Author(s):   Brown, V. ; Griffith, R. ; Mitchell, M.S. ; Robinson, S. ; Ryan, P. ; Walker, B. ; Walkerden, G.

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Applying resilience thinking to natural resource management through a "planning-by-doing" framework

Address correspondence to Dr. Michael Mitchell, Institute for Land, Water and Society, Charles Sturt University, Albury NSW 2640, Australia. E-mail mimitchell@csu.edu.au

MICHAEL MITCHELL

National Centre for Groundwater Research and Training, Albury NSW, Australia

ROD GRIFFITH

Institute for Land, Water and Society, Charles Sturt University, Albury NSW, Australia

PAUL RYAN

Interface NRM, Beechworth VIC, Australia

GREG WALKERDEN

Department of Environment and Geography, Macquarie University, Sydney NSW, Australia

BRIAN WALKER

CSIRO Ecosystem Sciences, Canberra ACT, Australia

VALERIE A. BROWN

Fenner School of Environment and Society, Australian National University, Canberra ACT, Australia

SANDY ROBINSON

Sandy Robinson & Associates, Cairns QLD, Australia

Abstract

Natural resource management (NRM) organisations are increasingly looking to resilience thinking to provide insights into how social and environmental systems interact and to identify points of intervention. Drawing on complex systems analysis, resilience thinking emphasises that landscapes constantly change from social and ecological interactions, and focuses NRM planners' attention on identifying key variables, feedbacks and thresholds that can help improve intervention strategies. More deliberative approaches are being developed to use resilience thinking in ways that engage and build human capacity for action. This paper documents experiences shared with NRM agencies in rural Australia as we developed new approaches to link resilience thinking with collective learning principles. We present an emerging framework through which heuristics associated with resilience thinking are being used as part of a planning-by-doing process. The framework is being tested to assess whether and how it can enable change agents to advance their capacities for adaptation and transformation.

Introduction

All landscapes are the product of human modification, and function as complex and co-evolving social and ecological systems. The environment self-organises in response to changes caused by human intervention, as do humans in response to changes in the environment. Understanding and anticipating this complex network of feedback loops have led natural resource management (NRM) organisations to explore whether resilience thinking can offer strategic analysis to improve interventions. This paper draws on the initial stages of a longer term case study with Murray Catchment Management Authority (CMA), a statutory sub-catchment NRM authority of the New South Wales (NSW) Government with a Board comprising community appointees. Murray CMA is one of over 50 regional NRM agencies in Australia created as part of an experiment in devolved governance with the aim of more effectively engaging local communities in government NRM programs and policy development (Lockwood et al. 2009). It is one of several such agencies seeking to improve its adaptive capacity by developing planning strategies based around resilience thinking (also see Leith et al. 2012).

Within this systems-oriented "resilience thinking" discourse, resilience is defined as "the amount of change a (social-ecological) system can undergo (its capacity to absorb disturbance) and remain within the same regime" (Walker and Salt 2006, 164). There may be multiple permutations for how the regime state is maintained, but at a fundamental level, the system is resilient if it can retain the same overall function, structure and identity. Resilience is therefore seen as a process of constant change, involving both adaptability (the capacity of human and non-human actors to learn and respond to changing internal and external drivers, and avoid crossing critical thresholds that could establish an unwanted new regime) and transformability (our capacity to bring about a shift to a new, different kind of system when the current system of interest is no longer tenable) (Walker et al. 2004; Folke et al. 2010).

This systems view of resilience is also receiving increased attention by social scientists, including in this journal. Much of the discussion of resilience in *Society and Natural Resources* relates to the capacity within people to bounce back from adversity – analysed in terms of the resilience of communities, organisations and societies (e.g. Gooch and Warburton 2009; Magis 2010; Baral and Stern 2011). Efforts have been made by these authors, and more directly by Berkes and Ross (2013), to integrate this community resilience discourse with the above-mentioned social-ecological systems view of resilience. A nagging issue is that the systems approach to resilience thinking is seen as not readily applicable to social systems given its origins in the natural sciences (Davidson 2010). In particular,

Davidson argues that resilience thinking has not fully integrated the potential for human agency into its prescriptive framework. Human agency involves purposeful interventions that draw on disparate human capacities to imagine, anticipate and motivate individual and collective action (Davidson 2010). Tapping into these reserves of human agency involves a process, which can be channelled towards adaptive or transformative outcomes, but could also end up as maladaptive outcomes (Davidson 2013). We share these concerns, and have sought to identify practical ways to apply resilience thinking at the regional scale that could help engage and build human agency towards improved outcomes.

The issue here is partly one of scale. Davidson (2010) is concerned about the catastrophic potential of human-induced climate change, a challenge that is being played out at the planetary scale. To undertake a resilience assessment, it is first necessary to define a focal scale for the social-ecological system (Resilience Alliance 2010), while still appreciating that social and ecological systems function at multiple scales (Cash et al. 2006) and rarely "fit" with each other (Folke et al. 2007; Olsson et al. 2007). Current applications of resilience thinking have mostly focused on particular local or regional landscape scales. It is often easier to make space for collective agency to emerge at local or regional scales. Connections are then made to broader scales and embedded scales, an aspect that gives resilience thinking analytical strength (Silver 2008). A challenge when defining a focal scale for a co-evolving social and ecological system is that it can be difficult to transfer concepts of diversity within system identity for an ecological landscape to social diversity within a community that self-identifies as part of a particular social landscape. The risk is that "functionalist" assumptions might be applied when discerning community aspirations that inadequately address the complexity of "competing interest groups, imbalances of power, and ambiguous and subjective social phenomena" (Lockie 2001, 281).

As a research team (this paper's co-authors), we brought together expertise in the application of resilience thinking with expertise in nurturing social learning among diverse communities that construct knowledge in multiple ways. Our shared purpose was to investigate strategies to build capacity for transformative action. We hypothesised that improved strategies to build transformability could be developed by linking the resilience thinking approach with theories and methods associated with experiential and collective learning (Kolb 1984; Brown 2008; Brown and Lambert 2013). This broader research agenda is still a work in progress. This paper's contribution builds from initial learnings that help frame the practical application of heuristic devices drawn from resilience thinking within a collective learning inspired planning-by-doing process.

 The practical research agenda at this initial stage involved Murray CMA's collaboration with Wakool Shire Council, one of the 14 local government authorities whose areas traverse the regional sub-catchment area. The two organisations sought to engage the Wakool Shire rural community in strategic planning out of an untenable situation. The Shire boundaries have created a disparate and disconnected community, but a strong component of

community identity is tied to irrigated agriculture. Our project coincided with an extended and severe drought, which had resulted in minimal or no water allocations for most years between 2002 and 2009, and governments were expected to implement a permanent reduction in water entitlements. Adaptive responses seemed inappropriate, and our two partner organisations were interested in exploring ways to proactively manage the community's transition through a transformative change.

This paper proceeds by providing an overview of how resilience thinking is evolving to incorporate concepts and methods from social research, leading to an explanation of why we argue that resilience thinking could benefit from building synergies with Brown's (2008) collective learning principles. We then present our experiences of combining the analytical strength of resilience thinking with principles underpinning collective learning processes. Based on these experiences, we present an emerging conceptual framework for a planning-by-doing process developed in collaboration with our partners, which is currently being tested as part of our ongoing research endeavours.

Evolution of resilience thinking to incorporate social perspectives

A number of broad shifts are evident in the systems-oriented resilience discourse from its introduction in the 1970s to the present (Folke 2006). When Holling (1973) wrote his seminal paper on resilience in ecological systems, he realised that a mechanism was needed to manage it – and adaptive management was conceived (Holling 1978; Walters 1986). From the 1980s ecological resilience was extended to cover linked social and ecological systems. In recognition that no one organisation or social group can manage common pool resources, the term adaptive co-management was introduced by linking adaptive with collaborative management. Olsson et al. (2004) explained that adaptive co-management was the means to operationalise what Dietz et al. (2003) referred to as adaptive governance, a concept explored in greater detail by Folke et al. (2005).

Duit et al. (2010) suggest that contemporary resilience thinking is breaking free from its ecological roots, and is incorporating perspectives that acknowledge how social dynamics operate in different ways to ecological dynamics. There has been a rapid increase in cross-fertilisations of ideas between resilience thinking and theoretical perspectives offered by the social sciences, including social network analysis (Bodin and Crona 2009), governance (Lebel et al. 2006; Olsson et al. 2006), collective action (Tompkins and Adger 2004), social learning (Berkes 2009; Reed et al. 2010), social innovation (Biggs et al. 2010; Westley and Antadze 2010), socio-technical studies (Smith and Stirling 2010), institutional dynamics (Young 2010), and new approaches to analysing social relations (Hatt 2013) and power dynamics (Moore and Tjornbo 2012) within social-ecological systems. This new wave of resilience thinking is offering an alternative approach to efficiency-driven technology-centric command and control management, well suited to adaptive management responses to situations characterised by high levels of complexity and uncertainty and low levels of controllability (Allen et al. 2011).

The work of researchers associated with the Resilience Alliance has shown that applying resilience thinking to wider NRM practice requires profound changes to value systems and methodologies, including the current dominant ways knowledge is constructed and the way entities are viewed. In particular, a profound shift is needed to move away from simple linear cause and effect analysis towards complex systems analysis that takes into account unexpected as well as predictable feedbacks following management interventions (Holling 1973). However, the resilience literature is yet to provide sufficiently useful examples of how to translate resilience thinking into prescriptive practice. Much of the analysis remains retrospective and theoretical, drawing on case studies for anecdotal illustrations (Anderies et al. 2006; Walker and Salt 2006). Considerable attention is devoted to strategies that build adaptive capacity, with limited documentation of experiences purposefully designed to enable transformative change to develop. Olsson et al.'s (2006) analysis of changes evolving at Kristianstads wetlands reserve in Sweden results in a list of factors thought to be enablers of transformative change, including transformational or visionary leadership and the emergence of shadow networks. Biggs et al. (2010) draws on a social innovation theoretical framework to enhance comparison between Olsson et al.'s (2006) case study and other key Resilience Alliance case studies. Walker et al. (2009) re-examined the Goulburn-Broken Catchment case study in Australia to underline the need for a strategy to promote transformation, and posit some conditions needed for a transformational shift, including recognition that transformation is needed (which often entails overcoming a state of denial).

The research team's interest in pursuing an agenda to support a community-led transformation led us to consider how to integrate this above resilience analysis around transformational change with Brown's (2008) four step collective learning process (see Figure 1). The four step workshop process is intended to create constructive debate between participants purposefully selected to cover diverse ways people associated with a particular community construct knowledge, including local and scientific knowledge constructions as well as those of a more individual, organisational and holistic nature (Brown 2010). A critical aspect is to include contributions from participants whose views challenge prevailing attitudes that constrain innovation, and can open up spaces for marginalised views that are often dismissed as being emotional, subjective or irrelevant (cf. Lockie 2001). The strategy to achieve this constructive debate is to focus all dialogue around a common question and a set of shared ideals, as described below.

The collective learning process begins with sharing ideals ("what should be"), encouraging people to step out of the problem rather than start with the problem. Starting with the problem carries a risk that collective thinking will remain constrained by the way the problem is framed. Through this process of sharing ideals, the collective also learns to appreciate its diversity by reaching agreement on a set of shared principles, even when these are apparently conflicting. The process helps bind the collective in the pursuit of common aspirations. Brown (2008) emphasises that collective learning is like a spiral that

takes participants on a journey. Collective learning experiences can occur at specific events or over periods of time and lead to new collective cycles of learning involving different circumstances, time and people. So collective learning can be experienced as an overarching longer-term process that encompasses shorter and smaller cycles; they can also coalesce as new cycles drawn from the experiences of one or more cycles of learning. The image of eddies in a river seemed the best depiction for how these experiences might evolve (as depicted in the inset in Figure 1).The next section explains our efforts to draw on these collective learning principles as a means to apply resilience thinking in our case study contexts, and what was learned as a result.

Figure 1: The collective learning spiral
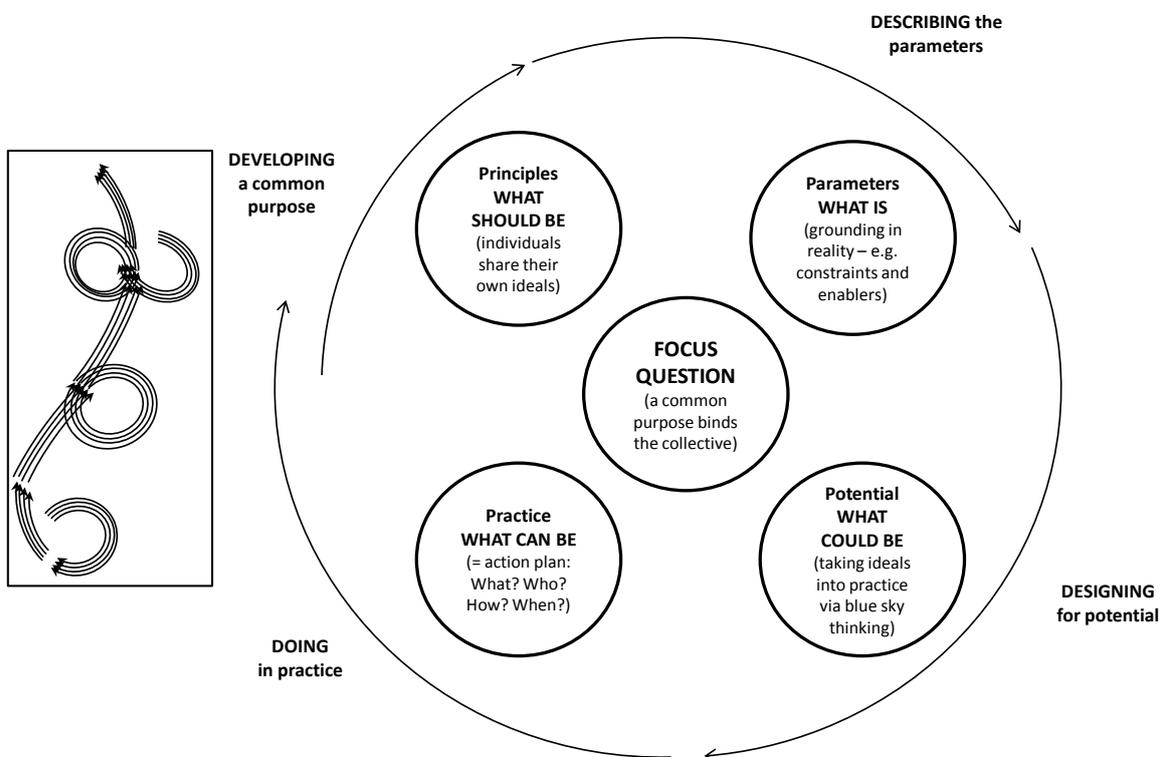
(Source: modified from Brown 2008)

Practical experiences in building synergies between resilience thinking and collective learning

Research context, methods and process

The case studies where we explored the application of resilience thinking together with collective learning evolved as part of the *Transformation for Resilient Landscapes and Communities Project*. This project is a work-in-progress, and this paper focuses on its initial stages involving the Wakool Shire in south-western NSW. An additional multi-regional case study has since been established with the newly formed Cape York NRM, whose Board

comprises a majority Indigenous membership, and three other regional NRM organisations in Far North Queensland.

Murray CMA helped fund the project involving Wakool Shire, in part because it saw the project as an opportunity to acquire skills in applying resilience thinking in-house. Identifying new approaches to the application of resilience thinking was a research agenda we shared with Murray CMA. Despite substantial effort to make resilience thinking more accessible to NRM practitioners, including accessible explanations of resilience practice (Walker and Salt 2012) and a freely available workbook (Resilience Alliance 2010), most NRM organisations still choose to engage resilience experts to instruct them in how to apply resilience thinking in their contexts. This means that NRM practitioners are usually first introduced to resilience thinking through slide show presentations, often followed by group discussions involving 20 people or more led by the resilience expert(s). While the intention is that these discussions are the starting point for a participatory resilience analysis (Walker et al. 2002), we agreed that more thought and creativity was needed into a range of additional activities more focused around experience-based learning. We also recognised the need to frame an approach to help deliver these activities over a longer period of time.

Our project therefore developed as participatory action research (Kemmis and McTaggart 2005). Murray CMA's leadership and key staff had ongoing input into the research direction, but their work commitments prevented them from becoming full research team members. They approached Wakool Shire Council in mid 2009 to be a partner in the research. The research effort acquired a practical focus when legislation required both organisations to engage their communities in strategic planning.

The research team included individuals with different but complementary expertise and a commitment to developing synergies between resilience thinking and collective learning. Despite this quest for synergy, translating that intention into practice proved elusive. Our first major interaction with Murray CMA and Wakool Shire Council occurred in December 2009 where we introduced resilience thinking and collective learning as separate processes. This one-day workshop involved 26 participants, including 13 from Murray CMA and six from Wakool Shire Council. The resilience assessment began with a short expert introduction to resilience thinking followed by a two hour group discussion to develop a preliminary resilience assessment for Wakool Shire. The discussion started by asking the question "resilience of what?" to establish and describe Wakool Shire as the focal scale, and then moved to the question "resilience to what?" to include consideration of the larger scale processes that impact on Wakool's resilience, and the thresholds that could transform Wakool Shire. The discussion was conducted as a whole-of-group activity, and only a minority of participants actively contributed. Most participants chose to use the workshop experience as an opportunity to listen and learn, with occasional interjections to seek clarification on terms (e.g. "adaptive governance"). By contrast, the collective learning activities centred on small group discussions with six participants per table to maximise

opportunities for individual contributions. These discussions revolved around a focus question: "How can our communities work together to ensure our collective survival in a time of change?" Participant feedback indicated appreciation for the participatory process used in the collective learning part of the workshop, but greater interest in how to draw on the analytical potential of resilience assessment. At a follow up meeting with the research team on 17 December 2009, our partner representatives expressed a clear call for an integration of the two approaches to provide solid theoretically-grounded ideas and processes they could use to support their communities in identifying and directing the changes they need.

At that stage, we decided to undertake a resilience assessment with the community first, and use that as an input into a whole of community collective learning process. The resilience assessment workshop was held in June 2010 while the collective learning workshop was held over until April 2011, which suited the timing of the Council's efforts to develop a community-led strategic plan. By that time, the long drought had been followed by two seasons of heavy rainfall, including an extreme flood event affecting the area in January 2011. This change undermined majority community perceptions that any permanent reduction in irrigation was required. As Davidson (2013, 22) has noted, when it comes to extreme events associated with climate change, "we do not take those shocks seriously enough." In this case, the motivation to explore transformation shifted such that the dominant community discourse was now one which could be best described as involving a state of denial about the need for change.

Trialling new ways to increase the participatory and change potential of the resilience assessment process

The June 2010 resilience assessment workshop provided an opportunity to trial new approaches to engage participants in resilience assessment that built on their prior experiences. The tables in the room were laid out to encourage small group discussions. We began by using an individual brainstorming activity where each participant wrote on post-it notes their responses to the question "what makes Wakool Shire work?" Each participant was asked to prioritise their ideas so that they could share their "best" ideas with other participants at their table, and then with the whole group. Once all the ideas were placed on the wall, the entire group worked together to organise the ideas into themes. The result was an array of themes focused on location, natural resources, individual and community capacities, lifestyle and infrastructure. These ideas were then used as the basis for an expert-led whole-of-group discussion to enable participants to start identifying key system variables, drivers and feedbacks. This process meant that participants' inputs were used to introduce resilience thinking, rather than beginning the workshop with a presentation on resilience thinking.

A number of the heuristics used in resilience thinking were then applied as part of small group discussions. The shared construction of a historical timeline showing significant past

events shaping Wakool Shire is one example. Gunderson and Holling's (2002) adaptive cycle is another heuristic that can tap into existing experience well. In this case, the workshop coincided with a NSW government decision to convert large tracts of multi-use local forests into national parks, which seriously undermined the viability of several local logging businesses. Some workshop participants were able to identify the demise of their logging industry as an example of the back loop of the adaptive cycle. They also saw themselves as preparing for a transformation through the back loop, where the imposed collapse of the industry had forced them to radically rethink the future business and employment prospects for their community (cf. Biggs et al. 2010). Rather than seeking to re-establish the old system, they identified themselves as being in the renewal phase where they could create new opportunities out of the chaos; potentially transforming into a new system, with new functions, structures and feedbacks.

Strategies to build collective agency and self-organising capacity

A key longer-term objective of the Wakool project was to help build collective agency by establishing a self-organising network that would drive analytical and innovative thinking in the Shire. This strategy was modelled on Olsson et al.'s (2006) experience that it is informal community "shadow" networks that often produce innovative and potentially transformative ideas for change. The strategy was to draw on innovators identified through a network analysis that could inform the development of a resilience assessment. In so doing, the aim was to create an active network of individuals who could inspire community participation in wider strategic planning events. However, the network analysis undertaken with council staff failed to reveal these individuals, and the staff were left with the responsibility of identifying suitable participants for the workshop.

The resilience assessment developed at the June 2010 workshop was later published on the Council's website so that workshop participants could draw on wider support to revise the assessment, thus keeping the network active, and helping build momentum for change. However, this approach floundered, and the research team and Wakool Shire Council eventually decided that a second workshop was needed to try to re-activate the network. This workshop occurred in January 2011, but few of the original workshop participants attended, and discussions were dominated by preparations for the forthcoming community workshop planned for April that year.

An explanation for the failure to create a self-organising network in the Wakool case study is that our efforts were contradictory to how such "shadow" networks emerge (Olsson et al. 2006). By their very nature, these networks are self-organising, often in the shadows, and external efforts to organise them are simply not required or are rejected. This led to realisation that the proposed community-led process towards transformation was not driven from the inside-out as originally intended. Our capacity building efforts should have focussed more on our partner organisations and building their capacity to engage communities in intentional transformative action.

The quest for synergy remained

Our overall objective was to apply resilience thinking in ways that would engage human agency among a diverse community with porous boundaries. High expectations were placed on the collective learning process adopted for the April 2011 workshop. The workshop aimed to engage the Wakool community in creating innovative and collaborative plans and projects and identify champions who would further develop and implement their project ideas. Around one hundred participants attended the workshop, and were carefully selected to encompass a diverse spectrum of stakeholders from the Wakool community and beyond. This included government officials based elsewhere but whose area of responsibilities covered the Wakool area, such as staff from Murray CMA. We imagined that this might provide an alternative avenue to pursue projects which fail to develop because of the power play associated with bureaucratic barriers. Directly engaging with staff of government agencies might help build the momentum for change. Despite some robust discussions about the kinds of innovative changes that would meet challenges faced by the Wakool community, most of the projects were minor advances on business-as-usual. The main feedback from Murray CMA was that the collective learning workshop did not draw sufficiently from the resilience analysis, and that the workshop process lacked an analytical approach to identifying the most effective set of projects that could intervene in the system to achieve desired outcomes. This feedback reiterated the need for an approach that more effectively combined the best aspects of both resilience thinking and collective learning.

While our initial experiences with the Wakool community helped us develop more participatory approaches to the application of resilience thinking to NRM, it was in Far North Queensland that we were eventually able to build synergies between resilience thinking and collective learning. During initial discussions to establish a community engagement strategy with Cape York NRM it was apparent that a new strategy was required, especially in relation to engaging disparate Indigenous communities in the region. These discussions shaped the planning-by-doing framework presented below.

A framework for incorporating resilience thinking into NRM "planning-by-doing"

Developing the framework

The framework we present here is a work-in-progress. Its development began by simplifying the resilience assessment process into four stages (the clouds in Figure 2) and overlaying those stages with the four steps of the collective learning process (Figure 1). A synergy emerged. The notion of exploring "resilience to what?" corresponded with the scoping period required to prepare for a collective learning workshop event involving a particular community. The collective learning step of building a common purpose through the sharing of ideals was then added to the "resilience of what?" stage, and prior to a discussion of "what is". The "what is" step could then be enhanced by drawing on heuristics and tools

from resilience thinking associated with the "resilience to what?" stage. The transformative potential of the new process is strengthened by returning to the shared ideals through the collective learning exercise involving blue sky thinking associated with the "what could be" step. These ideas provide the foundation for the analysis to be undertaken as part of the "so, what?" stage. Activities from the "what can be" step in the collective learning process help set the agenda for action, corresponding with the "now what?" stage (Figure 2).
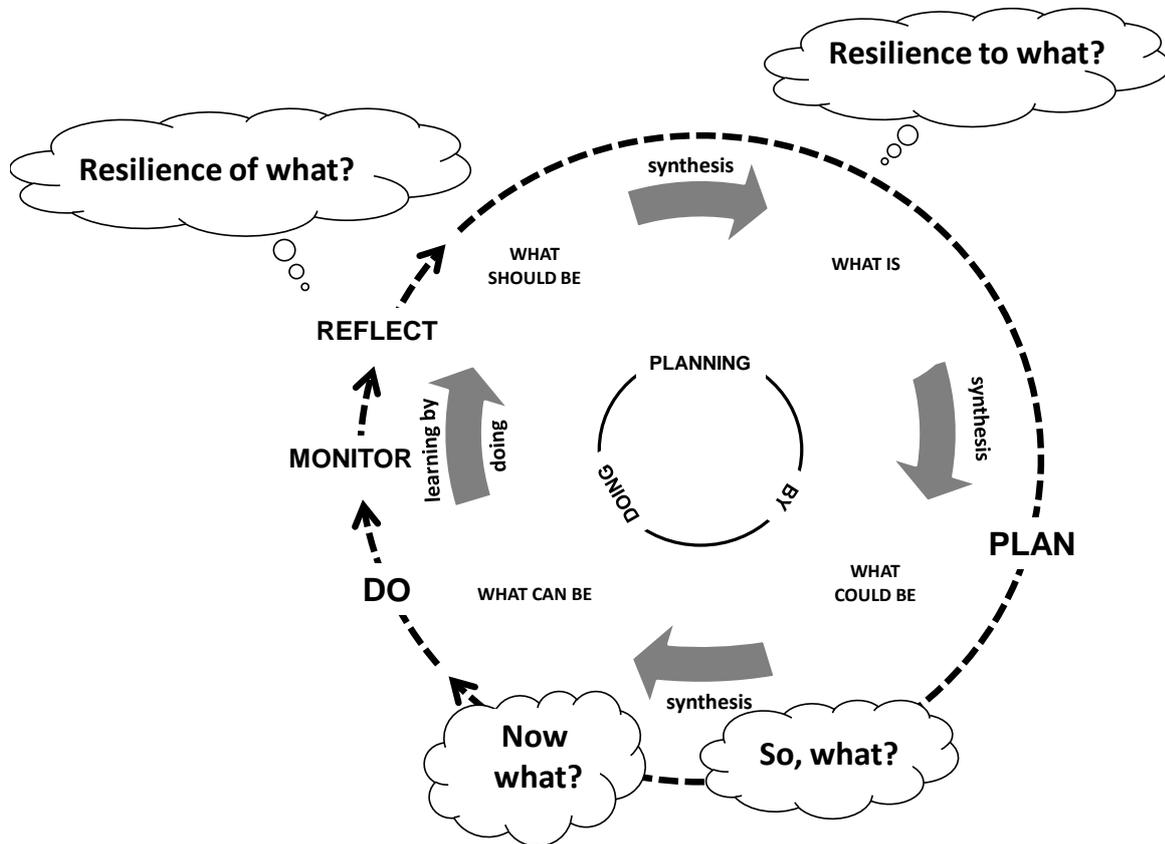
Figure 2: Combining resilience thinking and collective learning in a planning-by-doing framework

A problem with the depiction in Figure 2 is that most of the activities appear to relate to planning only, which are then followed with a separate set of activities at the post-planning implementation and monitoring phases. This separation between planning and doing undermines the intention that the new framework is to become a flexible approach to planning-by-doing. For the process to truly become planning-by-doing (rather than planning-then-doing), it needs to move away from the idea that planning is a separate activity from doing and reviewing, a key aspect that Figure 2 fails to depict. We therefore redrew the process, as shown in Figure 3, as a network of activities, each appropriate in particular circumstances, with each understood as an occasion for learning, and thence for capacity building. In the kind of NRM practice we envisage, an exploratory, learning-by-doing approach, which is inherently capacity building, is normal practice. NRM is undertaken as a "learning-as-we-go" process of adaptation and/or transformation.
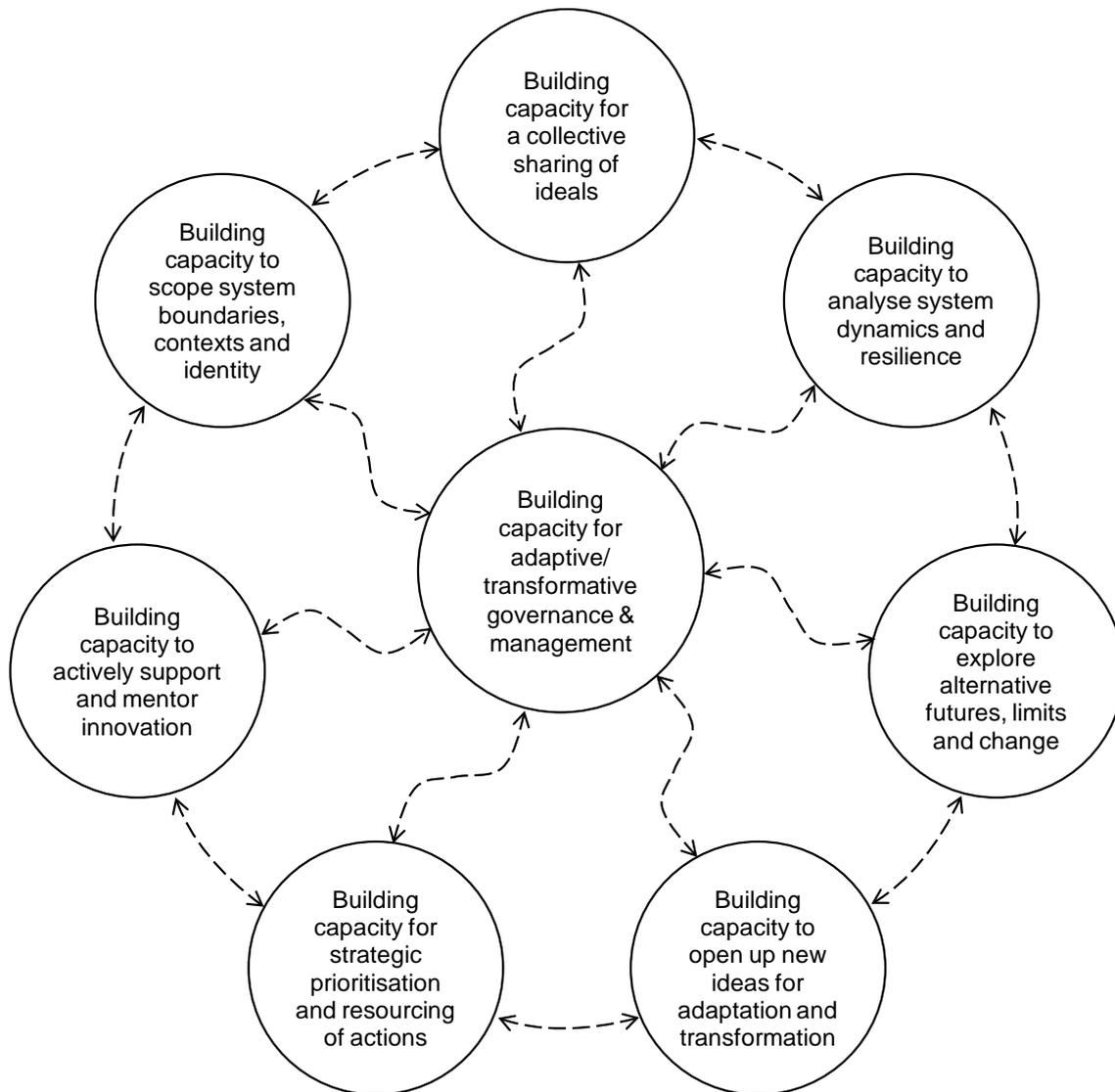
Figure 3: A planning-by-doing framework to build adaptability and transformability

Exploring how the framework could build transformability

The planning-by-doing framework shown in Figure 3 emphasises opportunities to build capacity for adaptation and transformation in NRM practice. We envisage these activities as part of normal NRM practice, changing its tone or flavour, and punctuating it by shaping pauses for reflection. The framework envisages NRM as a critical learning system with subsystems that are sites of engagement and capacity building through which people and nature can co-evolve (cf. Bawden 2005). In describing each of the components of the framework below, we also provide propositions for how their implementation could contribute to building transformability, propositions that are being assessed as part of our ongoing research efforts.

The capacity for adaptive forms of governance and management is central to the framework. All social-ecological systems have existing governance regimes that influence NRM investment priorities and actions. As transformability is built, these regimes may

undergo transformation as a result of regular critical evaluations, especially those inspired by learnings at different stages in the planning-by-doing process.

The capacity for scoping is a background research and listening space. Useful tools include network mapping that could help to uncover existing networks operating in the shadows and/or nodes of influence. The capacity for sharing ideals and goal setting provides an opportunity for community members to explore and critically reflect on their mental models, values, worldviews and identities, and identify a common purpose that can provide focus for future deliberations. The capacity for working through system dynamics can be looked at from two different perspectives. From a resilience perspective it is essentially a multi-scale modelling process in which variables, feedbacks, thresholds, shocks, drivers, and state and transition models have a role in building system knowledge and hence capacity to influence resilience. The collective learning objective is to explore what it is about the existing system that enables or constrains the achievement of a set of shared ideals.

The capacity for exploring plausible alternative futures extends from the "what is" theme, and is the site of learning around "what might be – if". Scenario development is envisaged as a key tool, again comparing those scenarios back to shared ideals. We envisage that shadow networks may have a crucial contribution to enhancing the transformability potential of these shared learnings. The capacity for opening up new ideas to pursue ideals depends on the establishment of a safe arena in which blue sky or outside-the-box thinking is encouraged. Building this capacity to imagine and articulate "what could be" is intended to be a source of innovative ideas that could lead to transformative action. Undertaking this activity collectively promotes collaborative design and exposure to new ideas and ways of thinking. The capacity for strategic prioritisation and resourcing of action is where the practicalities of particular actions/ interventions are considered. We have developed a rapid assessment tool to support consideration of intended and unintended consequences of a proposed action on social-ecological system dynamics. The capacity for active support and mentoring of innovation and experimentation relates to on-ground actions, including those that are potentially transformative. Adequate resourcing enables innovative experiments to be supported and nurtured. Monitoring of processes and outcomes is fundamental to identifying and learning from potentially transformative experiments.

Conclusion: Where to from here?

The *Transformation for Resilient Landscapes and Communities Project* began as a pilot study with Wakool Shire to explore new ways to apply resilience thinking and collective learning to respond to entrenched and intractable NRM issues. It involved a rural, resource-dependent community facing a potential imposed transformation in social-ecological system function and identity. While the project did not evolve as a community-directed transformation, it provided key learnings to underpin the benefit of building synergies between the transformational potential of the collective learning approach and the analytical strengths provided by resilience thinking. These experiences led to the

development of a flexible planning-by-doing framework through which participatory tools can be used to apply resilience thinking as part of strategic planning to improve NRM.

The planning-by-doing framework is currently being tested with Murray CMA and the four regional NRM Boards in Far North Queensland. The Murray CMA is engaged in a review of its Catchment Action Plan and making use of the practical tools and heuristics that have been developed to date (Griffith et al. 2012; Mitchell 2013). The four NRM organisations in Far North Queensland are working with each other and the research team to put the framework into practice. Many other regional NRM organisations across Australia are keen to learn from the experiences of the organisations involved in this project, and have committed to establishing a community of practice to facilitate this exchange.

Some nagging issues remain. It can be too easy for NRM organisations to conceive community engagement in functionalist ways. Change agents seeking to identify strategies to engage communities more effectively might find support from the principles that underpin collective learning. In the Cape York region, it has been clear from the outset that the overarching governance system needs transforming, as this has historically exacerbated community conflicts and undermined the pursuit of a collective set of aspirations. However, the exercise of power in social relations is an area that continues to need further attention. In some cases, power can be exercised in astonishing ways that can lead to positive, even transformational change (Moore and Tjornbo 2012). However, it remains unclear how to draw effectively from such analyses to steer future changes, rather than just allow change to emerge, potentially leading to maladaptive outcomes.

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References

Allen, C. R., J. J. Fontaine, K. L. Pope, and A. S. Garmestani. 2011. Adaptive management for a turbulent future. *Journal of Environmental Management* 92(5):1339-1345.

Anderies, J. M., B. H. Walker, and A. P. Kinzig. 2006. Fifteen weddings and a funeral: Case studies and resilience-based management. *Ecology and Society* 11(1):21.

Baral, N., and M. J. Stern. 2011. Capital stocks and organizational resilience in the Annapurna Conservation Area, Nepal. *Society and Natural Resources* 24(10):1011-1026.

Bawden, R. 2005. Systemic development at Hawkesbury: Some personal lessons from experience. *Systems Research and Behavioral Science* 22(2):151-164.

Berkes, F. 2009. Evolution of co-management: Role of knowledge generation, bridging organizations and social learning. *Journal of Environmental Management* 90(5):1692-1702.

Berkes, F., and H. Ross. 2013. Community resilience: Toward an integrated approach. *Society and Natural Resources* 26(1):5-20.

Biggs, R., F. R. Westley, and S. R. Carpenter. 2010. Navigating the back loop: Fostering social innovation and transformation in ecosystem management. *Ecology and Society* 15(2):9.

Bodin, Ö., and B. I. Crona. 2009. The role of social networks in natural resource governance: What relational patterns make a difference? *Global Environmental Change* 19(3):366-374.

Brown, V. A. 2008. *Leonardo's vision: A guide to collective thinking and action*. Rotterdam, The Netherlands: Sense Publishers.

———. 2010. Collective inquiry and its wicked problems. In *Tackling wicked problems through the transdisciplinary imagination*, eds. V. A. Brown, J. A. Harris and J. Y. Russell, 61-83. London, UK: Earthscan.

Brown, V. A., and J. A. Lambert. 2013. *Collective learning for transformational change: A guide to collaborative action*. London, UK: Earthscan.

Cash, D. W., W. N. Adger, F. Berkes, P. Garden, L. Lebel, P. Olsson, L. Pritchard, and O. R. Young. 2006. Scale and cross-scale dynamics: Governance and information in a multilevel world. *Ecology and Society* 11(2):8.

Davidson, D. J. 2010. The applicability of the concept of resilience to social systems: Some sources of optimism and nagging doubts. *Society and Natural Resources* 23(12):1135-1149.

Davidson, D. J. 2013. We still have a long way to go, and a short time to get there: A response to Fikret Berkes and Helen Ross. *Society and Natural Resources* 26(1): 21-24.

Dietz, T., E. Ostrom, and P. C. Stern. 2003. The struggle to govern the commons. *Science* 302(5552):1907-1912.

Duit, A., V. Galaz, K. Eckerberg, and J. Ebbesson. 2010. Governance, complexity, and resilience. *Global Environmental Change* 20(3):363-368.

Folke, C. 2006. Resilience: The emergence of a perspective for social-ecological systems analyses. *Global Environmental Change* 16(3):253-267.

Folke, C., S. R. Carpenter, B. Walker, M. Scheffer, T. Chapin, and J. Rockström. 2010. Resilience thinking: Integrating resilience, adaptability and transformability. *Ecology and Society* 15(4):20.

Folke, C., T. Hahn, P. Olsson, and J. Norberg. 2005. Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources* 30(1):441-473.

Folke, C., L. Pritchard Jr, F. Berkes, J. Colding, and U. Svedin. 2007. The problem of fit between ecosystems and institutions: Ten years later. *Ecology and Society* 12(1):30.

Gooch, M., and J. Warburton. 2009. Building and managing resilience in community-based NRM groups: An Australian case study. *Society and Natural Resources* 22(2):158-171.

Griffith, R., P. Ryan, M. Mitchell, G. Walkerden, and S. Robinson. 2012. *Transformation for Resilient Landscapes and Communities Project: Taking Transformative Action in the NSW Murray Catchment Region.* Canberra, Australia: Rural Industries Research and Development Corporation.

Gunderson, L. H., and C. S. Holling, eds. 2002. *Panarchy synopsis: Understanding transformations in human and natural systems.* Washington DC: Island Press.

Hatt, K. 2013. Social attractors: A proposal to enhance "resilience thinking" about the social. *Society and Natural Resources* 26(1):30-43.

Holling, C. S. 1973. Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics* 4(1):1-23.

———. 1978. *Adaptive environmental management and assessment.* Chichester, UK: Wiley.

Kemmis, S., and R. McTaggart. 2005. Participatory action research: Communicative action and the public sphere. In *The SAGE handbook of qualitative research*, ed. N. K. Denzin and Y. S. Lincoln , 559-603. Thousand Oaks, CA: Sage.

Kolb, D. A. 1984. *Experiential learning: Experience as the source of learning and development.* Englewood Cliffs, NJ: Prentice Hall.

Lebel, L., J. M. Anderies, B. Campbell, C. Folke, S. Hatfield-Dodds, T. P. Hughes, and J. Wilson. 2006. Governance and the capacity to manage resilience in regional social-ecological systems. *Ecology and Society* 11(1):19.

Leith, P., B. Jacobs, P. R. Brown, and R. Nelson. 2012. A participatory assessment of NRM capacity to inform policy and practice: Cross-scale evaluation of enabling and constraining factors. *Society and Natural Resources* 25(8):775-793.

Lockwood, M., J. Davidson, A. Curtis, E. Stratford, and R. Griffith. 2009. Multi-level environmental governance: Lessons from Australian natural resource management. *Australian Geographer* 40(2):169-186.

Lockie, S. 2001. SIA in review: Setting the agenda for impact assessment in the 21st century. *Impact Assessment and Project Appraisal* 19(4):277-287.

Magis, K. 2010. Community resilience: An indicator of social sustainability. *Society and Natural Resources* 23(5):401-416.

Mitchell, M. 2013. From organisational learning to social learning: A tale of two organisations in the Murray-Darling Basin. *Rural Society* 22(3): 230-241.

Moore, M., and O. Tjornbo. 2012. From coastal timber supply area to Great Bear Rainforest: Exploring power in a social-ecological governance innovation. *Ecology and Society* 17(4):26.

Olsson, P., C. Folke, and F. Berkes. 2004. Adaptive comanagement for building resilience in social-ecological systems. *Environmental Management* 34(1):75-90.

Olsson, P., C. Folke, V. Galaz, T. Hahn, and L. Schultz. 2007. Enhancing the fit through adaptive co-management: Creating and maintaining bridging functions for matching scales in the Kristianstads Vattenrike Biosphere Reserve, Sweden. *Ecology and Society* 12(1):28.

Olsson, P., L. H. Gunderson, S. R. Carpenter, P. Ryan, L. Lebel, C. Folke, and C. S. Holling. 2006. Shooting the rapids: Navigating transitions to adaptive governance of social-ecological system. *Ecology and Society* 11(1):18.

Reed, M. S., A. C. Evely, G. Cundill, I. Fazey, J. Glass, A. Laing, J. Newig, B. Parrish, C. Prell, C. Raymond, and L. C. Stringer. 2010. What is social learning? *Ecology and Society* 5(4):r1.

Resilience Alliance. 2010. Assessing resilience in social-ecological systems: Workbook for practitioners (Revised version 2.0). Available from http://www.resalliance.org/index.php/resilience_assessment.

Silver, J. J. 2008. Weighing in on scale: Synthesizing disciplinary approaches to scale in the context of building interdisciplinary resource management. *Society and Natural Resources* 21(10):921-929.

Smith, A., and A. Stirling. 2010. The politics of social-ecological resilience and sustainable socio-technical transitions. *Ecology and Society* 15(1): 11.

Tompkins, E. L., and W. N. Adger. 2004. Does adaptive management of natural resources enhance resilience to climate change? *Ecology and Society* 9(2):10.

Walker, B. H., N. Abel, J. M. Anderies, and P. Ryan. 2009. Resilience, adaptability, and transformability in the Goulburn-Broken Catchment, Australia. *Ecology and Society* 14(1):12.

Walker, B. H., S. R. Carpenter, J. M. Anderies, N. Abel, G. S. Cumming, M. Janssen, L. Lebel, J. Norberg, G. D. Peterson, and R. Pritchard. 2002. Resilience management in social-ecological systems: A working hypothesis for a participatory approach. *Conservation Ecology* 6(1):14.

Walker, B. H., C. S. Holling, S. R. Carpenter, and A. P. Kinzig. 2004. Resilience, adaptability and transformability in social-ecological systems. *Ecology and Society* 9(2):5.

Walker, B. H., and D. Salt. 2006. *Resilience thinking: Sustaining ecosystems and people in a changing world*. Washington, DC: Island Press.

Walker, B. H., and D. Salt. 2012. *Resilience practice: Building capacity to absorb disturbance and maintain function*. Washington, DC: Island Press.

Walters, C. 1986. *Adaptive management of renewable resources*. New York, NY: McGraw Hill.

Westley, F., and N. Antadze. 2010. Making a difference: Strategies for scaling social innovation for greater impact. *Innovation Journal* 15(2):1-19.

Young, O. R. 2010. Institutional dynamics: Resilience, vulnerability and adaptation in environmental and resource regimes. *Global Environmental Change* 20(3):378-385.