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FORUM

A critical assessment of collaborative adaptive management in practice

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Summary

1. Collaborative adaptive management (CAM) is regularly touted as the best way to handle natural resource management in the face of uncertainty, change and conflict. Successful applications of CAM have, however, been elusive in practice.

2. This article examines the Glen Canyon Dam Adaptive Management Program (AMP) in the United States, and other CAM efforts, to illustrate why and how procedural shortcomings may lead to natural resource management failures and reflect on how they may be overcome.

3. *Synthesis and applications.* To increase the chance of success, CAM efforts should set clear overarching goals and concrete and measurable objectives, employ tools and incentives to facilitate participation and foster collaboration, implement well-defined joint fact-finding protocols to promote shared learning and manage scientific uncertainty, and commit to monitoring and adapting their management regimes over time. Even in complex and contentious resource management contexts, future CAM efforts that integrate these design elements are likely to lead to more effective natural resource management.

Key-words: collaborative adaptive management, collaborative planning, consensus, ecosystem management, environmental management, Glen Canyon Dam, joint fact-finding, natural resource management, public participation, stakeholder engagement

Introduction

Adaptive management (AM) emerged in the 1970s as a way to apply continuous process improvement to natural resource management (Holling 1978). Rather than making a single definitive decision despite information gaps or uncertainty about the systems involved, AM emphasises learning via the careful monitoring of provisional strategies and changing conditions, and incremental adjustments in the light of new information (Holling 1978; Williams, Szaro & Shapiro 2009; Doremus *et al.* 2011).

Many scholars and regulatory authorities support AM and endorse collaborative planning as a way to address deficiencies in conventional regulatory decision-making (Susskind & Secunda 1998; Williams, Szaro & Shapiro 2009; Innes & Booher 2010). Collaborative planning emphasises the involvement of all stakeholder groups to fully exploit local environmental knowledge and ensure mutual gains. This can overcome key problems that often thwart ecosystem management, including overlapping authority, conflicting decision-making processes and tension between stakeholders with different interests. The combination of AM and collaborative planning is often referred to as collaborative adaptive management (CAM).

Collaborative adaptive management programmes have been designed and implemented in different ways in a variety of resource management contexts around the world, from a wetland landscape in southern Sweden to the Glen Canyon Dam in the arid south-western United States [Glen Canyon Dam Adaptive Management Work Group (AMWG) 1997; Olsson, Folke & Hahn 2004; CAMNet 2011]. While almost all claim to involve the processes of incremental adjustment and public participation, they have approached the issues of stakeholder engagement and AM in different ways. Unfortunately, the results have been mixed, with many efforts falling short of the resource management results that were expected (Layzer 2008; Wiersema 2008; Ruhl & Fischman 2010).

The shortcomings of CAM efforts often arise from their failure to carefully formulate management processes and adjust

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them over time. Using the Glen Canyon Dam Adaptive Management Program (AMP) and other examples of CAM in practice, we explain that CAM experiments too often are designed without one or more of the following: (1) clear overarching goals as well as concrete and measurable objectives to guide the management process (2) well-defined fact-finding protocols to promote shared learning and manage scientific uncertainty; (3) tools and incentives that facilitate participation and foster collaboration; and (4) clear procedures for managing the programme adaptively and cultivating long-term capacity building.

CAM in Practice: The Glen Canyon Dam AMP

As one of the first attempts at CAM, the Glen Canyon AMP serves as a great exemplar of some of the problems that need to be avoided. The Glen Canyon dam, which is on the Colorado River in the U.S. state of Arizona, was contentious from its conception in the 1950s, and the body of legislation passed over the years relevant to the dam has only compounded conflict around how it should be operated. On the one hand, the Law of the River – that is, the collection of statutes, regulations, court rulings and agreements that define how the Colorado River must be managed – focuses primarily on water storage and secondarily on hydroelectric power generation, containing few environmental and cultural preservation protections (Bureau of Reclamation 2008). On the other hand, various environmental and preservation laws have direct implications on how the dam is operated. The Endangered Species Act (U.S. Congress 1973), for example, mandates the protection of various species that have been impacted by the dam, including the humpback chub (*Gila cypha*), razorback sucker (*Xyrauchen texanus*) and Kanab ambersnail (*Oxyloma haydeni kanabensis*) (Glen Canyon Dam AMP 2006).

The Grand Canyon Protection Act of 1992 was expected to reduce conflict and clarify how the dam should be operated. Unfortunately, the U.S. Congress simply reiterated the importance of water management, power generation, and environmental, cultural and recreational resources, failing to set priorities among these competing concerns (see U.S. Congress 1992). The Act does mandate long-term monitoring in consultation with various stakeholders and directed the U.S. Secretary of the Interior to complete an environmental impact assessment of the dam's operations (U.S. Congress 1992). The results of the assessment led to the creation of the Glen Canyon Dam AMWG, the federal advisory committee at the core of the AMP, in 1996. The AMWG's charter stipulates that membership shall come from federal and state agencies, Native American tribes, the basin States, environmental groups, recreation groups and power-purchasing contractors (AMWG 1997).

The Glen Canyon Dam AMP was established to develop an AM plan, reduce conflict and protect or improve ecological conditions. Unfortunately, insufficient attention to the design of the programme led to difficulties. Despite the passage of time and the dedication of considerable resources to the AMP's operation, the dam still relies on the same 'modified low fluctuating flows' regime that it did before the AMP was created (Feller 2008). Three highly publicised and much celebrated 'high-flow experiments' yielded important scientific data about the River's downstream hydrology and ecosystems, but 15 years on these data have not led to adjustments in the management or operation of the dam, despite the persistence of problems (Melis 2011). This is because the AMP has no procedure requiring that information gleaned over time be used to adjust its management protocols. The role of the group in resolving regulatory confusion and inconsistency remains unclear, and considerable discord remains (Camacho 2008).

The AMP's failures have had serious negative consequences on the species and habitats the AMP was supposed to protect, including the endangered humpback chub. While a recent positive trend in humpback chub abundance has been identified, estimates put the 2008 population at only ~70% of the 1989 population (Andersen 2009). Moreover, the current population ultimately represents a fraction of the likely population before dams were constructed on the Colorado River (AMP 2006). Although Andersen (2009) posits that experimental water releases conducted under the auspices of the AMP are at least in part responsible for the more recent resurgence of the humpback chub, a permanent modified flow regime has not been adopted, and even the continuation of high-flow experiments in the near future is uncertain (Reese 2009; Melis 2011).

Designing CAM: Lessons from the AMP and Beyond

The inability of the AMP to produce widely supported modified flow regime recommendations is in large part attributable to inadequate attention to the design of the CAM process. Drawing on prior analyses of the AMP (Camacho 2008; Susskind, Camacho & Schenk 2010), we outline four process-related requirements for CAM programmes that the AMP failed to implement and that exemplify the most common deficiencies of CAM in practice: (1) establish clear overarching goals and concrete objectives; (2) promote participation and collaboration; (3) define clear roles and processes for shared learning; and (4) manage CAM programmes themselves adaptively. We also provide a number of other examples that have either experienced or avoided these particular pitfalls. Through careful initial design and systematic tailoring, CAM can be an effective approach to resource management, even under the conditions of conflict and uncertainty.

ESTABLISHING CLEAR GOALS AND CONCRETE OBJECTIVES

Collaborative adaptive management groups should be empowered to develop management recommendations, but these must be linked to an overarching set of goals that the group unanimously agrees to work towards (Doremus *et al.* 2011). Any conflicting goals should be prioritised. Moreover, specific objectives should be adopted which are measurable, achievable, results oriented and time fixed (Williams, Szaro & Shapiro 2009). Objectives will shift as the management regime advances, but they provide substantive targets against which the impacts of interventions can be measured.

When the U.S. Congress passed the Grand Canyon Protection Act in 1992, it failed to provide guidance on how to prioritise competing uses of the river. Similarly, when the U.S. Secretary of the Interior created the AMWG, he failed to set such priorities, ostensibly leaving this tall order to the group itself (Glen Canyon Dam AMWG 1997). As a result, the relative importance of different uses has remained a constant point of contention. The AMP has adopted a strategic plan that includes a mission statement listing a range of goals for the Colorado River ecosystem (AMP 2001), but it simply rehashes the conflict. For example, it is far from clear that the goals of maintaining viable fish populations and maintaining current levels of power production can be achieved simultaneously (Glen Canyon Dam AMP 2001).

In fact, a committee of the AMWG established to review its progress found that underlying conflicts have not been resolved, quantifiable targets have not been established for any of the AMP goals and many of the stakeholders have not even committed to the process of setting goals let alone objectives [AMWG – Roles Ad Hoc Group (RAHG) 2007]. Unfortunately, the failure to prioritise and develop measurable objectives allows those with more power to form voting blocks and advance their agendas relatively unencumbered, while others remain frustrated and find other ways – most commonly lawsuits – to challenge the management decisions made (Orenstein, Palmer & Lewis 2010).

Wiersema (2008) argues that the neglect of 'specific substantive goals' is a common problem among 'new governance' initiatives as they strive for flexibility at the potential cost of long-term management objectives. She uses the Chesapeake Bay Program's efforts to manage blue crabs (*Callinectes sapidus*) in that U.S. east coast region and the challenges to establishing terms within the global Ramsar Convention on Wetlands as case studies to illustrate why goals, enshrined in law, are important foundations for any governance system (Wiersema 2008). Likewise, Doremus *et al.* (2011) detail how the Comprehensive Everglades Restoration Plan for the Florida Everglades in the U.S. has largely faltered despite considerable funding because stated goals are not prioritised, leaving the programme 'in a planning mode, rather than an adaptive implementation mode'.

In contrast, the Suwannee River Partnership in Florida brings together a range of interest groups with the clear overarching goal of making measurable reductions in nutrient pollution, as required by the U.S. Federal Clean Water Act (Dedekorkut 2005). Stakeholders jointly evaluate and select concrete and measurable objectives and strategies on a case-by-case basis to minimise nutrient discharges, resulting in a reduction of almost 600 tons of nitrate within the first year (Dedekorkut 2005).

FACILITATING PARTICIPATION AND BUILDING AGREEMENT

Collaborative adaptive management processes typically require substantial time and resource commitments. To be successful, CAM processes must ensure that stakeholders have both the capacity and sufficient incentives to participate (Williams, Szaro & Shapiro 2009; Innes & Booher 2010). In fact, a research project examining 105 'ecosystem management' efforts found that the 'dedication of participants' is the single most important factor behind success (Yaffee 2002).

Specifically, participants in collaborative processes need to know that, if they can reach near unanimous agreement, formal decisions are likely to follow their recommendations (Susskind, McKearnan & Thomas-Larmer 1999). Although assigned decision-makers cannot legally delegate all authority to such groups, meaningful stakeholder participation requires both a clear delineation of how group deliberations will influence decisions and an explicit commitment by decision-makers that such deliberations will weigh heavily on decisions made. In practice, the U.S. Secretary of the Interior has often failed to even respond to the AMWG's inquiries or provide details on programmatic changes. For example, the Secretary proceeded with key experimental tests without even asking the AMWG for its recommendation (Camacho 2008).

Furthermore, although the AMWG's operating procedures ostensibly call for unanimous agreement, for most decisions, the group defaults to two-thirds majority votes (see AMP 2010). The 2007 Roles Ad Hoc Group actually concluded that the level of collaboration among stakeholders has fallen since the AMP process was launched (RAHG 2007). Stakeholders have become increasingly entrenched, manoeuvring to win majority votes and using channels outside of the AMP process – including lawsuits and lobbying – to get their way (Camacho 2008; Charter Ad Hoc Group 2011).

Moreover, there is substantial evidence that a neutral mediator can be important to building agreement (Beierle & Cayford 2002). The AMWG brought in a professional mediator to assist in collaborative decision-making, but that person has not been adequately empowered. All decision-making power, including when to bring a motion to a vote, still rests with the Chair of the group (RAHG 2007). Other CAM processes suggest the value of fostering participation and collaboration through focusing on process design, stakeholder incentives and capacity building (Fuller 2006).

ESTABLISHING CLEAR ROLES AND PROTOCOLS THAT PROMOTE SHARED LEARNING

In order for CAM participants to enhance their understanding and reach resource management goals, they must agree on the research questions that need to be answered and methods for addressing them. They must accept the legitimacy of jointly commissioned research, even if their interpretations of the findings ultimately differ (Ehrmann & Stinson 1999).

The AMP has many of the right ingredients for successful joint fact-finding. These include a Technical Working Group, comprised of specialised representatives, which can draft questions and translate findings into materials useful to AMWG members, the independent Grand Canyon Monitoring and Research Center (GCMRC), which has the capacity to conduct or contract out research, and adequate financial and political support to engage in collaborative learning. However,

the AMP has failed to make significant substantive progress on a series of important technical questions, in part because of a failure to establish mutually agreed upon research protocols. More significantly, no long-term changes in management have been made in response to what they have learned (Reese 2009).

Two issues are the lack of clarity regarding the relationship and substantial distrust between the AMWG and the GCMRC (RAHG 2007; Camacho 2008). Some AMWG members have been critical of the GCMRC for not being more attentive to the group's requests and making unilateral decisions and changes to documents, while the GCMRC has complained of AMWG members having unrealistically high expectations and of attempting to direct their work (RAHG 2007). It is not necessary for the AMWG to have total authority over the GCMRC. However, it should be clear that the AMWG is responsible for crafting the questions that need to be answered and for using the results to develop recommendations, and the GCMRC is responsible for independently conducting the research (RAHG 2007). Scientists must recognise and be responsive to decision-making dynamics to be useful, while decision-makers need to acknowledge the importance of independently conducted research (Ehrmann & Stinson 1999). Clearly, fostering successful relationships centred on effective social learning between 'experts' and other stakeholders is an oft-cited challenge in participatory governance processes (see Reed 2008).

Joint fact-finding is an integral part of the CALFED Bay-Delta Program, a joint state (CAL) and federal (FED) CAM process that is managing the San Francisco Bay-Delta in California. Stakeholders have agreed on a common set of baseline findings, allowing them to respond quickly when decisions must be made. The Data Assessment Team, comprised of agency and other stakeholder representatives, talks weekly and draws on a common pool of experts (Innes & Booher 2010). Even when mistakes have been made, the participants have stood by the CAM process.

MANAGING THE PROGRAMME ADAPTIVELY

Collaborative adaptive management is a long-term task that requires the building of ongoing institutional and organizational capacity. AM must go beyond the monitoring and assessment of individual management strategies; it should aim for periodic modification of the regulatory programme itself (Doremus *et al.* 2011). Such an approach allows the convener, the stakeholders and the broader public to evaluate a programme's progress, enhance institutional capacity and follow through on commitments that have been made.

Despite its emphasis on adaptation, the AMP has failed to engage in genuine adaptive resource management – either in how it makes resource management decisions or in how the programme itself is managed. The Roles and Charter Ad Hoc Groups – in 2007 and 2010, respectively – have represented organised attempts to assess progress, but their recommendations have not been adopted nor formally rejected by the AMWG or the Secretary of the Interior thus far (RAHG 2007; Ornstein, Palmer & Lewis 2010; Glen Canyon Dam AMWG – Charter Ad Hoc Group 2011). The Roles Ad Hoc Group (2007) noted a lack of technical capacity among stakeholder representatives, along with difficulties in meeting participatory requirements, but no significant investments in training or organizational development have been forthcoming. Similarly, the Committee on Grand Canyon Monitoring and Research (1999) recommended hiring an AM specialist to help the parties deal with the tension that had emerged between research and policy decisions, but that has not happened.

It is notable that a new Charter Ad Hoc Group was created in February 2010 to review the AMWG's charter and operating procedures, indicating that the group may be interested in structural improvements. The group reported back in January of 2011, and it remains to be seen whether or not its recommendations will be taken up by the AMWG or the Secretary of the Interior (Glen Canyon Dam AMWG – Charter Ad Hoc Group 2011). Although these rare attempts at adapting the AMP's process are encouraging, even these recommendations ignore the need to methodically adjusts resource management decisions and processes over time.

In contrast, there are CAM processes that are structured to ensure that they improve over time. The Northwest Forest Plan in the United States, which brings together stakeholders to balance the interests of logging and wildlife conservation, is one such case (Ruhl & Fischman 2010). Despite significant controversy and several legal challenges, the programme has succeeded in drawing lessons from experiments in 'AM zones' and applying them to the overall management regime (Ruhl & Fischman 2010).

Conclusions

Collaborative AM is a promising approach to managing scarce natural resources in the face of significant uncertainty and changing conditions. However, as exemplified by the Glen Canyon Dam AMP, CAM processes can fail to live up to expectations in practice. Despite the establishment of a multistakeholder forum, the creation of a scientific data centre and the provision of considerable resources, the AMP has not helped stakeholders increase their understanding of the riverine ecosystem or make useful, broadly supported, recommendations regarding its long-term management. In addition, participants have not used what they have learned to improve upon the way in which they operate. This is in large part because inadequate attention was given to the initial design of the collaborative process. Unfortunately, these design failures have resulted in ongoing conflict among stakeholders, creating winners and losers, and leaving the ecological systems involved in jeopardy.

Future attempts at CAM would do well to heed the lessons learned from the AMP and other first-generation CAM experiments. These include: (1) either prior to or during the initial stages of any process, establish clear goals and concrete objectives against which progress can be measured; (2) provide tools and incentives, such as the appointment of qualified mediators and the offer of financial support for the process, to encourage participation and foster collaboration; (3) delineate clear roles

and fact-finding protocols that promote shared learning; and (4) create well-defined processes and triggers for monitoring, assessing and adjusting provisional management strategies, including the design of the implementing entity.

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