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Synthesis

A decade of adaptive governance scholarship: synthesis and future directions

Brian C. Chaffin¹, Hannah Gosnell¹ and Barbara A. Cosens²

ABSTRACT. Adaptive governance is an emergent form of environmental governance that is increasingly called upon by scholars and practitioners to coordinate resource management regimes in the face of the complexity and uncertainty associated with rapid environmental change. Although the term “adaptive governance” is not exclusively applied to the governance of social-ecological systems, related research represents a significant outgrowth of literature on resilience, social-ecological systems, and environmental governance. We present a chronology of major scholarship on adaptive governance, synthesizing efforts to define the concept and identifying the array of governance concepts associated with transformation toward adaptive governance. Based on this synthesis, we define adaptive governance as a range of interactions between actors, networks, organizations, and institutions emerging in pursuit of a desired state for social-ecological systems. In addition, we identify and discuss ambiguities in adaptive governance scholarship such as the roles of adaptive management, crisis, and a desired state for governance of social-ecological systems. Finally, we outline a research agenda to examine whether an adaptive governance approach can become institutionalized under current legal frameworks and political contexts. We suggest a further investigation of the relationship between adaptive governance and the principles of good governance; the roles of power and politics in the emergence of adaptive governance; and potential interventions such as legal reform that may catalyze or enhance governance adaptations or transformation toward adaptive governance.

Key Words: *adaptive governance; environmental governance; literature review; resilience*

INTRODUCTION

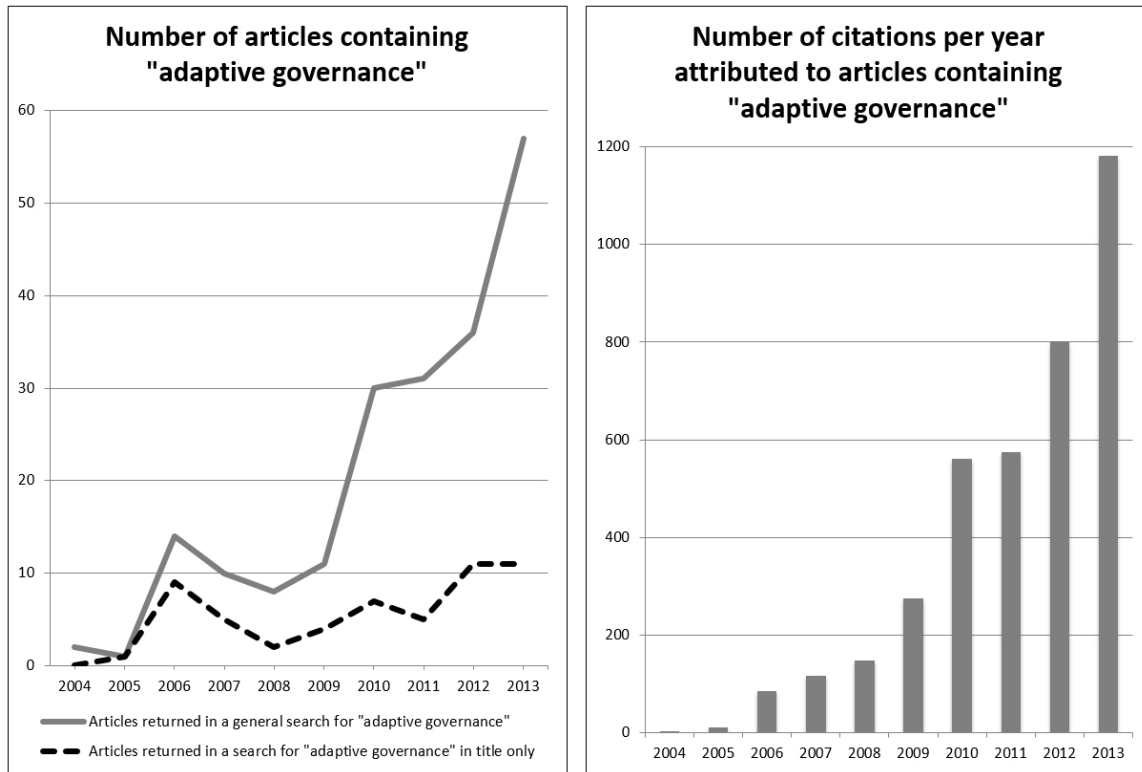
As humans enter an age of unparalleled resource consumption, the inherent link between social and ecological systems increasingly reveals itself to be significant. Anthropogenic global warming and accelerated rates of biodiversity loss are just two of numerous indicators that social and ecological systems do not and cannot exist in isolation, but instead exist as a complex whole, each a function of the other and expressed in a series of complex feedbacks (Berkes and Folke 1998, Berkes et al. 2002). Managing the complex relationship between the social and the ecological through approaches to resource or environmental governance should be of paramount concern for those interested in establishing sustainable natural resource use patterns. Environmental governance can be viewed as both a link between the social and the ecological, and a mechanism to influence the trajectory of social-ecological systems (SESs).

Broadly, environmental governance can be thought of as a “set of regulatory processes, mechanisms and organizations through which political actors influence environmental actions and outcomes” (Lemos and Agrawal 2006:298). Brunner et al. (2005) define environmental governance with an emphasis on the role of scientifically derived information about ecosystem function in decision making, while Kay et al. (2001) characterize the concept in a more normative way, as the process of resolving trade-offs and of providing a vision and direction for sustainability. Although we believe that appropriate governance processes increase the likelihood that “good governance” choices are made, we take a value neutral approach to defining environmental governance (Lockwood 2010). In short, environmental governance is the system of institutions, including rules, laws, regulations, policies, and social norms, and organizations involved in governing environmental resource use and/or protection, and there are a variety of different approaches.

One emergent approach is that of adaptive governance (AG). AG is an outgrowth of the theoretical search for modes of managing uncertainty and complexity in SESs (Dietz et al. 2003, Walker et al. 2004, Folke et al. 2005, Folke 2006). Given the uncertainties associated with global environmental change, including climate change and massive shifts in land use, environmental governance systems going forward must be highly adaptive. Governance systems, particularly those of top-down, state-based orientation, rarely match the relevant scale of ecological complexity, especially in the face of rapid environmental change (Young 2002, Cumming et al. 2006). Centralized governance via top-down directives or command-and-control policies often fails to provide effective solutions for highly contextualized situations, and also often falls short in efforts to coordinate governance across large-scale ecosystems that cross multiple jurisdictional boundaries (Lemos and Agrawal 2006). In response, a growing number of bottom-up approaches to governance have emerged via groups of local actors, social networks, and various collaborations of community leaders sensing the need for alternatives to top-down government and new approaches to environmental decision making (Weber 2003, Brosius et al. 2005). However well received and effective these pockets of local governance can be, they too suffer from coordination problems across complex geographies, e.g., large river basins (Cosens et al. 2014). Additionally, local governance is not always inclusive of all voices, especially those of stakeholders who are marginalized by dominant power relations and deprived of rightful access to resources, e.g., indigenous communities. There is a need, therefore, to champion new approaches to environmental governance capable of confronting landscape-scale problems in a manner both flexible enough to address highly contextualized SESs and dynamic and responsive enough to adjust to complex, unpredictable feedbacks between social and ecological system components.

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Fig. 1. Adaptive governance citation record since appearance of term (2004-2014). Based on a Web of Science search 24 February 2014.



AG is increasingly recognized as a way to address this need (Dietz et al. 2003, Folke et al. 2005, Lebel et al. 2006), and the concept is being applied in a variety of arenas. For example, theoretical and empirical exploration of AG is ongoing in disciplines of international trade (Cooney and Lang 2007), health research (Andrew and Kendra 2012), political science (Heilmann and Perry 2011), disaster research (Djalante et al. 2011, Djalante 2012), and appropriately, in law (Ebbesson and Hey 2013, Garmestani et al. 2013, Garmestani and Allen 2014). The purpose of this paper, however, is to organize and clarify conceptualizations of AG posed in the literature on environmental governance, resilience, and the management of SESs.

Over a decade has passed since Dietz et al. (2003) formally coined the term “adaptive governance” in *Science*, and nine years have passed since Folke et al. (2005) presented AG as a strategy for mediating the social conflict that plagues adaptive management of complex ecosystems. Since 2004, use of the term “adaptive governance” has grown significantly (Fig. 1), but a review of the literature suggests that consistent use of the term and an explicit research agenda have not yet coalesced. A synthesis of the literature on AG is thus necessitated by two related issues: (1) the search for new models of environmental governance that can address the dynamic, large-scale nature of the most pressing environmental crises; and (2) the widespread and growing interest in AG as a potential model. We address this need by articulating a clearer vision of the drivers, components, and pathways to AG.

We aim to: (1) provide an overview and brief chronology of the major scholarship on AG and its development in the environmental

governance, SES, and resilience literature; (2) synthesize existing theoretical and empirical literature on AG in an attempt to organize various concepts and criteria that currently characterize governance systems as AG; and (3) suggest a focused and empirically rigorous research agenda organized around current debates in AG research including the role of values and legitimacy, and the potential for institutionalizing AG in current legal frameworks.

THEORETICAL FOUNDATIONS AND MAJOR WORKS

A Web of Science topic search for “adaptive governance” reveals that citations have increased dramatically since 2004 (Fig. 1). The top two cited articles returned in this search, Folke et al. (2005) and Folke (2006) are cited 696 and 611 times, respectively (1545 and 1462 times, respectively according to Google Scholar). This key word search approach does not reveal all relevant references, however, e.g., the initial article proposing AG, Dietz et al. (2003), cited 739 and 1944 times according to Web of Science and Google Scholar, respectively. For this review, we use a combination of Web of Science and Google Scholar searches as well as a snowball sampling from citations within foundational articles to identify key references related to the genesis, definition, and application of AG (see Table 1).

Common beginnings

Distilling findings from a high profile National Research Council report on the state of managing common-pool natural resources (NRC 2002), Dietz et al. (2003) articulated the need for “adaptive” governance of SESs arguing that our knowledge of any system is

Table 1. A timetable for foundational references defining adaptive governance (AG).

Year	Author(s)	Times Cited [†]	Publication	Definition	Contribution	Research
1999	Gunderson	406	<i>Conservation Ecology</i>	Building resilience in the ecological system and flexibility in the coupled social system.	Outlined foundational principles for what would become a thread of theoretical and empirical research suggesting the need for AG.	Theoretical and Empirical
2003	Dietz et al.	739	<i>Science</i>	Managing diverse human-environmental interactions in the face of extreme uncertainty.	Coined term	Theoretical
2004	Walker et al.	480	<i>Ecology and Society</i>	The process of creating adaptability and transformability in SESs; the evolution of rules that influence resilience during self-organization.	Placed AG within the context of resilience scholarship.	Theoretical
2004	Olsson et al.	111	<i>Ecology and Society</i>	Dietz et al. 2003	First case study to analyze a transition to AG; highlights the role of social transformation.	Empirical
2005	Brunner et al.	n/a	Edited Book	Scientific and other types of knowledge integrated into policies that advance the common interest in environmental governance through open decision-making structures championed by community-based initiatives.	Contrasts AG against purely technocratic scientific management focused on efficiency and implemented through bureaucracy. Recognizes the need to include and balance a wide array of community interests in environmental governance as well as both scientific and local knowledge.	Theoretical and Empirical
2005	Folke et al.	696	<i>Annual Review of Environment and Resources</i>	The social contexts necessary to manage resilience in SESs.	Proposes the first comprehensive review and definition of AG. Relates AG to previously established concepts of adaptive management and adaptive comanagement. Foundational cite for building upon what is needed for successful AG.	Theoretical
2005	Scholz and Stiftel	n/a	Edited Book	The evolution of new governance institutions capable of generating long-term, sustainable policy solutions to wicked problems through coordinated efforts involving previously independent systems of users, knowledge, authorities, and organized interests.	Authors espouse a vision for the practical importance of developing AG concepts. They address five challenges to creating AG institutions: representation, process design, scientific learning, public learning, and problem responsiveness.	Empirical
2006	Olsson et al.	194	<i>Ecology and Society</i>	Dietz et al. 2003; Folke et al. 2005; environmental governance regimes that can deal with uncertainty and change.	Presents the importance of “windows of opportunity” in governance transformations toward AG. Links the concept of “transformability” (Walker et al. 2004) with early definitions of AG.	Theoretical and Empirical
2006	Folke	611	<i>Global Environmental Change</i>	Folke et al. 2005, but adds that systems of adaptive governance allow for management of essential ecosystem services through transformations in SES governance (as opposed to adaptation alone).	Folke links the aims and scope of environmental governance research with concurrent theoretical developments in literature on ecosystem services (see Carpenter et al. 2006); solidifies AG's place within resilience literature/scholarship.	Theoretical
2006	Gunderson and Light	55	<i>Policy Sciences</i>	Dietz et al. 2003, Folke et al. 2005; The integration of science, policy and decision making in systems that assume and manage for change as opposed to against it.	Thorough discussion and clarification of the relationship between adaptive management and AG.	Empirical

(con'd)

2007	Pahl-Wostl et al.	67	<i>Ecology and Society</i>	Folke et al. 2005	The learning environment fostered by AM is critically required for functioning AG, not just scaled up, but instead creating redundancy of learning through networks and across all scales and levels.	Theoretical
2007	Olsson et al.	55	<i>Ecology and Society</i>	Folke et al. 2005; a form of governance suitable for dealing with complex SES and enhancing the fit between institutions and ecosystem dynamics.	The authors develop the concept of “fit” between ecosystems and governance systems through more accurate scale matching and the function of bridging organizations.	Empirical
2008	Armitage et al.	146	<i>Global Environmental Change-Human and Policy Dimensions</i>	Brunner et al. 2005, Folke et al. 2005	Begins to recognize and link the subtle differences in terminology between the adaptive comanagement literature and AG literature.	Theoretical
2008	Olsson et al.	85	<i>Proceedings of the National Academy of Sciences USA</i>	Dietz et al. 2003, Folke et al. 2005	AG criteria are critical for transformations in governance. Transformations in perception, i.e., social transformation, through public involvement should not be overlooked as a window of opportunity for transformations in governance.	Empirical
2009	Huitema et al.	65	<i>Ecology and Society</i>	Folke et al. 2005, Olsson et al. 2006; authors never explicitly define AG, but their review of the adaptive comanagement literature with governance literature creates a synthesis very close to previous definitions of AG.	Present four key prescriptions for adaptive comanagement (with specific reference to water resources) extracted from literature on “governance.” Polycentric governance, public participation, experimentation, and bioregional scale are also key contributions as prescriptions of AG.	Theoretical
2009	Pahl-Wostl	134	<i>Global Environmental Change</i>	Dietz et al. 2003, Folke et al. 2005; AG is essential for governing SESs at times of abrupt change.	Presents a framework that characterizes AG as a multi-level learning process for clarification of how AG functions; supports the role of informal networks in AG as a critical part of the learning process.	Theoretical

[†]Based on Web of Science statistics gathered 24 February 2014.

likely to be wrong or at least incomplete, and the required scale of governance may shift because of changes in the biophysical and social system components. Research on collective action with specific attention to common-pool natural resource use, they suggested, revealed that effective governance conditions include systems in which: (1) resources and use can be monitored, verified, and understood at a relatively low cost; (2) rates of change are moderate; (3) communities have dense, intimate networks; (4) outsiders can be excluded at a relatively low cost; and (5) users support effective monitoring and enforcement (NRC 2002, Dietz et al. 2003). However, these conditions rarely, if ever, exist in coordination with one another. Instead, actual resource governance scenarios are generally predicated on incomplete information and conflicting or changing human values (Ostrom 2005). As such, Dietz et al. (2003) cited the need for a system of resource governance that is highly adaptive and allows rules to evolve from feedbacks originating both in the human and biophysical realms as well as combined elements of the system. This suggested form of “adaptive governance” of SESs requires adequate information about the resource (ecological), values (social), the human-environment interactions (e.g., feedbacks

through monitoring), as well as the most up-to-date information on uncertainty (Dietz et al. 2003). Dietz et al. (2003) also proposed the first general list of criteria necessary for AG: inclusive dialogue between resource users (analytic deliberation); complex, redundant, layered institutions (nesting); mixed institutional types (e.g., market- and state-based); and institutional designs that facilitate experimentation, learning, and change. The authors also defined what AG should do, thus providing a prescriptive research agenda going forward: (1) provide information (science and local knowledge); (2) deal with conflict; (3) induce rule compliance; (4) provide infrastructure; and (5) be prepared for change.

Situating AG in resilience scholarship

Much of the foundational AG literature approaches governance of SESs in terms of resilience: the capacity of a SES to absorb both natural and human disturbance while still maintaining structure and function (Holling 2001, Gunderson and Holling 2002, Folke 2007). Gunderson (1999) was one of the first scholars to articulate the idea that without recognizing resilience in the ecological system and “flexibility among stakeholders in the coupled social system, then one simply cannot manage

adaptively.” Additionally, an important component of a system’s resilience is its ability to reorganize in the face of sudden change (Holling 1973). Scholars of resilience call for AG to deal with uncertainty in the face of unexpected disturbance or sudden change by either building the resilience of the existing SES or facilitating transformation to an alternative state of SES function (Walker et al. 2004, Folke et al. 2005, Folke 2006). Some authors refer to this as incremental vs. transformative resilience building in SESs (Nelson et al. 2007, Pahl-Wostl et al. 2007). Using the terms “adaptability” and “transformability” to define properties of a SES and its associated governance institutions, Walker et al. (2004) firmly situated AG in the context of resilience scholarship. Governing SESs from a resilience perspective shifts the role of governance institutions and organizations from limiting change to managing and shaping the ability of a system to cope with, adapt to, and allow for further change (Berkes et al. 2002, Folke 2006, Gunderson and Light 2006).

Olsson et al. (2004a) presented an early case study analyzing a governance transformation under the resilience paradigm that took place in a wetland landscape in southern Sweden. Many of the factors critical to this transition, such as individual leadership and stakeholder dialogue, were associated purely with the social dimensions of SES transformation. Olsson et al. (2004b) framed the resulting governance institutions as “adaptive comanagement” (cited by others as “adaptive co-management” (e.g., Olsson et al. 2004a) and “adaptive (co-) management” (e.g., Huitema et al. 2009)). Many of the early empirical and theoretical contributions to AG are framed in terms of adaptive comanagement, and although more concerned with the expansion, operationalization, and scaling of adaptive management, adaptive comanagement is often, but not always, used synonymously with AG (e.g., Olsson et al. 2004a, b, 2006, 2007, Hahn et al. 2006, Huitema et al. 2009). Plummer et al. (2013) offer an excellent discussion of the relationship between environmental governance (and AG) and adaptive comanagement. In our consideration of AG concepts, we include foundational sources from the adaptive comanagement literature and draw distinctions in terminology where appropriate.

In a seminal work in the development of AG, Folke et al. (2005) presented AG as the social contexts necessary to actively manage resilience in SESs. Folke et al. (2005) suggested that adaptive management of resources alone is not enough to ensure resilient and sustainable outcomes because adaptive management is too narrowly focused on ecosystem outcomes. An exploration of the social contexts that enable adaptive management, they argued, could help to identify and avoid barriers to governance transformations at a scale larger than the management of specific resources. Folke et al. (2005) articulated the first comprehensive set of criteria necessary for a successful governance transformation toward AG. Most criteria are a function of social capital and include: knowledge generation and learning, organizational learning, collaboration, devolution of management rights or power sharing, participation, organizational flexibility, trust, leadership, social memory, and the formation of actor groups or teams (Folke et al. 2005).

Folke et al. (2005) also contended that AG is operationalized by adaptive comanagement. It is tempting here to relate the two via

a simple scaling up from adaptive comanagement to AG, but instead Folke et al. (2005) suggested that adaptive comanagement represents a suite of nested processes including the collaboration and learning associated with specific resource management objectives, without which AG could not function. Alternately stated, adaptive comanagement is characterized by scaled approaches to resource management provided for and coordinated within an adaptive and collaborative learning environment fostered by AG (Olsson et al. 2006). It is important to note that in order to create such an environment, AG requires functioning social networks that connect individuals and organizations across multiple levels and scales (Folke et al. 2005) and that strengthen the capacity for taking advantage of windows of opportunity for transitions toward AG (Olsson et al. 2006). Olsson et al. (2006) presented a set of case studies from around the world to depict transitions to AG in two phases: preparing the system for change and navigating that change. This seminal article directly connects the proposed structure of AG (Folke et al. 2005) with the concept of transformability (Walker et al. 2004), which has bearing on the likelihood of AG emerging during windows of opportunity. Under the right conditions, they theorize, AG will emerge as an adaptation or transformation in social organization to better achieve an agreed-upon ecological vision.

According to Nelson et al. (2007:409), “[s]uccessful adaptation in effect entails steering processes of change through institutions, in their broadest sense.” This insight hints at the normative nature of most characterizations of AG—adaptability and transformability are seen as necessary characteristics of governance regimes, employed to guide an SES toward a “desired ecosystem state” (Walker et al. 2004, Folke 2006), e.g., “ecological health” (Rapport et al. 1998). Some discussion has proceeded in the literature regarding the implications of this normative stance (Adger et al. 2005, Nelson et al. 2007, Smith and Stirling 2010) but we suggest that more attention should be paid to the potential disconnects between what science tells us is necessary for a healthy ecological system, what society wants from that ecosystem, and perhaps more importantly, what is politically feasible. The resilience literature outlines the objectives of a system of AG—to reach and maintain a desired state for coupled SESs, but who and what sets of values determine the desired state, in both ecological and social terms?

Concurrent conversations

While AG was developing as an outgrowth of resilience scholarship, a different group of scholars concurrently adopted the term to explain governance changes taking place in policy arenas with relation to the emergence of community-based natural resource management (CBNRM). Brunner et al. (2005) offered a practical view of AG in their edited volume, *Adaptive Governance: Integrating Science, Policy, and Decision Making*, as an alternative to legal and political gridlock in resource governance. The authors presented AG as a framework for adapting “policy decisions to real people” and for the “adaptation of policy decisions on the ground” through examples of both successful and unsuccessful transitions to AG (Brunner et al. 2005:19). They further suggested that AG cannot be reduced to a list of specific prescriptions, but is instead context dependent, and thus “a pattern of practices” (Brunner et al. 2005:19). We

suggest that the model presented in Brunner et al. (2005) has been previously framed as collaborative conservation (Cestero 1999, Wondollock and Yaffee 2000, Snow 2001), civic environmentalism (DeWitt 1994), community-based initiatives (Brunner et al. 2002), and/or community-based natural resource management (Brosius et al. 2005, Dressler et al. 2010). Taken together, this literature documents techniques, tools, and case studies of consensus building and conflict resolution in natural resource decision making, potentially foundational for fostering emergent AG.

Literature on CBNRM highlights the importance of local resource management initiatives for resolving contestations over resource use arising at small scales and often involving livelihoods that are seemingly incompatible with higher-scale policy directions (Brosius et al. 2005, Dressler et al. 2010). CBNRM initiatives also have the potential to infuse larger-scale resource use conflicts with local knowledge, leadership, and capacity (Brosius et al. 2005). However, this approach alone is not fully adequate to manage natural resource conflicts. Community-based initiatives often suffer from a lack of governing authority, legitimacy, funding, adequate flow of knowledge and resources, and sustained leadership (Brosius et al. 2005, Brunner et al. 2005). Furthermore, they function at a scale smaller than most ecosystems they rely on, leaving them vulnerable to changes outside their sphere of influence (Cash et al. 2006). Several governance scholars have suggested that AG has the potential to address failures of CBNRM by bridging locally oriented resource management initiatives with government interests for the development of improved environmental governance policies (Scholz and Stiffler 2005, Nelson et al. 2008). Theoretically, AG is an approach to governance in which CBNRM initiatives are not constrained, but instead coordinated and organized into a larger-scale framework of governance to achieve a desired state in SESs through either adaptation or transformation.

CHARACTERIZING ADAPTIVE GOVERNANCE

A review of AG definitions and the contributions of major works (see Table 1) reveals that AG is unanimously viewed as a system of environmental governance with the potential to mediate the complexity and uncertainty inherent in SESs. AG can be thought of simply as the social conditions that enable ecosystem management through the implementation of adaptive management (Folke et al. 2005, Gunderson and Light 2006). AG encompasses the social contexts that collectively mediate what humans want from ecological systems, e.g., a certain level of function or a specific set of services. Despite this explicitly normative function for AG, the concept can still be thought of as value neutral, i.e., neither good nor bad. For example, a system of environmental governance focused on rapid resource extraction can exhibit properties of AG similar to that of a system with a goal of sustainable resource use; the determining factor is what is prioritized in governance. With that in mind, AG of SESs can be broadly defined as the following: A range of interactions between actors, networks, organizations, and institutions emerging in pursuit of a desired state for social-ecological systems.

The role of adaptive management

Brunner et al. (2005:19) wrote that the “rise of community-based initiatives marks the emergence of adaptive governance from the remnants of scientific management in certain places.” Beginning with Holling (1978), scholars, particularly resilience scholars,

have recognized that the bureaucratic and efficiency-driven maximum-sustained yield (MSY) paradigm, part of what Brunner et al. (2005) referred to as “scientific management,” is inadequate in the face of inherent uncertainty about ecosystem dynamics. Instead, adaptive management, where experiments become policy and results are continuously monitored to further inform that policy, is the preferred approach (Walters 1986, Walters 1997, Gunderson 1999, Lee 1999). Dietz et al. (2003) recognized the inherent relationship between AG and adaptive management early on, referring to AG as the social contexts that facilitate adaptive management.

Although not explicit, Brunner et al. (2005) began to articulate two fundamental aspects of the dialogue linking adaptive management and AG. First, without the science-based monitoring and feedback loop made possible by processes of adaptive management, AG will fail to account for uncertainty and nonlinearity in the response of ecological systems to management actions. Gunderson and Light (2006:325) built on Brunner et al.’s (2005) arguments concurring that adaptive management is a “critical component” of AG, one that focuses on integrating science with decision making to foster a greater learning environment in the face of uncertainty. In a discussion of water resource management, Pahl-Wostl et al. (2007) also explored the importance of adaptive management in fostering learning processes, generating feedback of information essential for guiding a vision and goals of AG. Multiple, nested implementations of adaptive management within a framework of AG create a culture of learning that can provide a continuous flow of new information used to coordinate resource management across the SES (Folke et al. 2005, Cosens and Williams 2012).

Second, in complex SESs, adaptive management requires AG to be successful (Brunner et al. 2005, Gunderson and Light 2006, Huitema et al. 2009). Adaptive management has been difficult to implement because of the complex political nature of carrying out experiments with the goal of adjusting policy in response to monitoring results, no small feat given the short time frames associated with modern political cycles (Allen and Gunderson 2011). With the possible exception of single owner/single goal management, or totalitarian governments where adaptive management alone might be sufficient, implementation of adaptive management without the inclusion of governance principles will lack legitimacy and ultimately fail (Cosens 2013, Cosens et al. 2014). AG employs networks to coordinate multiple adaptive management learning processes across levels of governance, while recognizing, working within, and shaping the complex social system within which governance goals are set (Folke et al. 2005). Cosens and Williams (2012) even use the term AG to indicate “the type of governance necessary to allow sufficient flexibility for adaptive management.”

The role of scale: finding a governance “fit” between social and ecological

Rijke et al. (2012) found that any lasting AG regime must operate on a scale with the best “fit” between social and ecological components of a system. However, finding adequate fit between governance systems and ecosystems is elusive because of the complex nature of biophysical systems, e.g., groundwater, the “built” human-natural environment, e.g., dammed river basins or transbasin diversions, and the myriad of established and transient

political boundaries. Olsson et al. (2007) discussed “enhancing fit” between ecosystems and governance systems as part of AG, suggesting a focus on three key social connectors: (1) leadership by individual actors; (2) coordinating actors across a multilevel governance system through networks; and (3) activating social memory stored in social networks. The authors also suggested that institutions are often mismatched with ecosystem dynamics and that AG relies upon moral, legal, and financial support from networks to connect governance with a specific scale of ecosystem dynamics to produce “adaptive governance that enables ecosystem management” (Olsson et al. 2007).

Huitema et al. (2009) introduced the concept of matching AG to a “bioregional scale,” an operational scale where ecosystems and institutional arrangements are compatible. A bioregional scale crosses administrative and political boundaries and focuses on the optimization of governance by aligning ecological goals and social feasibility (Huitema et al. 2009). The bioregional scale mirrors the idea of a “problemshed”: a geographical area affected by the environmental problem prioritized in management (Mollinga et al. 2007, USBR 2014). That said, such a fit will vary from problem to problem and may change over time because of the variable political, economic, and cultural drivers that often determine jurisdictional boundaries (Cosens 2010, Ruhl and Salzman 2010, Rijke et al. 2012). Introducing even greater complexity are situations in which the source of the problem occurs at a different scale than the locus of the affected people (Long 2009). Ideally, the scale of AG will be adapted to the social and ecological nature of the problem as well as to societal goals, through sufficient response flexibility within and between existing political boundaries (Cosens 2010, 2013, Termeer et al. 2010).

Polycentricity, redundancy, and diversity

As AG theory developed, scholars described the need for AG institutions and organizations to be nested across levels of governance, structured with multiple centers of power, redundant in function, and connected across space and time through networks (Dietz et al. 2003, Folke et al. 2005, Folke 2006, Huitema et al. 2009, Cosens 2010). These criteria are all related. A multilevel governance system made up of multiple governing authorities will generally house multiple centers of power that partially overlap and are often redundant across a given scale (McGinnis 1999). The term polycentricity or polycentric is used to describe multiple centers of power or decision making with authority divided amongst bodies with overlapping jurisdictions (Ostrom et al. 1961, McGinnis 1999, da Silveira and Richards 2013). Higher scales of governance are usually more generalized but house nested layers (or levels) of governance institutions with increasing specificity (Huitema et al. 2009). Polycentricity is thus related to redundancy in power relations, which is necessary for AG to continue to function in the face of disturbances and surprise (Huitema et al. 2009). Theoretically, an AG system requires a structure of nested institutions (complex, redundant, and layered) and institutional diversity (a mixture of market, state, and community organizations) at the local, regional, and state levels, connected by formal and informal social networks (Dietz et al. 2003).

As the past decade of AG scholarship reached its halfway point, the focus began to shift from major theoretical contributions and foundational empirical examples to a search for real world examples of adaptations and transformations that resemble

conceptualizations of AG. Many potential examples of AG have been described, such as the AG of Amazon deforestation (Boyd 2008), regional drought governance in Australia (Nelson et al. 2008), AG of the Great Barrier Reef World Heritage Site (Olsson et al. 2008), collaborative water governance in the California Bay Delta (Kallis et al. 2009), AG of climate change effects in the Pacific Islands (Lynch and Brunner 2010), AG in the English National Park protected landscapes (Clark and Clarke 2011), and assessments of AG in Model Forest reserves in Russia and Sweden (Elbakidze et al. 2010, 2012), among others. Theoretical work continues concurrently, however, including an increased focus on learning processes (e.g., Armitage et al. 2008, Pahl-Wostl 2009) and the role of adaptive capacity in AG (e.g., Pahl-Wostl 2009, Gupta et al. 2010).

DISCUSSION: PROBLEMS AND QUESTIONS

Disentangling the role of the desired state

In the context of AG of SESs, many if not most scholars approach the concept in terms of a vision for sustainability (e.g., Folke et al. 2005, Sanginga et al. 2010) and more specifically, as a “precondition for the emergence of sustainable development” (Clark and Clarke 2011:314). Brunner and colleagues refer to the goal of AG as pursuing a “common interest” amongst stakeholders and public involved in resource management (Brunner et al. 2002, 2005, Lynch and Brunner 2010), while Olsson et al. (2007) discuss AG in the context of maintaining “the capacity of complex and dynamic ecosystems to generate services for human well-being.” All these normative connotations suggest AG as the pursuit of a desired state for SESs.

In most examples put forth as AG, the desired state is referenced as a set of ecological outcomes, generally agreed upon by users in the system, which not only necessitate a shift in governance, but also serve to guide that shift (e.g., Olsson et al. 2004a, 2008). However, in the context of AG of a SES, the desired state would theoretically include desirable social and governance outcomes as well, thus creating confusion as to whether AG itself is part of the desired state. This leads to several important questions regarding the role of the desired state in the emergence of AG: (1) What is the relationship between the human values underlying a desired state and resultant AG approaches; (2) How is a desired state identified and employed to initiate a shift in governance towards AG?

If we assume AG emerges as the pursuit of a desired state (specific ecological and social outcomes), then deconstructing the context of that desired state could lead to a more complete understanding of AG. For example, do the values underlying the pursuit of this state have any bearing on the resultant structure, scale, timeliness, and resilience of AG? Can AG achieve desired ecological outcomes at the expense of good governance? Or alternatively, are the principles of good governance, specifically legitimacy, transparency, accountability, inclusiveness, and fairness, inherently part of a desired state for SESs and thus part of AG itself (Lockwood 2010)? In other words, is a shift toward AG of SESs largely just a shift toward good governance in the face of complexity and uncertainty?

An implicit assumption in our definition of AG is that a shift in governance toward AG, and thus the pursuit of a desired state, will only occur when the current state of an SES is undesirable, untenable, or both, e.g., loss of important ecosystem function

such as filtration, pollination, flood abatement, or social conflict over the management of scarce resources. What is unclear, however, is how the articulation of a desired state emerges amongst entrenched resource users and established levels of governance, even in the face of resource crisis. Does the desired state need to be established with public input? Although alternative forms of collaborative governance, including AG, have been critiqued for their call for consensus (e.g., Ansell and Gash 2008), it remains unclear how important consensus among resource users and governance stakeholders is for envisioning a desired state. A concerted attempt to find consensus with every possible effort until critical mass is reached in support of a desired state may be sufficient (Innes and Booher 2010). However, if a shift toward AG necessitates a change in the status quo controlling resource governance, how are these power relations challenged without consensus? These questions build the base for important but nascent discussions on the relationship between the emergence of AG and underlying values.

Understanding how AG “emerges”

Discussions regarding the development of AG in the resilience literature suggest that the social components of a SES must be adequately “prepared” before transformation can take place (Olsson et al. 2004a, 2006). Although it is essential that a diverse array of vested stakeholders eventually participate, individual leadership and trust building among stakeholders at the local level are what drive the emergence of AG (Olsson et al. 2004a, b, 2007, Folke et al. 2005). To bridge various levels of existing multilevel governance structures, networks develop that span scales from the local to bioregional to higher scales to secure resources necessary to both facilitate change and engage those who have the power to prevent it. Further, networks facilitate the communication and integration of both scientific and local knowledge as well, and also serve to encourage diversity and mobilize social capital. In these ways they are able to generate or enhance the adaptive capacity necessary for flexible response, learning, and adjustment (Folke et al. 2005, Bodin et al. 2006, Lebel et al. 2006, Bodin and Crona 2009).

Olsson et al. (2006) suggested that in addition to “preparing the system,” a shift in governance towards AG may require “windows of opportunity.” Such windows may appear as a significant boost in capital or legitimacy, e.g., a shift in policy, a disruptive political election, a significant increase in funding or autonomy, a biophysical perturbation such as a natural disaster, or the recognition of a previously informal network as a formal governance organization. One such example noted by Österblom and Folke (2013) was the formalization of ISOFISH, previously an informal network collaboration between government, industry, NGOs, and the scientific community created to address a perceived illegal fishing crisis in the South Pacific. In an earlier example from southern Sweden, the legitimacy of a transition to AG was attained through the creation of a formal (municipal) organization without rule-making authority, but with adequate leadership, vision, and the capacity to participate in and facilitate governance collaborations (Olsson et al. 2004a). In both cases formal recognition was critical to ensuring legitimacy for AG as each organization was then able to serve more effectively in a bridging function between actors, networks, and other organizations, both within existing structures of multilevel governance and for the pursuit of a desired social-ecological state (Hahn et al. 2006).

However, how does a vision arise compelling enough to catalyze adaptation or transformation toward a new desired state? How are the fetters of an existing system of environmental governance shed? When does preparation for a shift in governance begin? Threats to values, both ecological and social; intractable policies confounding resource management efforts; direct competition and conflict over scarce resources; and perceptions of crisis are generally recognized as signs of an undesirable state of environmental governance (Gunderson 1999, Olsson et al. 2004a, 2006, 2007, 2008, Gunderson et al. 2005, Hahn et al. 2006, Cosens et al. 2014), as is protracted litigation and civil disobedience in certain circumstances (Cosens 2013). The contested nature of scarce resources and the potentially negative effects of forced resource redistribution can be essential in mobilizing individuals, networks, and organizations toward a shift in governance (Olsson et al. 2008, Österblom and Folke 2013). Clark and Clarke (2011) found this to be true in their study of National Park governance units in England; fixed or finite resources were important in bringing stakeholders, including organizations, into efforts to transform governance toward AG. Similarly, Österblom and Folke (2013) found that the perceived crisis of illegal fishing and the associated negative implications for fishery resources and commercial fishing livelihoods not only led to the articulation of shared beliefs and values but also catalyzed a shift in governance.

Such resource management crises can also create space for the emergence of shadow governance, informal networks primed to exploit a window of opportunity and initiate adaptation or transformation of existing governance toward a new system of AG, controlled by a new set of variables (Gunderson 1999, Olsson et al. 2006). Lynch and Brunner (2010) characterize this shift not as a discrete choice between two types of governance, but instead a realization that fundamentally new pathways beyond the status quo are needed to address complexity and uncertainty. However, an entrenched status quo controlling environmental governance through a combination of policy, funding, authority, or knowledge can be a significant barrier to the emergence of AG, despite windows of opportunity. Resource conflict in the Everglades bioregion (USA) provides an empirical example of this: a federal-level, command-and-control management structure involving significant subsidies promoted the rigid maintenance of a status quo of “crisis-and-fix” environmental governance, preventing any shift toward AG despite growing windows of opportunity (Gunderson 1999, Light et al. 2005, Gunderson and Light 2006). As such, any attempt to consciously catalyze AG or create windows of opportunity for governance transitions through intervention should be preceded by an explicit analysis of relevant power and politics (Armitage 2008) that may be precipitating environmental and social injustices stemming from the marginalization of minority cultures, religions, worldviews, and environmental ethics.

Building social-ecological resilience in the new desired state

The question of how AG is institutionalized once a window of opportunity is exploited is another important question for environmental governance scholars to examine more closely. How can adaptive capacity mobilized in earlier phases become institutionalized to preserve functions essential to AG such as monitoring of fit between governance, ecological resources, and the desired state (Olsson et al. 2007)? How can the relationships between actors, networks, and organizations built during the preparation phase, which may be “robust yet fragile” (Janssen

2006), gain the legitimacy necessary to withstand future disturbances to the governance system in particular and the SES in general (Hahn 2011)? This final phase in the transformation process can also be described as the process of building resilience in governance.

Borrowing from the language of Gunderson et al. (2005), two major challenges associated with transitioning to a more resilient system of governance can be described as (1) overcoming legal and institutional “barriers” and (2) building “bridges” from current governance structures. These steps represent a significant challenge and deserve further exploration. Although major legal reform may be the most direct means of addressing barriers in current governance structures (Ebbesson and Hey 2013, Garmestani et al. 2013, Garmestani and Allen 2014), the complex and politically charged nature of this process in most SESs often renders legal reform infeasible in the short term. Sometimes myths and underlying perceptions must be challenged for progress to be made (Gunderson et al. 2005). Given the slow and complex nature of changing institutions (i.e., rules, norms, laws, and policies), cultivating incremental change in existing legal institutions may have more promise (Cosens and Gunderson 2013). This may require an increased capacity for conflict resolution as well as significant participatory capacity: a function of stakeholders’ ability to participate in knowledge generation (Bark et al. 2012, Cosens et al. 2014), and the presence or absence of resources that promote and enable meaningful participation in decision making processes (Brunner et al. 2005). In addition, a deep ecological understanding derived from generation of both scientific and traditional ecological knowledge is necessary to advance resource management systems under AG (Folke 2006, Bark et al. 2012).

Prior to fundamental institutional change, and as a step toward building resilience in governance, existing governance organizations will theoretically begin to legitimize emerging AG networks through trusted actors shared by both (Olsson et al. 2008, Lynch and Brunner 2010, Österblom and Folke 2013). In this way, organizations across an existing multilevel governance system may take up similar roles toward achieving a desired state, promoting redundancy and overlap of function, and thus buffering against perturbations to the system (Folke et al. 2005). As formalized governance organizations begin to share a common vision of governance, it is more likely that polycentricity will develop across a system (Huitema et al. 2009, da Silveira and Richards 2013). Through the cascade of connections, from individuals through networks to organizations, it is likely that some devolution of power may be possible, especially if informal networks are institutionalized as organizations and provided with some decision making authority (Österblom and Folke 2013).

The reality is, however, that organizations often have a long history and established culture, prior political relationships and responsibilities, and operate under a rigid set of social norms. In addition, the place in which these organizations operate, i.e., the SES in question, has its own legacy context including the history, politics, and conflict surrounding environmental degradation. Although AG may begin to emerge at the level of individuals, every SES has significant contextual differences, both ecological and social, that shape how individuals and networks further organize and operate (Elbakidze et al. 2010, Huntjens et al. 2012).

CONCLUSION AND RESEARCH AGENDA

AG is an emergent form of environmental governance that cannot be created by a unilateral action of government. AG is never the same in two places; it is messy and often develops organically within the context of a SES, but it can also be encouraged with an intervention aimed at boosting adaptive capacity. It exists across a spectrum, from top-down to bottom-up, from rigid to flexible, from global to local, but never exists at one extreme. The convergence of concepts from different areas of scholarship presented here supports the proposition that AG is essential for dealing with complexity and uncertainty associated with rapid global environmental change. AG may emerge when actors, networks, and organizations initiate a transformation in search of a new, more desirable state of environmental governance or when they reorganize in response to perturbations such as policy windows, funding opportunities, and/or biophysical shocks to the system.

AG represents a dynamic link between social and ecological landscapes that recognizes the complexity of ecological systems, inherent uncertainty, and unknown feedbacks stemming from social actions taken to manage ecological resources. AG is born from the social will to manage SESs holistically for either increased resistance to undesirable change or the ability to transform a system to a more desirable state. AG cannot be realized without functioning social networks and the authority and resources to implement adaptive management. Networks create cross-level and cross-scale linkages that allow for broad participation and experimentation to harmonize at a system-wide scale, establishing a culture of learning that increases knowledge generation and learning across a multilevel governance structure. AG theoretically culminates in coordination at a bioregional scale, a scale at which the governance structure best fits ecological function.

Our review and synthesis of literature on AG reveals the need for further research that addresses three major questions:

1. What is the relationship between principles of AG and principles that fall generally under the heading of “good” governance? Are these separate areas of inquiry, one focused on the governance of ecological systems and one focused on purely societal issues of legitimacy, equity, and justice? Or, does inclusion of “social” in the SES concept suggest that the resilience and desirability of the social system is equally important to that of the ecological system, thus requiring a broader integration of good governance concepts into theoretical and practical discussions of AG?
2. What is required to prepare for and take advantage of windows of opportunity to increase the likelihood of successful transformations to AG (Olsson et al. 2004a, 2006, Brunner et al. 2005, Cosens et al. 2014)? Can a window of opportunity be exploited with little or no system preparation? Are there legal and regulatory frameworks that inherently create windows of opportunity and thus make the emergence of AG more likely?
3. What are the barriers within existing institutions to adoption and implementation of AG? Are there common targeted interventions or legal reforms that can be pursued to support the emergence of AG when a window opens? Where are

specific changes in the law necessary to open up policy space and allow a degree of flexibility for potential innovation (e.g., Garmestani and Benson 2013)? Conversely, where are the authorities lacking to manage experimentally and to coordinate across jurisdictional and substantive boundaries?

The last two areas of our proposed research agenda require the integration of legal scholarship with scholarship on ecological resilience and the study of social-ecological systems. The authors are participants in an NSF funded synthesis project designed to begin that process (Cosens and Gunderson 2013). In addition, each of these research questions calls for a significant development of the empirical record, an increased effort to explore case studies of both successful and unsuccessful transformations toward AG. With particular reference to unsuccessful transitions, researchers should pay careful attention to the politics of AG to define the roles of power, equity, and justice (social and environmental) in fostering or inhibiting AG for sustainable resource use. Who determines the desired state sought through a transformation toward AG and what voices are left unheard? Alternatively, do commonalities exist among governance transitions successful in altering power dynamics to include marginalized populations of resources users?

To address these questions, governance scholars should develop and refine multiple methods for identifying and characterizing transitions to AG. Building on the AG criteria identified in this paper, researchers might create innovative metrics applicable to a variety of SESs, regardless of scale, that describe and quantify governance transitions in replicable ways. Techniques such as institutional mapping and social network analysis (SNA) should be further explored (Aligica 2006, Crona and Bodin 2006, Bodin and Crona 2009). Our hope is that this narrative of the conceptual development of AG, along with our proposal for a directed research agenda, will serve to unite interdisciplinary collaborations of scholars interested in various aspects of AG, but previously deterred by the ambiguity of the concept.

Responses to this article can be read online at:
<http://www.ecologyandsociety.org/issues/responses.php/6824>

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