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A preliminary assessment into the utility of social networks for engaging local communities in climate adaptation policy

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Adaptive Communities Node subproject:

Understanding and improving the community-policy-science interface in New South Wales to promote the uptake of climate adaptation options

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TABLE OF CONTENTS

TABLE OF TABLES

TABLE OF FIGURES

EXECUTIVE SUMMARY

There has been a growing recognition regarding the use of social networks to engage the community in government actions. However, despite increasing awareness about the potential importance of social networks, there is very limited evidence for their application in relation to climate policy. This study addresses this gap by assessing the potential of social networks for engaging local communities in climate adaptation policy, drawing on a case study of the Shoalhaven region in Australia Participants from key representative groups were recruited using a purposive snowball sampling technique (N = 24). By mapping the knowledge networks (both in terms of knowledge acquisition and diffusion) in relation to climate adaption at the local scale, this study identified key nodes within the networks where information was shared.

Findings demonstrate that that although climate adaptation information was acquired from a diverse range of sources, the sharing knowledge networks were far more dispersed. Furthermore, although 165 knowledge sources were identified through surveys, only three nodes had coverage cross the entire network, and as such acted as boundary spanners within the sharing network.

One of the key findings of the study is the limited pathways for disseminating climate change information, which provides useful insights for policy but raises as a new challenge as to how to respond to these limited pathways within a policy context. This challenge will be a key focus for subsequent phases of the project, however it is possible to draw out some initial insights from existing literature on this topic. The more social ties the greater possibility for joint action and collaboration. A high degree of trust within a network also facilitates interaction and collaboration which is important for both information transmission and deliberation. Increased levels of collective action can also promote development of knowledge and understanding through exposure to new ideas and increased levels of information.

This research demonstrated the utility of social network analysis (SNA) to reveal the underlying knowledge networks and structures which influence community engagement pathways, and in doing so outlined the key implications in relation to engaging local communities in climate policy and action. The findings demonstrate there is potential to astutely engage the existing networks for community engagement tasks for which they are already well suited, namely, relatively simple information about specific hazards and responses to those hazards. When it comes to more complex issues, it may be more appropriate to foster new avenues, rather than rely on the existing social network system. As the acceptance and uptake of strategies are contingent upon local communities, this approach of mapping knowledge networks using SNA provides much needed insight into this process.

The degree to which these findings are unique to the Shoalhaven region or representative of the style of social networks that exist in other rural and regional communities throughout NSW, and Australia more broadly, should be the focus of future case study research and analysis.

1 INTRODUCTION

Anthropogenic climate change is widely recognised as a global threat to natural systems, human populations and economies. Despite global efforts to ameliorate these concerns via the mitigation of greenhouse gases, historical and ongoing emissions mean that some impacts from climate change are now unavoidable (Solomon et al, 2009). Accordingly, the scientific literature has identified the increased importance of adaptation for managing the now unavoidable impacts of climate change (Bassett and Fogelman, 2013). In turn, this has resulted in the development and implementation of a range of adaptation policies and programs globally. Underpinning the success of such policies, however, is their acceptance and uptake by local communities which to date remains a significant challenge (Sutton and Tobin, 2011; Schweizer et al, 2013).

The literature identifies a number of underlying causes in relation to the difficulties associated with engaging local communities in climate policies and programs. For example, several studies have demonstrated the difficulties many people face identifying the importance of climate change to themselves, instead believing that it is an issue for other communities and future generations (Lorenzoni and Pidgeon, 2006; O'Neill and Hulme, 2009). Furthermore, there is a widening gap between the public's awareness of what action is needed and what actions are being taken (Schweizer et al, 2013). This is problematic in that without an understanding about what to do, individuals may be left feeling overwhelmed and/or frightened, or even ignorant to the issue through denial (Moser and Dilling, 2004). Finally, recent studies have also demonstrated a lack of trust among communities in climate science and policy, resulting in individuals misinterpreting or even refuting the information being provided (Levistan and Walker, 2012). Accordingly, identifying options to overcome these barriers to engage local communities in climate action will be critical to the success of future climate initiatives.

In recent times there has been a growing recognition and discourse regarding the use of social networks to engage the community in government actions. (Westerhoff et al., 2011). This is because strong social networks have been shown to improve collaborative governance processes by facilitating the generation, acquisition and diffusion of different types of knowledge and information (Dowd et al., 2014; Burch et al., 2014; Joyce et al. 2013; Bodin, and Crona, 2009), overcoming many of the traditional barriers associated with knowledge sharing. For example, social networks are believed to be more flexible than most top-down communication strategies, typically implemented by governments or other institutions. As such, using social networks to disseminate information allows for messages to be tailored according to individual or community perceptions and attitudes, and the tailoring of messages will naturally occur as information is shared throughout the network. Furthermore, using social networks to engage the community in climate policy should prove advantageous as the information being disseminated is likely to be trusted and accepted by individuals within the network, prompting individual and collective action (Chomsky, 2012; Pfeffer and Carley, 2012). Finally, using social networks to engage local communities is advantageous given the speed and ease in which information can be disseminated, for example, through the use of social media networks such as Facebook or Twitter (Acar and Muraki, 2011; Vroegindewey, 2011).

Despite increasing awareness about the potential importance and benefits of using social networks to engage communities in climate policy, there is very limited evidence or proof

of their application. Therefore, the aim of this study was to assess the utility of social networks for engaging local communities in climate adaptation policy. We do so by mapping the knowledge networks in relation to climate adaptation at the local scale, in order to identify key nodes within the networks where information is shared. These networks involve informal links which have been recognised as playing an important role in information sharing, particularly at sub-national scales (Westerhoff et al., 2011). Doing so also allows us to provide a preliminary assessment into the effectiveness of utilising social networks for community engagement in relation to climate policy, which could have wider application to other environmental policies or programs in which stakeholder engagement is paramount (e.g. Cvitanovic et al, 2013).

The study forms part of a research project focused on understanding and improving the community-policy-science interface in New South Wales to promote the uptake of climate adaptation options, within the Adaptive Communities Node includes a wider suite of research outputs (Measham et al., 2014).

2 METHODS

2.1 STUDY AREA

This study was undertaken between March and April 2014 in the Shoalhaven region on the New South Wales south coast, approximately 160km south of Sydney, Australia. European settlement in the region dates from 1822 when land was taken up near the mouth of the Shoalhaven River and was progressively cleared for agricultural and forestry purposes. Today, the Shoalhaven region is a growing residential and tourist area, encompassing an area of 4,531km^2 including substantial areas of national park, state forest, bushland, beaches and lakes. The current population of the Shoalhaven region is 97, 694 people (density of 0.22 people per 0.01km^2 - ABS, 2014), concentrated along the coastal fringe, in major centres and numerous small settlements. Rural land is still used primarily for dairy farming, beef cattle, nurseries, and a growing number of more intensive agricultural activities. The area has a strong light manufacturing industrial base including goods such as paper, starches, ethanol, cheese, boats, avionics, building products, surfboard and surf-wear. The main sectors of employment within the Shoalhaven region are manufacturing, government (including Defence), retail and tourism. These sectors are supported by building and construction, community services and education (ABS 2014).

2.1.1 Sampling design and data collection

We used qualitative social network analysis (Scott and Carrington, 2011) in order to identify the formal and informal social networks in relation to the sharing and acquisition of adaptation information in the study area. Data was collected using semi-structured interview questions, focusing on where participants accessed climate adaptation information and with whom they share this information. Participants were asked to describe each of the sources mentioned (e.g., websites, magazines, mass media, government or research institutions or individuals). In the instance of an individual being identified, details including their full name, gender, and where possible, role and location were requested.

Participants were recruited using a purposive snowball sampling technique, which allowed the research team to select participants in a strategic manner to ensure that those sampled were relevant to the research (Bryman, 2012). This approach has been identified as particularly useful for overcoming some of the logistical constraints associated with sampling large and geographically disparate communities, such as those characteristic of the Shoalhaven region (Noy, 2008). The initial interviews were with 12 participants from key government agencies responsible for the implementation of climate adaption policies in the Shoalhaven region. These participants were representative of senior management and their responses started to identify formal network actors. In order to identify the informal network actors, we interviewed a further 12 representatives from key climate community groups within the region, who were identified using web searches on key words such as ‘Shoalhaven council’ and ‘climate community group’. At the completion of all interviews, participants were asked to suggest others they believed would be relevant to the study. In total, 24 interviews were completed. To ensure accuracy, all interviewees were asked if the interviews could be audio-recorded, with all but one interviewees agreeing to this request.

2.2 DATA ANALYSIS

All social networks are made up of a series of interconnected individuals, and as such they are considered as having a social structure (O'Toole, 1997). Accordingly, research focused on understanding and describing social networks has identified a number of important features (Bodin et al, 2006), which can be identified through dedicated social network analyses software packages. In the present study we utilise UCINet, a program specifically developed by Analytics Technologies for social sciences to undertake SNA (Borgatti and Freeman, 2002). While other analysis tools were available (e.g. Clunn et al, 2013) , UCINet was selected on the basis that it provides a wide range of analysis options, including some which are unique to this program, but highly relevant to the questions posed in this study (e.g. multiple cohesion measures). KeyPlayer software was also used to help identify the key nodes within the social network responsible for knowledge dissemination.

Responses from the interviews were used to create affiliation and attribute data which included name, gender, location and affiliation. All of the entities identified through the interviews (i.e. individuals, websites, media, etc) were placed into symmetric (undirected) matrices and analysed for a number of specific features. We calculated values for network cohesion which included average degree (the average number of ties attributed to each node), average distance (average geodesic distance amongst reachable pairs), closure (measure of the completeness of relational triads), components (number of cliques), density (number of ties divided by the maximum number possible) diameter (length of the longest geodesic across the network) and fragmentation (proportion of pairs of nodes that are unreachable). These measures were selected specifically due to the research question and design. For example, social networks with higher levels of cohesion mean that nodes within the network are more connected to each other. Higher cohesion in a social network would mean that it would be easier for knowledge to flow through the community.

The social network visualisation tool NETDRAW was used to develop sociograms based on the original social network and group composition network matrices resulting from the UCINet analysis. For the purpose of reporting, the layout of the figures is constrained by Euclidian distance, with the more central nodes being located at the centre of the image.

3 RESULTS

3.1 ACCESSING CLIMATE INFORMATION

In total, the 24 participants interviewed in this study reported a total of 165 entities from which they obtained their climate adaptation information (inclusive of the participants themselves). Of these, 12 were international entities, 45 government entities (either local, state or federal), 14 Non-Government Organisations, 25 Community based organisations, 23 mass media entities (e.g., tv, radio, newspaper), 12 mass communication channels (e.g., internet, mobile), 5 social media outlets, 6 research organisations, and 16 other entities, such as individual community members. Figure 1 shows the entire climate information access network. Nodes are coded for affiliation by colour and for degree by size.

When analysing the cohesion of this network, the average degree of each node was 2.558, with an average distance or reach for each node was 4.417. This means that on average, each node had ties to 2.5 alternate nodes, and through these alters could reach up to a further 4.4 alters. There was only one component and 0 fragmentation in this network which had a diameter of 9 (diameter meaning that it took only 9 nodes to make a path through the network) with a degree of closure of 0.15 (for full cohesion measures please see the following Table 1).

Table 1 Full Cohesion measures Shoalhaven network "Where do you find your climate information?"

1	Avg Degree	2.558
2	H-Index	9
3	Density	0.016
4	Components	1
5	Component Ratio	0
6	Connectedness	1
7	Fragmentation	0
8	Closure	0.015
9	Avg Distance	4.417
10	SD Distance	1.417
11	Diameter	9
12	Breadth	0.739
13	Compactness	0.261

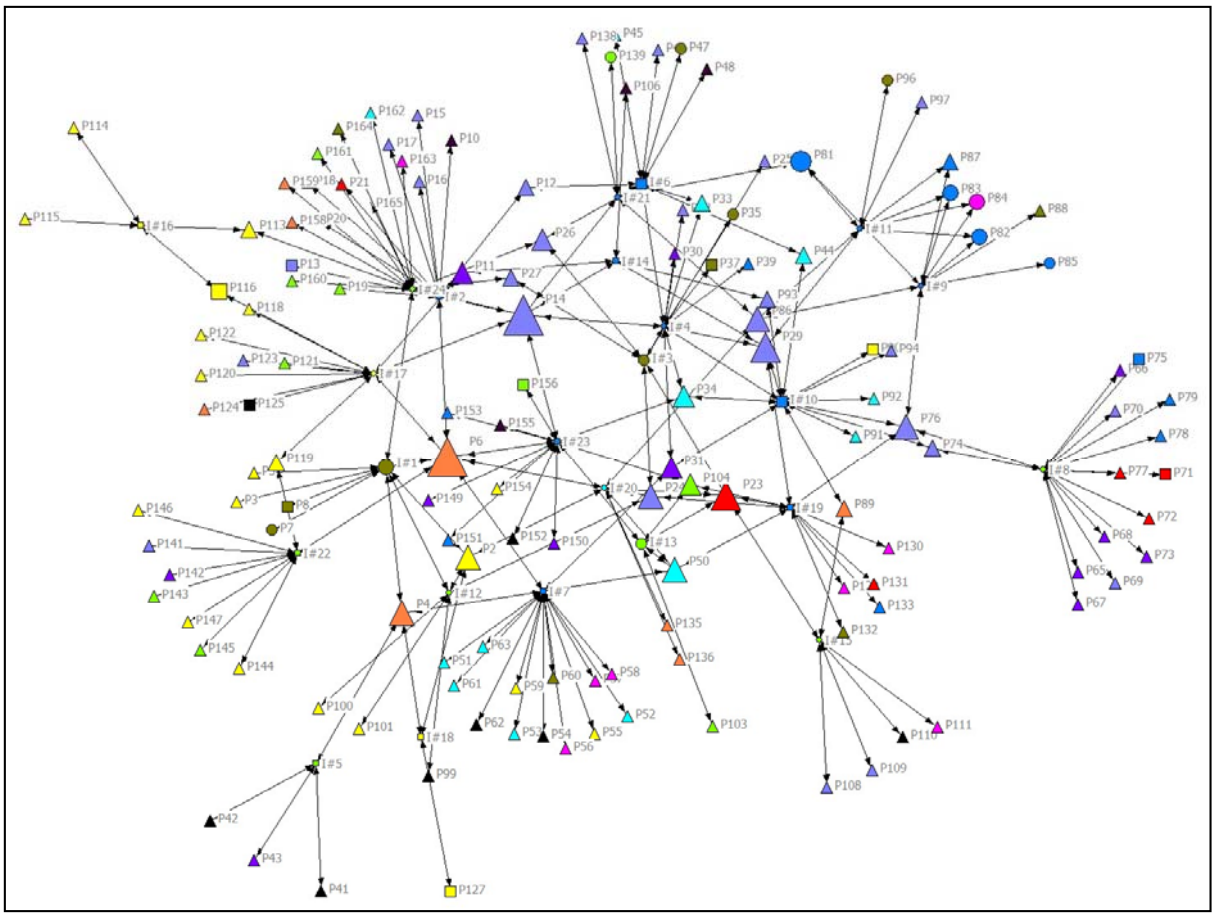

Figure 1 Shoalhaven network "Where do you find your climate information?"

Legend		
Node shape denotes gender:		
Female = Circle	*Male =Square*	*Not applicable = Triangle.*
Node size denotes popularity or the number of times the node was mentioned by other participants:		
Small node = less mentioned	*Large node = most mentioned.*	*Small node = less mentioned*
Node colour denotes the type of org:		
International = red	*Federal Government = orange*	*State Government = yellow*
Local Government = green	*NGO = light blue*	*Community Based Organisation = blue*
Mass Media (tv, radio) = indigo	*Mass Communication Channels (internet, mobile sms) = violet*	*Social Media = magenta*
Research Centre = black	*Individual = kaki*	*Other = Deep burgundy*
Political party = forest green		

Further exploration of the data through Keyplayer demonstrated there were 3 key nodes in each scenario as outlined in Tables 2 and 3. The key nodes were #6 - the Australian Bureau of Meteorology #14 – ABC Radio, and #76 the Sydney Morning Herald. This

analysis indicates that although individuals may gather information from other sources such as personal weather stations, websites, reports, and other mass media devices, the three key nodes #6, 14 and 76 could reach almost the entire network with a reach of 84.2%.

Table 2 Keyplayer findings - Where do you find your climate information

6	Bureau of Meteorology
14	ABC Radio
76	Sydney Morning Herald
No. of distinct persons reached by the key players: 139 (84.2% of network)	

Table 3 Full Cohesion measures Shoalhaven network "Who do you share climate information with?"

1	Avg Degree	1.990
2	H-Index	10
3	Density	0.010
4	Components	7
5	Component Ratio	0.031
6	Connectedness	0.551
7	Fragmentation	0.449
8	Closure	0.007
9	Avg Distance	4.249
10	SD Distance	1.457
11	Diameter	7
12	Breadth	0.847
13	Compactness	0.153

3.2 DISSEMINATING CLIMATE INFORMATION

Despite study participants accessing climate information from a diverse range of sources, in comparison, we found that participants did not disseminate their knowledge broadly. Specifically, we found that in terms of knowledge dissemination participants primarily shared information within their local professional and often geographical group only. The 24 participants reported a total of 194 entities with which they shared climate information (inclusive of participants themselves). Of these, none were international entities, 47 were federal, state or local government entities, 15 were Non- Governments Organisations, 79 were Community Based Organisations and members, 6 were mass media (e.g., tv, radio, newspaper), 7 were Mass Communication Channels (e.g., internet, mobile), 5 were social media, and 3 were Research Centres. In addition, there were 32 other entities, such as individuals, friends, and neighbours.

When analysing the cohesion of this network, the average degree of each node was 1.990, with an average distance or reach for each node of 4.249. This network was far more fractious than the information access network (Figure 2) having 7 components with a fragmentation factor of 0.449. The main component had a diameter of 7 with a degree of closure of 0.007 (for full cohesion measures please see Table 3).

Keyplayer analysis demonstrated there were 3 key nodes being #6 – a local radio station, and two individuals #25 and #54 – that were the most effective in disseminating climate information. These key nodes with the longest reach communicated information to both government and community based organisations (Table 4).

Table 4 Keyplayer findings - Where do you find your climate information?

6	2ST Radio
26	Interviewee #4
54	Interviewee #7
No. of distinct persons reached by the key players: 136 (70.1% of network)	

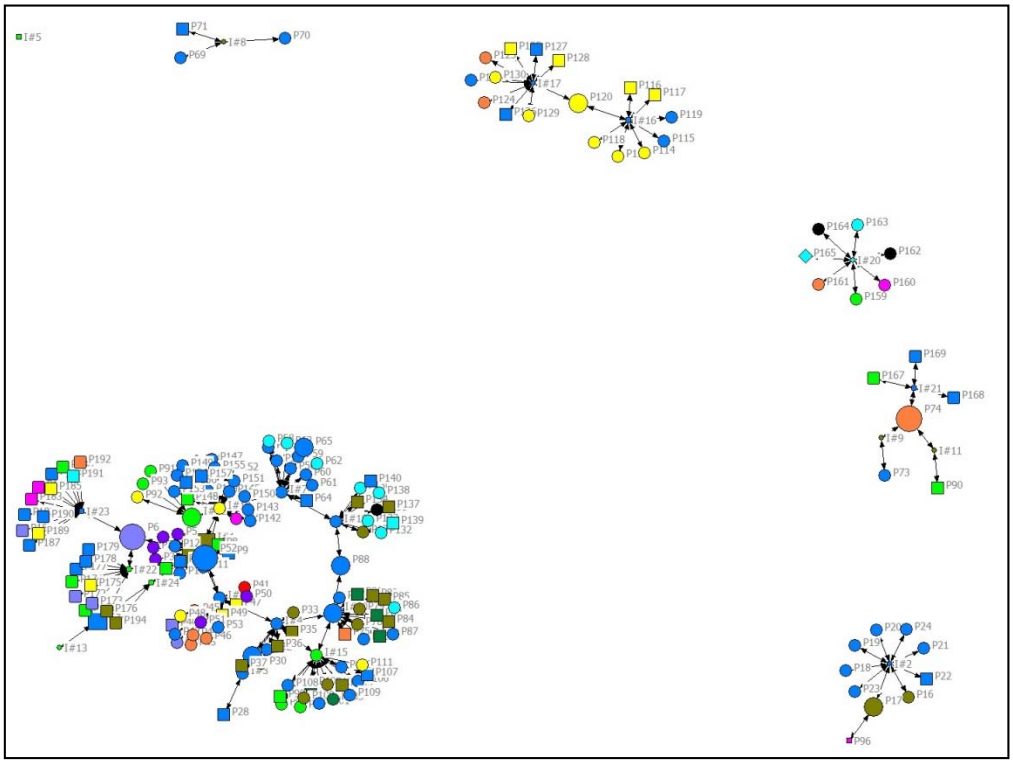

Figure 2 Shoalhaven network "Who do you share climate information with?"

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4 DISCUSSION

Engaging the community in climate action and policy remains a significant challenge undermining progress towards successful adaptation. Here, we provide the first quantitative assessment into the viability of using social networks to engage rural NSW communities in climate policy, using a case-study approach. In doing so, we find that participants access climate information from a variety of sources, including mass media, state government and research centres. However, the majority of the community included a national weather bureau, a national radio station and a capital city newspaper as key places to access information. In comparison, the network depicting the extent to which participants share climate information was far more disperse, and participants tended to share climate information more widely. Considering the nature of the Shoalhaven region (being made up of dozens of smaller coastal villages) this may be the result of both history and geography. Further, it is reflective of the in and out degree of each interviewee as some interviewees reported many outgoing ties which included a range of community members, and great reach through the social system in addition to using means such as social media to report climate information; while others reported that they would share climate information with only their social circle; one interviewee reported sharing climate information with no one.

Furthermore, the main component in figure 2 shows a greater level of connectivity, with both local and state government sharing information. This analysis indicates that although individuals may share to varying degrees both in person and via email lists, websites and social media, three nodes #6, 26 and 54 could reach almost the entire network with a reach of 70.1%, despite the network's tendency to form cliques. The vulnerability of this network is that if the nodes #26 and 54 were removed (e.g., moved away, or ceased to perform their roles), this network may fragment further. Each of these interviewees are members of community based organisations and are intensely embedded within their community.

To better understand the challenge of limited pathways for disseminating information within the local community, it is important to acknowledge that viewing the community as a network of social relationships, while it is often seen as tied to a particular place, it doesn't have to be restricted to place-specific interactions (Walker, 2011.) Therefore, while in the Shoalhaven case study the flow of information was largely dominated by local actors representing a community of place, there were other sources which could (at least in theory) be expanded as avenues to disseminate more complex information about climate adaptation. However, from a policy perspective, this needs to be done in a way that complements the existing centralised structure, which will perform simple tasks very effectively, such as disseminate information about specific hazards (e.g. floods and heatwaves).

Centralised and cohesive networks involving a small number of influential actors are recognised as highly effective when it comes to dissemination of simple information (Bodin, and Crona, 2009). From this point of view, the Shoalhaven case study is already well suited to disseminating simple information, however less well suited to more complex information.

For example, if there was important climate or policy information to be shared within this community it would be important to ensure that information in question was input into the government (both state and local), community based organisations and select non-government organisations. Within this specific case study key nodes within the community would be the most effective channels for knowledge dissemination.

Fostering wider networks for more complicated communication across the science-policy-community interface doesn't need to be officially labelled as climate adaptation, nor taken charge of by formal agents in climate governance. Climate adaptation 'by stealth' (i.e. not recognised explicitly as adaptation) is an important avenue in contexts where support for official climate adaptation may be lacking (Hamin, 2012). An illustrative example of community-based adaptation through informal networks is the 'City repair project' in Portland, USA. This initiative was not overtly designed to address climate change so much as retrofit buildings and increase urban vegetation to improve liveability and reduce heat-island effects. Local communities volunteered to take part in urban street plantings, installing green roofs and constructing trellises which served to reduce vulnerability to heat stress, while simultaneously recording improvements in mental health and social capital (Ebi and Semenza, 2008). This approach to climate adaptation through informal networks also has been applied in rural areas, involving local residents in building improvements to reduce heat stress in individual homes and registering changes in insect distribution in rural areas (Ebi and Semenza, 2008). It is important to note however, there are both empirical examples and theoretical models to suggest that the positive effects of highly centralised and dense networks, as described above, may in fact decline at very high densities. For example, scholars have found that extremely high tie density in a network can lead to homogenisation of information and knowledge and reduce a group's effectiveness in collective action (Oh et al 2004).

In instances where there are limited pathways for the dissemination of information within the system, it would be worthwhile to build resilience with the community by creating more opportunities for knowledge exchange. This may happen in the form of government meetings with community bodies and information being transmitted via mass media broadcasts. When the message to be shared is complex, it is important to have the same information translated to a variety of mediums which may include online databases, mass media including television and radio on both national and local scales in addition to social media. This allows for community members to access the information at a variety of intervals, and different depths. Most importantly it is the roles of the key nodes, who in this instance were boundary spanners who were highly embedded and active members of their network, having ties and contacts to a variety of community members at a variety of levels.

While this research found that a select few key players reach the majority of the network, this provides an important avenue for agencies to tailor and deliver specific and targeted communication of adaptation within the existing network. It allows governing agencies to target key nodes of highly centralised actors to ensure information, knowledge and collaboration is maximised to enhance collective action and community resilience. While the SNA above shows a discrete number of actors responsible for information dissemination (i.e. network coverage) there may be scope for governing agencies to broaden the coverage by engaging representatives of different subgroups in the participatory processes (Prell et al. 2008).

By using a case study approach we have demonstrated that utilising SNA to uncover the underlying knowledge networks and structures may provide useful insight for community engagement. In this instance key nodes acted as boundary spanners within the sharing network. These embedded individuals had both professional attachments to the formal networks while maintaining active attachments within the informal networks with a range of actors including community based endeavours, such as local schools, community based organisations and non-government organisations. This project and subsequent findings have demonstrated that SNA may be used to guide governing agencies' communication and engagement efforts to maximise efficiency and or target specific subgroups. A dedicated monitoring and evaluation framework along with a longitudinal case study could test the feasibility and validity of policies for improved engagement and information flows in the context of climate change adaptation.

One of the key findings of the study is the limited pathways for disseminating climate change information, which provides useful insights for policy but raises as a new challenge as to how to respond to these limited pathways within a policy context. This challenge will be a key focus for subsequent phases of the project, however it is possible to draw out some initial insights from existing literature on this topic. The more social ties the greater possibility for joint action and collaboration (Bodin and Crona 2009). A high degree of trust within a network also facilitates interaction and collaboration which is important for both information transmission and deliberation (Newig et al. 2010). Increased levels of collective action can also promote development of knowledge and understanding through exposure to new ideas and increased levels of information (Bodin and Crona 2009).

5 CONCLUSION

The Shoalhaven case study has demonstrated the utility of social network analysis to reveal the underlying knowledge networks and structures which influence community engagement pathways. In this instance the key network nodes acted as boundary spanners within the sharing network. Although a network of social relationships is often seen as tied to a particular place, it doesn't have to be restricted to place-specific interactions. As such, there is potential to astutely engage the existing networks for community engagement tasks for which they are already well suited, namely, relatively simple information about specific hazards and responses to those hazards. When it comes to different and more complex issues, it may be more appropriate to foster new avenues, rather than rely on the existing network system. Developing a mechanism to disseminate more nuanced and complex communication may need to occur through fostering experimentation in a different part of the social network. The findings from this project demonstrated that activated key nodes within the case study community would be the most effective channels for knowledge dissemination.

The degree to which these findings are unique to the Shoalhaven region or representative of the style of social networks that exist in other rural and regional communities throughout NSW, and Australia more broadly, should be the focus of future case study research and analysis. A comparative assessment between case study selections will assist with understanding the different contexts (e.g. spatial, demographic, land use, political etc) in which social networks currently mobilise. Understanding the way in which these different contexts influence social networks will assist with tailoring specific adaptation policies to improve communication and engagement techniques.

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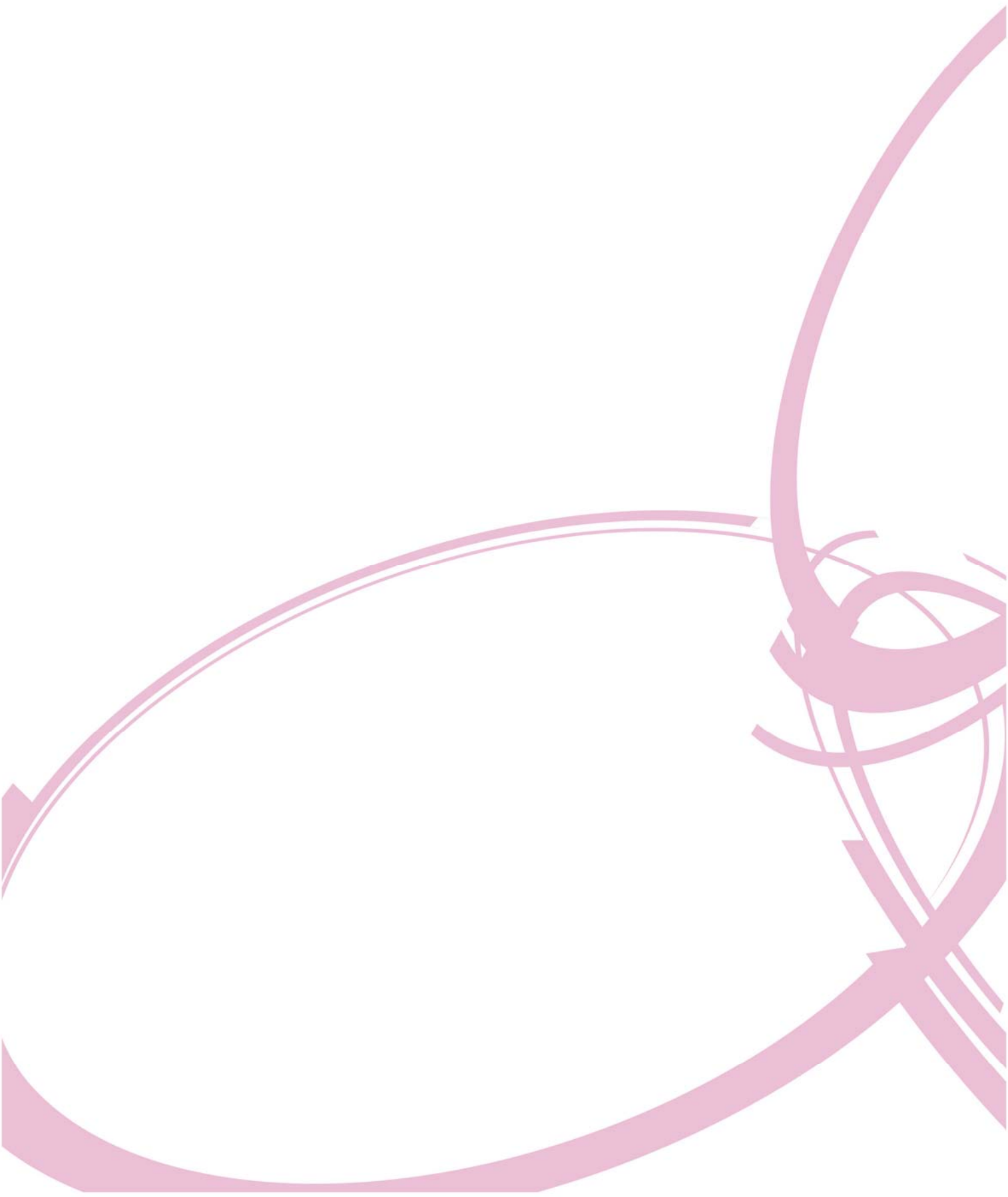

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