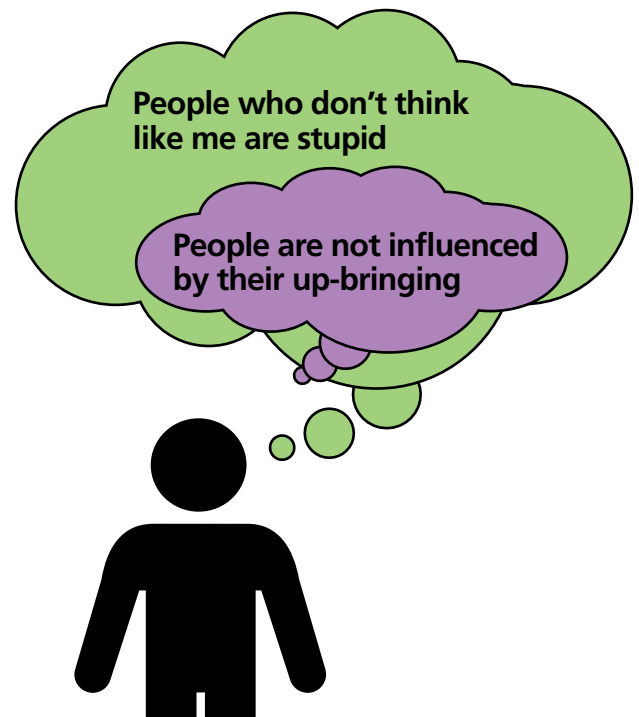
Figure 4. A factual model (purple) within a values and beliefs model (green) that focuses on knowledge of other people.

We can have beliefs about other people, what they are and are not capable of, how they will behave etc. These beliefs inform how we act towards them. The person in Figure 4 has a belief that our behaviour is not influenced by our up-bringing. When this person sees another acting differently they attribute this to stupidity rather than background or culture. If the person in Figure 4 were to change their belief about others their ability to understand and form relationships with other people would change dramatically.

Our beliefs about others, human nature and human capacity have a huge bearing on trust and the sharing of knowledge. If we have low expectations of those we are working with, the way we relate to them will reveal our attitude and they are unlikely to trust us.

Credibility, trust and knowledge

Though many of our mental models come to us from others, we don't just believe anything anyone tells us. Instead, when we hear some new information we consciously and unconsciously ask ourselves whether we can trust the source. Trust, then, is a crucial 'lubricant' in the flow of knowledge. This is especially true of knowledge or information that can directly affect our lives (see Paton 2008).

We tend to consider information that has been attained through personal relationship as being the most credible. We also look for sources of information that those we trust have told us are credible. For example, the newspaper I read may be the one my parents read. This is because in most cases our first *working* models of the world come to us through personal, supportive and trusting relationships – our family and caretakers. As adults we look to assess the credibility of what someone is telling us in light of our relationship with them.

In the process of developing and testing our models of the world through stories and experiences, we discover that very often it is the people we know best – people we trust – who relate the most reliable knowledge about the world, e.g. our mother tells us fire is hot.

Example
Belief in climate change – a generalised account
Some farmers are reluctant to believe in climate change because, in their experience, droughts always break and the land becomes productive again. Some farmers will also tell you that not only have they experienced this but that their fathers and grandfathers have told them about terrible droughts of the past that have eventually broken.
Commonly, for farmers, it is not only their own direct experience but the knowledge that has been passed on to them by people they trust that impacts on the formation of their mental models of the climate. For this reason, the knowledge of scientists, who they do not know, is less credible.

Mental models and learning

Our knowledge of the world and our mental models can and do change – this is learning. Our models of the world may change completely or, more likely, become more complex as we connect different experiences and ideas together.

Example	
Mental models change and learning occurs when:	
We have a new experience	I may discover that repeated use of fire in drought conditions does not always bring back the best grasses for cattle. This experience may alter my mental model of interactions between grass, climate, fire and cattle.
Someone we trust tells us something new	In a conversation with a zoologist who I trust, I learn that the impact of fox predation on fauna populations is a far more significant impact than the impact of fire. I may change my mental model of fauna and fire inter-relationships to include considerations of fox predation.

Two approaches to learning

Organisations, such as DSE, also develop ways to bring about learning. Organisations traditionally foster learning by giving or telling us (what people in the organisation think to be) the relevant facts. Another way of fostering learning is by bringing a group of people together to share perspectives. In doing this, people can expand their contextual understanding of a situation or issues. This is often called collaborative learning[7] (Daniels & Walker 1996; Fernandez-Gimenex, Ballard & Sturtevant 2008; Mostert et al. 2007; Schusler, Decker & Pfeffer 2003; Tàbara & Pahl-Wostl 2007).

The two approaches are best used in different circumstances and should be thought of as existing on a continuum, where approaches are more traditional or more collaborative. By incorporating the ways of working, outlined at the beginning of the report, a process becomes more collaborative and more likely to result in changes to our mental models.

Notes

7   'Collaborative learning' is also often called 'social learning', or 'sustainability learning' in natural resource management contexts.

Traditional

Traditional approaches to learning approach knowledge in a way that is the opposite of the model of knowledge outlined on pages 11-13 which states that knowledge is always social, is more than facts, exists in process and is developed through different modes of being). In traditional approaches, knowledge is understood as an object that can pass from person to person, irrespective of who they are or what their values and beliefs are. The approach assumes people will simply accept what is being said, discounting the role of trust in the learning process. By turning learners into passive recipients of information, practitioners who use the traditional approach also discount the role of experience, emotions and physical interactions in learning.

The traditional approach leaves us unable to 'work through' the context, making it very difficult to incorporate the facts we are being given into our lives in a meaningful way. Development or growth of our mental models (i.e. learning) is quite difficult to achieve using the traditional approach.

Example

Fire Operations Plan – a generalised account

Sometimes we present our Fire Operations Plan to an audience using a traditional approach and treat knowledge as an object. We stand in front of a seated audience for 45 minutes and emit information. We expect the audience who sits before us to receive and then use that information as if we were handing them some luggage.

When we *only* do this we have limited understanding of what has brought the audience to the presentation. They may have come because they are uncomfortable with planned burning and don't believe humans should be intervening in the natural environment. Or they are concerned about how to protect themselves and their homes against bushfire. Or they may have had a lifelong association with a place we intend to change by burning.

On hearing DSE's Fire Operations Plan, the audience is no more informed about how what they are being told relates to what they think is important. The approach has left people unable to work through the connections – through conversation, questions, sharing, interaction – between DSE's mental model and their own.

Presentations can turn hostile – especially in times of high anxiety or crisis – because the person in front has literally elevated themselves and their knowledge (values and facts mental model) above those of others.

Collaborative learning – we all have knowledge

By bringing different people together, collaborative learning creates contexts where people are exposed to different ways of thinking about, and engaging with, the world. Collaborative learning starts from the assumption that *we* all have knowledge. Some of it may be specialised to a field of endeavour (e.g. fire behaviour knowledge) and some of it may be specialised to a particular place (e.g. local knowledge of wind patterns). Neither kind of knowledge is more important than the other, and when combined through sharing could be immensely powerful.

In collaborative settings, people are encouraged to listen to and work with others, and reflect on and analyse their own mental models and how these relate to new sources of knowledge entering the learning context. As they interact with one another, they begin to trust one another and, as they do, the new knowledge emerging from the group develops credibility.

By allowing people the space and time to explore the context of facts and see new perspectives, collaborative approaches have the best chance of transforming values/beliefs knowledge – and changing what is considered right, normal or proper. Paradoxically, it is because these settings *do not force people to change their minds, or even imply that they should* that they have the most potential to do just that.

Many collaborative learning processes incorporate learning with decision making (e.g. Daniels & Walker 1996), but this does not need to be the case. If we establish the goal as being learning, rather than decision making, then interactions between different people are less likely to be competitive and divisive.

Collaborative learning and systems thinking

When people work to explore the context of a fact or phenomenon they are engaging in systems thinking. For example, an increase in fire severity and frequency is related to fuel accumulation and weather, but can also be related to the increasing amount of fossil fuels being used by some societies. In exploring context, people inevitably build a larger more interconnected mental model of the phenomena they are discussing.

In a collaborative learning setting, people may learn about the fact of more severe fires. At the same time, they may learn about the context of that fact, which will help them to incorporate it into their current mental model of the world. They can learn:

- why different people think the way they do about influences on fuel accumulation and weather – natural or anthropogenic
- how the group expects them to act in a learning setting
- personal assumptions about the environment and the community that have not been reflected upon previously
- the different ways others learn
- the way the land used to be used by long-term residents, forebears or indigenous peoples.

I may be uncomfortable with planned burning because I don't think humans should intervene in natural processes. However, when I start to think about it in the context of climate change I may change the way I feel about it because I begin to see that everything I do changes the world and is leading to atmospheric change. I may decide that I have to intervene in nature to protect it. Ultimately, by learning with and from other people we develop a more complex mental model of the socio-ecological system that is our world.

Cultural diversity and learning

Working and interacting with other people will always develop our capacity to view the world in new ways, since no individual's mental model of the world is like another's. Some mental models are more alike than others, however. This is often because people have been raised in the same family, culture or way of life.

When groups of people hold more or less similar mental models of something, we call them communities of interest or even 'stakeholder groups'. Since mental models are learned from, and shared with, others it is common for certain mental models to define a group, community or culture.

A person's culture, background and so on has a huge impact on:

- how they interpret and incorporate new information
- how they behave towards others.
- what they view as important or unimportant
- what motivates them to act.

The examples below explore two different mental models that pertain to two generalised cultural groups (see also Daniels & Walker 1996; Stent 2003).

Perspective one – a generalised account

A naturalist engages with the environment by observing and noting down particular plant or animal species as he or she walks through the landscape. He or she may undertake these activities for conservation purposes or out of scientific interest. The naturalist's objective is, as much as possible, to observe and record the world in such as way as to not change it. The naturalist's values mental model does not include human activities as part of the ecosystem.

For this person, attempts by people (including government agencies) to intervene in natural processes are perceived as a violation of nature (or the fundamental structure of the world).

Perspective two – a generalised account

Until very recently, many people have used public land to graze cattle for their livelihood. They managed this country in order to provide fodder and passage for their stock. In the past, they often used fire to clear scrubby vegetation and promote the growth of grasses. These cattle farmers held a utilitarian relationship with the land. They walked, rode and slept there on a day-to-day basis. In order to keep the land productive for their cattle, they often used fire. Fire was part of their 'tool box'. Their mental model included humans as part of the ecosystem.

For this person, government/ humans must intervene in the world and turn it to their purposes because those purposes are the most important.

We can see from these two perspectives that each cultural perspective entails facts and values/beliefs. At one level, we can say that each person cares deeply about that environment. At another level, we can say that each perspective is fundamentally at odds with the other. Sometimes, such differences are a source of conflict (see for e.g. Soeterboek 2008; Trigger 1999; Whittaker & Mercer 2004).

Fire managers have often attempted to address and change these very different views by separating people into different cultural groups, and then explaining to each group what they see as the facts about land management. This approach does not acknowledge or address underlying values and beliefs, and is unlikely to change understanding. The approach can even entrench 'group think' by keeping people apart.

Bringing different cultures together can be a departure point for learning. People who hold different mental models of the world can enrich each other's perspective by sharing the insights that each perspective brings.

The way in which people are brought together to share and learn from one another is crucial, and must entail ways of working that build trust (see ways of working p. 14–18; and collaborative techniques and processes p. 44). Without trust, no one's perspective or actions will attain credibility.

CONVERSATION BEGINS TIME = 1
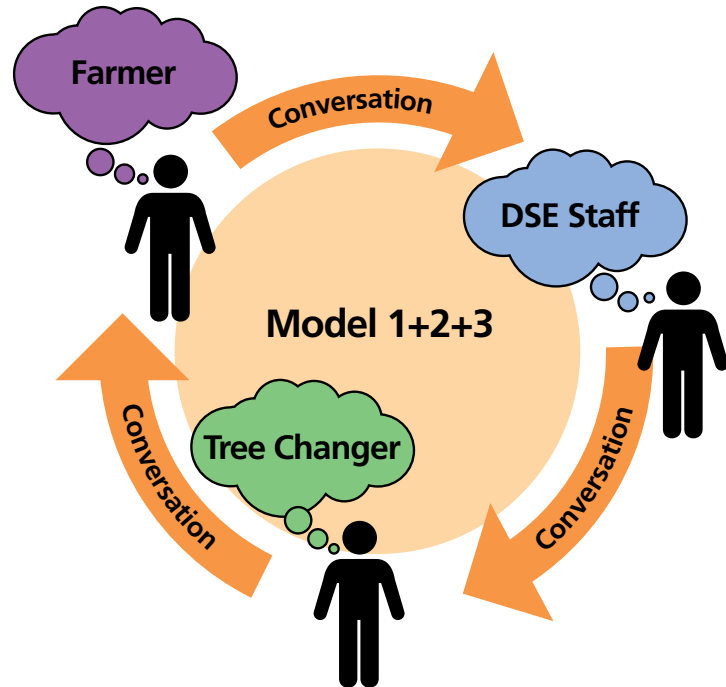
CONVERSATION CONTINUES TIME = 2

Figure 5. How knowledge (mental models) develop through collaborative approaches

In the first conversation (time = 1), each participant has a different mental model or understanding of the situation e.g. how fire affects the environment. As they speak to one another, a new unstable model of the situation develops that is composed of aspects of each participant's working mental model.

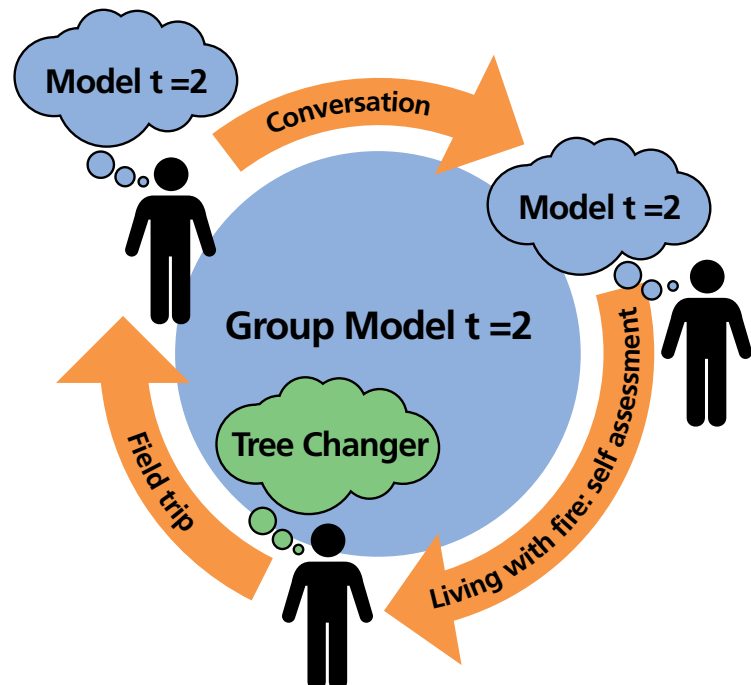In the second conversation (time = 2), participants have undertaken another collaborative learning activity together – another conversation, a field trip or self-assessment (see tools and techniques p. 47 and 'living with fire' self-assessment p. 25). Some participants have developed a new mental model of fire and environment interactions, others have not. But as the figure in t=2 illustrates, the group itself has started to develop a group-specific mental model.

Can we really change people's values and beliefs?

Our values and beliefs do change. However, because they are so fundamental to how we approach the world they change very rarely and very slowly. If someone tries to directly challenge what is important to us, we do not often react well. Working with others and learning from new experiences can change how we organise our values and beliefs, or how we view those values and beliefs in relation to other people. In other words, our mental model of the values and beliefs of others may change – fundamentally changing our relationship with them.

To illustrate, I may believe that we use what is in nature to live and, as a consequence, dismiss the ideas of so-called greenies as selfish and ignorant. However, if I spend more time with a so-called greenie (someone whose beliefs are different to my own), I may come to see that they are not selfish and begin to feel that my beliefs can live alongside theirs. Alternatively, as I work with them and get to know them better, I may see that my values can be reconciled with theirs at another level, e.g. we both value the natural environment. Most profoundly, I may come to see them as a whole person, not just 'a greenie' and can no longer dismiss them. I have to question all my assumptions of them. In all these ways, my mental model of how to categorise and relate to other people changes. My values and beliefs do not change, but the way I work with people who hold different values and beliefs does. This fundamentally changes the situation.
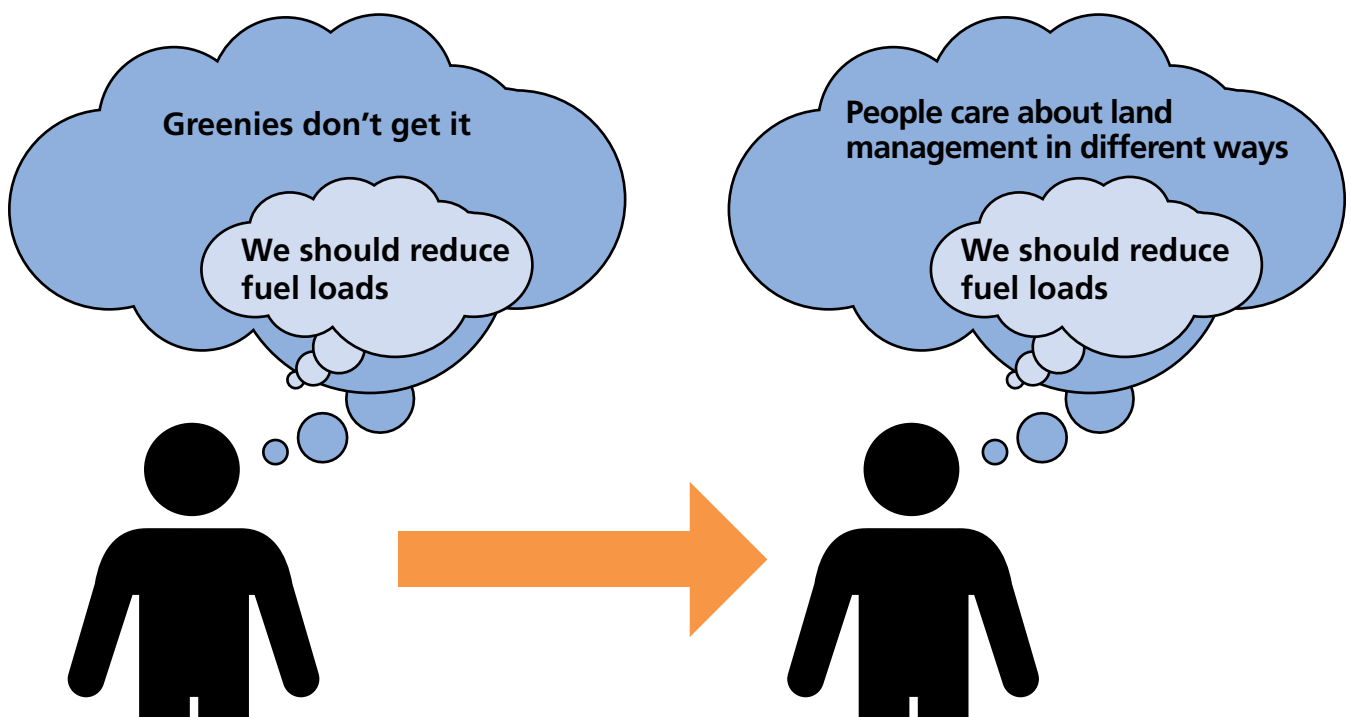

Figure 6. How we can change our beliefs about other people

IT support for knowledge and learning

Learning can be supported by information technology (IT) interfaces. IT-mediated collaborative learning is being increasingly used in universities, schools and professional organisations. However, because these approaches and tools are so recent, their effectiveness is still not well understood.

IT-supported learning has the same aim as face-to-face approaches: to increase learning by bringing people together; and offers an opportunity for them to learn from one another and share experiences, ideas and interpretations in a trust-building environment.

IT systems can support learning by:

- facilitating interactions between individuals and groups
- simulating novel learning contexts.

Facilitating interactions

One clear benefit of IT-mediated collaborative learning is that it allows people who are distant in time and space to 'come together' to learn from one another – Wikipedia, an online socially mediated encyclopedia, is a good example of this.

The introduction of web 2.0 has enabled social networking tools and techniques, such as those found on Facebook™ and Blogger™. These tools may be particularly useful in supporting collaborative learning. They may facilitate the development and deepening of social relationships by allowing users to personalise their virtual space and their social interactions. This, in turn, may foster trust between learners.

In addition, tools that allow people to rate or rank knowledge sources, comments, ideas and so on can increase a learner's ability to assess the credibility of their peers' ideas and understandings, or the credibility of materials in the learning environment. These tools are found on websites like Digg™.

Simulating scenarios

IT can also support learning about fictional, future or risky situations by simulating scenarios based on what is currently known about human relationships or the environment.

Role-playing games or virtual worlds, for example, can allow people to test and explore what does not (yet) exist – environments, ideas or different states of being (e.g. a Second Life avatar). In these computer-generated environments, a person learns by playing the role of a character with a different perspective on an event (see Barreteau 2003; Naidu, Ip & Linser 2000; Pata & Sarapuu 2003; Promburon & Bommel 2005 for examples).

Example
LandandFireSIM

One could envisage a Victorian land and fire management version of SimCity™, where players make different land-management decisions that generate probabilistic scenarios. For example, a player may choose to reduce fuel at a certain location at a certain time and then see if a fire will burn there, given specific weather/climate parameters etc.

Players may also learn about emotional, social and political contexts of land-management decisions by being part of a simulated negotiation between characters with different value parameters. For instance, a player may take on the role of a grape grower in a discussion about fire management.

An IT environment may support this learning by facilitating conversations between players about these different scenarios and their outcomes.

Summary of benefits

IT can support people to:

- connect when they are distant in time and space
- learn about rules and processes for a particular scenario e.g. a planned fire

- explore how different management interventions will affect the landscape over time, using computer-modelling tools
- explore the level of risk they are prepared to live with for given values – life, environment, heritage etc – without experiencing the threat.
- learn about generalised viewpoints of different players in a conversation or negotiation
- better understand the emotional content of negotiations, without incurring the emotional risks that real negotiations pose.

Websites

Facebook™, <http://www.facebook.com/>.

Blogger™, <https://www.blogger.com/start>.

Second Life™, <http://secondlife.com/>.

Digg™, <http://digg.com/>.

SimCity™, <http://simcitysocieties.ea.com/index.php>.

Learning for sustainability, <http://learningforsustainability.net/internet/online_games.php> – lists a range of computer games that facilitate collaborative learning.

Limitations of using IT

In IT-mediated environments, the personal, emotional, and immediate qualities of face-to-face relationships, which are the wellspring of trust, can only be replicated in part. This can limit a person's ability to learn from others, since it limits the formation of credibility.

IT-mediated interactions between people are what could be called, 'sequential' learning settings – where participants encounter objectified information/communication (e.g. emails and posts) in sequence, one after the other. The interface renders the encounter sequential whether the time delay is one second or one year. In this 'conversation', the 'listener' is totally passive, waiting for their turn to respond. They cannot influence the

course of the conversation through body language (e.g. nodding, smiling, frowning and coming closer), so the conversation is not produced jointly[8]. Imagine how challenging it is to have a 'difficult' conversation without the softening techniques of tone, body language and facial expression[9]. Or imagine how challenging it is to use humour and irony without tone or facial expressions.

In a 'real' conversation, speakers and listeners actively and simultaneously work together to produce the dialogue and its direction. An IT-based conversation does not entail joint synthesis (and the creativity or inventiveness that follows from this way of working), and so it is far less likely to develop a richer perspective. Without the quality of joint synthesis, the new perspective is also unlikely to be co-owned by participants.

It is difficult to replicate the complexities of a person's mental model (and the motivations, values and beliefs that flow from them) in simulated settings. By playing the roles of simulated characters, people are inevitably exposed to stereotyped behaviours. There is a danger, then, that role playing may entrench stereotypes or develop biases against those who hold different perspectives. Even context-rich interfaces, such as 'serious games' have narratives that will be interpreted by users in a way that their authors cannot fully control (see Drewberry 2009 for a discussion of serious games).

In addition, real-life learning contexts cannot be adequately reproduced in IT environments (Winn et al. 2006). For example, it would be difficult to learn how to identify the signs of fire history in a forest on a computer. It would be much better to learn this in the field.

IT interfaces are 'knowledge objects' and therefore cannot initiate relationships or extend personal invitations to people to learn with them. This means that they rely on highly motivated people to 'find' them and then use them.

Social networking tools, such as Facebook™ and like Digg™, tend to connect and support people of the same mind and values systems (i.e. stakeholder groups). This is because people join groups they are comfortable with. These sites are likely to be less useful for supporting connections between people with different values and beliefs for the reasons described above. Interactions can be divisive when user interfaces do attract groups with different values and beliefs, even with web moderators. The comments posts on newspaper websites are a good example.

IT systems are great for 'mass communication' and providing practical support for personal relationships that already exist. It is certainly not the most effective way to explore values and beliefs, to catalyse behaviour change or develop systems-thinking skills. IT seems best placed to support rather than replace face-to-face learning and relationship building – by enabling people to arrange meetings, store group information and learn from one another once trust has been established.

Summary of limitations

IT interfaces have a number of limitations they:

- tend to render communication as a sequence, rather than a jointly produced dialogue
- constrain the full range of human communication behaviours e.g. body language and tone
- limit ability to form trusting relationships (for reasons listed above)
- can teach stereotyped behaviours and narratives and reduce the complexity of the real world when used to simulate real life
- cannot facilitate or mediate values and beliefs conflicts well
- cannot visit or phone people. IT interfaces rely on the motivation of users to find and use them.

IT for storing knowledge objects

IT systems can be used to store and transfer information in many different forms (written, audio or audio-visual). The great benefit of this is that the information can be shared in time and space and allow distant users to access information that they would not ordinarily be able to.

To become knowledge, however, this information needs to become meaningfully incorporated into a person's life. This is a more difficult function for IT systems to perform, as they cannot replicate the emotional quality of mutually supportive and trusting social relationships, or the rich contexts in which experiential learning takes place.

Systems that allow knowledge to be stored and accessed in a way that allows personalisation are more likely to be used. To illustrate, the social enablers found on social networking sites, such as Facebook™, allow people to personalise information. This, in turn, allows other users to assess its credibility by identifying whose knowledge this is.

People can increase their likelihood of being perceived as trustworthy by posting photographs of themselves and others, by placing themselves on a map, and/or by providing an inventory of personal details. There are many more enablers that can aid in increasing a person's credibility and, therefore, the credibility of the information they have posted.

Notes

8   Live video linkups or video posts can allow richer communication. However, the computer interface renders the encounter less immediate and, therefore, less compelling. Posts are still sequential.

9   Tools such as emoticons are an attempt to improve this situation.

There are many techniques and processes that can be used to facilitate learning and knowledge sharing. A small number are outlined in Table 5, below. As processes, they entail a ways of working outlined at the beginning of this report, and are informed by our model of knowledge.

The processes are intended to:

- build relationships
- support people to learn in a trust-building environment
- increase contextual awareness of a situation or problem
- recognise that knowledge exists and is developed through interaction i.e. is a process.

It is important not to become preoccupied by the specifics of the methods or prescriptions. Techniques should always be used as guides and tailored to an individual context. Even the names of the tools can be changed to suit context, if necessary. What is important is to remain faithful to the principles or ways of working outlined earlier. There are many other techniques and tools that could have been included here.

Table 5. Overview of techniques and processes used to facilitate learning and knowledge sharing.

Technique	Description	Type of knowledge developed	Can be part of a strategic conversation
Strategic conversation	Facilitated group conversation	Contextual Factual Multi-modal	
Group self-assessment	Group assesses its knowledge gaps	Contextual Multi-modal	Yes
Situated learning	Learning in context	Contextual Factual Multi-modal	For best learning and reflection, yes.
Monitoring	Group monitors environmental parameters	Contextual Factual Multi-modal	For best learning and reflection, yes.
Peer assist	Group shares knowledge with other groups	Contextual Factual Multi-modal	Yes
Participatory evaluation	Group assesses progress together	Contextual Factual Multi-modal	Yes

Note: Multi-modal entails learning settings that are highly experiential or interactive.

Strategic conversation

A strategic conversation[10] is simply a facilitated conversation where a facilitation team guides discussion around a particular topic or issue (see Blair, Campbell & Campbell 2010 and Campbell, Campbell & Blair forthcoming, for detailed descriptions and a case study of a strategic conversation). Conversation is an age old and natural way to share knowledge, grow understanding and build relationships. Many current community capacity building processes have 'conversation' or dialogue at their heart (see for example Born 2008; Everyday Democracy 2010; Open Space 2010).

The overall aim of a strategic conversation is for all participants to gain a better understanding of an issue, concern or situation. In a strategic conversation, participants concentrate on learning and understanding, rather than decision making. A conversation that doesn't involve making decisions as its goal is less divisive.

The most effective and dynamic strategic conversations involve people who hold a range of different mental models. If we all know and believe the same thing then we can learn little from one another.

A strategic conversation process is similar to so called "Open Space" approaches (Open Space 2010). The main difference is that the topic of a strategic conversation is focussed on, in this case, fire. Within this topic though participants are encouraged to discuss what is most important to them at the time. Strategic Conversations, unlike Open Space facilitation, do not have a goal of finding a solution and occur more than once.

Notes

10 Some call these 'community conversations' or 'fire conversations'. It is best to use a name that suits participants.

Taking a strategic conversation approach can achieve multiple aims, including:

- mutual understanding
- strengthening relationships
- learning and sharing knowledge – especially context awareness
- reconciliation of ideas, people or groups
- resolution of conflict.

These conversations can lead to real change in individual, group, organisational and community understanding and, as a consequence, may lead to changed circumstances.

How does it work?

As participants listen to different views their mental models develop and shift. Trust plays an enormous part in people's willingness to learn from others. If they don't trust each other they are unlikely to listen. Strategic conversations, then, have the best results when they are repeated over time. In this way, people spend more time with each other, build trust and credibility, and learn from one another more easily.

Resources

Campbell, Campbell and Blair (forthcoming), 'Guidelines: facilitating strategic conversations as part of adaptive management'.

Paul Born 'Community Conversations: mobilising the ideas, skills and passion of community, organizations, governments, businesses and people.'

Open Space <http://www.openspaceworld.org/>

The Victorian Women's Trust – Purple Sage Project, <http://www.vwt.org.au/takingaction/purplesage.php>.

Everyday Democracy – Study Circles <https://www.everyday-democracy.org>

Example

A strategic conversation in Victoria

1. 8–20 participants came together around a table or formed a circle.

2. Participants were invited by the facilitator to introduce themselves and explain why they wanted to come to the conversation.

3. As participants spoke of their motivations for joining the conversation and their personal experience of fire and fire management, recurring themes and significant points were noted down.

4. Participants broke into small groups of 3 or 4 to discuss issues and interests raised in the group discussion. They were asked to note any new ideas that emerged.

5. Facilitators wrote the major themes and topics of interest to arise on a whiteboard.

6. Individuals were then asked to 'vote on' the issue that they thought was the most important to learn more about.

7. Issues with the highest number of votes were explored and new information reflected upon in subsequent conversations, with additional relevant learning materials and/or speakers introduced.

Group self-assessment

Each group that comes together is unique. It has different kinds of people who know different things and have different strengths; and so each group has different competencies and knowledge gaps. A group self-assessment is used to focus the group's attention on its strengths and capacities.

How does it work?

Early on in a collaborative learning context, the facilitator asks the group to reflect on its capacities and strengths in relation to a certain behaviour/ability e.g. living with fire. This reflection may involve people discussing what they can do, what they are good at, what they know, how they know what they know and their feelings about the quality and significance of that knowledge. It may involve the group identifying what its strengths are and where its knowledge is lacking, and how to go about improving its knowledge base in the areas it identifies to be important.

Through the process of a group self-assessment, the group can come to understand the extent and depth of its collective understanding of an issue. Participants reflect on where they gained their knowledge about a particular issue and the nature of the source, i.e. how trustworthy it is.

The approach can also show people how they change over time – as they interact and grow. This process has a dual benefit of bringing people together to reflect on individual and group change. A self-assessment can be used to observe and record group change (see pp 20–21.) for a more detailed outline of process).

Resources

Collison, C & Parcell, G 2004, *Learning to fly: practical knowledge management from leading and learning organisations.*

The Constellation for AIDS Competence project, <http://www.aidscompetence. org/content/2.13_river_diagram.htm>.

Applied or situated learning

At times, simply talking about an issue is not enough to develop new knowledge. We may need to experience it before this can happen. Applied or situated learning fosters practical insight through apprenticeship-like relationships. In these relationships, knowledge is transferred through demonstration and mimicry in a 'real life' context.

How does it work?

Say, for example, that a group wants to better understand fire behaviour. A forest firefighter, in order to share knowledge about fire behaviour with the group, takes it to look at a recently burned area. Here, the firefighter points out how moisture and terrain affected the path of the fire. In this way, the group may begin to see the fire's behaviour through the eyes of a firefighter. The group may begin to comprehend, or even take on, the mental model of the firefighter. Opportunities for developing field-based knowledge are very powerful as people see for themselves.

Situation-based collaborative learning enables the transfer of both explicit and implicit knowledge. This is very important as most of the knowledge we use day to day is not stated but implicit. In addition, situated learning provides an important 'casual' context in which people can get to know one another and develop trust.

Monitoring

Monitoring simply involves an individual or group following a monitoring methodology to collect data on a particular environmental variable. They then draw conclusions based on how that data indicates changes over time.

Generally, there are two types of monitoring groups:

- community of interest
- multi-party.

Many non-government groups or groups supported by government are also involved in monitoring, e.g. Waterwatch. (www.vic.waterwatch. org.au)

Monitoring can also be a collaborative learning technique and is often helpful when there is little trust in the usefulness of current management interventions; or where there is disagreement between groups about the effects of a management intervention. Community monitoring is also termed 'community science' (Carr 2004).

How does it work?

Fernandez-Gimenex, Ballard and Sturtevant (2008) have found that when people undertake monitoring together the benefits can include:

- shared understanding of the ecosystem
- community building through the growth of relationships and understanding around a common problem
- increased trust within the group, and between the group and support agencies
- better communication of findings to the wider community, i.e. community is better at sharing learnings within the community than is government.
- an increased likelihood that monitoring information will be acted upon.

In addition, this approach can lead to:

- increased understanding of, and trust in, the scientific method
- ultimately, better ecosystem outcomes.

Community of interest monitoring

A community of interest monitoring group consists of participants who share a similar mental model of the environment. Most monitoring groups that form spontaneously are of this type, e.g. Waterwatch, and generally

contain people who have a passion for environmental conservation. These groups need little prompting to form given that the people share common values and interests.

Such groups will learn much from the collection of factual data, but may not develop richer perspectives on socioecological systems because the group is not very diverse culturally.

Multi-party monitoring

A multi-party monitoring group contains participants with diverse mental models of the environment, community and so on. These groups are usually brought together by a more 'neutral' party, with the objective of building consensus around, and understanding of, an environmental management issue.

This approach can develop or transform participants' mental models as they learn more about the context of the object they are monitoring. For example, as participants work with others (e.g. land management staff, farmers and conservationists), they gain insight into the ecological context, as well as the social, political and economic context, of the monitored object.

Multi-party monitoring is a more powerful form of monitoring because it creates a learning context in which diverse mental models are brought together, broadening learning possibilities.

Fernandez-Gimenex, Ballard and Sturtevant (2008:3) point out that during the process of multi-party monitoring a group member may:

- learn about the assumptions underlying [his or her] actions
- undergo learning that challenges the values and norms that underpin [his or her] assumptions and actions.

Resources

United States Department of Agriculture 2003, *Multi-party monitoring and assessment guidelines for community based restoration in southwestern ponderosa pine forests,* <www.fs.fed.us/r3/spf/cfrp/monitoring/>.

Example

US Case Studies

In a study of the outcomes of a number of community based monitoring projects in western USA, participants reported that their involvement in the monitoring project had helped them understand the perspectives of other participants and, as a result, changed their thinking about how the ecosystem worked.

Ultimately, the study found that (in many cases) through interacting extensively with one another, participants who had originally held conflicting mental models of the ecosystem (e.g. conservationists and foresters) developed a different, and more encompassing mental model of the forest ecosystem. This was despite many individuals having expected that their views would be upheld.

The research found that people learned that the ecosystem was more complex than they had initially thought. Significantly, most learning occurred when monitoring groups contained people with different mental models of the ecosystem. In these groups, people learned that ecosystems were more complex than they had first imagined, and also that the views of others had some basis in experience (Fernandez-Gimenex, Ballard & Sturtevant 2008).

Designing the methodology

In addition to conducting monitoring, the individual or group may also design the method. This can deepen learning even further.

Example

Development of methodology – a hypothetical situation

A hypothetical conservation group has raised concerns about the relationship between fauna and fire. They nominate that the way to find out more about the relationship is to monitor the quality and quantity of hollows before and after a planned burn. This method was nominated as it seems the closest to monitoring the animal itself (i.e. in the process of monitoring hollows people may come across animals).

Although this method can be undertaken, within the scientific community it is understood to be complex and arduous. More time-efficient methods exist that lead to better answers across wider areas for a given amount of effort.

The conservation group, however, may consider scientific knowledge to be less valuable than the methods they already use, informally, to monitor fauna (e.g. looking for animals in hollows).

Instead of telling the group that this approach is inefficient a land manager could, for example, invite the group to formulate a process that others can easily replicate. This would invite people to think about their data as part of a wider effort – to think beyond the local. In the process, the notion of scale would be introduced as well as practicability and consistency. These are often the concerns of land managers and scientists. Inviting people to think about these concerns also gives them insight into the perspectives of many land managers and scientists.

The knowledge and experience they gain from this exercise could be shared with other groups – via a peer assist process, see below. This knowledge is more likely to be accepted by other groups because it is perceived as impartial and more trustworthy – especially if it is shared in trust-building contexts, such as peer assists.

Peer assist

Groups may want to share what they have learned with other groups concerned with similar issues. An intentional way of enriching current knowledge and spreading learnings from one group to another is to use a process called 'peer assist'.

Bringing groups together through peer assist:

- creates even richer knowledge (e.g. develops a context in which people from different places/communities can share and learn, creating even broader landscape and social awareness).

- ensures that groups separated by space do not need to relearn what a group elsewhere has already learned. In the process, the adaptive management cycle is sped up.

- builds momentum within the groups as they see their knowledge is valued and their vision is shared with others.

How does it work?

In this process, groups come together to share ideas and knowledge about an issue or problem that they have both faced. As groups are composed of different people and operate in different contexts, they will address the same problem in different ways. In coming together, groups can pass on novel ways of addressing the same problem and learn from one another.

During a peer assist, groups gain perspective on the problem they are addressing. They discover, through conversation with the other group, what issues are particular to them and what issues everyone faces. Peer assist also shows groups that they are not alone and are working as part of a wider community of interest.

Resources

Collison, C & Parcell, G 2004, *Learning to fly: practical knowledge management from leading and learning organisations.*

The Constellation for AIDS Competence project, <http://www.aidscompetence.org/content/2.13_river_diagram.htm>.

Participatory evaluation

Traditionally, community development programs are evaluated according to measurement criteria that the agencies that initiated them have developed. The initiating agency usually chooses the measures of success, which is why they are often not meaningful to participants.

Participatory evaluation asks the project participants to identify:

- what meaningful change looks like and how to measure it, or

- what, from their perspective, was the most significant change that occurred.

They may do this at the beginning, middle and/or end of a project.

The benefits of participatory evaluation include:

- measures change that is meaningful

- provides opportunities to learn about the subject matter and the group during the process of designing, implementing and interpreting the evaluation

- builds better relationships between everyone and creates even more trust.

Participatory evaluation can be very simple and need only entail participants identifying a few changes – to themselves and/or the group – as success. The self-assessment process described on pages 20–21 is a type of participatory evaluation. Participants can use self-assessment to understand how they have changed, based on indicators they think are important. Process organisers may also use a self-assessment tool to understand how they are also changing, as a result of initiating the process. Examples of other participatory methods are listed below.

Resources

Most Significant Change (MSC), <http://www.clearhorizon.com.au/>.

New Zealand's International Aid and Development Agency, <http://nzaidtools.nzaid.govt.nz/?q=participatory-evaluation>.

Conclusion

In order to improve our practice of managing land and fire, become better learners, and become more resilient communities and organizations, we must become better and better at learning from what we do and how we share what we know across social and institutional divides.

As such, DSE has a role to facilitate the creation and sharing of new knowledge. It can do this by creating opportunities where change towards a more mutual understanding of land and fire management in Victoria is possible. DSE's role is not to change people's minds to what *it* thinks but to share, to the best of its abilities, what is has learned. This benefits all Victorians, DSE and public policy makers.

Ultimately, the elected Victorian government decides how public land will be managed. However, DSE makes numerous decisions day-to-day and has an indirect role to play in informing the bigger decisions by providing advice to the government and supporting a more cohesive and insightful public understanding of land and fire management.

This report argues that what we know is social. This means we cannot share what we know without considering the social relationships through which sharing takes place. And since trust is the 'currency' of any constructive human relationship, we must consider trust as a key lubricant of learning and sharing.

Typically, managers of land and fire work in contexts where there is conflict or anxiety about what the 'right' thing to do is. This can arise because the knowledge about fire is more ambiguous or poorer than desired. In addition, conflict and anxiety can arise because people have different ideas about what is important – asset protection or biodiversity or amenity, and how much we are prepared to pay for example. When someone asks us to genuinely explore or reconsider what is important to us, trust becomes an essential aspect of the learning setting.

Trust can fully develop only over time and in face-to-face settings. To achieve ongoing and effective knowledge development and sharing, then, we must change the paradigm of the way we distribute our energies. We need to move away from simply amassing and 'emitting' data/research. Instead, we need to create trust-building environments in which research, local knowledge and different perspectives come together in such a way that people truly have a chance to incorporate the new knowledge into their lives.

Here we have proposed a way of working based on a new model of knowledge. In keeping with an adaptive management approach, DSE should test this model and develop ways of working based on what is learned. It should also seek to share what is learned and identify new contexts and forums in which to apply this model of knowledge.

By addressing what it is to know something and how we come to know what we know, DSE will be better equipped to tackle a number of its most challenging responsibilities, such as working with the community and researchers, incorporating local knowledge into organisational plans and sharing its expertise.

Barreteau, O (2003) 'The joint use of role-playing games and models regarding negotiation processes: characterization of associations', *Journal of Artificial Societies and Social Simulation,* 6(2), viewed 6 July 2009, <http://jasss.soc.surrey.ac.uk/JASSS.html>.

Bateson, G (1972) *Steps to an Ecology of Mind: Collected essays in Anthropology, Psychiatry, Evolution and Epistemology,* Aronson, Northvale N.J.

Blair, S., Campbell, C. & Campbell, M (2010) 'A case study of a strategic conversation about fire in Victoria', *Fire and Adaptive Management,* report number 79, Department of Sustainability and Environment, Melbourne.

Bostrom, A., Fischhoff, B & Morgan, MG (1992) 'Characterizing mental models of hazardous processes: a methodology and an application to radon', *Journal of Social Issues,* 48, pp. 85–100.

Born, P (2008) *Community Conversations: mobilising the ideas, skills and passion of community, organizations, governments, businesses and people,* BPS Books, Toronto.

Campbell, C., Blair, S & Wilson, AAG (2010) 'Adaptive management of fire: the role of a learning network', *Fire and Adaptive Management,* report number 76, Department of Sustainability and Environment, Melbourne.

—— (2010b), 'Developing a fire learning network: a case study of a first year', *Fire and Adaptive Management,* report number 78, Department of Sustainability and Environment, Melbourne.

Campbell, M, Campbell, C & Blair, S (Forthcoming) 'Guidelines: facilitating strategic conversations as part of adaptive management', *Fire and Adaptive Management,* report number 80, Department of Sustainability and Environment, Melbourne.

Carr, AJ (2004) 'Why do we all need community science?' *Society and Natural Resources,* 17, pp. 841–849.

Chaiklin, S & Lave, L editors (1993) 'Understanding practice: perspectives on activity and context. Cambridge University Press, Cambridge.

Checkland, P (1981) *Systems Thinking, Systems Practice,* J. Wiley, Chichester.

Collison, C & Parcell, G (2004) *Learning to fly: practical knowledge management from leading and learning organisations,* Capstone Publishing Limited, West Sussex.

Cooperrider, D, & Avital, M (2004) *Constructive discourse and human organisation,* Elsevier JAI, Amsterdam.

Daniels, S & Walker, G (1996) 'Collaborative learning: improving public deliberation in ecosystem-based management', *Environmental Impact Assessment Review,* 16(2), pp. 71–102.

Dewalt, K, Dewalt, BR & Wayland, CB (1998) 'Participant observation', in HR Bernard (ed.), *Handbook of methods in Cultural Anthropology,* Altamira Press, London.

Drewberry, A 2009, *Serious thoughts about immersive environments for learning and productivity,* viewed 6 July 2009, <http://imserious.typepad.com/>.

Edelman, G (1992) *Bright air, brilliant fire: on the matter of the mind.* Basic Books, New York.

Everyday Democracy (2010) *Organizing community-wide dialogue for action and change,* Study Circles Resource Centre, viewed 8 January 2010, <http://www.everyday-democracy.org/en/index.aspx>

Fernandez-Gimenex, M, Ballard, H & Sturtevant, V (2008) 'Adaptive management and social-learning in collaborative and community based management: a study of five community-based forestry organisations in the western USA', *Ecology and Society,* 13(2), viewed 7 July 2009, <http://www.ecologyandsociety.org/vol13/iss2/art4/>.

Goldstein, B (2008) 'Skunkworks in the embers of the Cedar Fire: enhancing resilience in the aftermath of disaster', *Human Ecology,* 36, pp. 15–28.

Hoffman, S, & Oliver-Smith, S (2002) *Catastrophe and culture: the anthropology of disaster,* School of American Research Press, Santa Fe.

Holling, CS (1978) *Adaptive environmental assessment and management,* John Wiley and Sons, New York.

Holling, CS, & Meffe, G (1996) 'Command and control and the pathology of natural resource management', *Conservation Biology,* 10(2), pp. 328–337.

Hutchins, E (1995) *Cognition in the wild,* MIT Press, Cambridge.

Kalland, A (2000) 'Indigenous knowledge prospects and limitations', in R Ellen, P Pakes & A Bicker (eds), *Indigenous environmental knowledge and its transformations,* Routledge, London.

King, T. (2005) 'Crisis of meanings: divergent experiences and perceptions of the marine environment in Victoria, Australia', *The Australian Journal of Anthropology,* 16(3), pp 350-365.

Kuhn, T (1959) *The Copernican Revolution: planetary astronomy in the development of western thought,* Vintage, New York.

Lave, J & Wenger, E. (1991) 'Situated learning: legitimate peripheral participation'. Campbridge University Press, Cambridge.

Lewis, S, Passmore, J & Cantore, S (2008) Appreciative inquiry for change management: using AI to facilitate organisational development, Kogan Page, London.

May, T (1997) *Social research: issues, methods and process,* Open University Press, Buckingham.

Milton, K (1993) *Environmentalism and cultural theory: exploring the role of anthropology in environmental discourse,* Routledge, London.

Mostert, E, Pahl-Wostl, C, Rees, Y, Searle, B, Tàbara, D & Tippett, J (2007) 'Social learning in European river-basin management: barriers and fostering mechanisms from 10 river basins', *Ecology and Society,* 12(1), viewed 2 October 2008, <http://ecologyandsociety.org/vol12/iss1/art19/>.

Naidu, S, Ip, A & Linser. R (2000) 'Dynamic goal-based role-play simulation on the web: a casestudy', *Educational Technology and Society,* 3(3), pp. 190–202, viewed 2 October 2008, <http://www.ifets.info/journals/3_3/b05.pdf>.

Norris, F, Stevens, S, Pfefferbaum, B, Wyche, K & Pfefferbaum, R (2008) 'Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness', *American Journal of Community Psychology,* 41, pp. 127–150.

Olssson, P, Folke, C & Berkes, F (2004) 'Adaptive co-management for building resilience in socio-ecological systems', *Environmental Management,* 34(1), pp. 75–90.

Open Space (2010), Viewed 12 February 2010 http://www.openspaceworld.org/

Paolisso, M (2002), 'Blue crabs and controversy on the Chesapeake Bay: a cultural model for understanding Watermen's Reasoning about blue crab management', *Human Organisation,* 61(3), pp. 26–39.

Pata, K, & Sarapuu, T (2003) 'Development of mental models by environmental role-play in synchronous collaborative virtual workplace', *E-learning in Science and Environmental Education October 2003 Conference,* viewed 2 October 2008, <http://www.ut.ee/eLSEEConf/Kogumik/Pata.pdf>.

Paton, D (2006) *A review of issues that inform the development and delivery of risk communication,* Bushfire CRC, viewed 5 April 2009, <http://www.bushfirecrc.com/research/downloads/Risk%20Communication%20Summary.pdf>.

——(2008) 'Risk communication and natural hazard mitigation: how trust influences its effectiveness', *International Journal of Global Environmental Issues,* 8(1/2), pp. 2–16.

Paton (forthcoming), 'Developing community bushfire resilience: integrating household, community and fire agency perspectives', in D Paton & F Tedim (eds), *Wildfire and community: facilitating preparedness and resilience,* Charles C. Thomas Publisher, Springfield, viewed 20 October 2009, <http://www.bushfirecrc.com/research/downloads/Paton-Bushfire-Resilience-Chapter.pdf>.

Promburon, P, & Bommel, P (2005) 'Participatory multi-agent system modeling for collective watershed management in Northern Thailand: a companion modeling method', V Kachitvichyanukul, U Purintrapiban & P Utayopas (eds), *Proceedings of the 2005 International Conference on Simulation and Modeling,* viewed 2 October 2008, <http://www.mssanz.org.au/simmod05/papers/C6-02.pdf>.

Quinn, N & Holland, D (1987) 'Culture and cognition', in D Holland & N Quinn (eds), *Cultural models in language and thought,* pp. 3–40, Cambridge University Press, New York.

Raish, C., A. González-Cabán, W. Martin, I. Martin & H. Bender, (2005) 'Cultural variation in public perceptions concerning fire use and management', *People, fire, and forests: a synthesis of wildfire social science,* T. Daniel, M. Carroll, C. Moseley & C. Raish (eds.) Oregon State University Press, Corvallis, pp. 70-88.

Resilience Alliance, (2007) *Assessing and managing resilience in social-ecological systems: A practitioners workbook.* Volume 1, version 1.0. Available online, viewed June 2010 <http://www.resalliance.org/3871.php>

Schusler, T, Decker, D & Pfeffer, M (2003) 'Social learning for collaborative management', *Society and Natural Resources,* 15, pp. 309–326.

Soeterbroek, C (2008) 'Folk ecology in the Australian Alps: forest cattlemen and the Royal Commission of 1939', *Environment and History,* 14, pp. 241–263.

Stent, K (2003) 'Cattlemen and conservationists in the Victorian high country: a case of incommensurable belief?', unpublished honours thesis, Department of Anthropology, University of Melbourne.

Stocker, L & Burke, G (2006) 'Overlay mapping – a methodology for place-based sustainability education', in S Wooltorton & D Marinova (eds), *Sharing wisdom for our future, environmental education in action: proceedings of the 2006 Conference of the Australian Association of Environmental Education,* pp. 228–238.

Stokols, D, & Altman, I (eds.) (1987) *Handbook of environmental psychology,* Wiley, New York.

Strauss, S & Orlove, B (2003) *Weather, climate, culture,* Berg, New York.

Tàbara, D & Pahl-Wostl, C (2007) Sustainability learning in natural resource use and management, *Ecology and Society,* 12(2) , viewed 2 October 2008, <http://ecologyandsociety.org/vol12/iss1/art3/>.

Thompson, M, Ellis, R & Wildavsky, A (1990) *Cultural theory,* Westview Press, Boulder.

Trigger, D (1999) 'Nature, work and the environment: contesting sentiments and identity in the southwest of Western Australia', *The Journal of Anthropology,* 10(2), pp. 163–176.

United States Department of Agriculture (2003) *Multi-party monitoring and assessment guidelines for community based restoration in southwestern ponderosa pine forests,* viewed 6 August 2008, <http://www.fs.fed.us/r3/spf/cfrp/monitoring/>.

Victorian State Government (2008a) *Living with fire: a community engagement framework 2008–2012,* viewed 20 January 2009, <http://www.dse.vic.gov.au/DSE/nrenfoe.nsf/LinkView/B253955C0FF624F9CA257527007B2B5A44688EB30B57BF124A2567CB000DB2EF >.

—— (2008b), *Living with fire: Victoria's bushfire strategy,* Department of Sustainability and Environment, (Victoria).

Waltner-Toews, D., J. J. Kay, & N. E. Lister (eds.), (2008), 'The ecosystem approach: complexity, uncertainty and managing for sustainability,' Columbia University Press, New York.

Walters, CJ & Holling, CS (1990) 'Large-scale management experiments and learning by doing', *Ecology,* 71(6), pp. 2060–2068.

Waterwatch (2010). www.vic.waterwatch.org.au.

Wenger, E, McDermott, R & Snyder, W. (2002) 'Cultivating communities of practice: a guide to managing knowledge', Harvard Business School Press, Boston.

Whittaker, J & Mercer, D (2004) 'The Victorian bushfires of 2002-03 and the politics of blame: discourse analysis', *Australian Geographer,* 35(3), pp. 259–297.

Winn, W, Stahr, S, C. Sarason, C, Fruland, R, Oppenheimer, P & Yen-ling, L (2006) 'Learning Oceanography from a computer simulation compared with direct experience at sea', *Journal of Science Teaching,* 43(1), pp. 25–42.

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1. 1977. A Study of the distribution of aerially applied fire retardant in softwood plantations. R. Rawson.

2. 1978. Low intensity prescribed burning in three *Pinus radiata* stand types. D. S. Thomson.

3. 1978. Fuel properties before and after thinning in young Radiata Pine plantations. D. F. Williams.

4. 1979. Using fire to reduce fuel accumulations after first thinning in Radiata Pine plantations. P. R. Billing.

5. 1979. Some of the effects of low intensity burning on Radiata Pine. P. R. Billing.

6. 1980. A low intensity prescribed burning operation in a thinned Radiata Pine plantation. P. R. Billing.

7. 1980. Some aspects of the behaviour of the Caroline Fire of February 1979. P. R. Billing.

8. 1981. Changes in understorey vegetation in Sherbrooke Forest following burning or slashing. R. Rawson and B. Rees.

9. 1981. Hazard reduction burning in the Big Desert. P. R. Billing.

10. 1981. The effectiveness of fuel-reduction burning: five case histories. P. Billing.

11. 1982. A fire tornado in the Sunset Country January 1981. P. Billing and R. Rawson.

12. 1982. A summary of forest fire statistics, 1972-73 to 1980-81. R. Rawson and B. Rees.

13. 1982. Fuel moisture changes under Radiata Pine. M. Woodman.

14. 1982. Fuel reduction burning in Radiata Pine plantations. M. Woodman and R. Rawson.

15. 1982. Project MAFFS/HERCULES: the Modular Airborne Fire Fighting System in Victoria. R. Rawson, B. Rees, E. Stuckey, D. Turner, C. Wood, and M. Woodman.

16. 1982. Using fire to reduce aerial fuels in first thinned Radiata Pine. P. R. Billing and J. V. Bywater.

17. 1982. Fuel properties before and after second thinning in Radiata Pine. M. Woodman.

18. 1983. Retardant distributions from six agricultural aircraft. B. Rees.

19. 1983. The Bright plantation fire: November, 1982. N. Watson, G. Morgan, and D. Rolland.

20. 1983. Otways Fire No 22 – 1982/83: Aspects of fire behaviour. P. Billing.

21. 1983. Otways Fire No 22 – 1982/83: A case study of plantation protection. P. Billing.

22. 1984. Forest Fire Statistics, 1974-75 to 1983-84. B. Rees.

23. 1985 The Avoca Fire, 14 January 1985. P. Billing.

24. 1985. Fuel management in Radiata Pine following heavy first thinning. P. Norman.

25. 1985. Effectiveness of Fuel Reduction Burning – 10 Case Studies. R. Rawson, P. Billing and B. Rees.

26. 1986. Operational aspects of the Infra-Red Line Scanner. P. Billing.

27. 1987. Heathcote fire: Bendigo Fire No.38 – 1986-87. P. Billing.

28. 1990. Fire behaviour and Fuel Reduction Burning – Bemm River. A. J. Buckley.

29. 1991. Fire hazard and prescribed burning of thinning slash in eucalypt regrowth forest. A. J. Buckley and N. Corkish.

30. 1987. Monitoring the ecological effects of fire. F. Hamilton (ed.)

31. 1992. Assessing fire hazard on public land in Victoria: fire management needs, and practical research objectives. A.A.G. Wilson.

32. 1992. Eucalypt bark hazard guide. A.A.G. Wilson.

33. 1992. Fuel reducing a stand of eucalypt regrowth in East Gippsland – a case study. A. J. Buckley.

34. 1992. Monitoring vegetation for fire effects. M.A. Wouters.

35. 1993. Elevated fuel guide. A.A.G. Wilson.

36. 1993. Wildfire behaviour in heath and other elevated fuels: a case study of the 1991 Heywood fire. M. A. Wouters.

37. 1993. The accumulation and structural development of the wiregrass *(Tetrarrhena juncea)* fuel type in East Gippsland. L.G. Fogarty.

38. 1993. A case study of wildfire management in the Byadbo and Tingaringy Wilderness Areas. A.G. Bartlett.

39. 1993. Developing Fire Management Planning in Victoria: a case study from the Grampians. M. A. Wouters.

40. 1993. Fuel reducing regrowth forests with a wiregrass fuel type: fire behaviour guide and prescriptions. A.J. Buckley.

41. 1993. The effect of fuel reduction burning on the suppression of four wildfires in western Victoria. S.R. Grant and M.A. Wouters.

42. 1994. Fire behaviour and fire suppression in an elevated fuel type in East Gippsland: Patrol Track wildfire, February 1991. A.J. Buckley.

43. 1996. Fuel hazard levels in relation to site characteristics and fire history: Chiltern Regional Park case study. K. Chatto.

44. 2004. Surface fine fuel hazard rating – forest fuels in East Gippsland. G. J. McCarthy.

45. 1998. Effectiveness of firefighting first attack operations by the Department of Natural Resources and Environment from 1991/92-1994/95. G. J McCarthy and K.G. Tolhurst.

46. 1997. The development and testing of the Wiltronics T-H Fine Fuel Moisture meter. K. Chatto and K. Tolhurst.

47. 1998. Overall fuel hazard guide. G. J. McCarthy, K. Chatto and K. Tolhurst.

48. 1999. Development, behaviour, threat, and meteorological aspects of a plume-driven bushfire in west-central Victoria: Berringa Fire February 25-26, 1995. K. Chatto, K. Tolhurst, A. Leggett and A. Treloar.

49. 1997. Analysis of fire causes on or threatening public land in Victoria 1976/77 – 1995/96. C. Davies.

50. 2000. Assessment of the effectiveness and environmental risk of the use of retardants to assist in wildfire control in Victoria. CSIRO Forestry and Forest Products.

51.   2001. Effectiveness of broadscale fuel reduction burning in assisting with wildfire control in parks and forests in Victoria. G. J. McCarthy and K. Tolhurst.

52.   2003. Effectiveness of aircraft operations by the Department of Natural Resources and Environment and Country Fire Authority 1997-1998. G. J. McCarthy.

53.   2003. Modelling transport, dispersion and secondary pollutant formation of emissions from burning vegetation using air quality dispersion models. O. D. Valianatos, K. Tolhurst, S. Seims and N. Tapper.

54.   2003. Determination of sustainable fire regimes in the Victorian Alps using plant vital attributes. G. J. McCarthy, K. Tolhurst and K. Chatto.

55.   2004. Analysis of wildfire threat: issues and options. A. A. G. Wilson.

56.   2003. Prediction of firefighting resources for suppression operations in Victoria's parks and forests. G. J. McCarthy, K. Tolhurst, M. Wouters.

57.   2003. Ecological effects of repeated low-intensity fire in a mixed eucalypt foothill forest in south-eastern Australia. Summary report (1994-1999). Department of Sustainability and Environment.

58.   2003. Effects of repeated low-intensity fire on the understorey of a mixed eucalypt foothill forest in south-eastern Australia. K. Tolhurst.

59.   2003. Effects of a repeated low-intensity fire on fuel dynamics in a mixed eucalypt foothill forest in south-eastern Australia. K. Tolhurst and N. Kelly.

60.   2003. Effects of repeated low-intensity fire on carbon, nitrogen and phosphorus in the soils of a mixed eucalypt foothill forest in south eastern Australia. P. Hopmans.

61.   2003. Effects of repeated low-intensity fire on the invertebrates of a mixed eucalypt foothill forest in south-eastern Australia. N. Collett and F. Neumann.

62.   2003. Effects of repeated low-intensity fire on bird abundance in a mixed eucalypt foothill forest in south-eastern Australia. R. H. Loyn, R. B. Cunningham and C. Donnelly.

63.   2003. Effects of repeated low-intensity fire on terrestrial mammal populations of a mixed eucalypt foothill forest in south-eastern Australia. M. Irvin, M. Westbrooke, and M. Gibson.

64.   2003. Effects of repeated low-intensity fire on insectivorous bat populations of a mixed eucalypt foothill forest in south-eastern Australia. M. Irvin, P. Prevett, and M Gibson.

65.   2003. Effects of repeated low-intensity fire on reptile populations of a mixed eucalypt foothill forest in south-eastern Australia. M. Irvin, M. Westbrooke, and M. Gibson.

66.   2003. Effects of repeated low-intensity fire on tree growth and bark in a mixed eucalypt foothill forest in south-eastern Australia. K. Chatto, T. Bell and J. Kellas.

67.   2003. A review of the relationship between fireline intensity and the ecological and economic effects of fire, and methods currently used to collect fire data. K. Chatto and K. Tolhurst.

68.   2003. Effects of fire retardant on vegetation in eastern Australian heathlands: a preliminary investigation. T. Bell.

69.   2003. Effects of fire retardant on heathland invertebrate communities in Victoria. N. Collett and C. Schoenborn.

70.   2003. Effects of fire retardant on soils of heathland in Victoria. P. Hopmans and R. Bickford.

71.   2004. An evaluation of the performance of the Simplex 304 helicopter belly-tank. H. Biggs.

72.   2004. Operational performance of the S-64F Aircrane Helitanker – 1997-98 fire season. H. Biggs.

73.   2008 Underpinnings of fire management for biodiversity conversation in reserves. M. Gill.

74.   2008. Flora monitoring protocols for planned burning: a user's guide. J. Cawson and A. Muir.

75.   2008. Flora monitoring protocols for planned burning: a rationale report. J. Cawson and A. Muir.

76.   2010. Adaptive Management of Fire: The role of a learning network. C. Campbell, S. Blair and A.A.G. Wilson.

77.   2010. Understanding, Developing and Sharing Knowledge about Fire in Victoria. S. Blair, C. Campbell, A.A.G. Wilson and M. Campbell.

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79.   2010. A case study of a "Strategic Conversation" about fire in Victoria, Australia. S. Blair, C. Campbell and M. Campbell.

80.   Forthcoming. Guidelines: Facilitating Strategic Conversations as Part of Adaptive Management. C. Campbell, M. Campbell and S. Blair.

81.   2010. Fire Boss amphibious single engine air tanker: Final Report, November 2008. H. Biggs.

Supplementary report

1992. Ecological effects of fuel reduction burning in a dry sclerophyll forest: A summary of principle research findings and their management implications. Department of Conservation and environment., Victoria. 52pp. K Tolhurst, D.W. Flinn, R.H. Lyon, A.A.G. Wilson, and I. J. Foletta.

1992. Ecological effects of fuel reduction burning in a dry sclerophyll forest: First Progress Report. Department of Conservation and environment.,Victoria K. Tolhurst and D. Flinn (eds.).