Burning through organizational boundaries? Examining inter-organizational communication networks in policy-mandated collaborative bushfire planning groups

Rachel F. Brummel [a,*], Kristen C. Nelson [b], Pamela J. Jakes [c]

[a] University of Minnesota, Department of Forest Resources, 115 Green Hall, 1530 Cleveland Avenue North, Saint Paul, MN 55108, United States
[b] University of Minnesota, Department of Forest Resources and Department of Fisheries, Wildlife, and Conservation Biology, Saint Paul, United States
[c] USDA Forest Service, Northern Research Station, Saint Paul, United States

ABSTRACT

Collaboration can enhance cooperation across geographic and organizational scales, effectively "burning through" those boundaries. Using structured social network analysis (SNA) and qualitative in-depth interviews, this study examined three collaborative bushfire planning groups in New South Wales, Australia and asked: How does participation in policy-mandated collaboration affect bushfire communication networks amongst organizational representatives? Inter-organizational communication networks became more active, less centralized, and more closely connected during planning than they had been prior. However, efforts to institutionalize collaboration were intrinsically biased towards placing administrative power and influence in public agencies. Further, collaborative planning groups did not maintain "during planning" levels of network activity and structure after planning was completed. In one case, the mandated planning process had a negative impact on inter-agency communication networks. Contextual aspects such as group size, history of inter-organizational conflict and fire occurrence, and process management were important in the development of inter-organizational networks. Though communication diminished after planning was completed, participation in the collaborative planning effort may serve as an important basis for the continuation of inter-organizational relationships beyond the scope of the planning process.

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1. Introduction

1.1. Wildland fire and collaborative environmental planning

A central challenge for environmental governance is creating institutions that effectively attend to dynamic ecological and socio-organizational phenomena in the context of accelerating environmental change (Ostrom, 1990; Barham, 2001; Folke et al., 2007). One concern is that natural resource agencies are generally delineated by level of government (municipal, state, federal) and driven by specific policy directives that narrow management foci. Single-agency management may be administratively expedient, but may also emphasize organizational efficiency over managing for broader environmental goals such as watershed management, ecosystem restoration, and landscape-level biodiversity conservation (Dombeck et al., 2004). Collaborative governance models hold that networks of organizations offer the flexibility, coordination, and innovation necessary to adequately address complex management issues that single agencies cannot (Ansell and Gash, 2008). Further, building social networks may enhance resilience, adaptability, and innovation in the face of environmental change (Tompkins and Adger, 2004). In Australia, where this study took place, collaborative or "integrated" models of environmental management and planning are widely applied (Bellamy and Johnson, 2000; Margerum, 2002; Lane and Robinson, 2009). Still, organizations are challenged to balance cooperation across boundaries with the traditional notion of an organization as a 'boundary reinforcing' entity with largely independent interests. Collaborative environmental planning is a model of collaborative governance that seeks to address cross-scale complexity through multi-stakeholder approaches, and is often used when the environmental system at hand extends beyond the boundary of any given organizational jurisdiction or substantive charter. Environmental planning scholars cite the creation of new relationships, capacity to accommodate socio-ecological change, and coordination of management as the most impactful benefits of collaboration (Innes and Booher, 1999; Wondoleck and Yaffee, 2000; Booher and Innes, 2002), but changes in these elements are also the most difficult to measure (Beierle, 2002).

* Corresponding author. Tel.: +1 612 624 0702; fax: +1 612 625 5212.
E-mail address: brumm043@umn.edu (R.F. Brummel).

Wildland fire is one of those environmental phenomena that 'burn through' organizational, ecological, and geopolitical boundaries. A given wildfire may move through diversely owned land from private, to industrial, to public forests. However, coordination in wildland fire planning is complex due to the assignment of management activities – such as suppression, fuels mitigation, and biodiversity conservation – along organizational lines. These challenges are compounded by the expected impact of climate change and environmental change on global fire regimes (Pitman et al., 2007; Bowman et al., 2009; Driscoll et al., 2010); fire management institutions will need to adapt to address increases in wildland fire intensity and occurrence. Scholars propose that wildland fire planning should integrate interdependent management goals, enhancing coordination and as well as the capacity to attend to future changes in the environment through the creation of inter-organizational networks (Handmer, 2003; Dombeck et al., 2004; Stephens and Ruth, 2005; Steelman and Burke, 2007; Jakes and Nelson, 2007). Thus, collaborative wildland fire planning has grown in both the US and Australia with goals of expanding inter-organizational planning networks. In New South Wales (NSW), Australia, Bush Fire Management Committees are directed to apply the concepts of collaborative planning in Bush Fire Risk Management Planning processes. The NSW process is a part of a growing trend in natural resource management and wildland fire planning of using policy to *mandate* collaborative environmental planning. Previous research on mandated collaboration in wildland fire planning has shown that both the design of the mandating policy and the local context influence collaborative outcomes (Grayzeck-Souter et al., 2009; Brummel et al., 2010), such as the formation of inter-organizational communication networks.

This paper presents findings from an investigation of inter-organizational communication networks existing before, developed during, and maintained after the policy-mandated collaborative planning process in three NSW bushfire groups. Despite the growth of 'network-centered' literature, there are few studies that report on structured and in-depth analyses of network changes occurring as a result of collaborative planning and none that investigate the formation of inter-organizational communication networks in mandated collaboration. The research reported here poses three questions:

(1) How does participation in policy-mandated collaboration affect structural aspects of bushfire communication networks amongst organizational representatives?
(2) How do contextual issues influence the development of inter-organizational communication networks?
(3) What are the effects of changing network structures on participants, inter-organizational relationships, and bushfire management more broadly?

1.2. Research approach: social networks and the environment

Connection is a growing trend in natural resource management. Policy-makers and environmental management professionals seek to facilitate connection through the creation of social networks amongst stakeholders. In its most basic iteration, a social network "consists of a finite set of actors and the relation or relations defined on them" (Wasserman and Faust, 1994). An "actor" can be an individual, an organization, or even a nation-state. Actors form a social network when relational ties develop amongst them, and linkages serve as conduits for the exchange or "flow" of material or immaterial resources. This research investigates "communication networks" between organizational representatives around a collaborative bushfire planning process. Social networks have been found to foster learning and joint understanding (Daniels and Walker, 2001; Schusler et al., 2003; Tompkins and Adger, 2004)

and to facilitate coordination, innovation, and the integration of management activities (Pretty and Smith, 2004; Folke et al., 2005). Social network theory focuses on the primacy of social relationships in influencing behavior through providing constraints and opportunities to individuals (Wasserman and Faust, 1994; Emirbayer, 1997). As Granovetter (1985: 504) argues "Most behavior is closely embedded in networks of interpersonal relations".

Much of the recent literature suggests that the expansion of networks is necessary to improve environmental and social outcomes in environmental management (e.g. Innes and Booher, 1999; Pretty and Smith, 2004; Tompkins and Adger, 2004; Janssen et al., 2006). For example, cross-organizational knowledge exchange may improve organizational performance (Reagans and McEvily, 2003), enhance access to resources, and lead to innovated practices (Ruef, 2002). Bodin and Crona (2009) propose four network characteristics – network density, cohesiveness (measured here as average geodesic distance), subgroup interconnectivity (measured as betweenness), and network centralization – as important in influencing actors' ability to manage their relationships, as well as the natural environment. Each of these measures is operationally defined in Table 1. Greater density of relationships in networks may improve capacity for collective action (Diani, 2003), knowledge sharing, and idea creation (Sandstrom and Carlsson, 2008). Actors in networks with low average geodesic distances may be efficient at communicating information across the network quickly (Hanneman and Riddle, 2005). Groups with high network betweenness may tend to 'other' distinct groups within the networks, which may lead to unproductive deliberations (Borgatti and Foster, 2003). While high network centrality may improve coordination within a group (Sandstrom and Carlsson, 2008; Bodin and Crona, 2009), it can lead to disparities in power and influence (Diani, 2003; Ernstson et al., 2008). Further, centralized networks are focused around a few prominent individuals and may not be compatible with the complex project of environmental governance (Bodin and Crona, 2009).

This research focuses on inter-organizational communication networks – a particular form of social network – existing before, developed during, and maintained after a mandated collaborative bushfire planning process. Communication is the most common currency amongst diverse participants and is an important indication of one's degree of engagement in a collaborative planning network. Further, communication that occurs between organizational representatives during planning can have implications for wildland fire management at the organizational level. As Dal Fiore (2007: 861) writes, such "...networks are the places for boundary-spanning learning" in that they tend towards evolution of ideas, creative communication, and a sense of comparing. We investigate communication between representatives that are mandated to participate in a planning process according to organizational affiliation (see Appendix A for list of organizations); these are organizations that policy-makers have identified as being important in the context of bushfire management in NSW. The planning network examined in this research functions as an inter-organizational network because participants are directed by policy to represent their organizations during planning and are only participants in the planning process *due to* their organizational affiliation. Organizations only "communicate" in as much as individual representatives for organizations communicate; the individual representative behaves as the network actor since they communicate, share information, and actively participate in the planning process. Mandarano (2009) investigated the creation of inter-organizational networks within a voluntary estuary restoration collaborative planning process and found increased number and strength of knowledge, resources, and funding exchange

Table 1
Summary of structural social network measures used in this paper, including descriptions of the measures and potential social meaning of these measures. All actor-level measures are normalized to facilitate comparison and all measures are for non-directional networks.

Structural measure	Measurement	Social meaning
Network density	**Network:** The proportion of ties that are present amongst actors in the network in relation to the potential number of ties in a network. Expressed as a value between 0 and 1, where 1 indicates that all potential relationships exist.	A measure of *network activity* (Wasserman and Faust, 1994). A denser network can facilitate common identity and collective action (Diani, 2003).
Geodesic distance (network average)	**Network:** Geodesic distance is the shortest path between two actors in a network. Average geodesic distance takes the average geodesic distance between all pairs of actors in the network.	A measure of *network cohesion* (Wasserman and Faust, 1994). Actors in networks with low average geodesic distances can efficiently communicate across the network (Hanneman and Riddle, 2005).
Degree centrality	**Actor centrality:** The number of ties that a given actor has with other actors in the network.	**Actor-level:** A measure of *prominence, involvement, and visibility* in a network (Wasserman and Faust, 1994). The more central an actor is, the more influential they may be (Degenne and Forsé, 1999).
	Network centralization: Measures variability in individual actor degree centrality. The measure ranges between 0 and 1, and is expressed as a percent. Network centrality of 100% indicates one central actor with whom all the other actors singly interact.	**Network-level:** A measure of equal actor involvement across the network. Networks with high levels of centrality have better coordination, but may be less likely to solve complex issues.
Betweenness	**Actor betweenness:** The number of times that a given actor is on the shortest path that connects two other actors in a network. Betweenness measures how much a given actor "contributes to decreasing the distance between other actors in a network" (Bodin et al., 2006).	**Actor-level:** A measure of *interpersonal influence* and *information control* (Wasserman and Faust, 1994). Individual actors with high betweenness are vital bridges between groups or individuals (Freeman, 1979).
	Network betweenness: Measures heterogeneity of actor-level betweenness measurements in a group. Varies between 0 and 1 and is then represented as a percent, so that a network where every actor has equal betweenness measures would have a network betweenness of 100%.	**Network-level:** A measure of *modularity* – or the propensity to develop multiple groups – in a network (Bodin et al., 2006). Groups with high network betweenness may tend to "other" distinct groups within the networks (Borgatti and Foster, 2003).

relationships amongst participants. However, research on state-initiated collaborative river-basin management in Wisconsin, USA found that 10 years after initiating partnerships, half of these planning networks were no longer active (Genskow, 2009), calling into question temporal patterns in network formation and dissolution around mandated collaborative efforts. Others have found that mandated collaboration failed to enhance inter-organizational relationships, and that social networks may even deteriorate during planning if collaboration is not supported by multiple governance mechanisms (Rodriguez et al., 2007).

Social network analysis has gained prominence in environmental social science research as a means to investigate relational and structural properties of social organization around natural resource management (see Adger et al., 2005; Bodin et al., 2006; Crona and Bodin, 2006; Sandstrom and Carlsson, 2008; Mandarano, 2009). Social network analysis takes a quantitative and decidedly reductionist approach to understanding relationships by evaluating the presence, absence, and sometimes the value (i.e. frequency, strength, quality of interaction) of a relational tie. By simplifying relationships, researchers are able to measure structural qualities of a social system. However, purely quantitative analysis may overlook contextual elements and interpersonal understanding of social processes that may be better captured through qualitative methodology. Thus we interpret structural changes in social networks in light of previous research and supporting qualitative evidence from interviews.

This study makes a unique contribution to the literature by using multiple case studies with a mixed-method qualitative/social network analysis approach to examine how inter-organizational communication networks may change through a policy-mandated collaborative environmental planning effort over time,

in different contexts, and how network changes may affect organizational relationships and bushfire management more broadly. Many studies of social networks in natural resource management use single case studies or do not focus on longitudinal changes in networks. Further, mandated collaboration is still a relatively unexamined innovation in environmental management and public policy. Ultimately, the findings contribute to our evaluation of mandated collaboration as a policy tool and to ongoing discussions about sustainable wildland fire planning and policy.

2. Methods

2.1. The bushfire planning network

Bush Fire Management Committees (subsequently referred to as "committees") are created under the New South Wales (NSW) Rural Fires Act (1997) to "...provide a forum for cooperative and coordinated bushfire management in their Areas" (BFCC Policy No 1/2006, p. 1). The policy calls for the establishment of committees for each of the 44 NSW rural fire zones and identifies 16 potential committee members according to organizational affiliation, though more can be added as locally appropriate (see Appendix A for list of legislated organizations). Participation in the committee is not itself mandated, but the policy requires that all parties on the legislated list be invited. Committees are required to collaboratively create a Bush Fire Risk Management Plan (subsequently referred to as "the plan" or "the planning process"), and to update the plan every 5 years to "...minimise the risk of adverse impact of bushfires on **life, property, and the environment**" (Annex B, BFCC Policy 1/2008, p. 9). Though committees generally meet 2–4 times a year for regular business, they hold

Table 2
Organizational role in bushfire management. Representatives of these organizations are included in the analysis for this paper due to the level of their participation in the Bush Fire Risk Management Planning process for the case studies we examined. Representatives each of these organizations have been legislated to participate in the Bush Fire Management Committees or deemed appropriate planning stakeholders by the state-level Bush Fire Coordinating Committee. For a full list of organizations included in the legislation, see Appendix A.

Organization	Primary Role in Bushfire Management
NSW Rural Fire Service	Provides and oversees services regarding the prevention, mitigation, and suppression of bushfire in all rural fire districts; assists other organizations in their fire protection and response activities. Primary bushfire agency and fire authority in NSW.
NSW Rural Fire Brigades	Local, volunteer fire fighting brigades under the organization and administration of the NSW Rural Fire Service. Comprised of trained volunteers that are central to fire suppression activities in the state of NSW.
NSW National Parks & Wildlife	A designated fire authority that is responsible for management of fire on all land under its control. This organization has a policy directive for biodiversity conservation, as well as to protect life and property on their land and adjacent land from bushfire.
Forests NSW	Manages fire on its land through both suppression and hazard reduction activities and is a designated fire authority. Manages land for multiple objectives, but protecting their extensive timber production assets from bushfire is a primary management objective.
Department of Lands	Oversees and implements fire management on all Crown land in the state of NSW, including managing fire trails and organizing prescribed burning (usually done through contract). Not a designated fire authority.
Local Authority (Council)	Oversees and implements fire management on all council owned land. Also partially funds local NSW Rural Fire Service activities. Have authority to administer burn certificates landowners, but is handed over to the NSW Rural Fire Service.
NSW Fire Brigade (Fire & Rescue NSW)	Manages fire emergencies in urban areas of NSW through emergency response and fire fighting. A designated fire authority in NSW.
Nature Conservation Council of NSW	A non-profit organization that acts as an umbrella organization for community environmental groups in the state of NSW. Representatives act as volunteers in the Bush Fire Management Committee to advocate for environmental concerns.
RailCorp	State-owned corporation that operates and maintains passenger rail systems in NSW. They are responsible for fire hazard mitigation to their assets through actions like vegetation reduction along tracks and trail access maintenance.
Australian Rail Track Authority (ARTC)	A government-owned corporation that manages the track for all interstate rails in the Queensland, NSW, Victoria, South Australia, and Western Australia. Responsible for fire management in the rail corridor, including vegetation management.
NSW Farmers Association	A non-governmental organization that advocates for the interest of farmers in NSW; they represent agricultural interests in the Bush Fire Management Committee.
Energy Provider	Depending on location, a state-owned or private energy network provider that supplies energy to households and businesses NSW. Responsible for hazard mitigation on their property and around power lines.
Sydney Catchment Authority	A state government agency that manages the Sydney drinking water catchment. SCA is a fire combat agency, responds to fire in the catchment, and manages fire through activities such as prescribed burning and the maintenance of fire trails.
Mining company	A private mining corporation with large landholdings in the Illawarra zone. They are responsible for maintaining asset protection zones on their land, as well as general fire management and mitigation practices.

additional meetings during planning years, interacting more frequently and substantively during this time. All members of the committee may participate in the planning process or a subgroup may act as a standing committee to create the plan which is then reviewed by the entire committee. At the time of this study, the NSW Rural Fire Service had recently developed a new spatially explicit risk management software program to guide the bushfire planning process. See Table 2 for descriptions of organizations that were active in the planning processes in the case studies examined in this study.

For this study, the bushfire planning process is analyzed as an opportunity to create and enhance inter-organizational communication networks supporting bushfire management. In line with recommendations by Bodin and Crona (2009), this research investigates the impacts of the planning process on inter-organizational networks as indicated by changes in network density, degree centrality, betweenness centrality, and geodesic distance in planning networks (see Table 1 for definitions).

2.2. Case selection and description

We conducted case studies of three planning groups that were pilots for the new planning process (Fig. 1). At the commencement of this study, these were the only groups that had completed the planning process. The NSW Rural Fire Service selected these three committees as pilots because they represent the diversity of social contexts, ecosystem contexts, and fire risks in the state.

2.2.1. Murrumbidgee Irrigation Area zone

The Murrumbidgee Irrigation Area covers 10,432 km^2 and four local government areas in southwest New South Wales. The zone is primarily agricultural, with a system of irrigation canals in parts of the planning area. Areas that have not been altered for agriculture are primarily grassland and river red gum, a eucalypt forest type. The Murrumbidgee Irrigation Area zone's population is nearly 45,640, with four small population centers. Compared to the other case studies, The Murrumbidgee Irrigation Area does not have a
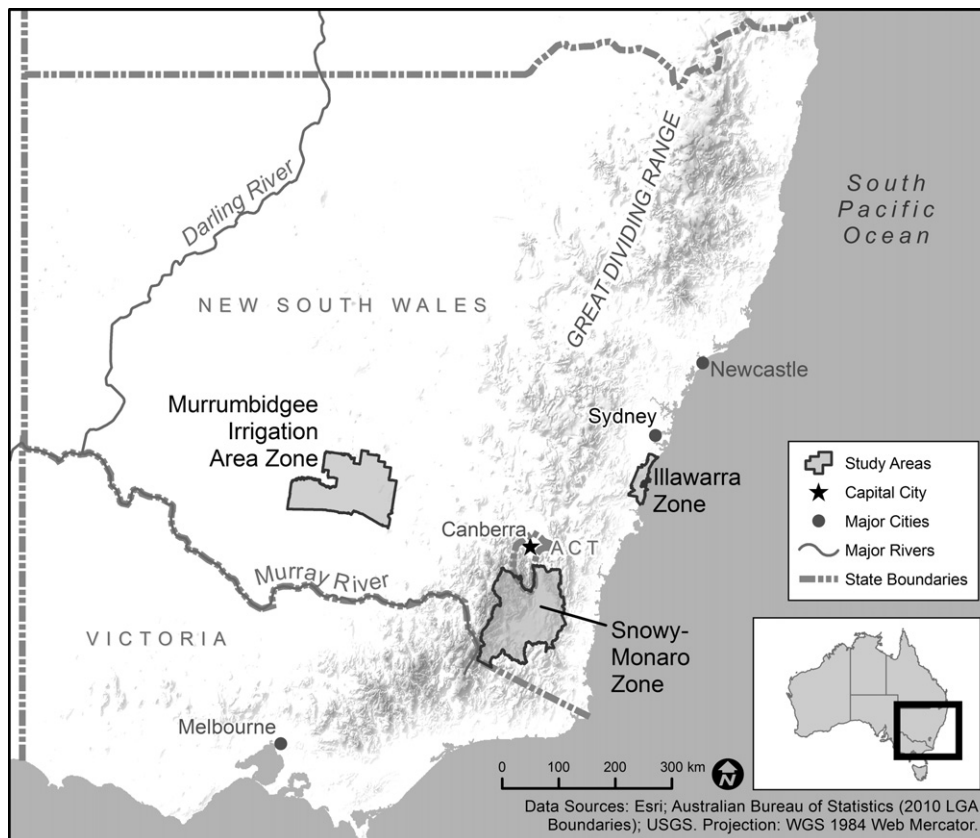
Fig. 1. Map of Australia, featuring the state of New South Wales and the three case studies of collaborative bushfire planning conducted in this study: Murrumbidgee Irrigation Area, Illawarra, and Snowy-Monaro.

history of frequent fire and is thought of as a low fire risk area. Most of the planning area is privately owned, although there are small sections of NSW National Parks, NSW Department of Lands, and NSW State Forest lands.

2.2.2. Illawarra zone

The Illawarra is a coastal area directly south of Sydney with an area of 1129 km^2 that contains three local government areas. The area is characterized by a large escarpment that runs north-south; most of the 271,500 residents of the Illawarra area live between the coast and this escarpment. The escarpment and plateau are heavily forested with dry sclerophyll forests – forests of hard-leaved trees dominated by eucalypts with an understory of shrubs – and patches of fire-sensitive rainforest refugia. The Illawarra zone has a history of large bushfires, at the time of planning the most recent of which was in late 2001–early 2002 that burned areas in the north of the planning area, both above and below the escarpment. There is a large National Park in the north of this planning area, as well as the publically managed Sydney Water Catchment Authority area that provides drinking water to the residents of Sydney. Mining companies are amongst the largest private landowners in the zone. Much of the other land is municipally owned or managed by electricity providers or the NSW Roads and Traffic Authority.

2.2.3. Snowy-Monaro zone

The Snowy-Monaro zone is an inland area of 11,259 km^2 that includes two local government areas and most of NSW's largest National Park, Kosciuszko. The landscape is quite diverse in that it contains large tracts of agricultural land, wet and dry sclerophyll forest types, and unique sub-alpine ecosystems of alpine ash and snow gum forests. The permanent population of this zone is nearly

17,000, though population increases during winter ski season and summer hiking season. The area is considered quite high in fire risk and has a relatively frequent fire occurrence. In 2003, a significant portion of the National Park and adjacent private lands burned in a bushfire that destroyed numerous structures, but claimed no human lives. More than a quarter of the planning area is managed by NSW National Parks, but there are also a number of NSW State Forest pine and eucalypt plantations. Much of the rest of the area is privately-owned and -managed.

2.3. Data collection

2.3.1. Interviews

In investigating inter-organizational communication networks, we conducted 44 interviews with committee members in the Murrumbidgee Irrigation Area (n = 11), Illawarra (n = 12), and Snowy-Monaro (n = 21) between April and July of 2008. Interviewees were active participants in the planning process (based on planning meeting attendance and/or identification by other planning participants) and represented the array of organizations within each planning group. Striving for complete coverage, we interviewed 77% of planning participants across case studies, and all of the planning participants that interviewees and facilitators identified as being the most active. The semi-structured interviews centered on understanding the planning context, process, and outcomes, while focusing specifically on changes in inter-organizational relationships. With the permission of interviewees, we digitally recorded all interviews, which ranged in length between 30 min and 2 h. Interviews were transcribed verbatim from audio and then checked by a second transcriptionist for accuracy.

2.3.2. Social network survey

To collect quantitative data on structural changes in social networks, we administered 37 social network surveys (Murrumbidgee Irrigation Area = 11, Illawarra = 10, Snowy-Monaro = 16) to participants who reported themselves as being at least moderately active in the planning process (84% of interviewees). The questionnaire asked participants to report the presence or absence of communication regarding bushfire issues with each of the other planning participants (identified by organization and name) before, during, and after the planning process.

2.4. Data analysis

2.4.1. Interview data analysis

We coded interview text for social network themes using the qualitative analysis software NVivo 8. Our coding scheme was designed to examine personal accounts of the presence, quality (e.g. improved, degraded, more frequent communication), and effect of inter-organizational relationships before, during, and after the completion of planning. We developed codes iteratively as themes emerged, and ultimately completed several cycles of coding to identify patterns across and differences between interviewees, types of organizational representatives, and planning contexts.

2.4.2. Social network analysis

We constructed a series of complete communication networks – one before-planning, one during-planning, and one after-planning – for each of the three case study groups. We symmetrized relationships so that a tie was included only if both actors it connected had reported the communication relationship as active. Using the social network analysis software UCINET 6.232 (Borgatti et al., 2002), we measured network density, network degree centralization, network betweenness centralization, and network average geodesic distance for each communication network (Table 1). We also measured node-level degree centrality and betweenness centrality for all players (Table 1). We illustrated the networks using NetDraw (Borgatti, 2002), specifying Spring Embedding configuration with node repulsion and equal edge length. The Spring Embedding algorithm utilizes iterative fitting to place nodes with the smallest path lengths closer in the network layout, while creating enough distance between nodes and placing ties so that distances between adjacent nodes are similar (Hanneman and Riddle, 2005).

3. Results and discussion

This study investigated how a mandated collaborative bushfire planning process affected inter-organizational communication networks amongst the organizations that participated. Participants created and enhanced inter-organizational networks during the planning process. Further, inter-organizational communication became less hierarchical and participants became more directly connected to each other during planning. However, inter-organizational communication dropped off to varying degrees after planning was completed. Thus, legislatively mandated collaborative planning had the *potential* to enhance inter-organizational communication networks, but with several important contingencies; contextual factors such as the conflict history, group size, process management, and the collaborative mandate design may influence the creation of cross-boundary networks.

3.1. Pre-planning communication networks

Previous research on collaborative environmental planning (e.g. Selin and Chavez, 1995; Bentrup, 2001) found that antecedents to

collaboration – such as a previous relationships or a history of antagonism – influence collaborative success. Examining pre-planning communication relationships provides a baseline of understanding important for interpreting changes in the network. The pre-planning bushfire communication network amongst committee members varied across cases, but density measures demonstrated that network activity was low or moderate (Table 3). The Snowy-Monaro and Murrumbidgee Irrigation Area groups had the most active networks, while the Illawarra group was less active prior to planning. Previous relationships were commonly forged around fire suppression and/or previous non-planning related interactions on the committee. However, fire suppression relationships were restricted to those participants that represented fire-response agencies. Centrality analyses of pre-planning networks supported interview assertions that agency representatives such as the NSW Rural Fire Service and National Parks were the central communication nodes in all three of the planning groups (Fig. 2).

While communication ties existed prior to the planning process and were largely congenial in the Murrumbidgee Irrigation Area and Illawarra, many Snowy-Monaro relationships were rooted in previous disagreements about bushfire. Tensions stemmed from the 2003 bushfires and the belief that mismanagement of the NSW National Parks contributed to their intensity. The recent bushfires, discourses of blame, and disagreements about appropriate bushfire management were the central lenses through which parties understood inter-organizational relationships.

"... Some people have had an axe to grind for many, many, many years ..." (Snowy-Monaro)

"Our whole life, whether we like it or not, is before the fires and after the fires." (Snowy-Monaro)

Thus prior to the planning process, some members of the Snowy-Monaro group perpetuated an "us-them" mentality tied to their position on fire management practices.

3.2. During-planning communication networks

This research supports previous studies which demonstrate the capacity of collaborative environmental planning to create and enhance relationships amongst stakeholders (e.g. Mandarano, 2009). During the 12–18 months of the Bush Fire Risk Management Planning process (which included between 6 and 12 planning meetings), bushfire communication networks amongst participants became more active and connected, as measured by increased network density and decreased average geodesic distance (Table 3). Participants underscored this enhanced communication in interviews.

"We have gotten together quite a lot more frequently... you get to know [planning participants] a bit better than just a face in this big meeting with about 40 other representatives that you've never met before."(Illawarra)

Thus, planning meetings were a forum to create new relationships and to re-connect with colleagues.

Theoretically, participation in collaborative planning may empower greater equality of voice and influence amongst participants and across institutional scales (Adger et al., 2005; Kesby, 2007). Though NSW Rural Fire Service employees were the most central communicators (Fig. 2), network-level degree centralization measures decreased across all groups during planning (Table 3). This shift indicates that individual node centralities were more similar – and that by this measure, actors were more 'equal' – during the planning process than they were

prior. Network-level betweenness in the Murrumbidgee Irrigation Area and Illawarra groups also decreased during planning (Table 3). Reduced betweenness means that planning group relied less on a select group of participants to act as information brokers and may be more resilient to changes in staff/representatives. In less-centralized planning groups such as these, other scholars have proposed that disparities in power and influence may be diminished (Diani, 2003; Ernstson et al., 2008) and groups may be more likely to innovatively address complex issues (Bodin and Crona, 2009). Further, studies suggest that lower network betweenness indicates the existence of fewer subgroups that could facilitate an "us-them" mentality during planning (Borgatti and Foster, 2003).

As already mentioned, local context and history have the potential to influence collaborative planning and the creation of cross-organizational networks (Selin and Chavez, 1995). Though planning committees operated under the same legislative mandate and planning processes were essentially identical, the magnitude of network transformation was variable according to critical contextual elements such as committee size, history of conflict, and recent fire. The Illawarra group saw the greatest change in network measures, potentially due to their relatively low level of pre-planning network activity (Table 3). The Murrumbidgee Irrigation Area network measures changed modestly relative to the Illawarra planning group. However, the Snowy-Monaro group showed relatively minimal network changes during planning. This may be due, in part, to a higher pre-planning communication network activity attributable to previous communication driven by the 2003 fires. However, this group also had the least active, least connected, most centralized, and most between "during planning" measurements of any group. Like previous scholars examining conflict in collaborative environmental planning (Ansell and Gash, 2008), we argue that this group owes its lower "during planning" communication network activity in part to perceived social barriers due to inter-organizational conflict around the 2003 fires.

Though structural network measures show an increasing 'equality' in communication amongst planning participants, interviews with participants revealed that increasing equality in the distribution of inter-organizational communication across planning networks did not translate to equal influence within the process. Participants singled-out NSW Rural Fire Service paid staff as the drivers of the planning process noting that "*they did most of the work.*" Though NSW Rural Fire Service staff pushed the notion of 'tenure-blind' planning and emphasized mutual ownership of plans, participants noted that this was not the reality of the planning process. The NSW Rural Fire Service owes some of its centrality to their ownership of the risk planning software, their expertise, and their administration of the planning process:

"...The large part falls on the Rural Fire Service because they've got ownership of the software... So they basically end up having to do the work on it...They don't like to say it, and they try to avoid it, but they're the people who are running the whole process...They're the leaders, they have the knowledge and resources together." (Illawarra)

Thus, as other scholars have noted "...When one organization has disproportionate control over the resources necessary to undertake collaborative activities, it gains power that others lack." (Imperial, 2005). However, the nature of bushfire management in NSW is such that – despite desires for tenure-blind or consensus-based planning – the NSW Rural Fire Service has primary responsibility for bushfire management as set in policy. Thus it is neither surprising, nor entirely unreasonable that the NSW Rural Fire Service was more central and more influential than other planning participants.

Table 3
Summary of changes in structural network measures before, during, and after the planning process.

Network measure	Murrumbidgee 11 network actors			Illawarra 10 network actors			Snowy-Monaro 16 network actors		
	Before	During	After	Before	During	After	Before	During	After
Density	0.56	0.76 (+35%)[a]	0.58 (+3%)[a]	0.38	0.84 (+124%)	0.71 (+88%)	0.61	0.69 (+14%)	0.63 (+4%)
Betweenness network centralization	18.17%	4.96% (−73%)	14.85% (−18%)	34.26%	2.73% (−92%)	7.10% (−79%)	7.52%	7.86% (+4%)	16.97% (+126%)
Degree centrality network centralization	53.33%	28.89% (−46%)	51.11% (−4%)	63.89%	19.44% (−70%)	36.11% (−44%)	37.14%	35.24% (−5%)	41.90% (+13%)
Geodesic distance (average)	1.44	1.24 (−14%)	1.42 (−1%)	1.53	1.16 (−24%)	1.29 (−16%)	1.39	1.31 (−6%)	1.37 (−2%)

[a] The percentages in parentheses indicate the percent and the direction of change for each measure as relating to the "before planning" network measures.
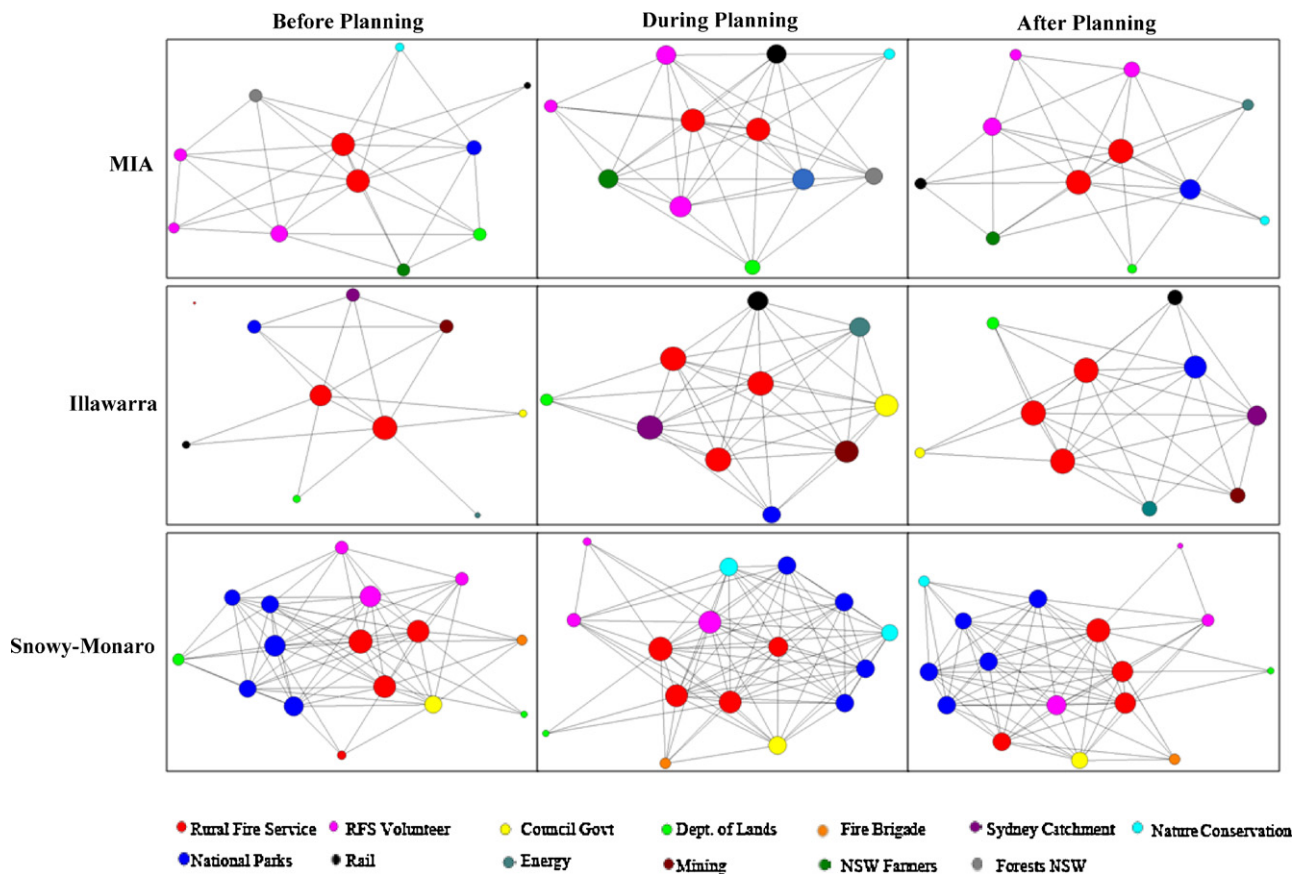
Fig. 2. Inter-organizational communication networks before, during, and after the policy-mandated collaborative bushfire planning process. Density of the network is visible through the number of ties. Node size indicates node-level degree centrality, and the variability in node size within a given graph indicates the whole network centralization. The more similar the nodes in size, the less centralized the network. Networks are visualized in NetDraw (Borgatti, 2002) using Spring Embedding configuration with node repulsion and equal edge length. Network shape is not critical to this analysis.

Collaborative partnerships often lean on agency representatives for resources and support (Bidwell and Ryan, 2006). In our study, interviewees identified a consistent list of public land-owning agencies as "major players" in terms of their influence.

"There's an executive [group] who really have the power-...made of the people who own the fire prone land, so National Parks, State Forests, and Local Government, which is Rural Fire Service..." (Murrumbidgee Irrigation Area)

This dominance may be due in part to the centrality and visibility of these players in communication network, which is one of the characteristics of actor-level centrality suggested by Wasserman and Faust (1994). However, similar to previous findings (Adger et al., 2005), we argue that this centrality may be a consequence of legislatively mandated collaboration: institutionalizing collaboration lent itself to placing certain administrative power in the hands of established public organizations. Such agencies are stable, have integrated scales of leadership, and often discussed having a greater stake in landscape-level planning since they are accountable to the public and subject to governmental audits. Conversely, non-agency representatives and volunteers found it difficult to be a driving force in this institutionalized planning process. Participants such as Rural Fire Service volunteers and volunteer representatives for the Nature Conservation Council consistently remained peripheral in communication networks (Fig. 2). Some of these non-fire professionals felt that they did not have the expertise to legitimately influence the group.

"[The risk planning process is] a lot to understand and take in when you're not working with [bushfire planning] all the time. It's bloody ridiculous. Keep it simple...it's very, very hard to understand. It was a lot to take-in in a short period of time." (Snowy-Monaro)

Thus it was challenging for volunteers to comment on any of the decisions, which – as other authors have argued (Fischer, 2000) – is often the case in technologically driven planning contexts.

Numerous studies demonstrate the importance of process elements in collaborative planning success (Schusler et al., 2003; Ansell and Gash, 2008), including facilitation, open communication, and democratic process. In these case studies, collaborative process and process management contributed to the centrality and influence of the NSW Rural Fire Service and reduced opportunities for direct inter-organizational engagement of other organizational representatives during planning. Groups were provided a planning template created by the NSW Rural Fire Service that defined goals, and set a specific path for the planning process based upon identifying assets at risk, estimating risk, and then assigning a hazard treatment. Participants in all groups described a process where each land-owning organization provided information on their property to a Rural Fire Service staff member, who then compiled the data. Scholars underscore the importance of bridging organizations for supporting and lowering the cost of collaborative planning processes (Folke et al., 2005). While our structural data hinted that the NSW Rural Fire Service may be operating as a bridging organization since they are the most central in the network and connect multiple stakeholders (Fig. 2), interview data

clarified that the NSW Rural Fire Service acted more as a pooling organization. For example, Rural Fire Service representatives were consistently the most central players structurally according to centrality measures (Fig. 2). However, participants indicated that many aspects of planning were consolidative, with each representative providing data on the land they managed to one NSW Rural Fire Service administrator.

"Well, the process is, basically, we're feeding the information that we want into the employed staff. And it's [Rural Fire Service employee's] interpretation. If [Rural Fire Service employee] has questions [they'll] come to ask people but [Rural Fire Service employee] is basically driving it." (Snowy-Monaro)

While pooling tasks within one organization may have facilitated the creation of a strategic planning document, it did not foster collaborative goal-setting, creative dialogue, or innovation on the local level, found by many to be hallmarks of successful collaboration (Gray, 1989; Innes and Booher, 1999; Margerum, 2002). However, again, we recognize the centrality of the NSW Rural Fire Service in the administration of the planning process is a function of their pivotal role in fire management in the state, as well as their capacity to dedicate resources and professional staff to the planning process.

The collaborative process also influenced who were and who were not the primary players, as well as the ways representatives engaged with each other during planning. In planning committees, the rationality of the asset-based planning framework compounded the centrality and influence of public-land-owning agencies (Fig. 2), diminished centrality and influence of volunteers and non-land owning organizations (Fig. 2), and focused participants on their own land rather than on the consideration of landscape-level concerns. While the NSW Rural Fire Service designed the planning process to be tenure-blind, many landowning participants only commented on their "own bit" and many non-landowning participants did not feel justified in commenting at all. The asset-based process focused participants on the assets within tracts of land that were "owned" by the representative who managed them. One participant described the interactions within the planning process in terms of "working for the [agency] badge". Non-agency representatives were generally unquestioning of land-managers' expertise and trusted others to know their own land.

". . .People. . .were quite happy to just sort of [say]. . .they know that area, they know that patch of ground. . . they were quite happy to take the dialogue at the face value." (Illawarra)

Given the practice of engaging primarily with the land that participants represent, non-land-owning entities did not have strong voice or influence in planning:

"I watch, yes, I observe. My input is minimal. . .People don't tend to cross over into other people's areas. . .. I wouldn't get involved in it because it's not my right to or field to do it." (Snowy-Monaro)

Representatives of non-landowning interests often were not included in asset-related steps of the collaborative planning process.

"Now all of that sort of stuff on identifying. . .key assets. . . [agency representatives] came with having done a lot of work on that before they ever came to the committee. . .So they know these things and they all readily agreed. . . they all understood it, whereas I didn't. . ." (Snowy-Monaro)

Often, participants with opportunity to comment on other representatives' land bases were simply not concerned with actions outside of their management boundaries:

"To be blunt, what happened beyond the [land I manage] doesn't really worry me. You know, if they assessed a town away from [the land I manage] as an extreme risk and I don't think it is . . .I'm not going to raise that as an issue." (Snowy-Monaro)

Thus, planning was a task-based process where focal points were the planning document and the land which it covered, which arguably diminished opportunity and motivation for some participants to meaningfully engage with others during the planning process.

3.3. After-planning communication networks

Though the creation of relationships is often put forth as one of the most intangible, but long-lasting benefits of collaborative planning (Innes and Booher, 1999), our findings indicate that approximately 2 months after completing the bulk of the planning work, the planning process had varying degrees of influence on bushfire communication networks (Table 3). For all groups, the "after planning" bushfire communication network was less active, more centralized, and more heterogeneous than during the planning process. These findings highlight the often over-looked temporal dynamics of social networks in collaborative planning. By evaluating multiple stages in planning, the longitudinal changes in inter-organizational relationships start to become clear. In the Murrumbidgee Irrigation Area, for example, though network activity was enhanced during planning, structural aspects of the network (density, centralization, average geodesic distance) before and after the process were similar (Table 3), suggesting that the planning process may not have had broad and lasting effects on inter-organizational communication networks in this case. However, we find some qualitative evidence that, in some cases, interaction occurring during the planning process may enhance the propensity for planning participants to communicate in the future even if participants had not yet acted to maintain these communication networks at the time of our study.

The Snowy-Monaro group actually saw deterioration in certain network measures after planning. The post-planning communication network was more centralized and had considerably higher betweenness measures than before or during the planning process (Table 3). While the post-planning communication network was slightly denser and participants were somewhat closer to each other than before planning, the increased centrality and betweenness measures suggest that a few members became more important to the planning group, while others became more peripheral. Longstanding disagreements about fire management and the antagonistic 'othering' of participants – a well-documented barrier to collaboration (Gray, 1989; Margerum, 2002; Ansell and Gash, 2008) – was likely a barrier to meaningful and lasting communication.

The Illawarra group maintained the complex network they had gained during the planning process to a greater extent than any other group (Table 3). Their communication network was 88% more dense after planning than it was prior. This increase in network activity may improve capacity for collective action across organizational boundaries, as suggested by other scholars (Diani, 2003) and emphasized by planning partners.

"For me, [the planning process was] also getting those contacts. I could easily ring up any person in this committee and just chat about an issue and resolve something or cooperatively do something."(Illawarra)

Similarly, the network was 44% less centralized than it was prior to the process, meaning that communication was more equal across

participants, rather than there being a few key communicators in the group. Further, the group had 79% lower betweenness, and diminished average distance between planning participants after the process than when it began (Table 3). All of these measures indicate that members of the Illawarra planning group were more connected to each other after the process than they were when the process began. Context, including a smaller planning committee size, influenced the Illawarra group towards maintaining these network characteristics more than the other planning groups. The small group size of the Illawarra group likely contributed to enhanced network outcomes since participants had fewer people with whom to maintain relationships. In contrast, the Murrumbidgee Irrigation Area and Snowy-Monaro were larger planning groups that included all members of the broader bushfire committee. Scholars caution against the kind of centralized approach that funnels all collaborative activities through the same structure (used in the Murrumbidgee Irrigation Area and Snowy-Monaro) as it can increase transaction costs by involving non-relevant participants without providing them benefit (Imperial, 2005). This might be avoided by creating a smaller planning subgroup as the Illawarra group. However, designating a boundary around collaborative membership can be contentious and creating a smaller group may also mean reducing representational diversity. Thus, groups should be aware of balancing smallness with diverseness so as not to exclude critical participants, especially since some scholars have found that *increasing* number of different types of stakeholders leads to greater belief in the legitimacy of collaborative governance (Schneider et al., 2003). However, reducing the number of participants from any *one* organization may diminish "us-them" mentality that can emerge within collaborative planning (Imperial, 2005).

3.4. Effects of network changes

Qualitative accounts by participants added richness to social network analysis findings by enhancing understanding of the effects of some of these structural network changes on participants' inter-organizational relationships. Previous research has shown that consensus-based processes can lead to both positive and negative changes in participants' perceptions of the process and the substance of the issue hand (Schively, 2007). Whether a participant evaluated the process as positive, neutral, or negative varied primarily by group, and was tied to contextual factors such as planning group size, the salience of fire as a management concern, and the history of inter-agency conflict.

Most participants in the Murrumbidgee Irrigation Area and the Illawarra and several in Snowy-Monaro viewed the effect of the planning process on bushfire management and inter-organizational relationships as positive. Participants spoke about the process resulting in greater unification of the group.

"...This has happened in this way that everybody comes together and we can all work for a common cause; there's uniformity there, commonality." (Murrumbidgee Irrigation Area)

Focusing on the importance of communication, participants created a more extensive network that they believed they would draw upon beyond the process:

"[The planning process has] given us a very, very close communicative stream for quite a period of time. I think now that we've established that, it will be reasonably easy to maintain." (Illawarra)

So while some participants may not have maintained relationships in the months directly after planning, they felt confident they could maintain relationships long-term.

Similar to Brummel et al.'s (2010) findings regarding US collaborative wildfire planning groups, NSW participants indicated that communicative learning – or learning about motivations and values (Mezirow, 1994) – provided a better understanding of why other organizations do things the way they do, the basis for other players' diverse perspectives on bushfire management, and policies that dictate others' approaches to bushfire.

"I think it's probably given all agencies a better understanding of each other's roles and responsibilities and objectives, which...makes it easier to work with other agencies when you understand where each other is coming from...So I think from that perspective, we all would have learned from each other and that's really valuable."(Illawarra)

Also similar to studies in the US (e.g. Brummel et al., 2010), NSW participants emphasized the importance of inter-organizational coordination as a planning outcome, but qualified that they did not innovate substantive management practices, as many theorists put forth that collaborative planning often can (Innes and Booher, 1999; Wondoleck and Yaffee, 2000).

"So . . . as I said. . . [planning] didn't necessarily move the focus from us working along the lines of what you would probably normally do."(Snowy-Monaro)

These participants saw the planning process as simply formalizing already-existing fire management approaches on paper, which is a common phenomenon found in other collaborative planning studies (Cheng and Daniels, 2003; Bidwell and Ryan, 2006). Thus, the planning mandate connected people and tracts of land, but did not push participants to innovate or integrate views on wildland fire management across the landscape.

Some planning participants were more conservative when evaluating the impact of the planning process on bushfire management and on inter-organizational relationships. Snowy-Monaro participants most commonly expressed a moderate view:

"Generally I don't think I've got any better or worse relationships out of this." (Snowy-Monaro)

Others in the Snowy-Monaro group felt that relationships did not change because of intractable perspectives on bushfire management:

"No, I don't think [relationships changed]...there is some underlying philosophical differences in the way people view things..." (Snowy-Monaro)

These and other findings suggest that more transformative social change in highly contested contexts is probably not achievable within the span of a single planning process.

Several Snowy-Monaro representatives were negative about the effects of the mandated planning process on inter-organizational relationships in their zone. These participants saw planning as an extension of the conflict that grew out of the 2003 bushfires. A number of the NSW Rural Fire Service volunteers and some staff were emphatic that the National Parks should be doing more hazard reduction burning within the parks, which reflects broader competing discourses in Australia (Whittaker and Mercer, 2004).

"...We want to get back to good serious broad-acre burns...A farmer on this side [of the park boundary]...has to manage [his country] and run it productively to make a living. He can't just put a fence up and shut it up." (Snowy-Monaro)

However, there is disagreement, both in the scientific community and the fire management community, as to the

efficacy of burning to reduce fuels in Australian alpine and sub-alpine forests. Some scientists suggest that burning actually increases fuel loads due to re-growth of the brushy layer (Fernandes and Botelho, 2003) and that frequent burning reduces biodiversity and ecological value in eucalypt forests (Gill, 1981; Whelan et al., 2003). This tension between conservation and hazard mitigation posed a challenge for National Parks representatives:

> "...under our act, we've got an obligation ... to make sure that we don't have fires escaping out of the park...But also we've got our role to make sure that we're protecting the flora and fauna species....That was the thing I was involved in: trying to get a balance between looking after the flora and fauna values and looking after life and property."(Snowy-Monaro)

Though NSW National Parks representatives pushed back on others' calls for more burning due to their concern for ecological values, they noted that they did not have much political leverage in the planning process because of finger-pointing relating to the management of 2003 fires. According to several interviewees, though fire scientists said the National Park should cut down on burning after the fires to let the forests recover, their plan contained five times more proposed prescribed burning hectares on National Parks land than in any previous plan. As one National Parks representative said:

> "But the basic reason for it is we can't argue "no" any more. It's kind of suicide politically."(Snowy-Monaro)

Wildland fire is often a catalyst for social conflict (Carroll et al., 2006), so it is not surprising that the Snowy-Monaro group saw recent fires contributing to intractability in the planning process.

Though the planning process provided a forum for interaction, several participants were unsatisfied with the content of the final document. Some NSW Rural Fire Service volunteers attributed what they saw as an unacceptable planning outcome to the varying perspectives on fire management amongst the National Parks, the Rural Fire Service, and Rural Fire Service volunteers. They articulated conflicts or contradictions between academic knowledge and local knowledge when trying to make sense of why the process did not accomplish what they hoped it would:

> "It's due to too many academics putting plans like this together without consulting people on the ground.... Everybody wants a plan or they want to put something on paper before they can approach things or do things, you know? They can't just do it off their own bats. And we understand that too, but you don't need something like this."(Snowy-Monaro)

However, some interviewees pointed to other participants' approach to engaging during the process, saying that the diverse group failed to come to a shared understanding of fire management because of their more narrow, organizationally specific view of what it meant to collaborate:

> "...They come at it with their own issues, with their own concerns... they're too busy looking at their own patch and not looking at the big picture...This was a negotiation process."(Snowy-Monaro)

Some Snowy-Monaro participants believed that the planning process divided participants more than it united them. This sentiment was emphasized mostly by Rural Fire Service volunteers:

> "If anything...I'd say [the planning process is] just another nail in the coffin if you ask me."(Snowy-Monaro)

Participants went on to express the intractability of the conflict saying

> "...They've always argued and they will continue to argue" (Snowy-Monaro)

and suggested that mandating the planning process will not resolve differences:

> "Yeah...there is always going to be conflict when you get different agencies in. You might discuss it and just because you want to do such and such a thing doesn't mean the other side is going to want to do it that way."(Snowy-Monaro)

Acknowledging the challenging relationships, some Snowy-Monaro participants framed the process more optimistically:

> "I don't think you should look at it as a negative. I think you should look at it as a positive and see what you can achieve out of this, and if you can't achieve it this time, then you make sure you do it next time." (Snowy-Monaro)

In contentious contexts "success" may be viewed as a long term process rather than an immediate outcome of collaborative planning, particularly with inter-organizational relationship-building. However, because this is a recurrent planning process, small progress and new relationships may enhance the potential for improved inter-organizational networks in the future.

4. Conclusions

Policy-makers in NSW, Australia met the trans-boundary complexity of bushfire with a legislative-mandate for collaboration that was designed to create an inter-organizational, landscape-level bushfire plan. This research demonstrates that such a legislative mandate can 'burn through' organizational boundaries to foster inter-organizational communication, but in ways that are modified by contextual factors and time. However, in groups with a history of conflict, planning mandates may have limited and – by some measures – negative effects on inter-organizational communication networks. Furthermore, efforts to institutionalize collaboration may be intrinsically biased towards placing administrative power and influence in public agencies. Though representatives for public-land agencies were the most influential across all groups, they largely avoided commenting on management outside of their tenure boundaries. In this way, the participants generally maintained a conservative view of individual agency authority despite state-level policy calling for a "tenure-blind" approach. The bushfire planning framework also fueled this predisposition towards greater influence of public-land agencies and lack of influence of non-land managers by making assets on the landscape the focal point of the planning process. This dynamic demonstrates the practical challenge of power-sharing and cross-jurisdictional planning within governmental frameworks that hold individual agencies accountable and responsible for decisions created collaboratively.

Policy-mandated collaborations may produce more consistent social network outcomes and may be more adaptable in the face of environmental change by creating a structure flexible enough to accommodate the local political, social, and ecological context. We must be careful not to view network structure as simply a pre-cursor to collaboration, but an effect of local context, dominant discourses about natural resource management, and basic difference between players. In reoccurring collaborative planning processes, policy-makers should be aware that one negative planning process may threaten the viability of future efforts (Imperial, 2005). Further, in situations where central authorities

supply standardized templates, planning frameworks should enhance the relational aspects of planning to encourage periods of open dialogue, joint goal setting, and opportunities for conflict management. This is not to propose that group should each invent their agenda from scratch; research has shown that mandated collaborations need to be supported by additional governance mechanisms such as top-down rules (Rodriguez et al., 2007). Policy mandates can set specific and achievable planning objectives for the groups to guide planning on the local level.

Just as important as acknowledging each unique planning context is recognizing the potential limitations of collaborative planning. Many groups may not be amenable to the social engineering that policy-mandates may hope to accomplish; there are significant barriers – such as inconsistent missions, budget-ary responsibilities, and resource limitations (Imperial, 2005) – that a mandate may not overcome. Thus many scholars caution against forcing collaborative processes where there is a high likelihood of failure (Gray, 1989; Imperial, 2005). However, with wildland fire planning, collaboration is necessary to protect lives, infrastructure, and natural resources. Policy-makers may not have the luxury of exercising discretionary caution about when and where to mandate collaboration. Again, maintaining contextual flexibility in the policy will allow groups that are capable of pushing the boundaries of their organizations to innovative and highly contentious groups to identify mutually agreeable actions directed towards achieving the policy-defined planning objectives that can be built upon in future planning efforts.

Though we cannot speak directly towards on-the-ground management outcomes, there are many aspects of this inter-organizational mandate that worked well and provided benefits to participating organizations which may enhance bushfire man-agement in NSW. The policy creates a formal and reliable forum for interaction that may not otherwise occur; while this may not lead to transformation of wildland fire management, it does lead to the creation of a strategic, action-oriented, plan in areas that are susceptible to potentially devastating bushfires. Further, the communication that occurred between organizational represen-tatives during the planning process may serve as a basis for future interaction, even if we did not capture this communication occurring with our social network analysis. Additionally, the 5-year plan renewal promotes maintenance of inter-organizational ties on a longer time-scale and gives groups repeated opportu-nities to build communication networks that are central to promoting adaptable governance in uncertain and changing fire environments.

This study contributes to international discussions on sustain-able wildland fire policy by highlighting that collaborative planning has measurable effects on inter-organizational wildland fire communication networks. In an issue as contingent upon coordination as wildland fire management in a changing climate, consideration of the impact of policies on inter-organizational relationships is not simply an added benefit, it is a necessity. Policy-makers should not only explicitly investigate the potential impact of any policy on relationship-building across boundaries, but also make cross-boundary relationship-building a policy goal, particularly in the context of global environmental change. Our research suggests that mandating collaboration may be an effective policy strategy to achieve strategic, cross-tenure fire planning, but can also have unintended and sometimes negative consequences on relationships. Ultimately, relational outcomes will be colored by local social and political history, personality and leadership, and ecological context. Regardless of the substantive context of mandated collaboration, policy-makers have the challenging task of balancing flexibility to accommodate both local context and environmental change, with governance mechanisms that provide administrative support and political guidance.

Appendix A. Membership of Bush Fire Management Committees, as prescribed by the New South Wales Rural Fires Act of 1997

(1) Local authority, (2) Roads and Traffic Authority, (3) Depart-ment of Lands, (4) NSW Fire Brigades (Fire & Rescue NSW), (5) NSW Police, (6) Electricity network provider, (7) Rural Lands Protection Board, (8) RailCorp, (9) Australian Rail Track Corporation, (10) National Parks and Wildlife Service, (11) Forests NSW, (12) A person representing the local authority's functions respecting the environ-ment, (13) Nature Conservation Council of New South Wales, (14) One or two people from Rural Fire Brigades (volunteers), (15) Rural land holder nominated by the NSW Farmers Association or local authority, (16) each Local Aboriginal Land Council.

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