Anchored At Adjust

Four practices to depoliticize science and operationalize learning in adaptive management programs

By Jason Farnsworth, Chadwin Smith, and Malinda Henry

Headwaters Corporation specializes in engaging stakeholders to develop and implement collaborative solutions for complex and emerging natural resource management challenges – so-called "wicked problems". For more information about our services and people, visit www.headwaterscorp.com .

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Headwaters Corporation provides an independent Executive Director and staff for the Platte River Recovery Implementation Program and works with several other large scale recovery programs around the United States. The findings and conclusions in this article are those of the author(s) and do not necessarily represent the views of any program or stakeholder.

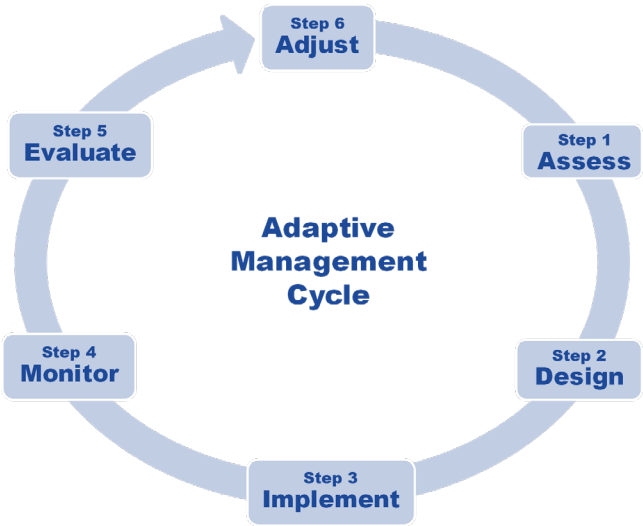
BACKGROUND

Adaptive management (AM) and its derivatives including collaborative adaptive management (CAM) and adaptive comanagement (ACM) have become the science-policy framework of choice for many major species recovery and ecosystem restoration efforts around the globe. This is no accident. AM is highly attractive to decision makers dealing with “wicked problems” as it provides a path forward in the face of uncertainty and disagreement. The science will sort it out!

In practice, the track record of AM is mixed at best.[1,2] Some programs are hampered by institutional and legal barriers to AM implementation. Others struggle to develop the organizational and science frameworks necessary to implement and evaluate management experiments. Still others anchor at the last step in the AM cycle, failing to operationalize learning due to major disagreement over the meaning and reliability of program science for decision-making. This white paper is for programs that are or fear becoming anchored at adjust.

ANCHORED AT ADJUST

In its simplest form, AM promises to harness the power of the scientific method to select between competing management hypotheses or strategies - building scientific consensus that compels policy-makers to choose the most effective strategy.[3,4] This linear process is typically presented as a loop or cycle of continual improvement driven by repetitive application of design, implementation and assessment of management experiments. We have observed that many AM programs can navigate the cycle successfully until the adjust step. Here at the science-policy nexus, stakeholders repeatedly fail to agree on the reliability and meaning of science learning. Instead of adjusting management, decision-makers get caught in a science "do-loop" where more and more learning gets added to a "science pile" they never use.



Why do programs anchor at adjust?

In his book The Honest Broker[5], Roger Pielke Jr. asks: can science compel action? His answer is yes but only in situations characterized by shared values and low uncertainty about how science outcomes affect those values. AM theory emerged in this context – application of rigorous experimental designs to improve management of forests, fisheries and other natural resources.

AM quickly spread beyond those applications as it became highly attractive to politicians and scientists grappling with complex conflict-riddled (wicked) problems such as recovery of endangered species or restoration of degraded aquatic ecosystems. Politicians and resource advocates welcomed the idea of science mediating conflicts over appropriate recovery/restoration strategies. Scientists likewise welcomed the opportunity to do meaningful research. The attractiveness of AM was further heightened because it allowed decision-makers to move forward – to take action – despite unresolved fundamental disagreements. Let the science sort it out!

Pielke predicts failure of AM in these situations because the underlying conflict is never resolved, it is merely driven underground camouflaged as objective scientific disagreement over the reliability and meaning of science learning for decision-making. As Pielke put it, *"both sides argue about science as a proxy for actually discussing the worth and practicality of possible alternative courses of action."* In the end, the science is never good enough to compel stakeholders to adopt a course of action that conflicts with their values. As a result, the program becomes anchored.

In our experience, there are several signs warning that a program is anchored or is likely to become anchored at the adjust stage of AM.

Changing tolerance for uncertainty

Most stakeholder scientists embrace objectivity. They also feel immense pressure to protect their organization's values and are incentivized to push for action when doing so supports their values and oppose action when doing so threatens those values.[6] Acting under uncertainty involves risk and risk tolerance is inherently subjective so it becomes a focal point of underground values conflict expressed as disagreement over remaining uncertainty and associated risks for decision making. Values-aligned stakeholders argue action despite a high degree of remaining uncertainty in situations where science supports their values positions. Conversely, they argue for restraint under a much lower degree of uncertainty when evidence supports policy changes that do not align with their values. As a result, the science program falls into a kind of predicable dissonance with the same groups arguing for or against the reliability of learning for decision-making depending on research outcomes.

Organizational-level mistrust of science

In many large programs, leadership and program staff are employed by a stakeholder or funding agency that actively takes positions on science issues to be arbitrated via AM.[7] Likewise, it is common for science to be conducted by stakeholders or funding agencies that take policy positions on science issues. Like disagreements about uncertainty, aligned groups express varying levels of concern about the motives and biases of researchers and science learning depending on research outcomes.[8] Regardless of a scientist's ability to set aside values and act objectively, their work will be viewed with skepticism when results confirm the policy position of their organization. That skepticism may prohibit a program from moving science forward to decision-makers or, in the extreme, result in stakeholders viewing program learning as a "science charade" whereby self-serving policy decisions are camouflaged as science.[9]

Accumulating science pile

For the reasons described above, anchored AM programs tend to generate an ever-growing body of science learning that is never used by decision-makers to adjust management. Faced with arguments about the reliability and meaning of science for decision-making, policy-makers understandably conclude that engaging in more/better science provides the best path forward. However, it is highly unlikely that the new learning will itself be sufficient to compel stakeholders to desert their values. A science "do-loop" thus emerges, generating a growing body of learning that is never quite good enough.

FOUR PRACTICES TO CLOSE THE LOOP

There are several practices that can be implemented to depoliticize science and close the AM loop. Here are four that we recommend. The first is reframing expectations for AM from science arbiter to broadening the range of policy options for decision-making. This takes the pressure off scientists, whose work is no longer expected to compel policy. The next two (creating space for independent science and generating multiple lines of evidence) further bolster the real or perceived reliability of learning for decision-making. The final practice – including stakeholder values at the evaluate step of AM, allows stakeholders to openly advocate for their policy preferences and weigh them alongside science learning. We expand on each of these practices below.

Reframe the role of adaptive management

In The Honest Broker, Pielke proposes that scientists take on the role of Honest Brokers of Policy Alternatives when they operate in contexts of high conflict and uncertainty. Honest Brokers understand that science cannot compel action in these situations and instead, seek to connect science with policymaking by identifying the range of policy choices that are consistent with science learning. This reframing takes the pressure off stakeholder scientists – they are no longer faced with defending or deserting their values. Instead, they are tasked with generating the best possible learning in support of policy-making.

At a programmatic level, decision-makers must let go of the idea that science will compel policy changes. Instead, they may need to spend time reassessing the science-related questions that need to be answered to make policy choices. One way to reframe AM and link science and policy is for policy-makers to develop a set of Big Questions (questions that need to be answered to make management adjustments). Scientists can translate those questions into hypotheses and design management experiments that address questions about which management alternatives contribute to meeting program objectives, which do not, and at what cost. Or, in the case of mature programs, it may be useful to reanalyze existing data to directly address the Big Questions.

Create room for independent science

As discussed previously, there is great potential for skepticism and mistrust of program science when it is staffed by and/or science is performed by staff under the control of a funding agency or from multiple agencies/stakeholders with no unified program identity or leadership. There are several increasingly involved ways to promote a culture of scientific objectivity including:

1. Creating and transparently communicating program staffing and roles. The websites (if they even exist outside of an agency umbrella) for most major restoration and recovery programs provide no information on implementation staffing structure, staff members, their roles and responsibilities, or their affiliations. The small step of identifying and communicating this structure provides an opportunity for staff to identify with the program instead of their agency employer (and their policy positions).

2. Creation of a program-specific implementation office. Housing personnel in a distinct physical location under centralized program leadership creates space for technical and administrative staff to identify with the program's objectives and their implementation roles and responsibilities. It also reduces direct exposure to organizational level advocacy, especially when program leadership is committed to protecting the independence and objectivity of science implementation.

3. Independent implementation. This is an extreme solution, employed when mistrust and conflict levels are so high that stakeholders are unwilling to accept any association between stakeholders and science implementation. In that scenario, program leadership and staff are employed by a non-profit or private company. As a result, staff are not aligned with a specific stakeholder and instead are equally accountable to all stakeholders. Even this level of independence can be questioned if funding is controlled by one or several stakeholders. Selection of an independent financial and contracting entity that manages program funds can add a final layer of independence.

4. Independent science review. Most large programs have some form of independent science advisory or review panel. It is important to avoid situations where independent science panel members conduct program science or are aligned with a stakeholder group. Likewise, the science panel should not be under the direct funding control of one stakeholder. These conflicts of interest invite charges of manipulation, providing grounds to object to panel recommendations. Use of a neutral party to identify, vet, and retain candidates is one way to protect panel independence.

Generate multiple lines of scientific evidence

Large program AM is often conducted in natural systems with high variability, low control and limited potential for replication of natural experiments. This decreases the potential for management experiments to provide definitive results that are robust to criticism. Broadening experimental design to generate multiple lines of evidence can provide unexpected insights and increase decision-maker confidence in program science.

Example lines of evidence include:

- Management experiments
- Simulation modeling
- Retrospective analyses
- Compare/contrast with other natural systems.

The process of collecting, evaluating, and weighing lines of evidence is conceptually similar to the weight of evidence approach used in ecological risk assessment.[10] Each line of evidence carries differing degrees of reliability and uncertainty. As multiple lines of evidence begin to converge on similar findings, the science becomes more robust to values-based criticism. Put bluntly, it is easy to challenge the results of any single management experiment. Consistent criticism of multiple converging lines of evidence is more easily identifiable as a values issue not science insufficiency.

Include stakeholder values in decision-making

Although often avoided due to inherent subjectivity, explicitly incorporating and weighing stakeholder values in decision-making reduces the potential for values disagreements disguised as objective scientific disagreement. We have found structured decision making (SDM) to be an important tool that allows stakeholders to explore and balance the importance of both science and values in decision making. Early in the SDM process, decision-makers identify "things that matter" as they navigate the science-policy nexus. Inclusion of important value-oriented objectives brings those issues into the open and gives them weight.

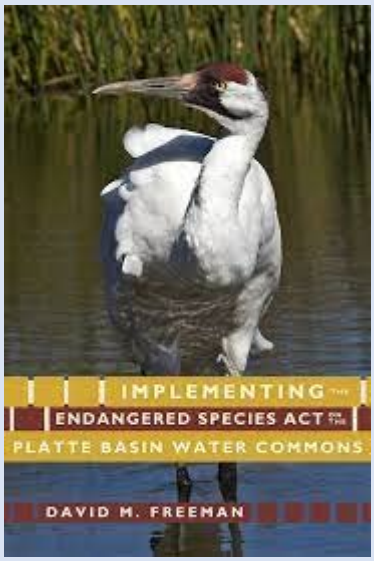
SDM also inherently increases the scope of policy options available to decision-makers. During the SDM process, stakeholders are asked to clarify their objectives and performance measures, develop a range of management adjustment alternatives, and then estimate the consequences of implementing those alternatives. AM-derived science is used to estimate quantitative consequences of alternatives but does not drive decisions. Once consequences of actions have been estimated, stakeholders evaluate trade-offs and select one (or more) to implement. The act of first expanding (instead of reducing) the choice of policy options creates room for creativity and consensus building. Compass Resource Management (Vancouver, BC, Canada) has written an excellent book on SDM and successfully facilitated SDM processes within AM programs. [11]

PLATTE RIVER CASE STUDY

Negotiations started in 1994 to form a multi-state endangered species recovery program in the Platte River basin for (in part) the piping plover (*Charadrius melodus*) and interior least tern (*Sternula antillarum*). Over a 13-year period, federal agencies, states, water users and conservation organizations negotiated a $317 million-dollar first increment of the Platte River Recovery Implementation Program (PRRIP) that would include acquisition of 10,000 acres of land and at least 130,000 acre-feet of water supported by a science program to reduce critical uncertainties.

Organizational-level mistrust was so high during PRRIP negotiations that policy-makers embraced an informal consensus decision-making model where all Governance Committee representatives had to agree before any actions were taken. They likewise decided to create an independent PRRIP leadership and staffing model instead of the typical agency staffing used in other large programs. That way no stakeholder could leverage PRRIP implementation through day-to-day operations. Even with this focus on collaborative decision-making and independent staff for implementation, PRRIP negotiations stalled due to deeply held disagreement over the appropriate strategy to contribute to the recovery of the target species.

Sociologist David Freeman developed a theoretical framework for negotiation of large-scale environmental programs based on PRRIP negotiations.



Environmental and regulatory agency stakeholders advocated for a strategy of managing river flow to create and maintain the kind of riverine sandbar nesting habitat used by the species on other regional river systems. State and federal water user stakeholders advocated for mechanical creation and maintenance of the kind of off-channel nesting habitat at sand and gravel mines used by the species along the central Platte River. AM provided a path forward in the form of a head-to-head experimental test of these very different management strategies. This commitment to scientific arbitration of fundamental management disagreements allowed the PRRIP to move forward to implementation. It also set the expectation that science learning would compel decision-makers to adopt a winning management strategy.

Reframing AM

PRRIP stakeholders developed an AM Plan (AMP) with a clearly defined purpose of testing the two competing management strategies. Early in PRRIP implementation, the new Executive Director (ED) and ED Office (EDO) staff were exposed to Pielke's cautions about the probable

failure of scientific arbitration under the context of high uncertainty and conflicting values. This was discussed with stakeholders resulting in an AM Implementation Plan[12] which reframed the purpose of AM to inform policy-makers instead of arbitrating a winning management strategy.

The original AMP included a set of 41 priority hypotheses, some of which had no clear policy linkages. Part of reframing AM included focusing and directly linking science to policy via the exercise of developing a set of Big Questions. These were science-related questions developed by decision-makers that they needed to have answered to make informed management adjustments. These Big Questions focused AM implementation on a constrained set of management hypotheses and provided structure to science communication.

> Big Question Example
>
> Will implementation of short-duration high flow releases produce suitable tern and plover riverine nesting habitat on an annual or near-annual basis?

As AM implementation proceeded, the EDO developed an annual State of the Platte Report[13] to communicate Big Question learning to decision-makers. The reports present the EDO's assessment of learning for each question, what is still needed to conclusively answer the question, and PRRIP management implications. Each year a draft report is provided to PRRIP's Technical Advisory Committee and independent science review. Their comments and feedback are placed at the beginning of the report so policy-makers had direct feedback and context before reading the technical assessments.

Independent implementation

Platte stakeholders committed to a high degree of independent implementation achieved by selecting an independent financial and contracting management entity, establishing a land interest holding entity (Platte River Recovery Implementation Foundation), and hiring an outside ED to staff and implement the PRRIP on behalf of all stakeholders. The PRRIP ED and staff are not employees of any PRRIP stakeholder; rather, they are employees of a private company contracted to the PRRIP's financial management entity. As a result, staff do not work for a specific stakeholder and instead are equally accountable to all stakeholders. This arrangement reduces the skepticism that accompanies stakeholder-aligned administration and/or science implementation. Despite this layer of independence, there are still situations where the ED or decision-makers believe that staff involvement in decision-making may inappropriately influence the outcome. In these cases, the Program requests assistance from a third-party neutral and staff assume a secondary technical support role.

> Independent Implementation Structure
>
> - Attachment 6 to the Program Document describes its organizational structure.
> - The Nebraska Community Foundation (NCF) serves as PRRIP's financial management entity. NCF also manages PRRIP's land interest holding entity.
> - Headwaters Corporation provides the ED and implementation staff.

General oversight of PRRIP science is tasked to an Independent Science Advisory Committee (ISAC). The

ISAC is comprised of subject matter experts that are identified by an independent third party neutral and approved by a consensus vote of the Governance Committee. Detailed technical review of science work products is accomplished via peer review. Like the ISAC, a third party identifies potential peer reviewers for science work products that will be used for decision making. The GC then selects from identified potential reviewers to form a panel that conducts the peer review. The process is similar to journal peer review with the objective of creating a final work product deemed acceptable by the panel. The GC then acts on the review and underlying technical work, accepting or rejecting it for use in decision-making.

Looking beyond management experiments

The reframed AM implementation plan placed a strong emphasis on development of multiple lines of evidence both in implementation of management actions as well as assessment of target species response. The PRRIP's AMP focused on implementation and assessment of short-duration high flow releases to naturally build on-channel sandbar nesting habitat. This focus was broadened to include retrospective investigations of sandbar dynamics, development of predictive models, mechanical creation of on-channel habitat in proximity to off-channel sites to compare selection and productivity, and initiation of compare/contrast studies with other segments and river systems that support tern and plover nesting. These studies approached the experimental objective from different perspectives, generating separate but converging lines of evidence indicating that short-duration high flows would not create or maintain suitable on-channel nesting habitat.

> An interior least tern and piping plover data synthesis compilation was completed in 2014 and peer reviewed by an independent panel comprised of:
> - Ecological modeler with tern and plover expertise
> - Population ecologist with tern and plover expertise
> - Fluvial geomorphologist with restoration and management expertise
> - Ecologist/geologist with expertise in tern and plover sandbar habitat.

These multiple related studies/lines of evidence were organized into a data synthesis compilation organizationally similar to a Ph.D. dissertation.[14] That compilation was subjected to independent peer review by a multi-disciplinary panel identified via a third-party neutral. The reviewed synthesis was then provided to decision-makers who considered it and accepted the underlying finding for use in program decision-making. This process allowed decision-makers to consider learning related to a critical uncertainty from multiple angles, receive independent feedback on the strength of that learning, and then affirmatively act on its utility for decision-making. The final document includes peer review materials as well as a statement of GC acceptance of the findings for use in PRRIP decision-making.

SDM - giving values weight in decision-making

Once decision-makers had accepted the determination that short-duration high flows would not create suitable nesting habitat, they began exploring ways to adjust management. On the advice of the ISAC, they brought in an independent third party (Compass Resource Management,

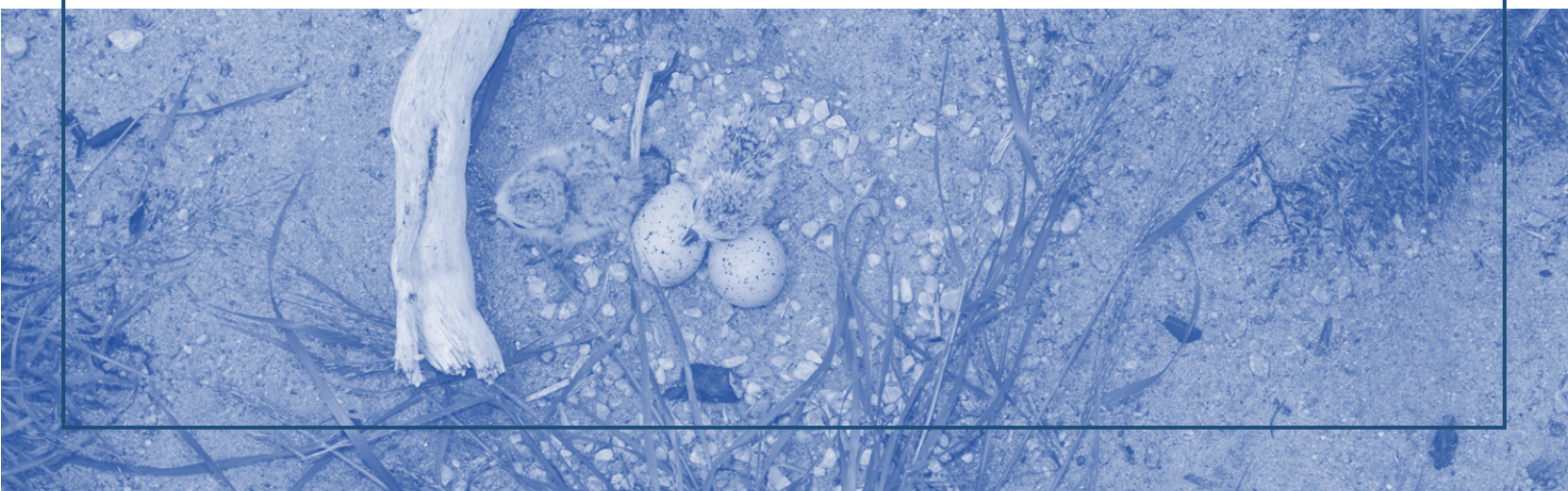
Vancouver, BC, Canada) to facilitate an SDM process to adjust interior least tern and piping plover management actions. Compass interviewed decision-makers and developed a set of decision objectives, including reproductive success, cost, and learning/management tradeoffs that guided the analysis of alternatives.

The EDO developed numerical models from synthesis compilation science to calculate reproductive success and cost of various alternatives. Values-based objectives were translated into qualitative scales, providing clarity to the relative importance of these objectives in the decision-making process. Decision-makers considered four rounds of alternatives, estimating consequences and identifying trade-offs. This enabled decision-makers to improve and narrow the focus of alternatives until consensus was reached to adjust management to focus on creation and maintenance of off-channel sandpit nesting habitat with a small amount of ongoing vegetation clearing on existing in-channel sandbars. Modeling, decision objectives, alternative development/ranking process and final results are documented in a final report on Structured Decision Making for Interior Least Tern and Piping Plover Habitat on the Platte River.[15]

Structured decision-making process steps:

Beyond the science-policy nexus

Since the SDM process concluded in 2016, the PRRIP has focused on increasing available off-channel nesting habitat by collaborating with miners to create new sites and through purchase and rehabilitation of habitat at abandoned mines. In 2021, the interior least tern was removed from the endangered species list, shifting focus to the piping plover. The PRRIP is currently updating its Adaptive Management Plan, providing an opportunity to assess uncertainties and the need for another AM loop for plovers. The AMP update is occurring during three years of low plover productivity, resulting in renewed focus on uncertainty related to the causes of egg and chick mortality (specifically predation) and the management actions that can be implemented to improve fledging success. Stakeholders are assessing the need for another AM cycle to deal with these issues.



FINAL THOUGHTS

Under Pielke's Honest Broker model, science learning is valued as one input in a decision-making process focused on broadening (instead of narrowing) the scope of policy choices. The organizational and implementation principles described above reframe AM implementation, protect the integrity and utility of program science, and ultimately removed science from the role of choice-limiting policy arbiter. This frees decision-makers to explore a range of policy options and transparently advocate for their values, weighing them alongside science learning. Ultimately, use of science to broaden policy choice (instead of arbitrate disagreement) removes the pressure for stakeholder scientists to anchor at adjust, allowing the PRRIP to successfully navigate the science-policy nexus.

Reframing AM, carving space for independent science and expanding experimental design to generate multiple lines of evidence can be implemented at any point in the AM process, although they are most easily and effectively incorporated at the assess and design steps. Giving values weight in decision-making is likely the most important principle. Often avoided due to inherent subjectivity, tools like SDM can be incorporated at the evaluate stage of AM to transparently include stakeholder values in the AM process.

On an optimistic note, many AM programs that are anchored at adjust may not actually have a science sufficiency problem at all. Applying tools like SDM to existing science could facilitate rapid AM progress. However, rapid progress comes with its own set of challenges, including the disposition of program science apparatus organized around legacy research and monitoring programs. Science staff are ultimately engaged in working themselves out of a job. This is a challenging but ultimately rewarding goal for all restoration and recovery programs.

ENDNOTES

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ABOUT THE AUTHORS

Jason Farnsworth is a board-certified environmental scientist (AAEES) with experience designing and implementing large-scale adaptive management experiments. He has special expertise in the integration of ecological and physical process modeling, monitoring and research. Jason has served as the Executive Director of the Platte River Recovery Implementation Program since 2018. In this role, he oversees day-to-day implementation of the program and supervises all staff and contractors.

Dr. Chadwin Smith is an expert in adaptive governance and adaptive management. For 25 years he has worked in and consulted on large-scale endangered species recovery and ecosystem restoration programs throughout the United States, with a focus on aquatic-based restoration programs involving the Bureau of Reclamation and U.S. Army Corps of Engineers. His technical expertise includes adaptive management, program governance, decision analysis, data analysis and synthesis, and use and management of independent science panels and peer review processes.

Dr. Malinda Henry is a behavioral ecologist who has worked on four continents to address human impacts on plant and animal communities. She has primarily worked with endangered primates, but has answered questions about how resource competition, social systems, disease, and habitat fragmentation work to limit populations. She integrates tools from her study of behavior, botany, zoology, ecology, physiology, endocrinology, and genetics to better understand endangered species response to their environment and uses this information to help plan for long-term species management.