

Adaptation in Collaborative Governance Regimes

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Abstract Adaptation and the adaptive capacity of human and environmental systems have been of central concern to natural and social science scholars, many of whom characterize and promote the need for collaborative cross-boundary systems that are seen as flexible and adaptive by definition. Researchers who study collaborative governance systems in the public administration, planning and policy literature have paid less attention to adaptive capacity specifically and institutional adaptation in general. This paper bridges the two literatures and finds four common dimensions of capacity, including structural arrangements, leadership, knowledge and learning, and resources. In this paper, we focus on institutional adaptation in the context of collaborative governance regimes and try to clarify and distinguish collaborative capacity from adaptive capacity and their contributions to adaptive action. We posit further that collaborative capacities generate associated adaptive capacities thereby enabling institutional adaptation within collaborative governance regimes. We develop these distinctions and linkages between collaborative and adaptive capacities with the help of an illustrative case study in watershed management within the National Estuary Program.

Keywords Adaptation · Adaptive capacity · Collaborative governance · Collaborative capacity · Institutional adaptation

Introduction

In the last few decades, we have witnessed the emergence of new kinds of governance systems working at different scales, across jurisdictional boundaries, and engaging multiple levels of government as well as nongovernmental stakeholders (Frederickson 1999; Jun 2002; Kettl 2002; Agranoff and McGuire 2003; Weber 2003; Koontz et al. 2004; Heikkila and Gerlak 2005; Gerlak et al. 2013). These new cross-boundary settings have become the proving ground for the evolving practice and study of collaborative governance. Collaborative approaches promise better coordination and integration of authorities (Bingham and O’Leary 2008) and are connected to participatory forms of governance that often include stakeholder engagement and public deliberation (Leach and Sabatier 2005; Cooper et al. 2006; Fung 2006). In environmental and natural resource arenas, diverse multi-partner governance arrangements have been created to represent hybrid combinations of state, market, and community-based systems, including co-management, public–private partnerships, and private–social partnerships (Agrawal and Lemos 2007).

At the same time, there is growing attention to governance challenges posed by the dynamism and uncertainties associated with environmental change in a body of research broadly construed as environmental change and adaptation research (e.g., Armitage et al. 2007; Dietz and Stern 2008; Juhola and Westerhoff 2011). In this literature, the concept of adaptive governance has been embraced by those who study environmental institutions and increasingly recognize

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that adaptability over time is necessary for institutions to retain their relevance and efficacy in the face of changing external conditions (Dietz et al. 2003; Scholz and Stiftel 2005; Brunner et al. 2005; Steinberg 2009; Gupta et al. 2010). Adaptation is also of primary concern in complex social-ecological systems (SES) research (Anderies et al. 2004; Ostrom 2009; Garmestani and Benson 2013). Here, institutional adaptation is viewed as a necessary condition of robust social and ecological systems (Janssen et al. 2007; Gupta et al. 2010). New research exploring human-landscape interactions in the anthropocene also emphasizes the importance of adaptation (Harden et al. 2013; Gerlak 2013).

Given the trend toward collaborative governance in environmental and natural resource management, it is important to study adaptation in this cross-boundary, multi-organizational context and shed light on how collaborative governance can be improved. In this paper, we explore the meaning and mechanisms of institutional adaptation in the context of collaborative governance regimes (CGRs). We attempt to clarify the relationship between collaborative capacity and adaptive capacity and how they contribute to adaptive action by CGRs. To do this, we first integrate the collaborative governance and environmental change and adaptation literatures to identify basic dimensions of institutional capacity that relate to cross-boundary collaboration, then explore adaptation within the context of one illustrative CGR, and conclude with a discussion of future research directions.

Collaborative Governance

The term “collaborative governance” was initially used in the professional fields of education and health in the 1970s to generally describe cooperation across departments and disciplines in the administration of curriculum and public health services. In the past 15 years it has taken on multiple meanings and applications as surveyed by Ansell and Gash (2008) in their extensive multi-case meta-analysis. In the fields of planning and environmental management, for example, researchers have been studying and describing cross-boundary collaboration as collaborative planning (Bentrop 2001; Innes and Booher 1999; Selin and Chavez 1995); collaboration processes (Daniels and Walker 2001); collaborative environmental management (Koontz et al. 2004; Gerlak and Heikkila 2006) environmental governance and conflict resolution (Agrawal and Lemos 2007; Emerson et al. 2009); and grass-roots ecosystem management (Weber 2003).

We draw on the following definition of collaborative governance as “the processes and structures of public policy decision making and management that engage

people constructively across the boundaries of public agencies, levels of government, and/or the public, private and civic spheres in order to carry out a public purpose that could not otherwise be accomplished” (Emerson et al. 2012, p. 3). This definition parallels other definitions of collaborative governance, but captures a wider range of emergent forms of cross-boundary governance, extending beyond the conventional focus on the public manager or the formal public sector, yet also inclusive of some of the more traditional forms of cross-boundary governance, such as interagency cooperation (e.g., Ansell and Gash 2008; Bingham and O’Leary 2008). There is general agreement among collaborative governance practitioners and scholars about the basic principles of constructive engagement among participants within collaborative governance. These principles include, but are not limited to fair and civil discourse, open and inclusive communication, balanced by representation of diverse interests, and informed by the perspectives and knowledge of all participants (Innes and Booher 1999; Susskind et al. 1999; O’Leary et al. 2006; Carlson 2007; Ansell and Gash 2008).

Collaborative governance regimes (CGRs) refer to public policy or service oriented, cross-organizational systems involving a range of autonomous organizations representing different interests and/or jurisdictions (as opposed to like-minded coalitions). CGRs enable repeated interactions among their participants through structured processes over time (distinguishing them from one-off participatory workshops or short-term collaborative forums). CGRs develop intentional institutional arrangements and procedural and behavioral norms that foster collaboration (as opposed to simple ground rules for guiding behavior in a short-term endeavor). CGRs are similar to goal-directed inter-organizational networks (Provan and Milward 1995) where “the particular mode of, or system for public decision making in which cross-boundary collaboration represents the prevailing pattern of behavior and activity” (Emerson et al. 2012, p. 6).

Collaborative governance is purported by some researchers to be more agile and responsive to increasing levels of change and uncertainty than state-centric, rigid bureaucracies (Henton et al. 2005; Pahl-Wostl 2007; Bingham and O’Leary 2008; Salehyan 2008; Wagner and Fernandez-Gimenez 2009; Emerson and Murchie 2010). Koontz et al. (2004) suggest that “collaborative environmental management offers a flexible approach that can be molded in response to emerging views and knowledge.” Despite such claims, however, the collaborative governance literature and associated scholarship on collaborative capacity has not focused particularly on adaptive qualities or capacities per se nor has it demonstrated that collaborative governance indeed cultivates such capacities (Cheng and Sturtevant 2012). Furthermore, in most frameworks for

collaborative governance, performance outcomes are given short shrift and there is little, if any, treatment of feedback or collective learning that might occasion opportunities for or demonstrate adaptation (Koontz and Thomas 2006; see Gerlak and Heikkila 2011; Cheng and Sturtevant 2012 as exceptions).

Institutional Adaptation and Adaptive Capacity

Nelson et al. (2007, p. 395, 397) offer a useful definition of institutional adaptation as “a process of deliberate change in anticipation of or in reaction to external stimuli and stress...[and specifically as]...the decision-making process and the set of actions undertaken to maintain the capacity to deal with future change or perturbations to a social-ecological system without undergoing significant changes in function, structural identity, or feedbacks of that system while maintaining the option to develop.” This can be applied to adaptive functions of cross-institutional, multi-organizational CGRs.

Adaptive capacity, or adaptability, can be seen as the ability of individuals and groups to respond to and shape change through learning and flexibility to maintain or improve a desirable state (Folke et al. 2005; Nelson et al. 2007). Gupta et al. (2010) work on the adaptive capacity wheel focuses on the characteristics of institutions that can best foster the adaptive capacity in society. With respect to multi-institutional governance systems, adaptive capacity then can be seen as the ability of the CGR to alter its internal processes or convert structural elements as a response to experienced or expected changes in the societal or natural environments (Pahl-Wostl 2009, p. 355).

Adaptation can be triggered or motivated by many factors through social networks (Adger 2003) and through the actions of individuals and organizations to meet their own individual or collective goals (Adger et al. 2005). It may occur in response to ecological, economic, and political variability that may be predictable and well understood as well as unpredictable temporal and spatial variation of social and natural variables (Janssen et al. 2007, p. 310).

In this paper, we hope to articulate how CGRs cultivate this adaptive capacity to respond to such external changes or triggers. Through better specifying and understanding these adaptive mechanisms within CGRs, it is hoped that we can then optimize CGR performance in responding to complex dynamic social and environmental systems. A related and important question is whether or under what conditions adaptive action is more effective through multi-stakeholder collaboration as opposed to through internal unitary governmental decision-making. While we do not directly address that question of comparative performance in this paper, we hope our conceptualization of adaptive

capacity and adaption within CGRs will contribute to that inquiry in the future.

Just as the collaborative governance research tends to neglect adaptive capacity, so too the environmental change and adaptation literature tends not to address cross-institutional change within the collaborative governance context where resource management and adaptation increasingly occurs. Inasmuch as cross-boundary collaboration is seen as well suited for managing complex dynamic environmental systems in environmental change research (Olsson et al. 2004), we hope to encourage further specification of adaptation and adaptive capacity within such CGRs.

Integrating Collaborative Governance and Adaptation Scholarship

In surveying both the collaborative governance and environmental change and adaptation literature, we found distinctions and considerable complementarity and overlap around four dimensions of capacity: structural arrangements, leadership, knowledge and learning, and resources. In collaborative governance research, these dimensions are associated with collaborative capacities (e.g., Emerson et al. 2012) necessary for joint action to sustain the broader collaborative effort (Weber et al. 2005). In environmental change and adaptation research, these dimensions are associated with supporting adaptive capacity (e.g., Gupta et al. 2010). Next, we explore and integrate the key findings from these literatures around these four dimensions.

Structural Arrangements

Collaborative institutions or CGRs vary considerably in their scale, purpose and structures (Margerum 2008, 2011; Prager 2010). Nonetheless, researchers generally agree they are based on voluntary and consensual engagement of diverse interests, organizations, and expertise (Beierle and Cayford 2002; Ansell and Gash 2008; Sirianni 2009). They are designed to be more transparent, participatory, and responsive than more centralized, top-down forms of public management (Fung 2006; Cooper et al. 2008; Thomson et al. 2008). The internal authority structure of collaborative institutions tends to be less hierarchical and less stable, more complex and fluid, than those found in traditional bureaucracies (Bryson et al. 2006; Huxham and Vangen 2005). The protocols that govern collaborative endeavors may include informal norms of reciprocity as well as more formal rules for joint decision-making and assigned responsibilities (Thomson and Perry 2006).

In the environmental change and adaptation literature, governance and structural mechanisms are increasingly

seen as central determinants of the adaptive capacity necessary in the face of change and uncertainty (Janssen et al. 2006; Pahl-Wostl 2007; Adger et al. 2009; Engle and Lemos 2010; Eakin and Lemos 2006). There is some evidence to suggest that more integrated cooperation structures that include governmental and non-governmental stakeholders might support the higher learning that characterizes adaptive capacity (Pahl-Wostl 2009). So too can diverse structures, including both informal and formal institutional structures better catalyze experimentation and learning to ensure that process results have an impact on management decisions (Moellenkamp et al. 2010). More flexible, democratic, and participatory designs are thought to increase adaptive capacity (Engle and Lemos 2010, p. 6). Likewise, more flexible approaches are seen to promote collaboration among stakeholders at various scales (Chapin et al. 2009, p. 14). In addition, the broader participation afforded by collaborative structures can help reduce uncertainties in the governance by reducing the likelihood of unexpected resistance during policy implementation (Newig et al. 2005).

Leadership

Leadership is essential in collaborative governance for initiating and convening multiple parties, during moments of intense deliberation or conflict, and in implementing decisions and agreements. Collaborative governance calls for many different leadership roles—those of sponsor, convener, facilitator/mediator, representative, and advocate of a group or constituency, science translator, technologist, or public advocate, among others (Agranoff 2006; Bryson et al. 2006; Carlson 2007). Of particular interest to scholars of leadership and collaborative governance are the qualities and skills of collaborative leadership and how they are cultivated (Crosby and Bryson 2005; Feldman et al. 2006; Morse 2007; O’Leary et al. 2009, 2012). Collaborative leaders cultivate inclusivity and instill confidence and commitment in participants. Effective collaborative leaders may draw from their executive or political authority but may also emerge based on reputational or moral authority. Collaborative leaders often need to be strategic, focusing their efforts where the likelihood of success is high to build relationships and trust while learning to work together (Imperial 2005).

While leadership has not been as central a focus for those studying environmental change and adaptation, it is thought to be critical in building trust, making sense of complex situations, managing conflict, linking actors, initiating partnerships among groups, gathering and generating knowledge, mobilizing broad support for change, integrating social and ecological understanding, and developing and communicating visions for change (Folke

et al. 2005; Gunderson et al. 2006; Kenward et al. 2011; Pahl-Wostl et al. 2013). Trust also is needed to keep information flowing, to adapt to changing circumstances and knowledge, and to provide the social capacity for confronting unknowns in these complex systems (Gunderson et al. 2006; Gutiérrez et al. 2011).

Knowledge and Learning

The role of shared knowledge generation, clarification, and legitimization is seen as important for the internal progress of collaboration and to its external legitimacy (Provan and Milward 1995).¹ Collaboration can provide important time and place specific information that may foster effective resource management (Koontz et al. 2004, p. 27). The acquisition of knowledge relates directly to learning, which is often seen as a central component of collaboration (Pennington 2008). Eugene Bardach (1998) sees continuous learning, or the capacity to learn how to improve by monitoring performance, as one of the building blocks of collaborative capacity. Gerlak and Heikkila (2011) highlight the role of learning and the structural conditions that support learning and institutional change. Other research suggests that collaborative subsystems stand the best chance for sustainable management of complex socio-ecological systems because learning is occurring across coalitions thereby, serving as a check on competing conceptual filters (Weible et al. 2010).

Many environmental change and adaptation scholars see learning and a flexibility to experiment and adopt novel solutions as a central component of adaptive capacity (Berkes et al. 2003; Walker et al. 2002; Janssen et al. 2007; Pahl-Wostl 2007; Raadgever et al. 2008; Gunderson et al. 2006; Lebel et al. 2006; Eakin et al. 2011). The ability to learn and adapt implies that a system can improve at pursuing a particular set of management objectives over time and at tackling new objectives (Adger et al. 2005; Brooks et al. 2005; Folke et al. 2005).

Learning is also central to the adaptive management and co-management literatures (Hollings 1978; Walters 1986; Lee 1993, 1999; Gunderson 1999; Carpenter and Gunderson 2001; Folke et al. 2002; Olsson et al. 2004; Fazey et al. 2005; Plummer and Armitage 2007; Armitage et al. 2008; Berkes 2009; Munaretto and Huitema 2012). Adaptive learning is thought to occur when individuals are able to draw on those social-ecological observations to improve understanding of the system’s behavior, evaluate the implications of emergent conditions and the various

¹ “Knowledge is information combined with understanding and capability: it lives in the minds of people...Knowledge guides action, whereas information and data can merely inform or confuse” (Groff and Jones 2003, p. 3).

options for actions, and respond in ways that support the resilience of the social–ecological system (Kofinas 2009, p. 96). The notion of “social learning” where individuals engage in joint problem-solving is gaining momentum in the environmental and natural resource policy literature (Clark et al. 2001; Schusler et al. 2003; Steyaert and Jiggins 2007; Newig and Fritsch 2009; Pahl-Wostl 2009; Reed et al. 2010). Social learning processes are thought to increase the capacity of organizations to respond to feedback in the environment and ensure sustainable human actions (Berkes et al. 2003; Johnson et al. 2012).

Resources

Working with multiple organizations or engaging the public in collaborative partnerships requires resources and can be costly (Beierle 1998; Charnley and Engelbert 2005). Fortunately, collaborative governance can leverage and mobilize resource capacity beyond what any one participant or participating organization has available (Thomson and Perry 2006). Successful collaboration requires the acquisition and application of adequate resources (Lubell et al. 2009; Leach and Pelkey 2001). Shared resources may include funding, legal, technical and expert assistance, logistical and administrative support, communication and information technology, and even power (Bryson et al. 2006; Huxham and Vangen 2005). The fairness, legitimacy, and efficacy of collaborative efforts depend in part on how well these resources are shared, developed, and managed (Bingham and O’Leary 2008; Thomson et al. 2008).

The literature on environmental change and adaptation also recognizes the importance of resources. The capacity to design and implement effective adaptation strategies is based to a large extent upon the resources available, including wealth, human capital, technology, and infrastructure (Yohe and Tol 2002; Haddad 2005; Eakin and Lemos 2006). Good financing is important in the context of adaptive resource management and governance (Raadgever et al. 2008; West et al. 2009; Eakin et al. 2011). Financially strong governments with stable and well-functioning communications infrastructure and per capita affluence are seen as critically important factors at the national level in supporting the ability to deal with environmental stress (Barnett 2003). Some research suggests that national guidance, support, and financial investments can be powerful factors in adaptation at more local levels (Naess et al. 2005; Eakin and Lemos 2006). Sources of biological, economic, and cultural diversity may provide the foundational raw material for adaptation (Elmqvist et al. 2003; Norberg et al. 2008; Barnes-Mauthe et al. 2013).

We summarize some of the key elements of collaborative and adaptive capacity as derived from these two streams of research in Table 1 below.

Table 1 Elements of collaborative and adaptive capacity

	From collaborative governance literature	From environmental change and adaptation literature
Structural arrangements	Voluntary engagement of participants evolves to broader cross-scale representation of diverse interests and expertise	Diversity of perspectives enhances sensitivity and accountability to broader range of short and long term SES impacts
	Cross-organizational linkages generate open and reliable communication and coordination systems	Broad participation reduces resistance to implementation
	Procedural rules and norms develop to promote inclusivity, fairness, open access to information, full participation in deliberation, and constructive conflict management	Formal and informal structures help to catalyze experimentation and change
	Consensual decision making processes and shared authority structures emerge as transparent and responsive	More integrated, participatory, and flexible designs at various scales support learning that increases capacity
Leadership	Multiple leaders are drawn on and cultivated to represent diverse organizations and perspectives	Diversity in leadership team generates external legitimacy to support adaptation efforts
	Multiple leadership roles and sources of authority required over time	Political, financial, scientific, and managerial expertise available to address range of adaptation demands
	Collaborative leadership styles cultivate inclusivity and commitment	Leadership maintains internal legitimacy and loyalty when faced with crises and adaptation challenges
Knowledge and learning	Shared knowledge generation enhances understanding of what is known and not known	Shared understanding enables appreciation and flexibility for forecasting, modeling and experimentation
	Enhanced transmission or conductivity of knowledge increases performance	Conductivity of knowledge enhances ability to synthesize and respond to feedback from monitoring actions and impacts
	Social learning leads to shared theory of action, strengthens shared understanding and commitment to shared goals	Social learning increases capacity for self-reflection, responsiveness to feedback
Resources	Added resources can be costly but can lead to downstream efficiencies	Upfront investments can help generate needed wealth, human capital, technology and infrastructure for future adaptation
	New resources can be leveraged and mobilized	
	Resource benefits and burdens distributed more equitably	Confidence in equity considerations can generate acceptance of deferred, reduced or redistributed benefits or burdens

Institutional Adaptation and Capacity

In reviewing and integrating these literatures, it becomes apparent that collaborative capacity and adaptive capacity are frequently conceptually intertwined. Are they one and the same? Are they different sides of the same coin? Are claims that collaborative governance systems are adaptive simply a tautology? If they are different capacities, how are they related? Part of the challenge is the conceptual fuzziness around institutional adaptation itself. We need to back up and clarify what we mean by institutional adaptation in the context of cross-boundary collaborative regimes if we are going to explore how and which capacities may enhance it.

We begin with Nelson et al.'s (2007, p. 395) definition of institutional adaptation as an intentional process of change in response to some trigger or set or sequence of triggers caused by "external stimuli and stress." Implied in this definition is some adaptive action taken by the institution as a consequence of and consistent with an intentional process of change. It is this process of change that is enabled by institutional capacities that can then change the likelihood or quality of adaptive actions.

Adaptive actions may be one of a suite or sequence of actions that contribute to shifting the nature or direction of the institution itself. Examples of adaptive action may be found in the adoption of new rules, organizational arrangements, operational or strategic modifications, management strategies or choices. In the context of CGRs, adaptive actions might include the addition of new participants, the revision of charters, changes in the scope of mission or operation, or procedural decision rules to accommodate changes in cross-boundary governance.

The process of change within a CGR has been described elsewhere as collaboration dynamics that include the iterative interactions of principled engagement, shared motivation, and the capacities for joint action (Emerson et al. 2012). In this integrative framework for collaborative governance, there is feedback between the CGR process and its capacities. As CGR participants engage and strengthen their motivation to work together, they build their capacity for collaboration, which in turn improves their engagement.

Building on this framework and our review of these two literatures, we propose that there are some key elements of collaborative capacity generated within CGRs that build or strengthen specific adaptive capacities that enable CGRs to respond to triggers and take adaptive actions. We illustrate this proposed distinction and linkage between collaborative and adaptive capacities further in the next section with the aid of a case illustration, the Piscataqua Region Estuaries Partnership.

Piscataqua Region Estuaries Partnership (PREP)

The Piscataqua Region Estuaries Partnership (PREP) is one of more than two-dozen National Estuary Programs

established under Section 320 of the 1987 Clean Water Act (CWA) Amendments as a U.S. Environmental Protection Agency (EPA) place-based program to protect and restore the water quality and ecological integrity of estuaries of national significance.² Researchers have found that networks in the National Estuary Program integrate more experts into policy discussions, nurture stronger interpersonal ties between stakeholders, create greater trust in the procedural fairness of local policy, and resolve conflict and building project-level cooperation than other comparable estuaries (Schneider 2003; Lubell 2004a, b; Imperial 2005).

In the early years, the National Estuary Program was lauded for its consensus-based decision-making, strong focus on capacity building, high capacity for learning, use of demonstration projects, flexibility in program development, and clear role for science (Imperial and Hennessey 1996, 2000). But the record has been mixed. Some research also calls attention to challenges in implementation and management coordination, as well as failed efforts at stakeholder participation and effective use of science (Korfmacher 1998, 2002, 2004).

PREP meets the basic criteria of a CGR, being focused on public policy concerns, and working across autonomous organizations in both the public and private sectors that represent diverse interests. Like other estuaries under the National Estuary Program, PREP has no regulatory authority, instead relying on voluntary commitments to targets and on a wide suite of existing federal, state, and local authorities for implementation. PREP has sustained a multi-jurisdictional, cross-sector watershed management collaboration for more than 15 years and has facilitated the development of an estuary-specific Comprehensive Conservation and Management Plan (CCMP). Established in the mid-1990s, PREP continues to operate today covering the coast of New Hampshire and parts of Southern Maine. The region faces water quality issues in a dynamic socio-ecological system. As a CGR, it holds the possibility for management adaptation to climate change (Peterson et al. 2008).

In studying this case, we drew on published and gray literature, available case meeting summaries and reports, as well as interviews with long-time participants in the CGR. Data on the case were collected between 2009 and 2013.³ Our case study methodology was exploratory in nature, following Gerring's (2007) characterization of a probative

² U.S. Environmental Protection Agency, National Estuary program (NEP) Overview at <http://water.epa.gov/type/oceb/nep/index.cfm#tabs-2>.

³ We want to acknowledge our debt to Marilyn Buchholtz ten Brink, Ph.D., Special Assistant to the Director, Atlantic Ecology Division U.S. EPA, Office of Research and Development, National Health and Environmental Effects Research Laboratory, who brought this case to our attention and on whose many direct observations we draw.

analysis. We restricted our focus in this paper to collaborative and adaptive capacity, and do not describe or analyze directly PREP's process of change or collaborative dynamics. As we note in the conclusion, studying the interactions and influences of collaborative processes on capacity and vice versa would be an important next step.

Case Background

The Piscataqua River and Estuaries Region (approx. 2,700 sq. km) of the northeastern U.S. is located on the boundary between the states of New Hampshire and Maine. The shallow Great Bay estuary in New Hampshire is connected via the river to the Gulf of Maine. Increasing population, land development, and legacy contaminants present significant challenges to improving water quality and quantity, and healthy living resources and coastal habitats (Dinan 2010). First established in 1995 as the New Hampshire Estuaries Project, the PREP aims to maintain water quality in the estuary and its watershed, including protection of public water supplies, protection of shellfish, fish and wildlife, recreational activities, and control of point and nonpoint sources of pollution (NHEP 2008a). PREP represents one of some 28 formal partnerships of the U.S. EPA's National Estuaries Program, a joint federal-state-local program with the goal of protecting and enhancing nationally significant estuarine resources (US EPA 2013).

PREP brings together federal actors (including U.S. EPA's Region 1 office, National Oceanic and Atmospheric Administration, National Resource Council, and U.S. Geological Survey), state actors [including University of New Hampshire (UNH), the states of New Hampshire and Maine], and more than 50 communities across the watershed (Truslow 2009). In addition, recreational interests, commercial groups, and environmental organizations participate in this long-standing CGR. In accordance with Section 320 of the CWA, PREP develops and implements a CCMP, a long-term plan that contains specific targeted actions designed to address water quality, habitat, and living resources challenges in its estuarine watershed. Using a consensus-building approach and collaborative decision-making process, stakeholders work closely together to implement the CCMP.

Generally, this CGR has helped improve monitoring and mapping of important ecological resources in the region and been instrumental in providing critical wildlife habitat and helping prevent further water quality degradation. Shellfish beds have opened again, wetlands and water flow have been restored, and contaminant sources reduced. Reductions of nitrogen loading have, however, been overwhelmed by stress from increases in development and population. In recent years, the CGR has been embroiled in

litigation following a lawsuit by a small group of municipalities challenging EPA's limits on how much nitrogen can be discharged from their wastewater treatment plants.⁴ In the wake of this litigation, PREP embraced a new process in crafting their 2013 State of the Estuaries Report, allowing for greater stakeholder involvement, especially from local government actors (Trowbridge, Philip. Coastal Scientist with PREP. September 25, 2013, personal communication; PREP 2013). Presently, the collaborative is re-examining some of its governance practices to provide great clarification around scientific and technical processes (Rouillard, Rachel. PREP Director. September 27 and 30, 2013, personal communication).

Adaptive Actions by PREP

In order to explore the role of capacity within PREP, we had to first identify instances of adaptive action and their corresponding triggers. Based on our interviews with state and federal agency participants in PREP, we were able to identify three instances of institutional adaptation and their triggers for which we could then investigate contributing capacities.

The first instance of adaptive action involved an expansion of the geographical extent of the program's purview or scope. Because the watershed program was first initiated by the state of New Hampshire, the partnership initially included only the New Hampshire watershed area of Great Bay, the Hampton-Seabrook Estuary, and other coastal watersheds in the state. But in 2007, the Management Committee made a unanimous decision to include the Maine side of the Great Bay Estuary, substantially increasing the partners and communities involved (New Hampshire Estuaries Project NHEP 2008a, b). The organization then began expanding some of its programs, adding members to its Management Committee, and collaborating with Maine organizations in 2008, and changed its name from the New Hampshire Estuaries Project to PREP in 2009 to better represent the focus area (PREP 2009a, b).

Stakeholders identified two key external triggers for this geographic expansion. First were administrative challenges of operating under the auspices of the state of New Hampshire, including a complicated and unmanageable contracting system (Trowbridge, Philip. Coastal Scientist with PREP. February 7, 2011, Personal Communication) and an increasingly difficult relationship with state officials (Kellman, PREP Human Dimensions Program

⁴ In September 2013, the coalition of municipalities, named the Great Bay Coalition, dismissed the litigation and the parties are now moving forward with a scientific review of the nitrogen standards (Fosters 2013).

Coordinator. February 10, 2011, personal communication). The expansion was also fueled by observed increases in nitrogen loads in the watershed that extended beyond the confines of New Hampshire and into neighboring Maine, where some 24 % of the Great Bay Estuary watershed lies.

In the second instance of adaptive action, the watershed partnership expanded its problem definition and associated approach to solutions. The first Management Plan adopted in 2000 focused on the early priorities around shellfish, reflecting the original composition of the early Management Committee and the initial scientific understanding of the ecological problems in the region (NHEP 2000; Kellman PREP Human Dimensions Program Coordinator. February 10, 2011, personal communication). The Plan was updated in 2005 to reflect changing scientific understandings around the nature of the ecological problems (NHEP 2005).

The key external trigger here were the findings from rapid assessment surveys conducted in the region during 2003 and 2004. These findings indicated that invasive aquatic species were extending far into the estuary and the ecosystem. This opened up questions about the scope and nature of problems in the watershed and the appropriate role for the watershed partnership.

Finally, in a third instance of adaptive action, as the collaborative moved forward pursuing actions adopted under the 2005 plan, it would again expand its problem definition and solution set further. In 2010, a new Management Plan was released to identify the most pressing issues facing the region and the necessary requisite actions. The Plan includes seven broad goals with more than 80 action plans to address current and emerging issues affecting the water quality and environmental health of estuaries in the region, including a new focus area on climate change and integration of climate into other program areas (PREP 2010).

A major external trigger for this second expansion was a series of floods beginning in 2006 that shut down many sea coast towns, negatively affected the estuary, and resulted in the loss of human life (Choate 2010). The flooding led to an interest from local stakeholders around storm water flooding and shoreline protection, which became apparent through an 18-month public engagement process with more than 150 organizations to identify the most pressing issues facing the region and the necessary requisite actions leading up the 2010 plan (PREP 2010; Kellman, PREP Human Dimensions Program Coordinator. February 10, 2011, personal communication; Rouillard, Rachel. PREP Director. September 27 and 30, 2013, personal communication). This trigger was amplified by the publication of research conducted through the University of New Hampshire's Stormwater Research Center as well as the PREP's State of the Estuaries reports.

Contributing Capacities

In researching these three instances of adaptive action, we sought evidence of enabling capacities from interviews, meeting summaries, public documents, and media coverage. We describe below the linkages between collaborative and adaptive capacities around the four dimensions integrated from the collaborative governance and environmental change and adaptation literatures.

Structural Arrangements

CGRs engage a diverse range of participants. New rules and informal norms are developed to include all participants as individuals and as representatives of their organizations or constituents in a fair and open manner. These inclusive structural arrangements incentivize and reinforce the participants' receptivity and sensitivity to others' interests, the potential impacts of problems or proposed actions on those interests, and the interactions between and among all the diverse interests within the CGR. This capacity becomes the basis for commitments responsive to shared goals that accommodate the broad range of interests embodied by the CGR.

From the outset, PREP involved a broad set of stakeholders participating in an open, inclusive, and fair process. When the geographical extent of the program's purview expanded to include the Maine side of the Great Bay Estuary, this substantially increased the partners and communities involved. As a result, programs expanded and new members were added to the Management Committee to reflect these new stakeholders (PREP 2013).⁵ This adaptive action reveals a sensitivity to a broad range of interests. In addition, the second adaptive action identified in our case reveals how these diverse stakeholders worked together—talking, meeting, and learning from the rapid assessment surveys to better understand the role of invasive species in the ecosystem. This helped open up the group's understanding of the nature of problems in the watershed and the appropriate role for the watershed partnership. Finally, in the third adaptive action we see how local stakeholders' concern around storm water flooding and shoreline protection developed during a public engagement process with local and regional actors to identify the most pressing issues facing the region and the necessary requisite actions leading up the 2010 plan. These stakeholder engagement processes illustrate a commitment to a broad range of interests, impacts, and interactions. According to PREP's Director, Rachel Rouillard, engaging stakeholders

⁵ The Management Committee members include citizens, educators, researchers, municipal officials, and representatives from state and federal agencies.

is a constant process that goes beyond the production of a single report. In recent years, communities are increasingly seeing themselves as stakeholders as a result of the regulatory process underway (Rouillard, September 27 and 30, 2013, personal communication).

Leadership

CGRs rely on multiple leaders at different levels and this was confirmed by the credit given to different leaders across these three instances of adaptive action. Multi-level leadership strengthens the internal and external legitimacy of CGRs and their capacity for effective advocacy. This generates political capital necessary to mobilize and support adaptive action.

In all three of the identified instances of adaptive action, leadership was identified by long-time participants in the CGR interviewed as important to the adaptive actions taken. The change in the geographic extent of PREPs region of interest was attributed to participating scientists who encouraged the inclusion of all sources of runoff and pollution inputs, which would then require attention to the pollution loadings from Maine. The Director of the NHEP at the time, Jennifer Hunter, was also credited with providing vital leadership in relocating the collaborative to the University of New Hampshire (Trowbridge, Philip. Coastal Scientist with PREP. February 7, 2011, personal communication). The expansion of the problem definition was also attributed to some of the scientists who began to call for action around a broader, more integrated view of the problem that would lend itself to shifts in their approaches to solutions. The second expansion was also influenced by scientists and new representatives on the Management Committee who began to push for more attention to the impacts of climate change. In all of these instances, leaders leveraged political capital to bring about the adaptive action and through the process strengthened both the internal and external legitimacy of PREP.

Knowledge and Learning

Participants in CGRs share a broad pool of information available from multiple sources. This leads to shared knowledge and joint inquiry that then generates new knowledge. The capacity to learn together, sometimes called collaborative or social learning, enables participants within CGRs to appreciate both the breadth of knowledge that is important to their shared task as well as the limits of what they currently know (Gerlak and Heikkila 2011). Knowledge is also a tool, used to support future decisions and often defend previous ones. CGRs can strengthen the individual and collective capacity to solicit and then accept and synthesize new information that may challenge prior

commitments or positions. This enables the cognitive flexibility needed to integrate new knowledge into action.

In each of the three adaptive instances in the PREP case, new knowledge and collaborative learning played an important role. The expansion of PREP's geographic scope was attributed in part to the increasing appreciation of the need to work at the full watershed scale in order to maintain ecosystem integrity and protect resource values (NHEP 2008b). The new information about the significant increases in nitrogen loads discovered as PREP participants worked on their 2006 State of the Estuary report was pointed to as a key development. The extension in problem scope from shellfish habitat to water quality issues and invasive species concerns was also the result of new information and understanding that led to modifications in the PREP monitoring plan that included some preventative actions targeted around invasive species. Their growing recognition internally of the advantages of a watershed approach was put into action (Trowbridge, Philip. Coastal Scientist with PREP. February 7, 2011, personal communication; Burdick et al. 2008; Hunter, Jennifer, Director, NEHP February 14, 2011, personal communication).

Resources

Resources are consistently found to be a significant institutional capacity for effective CGRs. By definition, CGRs are composed of participants who have not been able to previously solve the public problem of concern or provide a public service on their own. This is often due to limitations on resources available to any one actor or organization. Through transparent and equitable resource sharing, CGRs are able to make progress toward their shared goals. Through their multiple membership and overlapping social and organizational networks, CGRs have access to more resources and can then leverage resources as well as respond to new funding opportunities more readily.

In the PREP case, they translated their new commitment to controlling invasive species into their addendum to the 2000 plan. This allowed them to then dedicate funding for proposed actions around invasive species (Trowbridge, Philip. Coastal Scientist with PREP. February 7, 2011, personal communication). A new EPA program titled "Climate Ready Estuaries" played a role in the second expansion of PREP's problem portfolio. PREP was able to qualify as one of only four pilot estuaries in the U.S. (Kellman, D., PREP Human Dimensions Program Coordinator. February 10, 2011, personal communication). This provided important early seed money that was used to harness additional resources from other federal agencies and more closely integrate with state actions around climate change (Sowers, Derek, PREP Conservation Program Manager, September 27, 2013, personal communication).

Discussion

This case illustrates through three instances of adaption our proposition that collaborative capacity and adaptive capacity are not one and the same thing, but rather distinct, but linked capacities. Across the four dimensions of structural arrangements, leadership, knowledge and learning, and resources, we suggest that specific adaptive capacities derive from collaborative capacities generated within CGRs. In Table 2, we summarize these capacities.

With these linkages in mind, we offer a conceptualization of institutional adaptation within CGRs in Fig. 1. We posit that collaboration dynamics foster specific collaborative capacities that in turn generate associated adaptive capacities, and further, that together these capacities shape the collaboration dynamics of CGRs in an iterative fashion thus assisting institutional adaptation.

While we are seeking more clarity in distinguishing between collaborative and adaptive capacity, it is important to note that we are also finding significant interdependence between the dimensions of capacity, as illustrated in this case. For example, without the resources provided by the states and the U.S. EPA, staffing could not have supported periodic meetings of the CGR. Lack of funding would have hindered researchers’ ability to continue ongoing data collection and contribute to shared knowledge generation. Inclusive institutional arrangements strengthen the

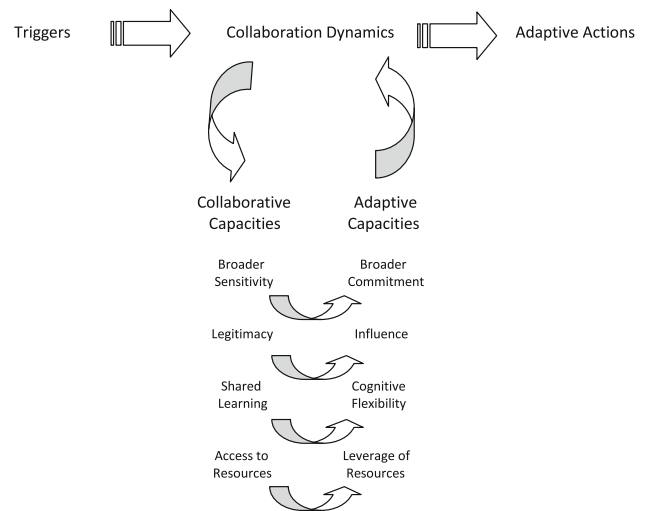


Fig. 1 Institutional adaptation in CGRs

Table 2 Key linkages between collaborative capacity and adaptive capacity

CGR characteristics	Dimensions of capacity	Collaborative capacity	Adaptive capacity
Engages a diversity of interests	Structural arrangements: Rules and norms for inclusivity and fairness	<i>Sensitivity to broad range of interests, impacts and interactions</i>	<i>Commitment to broad range of interests, impacts and interactions</i>
Requires multi-level leadership	Leadership: Multiple roles and sources of leadership cultivated	Internal and external <i>legitimacy</i> and effective advocacy	<i>Influence</i> to mobilize and support change
Shares and generates new information	Knowledge and learning: Generation and transmission of useable knowledge	<i>Shared learning</i> and appreciation of knowledge limits and information needs	<i>Cognitive flexibility</i> to respond to new and diverse information sources
Requires resource sharing	Resources: Transparent sources and distribution of resources	<i>Access to multiple resources</i>	<i>Leverage and qualify for multiple resources</i>

legitimacy of the CGR and can attract external leaders and cultivate more internal leaders.

This finding about the interrelationships between and across capacities echoes some earlier research. Institutional structure, for instance, has been found to shape learning by being more open to diverse participation and multiple sources of information, extended engagement, and unrestrained thinking (Schusler et al. 2003). Some researchers have found that more rigid and closed structures impede learning (Tippett et al. 2005; Mostert et al. 2007). Because the adaptation cycle itself is iterative, dynamic, interconnected, and non-linear (Wheaton and Maciver 1999, p. 217), we might expect adaptation to be so in CGRs as well.

Conclusion

In this paper, we have integrated two major literatures—collaborative governance and environmental change and adaptation—to identify four common dimensions of capacity within CGRs: structural arrangements, leadership, knowledge and learning, and resources. We have differentiated between collaborative capacity and adaptive capacity to re-conceptualize institutional adaptation specifically in the context of CGRs and tried to clarify and distinguish collaborative capacity from adaptive capacity and their contributions to adaptive action. We then developed the distinction and linkage between collaborative and adaptive capacities with the aid of an illustrative case study, the PREP. We have attempted to better specify the capacities that contribute to institutional adaptation with the view toward future research on how to strengthen those capacities and assure more effective adaptation.

We have not discussed questions concerning what “effective” adaptation is nor hazarded hypotheses as to which of these four dimensions of capacity are most important to effective adaptation. Further, we have not addressed how collaborative process dynamics within CGRs help generate these capacities. For this, we might draw on the integrative framework for collaborative governance to posit such interactions (Emerson et al. 2012). The process arenas for collaborative action developed by Cheng and Sturtevant (2012) may be another approach for exploring how CGRs build and support specific collaborative and adaptive capacities. Additionally, we have not made any claims at this point that CGRs produce more or better adaptive actions. With clearer specifications of adaptation and adaptive capacity, it will be possible to explore future comparisons among a range of different types of CGRs per Margerum (2008, 2011), for example, or between different forms of environmental management (such as government hierarchies, outsourcing, markets, and collaborative governance arrangements) per Tang and Mazmanian (2010).

Future research might also be directed to examine interdependencies between and within the four dimensions of capacity identified here to better understand, among other things, what happens in the absence of a particular dimension. It would also be useful to apply these dimensions and distinctions to the study of CGRs that cross international boundaries and involve nation-states with different political structures.

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