

CASE SUMMARY: GLEN CANYON ADAPTIVE MANAGEMENT PROGRAM

PART I: DESCRIPTION

Introduction

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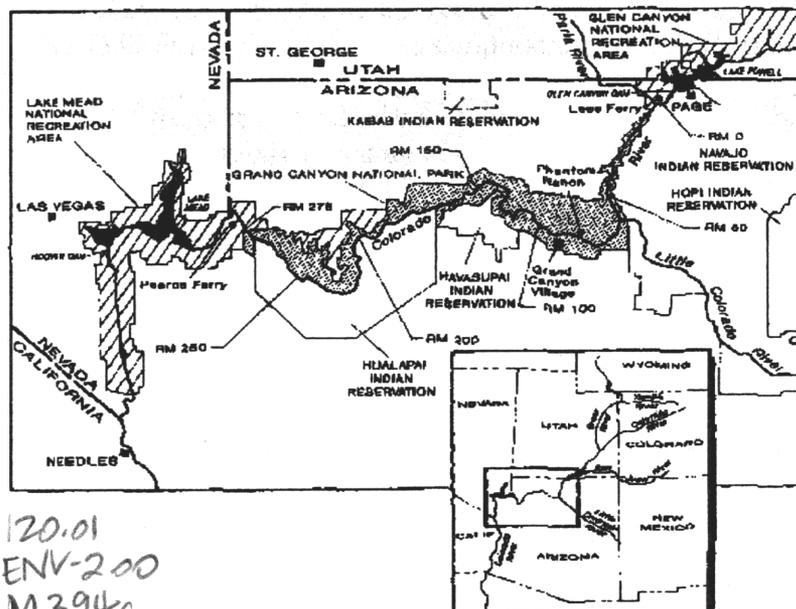
The Glen Canyon Dam Adaptive Management Program (AMP) involves a wide array of state, federal, tribal and non-governmental organizations in an attempt to manage the impacts of operations of the Glen Canyon Dam on the downstream resources of the Colorado River ecosystem. To date, the AMP has not only bridged divergent agencies and groups, but it has also rebuilt eroded credibility, implemented an integrated, ecosystem-based approach to research and monitoring, and successfully completed a series of experimental flows that have enriched understanding of how this ecosystem functions and the ways that dam operations may actually begin to restore ecological processes. Not surprisingly given the complexity of the science and the interests involved, it has not been an easy undertaking. This case summary examines the AMP process, its history, how it is organized and structured, how science has been integrated, who participates in decision-making, and the challenges and accomplishments of the process. The AMP is a unique and large-scale undertaking that is grappling with scientifically complex issues. Consequently, it is rich with lessons for effective collaboration in an adaptive management context.

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Origins and Scope

In 1956, the U.S. Congress passed the Colorado River Storage Project Act, authorizing construction of the Glen Canyon Dam across the Colorado River in Arizona. Just south of the Utah border and

upstream of the Grand Canyon, the Glen Canyon Dam was completed in 1963 and eventually impounded 25 million acre feet of water for the stated purposes of reclaiming arid lands, controlling floods and generating hydroelectric power. In the years since its completion, the dam has provided these services to the region. It also has been the focus of increasing controversy and critique from parties concerned about the role it has played in changing "hydrologic and temperature regimes in ways that have dramatically transformed the Colorado River ecosystem."¹



¹ - National Research Council. 1999. Downstream: adaptive management of Glen Canyon Dam and the Colorado River ecosystem. National Academy Press: Washington, D.C.

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The early efforts to assess the environmental impacts of the Glen Canyon Dam set the stage for the complex and problematic context in which the AMP was created, and also suggest important factors that need to be addressed in any attempt at adaptive management. These earlier efforts fell short for a number of reasons, including a serious lack of trust and credibility in the research process, the efforts' limited success in producing comprehensive, integrated information, as well as the reality of trying to make progress in the face of considerable scientific uncertainty. These factors, combined with external public pressure, eventually prompted the change in approach that would result in the Glen Canyon AMP.

Historical background

After over a decade of calling without success for an evaluation of the environmental impacts of dam operations, environmental groups responded swiftly when, in 1978, the Bureau of Reclamation (Reclamation) announced their plans to uprate and rewind the generators at the Glen Canyon Dam. Since before the turbines first went online, decisions about dam operations were made by a close coalition comprised of Reclamation and water and power distribution organizations, and other agencies and stakeholders felt that they had no way to ensure that their interests would be represented in this process. Dave Cohen, Arizona State Conservation Director of Trout Unlimited and the Bass Anglers Sportsman Society, said that when Reclamation announced their plans to modify operations of Glen Canyon Dam in 1978, "people stepped up and said 'Look, we're going to block this. You're not going to get additional capacity and power without doing something for the environment.'"

Responding to a lawsuit filed by the Environmental Defense Fund and to influential and well-financed lobbying from the clientele of Colorado River rafting trips and from fly fishermen who fish for trout below the dam, Secretary of the Interior James Watt in 1982 instructed Reclamation to examine the impacts of the Glen Canyon Dam. Environmental and recreation groups had hoped for the initiation of an Environmental Impact Statement (EIS) process on dam operations, but Reclamation succeeded instead in committing to launch a series of studies to assess the Colorado River ecosystem downstream of the dam. The resulting research initiative, Phase I of the Glen Canyon Environmental Studies (GCES) program, was launched that same year, and over some objections, was housed within the Bureau of Reclamation and funded by power revenues.

Lack of credibility

The initial mandates of the GCES were broad: to "determine the impacts of the operation of Glen Canyon Dam on the natural and recreation resources of the Grand Canyon" and to "determine whether there were ways, within existing Colorado River Storage Project mandates and the law of the river, to modify operations of the dam so as to minimize the impacts downstream."² However, the fact that GCES was housed within Reclamation, the agency in charge of dam operations, and funded through hydropower revenue generated by the Western Area Power Authority (WAPA), one of the dam's principal beneficiaries, raised concern about the independence and credibility of work the GCES would generate. Cohen expressed the opinion shared by many in the environmental community: "the Bureau did it, and CREDA [Colorado River Electric Distributors Association] and WAPA agreed to it, only because it allowed them to do what they wanted to do which is to continue to produce hydropower and deliver water without being affected. And that worked."

² - Wegner, David L. 1991. A brief history of the Glen Canyon Environmental Studies. In "Colorado River Ecology and Dam Management." National Academy Press: Washington, D.C.

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In 1986, in an attempt to address the criticisms that GCES research lacked credibility because management and funding resided within Reclamation and WAPA, Reclamation asked the National Research Council (NRC) to appoint a committee to evaluate GCES and to provide alternatives for dam operation. The results of the NRC review were released the following year and cited shortcomings in early planning, incomplete consideration of possible management options, and the fact that Reclamation's management decisions were not supported by the results of GCES research. David Wegner, Program Manager for the GCES, noted that "From the start, the GCES program was between a rock and a hard spot. On one side of the coin, the outside world and natural resources bureaus and agencies looked upon the GCES program as their opportunity to finally have a say in the management of Glen Canyon Dam. To the federal water managers and dam operators, it was a challenge to keep the lid on Pandora's box."

Limited success and uncertainty

Results from the first phase of the GCES were released in 1988 as a set of distinct, technical reports focused on each of the component resources and confirming an impact of the dam on the downstream resources. Because of four years of unusual flows, however, the Department of the Interior determined that more information was needed before changes in dam operations could be made. A second phase of the GCES was therefore initiated with no defined time frame and the loose instructions to incorporate as many of the NRC's recommendations as possible. Central among the NRC recommendations had been the suggestion that the project manager be answerable not to Reclamation but to an Assistant Secretary of the Interior. NRC hoped that this would facilitate coordination of research and minimize potential conflicts between agencies with overlapping interests and jurisdictions in the Grand Canyon. While the GCES would eventually follow the NRC recommendation to add a senior scientist, many other suggested changes were never made, leading the NRC to later conclude that "the history of GCES is marked with interagency conflicts that could have been minimized or avoided."³

Unsatisfied with Interior's decision to initiate further research and frustrated by the fact that the GCES studies had not been conducted in a systematic way that could make possible an integrated understanding of the whole system, environmental and recreation groups renewed their pressure on the Secretary of the Interior. In 1989, their effort bore fruit when Secretary of the Interior Manuel Lujan called for an EIS of the Glen Canyon Dam. Many in the environmental community were again frustrated, however, by the Secretary's decision to assign collection of data for the EIS to the already burdened and widely criticized GCES. Cohen articulated this frustration with the GCES when he commented "They spent about \$100 million from 1982 to the early 90s, but it was basically done inhouse, and the science that was collected was all over the board... Not a whole lot of information was garnered... We have a lot of stuff that still sits in archives around the country. A lot of it has not been synthesized. We still don't know where a lot of it resides."

This lack of adequate information, combined with the significant uncertainty inherent in managing such a large ecosystem, proved to be formidable challenges in the EIS process. A federal cooperators group, consisting of the Fish and Wildlife Service, National Park Service, Bureau of Reclamation, Bureau of Indian Affairs, and Department of Energy, was created in 1990 to oversee

³ - National Research Council. 1996. River resource management in the Grand Canyon. National Academy Press: Washington, D.C.

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the EIS process and to come up with a preferred alternative for operations of the dam. The following year, the Hopi Tribe, Hualapai Tribe, Navajo Nation, San Juan Southern Paiute Tribe, Southern Paiute Consortium, and Pueblo of Zuni were added to the cooperators group. Don Metz, Assistant Field Supervisor for Office Support and Federal Activities for the U.S. Fish and Wildlife Service, provided a perspective shared by many of the federal participants in the EIS process: "We all realized that we didn't really know enough about the resources and the problems. There was a lot of basic data that still had to be tied together so we knew we were going to have to have some kind of process to adjust what we would come up with as a preferred alternative... We were going to have to have some way of adapting and changing as we went along. And so that's how we came up with the Adaptive Management Program."

Outside pressure

Also critical to the formation of the AMP were the continued actions by groups outside of the formal process. Barry Gold, Chief of the Grand Canyon Monitoring and Research Center (GCMRC), described that "It is my understanding that environmental groups were concerned about the way the EIS was going, and they felt that the water and power folks had an upper hand in the EIS process. And so they went to Capitol Hill to get something called the Grand Canyon Protection Act passed." Focusing their lobbying attention on Congressman Miller (D-CA) in the House and Senator McCain (R-AZ) in the Senate, the environmental groups argued not just for passage of the bill but also for the recommendation of an adaptive management process. Their reason, as Gold described, was that they "felt like whatever they were going to get wasn't going to really achieve the goals of protecting the downstream resources and so they asked that it be implemented through an adaptive management program."

Passed in 1992, the Grand Canyon Protection Act was created to "mitigate adverse impacts to, and improve the values for which Grand Canyon National Park and Glen Canyon National Recreation Area were established."⁴ The Act called for the completion of the Final EIS in two years and for the establishment of long-term monitoring and research of the Glen Canyon Dam to be managed in consultation with a broad group of stakeholders. The language of the Act also raised questions about how cultural and natural resource conservation would be balanced with the body of laws governing water use in the West, stirring up some concern over the potential for establishing a far-reaching precedent.

The Final EIS on dam operations was eventually completed in 1995, followed in 1996 by Secretary of the Interior Bruce Babbitt's signing of the Record of Decision. Together, they called for the creation of the Glen Canyon Dam AMP to coordinate research and monitoring, downstream resource management, and the mitigation of effects of dam operations on the cultural and natural resources of the Colorado River between the Glen Canyon Dam and the western-most boundary of Grand Canyon National Park. A history of eroded credibility, insufficient information, profound uncertainty and effective mobilization by stakeholders outside of the process had created a complex and charged climate for the newly created AMP. This history, however, was also essential for the establishment of the AMP, as was made clear by Cliff Barrett, Regional Director of Reclamation when the GCES was launched and now a consultant for CREDA. "I think the genesis for the Adaptive Management Program was the fact that, even after all the research and study they did for actually almost ten years, there was no conclusive evidence that the things they were proposing

⁴ - Grand Canyon Protection Act, Section 1802(a)

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would solve the problems they had. And so everyone agreed, 'Well, you know if we can't agree on what exactly to do, we can agree on these first steps, and then we will watch the results of those, and see if they get us where we want to go or not.'"

Organizational Structure

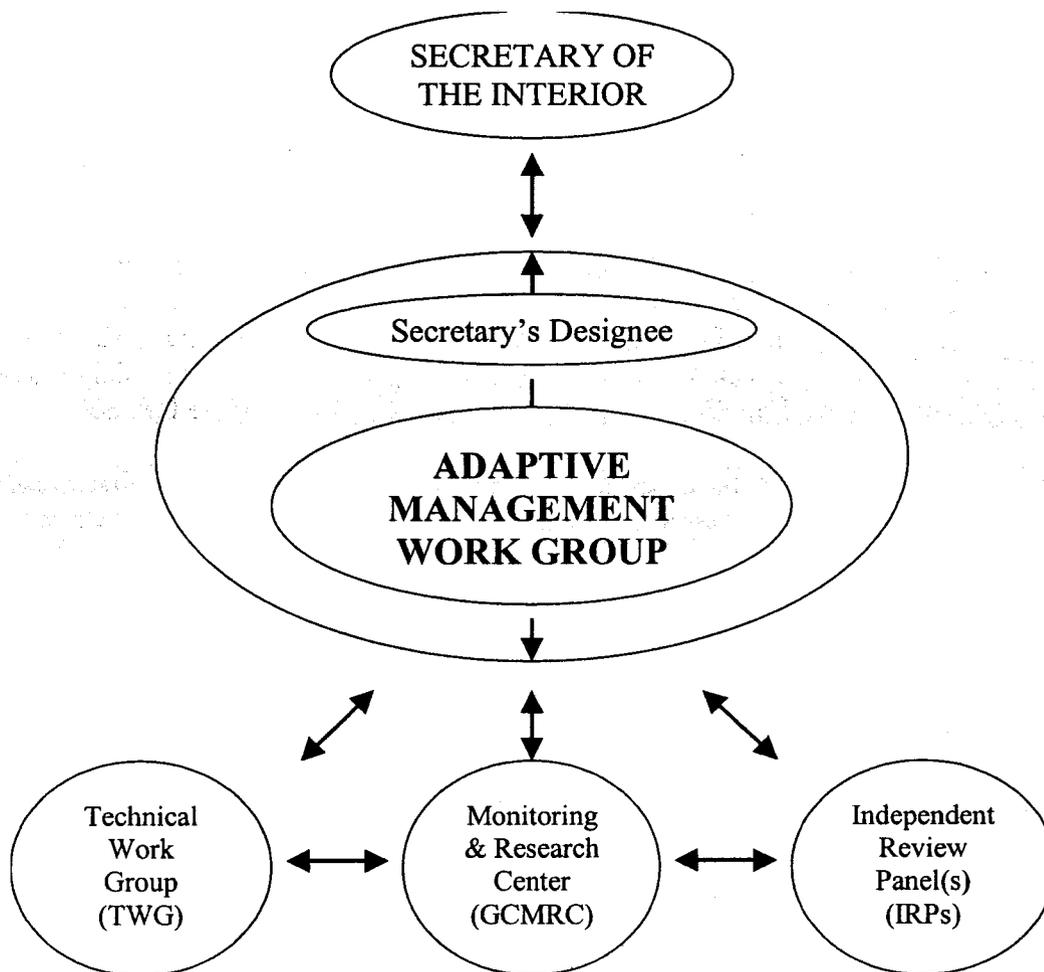
The large physical scale of the resources protected by the Grand Canyon Protection Act (GCPA), and the variety of agencies and organizations with a stake in how they were managed, posed considerable challenges for the designers of the Glen Canyon Dam AMP. Furthermore, they had to devise a program that was structurally less vulnerable to the shortcomings that plagued the GCES, particularly the lack of credibility and the incomplete stakeholder participation. Even during the early stages of the EIS process, non-agency parties like the environmental groups were not full participants. "We were, as stakeholders, pretty much on the outside looking in during those first years," Cohen described. "They allowed us to audit their meetings, they allowed us occasionally to ask questions. But when the questions got difficult they changed the days of our meetings, the times of the meetings and made it very difficult for those of us who were employed and doing other things to attend."

The GCES also suffered from a lack of integration of research across disciplines, often because the GCES Program Manager lacked sufficient authority to maintain his program's balance in the face of requests from higher ranked agency managers. One result, as Cohen described, was that "The people who got the lion's share of the money for years and years and years – and this goes back prior to the GCMRC, it goes way back to the 1982 studies – were the people who studied sediment... And so it became not a study of the downstream resources but a study of sediment, much to the dismay of a lot of us sitting around the table." This imbalance in the historic research effort, and the vulnerability of the research agenda to outside influences, provided additional challenges that any new institution would have to avoid and overcome. To address all of these challenges, and to hopefully ensure successful implementation of the GCPA, the drafters of the EIS designed an innovative organizational structure called by the 1999 NRC Committee a "triangle with parity."

Diagrammed below, this triangle had at its apex a Federal Advisory Committee, called the Adaptive Management Work Group (AMWG), which was chartered in February 1997. The primary mandate of the AMWG was to develop and evaluate strategies for operating the Glen Canyon Dam in a manner consistent with the GCPA, and to make recommendations to the Secretary of the Interior on dam operations. Designed to operate exclusively at a policy level, the AMWG now meets at least twice each year and is also responsible for recommending to the Secretary of the Interior the goals and objectives, and the budget, for all monitoring and research activities. To ensure participation by all interested stakeholders, the AMWG has twenty-five seats which are filled by: Reclamation; the Bureau of Indian Affairs; the U.S. Fish and Wildlife Service; the National Park Service; the Department of Energy; the Arizona Game and Fish Department; two federal power purchase contractors; the six area Native American tribes; the seven Colorado River basin states; and four representatives (Southwest Rivers, Grand Canyon Trust, Grand Canyon River Guides, and Arizona Flycasters/Trout Unlimited) from the 70-80 environmental and recreation organizations with interest in the Colorado River as it passes through the Grand Canyon.

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The twenty-sixth seat on the AMWG is filled by the Secretary's Designee, which the EIS required to be a senior DOI official with the responsibility for working as the Secretary of the Interior's contact for the AMP. Also the Chair of AMWG, the Designee's stated responsibilities include making sure that the AMP complies with the GCPA, EIS and the ROD, and reviewing and approving recommendations from the AMWG on changes in dam operations. Steve Magnussen is Deputy Director for Operations West at Reclamation and has served as the Secretary's Designee since the AMP's inception. Magnussen sees his role as making "the connection into the Department... [which] has a series of Assistant Secretaries who really carry all the weight of the Secretary in terms of a policy office. And for Reclamation, that Assistant Secretary's office is the Assistant Secretary of Water and Science, which uniquely... also includes USGS... So certainly one of my roles is to make sure that there is a good understanding by the Assistant Secretary and the staff on what are the issues and what are potential outcomes and things they should be thinking about as they wrestle through these issues."



Making up the base of the triangle of parity are the three entities designed to ensure that the AMWG is able to provide the Secretary with the most accurate and credible information on how to operate Glen Canyon Dam. The first of these to be established, the Grand Canyon Monitoring and Research Center (GCMRC), was established with the signing of the ROD in October 1996. In

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answer to the chronic critiques of GCES's capacity to produce useful and credible research, the GCMRC was designed from the outset to be an independent center, created to develop and administer unbiased, scientifically rigorous long-term research and monitoring of the Colorado River ecosystem. Staffed with a team of scientists, the GCMRC has developed a strategic plan for long-term monitoring and research in nine resource areas: hydropower, water, sediment, fish and aquatic, vegetation, threatened and endangered species, terrestrial wildlife, cultural resources, and recreation. Gold acknowledged that the GCMRC "started out sort of following the approach that had been here when we came on board which was to look at resource by resource." He pointed out that significant strides have been taken since then to integrate the research program. "We're really truly implementing an ecosystem approach so you won't see just a physical resource study. It's going to be a study that's integrated across a whole series of resource concerns."

GCMRC's research and monitoring plan, and the accompanying budget, is reviewed on a regular basis by AMWG and recommended to the Secretary for adoption, after which the GCMRC staff solicits and administers proposals for research through a competitive process. The results of all studies are analyzed, integrated and maintained by GCMRC, and GCMRC also coordinates the review and writing of reports, including what they call "The State of the Canyon Resources Report." This report, Gold described, "will be used to help people understand what the status of the resources are at the end of the calendar year so they can plan their management actions for next year. So we will both be integrating internally and providing the information in a way that it can actually be used by the decision-makers."

Also essential to the organizational structure of the AMP is the Technical Work Group (TWG), which was created by the AMWG at their first meeting in September 1997. Recognizing that they had neither the time nor the technical capacity to fulfill all of their responsibilities, the AMWG established the TWG to provide both GCMRC and AMWG with scientific information and advice. Specifically, the TWG is charged by the EIS with translating the goals and policies generated by AMWG into resource management objectives and guidelines that are scientifically sound and rigorous. Additionally, the TWG has responsibility for helping GCMRC with the design of their long-term monitoring and research program. As Gold explained "the Technical Work Group plays a much more detailed review and oversight role in that they look at the work plans that [GCMRC] develops in detail to see if they're comfortable that the work plan meets the objectives for that year. They're the ones when we present the results and findings of research activities who may interpret them differently and go to their respective bosses and say 'Well, this is how we see it works.'" The TWG has the same number of seats as the AMWG, and each AMWG representative appoints his or her representative to the TWG, though in some cases the same person has seats on both groups.

The final component of the "triangle with parity" is also the least concrete and one of the most critical. The Independent Review Panels (IRP), established by the EIS to provide regular review of monitoring and research programs, take one of four forms. The first are the peer review panels, in which a database of independent experts (academic, state and federal, and private sector) is created and selected from to provide review of both the initial research proposals and the reports of programs that have been implemented. Carefully designed to minimize introducing any bias from the GCMRC program managers, the review process is modeled on that used by the National Science Foundation. The same database of reviewers is also used to select reviewers for the Protocol Evaluation Program, in which monitoring protocols that have been implemented are

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reviewed. The next form of IRP used is for overall program review, which has traditionally involved hiring the National Research Council roughly every five years. The most recent NRC review of the GCMRC five-year strategic plan was completed and published in 1999. The final IRP that will be used by the Glen Canyon AMP is a group of science advisors called the Science Advisory Board (SAB). This group, which has yet to be finalized due to a series of legal issues that needed to be resolved, once formed will provide on-call counsel for GCMRC. As Gold described, members of the SAB "will be put on a panel that will continue to exist and provide guidance and oversight of the [GCMRC] program managers and the scientific activities on a continuing basis. And we will rotate membership on that panel in a staggered fashion so we maintain some institutional memory and at the same time we get new blood."

Even without the SAB in place, the Independent Review Panels have already made significant strides towards restoring credibility to the research process. Part of what needed to be overcome, as Gold described, was that "In the past, the research was a very insulated activity. So you were either in the club that worked in the Grand Canyon or you were outside of the club. And that was it." The establishment of the GCMRC and the introduction of a regular, external review process, has helped, as Gold noted, to break "down that barrier and there's now a lot more people who have knowledge and understanding and participate in the work that we're doing. And I think we're richer for it and I think the Adaptive Management Work Group and the stakeholders recognize that."

Even within the scientific community, the Independent Review Panels have had a positive effect on turning around popular perception of research in the Grand Canyon. Gold described that after GCMRC's first major peer review panel in 1998, they received comments from reviewers saying "'Well you know, we did this once as an experiment, but we don't really believe, given all the political forces that are at play in your program, that you're going to follow our recommendations. So we're not sure we want to come back.'" And then we did follow their recommendations. And then a few of them called and said 'Wow, I guess you're serious about putting high quality science on the ground. You can call on us again.' And that word spread."

Accomplishments

While the Glen Canyon AMP is still relatively new, given the complex nature of the collaboration and the difficult historical context in which it is set, the accomplishments that have been achieved so far are particularly worthy of note. Initial accomplishments were more procedural than ecological. The first accomplishment, which actually represents the last achievement of the Glen Canyon Environmental Studies program was, the basic but profoundly difficult task of initiating the first precedent-setting experimental flood. This early effort helped to reshape thinking about the function of the Colorado River system as well as about the extent of research that would be needed to adequately examine it. Other procedural accomplishments came as collaboration improved and the experimental response time accelerated, and now the most recent experiment seems to promise some of the first tangible ecological outcomes. Progress may be coming slower than some might like, but perhaps the greatest accomplishment of this complex process is that it is coming at all.

The first effort to apply adaptive management to the Glen Canyon Dam actually began before the creation of the AMP when, in 1994, the first proposal was put forward for doing an experimental flood. The idea was to initiate what is called a beach habitat building flow, and it was met with

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such tremendous opposition and threats of litigation that the proposal was tabled. With the completion of the EIS, which called for adaptive management experiments, planning resumed and culminated in the first experimental flood in April 1996. As Gold recounted, "It wasn't a great scientific accomplishment in that it was very limited in its objectives, but... I think the first success was just doing it, because doing that flood raised a lot of fears about some of the sacred cows that go along with water in the west and especially water in the Colorado River. Much credit goes to Dave Wegner and the GCES program and all of the others involved in making it happen. And the fact that the Secretary was willing to come forward and say it was a success. So the first success was administrative and political."

The actual results of the flood were considered to be of limited success primarily because they could not discriminate between cause and effect and therefore could not be used to answer specific research questions. What this first flood did do, as Gold noted, was to help the researchers "understand something about the scale of the system that they were working in, and just how robust the monitoring and research activities have to be." The flood also led to one important unexpected result relating to the much-studied physical resources of the river below the dam. As Cohen described, this first flow "did change the paradigm for sediment, however, and all of the things that they held inviolate were proved wrong, for the most part. [The experiment proved] that we were not storing sediment, and... to wait until we had adequate sediment loads in order to move them to the shoulders by using a flood all of a sudden went out the window. The sediment pretty much moves through the system so you have to capture it when it's there and then be done with it."

After the passage of the Grand Canyon Protection Act and the issuance of the EIS in 1995, a Transition Work Group was created until the AMP could be fully established. Creation of this Transition Work Group, the predecessor to the Federal Advisory Committee, was another significant step forward for the process. While the federal cooperators group had already met and succeeded in drafting the EIS, as Gold described, the Transition Work Group was the first time when they "actually brought all of the stakeholders together in an informal fashion and let them help design the protocols and the operating procedures. So that started the collaboration... and we actually were able to start creating the elements of the program."

Two other significant experimental flows have been implemented by the AMP, the first noteworthy from a process perspective, the second in terms of the actual results. While the 1996 experimental flood took two years to plan and implement, the 1997 flood, which was a habitat maintenance flow, took only two months from the point they recognized the opportunity to the point of carrying it out. As Gold noted, "I think there's a success now in just how quickly people were willing to say, 'Let's try to do science and do it in a meaningful way.'" The most recent experimental flow began in the summer of 2000 and was a test of low steady summer flows. This experiment is noteworthy in part because approximately two million dollars had to be secured to support it, when GCMRC's annual budget is only six million dollars. "So you can see the magnitude of these efforts," Gold said. "And again, I think the initial success is that we got the support and buy-in to do it rather quickly when the conditions presented themselves."

While final analysis and reports on this summer's flood will not be ready until December 2000, Gold described the initial results as "quite amazing... The native fish are responding in a very positive fashion, and scientist's predicted that we might get enhanced survival and the basic data

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looks like we're getting that. We'll know in another month or so whether we've gotten increased sand storage, which is something else scientist's thought we'd get, so that we might be able to do more in the way of beach-building in the future. We're not having any real negative consequences on the recreational activities. We've had an increased productivity in the aquatic food base, a profusion of trout up in the Lee's Ferry area. Reduced erosion in some of the cultural resource areas. So it's pretty interesting." If all of these anticipated results prove true, this most recent experiment will be strong evidence of the speed with which a well-designed adaptive management program can achieve results even in an extremely complex physical and political setting.

Indeed, in light of the tremendous challenges involved in bringing together so many stakeholders to recommend management in the face of profound uncertainty, the series of completed experiments should be seen as a remarkable accomplishment. Rick Johnson, former Director of Ecosystem Management for the Grand Canyon Trust, pointed out that "despite feeling like this has been this huge Gordian knot that you can't untangle and do anything, we have been able to get some experimental flows going. And these flows have resulted in pretty significant changes in our perspective of how this system works and what it takes to achieve especially the physical goals that we have for the system." Chris Harris, Environmental Program Manager of the Colorado River Board of California, agreed that at this point, success of the AMP is probably best measured not in actual ecological changes, but in the changes in trust and cooperation that the program has experienced. "There are modifications to dam operations being done... developed and then being implemented – in a consensus format or fashion with the members of the AMWG and the action agencies, particularly Reclamation, the Fish and Wildlife Service and the Park Service. Those things are successfully being developed and then coming to fruition, and that in itself is a pretty remarkable achievement."

PART II: ANALYSIS

Introduction

The struggles and the accomplishments of the AMP provide important lessons about how to foster broadly credible scientific assessment and analysis that can inform decision-making and provide a solid foundation for adaptive management. To more fully understand these lessons, however, it is necessary to look beyond what the AMP has accomplished to analyze the underlying factors that have facilitated and impeded any progress. Given the complex nature of this process, there are no simple answers, and often participants provide contrasting explanations of why events unfolded as they did. Regardless, themes and lessons emerge, and an analysis of the AMP provides useful insights into the management of structure, and the integration of science and the public in a collaborative framework.

Managing the Structure

The innovative "triangle with parity" structure adopted by the AMP has already made significant strides towards rebuilding trust and facilitating effective coordination between agencies in spite of a history of distrust and strained relationships. Magnussen singled out the important role that the

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organizational structure has played in the program's success to date. "The FACA chartered committee sets up a set of rules that everybody knows and understands and says 'This is how we'll play and this is how we get our influence.' And it's seen, I think generally, as a fair and equitable forum where everybody gets a say and there's a vote... That group continues to work, and to provide good analysis of issues. And the fact that that's there is probably pretty helpful." As a model, many participants feel that the organizational structure used by the AMP has a great deal to offer to other similar collaborations. As Johnson described, "I just met, with some other people in this project, with some folks who are starting a program in the Trinity River in California, and for the most part, what we advocated was setting up a structure fairly similar to what we have in the AMP."

This does not mean, however, that the implementation of this structure has been without problems. In fact, some of the most significant challenges the process has faced, and the one that has emerged most recently, stem in part from difficulties in cleanly distinguishing the roles and responsibilities of the different components of the balanced triangle. So far, the greatest area of blurring has surrounded the TWG, and the degree of overlap it shares with the AMWG and with the GCMRC. This blurring of roles has led at times to process inefficiency, micro-management of the GCMRC, and at least in part precipitated the recent shift of the GCMRC's institutional home and the challenges that followed.

Blurring between TWG and AMWG

The first area of blurred responsibilities exists between the TWG and the AMWG. By design, the TWG is supposed to provide technical expertise and advice to facilitate the making of policy decisions by the AMWG. In fact, the TWG has ended up working on both policy and technical matters, which has resulted in some frustration. Harris, who now represents California on the TWG, stated that "TWG needs to recognize that it is the technical arm, and it should be coming back with the data information to provide the AMWG members with sufficient detail so that they can make those policy decisions in a timely and efficient fashion. And I think so far we've not quite gotten there."

Several explanations have been offered by participants for the persistence of this blurring of roles. The first, as Magnussen described, is that some degree of overlap of responsibilities is unavoidable. "You always struggle with what's technical and what's policy... The fact remains that those things are so intertwined and people are going to have views and so there probably is nothing from a practical standpoint that is so clean you could cut it with a knife and say 'Well, we're not really going to talk about that because that's a policy issue.' It really doesn't work that way." Also contributing to the blurring is the fact that people without technical backgrounds have been appointed to the TWG. "I'm not a technician," described Barrett, who represents one of the power distributors on the TWG. "I'm there to make sure they don't screw up the policy side... And there's several of us around the table like that. We're there because our agency, maybe, one doesn't have any real technical people but we want to be participant, just to have a hand in, and to make sure that fundamental policy issues don't get mucked around in by the TWG. And so, I guess it works for us, but it probably is not the best way to do business."

Another reason for this blurring is a result of the schedule of annual meetings for each group, and the fact that policy level issues come up more frequently than they can be addressed by the AMWG

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schedule. As Cohen noted, "Probably the TWG meets too often and the AMWG not enough. If the Technical Work Group were really a technical work group, it would serve its purpose much better." Also complicating the clarity of the relationship between the AMWG and the TWG is the fact, as Harris indicated, "that you have quite a few of the AMWG members also participate in the TWG. So that line blurs in there of when you should be doing things from a policy perspective and when you should be doing things from a purely technical perspective."

Correcting this blurring of responsibilities may therefore require a mix of new rules on group membership, changes in the frequency of meetings, and a firmer delineation of the roles of each group. Harris, who until recently represented Arizona on both the AMWG and the TWG, had this to offer as suggestion and assessment: "Maybe we need to get to the point where AMWG members don't participate in [TWG], or if they do, there's some rule on how to deal with things and how you don't. I think there needs to be more clear direction to the TWG on what technical information is required. A lot of times the direction from the AMWG tends to be somewhat ambiguous or general, which then flips the ball back into the TWG's court... It's probably incumbent on the AMWG to more clearly define what issues or technical information is necessary. That may help focus people and focus the TWG on what really needs to be accomplished."

TWG and the GCMRC budget

One repercussion of the blurring of responsibilities between the AMWG and the TWG is that the TWG has found itself playing a role in recommending adoption of GCMRC's budget, which was never intended in the original organizational design. As Barrett explained, "AMWG is expected to recommend adoption of the GCMRC budget. Well, because of their budget cycle and the meeting cycle, the TWG all of a sudden gets itself deeply involved in that." The problem with this, as Cohen indicated, is that GCMRC "was created to be independent of virtually everybody so that they could go ahead and do science... When we control their budget and we micro-manage them, which is inappropriate, then are they really independent and can they actually do what they're supposed to do? ... The fact of the matter is that we've been giving them a bottom line and letting them figure out what in the hell they can do with it."

Gold agreed that the extent of the involvement of the TWG in the management of GCMRC has presented challenges, noting that the TWG has at times even tried to influence who GCMRC should and should not hire. "For some of them," Gold described, "it was their way of trying to control the process. If they thought they could have greater influence over what was done here internally than they could gain more control over the process. And that's one of the tensions of making the GCMRC independent of the management agencies was to cause quite a bit of concern on the part of all of the stakeholders, and especially some of the more vocal ones, on what they would lose in terms of control."

Reflecting on what could be done to address this tension, Harris commented that "what I'd like to see is that through the collaborative, consensus-based process, that you would have general acceptance, buy-off, and guidance to the GCMRC and then let them work out the details rather than the TWG feeling compelled to work out all the details." He added that he wasn't sure what it would take to make this transition, but as with the blurring between TWG and AMWG, the solution likely lies in finding some way to pull the process back to the initial program design, and re-establish support for the original separation of responsibilities. "What we really need to do is the AMWG

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needs to give policy advice and direction. The TWG needs to provide technical guidance and direction on the broad architecture of the Adaptive Management Program. But let the GCMRC figure out how their program elements need to be developed and interact with one another to actually achieve that.”

Change of institutional home

In an attempt to address part of this issue, the decision was made this summer to shift the institutional home of the GCMRC into the U.S. Geological Survey (USGS), effective October 1. The goal, as Gold described it, was similar to Secretary Babbitt’s rationale for creating the National Biological Service, “and that is to have the science agency at arms length from the managers, but still have it be relevant, doing work that’s relevant to their needs. But by having it at arms length you reduce the chance for folks to say ‘Oh, what they’re doing is biased.’”

The suggestion to place the research body in a science and not a management agency had long been a suggestion of the NRC during their reviews of the GCES. While the decision to follow through on this recommendation may ultimately be the best way to ensure the continued credibility of GCMRC’s work, the way that the decision was implemented produced waves that the process is still responding to. The decision was made by Mark Schaefer, former Deputy Assistant Secretary for Water and Science of the Department of the Interior in charge of both Reclamation and USGS, on the eve of his departure from this position. Given all that was at stake in this kind of move, some participants expressed frustration that Schaefer was not available to answer questions after the decision was made. In addition to feeling frustrated with the process, several important questions were also left unanswered. As Cohen described, “We still don’t know where we are from a budget standpoint now that the home is in USGS. We just know that it’s in a science agency which is what we were advised to do. We do know that the Bureau [of Reclamation] has been historically a much stronger budget organization than the USGS and so we don’t know what the implications and the impacts of this decision might be yet.”

Reflecting on the shift in institutional home, Magnussen observed that the transition will happen, but not without difficulty. “Once the decision’s made, our job as the career people is to go implement it and make it work. But it will have its problems, I tell you. It complicates things a lot more.” One of the main problems he pointed to that has become more complicated as a result of this move is the GCMRC budget. Specifically, he referenced actions that one party has taken outside of the AMP process by having language introduced into an Appropriations bill that caps GCMRC’s funding from power revenues, after a similar proposal to cap the budget had been rejected by the AMWG. Johnson described a reaction that others shared when news of this action spread. “This is, from my perspective, a very serious violation of a stakeholder process. And although I would certainly defend the freedom of anybody to do anything that’s legal to advance their cause, this is something that I think is really going to stifle this program. Because for a group of twenty-six stakeholders to come to agreement on how to keep moving things forward, you need to have a tremendous amount of trust. And that trust has just been very seriously violated.”

This action has been perceived as a breach of trust because AMWG has been making progress recently on the proposal to determine GCMRC’s budget based on need, and to use the strategic planning process to determine expected need over a five or ten year period. Introducing language that caps the funding from power revenues shifts the dialogue towards one based on maximum

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expense, and more significantly represents a break in the consensus process. Johnson summarized this position, saying "Now, will there be money for doing good things? Sure. Will it be the right amount of money? I don't know. But the whole issue here is the trust issue which to me is what's really important to make these processes work."

Reflecting on this recent challenge, Magnussen commented that "I've tended to gage by some degree that when the parties are staying at the table and at the meetings and there's a process for resolution, then things are going pretty well. Right now they're kind of out of the box." To address this situation, some parties have called for a strong statement from the Department of the Interior to Congress or for internal policing within the process through which, as Johnson described, "when somebody steps out the rest of the group has to stand up and say 'That ain't okay.'" For his part, Magnussen has been working to bring people back to the table on the budget issue by meeting with congressional committees in the hopes that compromise language can be agreed to and introduced that everyone can be satisfied with. This said, he indicated that emotions are still raw over this issue and so participants need to be careful in how they work through the process, taking particular care not to join up against each other. "Siding with one set of stakeholders over another one will probably have some long-term ramifications in terms of credibility," Magnussen noted. "But we'll just have to see how this one plays out."

Key individuals and good communication

As the AMP works to address these challenges, they will hopefully be able to draw on two factors that have in the past facilitated the effective implementation of their structure: good communication between the partners and the hard work and energy of key individuals. Many individuals have contributed a tremendous amount of energy to the AMP, but two in particular were singled out as playing particularly key roles. Barrett described Dr. Dave Garrett, the first head of the GCMRC, as particularly effective because of his scientific stature, his openness, and his energy. "And you figure he was given a job to do, starting right from scratch, I think he did a wonderful job building an organization, just the people and also putting together the framework from which the whole thing is operating." Gold also commented on the important role that Mark Schaefer played, even though some participants expressed frustration with his handling of the shift of GCMRC's institutional home. "We had, for a while, a champion within the agency who was willing to step in and keep the program strong when some wanted it weakened. And that's important. He's maintained a long-term commitment to this approach, and that view has now been picked up by his successor. So, that a champion, high enough in the management ranks, has really been important."

Also extremely important to the success of the AMP has been the generally good communication that has characterized the process so far. Given the diversity of stakeholders brought together by this organizational structure, effective communication has had to include communication between people with different backgrounds, and an effort to be sensitive to and work to overcome the barriers these differences may present. Johnson described that "Probably more than anything, although my training is in science, I think what you need to be able to do is find a way to work with all kinds of stakeholders. And you've got to be able to find the reasons why everybody wants to move ideas forward." While this has at times been a challenge for the AMP, Metz added that "The strongest thing about it is that there's been a lot of open dialogue... It seems like everybody is open to what other people's concerns are and management objectives are, and everybody listens a lot... I think there's been a lot of communication, a lot of coordination, a lot of good dialogue and I think

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we've all learned a lot in the process." The continuation of this learning will be important for the continued success of the program because, as Gold pointed out, "The organizational structure is really much more dependent on the personalities of the folks involved. So, in the end – I suspect this is true with a lot of these programs – you have to develop personal relationships. You could have a given structure and it still would fail, even if it was the right structure, given the personalities involved."

Summary

The recent events surrounding the shift in institutional home and subsequent process disruptions over budget demonstrate how even a well-designed organizational structure can have vulnerabilities, especially in a climate of high stakes. It is important here again to remember, however, that the AMP is a relatively young process, and still maturing. The organizational structure is widely viewed as sound, and the relationships between the component parts should continue to develop and stabilize as successive challenges are encountered and overcome, and key individuals and good communication continue to make positive contributions. And when offering advice for other similar processes, Gold made a recommendation that suggests that the blurring of responsibilities experienced by the AMP may actually have indirectly made it possible for the process to move forward. Gold noted that to successfully implement any structure, it is important to "Leave things fuzzy at the beginning. Which is counter-intuitive. You don't, in fact, draw clear boundaries because if you draw clear boundaries and have clear vision than you've also really created the opportunities for the conflicts to be of a higher intensity. And people haven't started working together so all they start doing is protecting their turf." Describing the current relationship between the TWG and the AMWG, Harris indicated that this phase of fuzzy boundaries may be ending as the AMP continues to mature. "I will say one thing: I think in both groups we're starting to develop better agendas and lay out more clearly, in advance, what we need to accomplish in each twelve month period. That's helped... We're starting to grow into our shoes now."

Managing the Science

Science is in many ways the core of the AMP. It was the uncertainty in the scientific information on the environmental impacts of dam management that precipitated the adoption of an adaptive management framework, and it has been an emphasis on accessible, credible science that has been central to the re-establishment of trust and the building of relationships between agencies. Central to the integration and management of science within the AMP have been the establishment of one science center, in the GCMRC, and the adoption and use of regular and rigorous review. Also largely seen as a success of the AMP has been the progress made towards integrating management across all of the affected resources. Monitoring programs have struggled somewhat, in part because of the gaps in the baseline information, in part because of the complexity of the system, and in part because of resistance within the AMP to support an adequate program. Some participants also expressed frustration with the flexibility with which experimental flows are designed and carried out, though as with monitoring, the general sense is that program effectiveness is improving. The most significant and recurrent challenge the AMP has faced with the management of science has been with narrowing and defining the scope of its work. Various visioning and strategic planning efforts have taken place over the course of the program's history, and the process of finalizing the scope continues. Yet even for the recurring challenge of defining scope, the AMP is making

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progress, and overall it continues to set a strong example for how a complex collaborative process can effectively incorporate science into its programs and its decision-making.

Single science center

As has been described, the first significant accomplishment of the AMP as a process committed to sound science was the decision to create and support one science center. Magnussen emphasized the importance of a process making this commitment to one source of scientific information, "so you don't have the situation like you've got on the Columbia where you've got your dueling biologists. What you've got is you've got one set of data coming up and then you've got the resource agencies that can look at the data and then hopefully make decisions. They might have different opinions, but at least they're not arguing over my data versus your data."

This need to negotiate between different interpretations of data, and between potentially different uses for it, is part of the reason why Gold feels that it is important that the AMP has chosen not to follow the NRC's suggestion to have a senior scientist in charge of the GCMRC. As he put it, "I think you really need someone at the head of an organization like this who's got more of a balance between science and policy kinds of experience because, internally, it's about managing the scientific activities, and making sure they're run in a way that's credible and of the highest quality and relevant to the mission. Externally, then, to the other group, it's how do you interface and understand their policy needs and their information needs and work with them in a way to develop that. It's a tough role to play. You sort of change parts from scene to scene."

Providing consistent, reliable information for all stakeholders has been one of the GCMRC's main objectives since its creation. And the stakeholders have bought in. Providing further explanations for why the parties have accepted the idea of a single science center and come to trust the work it produces, Gold commented that "we've opened up our process to using a tremendous amount of independent external review... In the past, the group had been perceived as being advocates for a particular set of management actions, and for a particular vision of the Canyon. And I think currently we're viewed as simply being advocates for good science and what we bring to the table is to tell them clearly what the consequences are, from our perspective, of the different activities that they're thinking about implementing. And that's been important because I can get in the same day the trout folks and the recreational folks and the power folks all calling and seeking advice and input."

Independent external review

As Gold indicated, this degree of trust in the work of GCMRC has been made possible in large part because of the commitment to, and the results of, their process of independent external review. Johnson summed up the almost unanimously positive view stakeholders had of the review panels when he said that they "have been invaluable. Invaluable for bringing additional ideas to the table for the Center. Invaluable in validating in the situations where the Center was doing good stuff. And I think they've been valuable in that they bring to the Adaptive Management Work Group, which are policy people, this sense that the science part of this is really important. So it brings that additional credibility to the table for doing good, solid science." Without independent review, Harris added, "you tend to become institutionalized. You build up your staff, you build up the way you're going to do things. And if you're really going to do adaptive management, philosophically, I

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think you need to have those checks and balances, just like our government. And that's really what independent review, or scientific review panel, does."

The one area where the Independent Review Panel process has fallen short of the initial goal has been in the establishment of the Science Advisory Board (SAB), which still has not been finalized. The purpose of the SAB, as has been described earlier, is to provide on-call technical advice for the GCMRC and the AMWG, and as Cohen described, "We don't necessarily get that from the independent review people. They're pretty much anonymous." The process of finalizing the SAB and determining the legal conditions under which it can be implemented is underway, but in the meantime, stakeholders have been able to draw on the resources of other participants in the external review process. As Cohen continued, "The only [reviewers] we've met with are the ones who've come to listen to the protocol evaluation panel presentations. And they've been very helpful in understanding certain biological and physical processes."

Integrating across resources

Research and management of the resources below Glen Canyon Dam have historically lacked an integrated, ecosystem-based approach. Randall Peterson, manager of the Adaptive Management and Environmental Resources Division at the Bureau of Reclamation, described that integrating across resources is "really the hardest issue to address... No matter how you approach it, there are lots of things that we just don't understand that will take time. And frankly, some of the decisions that have been made in the past have been completely reversed by additional monitoring and research. So even our basic understandings of some resources are changing dramatically. When that's the case, and you talk about how the whole ecosystem functions together, there's just a lot to learn." Other participants agreed, noting that one of the shortfalls of the EIS process was the fact that it did not resolve the inherent conflicts that exist between the different impacts that management strategies may have on the different resources. As Johnson described, "So if you manage the dam in a particular way it may benefit, say, native fish but it's going to hurt trout. Or it may benefit beaches for recreation but it might hurt cultural sites by accelerating erosion in certain reaches. But the EIS did not find a way to deal with those conflicts and so there was no overarching, philosophical approach to management."

As described earlier, the GCMRC has a strong commitment to an ecosystem perspective, and several initiatives are currently underway to integrate this approach more fully into research and management. The first one, as Johnson described, is to bring a strong ecosystem approach to the strategic planning process by working to "look at specific target levels, and within those target levels to acknowledge the inherent conflicts that you can't maximize all resources for all stakeholders. And so I think that's been a phenomenal breakthrough for people, and what it hopefully is going to result in, and I think it already is now, is clarity in just what this program intends to do... We can report back to the Secretary and say either the operating criterion that's in place is working, or it's not working. And if it's not working, this is what we suggest as being the next alternative in order to meet the spirit of the Grand Canyon Protection Act."

Another strategy used to increase the ability of the AMP to make decisions that integrate across the resources has been to use remote sensing and GIS technologies to facilitate the visual presentation of data. As Gold described, this is particularly useful for AMWG members who don't have a technical background and for that reason "have a hard time seeing a system this large. So, for

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example, one of the things that we did was we've created a little visualization and right now it's a fairly crude model, but we actually are able to virtually fly an AMWG member through the Canyon on the computer ... They were blown away. And they got a sense that that was going to be an important and effective tool for them when we are able to visualize floods and their effects. I didn't anticipate the tremendous response that we got from presenting where we are right now."

In addition to finding new ways to visually display information, technological developments are also leading to new analytic and prediction tools that can help integrate an ecosystem-based approach into the formation of management decisions. One example currently in development is a computer model of the Colorado River ecosystem. As this model is further developed and refined, researchers and managers will increasingly be able to use it to develop scientifically rigorous management decisions. Gold described an important example of the kind of service this model will provide. "I got a call this morning from Reclamation saying, 'The water forecast for next year is looking like this. What do you think we should do to operate the dam?' ... The hope is, when that call comes in two years from now, we'll be able to run some programs and integrate the data that we've got with the goals and objectives and actually produce something that's a bit more rigorous. Rather than what we're going to end up doing this time which is sitting around with a bunch of experts and basically providing expert opinion in a much more qualitative fashion."

Monitoring and experimental flows

This effort to increase the scientific rigor of the program also applies to the monitoring program, which some participants commented has not developed as quickly or efficiently as they had expected, in part because of a lack of adequate baseline data. As Barrett described, "It's taken a long time to get the monitoring into place. In fact I think it's probably just this year that real serious monitoring of most things is beginning to get put into place... I think everybody kind of underestimated how much work it would be to try and do that and they overestimated the quantity and the quality of the data they had on hand to begin with." Metz echoed this sentiment, adding as explanation that "The systems down there in the Canyon take so long to monitor, and it takes such a long time to see results of things, it's just going to take a lot more time than we even realized to know for sure how things are reacting to how we're operating the dam." This said, he did acknowledge that the program has made strides towards integrating baseline data and establishing meaningful monitoring.

In addition to system complexity and poor baseline data, the monitoring program has also had to contend with a limited budget. Part of the problem was that some stakeholders came out of the EIS process with the expectation that an adequate monitoring program could be implemented for two or three million dollars. As Gold described, "What we're learning based on trying to do work at that level is that you can't get sufficient data out to be able to detect change or be able to provide people information on the response the system has had to a given management action. And we're really talking probably about more of a six, six and a half million-dollar program minimum. And there's finally growing acceptance that that is what you're going to need to have in place." As this process progresses, participants' concern over what has been described as a piecemeal long-term monitoring program should be increasingly addressed. And in addition to support for increased funding, Cohen indicated another resource that will help to build and focus the monitoring program. "One of the processes that may help to develop this, which is interesting and vital, are the protocol evaluation

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panels... because you are then bringing to bear knowledgeable folks on how to apply your dollars to develop the most information and then to utilize that information.”

Also a source of some discussion has been, as Johnson indicated, the fact that “the program just is not very flexible, and so our ability to run the type of flows that we want when we want them is very much constrained in this system.” The problem, in Johnson’s opinion, are the hydrologic and biological triggering criteria, which he feels need to be updated, a proposal which is strenuously objected by many stakeholders. As it stands, Johnson claimed that the program has “to wait until we see what kind of hydrology we’ve got, which very seriously constrains the ability to put together very rigorous scientific programs.” One of the specific constraints this process places on the program is that it makes the advanced planning of experiments difficult, which is particularly challenging in a system as complex as the Colorado River through Grand Canyon.

A positive signal that the program is moving in a constructive direction comes from the fact that participants in the AMP are beginning to appreciate the relationship between the funding and the resulting effectiveness of the monitoring program. Specifically, there is growing appreciation for the fact that a more robust monitoring program can actually facilitate less involved, and less expensive, experimental flows. As Gold explained, “For example, rather than spending \$400,000 annually to monitor native fish, and then when the test comes up, needing to spend a half million dollars on top of that in order to really be able to distinguish the effect of the test, what we’ve proposed is going to a \$600,000 program that will require very minimal supplements when you go for a test. And I think everybody is starting to accept that.”

Struggle for scope

Possibly the most significant, recurring challenge the AMP has struggled with has been the definition of the program’s scope. In varying ways, participants expressed their frustration with the ongoing nature of this struggle. Metz commented “We have a vision statement and a mission statement that to me is very general, and lacks the specifics that to me we need. Do we want to maintain trout? Do we want to maintain native fish? How do we want the beaches to look? We really haven’t come up with a shared vision of how we want the river to look.” Harris described that “the part where it bogs down is that a lot of the participants tend to meddle with or try and influence very small pieces of it. So what happens is that you end up diluting your primary effort and you focus on these little chunks of the puzzle and it gets pretty frustrating, it gets pretty interminable.”

The issue of scope, as Barrett explained, “first blew up in TWG a year or so ago when we were talking about the strategic plan. And we just could not come to any agreement on the strategic plan because of this very issue of what’s the scope? What’s the geographic scope, what’s the scope of the whole program, what’s this all really about?” Part of the problem was that, as Metz described, “everyone wanted to have their needs met... We always had trouble coming up with a way to prioritize what the research needs were. And so we ended up with this great big huge laundry list of research management objectives and information needs.”

With the TWG struggling to define the scope, it was decided that the AMWG should work on the challenge of defining the vision and mission for the AMP during a raft trip on the Colorado River. Perspectives on the usefulness of this trip were generally positive. Gold commented that “the fact

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that we got the whole Adaptive Management Work Group and took them on the river and actually showed them the resource and helped them to work together in creating the vision and mission was one of the things that really moved people forward for a while. Because then they felt a lot of empowerment to be the designers of the program, they did feel empowered like a board of directors." Magnussen agreed that the trip provided a much-needed opportunity for real discussion and problem-solving. "Not only was it a great setting for people to be in, it also provided a long enough period of time where you could cuss and discuss and come to wordsmith vision and mission statements which you know is a complicated, difficult thing. But in fact it got done."

One of the decisions that came out of this trip, which Gold noted may have actually reduced some of the empowerment the trip had produced, was to refer a list of questions on the program's scope to the solicitor for the Department of the Interior. When answers came back with the Department's guidance, many considered the issue of scope to have been resolved, so they were surprised and frustrated when, at a recent AMWG meeting to start work on the five-year strategic plan, the issue resurfaced. Barrett described the frustration, saying "And right out of the box comes the question, 'Well, we need to discuss the scope of the program.' And I'm saying 'No, wait a minute. We discussed that once.' Well some people aren't happy with that. So you never know – some people just never accept that everything's final. And I guess that's human nature, and I would suspect that if there was something in that whole package which really rubbed us the wrong way, we would be doing that."

Gold offered a perspective that also gives some insight into why challenging problems may recur. "There is a spirit of collaboration at the same time that there is a constant tension in the program. And my view now is that that is going to be the fact of life for this program. That one will balance the collaborative spirit against sort of a dynamic tension, and that tension will increase when people feel that one of their sacred cows is going to be gored. And decrease when they feel like the results of the activities that we're proposing won't really have a major negative impact on their particular stake in the outcome." This said, the struggle remains, and other participants articulated the difficulty the program now faces in having to revisit the question of scope in spite of all the efforts at developing goals, objectives and overall vision. As Harris commented, "I think we still have not been successful in bridging or developing a comprehensive, over-arching architecture for the vision statement, or the mission statement, that naturally leads you to the management goals and objectives... And I'm not real sure how to do it. Because I can tell you, I've sat through a billion of these management objective meetings where we're going through this hundred-page document or table, and you're going through a zillion and five different MO's, and boy, your eyes glaze over pretty quick."

"It's in the trenches now," Magnussen said, reflecting on the current state of the process. "But I'd say on a scale of one to ten it's probably a seven or an eight. Progress is being made and issues are being brought back to meetings of the Adaptive Management Work Group. There's been a facilitator that's been hired that's been very helpful in the process and is generally seen by all parties as fair and has really good facilitative skills. And so that's something that the Technical Work Group has probably lacked. It doesn't have really good process skills, so she was able to bring skills and abilities that have helped significantly moving the process along." Metz also saw the process of completing the strategic plan as making progress. "I think we're really close to [finishing the strategic plan]. During the last year, everybody's worked a lot, and especially the

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Adaptive Management Work Group had a special work group, an ad hoc group, that works on that... I think it's going to come together in the next year or so, I really think it will."

Summary

The struggle over defining the scope for research and monitoring on the affects of the Glen Canyon Dam on downstream resources has tested both the structure and the ability to integrate science of the AMP. Forward progress in other areas of incorporating science, however, combined with the optimism some participants see for near-term resolution of the scope struggle, indicate a program that is increasingly coming into its own. And for the AMP as with any complex, collaborative process, participants indicated the importance of being patient. As Harris described, "You've got this learning curve and any process like this is going to have that, where the first maybe half a decade or full decade, you're going to be collecting information, assimilating it, organizing it, evaluating it. And then finally you get to the point where you start feeling like you have enough information to actually move forward with some on-the-ground projects and actions that can be adaptively managed." Reflecting on the current state and the future direction of the AMP, Magnussen agreed that progress is being made. "I guess, in my heart, I think we're probably doing pretty good... And frankly, I work in every basin in the western United States and I'll tell you, there's a lot more that are in a lot tougher shape than this one... There's a forum here where people can work and you get everybody in the same room and they do that. And you've got one set of data." The forum and the single source of information, combined with an independent review process that has restored credibility to the research process, provide a firm foundation from which the AMP can address and remedy other scientific challenges it confronts, as it continues to develop and grow as a program.

Integrating Public Participation

Interfacing with the public, and effectively integrating public participation into the collaborative process, has probably been one of the areas where the AMP has been more successful. Without exception, the participants interviewed felt that the program had succeeded in bringing the relevant parties to the table, giving them voice, and correcting the disparities and exclusiveness that had generated conflict in the past. "When the EIS was in process, it was the cooperating agencies and the rest of us all kind of looking on," Barrett described. "And then when they went to adaptive management and formed the Adaptive Management Work Group and the Technical Working Group, they opened it up to a much broader area of expertise and obtained a lot more buy-in. And I think buy-in is important in these things. So I think that's one of the marks of success."

This said, there were still areas related to the effective integration of the public into the process where participants saw room for improvement. All were related to the effectiveness of the representation at the table, which has become a source of frustration for some participants and onlookers who feel that variation in this effectiveness compromises the effectiveness of the entire process. Most agreed that there were differences in the involvement of participants in the process, and comments focused on two main areas: limited participation in particular by the Native American tribes and the seven basin states, and potential disconnects between representatives and their constituencies.

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Limited involvement

Barrett presented one perspective on the participation of the tribes, noting that "The Indian tribes you find pretty reticent to enter into any discussion except when it gets right down to their very narrow field which is the cultural resources thing. Then they get pretty excited about that. And that's alright." Johnson provided another perspective on the issue, adding that the participation of the Native American tribes is something that he and others feel is a very important part of the program. "I get the sense that having a meeting in an office building in Phoenix where you've got all these Type A white males in a high-powered, fast-moving conversation is not a very good way to incorporate those views and those values into the system. And so I think that's been a real issue that we've put a lot of thought and effort into how do we bridge that, but frankly we haven't come up with any good solutions to it."

Perspectives on the participation of the seven basin states were slightly different, as Barrett described. "The seven basin state people are typically pretty quiet and not big participants. They have to be there because law requires it, but it's good to have them there and I assume they feel they're being adequately represented." Having served as a representative of both Arizona and California, Harris explained that part of the reason why at least the lower basin states of Arizona, California and Nevada play a less active role is that shifts in how and when water is released at Glen Canyon Dam does not influence the set allotment of water they receive each year. The upper basin states of New Mexico, Utah, Wyoming and Colorado, on the other hand, have a direct financial interest because the diversion of water for experimental flows or of revenue to support research impacts their ability to fill their contracts.

The net result is that the lower basin states, as Harris described, "support our sister states when they need us to, or some of the constituencies when they need us to. But, in the main, we try to stay out of the line of fire. We go to the meetings, we attend the meetings, we monitor the meetings. You know, if there's something that really jumps up and makes itself known to us, we'll pipe up but largely the three lower basin states take sort of the back-seat role in this... I don't think that the process loses anything. We're there to look out for our long-term interests and I think we do that adequately."

For all members of the program, stakeholders commented that effective participation requires commitment to the process and to working to generate and contribute new ideas. With humor, Barrett summarized the point as "The biggest lesson I've learned is don't ever miss a meeting." Adding more specifics he described that "I do think it's important to be there at every meeting to hear what other people are saying and to make sure that your concerns are being voiced. Because if you don't voice them yourself, nobody's going to do it for you." Johnson agreed and added that "to make the system work you need to do more than attend the meetings, and you need to do more than rely on the agencies like Reclamation and Park Service to do the between-meetings grunt work... You can be there and reject other people's ideas, and certainly there are people at the table who seem to do that on frequent occasion. But if you really want to see the program move, if you want to see things done, you've got to be willing to invest the time and energy in putting ideas together and bringing them up to the rest of the group."

CASE SUMMARY: GLEN CANYON ADAPTIVE MANAGEMENT PROGRAM

Potential disconnects

While some parties at the table have questioned the effectiveness of representation, there also have been some challenges from individuals not at the table. As described earlier, the four seats for environment and recreation represent 70-80 organizations, which, as Cohen described, "is not an easy task...For a while we were keeping them advised through periodic newsletters and that kind of stuff, but that went by the wayside a long, long time ago. And really the first time we've coalesced formally has been when American Rivers dropped out, and they had to be replaced and that's just recently. And strangely enough, the recreation seats were not invited to the table to discuss that."

The challenge of having so few individuals representing such a large number of member organizations creates the potential for disconnect between some of the individual members and their representatives on the AMP. One such case happened recently when a group of recreationists sent in letters to the AMP to complain about their representation in the process. Magnussen described that, in response, "What we did was, we got back to the [recreation] representative and one, made sure there was an issue - he hadn't been copied on the letter so we made sure he was aware - and then made some suggestions both in the letter going back as well as back to the representative about things that they could think about and do." One natural response might be to suggest adding a seat to the AMWG but given the size and limitations on that group, Magnussen noted that other solutions are being pursued and the affected parties are now in the beginning stages of working to ensure broader representation.

Summary

While the AMP has had some challenges to the effectiveness of stakeholder representation, they have on the whole been small relative to the difficulties the process faced historically, and attention is being applied towards trying to remedy the problems that do exist. Perhaps more importantly, this process, for all its complexity, has more complete public participation than many similar attempts at collaboration. Johnson received some insight into this on his recent consultation visit with the Trinity River project managers. "They wanted to set up a system where the environmental and recreation interests really didn't have any decision-making authority in the program at all. If they wanted to, they could go get together and make suggestions. But whether or not those suggestions were taken and acted upon was purely up to the agencies. And my attitude then was, that's a death knell for the program because if you don't give people a real opportunity to be a part of the process, then they're going to be outside the process and they're going to turn to litigation. And if that's what you want, that's just going to tie up the program. You're not going to move forward. So stakeholders have got to have a real stake."

Reflecting further on this point, Johnson noted that the recent move by one of the AMP stakeholders outside of the process may have called into question the stake of the other participants. "Do we have a real stake?" he asked. "Do the less powerful entities, either because of money, or stature or the way they do business, do they have as much of a stake, as much of a voice as some of the other entities?" While no clear answers have yet emerged, these are important questions that must be seriously considered if the AMP's success at integrating public participation into the process is to continue.

CASE SUMMARY: GLEN CANYON ADAPTIVE MANAGEMENT PROGRAM

Summary and Lessons Learned

Overall, the AMP has achieved remarkable progress in its less than five years of existence. Adaptive management has provided a useful framework for organizing the effort and helped to secure broad stakeholder buy-in. The program expanded to allow previously excluded voices at the table and participation is generally marked by good communication and open dialogue. The organizational structure of the program is already being used as a model for other similar efforts, and the program has largely succeeded in breaking down the barriers between individual resources to facilitate the integrated management of the system as a whole. And perhaps most significantly, the decision to channel all research through one science center whose activities are monitored by rigorous and regular review has restored credibility to the research in the Grand Canyon and laid important groundwork for current and future management. As Harris noted, "I think the process has been good, it's been valuable and... the prognosis over the long-term in my mind is that it probably is going to achieve some good things for the ecology and for the Grand Canyon ecosystem."

The AMP still grapples with the challenges of delineating roles within the structure, defining the scope of research, and maintaining constructive and meaningful stakeholder participation, but the process as a whole has continued to evolve new ways to address these challenges, and to generate important lessons for the success of collaborative efforts. Perhaps foremost among these is the fundamental importance of patience and commitment to the process. As Peterson noted, "It does take time for both the science to unfold and the personal relationships to develop that allows for cooperative discussion." Reflecting more broadly, Barrett added that "Given time and enough good will and enough direction it's amazing to me how willing people are to compromise what I thought were basically fundamental, bottom-line issues and work at getting something that works for everybody." The challenges along the way have been and continue to be profound, but as Cohen concluded, "with patience we'll eventually get better than we are today. And ultimately, I think that this process could be a good guide for adaptive management processes elsewhere... It's the best way to go, and we will find ways to improve it. The fact of the matter is that all twenty-six seats are still occupied at the table, which is probably a surprise in itself. There have been ample opportunities for people to get up and walk away and say to hell with it... I can say that it's 100%, or probably more than that, better than it was in 1992, and by and large the people who are at the table are good folks and they're sincere... Overall, I wouldn't be at the table if I didn't think it was a good process. And I wouldn't have stuck with it for sixteen years if I didn't think it was important."

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