Closing the Feedback Loop:

Evaluation and Adaptation in Collaborative Resource Management

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A Sourcebook for Collaborative Resource Management Groups

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About the Author

Ann Moote is an independent contractor providing applied social science research, process design, and facilitation services to natural resource management agencies, nonprofit organizations, and collaborative groups.

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Purpose of this Sourcebook

How do collaborative resource management groups evaluate and adapt their work?

Collaborative resource management grew out of a desire to overcome gridlock and better address multiple needs and concerns. In the last 30 years, collaboration has come a long way toward building understanding and trust among formerly conflicting groups. Multiparty monitoring is increasingly common, and collaboration is mandated in new resource management programs and policies. Yet for many participants, questions remain: How well are we achieving our desired outcomes? What's working, and what could we do better? Why haven't we made changes based on what we learned last time? Many collaborative groups lack explicit processes for deliberative evaluation and adaptation.

This sourcebook provides answers from the field — strategies and tools that some collaborative resource management groups have used to systematically evaluate their work and adapt plans and management actions based on what they have learned. The examples described in this document are drawn from rapid assessments of nine collaborative resource management groups and informed by organizational and social learning, evaluation, and adaptive management concepts. Rapid assessment cases include:

- Allegheny Highlands Fire Learning Network, West Virginia
- Bankhead Liaison Panel, Alabama
- Blackfoot Drought Committee, Montana
- Bluewater Collaborative Forest Restoration Project, New Mexico
- Central Oregon Partnership for Wildfire Risk Reduction, Oregon
- Dinkey Collaborative, California
- Lemhi County Forest Restoration Group, Idaho
- Lower Dolores Working Group, Colorado
- White Mountains Stewardship Project, Arizona

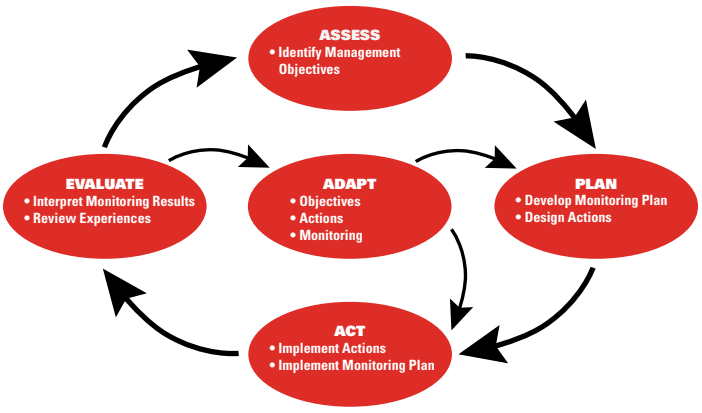

Figure 1: Adaptive Management Cycle

Adaptive Management: Definition

Adaptive management is an ongoing process of defining objectives, taking action, monitoring and analyzing outcomes, and applying what was learned to the next round of planning and management. The basic premise is to treat management actions as experiments and embrace desirable and undesirable outcomes as important feedback that can inform future actions. Because it may address plans and policies as well as actions, adaptive management involves policymakers, resource managers, and other stakeholders in identifying management objectives and questions and evaluating results.

For the purposes of this sourcebook, adaptive management refers to any process that begins with clearly defined objectives, uses an iterative process of learning and action, and draws on people with different backgrounds and perspectives to collectively evaluate and plan for change (see Figure 1).

Using this Sourcebook

This sourcebook has two purposes. The first is to provide a selection of evaluation tools and change mechanisms for collaborative groups to consider and use. The second is to stimulate discussion of evaluation and adaptation in collaborative resource management. Collaborative resource management and adaptive management are not new concepts, but experience has not caught up to theory, and there is much to learn from the rapidly evolving efforts under way.

This sourcebook is intended as a resource, not a manual. Appropriate process strategies and tools are context-dependent, and different groups will find different examples relevant to their situation. Some of the tools discussed in this sourcebook require more resources than others. Joint fact-finding, effectiveness monitoring, applied research, and developing new plans can each require considerable time, funding, and technical expertise. Many groups find it helpful to begin with less resource-intensive evaluation methods, such as after-action reviews, qualitative multiparty monitoring, and periodic process and program reviews. These processes provide rapid feedback that can be directly applied to improve resource management. They also can bring to light questions that warrant more intensive evaluation or research.

Process Strategies and Tools

The first section of the sourcebook, "Effective Evaluation," describes process tools and strategies for engaging in deliberative learning and collaborative evaluation, including:

- collaborative planning,
- joint fact-finding,
- utilization-focused evaluation,
- after-action review,
- process and program reviews,
- effectiveness monitoring, and
- qualitative multiparty monitoring.

The second section, "Change Mechanisms," provides strategies and tools for adjusting planning and management based on evaluation results. Change mechanisms include:

- written records,
- formal recommendations and requests for action,
- semi-binding agreements,
- decision points written into management plans and procedures,
- regular, informal communication,
- practitioner networks, and
- facilitators and coordinators.

The third section, "Closing the Feedback Loop," discusses a key lesson from the rapid assessments, which is that the two most important factors for successful evaluation and adaptation are:

- individual willingness to experiment and learn and
- organizational commitment to collaboration and adaptive management.

For More Information

Appendix I, "Conceptual Foundations," summarizes the theoretical basis for shared learning, adaptive management, and collaborative evaluation to improve policy, planning, and management. This section summarizes concepts from literature on social and organizational learning, adaptive management and adaptive governance, and utilization-based evaluation.

Appendix II and III provide more details from the rapid assessments. Appendix II includes case summaries of evaluation and adaptation in three collaborative groups, the Bankhead Liaison Panel, Blackfoot Drought Committee, and Dinkey Collaborative. Appendix III provides worksheets and examples of several of the tools discussed in the sourcebook.

Some collaborative resource management groups are using structured procedures to collectively evaluate their work and adapt their plans and management actions. *Photo by Marcus Kauffman*

Effective Evaluation

How can collaborative groups avoid positional debates and circular discussions?

Collaborative group participants can be frustrated by time and resources reallocated from on-the-ground work to meetings where disputes are raised but often not resolved. Groups that have completed collaborative planning and monitoring are frustrated further when lessons learned are not captured and used to inform ongoing work. Mutual learning and evaluation can help address these frustrations by reframing disagreements as questions to be answered and providing structured methods to address them.

Disagreements about management needs and practices often are based in deeply-held values and different social and political views. Such disagreements are not resolved through technical analyses and rational planning processes. They require mutual understanding of different worldviews and political realities as well as the best available scientific and technical information. These value-based differences, along with complexity of interrelated ecological, social, and economic systems, mean management decisions will never be clear-cut.

Concepts from organizational and social learning, adaptive management, and utilization-focused evaluation can help groups constructively address planning and management questions. Organizational learning provides guidelines for purposeful and collective learning from practical experience. Social learning emphasizes information sharing and deliberation across organizations and among people with different experiences and perspectives. Adaptive management aims to reduce uncertainty and improve management by monitoring programs and projects and comparing results to management objectives. A utilization-focused approach to evaluation produces concrete, actionable recommendations that can feed directly into policy, planning, or management decisions. Designing and conducting evaluation to produce clear recommendations helps ensure that results will be used.

Multiparty Learning

When people with different backgrounds and perspectives jointly review information, assess current conditions, raise questions about observed and proposed activities, and share their experiences and expertise, they build both their collective knowledge and their capacity to evaluate their individual and collective work.

Why Do It

- Build understanding of different perspectives
- Make tacit knowledge explicit
- Identify agreed-upon issues and challenges
- Locate and use relevant technical and practical information and expertise
- Challenge ingrained beliefs and practices
- Resolve conflicts
- Identify innovative solutions
- Build shared knowledge and reduce reliance on a few individuals

Multiparty learning and evaluation tools include **collaborative planning** and **joint fact-finding**.

Collaborative Planning

Many organizations and agencies use an interdisciplinary team approach to planning. However, involving external stakeholders throughout the planning process is less common. Collaborative processes such as multi-stakeholder and multidisciplinary landscape and watershed assessments help build understanding and trust among participants as they collectively evaluate conditions and identify management objectives before planning begins. Ideally, collaborative groups also participate in identifying alternative management actions and discussing how best to implement those actions. Although final decision making authority lies with one or a few entities, other stakeholders are more likely to accept those decisions if they were substantively involved in the discussions that led up to the decision. The process can be time consuming, but collaboratively developed plans often benefit from the additional expertise and innovations brought by people outside the core planning team and collaboratively planned projects are less likely to be delayed by appeals, objections, or litigation.

Joint Fact-finding

Joint fact-finding is a strategy to help stakeholders work through disagreements. The goal is to clearly separate agreed-upon issues from those still in dispute and report findings in summary documents that can be used to inform management or policy decisions. By synthesizing

Shared Sacrifice: Blackfoot Drought Response Plan

The Blackfoot Drought Committee was established in 2000 to address declining fisheries and water allocation in the Blackfoot River Basin in western Montana. The planning process brought together private landowners, state and federal agencies, and conservation groups to develop a solution to the fisheries decline by better managing water use during drought years. The Blackfoot Drought Response Plan, based on the goal of watershed-wide restoration of fishery resources and "shared sacrifice" among all water users, grew out of these discussions.

The Drought Response Plan is tiered to more than 100 individual drought management plans that lay out how and where irrigators will reduce their withdrawals. Participating senior water rights holders voluntarily reduce their water use when flows at the mouth of the river drop below pre-set thresholds. Those with rights junior to the state's instream flow right legally can be required to shut down operations, but under the Drought Response Plan the state has agreed to the individual management plans that give users more flexibility in how and where they will reduce withdrawals. The Drought Response Plan also limits fishing at predetermined low-flow and high-temperature thresholds. A Drought Committee with representatives from the Blackfoot Challenge, Trout Unlimited, Montana Fish, Wildlife, and Parks [FWP], U.S. Fish and Wildlife Service, the Montana Department of Natural Resources, irrigators, and outfitters was created to oversee plan implementation.

Drought Committee members point to two factors that make the plan effective: users were invited to help craft the management plan, and the state has always been willing to work with users to seek alternatives to shutting down operations. The state retains its authority to enforce water rights and close areas to fishing, but generally relies on the concept of shared sacrifice rather than formal enforcement to maintain compliance.

The Blackfoot Drought Committee was established in 2000 to address declining fisheries and water allocation in the Blackfoot river basin in western Montana. *Photo by Ron Pierce, Montana Fish, Wildlife, and Parks*

available information, participants avoid the challenge of trying to choose between different reference materials or "dueling scientists." The process of developing a summary document focuses the group on problem-solving rather than debate.

Process

1. Convene a team of people with different perspectives on the issue
2. Agree on the nature of the problem and questions that need to be answered
3. Identify and select qualified experts to assist the team
4. Work with the experts to refine the questions and agree on methods for answering them
5. Identify and review relevant information, including technical and scientific documents
6. Write a summary report synthesizing what has been learned, including any outstanding questions or disagreements

It is important to start by clarifying the questions that need to be answered, to focus data gathering on decision-relevant information and avoid reviewing the full range of available information on a topic of interest. It is also important to reach agreement on appropriate information sources at the outset, so that all participants will accept the fact-finding results. Experts consulted may include not only resource specialists with scientific and technical knowledge but also policy decision makers and other stakeholders who bring information on political constraints and financial feasibility into the discussion.

Evaluation Strategies

Although collaborative groups rarely undertake in-depth program evaluations, they can use principles from utilization-focused evaluation to produce concrete, actionable recommendations that feed directly into policy, planning, or management decisions. Collaborative groups also use rapid review processes to identify lessons learned and recommend changes. After-action reviews provide a systematic way to quickly capture lessons learned from management actions and recommend more effective practices. Regularly scheduled program and process reviews are used to assess and recommend adaptations to broader policies and programs.

A Way Forward: Lower Dolores Working Group

The Lower Dolores Working Group in Colorado used joint fact-finding to address participants' disagreement over the condition of native fisheries and minimum flow needs for whitewater boating. In an effort they called "A Way Forward," the group hired three fisheries experts to individually synthesize and interpret available data on native fish conditions, then collectively develop management options for addressing conditions and trends.

The group agreed at the outset that they would accept the experts' collective synthesis of the science, but that the scientists' management options would be further evaluated for social, economic, and legal feasibility. A subcommittee, including agency decision makers and county elected officials, environmental group representatives, and water users, discussed and refined the management options in terms of legal and fiscal feasibility and water users' needs. The group then separated the options into those that could be implemented immediately and those that would require fundraising or policy changes.

The Lower Dolores Working Group used joint fact-finding to address disagreement over the condition of native fisheries and minimum flow needs for whitewater boating. *Photo courtesy of the Lower Dolores Working Group*

Why Do It

- Identify best practices
- Correct unintended effects
- Improve programs, plans, and management practices
- Provide concrete, actionable recommendations for improved action
- Build capacity to reflect on practice and to give and receive critical feedback

Utilization-focused Evaluation

The utilization-focused approach to program evaluation provides an alternative to punitive performance reviews and descriptive reports by focusing on improving planning and management. The first step in a utilization-focused evaluation is to determine how the results will be used. This is done by asking key stakeholders, particularly the expected end users of the results, to identify how and why they would use evaluation results. Involving intended users helps ensure that they understand and feel ownership in the evaluation process and findings, which makes them more likely to use the results. Once expected users and uses have been identified, stakeholders can identify appropriate evaluation questions and methods for answering them.

Questions to Focus Evaluation

- What is the activity or decision that we want to influence?
- Why do we care (what's the issue)?
- Who is responsible for making the decision?
- Who is responsible for implementing the decision?
- What data and findings are needed to support decision making?
- What other factors will affect the decision making?
- How and when will decision makers and implementers use the evaluation results?

Answering these questions helps focus the evaluation on useful results and change and change mechanisms. Methods for answering these questions are selected based on their ability to produce useful results.

After-action Review

The after-action review (AAR) is a technique for rapidly reviewing management actions in terms of desired outcomes and implementation realities. In an AAR, people involved in or affected by a management activity discuss what happened in terms of intended results and unexpected events, isolate key lessons learned, and recommend changes to improve effectiveness. In a collaborative resource management context, participants in the review should be those directly involved in project planning, implementation, and monitoring.

To encourage open sharing, the AAR facilitator should begin by establishing that it is not a critique or performance evaluation. Discussion should be grounded in mutual respect, without judging people or their individual actions. Participants should be asked to keep individual comments confidential and participate freely, regardless of professional hierarchies. While individual input should be kept confidential, it is important to have a clear record of lessons learned and recommended actions.

Despite the name, AARs do not have to be performed at the end of a project or action. "Before-action reviews" can be used to make sure everyone agrees on the implementation process and desired outcomes and to review lessons learned from past actions. After-action reviews can be used periodically during planning or project implementation to evaluate progress and discuss whether strategies or operations should change.

Questions to Guide an After-action Review

- What did we set out to do?
- What did we actually achieve?
- What unexpected things happened?
- How did we respond?
- What went well?
- What could have gone better?
- What should we do next time?
- What additional information do we need?

Periodic Process and Program Reviews

Regularly scheduled multi-stakeholder reviews are important for evaluating social and policy structures and processes as well as management actions. These reviews commonly occur in annual meetings where stakeholders revisit program and policy strategies and goals. As with AARs, process and program reviews should involve people with decision making authority as well as those actively involved in implementing decisions. These meetings can encourage critical reflection on program purposes and underlying assumptions as well as effectiveness.

Multiparty Field Reviews: Central Oregon Partnership for Wildfire Risk Reduction

The Central Oregon Partnership for Wildfire Risk Reduction (COPWRR) uses a type of after-action review to evaluate implementation and outcomes of forest restoration and fuels reduction projects. Participants represent contracting foresters, environmental groups, and resource management agencies, including project interdisciplinary team members. The group evaluates projects using forms that describe the project's original purpose and need, management objectives, silvicultural prescriptions, and best management practices. Participants visit three to five treatment units and discuss how well the project met desired outcomes, what factors arose during implementation that affected the process or outcomes, what adaptations were made along the way, and lessons learned that the group would like to see carried forward into future projects. Through back-and-forth discussion and debate, the group develops a shared project evaluation and recommendations for future management, which then become part of the group's permanent record.

Members of the Central Oregon Partnership for Wildlife Risk Reduction gather during a field trip. The group often conducts multiparty field reviews to discuss how well the project met desired outcomes and share lessons learned to carry forward into future projects. *Photo by John Chinnock*

Annual Meetings: Blackfoot Drought Committee

The Blackfoot Drought Committee implements its Drought Response Plan through an iterative process of reviewing monitoring indicators, communicating with plan participants, implementing the plan, and reviewing and refining plan implementation. The committee meets monthly in winter and early spring and weekly in late spring and summer to review water temperature and flow data and trends and decide when to put the plan into effect. Each fall, the committee holds a year-end meeting where monitoring indicator data, drought plan participation, amount of water conserved, and outreach activities are reviewed and possible changes discussed. Over time, technical assistance has been expanded, trigger response requirements have been revised, and additional levels of response have been added as a result of the annual reviews.

> *Multiparty evaluation and shared learning are necessary to interpret results and provide an assessment of what works, what needs to change, and how it should change.*

Adaptive Management

Adaptive management is a structured process of evaluating resource management actions and using what is learned to adjust future management. The adaptive management cycle begins with a clearly defined objective and an expectation that a proposed action will lead to that objective. The action is then taken, results are monitored and evaluated, and a decision is made whether or not to change management. Using agreed-upon goals and objectives as the basis for evaluating results distinguishes adaptive management from simple trial-and-error and *ad hoc* management changes. Adaptations are not arbitrarily selected; they are based on the increasing base of knowledge from past action and evaluation.

Adaptive management is an iterative process, not a one-time change in response to monitoring results. Each time management is changed the cycle begins again, with identification of expected outcomes of the revised management actions followed by monitoring and evaluation. Over time, this ongoing process builds understanding of how the system works and leads to better management based on that improved understanding.

Why Do It

- Build knowledge of system conditions and functions
- Improve management practices and outcomes
- Base management recommendations on defensible data
- Avoid repeating mistakes
- Make learning, evaluation, and adaptation habitual
- Improve policy and strategic planning

Biennial Charter Review: Dinkey Collaborative

The Dinkey Collaborative in California was created in 2010, when the Sierra National Forest was awarded a Collaborative Forest Landscape Restoration Program project. The Dinkey Collaborative's charter includes provisions for biennial review and amendment of the charter itself. In 2012, charter review resulted in several recommended clarifications, including procedures for documenting group agreements and disagreements, clearly delineating when decision points are reached, and distinguishing decisions from recommendations.

For the Dinkey Collaborative in California, the process of field reviews and adjusting management is important because it builds trust and allows ongoing management improvement. *Photo by Dorian Fougères*

Monitoring — periodically and systematically gathering and analyzing data to understand trends over time — is used to provide feedback for adaptive management. Many different methods can be used, as long as they meet the standards of providing reliable results, meaning that different people using the same method would reach similar conclusions. Most often, collaborative resource management groups use quantitative (numerical) methods to measure changes in specific conditions before and after management. In some cases, particularly when less specific results are needed, qualitative (descriptive) methods may be used.

In highly uncertain or contentious circumstances where there is a need to establish more definitively whether observed results are due to management actions, experimental research design is used. In general, research-based monitoring is quite costly in terms of time and money, and qualitative methods are the least expensive. Balancing desired rigor with available resources and long-term commitment to monitoring helps groups tailor their adaptive management for success. Whether the monitoring is research-based or observational, multiparty evaluation and shared learning are necessary to interpret results and provide an assessment of what works, what needs to change, and how it should change.

Quantitative Effectiveness Monitoring: Bluewater Collaborative Forest Restoration Projects

The Bluewater Project on the Cibola National Forest in New Mexico includes meadow enhancement treatment areas where goals are to restore understory vegetation and historic hydrologic function. A multiparty monitoring team uses plots and transects to measure canopy cover; tree and sapling density, size, and species; and understory ground cover before and after treatment.

After treatments were completed on the initial 100 acres of a 300 acre project, monitoring data showed that the prescriptions were not reaching their target outcomes: too many trees were being retained to meet the objectives. The multiparty monitoring team determined that the contractor had met the prescription specifications, which called for cutting trees up to 8 inches in diameter, but that this did not achieve the target tree density.

The monitoring team worked with U.S. Forest Service (USFS) staff to identify what size of trees the next series of treatments could remove. A review of the Environmental Impact Statement (EIS) revealed that the maximum allowed size tree for removal in meadows was 10 inches in diameter. The USFS rapidly revised its prescription for the remaining 200 acres of the project, and the next round of monitoring showed that the treatment had met the desired density objectives. That year the Cibola National Forest secured funds to treat the remaining 2,000 acres of meadow restoration identified by the EIS. They implemented the revised prescription across the larger watershed based on the monitoring results.

Data collected by a multiparty monitoring team for the Bluewater Project on the Cibola National Forest in New Mexico revealed that prescriptions were not meeting their objectives. The Forest Service quickly revised its prescription for the remaining acres, which ultimately met desired densities. *Photo courtesy of Forest Guild*

Blending Quantitative and Qualitative Monitoring: White Mountains Stewardship Project

The White Mountain Stewardship Project (WMSP) is a 10-year effort to restore forest health, reduce wildfire risk to communities, and stimulate the wood products industry by implementing vegetation management projects on up to 150,000 acres of the two-million-acre Apache-Sitgreaves National Forests (ASNF) in Arizona. The WMSP multiparty monitoring board has developed and implemented an extensive monitoring plan that uses research-based protocols to measure treatment effects on several ecological, economic, and social conditions. For instance, they are monitoring tree densities, canopy cover, downed woody material, basal area, and height to live crown. They then use these data to calculate crown bulk density and fuel loading and estimate torching and crowning indices with fire behavior models.

Monitoring board members also attend annual field trips to both untreated and treated areas, examining project objectives and results. These field trips are considered part of the monitoring process, and participants are encouraged to share their observations and recommendations. In early years, one major area of feedback from stakeholders was a desire for more clumps and openings to better reproduce historic ecological conditions and improve wildlife habitat. However, the prevailing ASNF perspective at that time was that hazardous fuels reduction objectives should focus on evenly spaced, non-connecting trees and minimal retention of downed logs, snags, and other fuel sources. This, combined with a 16-inch diameter cap across most projects, resulted in a "jail bar" look, i.e., evenly spaced trees of similar size.

Based on the field trip feedback, one district siviculturist incorporated a groupy-clumpy prescription on the 1000-acre Eagar South project to test both fuels reduction and wildlife objectives. While basing the prescriptions on both pre-settlement tree structure theory and northern goshawk management guidelines, he also solicited collaborative group input to treatment design. The treatment incorporated ecological restoration concepts and wildlife habitat as well as fuels reduction needs. The prescription lifted the diameter cap on tree removal but continued to focus on removing smaller-diameter trees. Eagar South was treated as a demonstration project, and in addition to the existing WMSP monitoring protocol, a separate, specialized monitoring plan was developed to track goshawk prey populations, the number of trees over 16 inches in diameter removed, and the difference in tree-marking costs between this treatment and traditional fuels reduction treatments.

Economic monitoring showed that despite the more complex treatment layout and marking, marking costs per acre were similar on both the Eagar South project and a traditional fuels reduction treatment on a comparable site. Volume of material removed was nearly equal to the average across all WMSP projects. The number of trees removed over 16 inches in diameter averaged 0.49 trees per acre, which demonstrated to stakeholders that the lack of a diameter cap did not result in the excessive removal of large, mature trees. Based on the wildlife monitoring results, the board recommended a few treatment modifications, such as leaving more downed woody debris for small mammal habitat. Of all the sites included in the monitoring board's fire behavior analysis, only the Eagar South treatment showed statistically significant improvement in all of the fire variables. Based on initial field observations, monitoring data, and fire behavior models, the ASNF began using similar prescriptions on other projects.

This project marked a turning point for the WMSP. The monitoring board had not anticipated that their monitoring data would result in adaptive management changes until they had accumulated multiple years of post-treatment data. However, with the ASNF's rapid response to verbal feedback provided in the early phases of this project and to the Eagar South demonstration results, mid-project treatments were modified to reflect a multi-objective focus. One monitoring board member observed, "We were successful in adapting management, but not in the way we planned or intended. Sometimes change takes place through conversations, not data collection and analysis."

Different Types of Monitoring Answer Different Questions

Most agencies and businesses conduct implementation monitoring, tracking project operations and outputs to answer the question, "Did we do what we said we would do?" For adaptive management, however, it is necessary to use effectiveness monitoring or validation monitoring. Effectiveness monitoring measures changes in specific conditions relative to desired outcomes to answer the question, "Did we achieve our desired results?" Effectiveness monitoring documents how well management practices are meeting their intended objectives. Validation monitoring, like research, tests underlying assumptions to answer the question, "What caused the observed changes?" Validation monitoring uses careful experimental design to reduce uncertainty about the causes of observed changes.

For example, if a management objective is to reduce noxious weeds, implementation monitoring might track the number of acres treated to remove the weeds, effectiveness monitoring might measure the density of weeds in a management area before and after management, and validation monitoring might sample plots in several managed and unmanaged areas to determine if observed changes in weed density are due to the management actions or other causes.

> *"We were successful in adapting management, but not in the way we planned or intended. Sometimes change takes place through conversations, not data collection and analysis.*
>
> — Stakeholder from White Mountain Stewardship Project

Effectiveness Monitoring

Effectiveness monitoring is commonly used to determine how well management practices are meeting their intended objectives. Effectiveness monitoring tracks change by measuring specific indicators, such as water temperature or user satisfaction, before and after actions are taken. Usually, quantitative methods are used to measure changes in indicators, but qualitative methods such as photographs or interviews may also be used. The number and timing of measurements taken will depend on the indicator being measured and the level of accuracy needed.

Effectiveness Monitoring Process

1. Develop monitoring questions based on project objectives and potential undesirable effects of management actions
2. Choose indicators and methods to answer the questions
3. Develop a monitoring plan, including where and when data will be gathered and how and when it will be analyzed
4. Gather data
5. Analyze data and report conclusions

Qualitative Multiparty Monitoring

While quantitative monitoring and research projects are designed to reliably determine whether specific changes are occurring and why, they often fail to capture changes that are not part of their study design. Because they are less focused on specific indicators of change, qualitative methods can surface important information missed in indicator-based monitoring. Also, qualitative assessments provide immediate feedback that can be used to adjust management, while quantitative effectiveness monitoring and research often take years to produce results. By examining different participants' observations, the multiparty process provides a level of reliability: a convergence of opinions suggests that conclusions are accurate, while lack of agreement suggests more data may be needed. In most cases, qualitative assessments cannot determine the cause of observed outcomes. However, they often are appropriate for evaluating and adapting operations, and can be paired with quantitative effectiveness monitoring or research if there is a need to test conclusions.

Qualitative Multiparty Monitoring Process

- Involve people representing a wide range of perspectives, including people responsible for project development, implementation, and management decisions
- Identify initial project goals and objectives
- Discuss how well efforts met goals and objectives, and why or why not
- Record observations, agreements, disagreements, and recommended actions

Qualitative Multiparty Monitoring: Bankhead Liaison Panel

The Bankhead Liaison Panel uses qualitative multiparty monitoring to track management implementation and effects on approximately 30 restoration sites on the Bankhead National Forest in Alabama. Units were selected to represent different desired future conditions and treatments types, including hardwood, shortleaf pine, and longleaf pine restoration. The monitoring team and agency specialists visit each unit pre-treatment and establish photo points, then revisit the site immediately post-treatment and every few years thereafter to discuss how well it is moving toward desired conditions.

To guide and structure the discussions, the team uses forms developed by Wild South that include a checklist of items to be reviewed and sections for summary comments, follow-up actions, and schedules. If there is no line officer on the trip, the monitoring team coordinator has a follow-up meeting with the district ranger and project interdisciplinary team members to review the forms and discuss next steps. Reports on monitoring tours are also presented at quarterly Bankhead Liaison Panel meetings.

The multiparty field reviews and agreed-upon actions have resulted in changes to treatment prescriptions, particularly marking specifications. Treatments using the new specifications are also monitored to evaluate the effects of new management practices.

The Bankhead Liaison Panel's process of iterative multiparty monitoring reviews and management adaptations is both informed by and informs research. For example, the monitoring team observed that prescribed burns were meeting acreage targets but were not achieving hardwood regeneration goals. Participants hypothesized that burns were not hot enough and suggested changing from dormant-season burns to growing-season burns. Although the Bankhead National Forest had not used growing-season burns in the past, they agreed to experiment with them on some sites. Researchers from Alabama A&M University set up effectiveness monitoring plots on these units so that in the future they will know more definitively whether growing-season burns are improving hardwood regeneration.

Members of the Bankhead Liaison Panel conduct a field review to a restoration site on the Bankhead National Forest in Alabama. Multiparty field reviews and agreed-upon actions have resulted in changes to treatment prescriptions. *Photo courtesy of Wild South*

Change Mechanisms

How can collaborative groups ensure that recommended adaptations get used?

Collaborative groups use a variety of strategies to put management recommendations into action. The two factors most important to making adaptive change are 1) provide clearly stated, specific, and feasible action recommendations and 2) maintain close working relationships with the people responsible for making the change.

Written Records

A written record with specific, clearly stated agreements and action items provides direction for people responsible for decision making and management. Ideally, written records will include responsible parties and schedules or timeline for completion. They also may include rationales to help people understand the reasons for the decisions and an explanation of the assumptions behind the recommendations.

Why Do It

- Clearly identify areas of agreement and disagreement
- Create a record of specific agreements and recommended action items
- State commitment to follow through on agreements
- Build trust that agreements will be kept
- Provide a measure of accountability

Types of written records of agreement include meeting notes, monitoring and evaluation reports, formal recommendations or requests for action, semi-binding agreements, and decision points written into management plans and procedures.

Meeting Notes and Evaluation Reports

Meeting notes provide an important record of both agreements and disagreements. They can be used during scheduled reviews to check whether previously identified issues have been addressed and whether agreed-on actions are being implemented. They also are useful for bringing new partners up to speed on questions that have already been answered and decisions that have already been made. Evaluation reports that clearly state findings and recommended actions similarly can be drawn on to guide future management decisions.

Record of Agreements, Action Items, and Responsible Parties: Dinkey Collaborative

The Dinkey Collaborative's meetings and field reviews fully capture discussions and also flag agreements, action items, and parties responsible for each action item. Joint fact-finding reports describe original areas of disagreement, questions answered through the joint fact-finding process, information sources, assumptions, recommendations, and the level of group agreement with each recommendation. Collaborative group members are invited to sign on to the recommendations or share dissenting views.

Formal Recommendations or Requests for Action

It is helpful to separate recommendations from background material in a shorter document that states agreements, expectations, and requests. Because they are more specific than meeting minutes and monitoring or evaluation reports, action recommendations and requests are more likely to receive a response and be used in management decisions. Some collaborative groups specifically request a formal response from decision makers.

Statements of Support for Specific Actions: Lemhi County Forest Restoration Group and Dinkey Collaborative

Both the Lemhi County Forest Restoration Group (LCFRG) in Idaho and the Dinkey Collaborative provide written letters of support explicitly stating the group's level of agreement with specific proposed actions. For example, the LCFRG sent the Salmon-Challis National Forest's supervisor a memorandum on the Hughes Creek Project that spelled out the group's consensus recommendations regarding the project's purpose and need, priority actions, and preferred standards and methods. The Dinkey Collaborative provides formal letters of individual member support for specific management actions.

Agreement on Action Items: Bankhead Liaison Panel

The Bankhead Liaison Panel's multiparty monitoring field review forms include sections for follow-up actions, schedules, and signatures. In the panel's early years, the district ranger signed these forms during post-field-review meetings. In recent years, as the panel has gained trust that the agency will implement its recommendations, the signature line is less often used.

Semi-binding Agreements

Formal, signed agreements provide a higher level of assurance that agreed-upon actions will be put into practice. Signed charters or memoranda of understanding can specify procedural agreements, such as when and how a collaborative group will participate in planning and project review. Some groups develop and sign statements of dispute resolution. Signed agreements are commonly used when a mediator or an arbitrator is engaged to help resolve a disagreement and when the agreement is resolving a formal objection or appeal.

Signed Management Procedures: Bankhead Liaison Panel

A disagreement between Bankhead Liaison Panel members and Bankhead National Forest staff was resolved through joint development of new forest restoration marking guidelines. The final guidelines were signed by the district silviculturist, who writes treatment prescriptions; the district timber management administrator, who oversees marking crews and contractors; and the district ranger, who holds decision making authority over the project. These three signatures provide assurance that the management changes will be reflected in both treatment prescriptions and future project implementation.

Decision Points in Management Plans and Procedures

Specific management recommendations may be incorporated into management plans and agreements in the form of best practices, decision making criteria, mitigation measures, targets, or trigger points for action. A target is a clearly defined or measurable desired outcome that can help determine whether or not actions are working. A trigger is a predetermined point at which a specific, agreed-upon action will be taken. Targets provide feedback on whether or not management needs to be changed, while triggers direct that a specific change be made. Incorporating agreed-upon management specifications into management plans provides a high level of assurance that they will be used.

Memorandum of Agreement: Lemhi County Forest Restoration Group

The following excerpts from a memorandum of agreement between the Salmon-Challis National Forest and the Lemhi County Forest Restoration Group similarly show a formal commitment to collaborate throughout project planning:

> "The U.S. Forest Service shall … work directly with LCFRG at all phases of the NEPA process, seeking input on: the purpose and need statement, alternatives, collection and use of data, impact analysis, development of preferred alternatives, and/or recommendations regarding mitigation of environmental impacts (Council on Environmental Quality 2011, p.13)."

> "The U.S. Forest Service and the LFRG will work together to develop, discuss, evaluate, and implement innovative landscape-scale planning, project preparation, treatment, science integration, monitoring, and adaptive management strategies."

Members from the Lemhi County Forest Restoration Group conduct aspen tree monitoring. *Photo courtesy of Salmon Valley Stewardship*

Thresholds and Triggers: Blackfoot Drought Response Plan

The Blackfoot Drought Response Plan specifies conservation actions to be triggered when predetermined river flow and temperature thresholds occur. For example:

- If flows in the Blackfoot River fall to 700 cubic feet per second (cfs) at the mouth of the river, the committee notifies irrigators and other consumptive water users and requests that they implement their voluntary drought management plans (this trigger is mandatory for some users with junior water rights).
- If flows drop below 600 cfs and/or maximum daily water temperatures exceed 73 degrees Fahrenheit at the mouth of the river, the state issues mandatory fishing restrictions from 2 p.m. to 5 a.m. and makes additional calls for water from junior water rights holders.
- If flows in the Blackfoot River fall below 500 cfs, all junior water users must cease withdrawals, the committee works with senior water right holders to seek further water conservation measures, and the state issues mandatory all-day fishing restrictions.

Several Blackfoot Drought Committee members have been working together for decades to develop and implement land and water conservation projects in the Blackfoot Basin. Their solid understanding of the resources, array of projects, monitoring data, and function of the Drought Response Plan enables them to quickly coordinate responses to extreme events. *Photo by Ron Pierce, Montana Fish, Wildlife, and Parks*

Decision Making Criteria: Lemhi County Forest Restoration Group

As part of their qualitative socioeconomic monitoring, the Lemhi County Forest Restoration Group (LCFRG) interviewed contractors to understand why the objective of hiring locals was not met. The group then discussed the results of these interviews and determined that the USFS's process for evaluating bids for stewardship agreements and contracts did not adequately address a purpose of stewardship contracting — meeting local and community needs — or the best practices authority. To address this, the LCFRG worked with the Salmon-Challis National Forest to develop best value contract bid evaluation criteria that the USFS grants and agreements staff now uses to review stewardship contracting bids and award contracts. Criteria for technical approach, benefits to the local economy, experience, and past performance have been defined and assigned points that now feed into a contractor's overall bid rating.

Working Relationships

The most common, and arguably most important, change mechanism is individual commitment grounded in relationship-based accountability. Close working relationships characterized by frequent informal communication outside of regularly scheduled meetings provide a mechanism for maintaining agreements and rapidly addressing implementation delays.

Why Do It

- Build capacity for implementing agreements
- Build trust that agreements will be met
- Provide a mechanism for follow-through

Working relationships are built and maintained through regular, informal communication, practitioner networks, and facilitators, and coordinators.

Regular, Informal Communication

Ongoing informal discussion of new information and management practices among people from different organizations creates a cadre of individuals that can facilitate coordinated action. Often, this communication occurs outside of regularly scheduled meetings as individuals from different organizations call on each other for information and advice. Without explicitly focusing on management plans and agreements, these conversations provide a vehicle for tracking implementation of agreed-upon actions and coordinating rapid response to unexpected events.

> *"The most common, and arguably most important, change mechanism is individual commitment grounded in relationship-based accountability.*

Daily and Weekly Discussions: Alleghany Highlands Fire Learning Network

The Allegheny Highlands Fire Learning Network in West Virginia works to coordinate fuels reduction and prescribed burning on a portion of the George Washington-Jefferson National Forests, state lands, and a private inholding owned by The Nature Conservancy (TNC). Their partnership started slowly, with the agencies and the TNC sharing staff and equipment. After five years of working together on project implementation, the group developed a memorandum of understanding to share resources and jointly monitor their projects. Partners hold after-action reviews and annual meetings to review their work, but most coordination takes place during weekly or even daily discussions among agency and TNC project planning and implementation staff, who coordinate their work and give each other feedback on management plans and practices.

Long-term Relationships: Blackfoot Drought Committee

The Blackfoot Drought Committee has several long-standing members who were involved in plan development and have remained involved by both serving on the committee and working with individual water users. Some of them have been working together for decades to develop and implement other land and water conservation projects in the Blackfoot Basin. As a result, each of these individuals has a solid understanding of the condition of resources in the basin, the array of projects under way, monitoring data trends, and the ongoing functioning of the Drought Response Plan. They can stand in for each other when questions are raised, quickly coordinate responses to extreme events, and are comfortable enough in their collective understanding of water management goals and practices in the basin that they are not overly concerned by staff turnover in any one organization.

Project Review Meetings: Bluewater Collaborative Forest Restoration Project

The Wood Industries Network (WIN) was established in 2005 to help develop project-level monitoring plans for the Bluewater Collaborative Forest Restoration Project in New Mexico. WIN participants include Cibola National Forest line officers, project administrators, and resource specialists; harvesters; end-utilization businesses; and conservation groups. Since it was formed, the WIN has met regularly to review monitoring data, discuss lessons learned during project implementation, and discuss planned forest restoration projects on the Cibola National Forest. These discussions have led to changes in restoration contracts and agreements that have stabilized the local restoration industry by making management specifications more cost-effective while still meeting restoration objectives on the ground. When the Cibola National Forest was awarded Collaborative Forest Restoration Landscape funding in 2012, they incorporated the WIN into that project as well.

Discussions among members of the Wood Industries Network for the Bluewater Collaborative Forest Restoration Project have led to changes in contracts and agreements that have stabilized the local restoration industry. *Photo courtesy of Forest Guild*

Practitioner Networks

Collaborative groups often adapt tools and strategies from other agencies, organizations, and collaborative groups for their own use. One way to access these is by participating in communities of practice, where people working in similar areas share ideas, methods, and mutual support. The U.S. National Fire Learning Network (FLN), for example, connects leaders in landscape-scale, multi-stakeholder groups working to restore fire-dependent ecosystems. This group's purpose is not to solve problems or build agreements, but to increase individual and collective capacity through workshops, field learning exchanges, and information dissemination.

The National Forest Foundation's (NFF) Conservation Connect learning network offers web-based peer learning sessions focused on collaboration topics. In the sessions, members of community-based collaboratives and USFS employees share case examples, successful strategies, and lessons learned from negative experiences. Other communities of practice have developed around the USFS's Collaborative Forest Restoration Program (CFRP) and Collaborative Forest Landscape Restoration Program (CFLRP). These two programs fund collaboratively developed forest restoration projects. The CFRP coordinator hosts mandatory annual meetings for all grantees where they share lessons learned. Based in part on relationship build through Conservation Connect peer learning sessions, CFLRP project coordinators have developed their own network to focus specifically on monitoring questions.

Informal and professional networks and umbrella or "bridging" organizations contribute to horizontal information transfer among local groups and vertical information transfer between local groups and policymakers. Knowledge transfer through such networks and organizations helps collaborative adaptive management move beyond incremental, project-level change to incorporate learning into policy and professional practice.

Transferring Learning to Other Landscapes: Allegheny Highlands Fire Learning Network

The Allegheny Highlands Fire Learning Network is part of the Central Appalachian and national Fire Learning Networks. Participants attend regional and national FLN meetings and field trips to learn about other group's projects and practices. For instance, based on work they saw in Tennessee, the Allegheny Highlands group is changing its prescribed burns to better mimic natural disturbance patterns on mountain ridges. The group also based its monitoring protocol on one developed by a FLN group in Arkansas, so they could compare data sets.

Accessing Experts: Lemhi County Forest Restoration Group

The LCFRG is an active participant in the Rural Voices for Conservation Coalition (RVCC), a bridging network in the western United States. The LCFRG reached out to this network when it ran into collaboration challenges. For instance, after their socioeconomic monitoring identified undesired outcomes from the agency's contract bid evaluation process, the group asked the USFS to use best practices criteria to evaluate bids. They also asked to have a collaborative group member sit on the technical review team that evaluates bids. When the USFS Regional Grants and Agreements department raised concerns, the LCFRG reached out to a contracting expert in the RVCC network who showed the USFS the authorities that allowed them to both use the LCFRG's criteria and put a group member on the review team. LCFRG also drew on a lawyer in the RVCC network to help them negotiate an agreement with the USFS to hold a public meeting during National Environmental Policy Act planning so they could discuss the development of alternatives.

Informing Policy: Blackfoot Drought Committee

Blackfoot Drought Committee members maintain ongoing working relationships with the state drought committee, agencies monitoring conditions in the basin, and water managers in other watersheds in the state. When developing the Blackfoot Drought Response Plan, they reviewed plans in use in other watersheds and adapted and expanded on them. Now the Blackfoot plan is being adapted for use in other watersheds in the state. The committee also receives requests from outside the state to see the plan and discuss how it works. The Blackfoot Drought Committee also has influenced state policy through its review and modification of restrictions on anglers. After the committee reviewed temperature and fish stress levels in the Blackfoot and revised their plan, the state adopted a 2 p.m. instead of noon closure on fishing in rivers across the state.

Cross-generational Learning: Bankhead Liaison Panel

The Bankhead Liaison Panel is contributing to cross-generational knowledge transfer by involving forestry students from Alabama A&M University in their meetings and field reviews. Several of these students have research projects on the Bankhead National Forest, and they share their knowledge of forest ecosystem processes and management responses during multiparty field reviews. From interacting with stakeholders on the Liaison Panel, the students also are learning about different management practices and social, political, and economic factors that influence management. This learning is carried back into the classroom and ultimately into their careers as resource managers and scientists.

Facilitators, Coordinators, and Leaders

Even when strong working relationships exist among collaborative partners, it is important to have people assigned the tasks of compiling and synthesizing information, maintaining communication, mediating conflicts, and enforcing agreements. Paid coordinators are usually necessary to maintain communication and institutional memory. Group leaders help effect change by modeling willingness to question assumptions and experiment with new ways of doing business. Neutral facilitators can be most effective at mediating conflicts and reminding participants of their responsibility to group agreements.

Paid Staff: Dinkey Collaborative

Dinkey Collaborative participants say having a professional facilitator to hold everyone to timelines, tasks, and agreements and apply procedural pressure when necessary is instrumental to the group's success. Also, the Sierra National Forest and the Wilderness Society jointly fund a half-time monitoring coordinator who oversees implementation of the Dinkey multiparty monitoring plan. These individuals play important roles maintaining communication, keeping formal records and databases, and ensuring that agreed-upon actions are implemented in ways consistent with member expectations.

Leadership: Lemhi County Forest Restoration Group

When told, "We can't do that," the LCFRG coordinator can be counted on to ask, "Why not?" and then seek new ways to meet the group's goals. For instance, when annual contractor interviews identified a paucity of local residents with adequate forestry skills, she sought funding for and developed a forest worker training program. As described above, she also found legal ways to for the USFS to allow a collaborative group member sit on the technical review team evaluating contractor's bids and to share Environmental Impact Statement (EIS) development between traditional scoping and comment periods. Based on that experience, the LCFRG and Salmon-Challis National Forest developed memorandum of agreement that explicitly calls for collaborative group involvement throughout NEPA development.

The Lemhi County Forest Restoration Group provides written letters of support explicitly stating the group's level of agreement with specific proposed actions. *Photo courtesy of Salmon Valley Stewardship*

Closing the Feedback Loop

What makes or breaks collaborative evaluation and adaptation?

The previous sections, "Effective Evaluation" and "Change Mechanisms" describe strategies and tools that can be used to move collaborative adaptive management forward. Success depends on more than tools, however. Underlying the examples of successful evaluation and adaptation discussed above and in Appendix I are a willingness and ability to engage in shared learning and adapt management based on what has been learned. Ultimately, these are the keys that "close the feedback loop."

Individual Willingness to Experiment and Learn

In addition to committing their time to developing and maintaining working relationships, participants in collaborative adaptive management need to be willing to set aside pre-determined positions and consider new approaches to allow the group to evaluate and adapt. All participants need a capacity to give and receive criticism, which will help them consider different worldviews and management approaches. This is particularly important when evaluation goes beyond effectiveness monitoring to rethinking program or project purposes, rules of operation, or underlying assumptions.

Viewing policies and practices as experiments requires a shift in perspective for many people. In resource management, mistakes tend to be viewed as failures and people want to avoid drawing attention to them. This attitude is logical, as regulatory agencies, funders, interest groups, and the public all scrutinize resource management decisions to guard against negative outcomes. Yet it is the direct opposite of the experimental attitude espoused for adaptive management, which would embrace undesirable outcomes as important feedback that can inform future planning and management actions. Willingness to experiment means developing a tolerance for small failures.

> *"Willingness to experiment means developing a tolerance for small failures.*

As the rapid assessment examples have shown, a willingness to set aside tried-and-true practices and policies and consider something new creates space for rapidly identifying and addressing problems and developing more effective management solutions.

Spirit of Experimentation: White Mountains Stewardship Project

A member of the White Mountain Stewardship Project multiparty monitoring board observed that it was important for all partners to have a "spirit of experimentation." The Apache-Sitgreaves National Forests had staff willing to modify treatments within NEPA guidelines to demonstrate alternate prescriptions. The monitoring board was essential to help solicit support from all interested stakeholders for experimenting with different treatments on a small scale, and to ensure that feedback and monitoring would improve future management options.

Organizational Commitment to Collaboration and Adaptive Management

Collaborative adaptation can occur without affecting mandates, decision making authorities, or accountability. However, it does require that decision makers invite other stakeholders into their decision space to help develop and evaluate alternative approaches to resource management. Collaborative groups expect to play a substantive role in crafting management questions and goals, evaluating results, and recommending changes. Trust is built through decision makers' ongoing participation in collaborative group meetings, willingness to dedicate staff time to the effort, and follow through on agreements. In most cases where collaborative adaptive management has been successful, decision makers have made an explicit commitment to seriously consider and, where feasible, use input from collaborative group deliberations. Some agency leaders include the quantity and quality of their employee's interactions with colleagues in their performance evaluations.

Programs that provide assured funding and long-term commitments, such as a 10-year stewardship contract or 10-year Collaborative Forest Landscape Restoration Program (CFLRP) awards, help agencies and collaborative groups implement agreements. Lack of assured funding is a notorious constraint to collaboration, monitoring, and adaptive management. Proponents of collaboration and adaptation recommend viewing the money invested in these processes as an investment in improved resource management, rather than an unwelcome drain on limited resources.

Dedicated Time and Funding: White Mountains Stewardship Project

A White Mountain Stewardship Project multiparty monitoring board member notes that success boils down to people who are willing and committed to exploring management options and ensuring that adequate monitoring occurs. In their case, the forest supervisor attended every monitoring board meeting and allocated dollars and resource specialists' time to monitoring.

Management Flexibility: Blackfoot Drought Committee

The Blackfoot Drought Response Plan describes specific actions to be triggered when water flow and temperature thresholds are reached. In practice, however, the multi-stakeholder Drought Committee discusses and mutually agrees when the plan should be implemented based on their assessment of social and economic as well as a range of river conditions. Because plan implementation depends on goodwill among all participants, effectively maintaining flow in drought years in large part depends on maintaining positive working relationships among all parties, particularly between the Drought Committee and senior water rights holders who are not subject to mandatory restrictions. Therefore if water flows at the mouth of the river drop below the trigger point in late summer, the committee may decide not to implement the plan because they are approaching the fall season when farmers irrigate less and temperatures are cooler. Committee members emphasize the importance of being flexible in the short term to stay on course for the long term: what's important is not rigid application of triggered actions, but keeping water in the system and restoring fisheries in the long term.

Commitment to Monitoring and Evaluation: Dinkey Collaborative

For the Dinkey Collaborative, a USFS commitment to use research and monitoring results in project planning and adaptation is requisite for allowing management to move forward. This commitment reassures members that treatment effects will be carefully evaluated and changes will be made if there are undesirable outcomes. Experimental research and monitoring are important to this group because they provide a high level of confidence that restoration treatment results are due to management actions. The incremental process of field reviews and adjusting management is equally important, however, because it builds trust and allows ongoing management improvements without having to wait for long-term monitoring and research results.

> *"Proponents of collaboration and adaptation recommend viewing the money invested in these processes as an investment in improved resource management, rather than an unwelcome drain on limited resources.*

Photo by Marcus Kauffman

Achieving Collaborative Learning and Adaptation

As the examples in this sourcebook demonstrate, collaborative resource management groups can and do engage in mutual learning and evaluation and improve management based on what they have learned. The sections above describe several tools and strategies collaborative groups can use to evaluate and improve their work. Successfully implementing these requires individual and organizational capacity for mutual learning, experimentation, and change.

The processes described in this sourcebook were drawn from rapid assessments of nine collaborative resource management groups and from literature on organizational and shared learning, adaptive management, and utilization-focused evaluation. Appendix I provides an introduction to this literature. More detailed examples of strategies and tools are available in Appendix II and Appendix III.

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Appendix I. Conceptual Foundations

Table of Contents

Conceptual Foundations

The strategies and tools described in this sourcebook are supported by concepts from social and organizational learning, adaptive management, adaptive governance, and utilization-focused evaluation. Several of these ideas were introduced in the body of the sourcebook. The summaries below do not constitute a comprehensive literature review, but provide an introduction to sources that describe the concepts more fully.

Organizational and Social Learning

The goals of organizational learning are to avoid past mistakes, improve performance, highlight best practices that can be used elsewhere, and influence strategic thinking and policy through lessons learned from practical experience.[1] Organizational learning involves iterative, structured, and collective reflection on practice to improve performance. "Learning organizations" use a variety of approaches to encourage their employees to reflect on organizational objectives and means of achieving them.[2] One key strategy is to build knowledge through ongoing discussions among individuals with different information, experiences, and perspectives. In addition to providing a more robust knowledge base, expanding learning beyond a few key individuals builds organizational capacity by putting that knowledge into many hands.[3] Ongoing, practical interaction also helps managers make tacit knowledge explicit: to share the things that they know but don't ordinarily articulate, such as where they go for a particular type of information or how to complete a particular task.[4]

The social learning concept currently popular in collaborative resource management literature builds on organizational learning with concepts from conflict resolution. Social learning occurs through deliberation and information sharing among people with different experiences and perspectives.[5] According to the social learning literature, engaging in repeat interactions that build relationships and trust helps participants let go of routine, habitual ways of working and develop a collective capacity to reduce conflict, take risks, challenge individual perceptions, make better decisions, and change behavior.[6] Because it focuses on inter-organizational exchange through informal and formal networks, social learning can lead to learning and change not only at the individual and organizational levels, but also in public policy and professional practice.[7]

Intentional Learning

Building knowledge to improve processes or programs requires more than an ad hoc approach to learning. Most adult learning is experiential, meaning it comes not from focused study but when work is being implemented.[8] Capturing and applying such learning requires purposeful efforts to surface and examine different views, encourage deliberation, and test assumptions.[9] Employees in learning organizations are guided to look for opportunities to experiment and learn, develop tolerance for small failures, and be willing to postpone evaluation until ideas are fully formulated.[10] Learning organizations also invite people from outside of their project teams and outside of their organizations to share experiences and information.[11] Organizational and social learning are more than the sum of individual learning; they require discussion and debate to appraise individual learning and develop recommendations for change.

Modes of Learning

Learning theory differentiates between instrumental learning — gaining new skills, information, and communicative learning — learning about values, intentions, and working together.[12] Literature on shared learning in collaborative resource management posits that both kinds of learning are necessary to bring about changes in knowledge and behavior.[13] Organizational learning further differentiates between single-loop, double-loop, and triple-loop learning[14]:

> Single-loop learning is incremental improvement of skills and capabilities, often through formal study. In essence, single-loop learning is focused on the question, 'Are we doing it right?'
>
> Double-loop learning questions the purpose and function of work being done by looking at patterns and examining cause-effect relationships. In double-loop learning, the question is, 'Are we doing the right things?'
>
> Triple-loop learning, also known as transformational learning, involves questioning underlying beliefs, values, and worldviews, causing participants to critically assess their own assumptions.[15] Triple-loop learning asks, 'How do we define *right*?'

In other words, learning that improves management involves not only accessing and understanding the best available science and management practices. It also requires developing a habit of questioning assumptions and a willingness to learn about and from other people's beliefs and opinions. Managers need to develop a capacity for and tolerance of constructive criticism, which will help them be open to new information and approaches.[16] In the collaborative resource management context, scientists, managers, planners, and the organizations of which they are a part must be willing to open their assumptions and their work to scrutiny.[17]

Learning Strategies

Two tools for encouraging learning are communities of practice and after-action reviews. A community of practice is a group of people who share common experiences or management objectives and interact regularly to learn from each other and improve their work.[18] Communities of practice provide a "place" for people working on similar issues to share problems, strategies, and tools.[19] Through regular interaction, participants build their individual and collective knowledge and capacity to change.[20] The after-action review, a practice developed by the U.S. Army, is a tool used to capture experiential learning.[21]

Adaptive Management

Adaptive management is a structured process of evaluating resource management actions and applying what is learned.[22] The underlying premise is that there will always be some uncertainty about management effects, but projects can move forward based on what is currently known as long as they are monitored to learn whether they are resulting in desired outcomes or having unexpected effects.[23] It requires institutional flexibility so management decisions can be adjusted as conditions change and more information becomes available.[24]

Treating Actions as Experiments

Approaches to adaptive management range from scientific research to a general sense of "learning as you go." The basic process is to treat policies and management actions as experiments and embrace undesirable outcomes as important feedback that can inform future actions.[25]

Adaptive management is an ongoing process of defining objectives, taking action, monitoring and analyzing outcomes, and applying what was learned to the next round of planning and management.[26] Both the learning and the action components are necessary. As Stankey et al. (2005) put it, "learning involves more than increasing the stock of facts: it suggests we know what needs to be done, how to do it, whether it worked, and how to apply" it, while "action that lacks a base in improved knowledge is little more than hopeful activity."[27]

Methodological Debates

Adaptive management depends on monitoring — periodically and systematically gathering and analyzing data to understand trends over time. Many different methods can be used, as long as they are reliable, meaning that different people using the same method would obtain similar results; feasible given available resources; and produce useful results.[28]

Advocates of a scientific approach to adaptive management insist that management decisions should be treated as hypotheses, and monitoring methods should include statistically representative sampling designs and controls to determine whether observed effects are due to management actions.[29] As one researcher has written, "An experimental approach may be costly and onerous in the near term, but it is probably the only way to root out superstitious learning — erroneous connection between cause and effect."[30] However, the expense and logistics of implementing such research-based management means that it has rarely been achieved in practice.[31]

Others say the expectation that basing management adaptations on research is not practicable, and in many cases causality will be clear.[32] Most practitioners prefer to rely on non-experimental monitoring methods rather than scientific experimentation, because the costs of research-level monitoring are too high and the incentives too low to justify investing in it.[33] A common quantitative monitoring method is to identify indicators of change and measure them before and after an action is taken without attempting to use randomized sampling or controls. When indicators are measured using appropriate protocols and instruments, this method provides a relatively high level of confidence that observed effects are real and not a reflection of expectations or other observer bias.[34]

Qualitative monitoring methods include repeat photographs at established photo points, interviews, and multi-stakeholder evaluation processes such as after-action reviews.[35] Like quantitative methods, qualitative methods can use pre-, post-, and time-series measurement to identify relationships between interventions and effects. Using a social science research tool, triangulation, which cross-examines information from different sources, can help overcome observer bias and "superstitious learning."[36] A convergence of data from different sources or gathered using different methods provides a form of quality control, while lack of agreement suggests more data may be needed.

Joint Evaluation

Multiparty evaluation is important to ensure that monitoring results are accurately interpreted and appropriately used. Early adaptive management literature called for joint evaluation by scientists, policymakers, and resource managers.[37] More recent literature calls for including other stakeholders in the evaluation process to incorporate social values and experiential knowledge in evaluation and decision making.[38]

Adaptive Governance

Adaptive governance focuses on the social structures and processes needed to support social and political learning, innovation, and an ability to rapidly adapt to abrupt change. These social structures and processes include relationships that link individuals, organizations, and agencies at multiple levels.[39]

To identify innovations and use them to change policies and practices, adaptive governance, like organizational and social learning, requires communication, debate, and a willingness to rapidly change course when new opportunities or problems arise.[40] Like adaptive management, adaptive governance relies on monitoring and encourages experimenting with a diversity of policies and management approaches to foster innovation and experimentation.[41] The communication, coordination, and innovation required for adaptive governance are facilitated by informal networks, bridging organizations, and transformational leaders.

Informal Networks and Bridging Organizations

Informal or "shadow" networks are a key aspect of adaptive governance systems, because they provide opportunities for participants to share information and experiences, identify knowledge gaps, strategize creative solutions to resource management problems, and create nodes of expertise — all outside of the institutional constraints and scrutiny that can limit learning in formal networks and organizations.[42] Ongoing participation in informal networks has been found to build a "culture of consultation" among organizations that facilitates inter-agency response to unplanned events. [43]

Bridging organizations that engage multiple groups and levels of government also help transfer innovations and scale up local adaptations.[44] These organizations, typically umbrella groups of non-governmental organizations, corporations, and/or government agencies, are independent entities with their own missions and goals but seek to incorporate the values and knowledge of all of their member organizations.[45] Bridging organizations facilitate change by building horizontal linkages among diverse organizations at the local or regional level and vertical linkages between grassroots organizations and policy-makers.[46] Through these linkages, they serve as vehicles for information exchange and learning, manage conflicts and negotiate cooperation, and may engage in advocacy to influence policy or professional standards of practice.[47]

Transformational Leaders

Effective leaders for adaptive governance integrate diverse ideas and viewpoints, manage conflict and build trust among people with different perspectives, and model and teach reflective learning and experimentation.[48] Such leaders help transform traditional practice by fostering a learning environment that helps practitioners and decision makers critically and creatively examine different ideas and practices.[49]

Utilization-focused Evaluation

Evaluation reports that simply summarize actions taken or critique performance without offering solutions are not conducive to improving management decisions. Utilization-focused evaluation puts program evaluation in an action framework by engaging the expected end-users of the results in the evaluation process, making it particularly applicable to shared learning and adaptive change. The goal of utilization-focused evaluation is to provide concrete, actionable results that can feed directly into policy, planning, or management decisions.[50]

Criteria for selecting utilization-focused evaluation questions and methods are that they be useful, feasible, ethical, and accurate. While it is important that the evaluation be data-based and use accepted methods, usefulness of the results is more important than methodological rigor (experimental designs, quantitative data, and sophisticated data analysis).[51] Key stakeholders select the questions to be answered and appropriate evaluation methods through face-to-face discussions.

Research has shown that one of the most important factors in determining whether or not evaluation results are used is the "personal factor:" engaging interested, committed, assertive people, including the primary intended users.[52] In addition to helping ensure that results are used, involving key stakeholders in the evaluation process builds their capacity for both evaluative thinking and making change. The process itself may result in changes in individual assumptions and behavior and in organizational procedures and culture.[53]

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Appendix II. Closing the Feedback Loop: Case Summaries

Table of Contents

BANKHEAD LIAISON PANEL

The Bankhead Liaison Panel formed in 2000 to address conflicts on the Bankhead National Forest in Alabama and provide input to the Bankhead Forest and Restoration Project and decision. Panel members include representatives from environmental and conservation groups, recreation interests, cooperative extension, local tribes, and a research university, as well as representatives from other state and federal agencies. The group's long-term goal, and the goal of the 2004 Revised Land and Resource Management Plan (RLRMP) for National Forests in Alabama, is to restore native forest communities, including several types of fire-adapted forest communities. The panel worked closely with Bankhead National Forest line officers and resource specialists to develop the 16,500-acre Bankhead Forest Health Restoration Project. The group remains involved in project implementation and review through quarterly meetings and qualitative field reviews, which have led to changes in treatment prescriptions and marking guidelines.

Learning and Evaluation Processes

Qualitative Multiparty Monitoring

The restoration monitoring team evaluates silvicultural treatments, such as various types of thinning and timber stand improvement, prescribed burning, reforestation, and ecotype conversion treatments, using photo points and qualitative field reviews. The field reviews are attended by a subset of the Liaison Panel, resource specialists from the Bankhead National Forest, and sometimes the district ranger. Often other researchers, including university professors and students and U.S. Forest Service (USFS) Southern Research Station scientists, also participate.

The monitoring team tracks approximately 30 restoration sites from the Bankhead Forest Health Restoration Project and two subsequent watershed projects. Monitoring sites were selected to represent different desired future conditions and treatments types, including hardwood, shortleaf pine, and longleaf pine restoration. The monitoring team and agency specialists visit each unit pre-treatment and establish photo points, then revisit the site immediately post-treatment and every few years to discuss how well it is moving toward desired conditions.

To guide and structure the discussions, the team uses forms developed by Wild South that include a checklist of items to be reviewed and sections for summary comments, follow-up actions, and schedules. If there is no line officer on the trip, the monitoring team coordinator has a follow-up meeting with the district ranger and project interdisciplinary team members to review the forms and discuss next steps. Reports on monitoring tours are also presented at quarterly Bankhead Liaison Panel meetings.

The multiparty field reviews and agreed-upon actions have resulted in changes to treatment prescriptions, particularly marking specifications. For example, on early site visits the team observed that prescriptions were based on old databases and did not reflect current species composition. Now the timber management assistant ground-verifies all stands before layout and marking to see if there are hardwood inclusions in former pine stands or other features that may need special attention.

On one early treatment where the desired condition was open pine woodland restoration, the prescription called for removing most understory and mid-story trees. When the monitoring team visited the site post-treatment, some participants objected to the visual effect of removing smaller hardwoods, especially dogwoods and other soft mast species. The silviculturist agreed to change future prescriptions to retain all dogwoods greater than four inches in diameter and designate clumps of smaller dogwoods for retention. These changes have been incorporated into the revised marking guidelines that are now applied across the Bankhead National Forest. On other units, the team thought early treatments were leaving stands overstocked and sub-optimal for forbs, grasses, wildlife habitat, and carrying wildfire. Based on this observation, marking was changed from cut-tree to leave-tree marking and later treatments have better met basal area targets.

More recently, a disagreement between USFS staff and collaborative team members led to joint development of new marking guidelines for treatments in loblolly pine stands where the desired future condition is hardwood forest. The revised marking guidelines were developed over the course of several field reviews and Liaison Panel meetings and formally adopted by the district.

On another unit where the goal was to restore the oak woodland community by releasing hardwoods, after repeated monitoring visits over about eight years the group agreed that the treatment was not successful: loblolly pine instead of hardwoods were regenerating. After repeated visits, the USFS silviculturist suggested that this site was probably not suited to hardwoods. The group agreed, and the management objectives for this unit were changed to longleaf pine restoration.

Research Review

Project planning, implementation, and monitoring are informed by ongoing research on the forest and through research presentations and discussions at quarterly Liaison Panel meetings. Since 2005, Alabama A&M University's Center for Forest Ecosystem Assessment and the USFS

Southern Research Station have been conducting research on the Bankhead National Forest to study effects of anthropogenic and natural interventions on forest ecosystems. Although these are long-term studies and results are considered preliminary, initial data suggest that several forest treatments are moving the ecosystems toward desired conditions. A professor from Alabama A&M University sits on the Liaison Panel and the monitoring team and often brings students to meetings and field tours.

Researcher participation has helped the group reach agreement on management changes. Team members observe that skeptics are more willing to experiment with treatments when they know scientists are assessing the outcomes, and managers are more willing to accept the group's recommendations when scientists participated in the reviews. In addition, students attending the field tours have helped with data management by taking GPS coordinates of photo points and creating spreadsheets to track evaluations over time.

The qualitative multiparty monitoring reviews have informed research as well. Participants observe that there seems to be a merging of qualitative multiparty reviews and quantitative research through adaptive management. The research projects are designed to reliably determine what changes are occurring and why, using specific metrics. By taking a much broader focus, the multiparty monitoring trips sometimes raise significant issues outside of ongoing research. For example, the monitoring team observed that prescribed burns were meeting acreage targets but were not achieving some hardwood regeneration and woodland restoration goals. The group hypothesized that burns were not hot enough and suggested changing from dormant-season burns to growing-season burns. Although the USFS had not used growing-season burns in the past, they agreed to experiment with them on some sites. Researchers from Alabama A&M University set up monitoring plots on these units so that in the future they will know more definitively whether growing-season burns are more effective.

Change Mechanisms

In almost all cases, adaptive changes are made based on group discussions and verbal agreements made on field reviews and in panel meetings. Observations and action items are written on the monitoring field review forms, discussed at Liaison Panel meetings, and then implemented by the USFS. At times, formal signed agreements have been used when the panel felt a need for added accountability.

Formal Agreements

The district ranger, either in the field or in a follow-up meeting, verbally agrees to action items written on the field review forms. The form includes date lines for when monitoring team consensus was established and when observations were presented to the district ranger, a signature line for district ranger agreement to follow-up actions and schedules, and a return inspection date line. In early years, the district ranger signed the forms during post-field review meetings. In recent years, however, the team has not used this formal procedure and changes are implemented through mutual verbal agreement.

When staff turnover resulted in a difference of opinion between agency staff and monitoring team members, the panel again used a formal agreement to build trust. The revised marking guidelines jointly developed by the agency and the Liaison Panel were signed by the district silviculturist, who writes treatment prescriptions; the district timber management assistant, who oversees marking crews and contractors; and the district ranger, who holds decision making authority over the project. These three signatures provide assurance that the management changes will be reflected in both treatment prescriptions and implementation on future projects aiming to restore hardwood forest in loblolly stands.

Working Relationships

Through years of working together, the Liaison Panel and USFS staff have come to an understanding that verbally agreed-upon actions will be made and any deviations from planned actions will be discussed with the panel. Trust and accountability are based on ongoing working relationships.

When there is staff turnover at the USFS, Liaison Panel members meet with the new employees to explain the long-term goals of the Bankhead Forest Restoration Project and the Liaison Panel process and expectations. The USFS has worked to ensure that the panel membership reflects the full range of knowledge and perspectives on forest management, as well as community stakeholder interests.

One participant points to the USFS's willingness to be flexible and experiment as a key to successful change. The agency modifies treatments to meet different participant's needs as long as they can do so without taking too much away from the overall goal. Additionally, the agency works with researchers to design experimental treatments.

Appeals and Litigation

Before the Liaison Panel was created, forest management on the Bankhead National Forest was mired in appeals and litigation. There have been no appeals or litigation of Bankhead Project Environmental Assessments, and participants attribute this to the trust built through good-faith

implementation of collaborative agreements. Some Liaison Panel members observe that without an effective collaborative process, appeals and litigation could be fallback change mechanisms if agreements are not kept.

Information Transfer

Some Bankhead Liaison Panel members have shared their work at professional conferences and meetings and at Southern Appalachian Fire Learning Network practitioner meetings. Agency staff and panel members have shared the group's work with the USFS Collaboration Cadre. Groups like Wild South, who are involved in restoration and collaboration efforts throughout the region, help sustain informal information transfer throughout the South.

Perhaps the most significant way that learning and adaptations are disseminated is ongoing student participation in the monitoring field reviews and at Liaison Panel meetings. Several Alabama A&M University students have research projects on the Bankhead National Forest evaluating the effects of changing from production-oriented forestry to management for ecosystem health and ecosystem services. From interacting with stakeholders on the Liaison Panel, they are also learning about different perspectives on what that means and how to get there. All of this learning is carried back into the classroom and ultimately into their careers as resource managers and scientists.

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BLACKFOOT DROUGHT COMMITTEE

The Blackfoot Drought Committee in Montana's Blackfoot River Basin was established in 2000 to address declining fisheries and inequitable distribution of water resources during drought periods. The Big Blackfoot Chapter of Trout Unlimited; Montana Fish, Wildlife, and Parks (FWP); the U.S. Fish and Wildlife Service's Partners for Fish and Wildlife; and private landowners had been working together for more than 20 years to inventory conditions in the river and its tributaries and implement water conservation and restoration projects.

In the late 1990s, there were conflicts brewing in the state capitol over FWP's enforcement of its instream flow right. This right, known as the Murphy Right, was established January 6, 1971 and allows the state to require people with "junior" (newer) water rights to reduce or stop their water use, including irrigation, when flows are not adequate to meet the level of the instream flow water right. Prior to 2000, FWP had been enforcing the Murphy Right on approximately 12 irrigators in the lowest reach of the river. This limited enforcement did not affect water flow from the upper reaches that are a primary source of water. Also, imposing restrictions on only a subset of 49 junior water rights holders in the Murphy Right sections of the river placed severe economic strains on those irrigators.

The Drought Committee was formed through an effort of FWP, Trout Unlimited's Montana Water Project, and Blackfoot Challenge, a cooperative conservation group made up of private landowners, state and federal agencies, and non-governmental organizations. Blackfoot Challenge invited local landowners to meet with FWP to help develop a solution to the fisheries decline through water management in drought years. The Blackfoot Drought Response Plan, based on the goal of watershed-wide restoration of fishery resources and "shared sacrifice" among all water users, grew out of these discussions. The Blackfoot Drought Committee, with representatives from the Blackfoot Challenge, Trout Unlimited, FWP, U.S. Fish and Wildlife Service, the Montana Department of Natural Resources, irrigators, and outfitters, was created to oversee plan implementation.

Under the Blackfoot Drought Response Plan, participating junior and senior water rights holders voluntarily reduce their water use when flows at the mouth of the river drop below 700 cubic feet per second (cfs). The Drought Response Plan is tiered to more than 100 individual drought management plans that lay out how and where irrigators will reduce their withdrawals. These individual management plans allow irrigators more flexibility than simple calls on junior water rights. For instance, an irrigator may choose to reduce their withdrawals by agreeing not to run all pivots at one time or by shutting down senior instead of junior rights, as long as the net result is reduced withdrawal from the river. In a few cases people with junior rights but no senior rights trade off with other landowners who have senior rights. Water flow triggers are used to determine when irrigators apply their drought response measures. The Drought Response Plan also limits angling during low-flow and high-temperature periods.

Learning and Evaluation Processes

Committee Process

The Drought Committee applies the Drought Response Plan through an iterative process of reviewing monitoring indicators, communicating with plan participants, implementing the plan, and reviewing and refining plan implementation.

From January through May, the committee meets at least monthly to monitor drought indicators, including snow pack, soil moisture, and the Surface Water Supply Index. Approximately every two weeks they receive a projection for that year based on regression analysis of historical records and current snowpack and flows at gages. If, based on their review of monitoring data, the committee decides that significant water shortage is expected, they notify irrigators and anglers that the Drought Response Plan may be put into effect that year and conduct a variety of public outreach activities. One goal of this early outreach is to help irrigators plan crop and cattle rotation to reduce economic impacts of reduced withdrawals later in the season.

Throughout the year, the committee identifies and pursues opportunities to initiate long-term conservation actions. The Drought Committee has helped irrigators obtain soil moisture sensors, calculate their water flow rates, and assess the feasibility of long-term conservation measures such as ditch lining and piping; converting flood irrigation to sprinklers; installing bypasses to return excess water to the river; and installing fish ladders, screens and diversions. Blackfoot Challenge has engaged an irrigation consultant to help landowners irrigate more efficiently. The irrigation specialist works one-on-one with each irrigator and sends out weekly reports on current growing conditions and recommended irrigation strategies.

From June through September, the committee meets approximately weekly to review stream flow, precipitation, water temperature, and biotic monitoring data. If the committee expects drought based on their analysis of the monitoring data, water users are contacted to confirm that they will participate in the drought response. If pre-determined flow thresholds are reached, the committee announces that the drought plan is in effect and specific conservation actions are triggered.

Plan Implementation

Although the plan describes specific actions to be triggered when water flow and temperature thresholds are reached, in practice plan implementation is determined through committee discussions that take into account social and economic factors as well as a range of river conditions. Because implementation of the Drought Response Plan depends on goodwill among all participants, the Drought Committee focuses on long-term over short-term goals. For instance, if water flows at the mouth of the river drop below 700 cfs in late summer, the committee may decide not to engage the plan because they are approaching the fall season when farmers irrigate less and temperatures are cooler.

Implementation requires ongoing outreach and communication to maintain participation and bring new angling outfitters and new irrigators into the plan. For instance, one year there were conflicts between anglers and irrigators over the level of restrictions on different users: anglers observed irrigation pumps running when they were called off the river, and irrigators who had shut off all irrigation saw anglers in the river. The Drought Committee organized angler-irrigator meetings to address these issues so everyone understood that plan implementation for some irrigators means reducing but not shutting down irrigation, and for anglers, fishing restrictions are a function of water temperature as well as flow.

Plan Review and Revisions

Each fall, the Drought Committee holds a year-end meeting where monitoring indicator data, drought plan participation, amount of water conserved, and outreach activities are reviewed and possible changes discussed. Over time, technical assistance has been expanded, response requirements have been revised, and additional levels of response have been added. Individual drought management plans also are reviewed and revised annually.

For instance, the Drought Response Plan originally allowed fishing only from midnight to noon when the river dropped below 700 cfs. When anglers observed that the water wasn't reaching temperature stress levels until later in the afternoon and complained that they were losing business, the committee reviewed FWP's monitoring data, including the time of day when peak temperatures were reached in different parts of the river system. They found that peak temperatures were not reached until about 4 p.m., and so changed the closure to anglers from noon to 2 p.m. when flows drop below 700 cfs and temperatures below 70 degrees Fahrenheit at the mouth of the river.

Within the next 10 years, a 1904 water right, the Milltown right, will likely be transferred to and jointly managed by FWP and the Confederated Kootenay and Salish tribes for instream flow. The Milltown Right will affect irrigators junior to 1904 in the Clark Fork Basin and in upper reaches of the Blackfoot River system. The addition of the Milltown right will require additional review and revision of the Blackfoot Drought Response Plan.

Change Mechanisms

Thresholds and Triggers

The Drought Response Plan sets out a series of actions that will be triggered when flows hit pre-determined thresholds. For instance, when flows drop below 700 cfs, the Drought Committee will notify participants that the plan is active and request that they implement their individual plans. Participating senior water rights holders voluntarily reduce their water use. FWP and other committee members personally contact junior water rights holders and conduct field checks to confirm that junior users are participating. If flows are below 700 cfs and water temperatures are greater than 73 degrees Fahrenheit for three consecutive days, mandatory fishing restrictions come into effect. When the Blackfoot River falls to very low levels (<500 cfs), all junior rights holders are asked to stop irrigation and angling restriction are imposed on the river and key tributaries.

Monitoring

The drought committee itself does not monitor implementation beyond observing whether plans are implemented and anglers are in compliance. There is considerable biophysical monitoring in the basin, however, and drought plan implementation and revision are heavily dependent on monitoring data. FWP and the Big Blackfoot Chapter of Trout Unlimited measure water temperatures, fish habitats, and fish populations. The State Department of Natural Resources and Conservation and U.S. Geologic Survey monitor snowpack and water flows. FWP and Trout Unlimited also track conservation and restoration projects and the effectiveness of instream flow enhancement projects.

The following illustrates the importance of monitoring data for effective management. In 2001, flows in the North Fork of the Blackfoot dropped so low that bull trout, a federally threatened fish, were stranded in pools. The North Fork is important to bull trout spawning in the Blackfoot Basin, so in an emergency effort, the FWP captured the fish and immediately trucked them below the low flow area. In 2003, when projections were for equally low flows, the FWP, working with the Drought Committee, asked all irrigators on the North Fork for their help. Irrigators agreed to let the agency measure flows in every irrigation diversion as well as in the river. When the river reached 9 cfs while there were 22 cfs running in irrigation diversions, all irriga-

tors agreed to shut down for one week. After that week, river flow had increased to 23 cfs and two radio-tagged fish had migrated out. As a result of that experience, late-season flow and diversion monitoring is now part of the Drought Committee's drought analysis. In future, the committee may implement diversion monitoring elsewhere in the basin to determine whether drought plan goals are being met.

Shared Decision Making

As the previous example illustrates, effectively maintaining flow in drought years in large part depends on maintaining positive working relationships among all parties, particularly between the Drought Committee and irrigators not subject to the Murphy Right. The desire to maintain goodwill among all cooperators is one reason the Drought Committee does not always call on irrigators to implement their drought plans when the 700 cfs threshold is reached. Committee members emphasize the importance of being flexible in the short term to stay on course for the long term. What's important is not rigid application of triggered actions, but keeping water in the system and restoring fisheries in the long term.

Drought Committee members point to two factors that make the plan effective: users were invited to help craft the management plan and from the start FWP has been willing to work with users to seek alternatives to formal calls on water to maintain instream flow.

In recent years there has been increased funding available for water conservation and restoration projects on private lands in the basin. Drought Committee members hope that participation in the Drought Response Plan will help build and sustain users' commitment to restoration goals, so that conservation efforts are maintained and expanded in the future when less funding is available.

Enforcement

Depending on flow and water temperature conditions, the state retains its authority to enforce its water right on junior rights holders and close areas to fishing, but generally relies on the concept of shared sacrifice rather than formal enforcement to maintain compliance. If they become aware of a rogue irrigator or angler, Drought Committee members will go talk with them one-on-one. In its effort to maintain drought plan participation, the state tries to avoid threat of formal call on their water.

Information Transfer

Drought Committee members maintain ongoing working relationships with the state drought committee, agencies monitoring conditions in the basin, and water managers in other watersheds in the state. When developing the Blackfoot Drought Response Plan, they reviewed plans in use in other watersheds and adapted and expanded on them. Now the Blackfoot plan is being adapted for use in other watersheds in the state. In future, with transfer of the Milltown water right, the tribes and the state plan to engage with stakeholders in the Clark Fork Basin and develop a drought management plan modeled after the Blackfoot Drought Response Plan. The committee often receives requests from outside the state to see the plan and discuss how it works.

The Drought Committee also has influenced state policy through its review and modification of restrictions on anglers. After the committee reviewed temperature and fish stress levels in the Blackfoot and revised their plan, the state adopted the 2 p.m. instead of noon closure on fishing in rivers across the state.

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DINKEY COLLABORATIVE

The Dinkey Collaborative was created in 2010 with the initiation of the Dinkey Landscape Restoration Project (DLRP) on the Sierra National Forest (SNF) in California. The DLRP covers 154,000 acres, including approximately 130,000 acres on the SNF and 20,000 acres of private land owned by Southern California Edison. The SNF works with the Dinkey Collaborative to implement the DLRP. Collaborative group members include representatives from local government, forest industry, environmental organizations, California Native American tribes, local landowners, recreational organizations, and public resource management agencies.

The collaborative puts a premium on science-based adaptive management. Several collaborative group members consider all forest management on the DLRP landscape to have high risk and a low margin for error because of potential impacts on ecosystem health. There is particular concern about impacts to the Pacific fisher (Martes pennanti pacifica), whose population viability is in question. At the same time, environmental groups that formerly appealed and litigated forest management recognize that with no management, habitats and populations of concern may be lost to fire or beetle kill. Other collaborative group members are frustrated by the lack of management in recent years and concerned about maintaining the workforce and the infrastructure needed for forest restoration. Thus, there is high motivation on the parts of USFS staff and collaborative group participants to use research and monitoring data to develop, evaluate, and adapt projects.

Learning and Evaluation Processes

The Dinkey Collaborative and SNF jointly track project design and implementation through monthly meetings and field reviews. Research and quantitative monitoring inform these discussions.

Monthly Meetings and Qualitative Field Reviews

At meetings and field reviews, participants raise questions about planning, project design, and implementation specifications. Through back-and-forth discussions, which may span several meetings, the collaborative and USFS staff review relevant information from research, observation, and experience, discuss management options and constraints, and sometimes change management specifications. Discussions are recorded in detailed meeting summaries that identify agreed-upon recommendations and action items. USFS staff take the formal input, develop draft proposed actions, and then present those actions to the group for feedback.

The collaborative group uses field reviews to discuss site-specific issues of concern, such as desired vegetative structure and species composition as well as management operations. Field reviews are attended by on average 15 collaborative group members and approximately 10 USFS resource specialists, including most project interdisciplinary team members. The group held six field reviews in 2012.

Discussions are structured around specific management practices and informed by USFS plot data, experience on other projects, current research, and current management specifications. If treatments have been marked, the group reviews the mark to ensure that key habitats and features such as tree clumps, defect trees, unique landforms, and hardwoods are being retained. On post-treatment field trips, the group also compares results to desired conditions. Field review notes are discussed and revised in full collaborative group meetings.

This review process has resulted in several changes to marking guidelines. For example, after a scientist shared his photo record of fisher denning and nesting sites, marking guidelines were revised to instruct markers to use those photos to flag potential denning sites. On a post-treatment field review, the group observed that although denning site retention was good, they needed more resting sites for the Pacific fisher. They subsequently revised definitions of high-quality, mid-quality, and low-quality resting sites. Marking guidelines have also been adjusted to include more tree clumps after the group saw that meeting canopy cover and basal area specifications did not result in as much clump retention as they expected. The district has adopted these changes, trained marking crews in using them, and shared them with the neighboring district that is working on similar issues. Periodically, researchers also go out in the field with marking crews to explain fisher habitat needs to help them interpret and apply the marking guidelines.

Using Research in Evaluation and Adaptation

The collaborative draws on ecological research when developing and evaluating planning, monitoring, and management adaptations. Peer-reviewed published research is the primary basis for designing and evaluating treatments. The collaborative has also benefited by ongoing research on the SNF, notably Pacific fisher projects that started in 2005. Since then, the SNF and Pacific Southwest Research Station (PSWRS) scientists have worked together to refine fisher marking guidelines and coordinate management and research. Researchers now have considerable data on fisher populations and habitat conditions that the collaborative is using to define desired conditions and provide a baseline for monitoring.

The Dinkey Collaborative is using research-based

scenario modeling to evaluate project outcomes and compare projected long-term effects of different treatment options. USFS project design is based in part on vegetation and fuel model projections. Using USFS post-treatment plot data, the collaborative reviews how closely on-the-ground results match model projections. The group is also using a model developed by a PSWRS scientist that projects changes in desired fisher habitat attributes 10, 20, and 50 years post-treatment. The model takes pre-treatment stand exam data and prescriptions as input, uses USFS vegetation growth models to project future conditions, and compares results to desired habitat characteristics based on conditions in areas currently supporting healthy fisher populations. The collaborative is using this model to compare the relative risk to fisher populations from different treatments on planned project sites. USFS resource specialists participate in the discussion and provide input on possible treatment impacts to other resources.

PSWRS scientists also participate in meetings, field reviews, and on the Monitoring Work Group. Researchers have encouraged project implementation so that treatment effects can be studied. They also emphasize that it is important to tier new management actions off of previous work to further learning and avoid arbitrary management experiments.

Joint Fact-finding

The Dinkey Collaborative periodically uses a joint fact-finding process to address disagreements during project planning. Once the collaborative has determined that more information is needed to address a concern raised in group discussions, it forms a work group to gather and review relevant information and make recommendations. Importantly, joint fact-finding work groups are designed to include people with differing backgrounds to encourage thorough discussion of different perspectives and mutual learning. The group brings information from research, management, and field visits into their discussions. Final reports describe the initial areas of disagreement, questions addressed through joint fact-finding, information sources, assumptions, recommendations, and the level of agreement with each recommendation. Collaborative group members are invited to sign on to the recommendations or share dissenting views. The group is an advisory body, so if recommendations are not unanimously accepted, the USFS ultimately decides which recommendation it will adopt.

For example, in 2012 the Dinkey Collaborative initiated a joint fact-finding process to address questions about ladder fuels management. Work group members wanted treatment specifications to take into consideration Pacific fisher and spotted owl buffers as well as desired changes to fire intensity or severity. Their final report provides guidelines for addressing ladder fuels in fisher and spotted owl habitat.

Implementation and Effectiveness Monitoring

As part of local USFS inventory programs and contract administration, the Sierra National Forest gathers data on watershed, fuels, and vegetation conditions and conducts pre- and post-treatment stand exams. In addition, the agency has set up monitoring plots to directly measure some variables, such as canopy closure and basal area, on DLRP treatment units. Data from these sources are used to monitor project implementation (did we do what we said we would do?) and effectiveness (did we achieve our desired outcomes?) at the unit level.

Recognizing that treatment effects are uncertain, the collaborative also is developing a more sophisticated multiparty ecological monitoring plan using experimental design that includes, where possible, statistical design using randomization, replication, and controls. The plan will be used to evaluate treatment effects on species or ecological processes of concern at a landscape scale and provide a higher level of certainty that treatments are meeting the group's forest restoration objectives. A Monitoring Work Group, co-chaired by a USFS representative and a non-agency participant, is developing the plan. Over the course of two years the work group identified, refined, and prioritized monitoring questions; selected indicators and measurement methods; identified desired conditions; and established trigger points at which undesirable results will prompt action. A half-time monitoring coordinator has been hired to facilitate monitoring plan implementation. The collaborative plans to take advantage of existing data from the SNF and research scientists wherever possible, and the monitoring coordinator is reviewing existing USFS databases to cull information that can be used as baseline monitoring data.

Change Mechanisms

Semi-binding documents such as the Dinkey Collaborative Charter and SNF's Fisher Marking Guidelines clearly set out expectations for and agreements on specific management adaptations. Regular follow-up discussions and ongoing working relationships help ensure that agreed-upon changes are made. A commitment to adaptive management also helps ensure that recommended changes are made, because it deters objections, appeals, and litigation by reassuring members that actions resulting in undesirable outcomes will not be repeated.

Written Records and Signed Agreements

The Dinkey Collaborative Charter, which was signed by the Sierra National Forest Supervisor and interested parties who wanted to become formal group members, sets expectations for collaborative group involvement in project planning, evaluation, and adaptation. Although it is not a legally binding document, the charter clearly states that the collaborative will be directly involved in planning, evaluating, and adapting project treatments. For instance, the section on multiparty monitoring states:

"Dinkey Collaborative helps to develop monitoring plans, which include performance measures for assessing the positive or negative ecological, social, and economic effects of implemented projects; …

"as part of Planning, Dinkey Collaborative revisits stand-level desired conditions and develops proposed actions based on previous years' monitoring…; [and]

"SNF and Dinkey Collaborative co-host an independent science panel in 2015 and 2020 to interpret trends and adapt restoration efforts as needed."

Similarly, the charter states that the collaborative will work with USFS technical staff during pre-NEPA planning to "develop specific proposals for projects, including desired conditions and proposed actions to achieve strategy goals and objectives through the consensus process."

The charter also includes provisions for review and amendment of the charter itself. Every two years the collaborative reviews the charter, makes changes if necessary, revisits membership, and renews its commitment to the charter. In 2012, charter review resulted in several recommended clarifications, including procedures for documenting group agreements and disagreements, clearly delineating when decision points are reached, and distinguishing decisions from recommendations. Even before formal charter revision, the collaborative has changed its meeting records based on this review. All meeting and field reviews now specifically identify consensus decisions.

Formal letters of individual member support for specific management actions also provide a record of the group's recommendations to the SNF. All meetings and field review notes clearly state action items and individuals responsible for each item as well as consensus agreements of the collaborative.

Commitment to Adaptive Management

For the Dinkey Collaborative, a USFS commitment to use research and monitoring results in project planning and adaptation is requisite for allowing management to move forward. This commitment reassures members that treatment effects will be carefully evaluated and changes will be made if there are undesirable outcomes. Experimental research and monitoring are important because they provide a high level of confidence that restoration treatment results are due to management actions, but the incremental process of field reviews and adjusting management allows ongoing management improvements without having to wait for long-term monitoring and research results. Participants say the long-term scientific monitoring and near-term participatory field reviews are complementary, and both are important to project evaluation.

Relationship-based Accountability

Although the SNF is not required to adopt any of the collaborative's requests and recommendations, in practice there is an understanding that the collaborative's input will be carefully considered, and used where possible. This is particularly true when the group reaches a consensus recommendation or decision, given that its membership includes the range of major stakeholders.

The collaborative's experience with field reviews and revisions to the Fisher Marking Guidelines has built participants' trust that they will have opportunity to address specific components of project implementation, which in turn has allowed project planning to move forward where in the past it would have been appealed or litigated. Field reviews and USFS plot data are used to provide accountability that treatments are implemented as the group expected. Over time, as more projects are implemented and shown to be consistent with member expectations, it is likely that the group's capacity to work through the most complex issues and achieve landscape restoration will increase.

Dedicated Staff

Collaborative group participants say having a professional facilitator to hold everyone to timelines, tasks, and agreements and apply procedural pressure when necessary is instrumental to success. In addition to hiring a facilitator, the SNF has added a full-time position, the High Sierra Deputy District Ranger, whose position was created in part to support the Dinkey Collaborative. The USFS and The Wilderness Society are jointly funding a half-time monitoring coordinator who oversees implementation of the Dinkey multiparty monitoring plan. These individuals play important roles maintaining communication, keeping formal records and databases, and ensuring that agreed-upon actions are implemented in ways consistent with member expectations.

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Appendix III. Sample Evaluation Tools and Change Mechanisms

This appendix provides examples of several tools and strategies for evaluating and adapting collaborative resource management discussed in the "Closing the Feedback Loop" sourcebook. It is available online at http://library.eri.nau.edu/gsdl/collect/erilibra/index/assoc/D2013002.dir/doc.pdf.

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