

Managing Multi-Functional Landscapes at the Interface of Public Forests and Private Land: Advancing Understanding through a Comparison of Experience in U.S. and Australia

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Principle Investigator:

Dr. Eric Toman
School of Environment and Natural Resources, The Ohio State University,
Columbus, OH 43210, United States
Phone: 614.292.7313, Fax: 614.292.7432
Toman.10@osu.edu

Co-Principle Investigators:

Dr. Hannah Brenkert-Smith, Institute of Behavioral Sciences, University of Colorado-Boulder,
Boulder, CO 80309, United States

Dr. Allan Curtis, Institute for Land, Water, and Society, Charles Sturt University,
New South Wales, 2640, Australia

Co-authors:

Dr. Maureen Rogers, Charles Sturt University, Australia
Melanie Stidham, The Ohio State University, United States



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I. Abstract

Natural resource management in fire-prone systems is increasingly complex. Private and public land managers may seek to achieve a range of outcomes from natural landscapes. In some cases these outcomes, as well as the management approaches used to create them, may be contested by stakeholders, particularly at the interface of public and private lands. This project considers whether a stakeholder engagement process informed by the social sciences can contribute to developing agreement on how to manage multi-functional landscapes.

The research team developed and evaluated two approaches to engage diverse stakeholders in natural resource management decisions and better understand how they conceptualize social-ecological systems at the public/private land interface. These two methods were developed and evaluated in two separate locations: western Boulder County, Colorado, United States (U.S.), and the Whitfield locality in Victoria, Australia. In the U.S. location, stakeholders developed cognitive maps of current and desired future forest, social, and economic conditions, and identified mechanisms to achieve desired future conditions during individual interviews. Following the interviews the participants were brought together to review all of the cognitive maps, which facilitated discussion on shared perspectives and mechanisms to accomplish current management goals. Participants indicated that the method helped them to more clearly see the interrelated nature of social and ecological conditions on the landscape. In the Australia site, the research team worked with stakeholders to identify the perceived values at risk around a focal issue of importance to all research participants (roadside vegetation management in a bushfire context). During a participatory workshop participants watched an edited video of participants speaking about their perspectives on roadside management and developed individual cognitive maps to visually represent the values at risk on the landscape associated with roadside management. Participants indicated that the method was effective at helping them clarify and more fully articulate their viewpoints. Approaches used at both sites were effective at identifying areas of common ground among participants that could be built on for future management activities. In addition, these approaches also highlighted areas where perspectives diverged and appeared to provide a potential venue where such differences could be constructively considered by relevant stakeholders.

II. Background and purpose

Contemporary natural resource management is undertaken within a complex context. Natural systems, and related disturbance events, have generally been thought of as occurring within a fairly consistent range of variability. As such, much of today's resource management decisions are based upon long-term data records that describe the expected range of natural variability within a given system (Landres et al., 1999). However, evidence suggests that such a position is no longer tenable (see e.g., Brown, 2010; Milly et al., 2008; Westerling et al., 2006) resulting in substantial uncertainty regarding potential future conditions. Such uncertainty can serve to heighten concern about management approaches. This is particularly true at the interface of public and private lands where management is often closely scrutinized by stakeholders¹. In these settings, private and public land managers typically seek to achieve multiple objectives including hazard reduction, ecosystem restoration, biodiversity conservation, commodity production, and the provision of recreation opportunities. While these objectives may be complementary, in many cases they involve tradeoffs that are contested by stakeholders.

¹ In this report we define stakeholders broadly to include any person or entity that has a direct interest in the forest, the forest's conditions, forest management, or wildfire risk reduction and management.

While these trends suggest the need for the development of new ecological knowledge to reduce uncertainty, they also emphasize the need for additional social science information to better understand the decision-making process and how to better engage diverse stakeholders. Ultimately, the types of conditions and objectives managers seek to achieve as well as the specific interventions used to implement such approaches are based on human decisions and behaviors (Mascia et al., 2003).

Our work here is based on substantial existing literature on the social and psychological factors that influence human decisions and behaviors. A variety of theoretical models have been developed to describe how a range of variables interact to influence individual behaviors (where behaviors could include actual behaviors such as adoption of defensible space on private property or willingness to accept management practices such as prescribed burning on public lands). While the specifics of these models include many meaningful variations, at a general level they typically describe a type of hierarchical structure where behaviors are based on a set of preceding variables that often include *attitudes* (a positive or negative evaluation), *norms* (perceived expectations of others), *beliefs* (understanding or misunderstanding of relevant facts), *value orientations or worldviews* (patterns of basic beliefs that form the lens through which one looks at the world), and *values* (central, stable components to someone's belief system) (see e.g., Brunson and Shindler, 2004; Byrch et al., 2007; Vaske and Donnelly, 1999).

Forested landscapes in the wildland-urban interface include complex and reciprocal interactions between human and ecological systems; a relationship captured by the concept of social-ecological systems. While natural resource management historically focused primarily on ecological components (e.g., vegetation management for timber production, development of wildlife habitat), such actions are both influenced by and have meaningful impacts on related social systems and vice versa (e.g., settlement patterns in disturbance-prone landscapes influences future decisions about disturbance response). While natural resource management has increasingly attempted to address social system components, current planning approaches are generally limited in their ability to effectively identify the psychological or social factors that influence preferred outcomes or management approaches among stakeholders. Each stakeholder brings his or her own cognitive hierarchy to a natural resource management decision and this underlying structure influences his or her expectations and preferences. However, these underlying variables are rarely discussed openly and, in many cases, may operate largely subconsciously within individuals.

This project introduces two potential methodologies managers could use to engage stakeholders to help them more fully consider and articulate their understanding of a particular social-ecological system and their preferences for future conditions and outcomes that could be achieved on the landscape, with the goal of facilitating more effective management decisions.

Cognitive mapping

Knowledge is based on a person's culture and experiences and is filtered by their values and worldviews into a personal conceptualization of the world (Byrch et al., 2007). These conceptualizations are resistant to change and information that does not conform to existing conceptualizations is typically rejected, at least initially, rather than resulting in modifications of the individual's way of seeing the world. Furthermore, people generally believe their image of the world is shared by others (Byrch et al., 2007), which may or may not be true. These entrenched conceptualizations can pose considerable challenges to identifying common understandings in complex management settings, particularly if they are not acknowledged.

Cognitive mapping techniques have long been used in psychological analysis to understand an individual's perceptions of a given problem, allowing identification of the central tenets which may otherwise be obscured (Ackermann et al., 1992). It is a technique that can be used to structure, analyze, and make sense of accounts of problems. Byrch et al. (2007) define cognitive maps as a visual representation of how someone conceptualizes a particular issue including the factors viewed as relevant to the issue and relationships between these factors. By seeing how sequences of thoughts fit together an individual can better understand their own rationale, and see more clearly where isolated pieces of information fit in (Ackermann et al., 1992). According to Ackermann et al. (1992), when used in a group setting, individual maps can facilitate shared understandings and emergence of a common language. Each person is able to see their perspectives in the context of others, thus increasing understanding of their own and others' points of view, alternative approaches, and different ways of seeing the world.

Cognitive mapping has been used to improve organizational action and decision making by elucidating the thoughts and actions of those implementing management policies and practices (Cossette and Audet, 1992). More recent attempts to engage stakeholders in the field of natural resource management have begun to explore the use of cognitive mapping to help individuals explore their own knowledge structure, and to facilitate the development of shared understandings (see e.g., Hjortsø, 2004; Tikkanen et al., 2006; Zhang et al., 2013).

Drawing on this previous literature, this project set out to examine whether a facilitated approach to develop cognitive maps that describe participants' understandings of the structure and function of selected social-ecological systems could contribute to more effective stakeholder engagement in managing multi-functional landscapes. The intention was to maintain the participant's direct voice as much as possible by asking informants to create their own diagrams to describe key system components, links between components, and key processes that they believe will produce or maintain desirable outcomes. The resulting individual maps were then used to provide a foundation for stakeholder interactions regarding natural resource management decisions.

III. Study description and location

We employed two separate methods of engaging stakeholders through cognitive mapping exercises. One method (used in the U.S. study location) used cognitive maps to articulate participant views on current and desired future ecological, social, and economic conditions, and mechanisms to reach desired future conditions. The other method (applied in the Australia location) included multiple contacts with participants to facilitate development of a coherent articulation of their view on a specific management issue; participants were then recorded describing their perspective to share with other stakeholders. Both approaches also included a participatory workshop to enable group discussion regarding the topics addressed in the interviews. The approaches and study locations are described below. Greater details about each approach and a description of how they may be implemented by natural resource managers can be found in our Manager Guidebook posted on the Joint Fire Science Program project website at https://www.firescience.gov/JFSP_advanced_search.cfm².

² As specific web addresses may change, this link takes interested readers to the JFSP research projects search page where our project can be found by selecting "Toman, Eric L" as the researcher name. The full project name is: ["Managing Multi-Functional Landscapes at the Interface of Public Forests and Private Land: Advancing Understanding Through a Comparison of Experience in U.S. and Australia."](#)

Method 1: Using cognitive mapping to explore stakeholder perceptions of desired future conditions

Study location: Western Boulder County, Colorado, United States

The U.S. study location was in the western portion of Boulder County in the foothills of the Rocky Mountains. The study area was bordered by the Peak to Peak Scenic Byway on the west and the outskirts of the City of Boulder on the east. There was approximately a 3,000 foot (914 meter) elevation gain from the east to west boundary of the study area. The Boulder Valley stands at the intersection of the Great Plains to the east and the Rocky Mountain foothills to the west, creating a diversity of landscapes and biomes. The city of Boulder (population of ~100,000) is located immediately adjacent to the study area, while the city of Denver (~650,000 people) is about 30 miles to the southeast.

The two main public property owners in the study area are the U.S. Forest Service and Boulder County; both of whom manage multiple parcels and substantial acreage of land throughout. Historically there was a large mining influence in the area, resulting in a large number of private properties scattered across the foothills, many of which have been sold to residential owners. There are also several small communities with concentrations of rural households. Past surveys conducted in the study area found that most of the households are occupied full-time (Champ et al., 2011). Boulder County is serviced by 23 distinct fire protection districts (FPDs) each of which cover a number of communities. Fire protection districts provide emergency and fire services to residents in their respective jurisdictional areas while also supporting neighboring districts. Capacity among districts vary greatly in terms of funding support, whether personnel are volunteer or career fire fighters, and whether or not districts have mitigation services available for reducing wildfire risk before an event. Our study included four of the county's FPDs, representing 43 communities.

The landscape is forested and often steep, divided by several canyons that follow an east-west orientation. The forest type in the lower elevations is primarily ponderosa pine or Douglas fir, which historically experienced frequent low-intensity surface fires. There have been several large wildfires in the area in recent years, including the Fourmile Canyon Fire in 2010 that burned 169 homes within the study area. Boulder County has been ranked within the top 25 most at risk counties in the U.S. and within the state of Colorado, based on number of homes in the wildland-urban interface (Gude et al., 2008). As such there have been a number of efforts to bring a variety of entities together to reduce fire risk. Following the 2002 fire season the Front Range Roundtable was formed to bring together representatives from state and federal agencies, municipalities, interest groups, and scientists to improve forest health and reduce wildfire risk in the 10 counties located along the Front Range of the Rocky Mountains in Colorado (including Boulder County). This group is still active, and more recently has turned its attention to forest restoration on Forest Service lands through participation in a Collaborative Forest Landscape Restoration Program (CFLRP) funded project. Within Boulder County, a number of individual FPDs have developed community wildfire protection plans (CWPPs), including the four that were included in this study. A countywide CWPP was completed in 2011.

The lower montane portions of western Boulder County represent a prime example of a multi-functional landscape. The forests are highly valued for a variety of ecosystem services including aesthetic benefits, recreation opportunities, rural living environments, and as a supplier for much of the region's water supply, among others. They are also part of a fire-prone system that has over the years had its natural fire regime altered, potentially placing the forests at risk for an uncharacteristically catastrophic wildfire. The mosaic pattern of land ownership increases the challenge of achieving landscape-level management objectives.

Participants

Within this environment we sought to test a method of stakeholder engagement that could facilitate landscape-level planning by incorporating social values with ecological principles. To do this we selected a group of 20 individuals who have been engaged in forest management and/or risk mitigation within the study area. Participants were selected from five stakeholder groups: fire protection districts (8), U.S. Forest Service (5), Boulder County (5), recreation (1), and Colorado State Forest Service (1).

Cognitive mapping interviews

The goal of the interviews was to allow the research team and participants to gain an understanding of how each person conceptualized the social-ecological system within western Boulder County. Questions address three interrelated topics: 1) current forest, social, and economic conditions; 2) desired future forest, social, and economic conditions; and 3) mechanisms to reach desired future conditions, including management actions, policies and overarching management strategies, and partners and stakeholders needed (Figure 1). Within each category positive and negative influencing factors were identified. At the end of each section the participant was invited to review their developing map and make connections between the social, economic and ecological aspects of the map. Similarly at the end of the interview participants were asked to make connections between the sections.

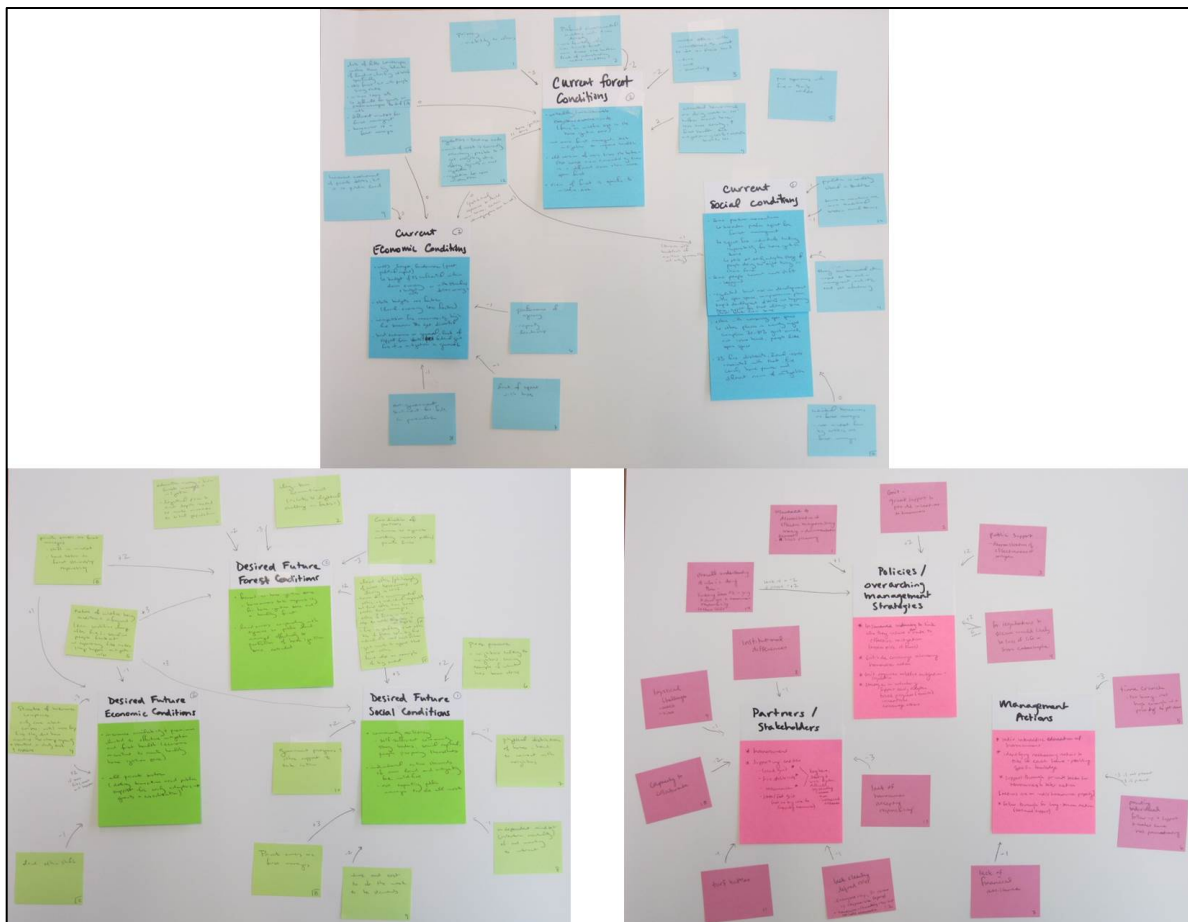


Figure 1. Example of cognitive map covering current conditions (blue sticky notes), desired future conditions (green sticky notes), and mechanisms to reach desired future conditions (pink sticky notes).

Participatory workshop

Following the interviews we examined all of the viewpoints across the sample to identify areas of common ground, divergent perspectives, and barriers and mechanisms to reaching desired future conditions. This analysis helped us to prepare for the participatory workshop with as many of the original participants as were available. During the workshop we led participants through several activities to explore the data on their own where participants looked at all of the cognitive maps developed during the interviews (maps did not have participant names on them and were written by a member of the research team, so were not identifiable). Following the activities we shared some of the findings from our own analysis and facilitated a discussion on the maps and potential future strategies to address some of the key management issues being faced by participants.

Method 2: Fire management in a multi-functional landscape

Study location: Whitfield locality, Victoria, Australia

The Australian study site was focused around Whitfield, which is a small rural locality in the King Valley in northeast Victoria. The King Valley is located approximately 250 kilometers (155 miles) from Melbourne. The Valley descends from the Australian Alps over a distance of about 100 kilometers (62 miles) to the riverine plains and the Murray River in the west.

The Whitfield locality covers an area of approximately 200 square kilometers (77 square miles). The locality has a population of 1,000 people living in two small villages and on a number of rural properties. The rural properties include a mix of small and larger holdings. Absentee landowners are an important landholder cohort. Whitfield is surrounded by forested hills that include a mix of publicly owned native forests and privately owned plantations, mostly radiata pine (*Pinus radiata*). Agriculture includes livestock (mostly cattle), some crops, and viticulture. There is an important tourism industry based around alpine sports, wine, and food. Most tourists arrive from Melbourne which is a three-hour drive away. Gold mining during the 19th century and the tobacco industry in the 20th century have provided additional layers of cultural heritage, but have also left a legacy of disturbance and in some cases, pollution. European settlement from the 1830's overlaid a long history of Indigenous occupation and land use, which continues today.

Northeast Victoria is one of the most fire prone environments in the world. Whitfield is very vulnerable to fire in that it is situated near the end of a long valley, close to steep, densely forested mountains, in pockets of cleared land that are surrounded by highly flammable native forests. Roads in and out of the valley typically traverse extensive forested areas. The most recent fire experience was in 2006 when much of the district was burned and subsequently was threatened by fire for an extended period. The expected impacts of climate change over the next 50 years are for hotter, drier conditions with increased frequency of extreme fire danger days.

As can be expected in a multi-functional landscape, there are conflicts over values in the King Valley, often around the extent and effectiveness of planned burnings on public land. There are also issues of trust between the place-based community and local government and the state agency responsible for the management of native forests and alpine parks. Local people often believe that public land managers make for poor neighbors in that they do not adequately manage for pest plants (e.g., weeds such as blackberries) and animals (e.g., wild dogs) or undertake sufficient work to limit the impact of wildfire.

Participants

A total of 16 individuals participated in one or more stages of the research process. Participants were drawn from a variety of organizations and stakeholder groups in the King Valley including: Parks Victoria (2), Indigenous and Cultural Heritage officer (1), Department of Environment and Primary Industries (1), State Emergency Services (1), Mansfield Shire Council (1), Council Risk Management officer (1), beef farmer (1), dairy farmer (1), grape grower (1), timber plantation risk manager (1), store owner (1), caravan park employee (1), community action group (1), large landholder (1), and a resident (1).

Method overview

While natural resource management generally has moved toward greater stakeholder engagement, with increasing use of a range of techniques designed to map shared understandings, there is little research into the cognitive influences around highly contested 'sticking points'. In this approach individuals were taken through a process in which their voice was directly sought and retained through a video recording, in order to help participants develop and clarify their own thinking. The methodology involved a four stage process, including semi-structured interviews, the creation of a short video where participants shared their perspectives, the creation of 'sticky dots' reflecting socio-ecological values, and a final workshop where the video and sticky dots came together to develop a cognitive map of values at risk along roadsides in the Whitfield locality.

Interviews

The purpose of the initial interview was to build rapport with participants and gain an understanding of their knowledge and experiences with past fires in the area, preparedness actions they or their community had undertaken, and needed future actions to ensure protection of values on the landscape. Through these conversations the research team identified four issues that came up across the sample including confusion around controlled burns, management of roadsides as a tool in fire management and prevention, campfires, and the potential fire hazard of flood debris build-up. The research team applied a set of criterion to each of these issues to determine which would be a suitable focal issue for the remainder of the research process.

A primary purpose of this method of stakeholder engagement was to ensure everyone's voice was heard and retained. The second interview, therefore, assisted each participant to clarify their thoughts about the focal issue (roadside management). At the beginning of the interview the participant was asked a series of three questions: the role of roadsides in managing the risks from bushfires, who they thought was responsible for managing roadsides, and what they believed needed to be done in the future. During their responses the interviewer asked clarifying questions and took notes to remind participants of the key ideas they mentioned. When the participant was ready they were again asked the same three questions, but this time their responses were video recorded. The video recordings were then edited into a compilation video where all participants contributed to answering the three questions that guided the interviews.

Participatory workshop

By viewing the edited version of the video recordings the research team was able to identify a range of values, priorities, and potential hazards around the focal issue. Each value, priority, and hazard was assigned a code and separate color of sticky dot. Five sticky dots were made for each value, priority and hazard, one for each potential level of importance (ranging from not important to very important). Participants were each given a set of sticky dots to place on a map of the study area. Through this process cognitive maps were made, creating a visual representation of participant perceptions of the values at risk across the landscape related to the research focal issue (Figure 2).

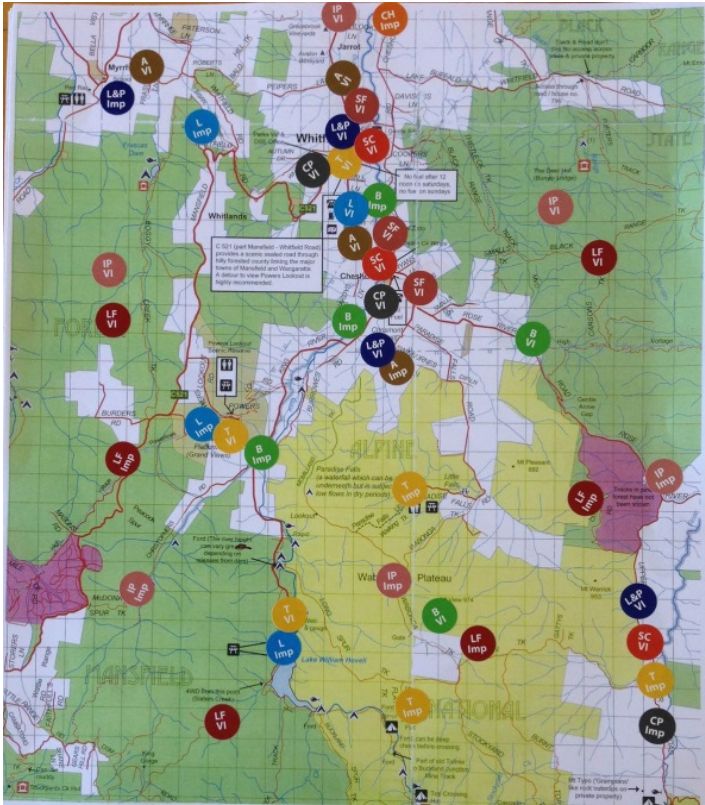


Figure 2. Example of a completed cognitive map for managing roadsides in the bushfire context in the Whitfield locality

The cognitive mapping activity, along with watching the video compilation of all the participant perspectives stimulated considerable discussion about the shared values and priorities around the focal issue. Some participants were also introduced to other values and priorities that they had not previously understood, such as the important cultural heritage values associated with roadsides in the Whitfield locality.

IV. Key findings

The underlying goal of this research was to assess whether an approach of stakeholder engagement informed by the social sciences could support the development of agreement on how to manage multi-functional landscapes. Specifically, we were interested in examining whether developing individual cognitive maps would help participants clarify their own conceptualizations of relevant social and ecological systems, provide a means to articulate these conceptualizations to other stakeholders, and help facilitate group decision making on potentially contested issues. Several key findings emerge from this research including:

- **Cognitive mapping approaches can help diverse stakeholders better understand their own conceptualizations of social-ecological systems and priorities for management.** Each study site used a different method of cognitive mapping and each was successful in that they helped participants clarify and articulate their viewpoints within a social-ecological framework. In the U.S. site, all of the participants were engaged in forest restoration or fire risk reduction as part of their

jobs or volunteer firefighter duties. Within this context they often had a narrow view of the problem, based on the tasks they regularly performed. By considering current and desired future social, economic, and ecological conditions they were better able to see the integrated nature of the social-ecological system and how their role contributed to overall landscape-level goals. In the Australia site, engaging people over time through a series of contacts enabled participants to reflect, clarify, and eventually articulate their values for the landscape and priorities for management. By the time of the workshop, participants were not only able to talk about specific values associated with the landscape, they were also able to place them on a map that managers could then use to manage for values at risk. This approach demonstrates the importance of taking time to engage stakeholders.

- **Individual-level cognitive mapping can facilitate group decision making in contested landscapes with complex management dilemmas.** Seeing other people's cognitive maps provided opportunities to see potential overlap and divergence of perspectives with other stakeholders. Having everyone map to the same framework diminished the focus on job-related roles and tasks and increased the focus on the conceptual level, which could then facilitate identification of shared values, visions, and pathways. The maps in the U.S. site were not associated with names, thus assumed differences in perspectives based on past interactions between individuals or stakeholder groups were not identifiable. Creating and reviewing the maps provided the space to see areas of common understanding and differences in perspectives without judgment. The maps, as well as the video recording in the Australia site, provided a useful platform from which to facilitate discussion among stakeholders on complex management issues. Establishing shared language and understanding can support decision making by helping identify areas of agreement on potential management decisions. Perhaps more importantly, this approach can also help identify areas of disagreement along with contextual information about those differences to allow for more effective dialogue regarding potential ways forward.
- **Cognitive mapping efforts can be completed with tools generally available to natural resource managers.** The scientific literature outlines multiple ways of generating cognitive maps, however most approaches require the use of specialized software, which may or may not be accessible to managers. We found immense value in having participants create their own maps using readily available office supplies (e.g., sticky notes and flip chart pages). Foundational analysis of concepts expressed through the mapping activity could be completed using software with basic spreadsheet functions.
- **The research approach used in the Australia site allowed participants to recognize the importance of roadside management in mitigating fire risk.** Some participants noted through the mapping exercise that each of the three possible exit routes from Whitfield involved travelling by car through extensive forests, presenting a potential hazard that had not yet been addressed in planning or management. This was seen as particularly important given that the main tourism season and associated traffic coincides with the main fire season. While appreciating the need for roadside management to focus on reducing that hazard, by listening to the video contributions by each stakeholder the group also came to realize the important biodiversity, aesthetic and cultural heritage values attached to roadsides, and the potential for conflict if roadside planning and managers fail to adequately consider those values. For instance, roadside vegetation is an important resource for food and medicine for Indigenous people due to easy access.

- **The research approach in the U.S. site revealed a high degree of common ground between participants.** Participants in the U.S. site and the research team alike were surprised by the high degree of common ground in cognitive maps, particularly in the characterization of current and desired future forest conditions. Viewpoints were so well aligned that none of the workshop participants were able to immediately identify their own maps (names were not on the maps and the handwriting was that of a member of the research team). The degree of agreement likely reflects the substantial previous efforts to engage key stakeholders in management decisions in Boulder County. Even with this history of working together, participants expected more differences suggesting the cognitive mapping approach provides a useful means for participants to assess their judgments of other stakeholder groups.

V. Management implications

Several management implications arose out of the data collected during the testing of the methodologies in this research project and the methodologies themselves.

- **Managing multi-functional landscapes is highly influenced by social as well as ecological components.** It became apparent over the course of the interviews in the U.S. site that relationships between stakeholders were a very important factor in accomplishing landscape-level management goals. Relationships were highlighted in discussions related to the varied roles different agencies might play. For example, fire protection districts were often seen as having strong relationships with their constituents, which placed them in a better position than other entities to interact with residents to encourage them to create and implement defensible space on their properties. Participants described reliance on different partners depending on management goals, each playing a different role within a broader management agenda. In all cases the importance of relationships indicated the value of investing time into building and maintaining relationships with a variety of partners and stakeholders.
- **Natural resource managers would benefit from developing a working understanding of the social sciences and partnering with social scientists.** Currently natural resource managers are well-trained in ecological aspects of the social-ecological system, but typically have less social science expertise; however, both are important for successful natural resource management. This is particularly true as managers are increasingly expected to incorporate public input into management decisions and participate in collaborative groups and other means of stakeholder engagement.
- **Cognitive mapping and participatory workshops have promise to more fully engage diverse stakeholders than traditional public participation processes.** Traditional public participation mechanisms as mandated by the National Environmental Policy Act (in the U.S.) are often not effective at reducing conflict on controversial projects. In part this could be because people do not feel their voices have been heard. In the Australia site, video recordings were used with great success to ensure each participant's voice was heard. As the researchers observed at the final workshop, when the edited video recording was played, all participants paid at least as much attention to watching and listening themselves as they did to the sections during which other participants spoke. It was also clear that participants reflected on what they said as well as how they presented themselves or were assessed by the other participants. To the extent that the video enabled each participant's voice to be heard and contributed to self-reflection, it appears that the video contributed to the consensus amongst workshop participants that the process ensured that "I have been heard" and "there is common ground".

VI. Relationship to other recent findings and ongoing work on this topic

Members of the research team are involved in a number of ongoing and recently completed efforts that are related to utilizing cognitive mapping to understand underlying values in management decisions, stakeholder engagement on multi-functional landscapes, and stakeholder perspectives of fire risk or forest restoration:

- **Toman, E., and Wilson R. Restoring Landscapes in the Context of Environmental Change: A Mental Models Analysis** Forest restoration is a commonly used term, however it can have different meanings for different people based on their worldviews, values, and expertise. This research used a mental models approach (similar to cognitive mapping) to assess how Forest Service administrators and managers engaged in the Collaborative Forest Landscape Restoration Program thought about restoration.
- **Brenkert-Smith, H. and Champ P. Homeowner Vulnerability to Wildfire Risk in a Changing Climate (USDA NFP grant)** This project created a panel data set of wildland-urban interface homeowners in Boulder and Larimer Counties before and after a major wildfire event in order to identify determinants of risk perception and wildfire mitigation activities.
- **Toman, E. and Olsen C. Examining the influence and effectiveness of communication programs and community partnerships on public perceptions of smoke management: A multi-region analysis (JFSP Project 10-1-03-7)** By surveying citizens in four study locations this project examined the social acceptability of smoke management practices, factors influencing acceptability, and the effectiveness of different communication approaches on acceptability and beliefs.
- **Shindler, B.A., Toman, E., and Brunson, M. Longitudinal Analysis of Public Responses to Wildland Fuel Management: Measures to Evaluate Change and Predict Citizen Behaviors in Agency Decision Processes (JFSP Project 06-4-1-26)** Using a longitudinal approach the goal of this project was to gauge changes in public responses to agency fire management policies, identify specific factors that influence citizens' support of fuel practices, and evaluate the role these factors play in the ability of managers to make decisions.
- **Brenkert-Smith, H., Champ P. Is the whole greater than the sum of its parts? Homeowner wildfire risk mitigation, community heterogeneity, and fire adaptedness (JFSP Project 14-2-01-31)** This project uses household surveys, expert property assessments, and community-level data to explore to what extent community heterogeneity influences determinants of mitigation activity.

VII. Future work needed

The development and testing of these two methodologies has opened the door for a number of future studies.

- **Additional testing to assess the effectiveness of these approaches in practice to address a contested management issue.** Both methodologies were successful in uncovering shared understandings between different stakeholders. Future work would be needed to follow-up to see how these shared understandings were carried forward in project planning.

- **How to know when a more involved public engagement approach is needed?** The approaches here are applicable to a limited number of stakeholders; too large a group would produce an unwieldy amount of data. Future work is needed to help managers know when they need an in depth approach such as the ones proposed, versus a more general approach to engage the broader public in a meaningful way. Research that engages in comparative case studies in which the central conditions of the scope of the management dilemma, the number of stakeholders, and/or the scale of the area where the dilemma is being addressed would further the refinement of the approaches described here, as well as help identify the limitations of these approaches.
- **Are different approaches more effective at addressing different types of management challenges?** Future work could test different scopes and scales of the methodologies tested here, both in terms of complexity of the problem considered and the size of the landscape in question. The U.S. method focused on a more abstract level of understanding, while the Australia method was geared towards an in depth understanding of a discrete management issue. Future work could examine whether the approaches could be successful in a range of contexts and help further identify the most appropriate approach for the types of issues facing managers.
- **Do benefits provided from engaging on particular management issues translate to other issues?** Engaging in deliberative and collaborative decision making may not only yield a successful decision making process, but also may contribute to building understanding and relationships that may be applied to other dilemmas. Further research would be needed to track these relationships and understandings (i.e., the social capital built through the process) to see if they facilitated future decision making.
- **Would these approaches be as successful in an area with a history of contention?** Future research would be needed to determine to what extent the approaches would also work to build and repair relationships that had historically been contentious.
- **Could the cognitive maps developed in the U.S. method be created in a group setting?** While effective at helping individuals clarify and articulate their perspectives on a social-ecological system and compare perspectives across maps, the process of developing individual maps was labor and time intensive. Future research would be needed to determine if similar maps could be generated by the individuals themselves in a facilitated group setting for management situations that required more immediate results.

VIII. The deliverables crosswalk table

Deliverable	Description	Status
Annual progress reports	Brief reports that describe the status of the data collection and analysis, obstacles and challenges of the project, and findings to date.	Completed
Final report	Detailed report that describes the data collection and data analysis processes, successes and obstacles in the project, study findings, innovative findings from this research and their potential management implications and ideas for future research.	Completed
Manager-oriented guidebook	This guidebook describes the principles and methods to reach agreement among a diverse set of stakeholders and decision-makers about desired future conditions that are ecologically possible at the local level	Chapter 1 (overview) completed Chapter 2 (US approach) completed Chapter 3 (Australia approach) draft Three total chapters
Peer reviewed publications	At least 2 peer-reviewed publications	In preparation
Metadata / data repository	Following JFSP policy, a copy of our metadata document(s) will be deposited with the Forest Service Research and Development Archive.	Currently working with USFS to finalize submission.

IX. References

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