International Journal of the Commons
Vol. 11, no 1 2017, pp. 248–274
Publisher: Uopen Journals
URL:http://www.thecommonsjournal.org
DOI: 10.18352/ijc.696

ISSN: 1875-0281

Purposeful collective action in ambiguous and contested situations: exploring 'enabling capacities' and cross-level interplay

James Patterson
Institute for Environmental Studies (IVM), Vrije Universiteit Amsterdam (VU), The Netherlands
james.patterson@uqconnect.edu.au

Abstract: Purposeful collective action is important for sustainably managing many kinds of natural resource issues in social-ecological systems. However, cultivating purposeful collective action is challenging in ambiguous and contested situations involving multiple issues, actors, levels, and drivers, and weak or missing feedback. A particular example is the problem of managing waterway health in large and diverse landscapes. This paper analyses the emergence of purposeful collective action for managing waterway health, focusing on a case study of a large and diverse region in Australia. It applies a heuristic developed to guide inquiry into 'enabling capacities' underpinning purposeful collective action, to analyse three local cases embedded within a broader regional landscape. A diverse range of enabling capacities at both local and regional levels, and cross-level interplay between these levels, are shown to be important. Findings imply that efforts to generate purposeful collective action require building enabling capacities across multiple levels of organisation, from which contextually-appropriate and adaptive action can emerge. Moreover, findings indicate the need for a practice-focused 'knowledge-action perspective' that recognises the importance of intersubjectivity and agency. The paper demonstrates a promising approach for investigating purposeful collective action in ambiguous and contested water and environmental governance situations.

Keywords: Ambiguity, capabilities, conflict, environmental governance, implementation, multi-level, multi-scale, water governance

Acknowledgement: The author thanks the anonymous reviewers for their constructive comments which helped to significantly improve the paper. This original study was supported by an Australian Postgraduate Award, a Queensland Government Smart Futures PhD Top-Up scholarship, and financial and in-kind

support provided by the University of Queensland and Healthy Waterways Limited (http://www.healthywaterways.org). The arguments presented also benefitted from subsequent conversations with colleagues at the University of Waterloo, and the 2014 Earth System Governance conference in Norwich, UK.

1. Introduction

Collective action is fundamental to sustainably managing many kinds of natural resource issues in social-ecological systems (Ostrom 2009; McGinnis and Ostrom 2014). This is a particular challenge in ambiguous and contested situations (e.g. involving multiple issues, actors, levels, resources, drivers, and weak or missing feedback) (following Kerr 2007; Poteete 2012; Marshall et al. 2013). Many contemporary environmental governance challenges are of this nature (Lubell 2015). Examples include: managing aquatic ecological health (Vörösmarty et al. 2005), conserving terrestrial ecosystems and biodiversity (Wyborn and Bixler 2013), and adapting to climate change in regional landscapes (Keskitalo 2010).

There is growing interest in understanding and analysing collective action in large and diverse social-ecological systems (Ostrom 2009; Marshall et al. 2013; Fleischman et al. 2014; McGinnis and Ostrom 2014). However, this can be very difficult because different actors have differing perspectives, knowledge, interests, and values, leading to uncertainty, ambiguity, and disagreement about both problems and solutions (Ison et al. 2007; Brugnach and Ingram 2012). Responsibilities for addressing causes of problems can be disputed and fragmented across multiple sectors and levels of organisation, and complicated by misaligned timeframes among various policy and decision-making cycles. Feedback between resource use and its consequences may be weak or missing, making it difficult to clearly identify causality, and to attribute accountabilities to specific actors.

Purposeful collective action, as defined in this study, entails multiple actors taking action intentionally to manage resources and shape change in a social-ecological system. This could focus on resource appropriation, or conservation and enhancement of the provisioning of public goods (e.g. ecosystem services). Considering collective action of a purposeful nature, particularly in situations characterised by contestation and ambiguity, raises a range of conceptual challenges (Ison et al. 2011; Thiel et al. 2015). For example, design principles that underpin the emergence of self-organised collective action for local resource appropriation problems (such as inshore fisheries, irrigation, forests, and groundwater basins) (Ostrom 1990) become difficult to apply. Problem boundaries may be unclear, actors may be heterogeneous with differing knowledge and perspectives, sanctions based on social relations and trust may be difficult or impossible to apply, and effective conflict resolution mechanisms may not be available. Actors may be temporally, spatially, and institutionally fragmented, those who cause impacts are not necessarily those affected, and feedback to actors on the impacts of their resource use may be weak obscuring the potential for building mutual understanding and motivation. Social processes related to agency, social construction, and

learning are likely to be particularly important (Bouwen and Taillieu 2004; Ison et al. 2007; Berkes 2010).

In response to these challenges, this paper applies a novel heuristic (Patterson et al. 2013) to explore how purposeful collective action can be understood and analysed systemically in ambiguous and contested water and environmental governance situations. This heuristic focuses on 'enabling capacities' across multiple levels of organisation underpinning the emergence of purposeful collective action. The concept of enabling capacities aims to provide a way to distill a plethora of relevant factors, which are often discussed in a fragmented way in the water and environmental governance literature, into a systemic heuristic to guide context-specific inquiry (Section 2). The heuristic takes a complex systems perspective (Duit et al. 2010; Ison 2010) where collective action is viewed as emergent from enabling capacities and their interplay. The notion of emergence refers to properties that arise from complex interactions, which could not be predicted by looking at sub-components of the system separately (Cilliers 2002; Ison 2010). The heuristic is applied in a case study of efforts to manage waterway health in the large and diverse region of South East Queensland (SEQ), Australia, focusing on three local catchment cases embedded within the broader region. The heuristic is used to analyse enabling capacities and cross-level interplay between local and regional levels that underpinned purposeful collective action in practice. This contributes to empirically validating the heuristic within the problem domain of waterway health, but also demonstrates its broader utility for other water and environmental problem domains where purposeful collective action is needed. The structure of the paper is as follows: Section 2 gives a theoretical overview of key challenges in studying purposeful collective action and presents the analytical heuristic; Section 3 explains the methodology applied; Section 4 presents an overview of the in-depth case study; Section 5 presents the empirical results; and Section 6 discusses implications for understanding purposeful collective action in ambiguous and contested situations more generally.

2. Purposeful collective action

This section elaborates on key challenges in studying purposeful collective action in ambiguous and contested situations, namely: multiple resource issues, actors, levels, drivers, and weak or missing feedback. It then explains why a complex systems perspective is required, and presents the analytical heuristic.

2.1. Conceptual and analytical challenges

Social-ecological systems involve multiple interconnected resource issues (e.g. water, land, biodiversity, climate, human infrastructure), which may be linked across different scales, making for complex clusters of resource appropriation and provisioning systems (McGinnis and Ostrom 2014). For example, managing water resources and aquatic ecological health in landscapes involves managing issues of water resource appropriation (Meinzen-Dick 2007), point source pollu-

tion (e.g. industry, sewage treatment plants), nonpoint source pollution (e.g. run-off from agricultural and urban areas), and cumulative patterns of land use change (Smith and Porter 2010; Patterson 2014). There is growing interest in understanding multi-issue collective action problems (Dolsak and Ostrom 2003; Ostrom 2009), although this is challenging because it brings in multiple sets of actors, governance processes, and dynamics and drivers of social-ecological change.

The involvement of multiple actors is a key challenge. Actors could include government, industry, academia, civic, or hybrid actors (e.g. bridging organisations). Different actors have heterogeneous perspectives, knowledge, interests, and values. Ambiguity can arise as a result of differing perspectives and frames among actors (Brugnach and Ingram 2012), indicating the importance of social learning for building some degree of mutual understanding (Bouwen and Taillieu 2004; Ison et al. 2007). Decisions may involve competing interests and be contested, indicating a need for ways of fostering coherence among activities of different actors (Marshall et al. 2013).

The multi-level nature of governance systems within which collective action occurs is a key challenge. Governance systems typically involve multiple levels of organisation, whether viewed in jurisdictional terms (e.g. municipal, state/provincial, and national governments), or in functional terms (e.g. operational, collective choice, and constitutional levels of analysis [following Ostrom 2005: 59]; or action, organisational, and policy levels [following Margerum 2008]). Local collective action will be linked to actors, institutions, and drivers across multiple levels of organisation (Ostrom 1990, 2005; Berkes 2002; Adger et al. 2005). Governance contexts for collective action may be polycentric, involving multiple relatively autonomous yet interdependent decision-making centres (Marshall 2008; Oakerson and Parks 2011).

A final key challenge is weak or non-existent feedback between the actions of actors and the consequences of their actions for resource sustainability. In local resource appropriation dilemmas, actors are typically 'close' to the management issue and more directly experience feedback from improvement or deterioration in the resource base. In contrast, actors in multiscalar social-ecological systems may be separated from feedback on the consequences of their actions. Furthermore, actors who produce a problem may not necessarily be those affected, and hence may not be easily motivated to participate in collective action to solve the problem. By the same token, actors who invest in working collectively to address an issue (e.g. mitigating water pollution, conserving biodiversity, adapting to climate change) may not see any immediate or direct payoff from their efforts, which can be a disincentive for taking purposeful collective action. Hence the 'closeness' or 'proximity' of actors to feedback from a problem situation is likely to have bearing on collective motivation and action.

2.2. Need for a complex systems perspective

A complex systems perspective is needed for studying purposeful collective action in ambiguous and contested social-ecological systems, because collective

action is likely to be influenced by a large number of variables and interactions, and involve high degrees of uncertainty and indeterminacy. A complex systems perspective implies that what it is possible to know about a situation is inherently limited (Cilliers 2002). It focuses attention "on emergent properties arising from the interaction between different parts be they systems or agents; … and on understanding system dynamics over time" (Duit et al. 2010). 'Emergent properties' are properties that arise "at a particular level of organisation [in ways that] are not possessed by constituent sub-systems", and are generated through "relational dynamics between the elements or subsystems that comprise a system" (Ison 2010). For example, integrated water management has been framed as being a problem of creating emergent patterns of coherent collective action (Marshall et al. 2013), and as an emergent property of joint practices in a particular context (Collins and Ison 2010).

2.3. Analytical heuristic

The analytical heuristic applied in this study is shown in Figure 1. This heuristic identifies 'enabling capacities' underpinning the emergence of purposeful collective action in ambiguous and contested situations, and was originally developed based on adaptive water and environmental governance literature (Patterson et al. 2013). Reflecting a complex systems perspective, collective action is viewed as emergent from a diversity of enabling capacities, and their interplay across multiple levels of organisation. 'Enabling capacities' are ana-

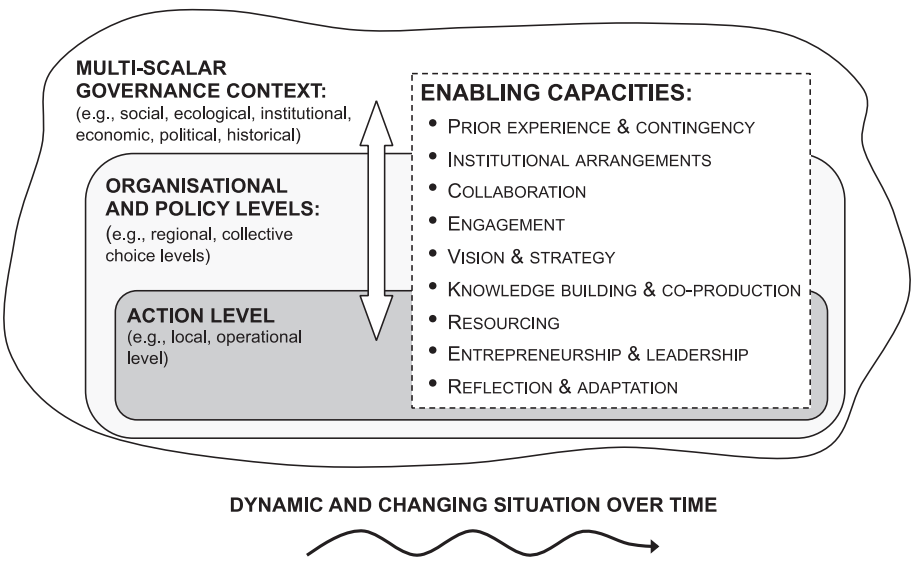

Figure 1: Analytical heuristic for exploring 'enabling capacities' underpinning purposeful collective action in contested and ambiguous situations (source: Patterson et al. 2013).

lytical constructs that attempt to synthesise functional clusters of more detailed variables and interactions, in order to capture important practical properties of a management system.

The heuristic aims to distil a wide range of factors that are potentially important for collective action. Collective action is nested and embedded within multiple levels of functional organisation (Ostrom 2005; Margerum 2008). The role of the heuristic is to guide theoretically-informed inquiry within a particular empirical setting, respecting the key role of context in conditioning the specific ways that purposeful collective action emerges. It provides a tool for systemic inquiry and cross-case comparison.

The analytical heuristic identifies nine enabling capacities that are understood to be important in underpinning the emergence of collective action (Patterson et al. 2013). These capacities are broad and open-ended because their purpose is to guide context-specific inquiry across diverse situations. Thus the capacities should be critically interpreted in ways that make sense in a given setting. The capacities identify key areas that are likely to be all important to some extent in any situation, yet the specific details of how they manifest might vary between different places, such as places with differing degrees of formal or informal character to their governance systems. Assessing enabling capacities involves informed interpretive analysis.

Prior experience & contingency refers to the capacity for action created by prior experiences of working together (e.g. existing relationships, knowledge, memory) (Ostrom 2005). *Institutional arrangements* refers to the capacity of the overall set of formal arrangements (e.g. regulations, policies, organisational setups) to enable and support collective action (Folke et al. 2005; Pahl-Wostl 2009). *Collaboration* refers to the capacity for actors to work collaboratively in practice, including relationships and trust among them (Bouwen and Taillieu 2004; Margerum 2008). *Engagement* refers to buy-in, and commitment of important actors who need to be involved in addressing a problem (Röling and Wagemakers 1998). *Vision & strategy* refers to the capacity to align visions, goals, and problem framings between actors and across different levels of organisation (Westley 1995; Brugnach and Ingram 2012). *Knowledge building & co-production* refers to the capacity to collectively generate and integrate relevant knowledge, in the context of different types of knowledge and ways of knowing (Blackmore 2007; Brugnach and Ingram 2012). *Resourcing* refers to the capacity to generate and sustain needed resources, such as financial, organizational, human resources, and authority (Robins 2008). *Entrepreneurship & leadership* refers to the capacity for social entrepreneurship (e.g. brokering relationships, providing agency in networks), and policy entrepreneurship (e.g. identifying windows of opportunity, influencing political leaders) (Meijerink and Huitema 2010; Moore and Westley 2011). *Reflection & adaptation* refers to the capacity for deliberate collective reflection and adaption among actors over time, generating and utilising relevant feedback, and learning across multiple levels (Folke et al. 2005; Pahl-Wostl 2009).

3. Methodology

The paper centres on an in-depth case study of ongoing efforts to manage waterway health in a rapidly urbanising coastal region in Australia – South East Queensland (SEQ). The concept of 'waterway health' encompasses both aquatic ecosystem health (e.g. water quality, ecosystem function), as well as its relationship to human wellbeing (e.g. social, cultural, health, and economic values) (SEQHWP 2006). The emergence of collective action was analysed in three contrasting local cases within the SEQ region, reflecting an embedded case design comprised of a single overall case with three embedded units of analysis (following Yin 2009, p. 46), which together comprised the in-depth case study. This approach allowed for examining how collective action arose in three contrasting cases within the same broader region. The local cases were each places that were widely considered by experts in the region to be innovative and successful in terms of fostering collective action for managing waterway health, and each had seen concerted effort through recent management or policy initiatives during the last 4–7 years. Although the three cases reflect a snapshot of several of the most significant challenges facing SEQ (Section 4), they are not intended to provide generalisability, but instead provide opportunities to explore the emergence of purposeful collective action in a variety of (arguably) 'successful' cases. The case study involved sustained engagement over 3 years (2010–2013) with a key regional science-policy organisation that has a long history of leading and coordinating activities in SEQ ('Healthy Waterways'). This allowed access to data sources, experts, and other organisations.

Data collection involved multiple methods, principally in-depth key informant interviews, as well as field observation (e.g. attending field days and committee meetings), and document review (including grey literature e.g. policy documents, project reports) (following Mason 2002). An initial round of unstructured key informant interviews (n=10) was conducted across the local cases to begin build a foundation for the subsequent main round of semi-structured key informant interviews (n=43). Key informants were drawn from multiple organisations active in each local case and in the broader SEQ region, which included local government (n=14), state government (n=7), waterway and natural resource management bodies (n=8), community environment groups (n=3), landholders (n=2), agricultural industry groups (n=2), water utility (n=1), scientists (n=2), consultants (n=4), and Aboriginal Traditional Owner representatives (n=2). Informants were selected through expert recommendation from Healthy Waterways, scoping activities (e.g. document review), and snowballing (Patton 1990). Sampling ended when a critical pragmatic judgment was made regarding 'saturation' (i.e. little new information being revealed by further interviews).

The analytical heuristic (Figure 1) provided a basis for the empirical study to ensure that data collection was theory-informed, while also allowing space for unexpected findings. Interview questions were kept general using neutral language that did not mention the enabling capacities to avoid leading questions and

facilitate semi-structured (i.e. partly open-ended) responses. Interview questions covered topics including current and emerging issues in each local case and the region, challenges for water quality and waterway health, strategies and initiatives being taken, and drivers and barriers for action. This generated a large body of data that was coded according to the categories of the heuristic to examine which enabling capacities were present, how they manifested, and whether there were any further capacities or other data that could not be explained by the heuristic. Data was coded using a systematic manual approach (rather than a specific software program) because this better suited the interpretive nature of the interview data. Thus operationalising the heuristic was an interpretive and partly inductive process due to the explorative nature of the research. 'Measuring' the enabling capacities involved an interpretive assessment based on the body of interview data available in each local case and at a regional level. Cross-level interplay was interpreted from the data by considering whether (and how) local and regional levels interacted, from the perspective/lens of each capacity. For example, how did local and regional levels interact in terms of institutional arrangements, collaboration, knowledge, etc.?

4. Case study: managing waterway health in South East Queensland, Australia

SEQ is a large region (approximately 23,000 km^2) containing diverse landscapes, and changing land uses and human activities (Figure 2). It contains the state capital city of Brisbane and its urban surrounds, a rapidly expanding peri-urban fringe, extensive rural and agricultural land uses, and ecologically significant terrestrial flora and fauna (SEQHWP 2006; DIP 2009). It is one of the fastest growing regions in the country, with a population of 2.8 million in 2006 forecast to expand to 4.6 million by 2031 (DIP 2009). Waterway health is recognised as a major sustainability challenge (SEQHWP 2006; Bunn et al. 2010). The region's many fresh and estuarine waterways flow into the highly ecologically-significant marine receiving water body of Moreton Bay (SEQHWP 2006), which is marine park and recognised in international agreements such as Ramsar. Waterways provide many social, economic and cultural values that underpin human wellbeing in the region (e.g. agriculture, tourism, recreation industries, water treatment, lifestyle, amenity) (SEQHWP 2006).

4.1. Regional governance context

The SEQ region has a long history of collaborative and self-organised waterway management activities over two decades (SEQHWP 2006; Patterson 2014). Many actors spanning multiple levels are involved in managing waterways, including all levels of government (local, state, national), waterway and natural resource management (NRM) bodies, community groups, industry, Aboriginal Traditional Owners, scientists, and citizens. Nonpoint source pollution has emerged as a key focus of collective efforts in the last decade, following earlier successes address-

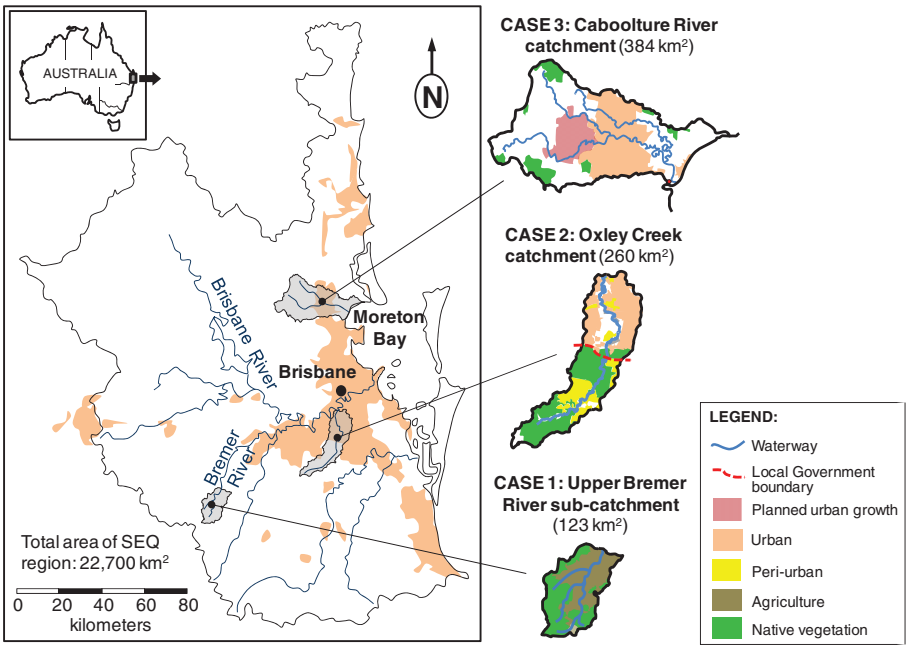

Figure 2: The South East Queensland region and the three local cases studied.

ing point source pollution from sewage treatment plants (SEQHWP 2006; Bunn et al. 2010). Nonpoint source pollution refers to pollutants (e.g. sediments, nutrients, toxicants) released broadly across landscapes in both rural areas (e.g. agricultural runoff and erosion) and urban areas (e.g. urban stormwater runoff) (Smith and Porter 2010; Patterson 2014). Addressing nonpoint source pollution is proving very difficult in the context of the multiple issues, actors, levels, drivers, and weak and unclear feedback between the impacts of the many resource uses and users on overall waterway health (Bunn et al. 2010; Patterson 2014). Generating purposeful collective action to address this issue is a major challenge.

Two collaborative bodies are particularly prominent at a regional level: a science-policy partnership called 'Healthy Waterways' (partners include: state and local government, research organisations, community groups), and an NRM body called 'SEQ Catchments' (partners include: federal and local government, agricultural landholders, community groups). Both organisations act as regional multi-actor platforms performing 'bridging' roles (Hahn et al. 2006) through providing horizontal (cross-sectoral) and vertical (cross-level) institutional linkages. A waterway health agenda has been driven in SEQ for over two decades by these organisations, which has included: collaborative science-based waterway and NRM strategies, tracking aquatic ecosystem health of waterways and high-profile public engagement, and ongoing programs (e.g. science and planning, commu-

nication and education, on-ground urban and rural programs) (SEQHWP 2006; Bunn et al. 2010). Local and state governments have also pursued a variety of policies and programs for waterway health and NRM during this time.

4.2. Description of the local cases

Three particular local catchments that have each seen concerted efforts to foster collective action in recent years are the Upper Bremer River sub-catchment, the Oxley Creek catchment, and the Caboolture River catchment (Figure 2). The Upper Bremer River sub-catchment is a rural catchment located in the upper reaches of SEQ, and is a hotspot for sediment pollution impacting downstream waterways and Moreton Bay, caused by agricultural land use activities and erosion (Crimp 2012). The Oxley Creek catchment has a complex mix of land uses and is heavily urbanised in its lower reaches (Schmidt and Morrison 2012), and is considered one of the most severely degraded waterways in SEQ. The Caboolture River catchment is located on the expanding urban fringe of SEQ, and considered vulnerable, yet set to experience major future urban expansion (BMT WBM 2010). These three cases involved contrasting local contexts (geographically, institutionally, socially), drivers of change, and initiatives and arrangements for fostering collective action (Table 1). Together they encompass a snapshot of some of the most pressing waterway health challenges facing the SEQ region overall (e.g. population growth, urbanisation, legacy impacts of degraded waterways and heavily modified landscapes). All three are also considered to be among the most

Table 1: Key features of local cases studied.

	Case 1: Upper Bremer River sub-catchment	Case 2: Oxley Creek catchment	Case 3: Caboolture River catchment
Area	123 km^2	260 km^2	384 km^2
Land use	Rural, native forest	Urban, peri-urban, rural, forest	Urban, peri-urban, rural
Waterway health issues	Sediment pollution from rural land use activities	Erosion and instability from past degradation; urban pressures	Rural and urban pollution, urban pressures
Drivers of collective action	• Regional program • Regional waterway health goals	• Community and local government concern • Urban renewal planning	• Local government concerns • State government policy for water cycle planning
Forms of collective action	• On-ground restoration	• On-ground restoration • Strategic land use planning	• 'Total water cycle management' planning
Actors involved	Landholders, NRM staff, scientists, state government	Local government, community group, industry, urban developers, scientists	Local government, water utility, consultants, state government, scientists
Institutional arrangements	Regional program involving multi-actor, multi-sector coordination	Local Government-led 'Taskforce'	Local Government-led coordination group
Contemporary initiatives	2007–2011	2006–2013 (ongoing)	2009–2013 (ongoing)

innovative examples of collective action to address difficult nonpoint source pollution issues in the region.

4.3. Collective action in the local cases

Differing forms of collective action occurred in the three local cases. In Case 1 collective action focused on on-ground restoration of degraded streams, involving innovative collaboration between landholders, NRM staff, and scientists. This was driven by a 4-year regional program ('Healthy Country') that aimed to foster a cross-sectoral, cross-level partnership approach to addressing rural nonpoint source pollution using non-coercive mechanisms (e.g. local facilitation, financial incentives). In Case 2, collective action involved innovative on-ground restoration of degraded streams (through collaboration between local government and a long-standing community catchment group) and strategic planning in the context of contested land use interests (e.g. conservation vs urbanisation, post-industrial land use transition). This was driven by a local government-led 'Taskforce' on waterway health using a mix of non-coercive mechanisms (e.g. community and business engagement), negotiatory mechanisms (e.g. negotiation between local government, state government, and industry), and coercive mechanisms (e.g. enforcing regulatory compliance by industry). In Case 3, collective action involved strategic planning to develop an innovative whole-of-water-cycle strategy for managing waterway health through collaboration between local government (including multiple internal departments, elected political representatives), a water utility, and consultants. This was driven by a local government-led coordination group using non-coercive mechanisms (e.g. internal organisational engagement) and negotiatory mechanisms (e.g. negotiation between Local Government and the water utility on joint funding).

4.4. Outcomes in the local cases

A variety of environmental, social and institutional outcomes were achieved in the three cases. Cases 1 and 2 were widely considered to have made significant progress in reducing acute sources of sediment pollution from degraded streams, and improving management of private lands (Crimp 2012; Patterson 2014). However, pollution reductions were not assessed quantitatively in either case (due to lack of appropriate monitoring, and attribution challenges such as time lags and weather variability). Cases 2 and 3 involved strategic planning and were considered to have made significant progress embedding waterway health actions within urban planning in Local Government (BMT WBM 2010; Patterson 2014). However, perhaps the most significant outcome across all cases was innovation and learning to collectively address complex waterway health issues in new ways. Innovative forms of collective action emerged over time, often in ways that were not foreseen at the outset. In Case 1, on-ground restoration arose through collaboration and knowledge co-production and through active experimentation to develop innovative on-ground measures, despite earlier conflict. In Case 2, actors experimented

and adapted their actions over time as new knowledge and policy windows of opportunity arose, in the absence of a clear strategy in advance. In Case 3, actors innovated in building a comprehensive knowledge base and working to build deep organisational commitment to meet an ambitious new state government policy goal.

5. Results

In this section the analytical heuristic (Figure 1) is applied to analyse enabling capacities and cross-level interplay underpinning the emergence of purposeful collective action in the three local cases. The results of this analysis are presented below, and summarised in Table 2.

5.1. Enabling capacities

5.1.1. Local level

Enabling capacities at a local level manifested in varying ways in the three cases, yet many commonalities were observable in the way they contributed to the emergence of purposeful collective action.

Prior experience & contingency was important for creating a receptive starting point for contemporary initiatives, through prior experience of water and NRM activities, and pre-existing relationships, and knowledge. It is unlikely that the contemporary initiatives would have occurred in the absence of this prior experience. For example, in Case 1 (a rural setting), landholders and state government had previously collaborated positively on an unrelated issue (fire management) creating residual trust and openness, which benefitted contemporary initiatives because "landholders are usually ... apprehensive of government. ...there's a lot of mistrust of government" (Interviewee#5). In Case 2 (an urban setting), prior experience of collaboration during the 1990's via an 'integrated catchment management' group (involving local, state and national governments, community, industry, scientists) provided background knowledge and a memory of past collaboration, which continued to embodied in an enduring community group who played a key role within the contemporary initiatives.

Institutional arrangements were important in creating platforms for multi-actor interaction at a local level. These platforms were created during the contemporary initiatives, and were considered by participants to be vital for allowing and encouraging multiple actors to interact in new ways. For example, in Case 1 a local committee was formed (involving landholders, NRM staff, state government, scientists) to make decisions about actions and investments, and was later considered "essential to the success of the project" (Interviewee#12). Formal arrangements for cross-sectoral and cross-level coordination (Section 4.3) were also vital. Case 3 established a coordination group (involving multiple local government departments, a water utility, consultants, scientists) which led knowledge-building and

planning following a volatile period of institutional change affecting urban water management roles and local government boundaries.

Collaboration was supported by institutional arrangements, and involved multiple actors working together in a problem-focused way at a local level. Collaboration did not necessarily pre-exist, but developed in both planned and evolving ways as the various initiatives unfolded, with relationships and trust being built over time. For example, in Case 1 despite beneficial prior experience, it took time to build collaboration at a local level, particularly due to persistent tensions among regional organisations. In Case 3, collaboration developed through concerted efforts by a core team of a small number of individuals spanning local government, a water utility, and consultants, who worked to engage and involve several other local government departments and elected officials.

Engagement was important in terms of involving relevant actors and building buy-in and commitment. The nature of engagement varied significantly between the cases, linked to problem and context. For example, Case 1 involved non-coercive approaches focused on building relationships and trust with landholders because on-ground actions focused on private lands, yet "if you don't have the landholders' confidence and trust then you're not going to get anywhere" (Interviewee#12). However, there were also major challenges due to early tensions between landholders and scientists and the relatively short 4-year program timeframe. Case 2 involved a 'negotiatory' approach focused on aligning multiple interests and concerns related to waterway health, and urban planning (especially local and state government, community groups, and urban developers). Coercive approaches were also employed regarding particular industrial landholders conducting poor or illegal practices, which would have been unlikely to occur without the political mandate of the Taskforce. Interestingly, all cases focused on engaging strategically-important actors who were vital to successful action (due to their institutional roles, powers, or resources), rather than necessarily widespread engagement.

Vision & strategy were important in terms of building mutual agreement about goals, and reframing regional issues to align with local concerns. For example, Case 1 was driven by a regional science-policy goal for waterway health (reducing nonpoint source pollutants), but this goal was not necessarily shared by local landholders who were concerned with local issues such as land productivity and weed management. A critical step was re-framing broad waterway health goals in terms of local concerns such as riparian restoration that bridged both sets of concerns. In Case 3, problems were initially framed as 'river recovery' but broadened over time to 'total water cycle management' (TWCM) which encompassed both water quantity and quality. This was also influenced by political concerns about whether state government planning targets for urban expansion compromised the ability of local government to meet simultaneous environmental protection targets for waterway health.

Knowledge building & co-production was important in terms of bringing together technical and local knowledge, in ways that reflected evolving forms of knowledge co-production. This was not planned in advance, but evolved in response to practical needs to bring together knowledge of different actors to inform action. For example, Case 1 involved knowledge co-production among scientists, landholders and NRM staff, but only following conflict that threatened to de-rail the initiative midway due to landholder resistance to an initially science-driven approach. Nonetheless, eventually "a common interest, a sharing of information and a common working through of problems and looking for solutions and way forward" (Interviewee#5) was achieved. Case 2 involved bringing together different types of knowledge (e.g. technical, policy, local) through ongoing collaboration between several actors (especially local government and a community group). This was vital for identifying issues and possible solutions in a complex setting, and also allowing these actors to gain a greater understanding of each other's concerns and constraints. Case 3 had an emphasis on technical knowledge, but later broadened to involve local government elected officials to incorporate knowledge about socially and politically feasible options for future action.

Resourcing (financial, human, organisational) was important for allowing many of the actions taken in each case. Having substantial resources provided by regional actors to the local level was unusual. In Case 1 a large amount of money was available for on-ground works ($1.65 m AUD) because it was one of three pilot catchments within a broader high-profile regional initiative ('Healthy Country'). This occurred within the context of general anxieties about declining investment in catchment and NRM activities over the last decade. In Case 2, a large amount of money was made available by local government (which is an atypically large entity in Brisbane), including $5 m AUD for strategic site acquisitions along the waterway corridor for restoration, and $1 m AUD for on-ground restoration works. Additionally, the political and institutional authority of the Taskforce was important for conferring a mandate to negotiate with private actors and take coercive action in some situations. However, in contrast, the local community group which played a critical role in the Taskforce has been poorly resourced for many years and was struggling to survive, despite being recognised as having a critical role and maintaining responsibility in the catchment for over a decade.

Entrepreneurship & leadership was reflected through critical roles played by key individuals (and alliances between them) in facilitating collaboration, knowledge co-production, and generating agency in local and cross-level networks. This was pivotal to the success of collective action in all cases, particularly in dealing with the challenges of the ambiguous and contested situations (e.g. fragmented roles and responsibilities, often unclear courses of action, tensions between individuals and organisations). For example, in Case 1 key NRM staff were critical in building relationships and trust between landholders, scientists and government, particularly in response to earlier conflict. Furthermore, a particular landholder

played a pivotal role in galvanising the support of other landholders. In Case 2, key individuals from the Taskforce and the community group were vital for identifying tangible actions and priorities in the absence of a clear strategy at the outset, which eventually led to it becoming "a lead agent for change" (Interviewee#23) in a catchment often viewed apathetically due to its complexity. In Case 3, key individuals in local government and a water utility were pivotal in recognising a window of opportunity created by a new state government policy to pursue a bold approach to waterway management, and later, to engage elected political officials in knowledge elicitation and decision-making.

Reflection & adaptation was reflected through 'learning-by-doing' at local level to develop new ideas and experiment with actions for dealing with difficult nonpoint source pollution issues. For example, in Case 1, local level actions evolved and adapted over time in the absence of a clear strategy at the outset (beyond general goals to engage landholders and implement on-ground works), and found ways of linking scientific and local knowledge as a basis for action. In Case 2, reflection and adaptation was vital for crafting a collective agenda and identifying tangible opportunities for action within the relatively 'open' scope of the Taskforce, and even restructuring participation of the Taskforce over time to "refresh, re-motivate, and renew" it (LocalGovt#7). In Case 3, the nature and focus of the coordination group changed over time (as problems were reframed from 'river recovery' to 'TWCM planning') to become more strategically focused on opportunities for policy influence. In all cases, key individuals underpinned and drove collective reflection and adaptation.

5.1.2. Regional level

Enabling capacities at a regional level were crucial for creating the broader governance context for local collective action (Table 2). These capacities also tend to occur over longer timeframes than at the local level. SEQ has a long history of collaboration for managing waterway health spanning over two decades, with the accumulated knowledge, experience, and public and political support providing a supportive regional governance context for local collection action (*Prior experience & contingency*). Regional collaboration (*Collaboration*) occurs largely through two regional multi-actor platforms (Section 4.1) which have provided flexible yet enduring structures for many actors from across different sectors and levels to interact (*Institutional arrangements*), and through which to continually work to engage others (*Engagement*). There have been ongoing efforts to build comprehensive scientific understanding of waterway health issues (*Knowledge building & co-production*), develop collaborative waterway management strategies that link science and policy (*Vision & strategy*), and jointly invest in agreed actions (*Resourcing*). A comprehensive regional monitoring program (Bunn et al. 2010) with annual 'report card' style reporting of waterway health across SEQ (to strong media and public interest) has been particularly important as a mechanism for ongoing science-policy feedback. This has triggered changes in problem fram-

ings over time (e.g. shift from point source to nonpoint source pollution). It also played a key role in triggering the local initiatives in all three local cases studied here (*Reflection & adaptation*). The leadership and influence of key individuals within various roles (e.g. local and state government agencies, science, community) (*Entrepreneurship & leadership*) is widely recognised as pivotal to these efforts (Patterson 2014).

5.1.3. Cross-level interplay

Cross-level interplay was important in underpinning collective action in the local cases (Table 2). This was explored through the lens of enabling capacities. Cross-level interplay occurred 'downward' (i.e. driven from the regional level), 'upward' (i.e. driven from the local level), or in both directions (i.e. driven simultaneously from both levels).

'Downward' cross-level interplay was largely associated with the presence and activities of the regional multi-actor platforms. For example, institutional structures and collaboration processes connected local actors to broader regional governance processes such as collaborative planning. Regional science-policy activities and long-term waterway health monitoring were key drivers for action in all three local cases (Sections 4.2, 5.1). This creates a regional context supportive of local action. However, there are also adverse pressures emanating from the regional level that affect the longer-term prospects for collective action at a local level within the cases and more widely in SEQ, particularly policy and funding uncertainty (e.g. Case 2 below).

'Upward' cross-level interplay was associated with strategies taken to connect local activities with regional activities. For example, aligning local concerns with regional priorities, such as land productivity and amenity (Case 1), urban renewal and post-industrial transition (Case 2), and managing population growth while preserving environmental health (Case 3). Local actors also worked to engage higher-level actors to support local activities in needed ways, such as acknowledging the value of local knowledge (Case 1), and supporting coercive action against illegal industrial practices (Case 2). Another key cross-level interaction was the learning experiences and wider interest generated in SEQ by the local cases, because 'success stories' flowed back to influence regional level thinking and planning. For example, Case 1 provided a formative experience that was the basis for a joint proposal among actors involved in the Healthy Country program (Section 5.1) to continue and upscale their efforts across SEQ (however, this proposal was rejected by state government treasury). Case 3 influenced state government policy, because their experimentation as an 'early adopter' under a new state government policy for TWCM planning led to its experienced feeding directly into policy guidelines for the broader SEQ region (Water by Design 2010).

Cross-level interplay in both directions was associated with collaborative relationships between actors across different levels, key individuals linking organisations and networks at different levels, and the enduring forums provided by multi-actor platforms for interaction between actors from different levels.

Table 2: Enabling capacities and cross-level interplay in the SEQ case study.

Enabling capacities	How the enabling capacities manifested		Cross-level interplay	
	Local level	Regional level		
Prior experience & contingency	Receptive starting point for contemporary initiatives due to prior relationships and knowledge base	Existing relationships, knowledge, and science-policy linkages through a long history of collaboration for managing waterway health over two decades	↓	Regional multi-actor platforms support local action over many years
			↑	Local actors participate in regional multi-actor platforms over many years
Institutional arrangements	Multi-actor platforms created at a local level provided mechanism for collaboration	Regional multi-actor platforms; regional policy and planning framework for waterways, NRM, and land use planning	↓	Regional multi-actor platforms formally link in local actors
			↑	Semi-formal links between local platforms and higher-level actors and networks
Collaboration	Problem-focused collaboration involving actors drawn across multiple levels	Ongoing regional collaboration for managing waterway health, largely fostered through the two regional multi-actor platforms	↓	Regional multi-actor platforms foster interaction among actors across multiple levels
			↑↓	Relationships between actors across levels
Engagement	Concerted efforts to engage strategically-important actors at local level (e.g. buy-in, commitment)	Concerted effort to engage strategically-important actors at regional level (e.g. government, industry), and to foster public and political engagement over time	↓	Regional multi-actor platforms working to engage local actors on waterway health issues
			↑	Local actors working to engage higher-level actors to support local activities in all cases
Vision & strategy	Building mutual agreement about collective goals, reframing regional initiatives to align with local concerns	Sustained efforts to collaboratively develop regional strategies linking science and policy, and multi-sectoral policy coordination	↓	Regional science-policy goals and collaborative waterway planning shape the context for local action
			↑	Efforts to align local concerns and priorities with regional goals and strategic priorities
Knowledge building & co-production	Efforts to combine technical and local knowledge through various forms of knowledge co-production	Strong technical knowledge base; major efforts to build science-policy linkages through regional collaboration over time	↓	Extensive knowledge about SEQ built up over time through regional multi-actor platforms
			↑	Efforts to link local knowledge meaningfully to scientific knowledge
Resourcing	Financial, human, and organisational resources made available for local activities by higher-level actors	Significant mobilisation and pooling of resources (e.g. financial, organisational, human) through regional collaboration over time	↓	Resources provided from broader levels to local level (e.g. financial, organisational, human, authority)

Table 2: (continued)

Enabling capacities	How the enabling capacities manifested		Cross-level interplay	
	Local level	Regional level		
Entrepreneur-ship & leadership	Key individuals facilitated collaboration, knowledge co-production, and generated agency in local and cross-level networks	Key individuals and organisations played pivotal role in initiating and sustaining regional collaboration (e.g. leadership, advocacy, relationship brokering)	↑↓	Key individuals link organisations and networks across levels either formally, or by brokering relationships, and 'championing' local initiatives
Reflection & adaptation	Innovation and learning-by-doing at local level in response to challenges (e.g. unclear strategies for action, conflict)	Science-policy feedback mechanism through ongoing regional waterway health monitoring; evolving problem framings and focus of action over time	↓	Regional waterway health 'report card' monitoring provides ongoing knowledge feedback to local level
			↑	'Success stories' in each local case flowed back to influence regional level learning and collaboration
			↑↓	Regional multi-actor platforms provide forums for ongoing collective reflection and learning

6. Discussion

Key implications of this study for understanding purposeful collective action are now discussed, relating to: the emergence of collective action; mechanisms of cross-level interplay; the importance of a 'knowledge-action perspective', and reflections on the research approach.

6.1. The emergence of purposeful collective action

A key finding of this study is that efforts to generate purposeful collective action requires building enabling capacities across multiple levels of organisation, from which contextually-appropriate and adaptive action can emerge. In all the local cases purposeful collective action emerged from a diversity of enabling capacities and their interplay across local and regional levels (Section 5.2). It would therefore not be possible to understand the emergence of collective action by looking at only a subset of the capacities, because it was their combined and interactive influence that was most important.

However, is it possible to identify patterns in causal relations between particular capacities and the emergence of collective action? This is inherently difficult because the research approach is underpinned by a complex systems perspective that implies a lack of linear causality. Nevertheless, pushing the analysis further, reveals some possible temporal patterns in the relative importance of different enabling capacities over time. Each case involved a 'pulse' of activity over a period of 4–7 years (Section 4.2) which allows for looking at the stages of a process of generating purposeful collective action. In the early stages of each case, existing relationships and knowledge (*Prior experience & contingency*), the establishment of institutional platforms at a local level (*Institutional arrangements*), and the availability of resources (*Resourcing*) were important. As the cases progressed, efforts to build problem-focused collaboration (*Collaboration*), involve strategically-important actors who needed to be part of collective action (*Engagement*), forge agreement on collective goals and align regional priorities with local concerns (*Vision & strategy*), and co-produce knowledge to support action (*Knowledge building & co-production*) were important. Throughout all this time, the role of key individuals in facilitating these processes was especially pivotal (*Entrepreneurship & leadership*). Overall, the capacity of actors to collectively learn-by-doing, largely fostered by key individuals, was critical for innovating in response to various a range of challenges (*Reflection & adaptation*).

Overall, collective action was contextually-embedded and shaped by complex interactions among multiple actors across multiple levels of organisation (Ostrom 2005, 2009; Berkes 2010). Social complexity was particularly salient regarding ambiguity and contestation among the multiplicity of actors involved (with differing perspectives, knowledge, interests, values) (Ison et al. 2007; Brugnach and Ingram 2012). Problem boundaries in the local cases (geographically, temporally, institutionally) were not fixed, and were sometimes narrowed (to better focus activities) or expanded (to encompass new important actors). The diffuse nature

of causes and effects of waterway health problems also meant that clearly attributing and enforcing responsibility for impacts onto single actors was difficult and politically-delicate. Consequently, collective action depended strongly on social relations and good will among actors who were not always formally bound to participate, and would be unlikely to face adverse consequences if they withdrew. Analysing collective action through the analytical heuristic reflected this social complexity in the differing ways that the enabling capacities manifested.

6.2. Mechanisms of cross-level interplay

Collective action at a local level was nested within a multilevel regional governance system. Cross-level interplay between local and regional levels was important to the emergence of collective action. The analytical heuristic provided a novel way of analysing cross-level interplay through the lens of enabling capacities, which encompasses both structural aspects (e.g. formal institutional linkages) and relational aspects (e.g. knowledge, frames, learning, relationships). Functional mechanisms of interplay important in underpinning collective action in practice were further identified. 'Mechanisms' refer to generalisable dynamics underpinning observed 'surface level' features, that can potentially be cultivated to improve system performance (Barzelay and Thomson 2007). Mechanisms were identified by interpreting ways in which local and regional levels were functionally linked, through the combined effect of several enabling capacities (Table 3). The significance of looking at cross-level interplay through the lens of the enabling capacities is that it provides a 'practice-based' perspective of cross-

Table 3: Mechanisms of cross-level interplay identified in the case study.

Mechanism	Description	Capacities involved
Institutional interplay	Formal institutional arrangements (e.g. regional and local multi-actor platforms); relationships among actors across levels; policies and programs that create new institutional linkages.	Institutional arrangements, Collaboration, Engagement
Negotiating knowledge and problem frames	Efforts to build and co-produce knowledge, and forge mutually-agreed goals among actors across levels; re-framing of problems to construct meaningful yet aligned problem frames across levels.	Vision & strategy, Knowledge building & co-production
'Flows' of resources and authority	Resource provision and mandate from higher-to-lower levels; legitimacy and credibility conferred 'upwards' from local success.	Resourcing, Knowledge building & co-production
Key individuals as linkages in networks	Key individuals providing cross-level linkage between organisations and networks through relationships, negotiation and advocacy, and knowledge co-production.	Entrepreneurship & leadership, Prior experience & contingency
Feedback and learning across levels	Regional monitoring creates ongoing science-policy feedback; interactional space provided by regional multi-actor platforms provides opportunity for collaboration and learning among actors across levels; feedback of local experiences to regional level.	Knowledge building & co-production, Reflection & adaptation

level interplay (Adger et al. 2005; Poteete 2012; Vervoort et al. 2012), because it identifies ways that local and regional level activities were functionally linked in practice.

Some mechanisms are well-identified in existing literature. These are the critical importance of vertical institutional linkages (Berkes 2002; Young 2006; Young et al. 2008), and the role of key individuals providing cross-level connectivity which is alluded to in literature on bridging organisations (Hahn et al. 2006). Other mechanisms are less well-identified in existing literature, yet appeared to be important in practice. These involve knowledge and framing processes, 'flows' of resources and authority, and feedback and learning across levels. This second group of mechanisms are highly interactional in nature, and seem to be generated *through* efforts to take purposeful collective action, since they are both structural and performative in nature. The mechanisms arise through being enacted and re-enacted in practice, in ways that are partly due to structural features (e.g. institutional arrangements) but are also strongly dependent on social processes.

6.3. A knowledge-action perspective of collective action

Collective action emerged from diverse enabling capacities and their interplay, but at the same time these capacities were largely generated through collective efforts to take action. This is because enabling capacities and forms of cross-level interplay are not necessarily 'latent' but need to be generated through purposeful efforts in a particular situation. Hence while enabling capacities underpin the emergence of collective action, they are also to some extent evoked *through* efforts to take collective action in response to real-world needs and challenges. This aligns with Ostrom's (2005) observation that rules-in-use shaping collective action are developed through problem-solving in response to real world dilemmas. It also aligns more broadly with emerging notions of 'practice' articulated by Cook and Wagenaar (2011), who argue that practice (or action) is not independent of knowledge and context, but indeed knowledge and context are fundamentally evoked through practice.

This finding highlights the importance of a knowledge-action perspective of purposeful collective action. A knowledge-action perspective "stresses agency, individual leadership, and the role of governance systems in shaping the way environmental problems are understood" (Young et al. 2008, p. 7–8). Reflecting on assumptions underlying different views on environmental institutions, Young et al. (2008) distinguish between a rational perspective (action based on utilitarian interests), a social practices perspective (action based on norms and values), and a knowledge-action perspective (action shaped by both structure and agency). In the case study it was clear that key individuals were sources of agency in several critical ways. For example, key individuals provided leadership, brokered relationships, built trust, generated vision, created meaning, led experimentation and learning-by-doing, responded to windows of opportunity, and triggered reflection and learning among other participants (Folke et al. 2005; Hahn et al. 2006;

Westley et al. 2011). Thus these findings indicate that purposeful collective action in ambiguous and contested situations should be viewed from a knowledge-action perspective.

6.4. Reflections on the research approach

The results indicate that all the enabling capacities analysed are necessary for purposeful collective action, but a key question is whether they are also sufficient? The research approach sought to be systemic in accounting for a diverse range of factors that can potentially influence collective action, and giving strong regard to the importance of context and multi-scalar drivers of action and change. It was theory-informed yet explorative, and open to data that did not fit within the structure of the heuristic. For example, interview questions were designed to allow for surprise (Section 3). However, no further data was discovered that did not fit within the heuristic. Yet it remains possible that there could be other exogenous and endogenous factors that have not yet been accounted for. For example, this could include wider policy and political dynamics that create windows of opportunity (such as in Kingdon's multiple streams model of policy change), reinterpretation and jockeying around institutional rules (Mahoney and Thelen 2010), or changing ideas and discourses in wider policy debates. This would require further comparative study across diverse cases to better understand.

7. Conclusions

This paper analyses purposeful collective action in ambiguous and contested situations. It demonstrates an approach where purposeful collective action is viewed as emergent from enabling capacities and cross-level interplay. Collective action in ambiguous and contested situations is sometimes viewed as an emergent property (e.g. Collins and Ison 2010; Marshall et al. 2013), although it remains challenging to analyse empirically in this way. The approach presented centres on a systemic and context-sensitive analytical heuristic that allows for cross-case analysis and comparison. The approach is promising, although its exploratory nature means that it needs to be applied in other places and problem domains to test its wider applicability.

The key finding of this study is that purposeful collective action cannot be 'implemented' or 'delivered' through conventional management planning and target-setting. Instead what is needed is to focus on building enabling capacities and cross-level interplay from which adaptive and contextually appropriate forms of collective action can emerge. The study contributes to scholarship exploring collective action in complex multiscalar social-ecological systems (e.g. Kerr 2007; Ostrom 2009; Oakerson and Parks 2011; McGinnis and Ostrom 2014), and particularly highlights the importance of intersubjectivity and agency (Bouwen and Taillieu 2004; Ison et al. 2007; Berkes 2010).

A range of questions for further research are raised. Firstly, could the heuristic be used diagnostically to critically assess collective action and identify oppor-

tunities for improvement in a given setting? The approach demonstrated could conceivably be applied to support a praxis (theory-informed practical action) of 'building enabling capacities and cross-level interplay'. However, challenges of doing so include its systemic perspective and open-ended nature which, whilst useful from a research perspective, may be difficult for individual actors in a particular setting to apply. Nevertheless, it could still be useful as a tool for strategic reflection among practitioners in interactive forums (such as a workshop) to structure discussion about governance-related strengths, weaknesses, and needs in practice. This could open up new insights about opportunities to intervene or target capacity building efforts to enhance the likelihood of cultivating effective collective action.

Secondly, since the enabling capacities manifest differently and can have different relative importance in different situations, how can we know what is necessary and sufficient for generating collective action in a given situation? Thirdly, given that enabling capacities and cross-level interplay are to some extent generated *through* efforts to foster collective action (in a performative manner), how can these capacities be sustained over time given the often ephemeral nature of specific funding and policy initiatives? Finally, how can longer-term dynamics and feedbacks be created that support and incentivise continued collective action over long timeframes? This study opens up opportunities for investigating these questions, and contributes to extending collective action scholarship into new and 'messy' contexts of application.

Literature cited

Adger, W. N., K. Brown, and E. L. Tompkins, 2005. The Political Economy of Cross-scale Networks in Resource Co-management. *Ecology and Society* 10(2):9. [online] URL: http://www.ecologyandsociety.org/vol10/iss2/art9/.

Barzelay, M. and F. Thompson, 2007. Making Public Management a Design-Oriented Science (April 3, 2007). Available at SSRN: http://ssrn.com/abstract=979041 or http://dx.doi.org/10.2139/ssrn.979041.

Berkes, F. 2002. Cross-scale Institutional Linkages: Perspectives from the Bottom Up. In *The Drama of the Commons*. eds. E. Ostrom, T. Dietz, N. Dolsak, P. C. Stern, S. Stonich, and E. U. Weber, 293–321. Washington, D.C.: Committee on the Human Dimensions of Global Change, National Research Council.

Berkes, F. 2010. Devolution of Environment and Resources Governance: Trends and Future. *Environmental Conservation* 37(4):489–500. https://doi.org/10.1017/S037689291000072X.

Blackmore, C. 2007. What kinds of knowledge, knowing and learning are required for addressing resource dilemmas?: a theoretical overview. *Environmental Science & Policy* 10(6):512–525. https://doi.org/10.1016/j.envsci.2007.02.007.

BMT WBM. 2010. *Total Water Cycle Management Strategy for Moreton Bay Regional Council*. December 2010, Brisbane, BMT WBM Pty Ltd.

Bouwen, R. and T. Taillieu. 2004. Multi-party Collaboration as Social Learning for Interdependence: Developing Relational Knowing for Sustainable Natural Resource Management. *Journal of Community & Applied Social Psychology* 143:137–153. https://doi.org/10.1002/casp.777.

Brugnach, M. and H. Ingram. 2012. Ambiguity: The Challenge of Knowing and Deciding Together. *Environmental Science & Policy* 15:60–71. https://doi.org/10.1016/j.envsci.2011.10.005.

Bunn, S. E., E. G. Abal, M. J. Smith, S. C. Choy, C. S. Fellows, B. D. Harch, M. J. Kennard, and F. Sheldon. 2010. Integration of Science and Monitoring of River Ecosystem Health to Guide Investments in Catchment Protection and Rehabilitation. *Freshwater Biology* 55:223–240. https://doi.org/10.1111/j.1365-2427.2009.02375.x.

Cilliers, P. 2002. Why We Cannot Know Complex Things Completely. *Emergence* 4(1/2):77–84. https://doi.org/10.1080/15213250.2002.9687736.

Collins, K. and R. Ison. 2010. Trusting Emergence: Some Experiences of Learning about Integrated Catchment Science with the Environment Agency of England and Wales. *Water Resources Management* 24(4):669–688. https://doi.org/10.1007/s11269-009-9464-8.

Cook, S. D. N. and H. Wagenaar. 2012. Navigating the Eternally Unfolding Present: Toward an Epistemology of Practice. *The American Review of Public Administration* 42(1):3–38. https://doi.org/10.1177/0275074011407404.

Crimp, O. 2012. *Healthy Country Program 2007–2011: SEQ Catchments non-urban diffuse waterway planning and protection implementation projects in the Bremer, Lockyer and Logan catchments final report*. SEQ Catchments Ltd, Brisbane. 45.

DIP (Department of Infrastructure and Planning). 2009. *South East Queensland Regional Plan 2009–2031*. Queensland Government, Brisbane.

Dolsak, N. and E. Ostrom, (eds.) 2003. *The Commons in the New Millennium: Challenges and Adaptation*. Cambridge, MA: MIT Press.

Duit, A., V. Galaz, K. Eckerberg, and J. Ebbesson, 2010. Governance, complexity, and resilience. *Global Environmental Change* 20(3):363–368. https://doi.org/10.1016/j.gloenvcha.2010.04.006.

Fleischman, F. D., N. C. Ban, L. S. Evans, G. Epstein, G. Garcia-Lopez, and S. Villamayor-Tomas, 2014. Governing Large-scale Social-ecological Systems: Lessons from Five Cases. *International Journal of the Commons* 8(2):428–456. https://doi.org/10.18352/ijc.416.

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. https://doi.org/10.1146/annurev.energy.30.050504.144511.

Hahn, T., P. Olsson, C. Folke, and K. Johansson, 2006. Trust-building, Knowledge Generation and Organizational Innovations: The Role of a Bridging Organization for Adaptive Comanagement of a Wetland Landscape around Kristianstad, Sweden. *Human Ecology* 34(4):573–592. https://doi.org/10.1007/s10745-006-9035-z.

Ison, R. L. 2010. *Systems Practice: How to Act in a Climate-change World*. Springer, London. https://doi.org/10.1007/978-1-84996-125-7.

Ison, R., N. Röling, and D. Watson. 2007. Challenges to Science and Society in the Sustainable Management and Use of Water: Investigating the Role of Social Learning. *Environmental Science & Policy* 10(6):499–511. https://doi.org/10.1016/j.envsci.2007.02.008.

Ison, R., K. Collins, J. Colvin, J. Jiggins, P. Paolo Roggero, G. Seddaiu, P. Steyaert, M. Toderi, and C. Zanolla, 2011. Sustainable Catchment Managing in a Climate Changing World: New Integrative Modalities for Connecting Policy Makers, Scientists and other Stakeholders. *Water Resources Management* 25(15):3977–3992. https://doi.org/10.1007/s11269-011-9880-4.

Kerr, J. 2007. Watershed Management: Lessons from Common Property Theory. *International Journal of the Commons* 1(1):89–110. https://doi.org/10.18352/ijc.8.

Keskitalo, E. C. H. (ed.) 2010. *Developing Adaptation Policy and Practice in Europe: Multi-level Governance of Climate Change*. Dordrecht: Springer.

Lubell, M. 2015. Collaborative Partnerships in Complex Institutional Systems. *Current Opinion in Environmental Sustainability* 12:41–47. https://doi.org/10.1016/j.cosust.2014.08.011.

Mahoney, J. and K. Thelen. 2010. *Explaining Institutional Change: Ambiguity, Agency, Power*. New York: Cambridge University Press.

Margerum, R. 2008. A Typology of Collaboration Efforts in Environmental Management. *Environmental Management* 41(4):487–500. https://doi.org/10.1007/s00267-008-9067-9.

Marshall, G. R. 2008. Nesting, Subsidiarity, and Community-based Environmental Governance Beyond the Local Scale. *International Journal of the Commons* 2(1):75–97. https://doi.org/10.18352/ijc.50.

Marshall, G. R., D. Connell, and B. M. Taylor. 2013. Australia's Murray-Darling Basin: A Century of Polycentric Experiments in Cross-Border Integration of Water Resources Management. *International Journal of Water Governance* 1:197–218. https://doi.org/10.7564/13-IJWG17.

Mason, J. 2002. *Qualitative Researching*, 2nd ed. London, U.K.: SAGE Publications Ltd.

McGinnis, M. D. and E. Ostrom. 2014. Social-ecological system framework: initial changes and continuing challenges. *Ecology and Society* 19(2):30. http://dx.doi.org/10.5751/ES-06387-190230.

Meijerink, S. and D. Huitema. 2010. Policy Entrepreneurs and Change Strategies: Lessons from Sixteen Case Studies of Water Transitions around the Globe. *Ecology and Society* 15(2):21. https://doi.org/10.5751/ES-03509-150221.

Meinzen-Dick, R. 2007. Beyond Panaceas in Water Institutions. *Proceedings of the National Academy of Science* 104(39):15200–15205. https://doi.org/10.1073/pnas.0702296104.

Moore, M. and F. Westley, 2011. Surmountable Chasms: Networks and Social Innovation for Resilient Systems. *Ecology and Society* 16(1):5. https://doi.org/10.5751/ES-03812-160105.

Oakerson, R. J. and R. B. Parks. 2011. The Study of Local Public Economies: Multi-organizational, Multi-level Institutional Analysis and Development. *The Policy Studies Journal* 39(1):147–167. https://doi.org/10.1111/j.1541-0072.2010.00400.x.

Ostrom, E., 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge University Press. https://doi.org/10.1017/CBO9780511807763.

Ostrom, E. 2005. *Understanding Institutional Diversity*. Princeton NJ: Princeton University Press.

Ostrom, E. 2009. A General Framework for Analyzing Sustainability of Social-Ecological Systems. *Science* 325(5939):419–422. https://doi.org/10.1126/science.1172133.

Pahl-Wostl, C. 2009. A Conceptual Framework for Analysing Adaptive Capacity and Multi-Level Learning Processes in Resource Governance Regimes. *Global Environmental Change* 19(3):354–365. https://doi.org/10.1016/j.gloenvcha.2009.06.001.

Patterson, J. J. 2014. *Enabling and Enacting 'Practical Action' for the Wicked Problem of Managing Non-point Source Water Pollution in Catchment*s. PhD thesis, University of Queensland.

Patterson, J. J., C. Smith, and J. Bellamy. 2013. Understanding Enabling Capacities for Managing the 'Wicked Problem' of Nonpoint Source Water Pollution in Catchments: A Conceptual Framework. *Journal of Environmental Management* 128:441–452. https://doi.org/10.1016/j.jenvman.2013.05.033.

Patton, M. 1990. *Qualitative Evaluation and Research Methods*. California: Sage.

Poteete, A., 2012. Levels, Scales, Linkages, and Other 'Multiples' Affecting Natural Resources. *International Journal of the Commons* 6(2):134–150. https://doi.org/10.18352/ijc.318.

Robins, L., 2008. Making Capacity Building Meaningful: A Framework for Strategic Action. *Environmental Management* 42(5):833–846. https://doi.org/10.1007/s00267-008-9158-7.

Röling, N. G. and M. A. E. Wagemakers. 1998. *Facilitating Sustainable Agriculture: Participatory Learning and Adaptive Management in Times of Environmental Uncertainty*. Cambridge, UK: Cambridge University Press.

Schmidt, P. and T. H. Morrison. 2012. Watershed Management in an Urban Setting: Process, Scale and Administration. *Land Use Policy* 29:45–52. https://doi.org/10.1016/j.landusepol.2011.05.003.

SEQHWP (South East Queensland Healthy Waterways Partnership). 2006. *South East Queensland Healthy Waterways Strategy 2007–2012: Coastal Algal Blooms Action Plan*. South East Queensland Healthy Waterways Partnership, Brisbane.

Smith, L. E. D. and K. S. Porter. 2010. Management of Catchments for the Protection of Water Resources: Drawing on the New York City Watershed Experience. *Regional Environmental Change* 10(4):311–326. https://doi.org/10.1007/s10113-009-0102-z.

Thiel, A., F. Mukhtarov, and D. Zikos. 2015. Crafting or Designing? Science and Politics for Purposeful Institutional Change in Social–Ecological Systems. *Environmental Science & Policy* 53. https://doi.org/10.1016/j.envsci.2015.07.018.

Vervoort, J. M., L. Rutting, K. Kok, F. L. P. Hermans, T. Veldkamp, A. K. Bregt, and R. van Lammeren. 2012. Exploring Dimensions, Scales, and Cross-scale Dynamics from the Perspectives of Change Agents in Social-ecological Systems. *Ecology and Society* 17(4):24.

Vörösmarty, C. J., C. Lévêque, and C. Revenga. 2005. *Chapter 7: Fresh Water, Millennium Ecosystem Assessment Vol. 1*. Washington DC: Island Press.

Water by Design. 2010. Total Water Cycle Management Planning Guideline for South East Queensland (Version 1, December 2010). Prepared by: water by design, SEQ Healthy Waterways Partnership, for: Department of Environment and Resource Management, Queensland Government, Brisbane, p 69. https://www.ehp.qld.gov.au/water/policy/pdf/twcmp-guideline.pdf.

Westley, F. 1995. Governing Design: The Management of Social Systems and Ecosystems Management. In *Barriers and Bridges to the Renewal of Ecosystems and Institutions*, eds. L. H. Gunderson, C. S. Holling, and S. S. Light, 391–427. New York: Columbia University Press.

Westley, F., P. Olsson, C. Folke, T. Homer-dixon, H. Vredenburg, D. Loorbach, D., J. Thompson, M. Nilsson, E. Lambin, J. Sendzimir, B. Banerjee, V. Galaz, and S. van der Leeuw. 2011. Tipping Toward Sustainability: Emerging Pathways of Transformation. *Ambio* 40(7):762–780. https://doi.org/10.1007/s13280-011-0186-9.

Wyborn, C. and R. P. Bixler. 2013. Collaboration and Nested Environmental Governance: Scale Dependency, Scale Framing, and Cross-scale Interactions in Collaborative Conservation. *Journal of Environmental Management* 123:58–67. https://doi.org/10.1016/j.jenvman.2013.03.014.

Yin, R. K. 2009. *Case Study Research: Design and Methods*, 4th ed. Thousand Oaks, California: Sage.

Young, O. 2006. Vertical Interplay among Scale-dependent Environmental and Resource Regimes. *Ecology and Society* 11(1):27. [online] URL: http://www.ecologyandsociety.org/vol11/iss1/art27/.

Young, O. R., L. A. King, and H. Schroeder, (Eds.). 2008. *Institutions and Environmental Change: Principal Findings, Applications, and Research Frontiers*. Cambridge, MA: MIT Press.