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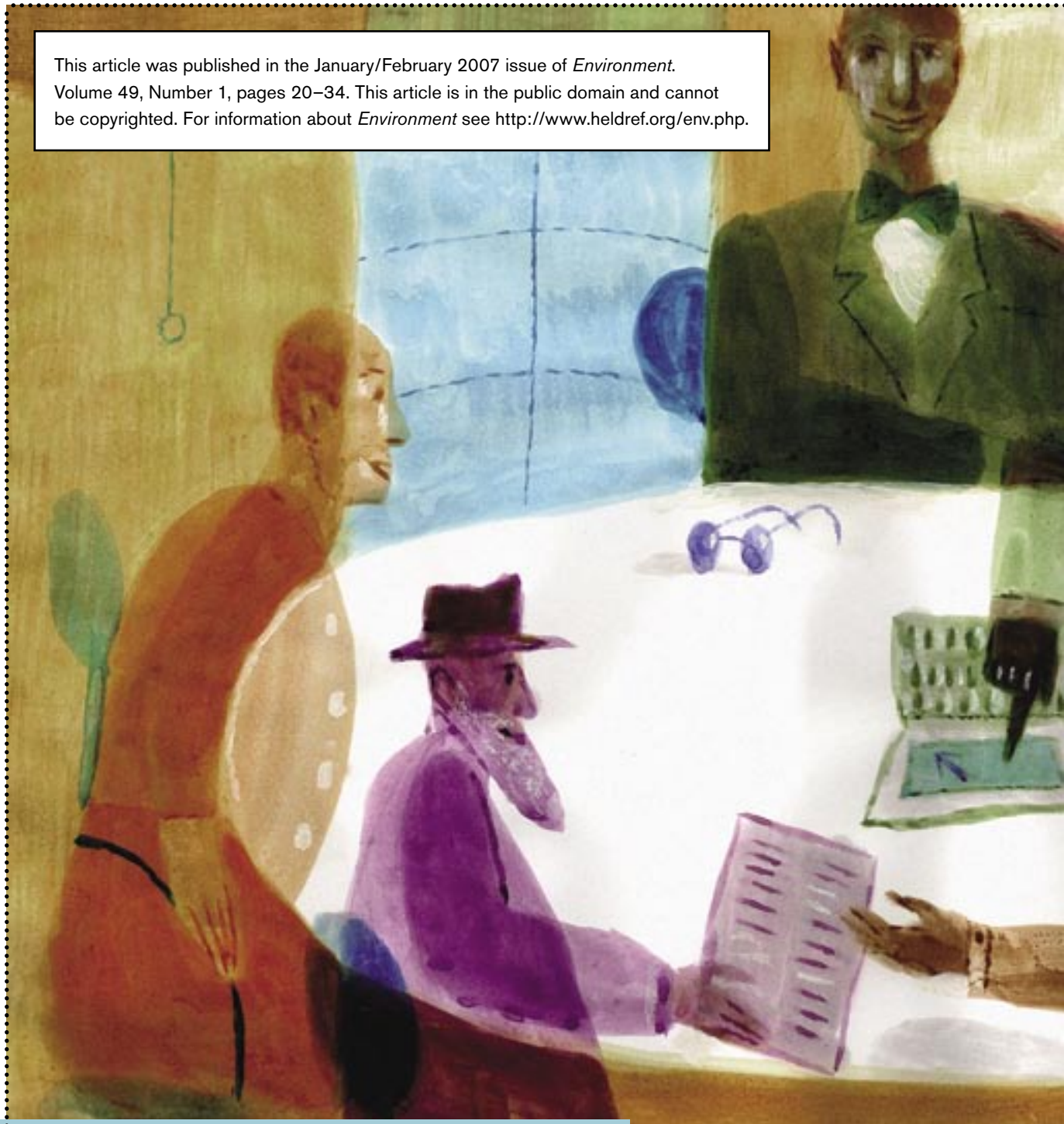
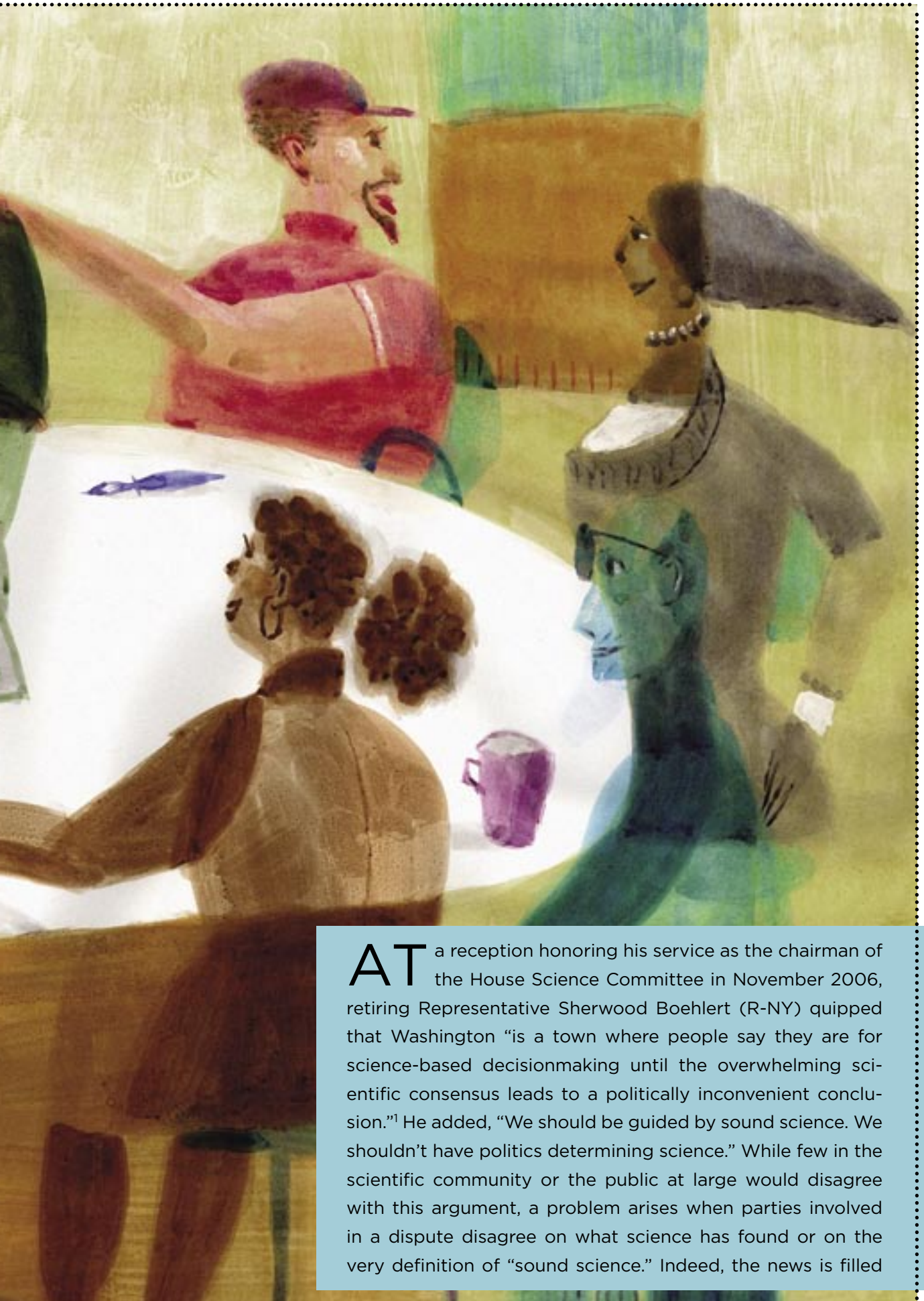


A DIALOGUE, NOT A DIATRIBE

Effective Integration of Science and Policy through Joint Fact Finding

by Herman A. Karl, Lawrence E. Susskind, and Katherine H. Wallace



AT a reception honoring his service as the chairman of the House Science Committee in November 2006, retiring Representative Sherwood Boehlert (R-NY) quipped that Washington "is a town where people say they are for science-based decisionmaking until the overwhelming scientific consensus leads to a politically inconvenient conclusion."[1] He added, "We should be guided by sound science. We shouldn't have politics determining science." While few in the scientific community or the public at large would disagree with this argument, a problem arises when parties involved in a dispute disagree on what science has found or on the very definition of "sound science." Indeed, the news is filled

with cases where politics has trumped science, particularly in environmental decisionmaking. Typically in such cases, parties on both sides of the dispute continue to argue that science is on their side or exploit the uncertainty in the data and interpretations to delay a decision. A case in point is the debate surrounding climate change in the United States.[2] To move forward, we need to acknowledge the role politics plays in policymaking and adopt a new and better way of ensuring that both science and politics are given their due in public policymaking.

Boehlert's remarks echo the sentiments of President Theodore Roosevelt and other political progressives at the end of the nineteenth century. They believed that the nation's resources could only be conserved for future generations through objective and rational decisionmaking—or management, as they called it—enabled by science. Unregulated exploitation of natural resources during the second half of the nineteenth century had led, in part, to a movement at the end of that century to base natural resource management decisions on sound science.[3] Gifford Pinchot, America's first professionally trained forester, was one of the primary proponents of this view. As the first chief of the U.S. Forest Service, he instituted science-based management practices for that agency that still stand as a model for other natural resource and environmental agencies (including those dealing with human health). The belief that science is the best means for solving society's problems gained strength during the twentieth century and was given an important boost with the publication of *Science: The Endless Frontier*—the report proposing the creation of the National Science Foundation.[4]

Is Decisionmaking Based on Sound Science?

While "decisions based on sound science" has been a credo of natural resource management and environmental policy in the United States for more than 100 years, science is still not independent of politics. The concept of "decisions based on sound science" is predicated upon the presumptions that science is a neutral body of knowledge immune from value judgments, science can predict with certainty and clarity what will happen in the physical world, and policymaking is a rational process. None of these is true.[5] Policymaking is not an entirely rational process of identifying problems and choosing optimal solutions, especially when scientists must make value-laden assumptions and extrapolations in the face of highly uncertain data to answer questions posed by policymakers.[6] What is needed is a way to ensure, politics aside, that our understanding of the workings of complex ecological systems informs public policy choices about where and how development should proceed, how natural resources are managed to ensure sustainable supplies, and whether and how to regulate economic activities that pose a threat to human health and safety as well as environmental protection.

In many contentious debates surrounding complicated natural resource management, environmental protection, and human health decisions, science is marginalized. This is due in large measure to the adversarial processes mandated by our legal and administrative systems. They often leave out the human dimensions that ought to be considered in all deliberations leading to natural resources management decisions or environmental policy choices.[7] Such decisions are unavoidably based on a range of values along with the interests of a great many stakeholder groups. Science cannot be separated from these values and interests. For many of our very complex environmental problems—so-called "wicked" problems[8]—decisions based on sound science must integrate social science, natural science, and stakeholder concerns.

Owing to the increasingly contentious nature of the disputes that erupt whenever such decisions must be made, it has become increasingly clear that established mechanisms and institutional frameworks, dominated by adversarial approaches that pit science against politics and interest group against interest group, are inadequate to achieve such an integration of sciences, values, and interests. In an adversarial process, advocates seek to prevail rather than to resolve their differences effectively, and science is not used as a common resource to inform wise decisionmaking. Rather, each side seeks to gain an advantage by exploiting whatever scientific and technical uncertainty exists. In adversarial processes, incomplete understanding (inherent in the complexity of natural systems) is used to delay decisions opposed by one group or individual. Scientists with different interpretations of the same data are pitted against each other, thereby canceling out what they have to say.

In many contentious debates surrounding complicated natural resource management, environmental protection, and human health decisions, science is marginalized.

Consider this example: For years, several industries in a central Philadelphia neighborhood had been indiscriminately dumping waste into Dock Creek. Fearful that the polluted water was making residents sick, community members petitioned their legislators to take corrective action. The industry sent in its own petition. Newspapers took sides. In a series of articles, a local scientist described the health risks and argued that the industries should relocate. Industry experts argued this would disrupt trade, and a more scientific plan would lead to better understanding and solve the problem through self-regulation. The year of this dispute was 1739, the industries were tanneries, and the local scientist was Benjamin Franklin.[9] Nearly 268 years later, Americans are still searching for a better way to incorporate science into policymaking.

For science to be more effectively used in public policymaking, it should—at a minimum—help to scope environmental (including human health) and natural resource management problems effectively, generate useful forecasts of what is likely to happen if nothing is done and how various responses might work, and assist stakeholders in selecting among possible responses even when they have very different levels of scientific and technical capability.

To help ensure that good science is considered in decisions that get made, a forum and procedure, in particular at local and community levels, are needed that bring experts, decisionmakers, and the general public together in meaningful deliberations and negotiations that incorporate scientific information, local knowledge, and all the relevant values and interests. What is needed is the development of an interface between the culture of science and that of policymakers and the general public that preserves the impartiality of the scientist and the best practices of scientific inquiry while still honoring the values and preferences of stakeholders. The credibility and legitimacy of science depend upon how and by whom information is gathered and the process by which scientific inquiry is conducted.[10]

In the last few years scientists have increasingly acknowledged the need to involve "'users' and stakeholders more directly in the design and interpretation of"[11] scientific studies, recognizing that "in a world put at risk by the unintended consequences of scientific progress, participatory procedures involving scientists, stakeholders, advocates, active citizens, and users of knowledge are critically needed."[12]

In this vein, a coherent and defensible strategy for helping to ensure that science is used more effectively to manage natural resources and make environmental policy is what is now called joint fact finding.

Joint Fact Finding

Joint fact finding (JFF) refers to a procedure or set of best practices that have evolved over the past decade or so for ensuring that science and politics are appropriately balanced in environmental decisionmaking at the federal, state, and local levels. Because JFF promotes shared learning, it helps to create knowledge that is technically credible, publicly legitimate, and especially relevant to policy and management decisions. JFF is a procedure for involving those affected by policy decisions in a continual process of generating and analyzing the information needed to shape scientific inquiry and to make sense of what it produces. It allows for the consideration of local and cultural knowledge as well as expert knowledge. A well-designed and managed JFF process does not result in "science by committee" or allow science to devolve to lowest common denominator thinking. A high-quality JFF process helps ensure that the best-quality science (from the standpoint of those committed to the norms of independent scientific inquiry) is used to inform decisions.[13]

JFF assumes that an agency of government (or a group of agencies) will act as the convener of whatever decisionmaking process is required. The convener, usually by law, is the final decisionmaking body. Stakeholders are those who believe they will be affected by (or have a right to have a say about) the decision(s) the convener proposes to make. Stakeholders include other governmental actors who are not conveners as well as representatives of a wide range of nongovernmental interests. Conveners often rely on "professional neutrals" (trained facilitators or mediators with experience working to resolve complex public disputes) to assist in the identification of stakeholder representatives and to manage consensus-building dialogue among large numbers of participants.[14] While JFF is usually driven by the tight deadlines and serious budget limitations that constrain convening agencies, sufficient time and money must be set aside to ensure reasonable opportunities for stakeholder engagement and group decisionmaking.

There are six steps in JFF, which is best undertaken as part of a consensus-seeking effort (see Figure 1 on page 24 and Figure 2 on pages 26–27). The first two are to understand the issues and interests at hand and determine whether JFF is appropriate. If a JFF process is appropriate, the next four steps are to scope the JFF process; define the precise questions to be addressed and the most appropriate methods for producing helpful technical inputs into political decisionmaking; agree on how the JFF results will be used; and review the preliminary results of the JFF process (and their policy implications) before any final decisions are made. Each step involves well-established consensus-building techniques. Consensus does not require that the group reach unanimity but rather that an overwhelming majority (defined by ground rules established by the group) supports whatever final agreement is reached (as long as all stakeholders have had a chance to express their concerns).[15] In addition, three conditions must be met for a JFF process to be minimally acceptable:

• *Representation*. All key stakeholder groups need to be involved in framing the inquiry. They need to choose who will represent them and who will do the research.

• *Neutral process management*. A professional neutral must be selected by the participants to manage the conversations so that all stakeholders—including scientists and technical experts—are engaged

in face-to-face conversations. The scientists and technical experts cannot leave the table when they finish their technical reports. They need to be part of the ongoing conversation about the implications of their findings for policymaking (although they should probably not advocate a particular policy outcome).

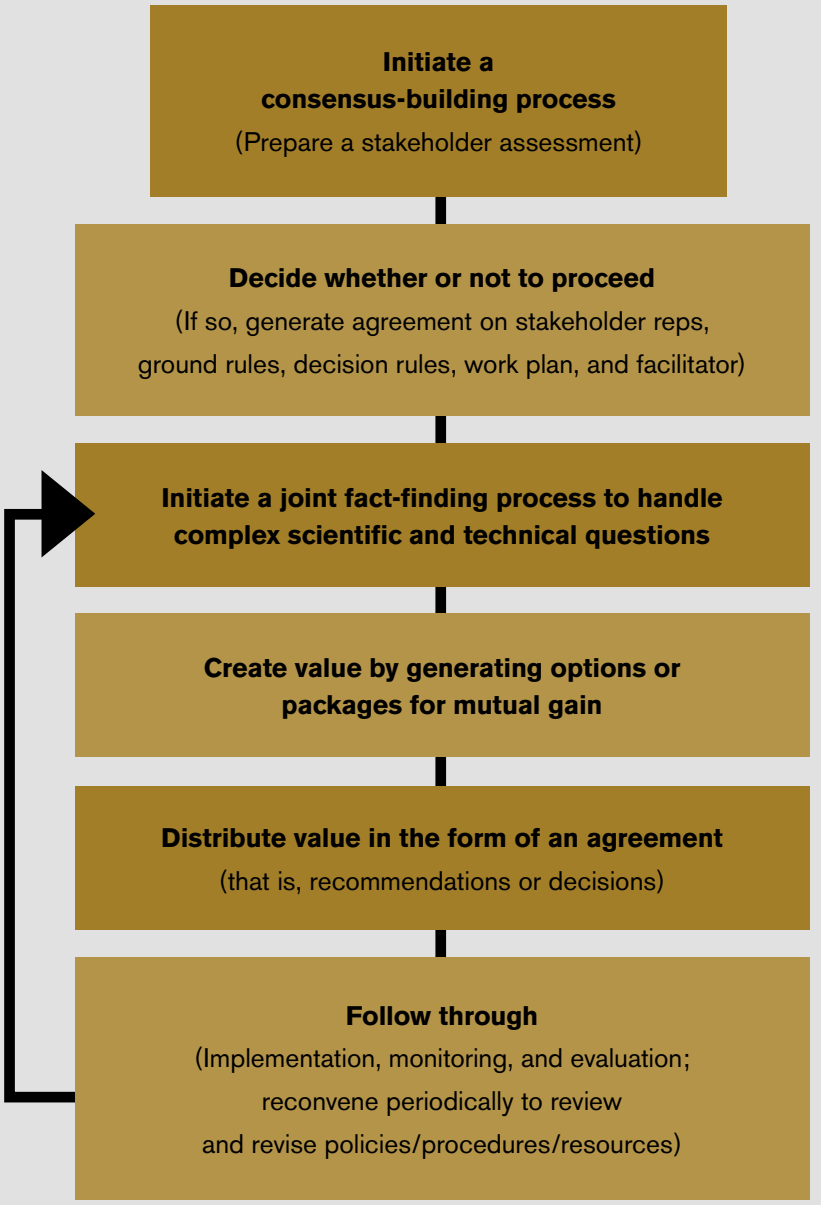
• *Written agreement*. The convener must agree to accept a written statement from the parties and promise to be accountable, especially if they decide not to follow the consensus recommendations of the group.

A Conversation, Not a Diatribe

Inclusive processes that bring people together to solve problems collaboratively are increasingly being seen as the best way to link the substance of science to decisions that must be made regarding environmental policy. Indeed, process design is now seen as central to the success or failure of any collaborative effort.[16] The inherent uncertainty surrounding scientific analysis and forecasting—owing to the complexity of natural systems—is a principal reason that collaborative approaches are best suited to incorporating science into decisionmaking. A participatory, collaborative process channels people holding opposing viewpoints into a civil discourse that can help them discover common ground; from this, mutual understanding may emerge. A conversation, not a diatribe, is needed to cope with the implications of scientific uncertainty.

Collaborative approaches to policymaking can generate the civil discourse necessary to produce creative and durable solutions to complex and contentious environmental dilemmas. The principles of consensus building and multiparty, interest-based negotiation provide a framework for decisionmaking in which citizens and government share responsibility for land-use planning, ecosystems and natural resources management, and environmental policymaking. This approach requires meaningful participation of everyone (agencies and citizens) with a stake in an issue to come together to talk about it.[17] Collaborative processes should not be confused with traditional public involvement efforts in which there is no or limited discussion and citizens typically have two minutes to present their critique of government policies or decisions that have already been made. Unfortunately, many public agencies still advocate the traditional approach best characterized by the phrase "inform, invite, and ignore."[18] These traditional techniques specifically prohibit meaning-

Figure 1. Joint fact finding in the consensus-building process



SOURCE: Consensus Building Institute, 2002.

ful discussion, discourage discourse, and fuel further conflict.

In summary, joint fact-finding rests on three key assumptions. First, scientists and technical experts must interact with stakeholders and policymakers throughout the policymaking process. All participants must jointly frame the questions that need to be answered and studied, analyze the likely impacts of alternative responses to a problem, and think together about the choice that must be made given resource limitations and scientific uncertainty. Scientists ought to be involved in all stages of this process. Second, scientific or technical studies must be organized as part of a prescriptive consensus-building process that engages self-selected stakeholder representatives in formulating specific recommendations that are then presented to policymakers for final action. To be effective and useful, scientific analyses should not be undertaken independently of the policymaking process. Third, scientific analyses ought to be linked to a commitment to adaptive management as a way of handling and acknowledging uncertainty. A well-designed, high-quality joint fact-finding process ensures accessibility to all forms of knowledge by all stakeholders, thereby building trust—an essential condition for people to work together successfully. JFF has been used in a number of cases.[19] The following three cases illustrate the importance of these assumptions and practices.

Collaboration in Practice

The three case studies that follow are examples of successful JFF processes. They are the Guadalupe River Flood Control Project Collaborative's assessment of alternative management strategies, the Northern Oxford County Coalition's analysis of cancer incidence and air pollution, and the CALFED Bay-Delta Program's Independent Review Panel's evaluation of agricultural water use. While not comprehensive, these brief case study reports demonstrate how JFF has been used to enhance stakeholder understanding and to evaluate the costs and benefits of alternative policy and management options. They also provide lessons regarding process management applicable to other science-intensive policy disputes. The case studies do not represent an exhaustive survey of JFF, and not all processes would necessarily be considered as successful as the three described below.

Guadalupe River

The Guadalupe River flows 19 miles from its source in the Santa Clara Mountains through San Jose, California, before reaching the San Francisco Bay in Alviso.[20] The 170 square-mile watershed lies completely within Santa Clara County. Over its short course, it transitions from mountainous upper reaches to the highly urbanized Silicon Valley.[21] In 1986, Congress approved the Downtown Guadalupe Flood Control Project in which four project sponsors—the U.S. Army Corps of Engineers (the Corps), the City of San Jose, the City of San Jose Redevelopment Agency (SJRA), and the Santa Clara Valley Water District (SCVWD)—developed and implemented flood control measures. Prior to the implementation of any measures, the San Francisco Regional Water Board (SFRWB) issued water quality certification and waste discharge requirements that were developed through negotiations between the four project sponsors, the U.S. Fish and Wildlife Service, the State of California Water Resources Control Board, the National Marine Fisheries Service, the California Department of Fish and Game, and the San Francisco Bay Region Water Quality Control Board. The SFWRB issued the certification to comply with the U.S. Clean Water Act and the California Water Code, and it required the development of a mitigation and monitoring plan, planting of riparian vegetation, maintenance of a low-flow channel for fish passage during the drier months outside the late fall and winter flood season, and improved recreational facilities and access consistent with San Jose's Guadalupe River Park Master Plan.

As is often the case with controversial resource management disputes, the threat of litigation led to the initiation of the JFF process. The Guadalupe-Coyote Resource Conservation District (GCRCD), a public agency under Division 9 of the California Public Resources Code that advises agencies and citizens on land use planning and resource management, issued a Notice of Citizen's Suit under the Clean Water Act in 1996. GCRD alleged that the mitigation and monitoring plan had not been fully approved by resource agencies and initial mitigation measures did not comply with 1992 certification requirements. Trout Unlimited and the Pacific Coast Federation of Fishermen's Associations joined the suit. GCRD and these two groups specified that they would be willing to pursue a negotiated resolution instead, however, and they formed the Guadalupe River Flood Control Project Collaborative with the four project sponsors in June 1997.

The stakeholders came to the table voluntarily and self-selected their representatives, a primary component of a JFF process. They chose the lawyer from the citizen suit, and the four project sponsors selected representatives from each of their agencies. The process also involved a professional neutral, another element of JFF. The Corps, the City of San Jose, SJRA, and SCVWD jointly funded the neutral facilitation team and, along with the stakeholders from the citizen suit, selected the facilitators. Collaborative members also created a contract specifying that the facilitators were responsive to the entire collaborative despite not being funded by the stakeholder group. This step helped to balance resource and power disparities.

Adhering to another JFF component, the collaborative's participants agreed to the process objectives and criteria—in this case, for flood protection and habitat conservation—at the outset. The objectives included avoidance of project-caused adverse effects; minimization of unavoidable impacts; maximization of on-site mitigation that created shaded, vegetative river cover; consideration of quality as well as the quantity of mitigation; and implementation of an adaptive approach to long-term management, which allowed for continued monitoring, evaluation, and

adjustments. The project evaluation criteria included at least as much flood protection as the current strategy, achievement of aforementioned objectives, timely project implementation and completion, cost-effectiveness and affordability, and compliance with relevant laws.

One difficulty that the collaborative encountered was differences in technical understanding among stakeholders. For example, some stakeholders were engineers whereas others specialized in policy. To address this obstacle, the facilitator suggested the formation of a technical fact-finding subcommittee to explore the scientific and technical components of the problem. All stakeholders agreed to this approach and nominated experts to serve on the subcommittee. These experts included scientists and consultants from project sponsors' and resource agencies and an environmental consultant who had worked on the initial Clean Water Act and Water Code certification. Similar to the facilitator, this consultant was funded by the project sponsors but answered to the entire collaborative.

The technical subcommittee identified areas where scientific consensus existed, as well as disagreement and uncertainty related to alternatives' impacts on hydraulic capacity and water temperature. It also developed process metrics and indicators that it used to compare alternative flood control management strategies. Within seven months, the subcommittee reported its findings to the entire collaborative, the collaborative applied its criteria to compare alternatives, and the group achieved a consensus on a management alternative. The collaborative drafted these findings and recommended a management strategy using a single-text approach, creating the Dispute Resolution Memorandum Regarding Construction, Operation, and Maintenance of Guadalupe River Flood Control Project. In July 1998, project sponsors, resource agencies, environmental groups, and second-tier elected officials and senior staff ratified the memorandum. The document and its management strategy fit within the existing planning and regulatory process. The preferred alternative underwent National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) review, and project sponsors developed a mitigation and monitoring plan to address all the components of the preferred alternative. The collaborative also created an adaptive management team to monitor and adjust the management strategy in light of project objectives.

The Guadalupe River Flood Control Project Collaborative illustrates how stakeholders avoided adversarial legal proceedings and instead jointly agreed upon project objectives and performance criteria. Mutually agreed-upon experts evaluated alternatives based upon these criteria, objectives, metrics, and indicators, and worked with the stakeholders to explain their findings. The JFF process informed stakeholders, balanced technical and financial disparities, and created an acceptable management strategy.

Northern Oxford County Coalition

In the early 1990s, allegations emerged that a paper mill in Maine's Androscoggin River Valley was responsible for a presumed cancer cluster in the four towns of Rumford, Mexico, Peru, and Dixfield, Maine.[22] The economy of the four rural towns featuring a combined population of 15,000 depended largely on a paper mill; the facility employed approximately 35 percent of the region's work force. The issue became more divisive when a Boston-based television program entitled "Chronicle" labeled the northern Oxford County communities "Cancer Valley" and suggested the paper mill might be the primary culprit. Some residents blamed the mill for the deaths of their loved ones, while others feared that criticism would destroy the area's economy. Further complicating the dispute, no scientific evidence existed to substantiate either side's accusations. To address the escalating controversy, the Maine Department of Environmental Protection (DEP), the U.S. Environmental Protection Agency (EPA), and community residents created the Northern Oxford County Coalition (NOCC) in 1994 to pursue a community-based consensus-building process.

Figure 2. Key steps in the joint fact-finding process

STEP 1 PREPARE for JFF	STEP 2 SCOPE the JFF process
Take account of how JFF ought to fit into a larger consensus-building process.	Work with stakeholders to draft ground rules specifying the roles scientists will and won't be expected to play.
Document the interests of all relevant policymakers and stakeholders using a formal stakeholder analysis.	Generate technical questions that need to be answered given the goals of the process and interests of the parties.
Work with a professional neutral (that is, a facilitator or mediator) to determine the most useful role for scientists.	Identify existing information and knowledge gaps likely to affect the group's ability to answer its questions.
Convene a joint fact-finding process.	Advise on methods for dealing with conflicting data and interpretations of facts and forecasts.

SOURCE: Consensus Building Institute, 2002.

The public agencies played a large role in initiating the process. Because citizens perceived DEP as the entity responsible for air quality, they accepted the agency's suggestions to initiate the process. An EPA grant provided the necessary funding to support the program. This contribution was critical because it provided money from what the parties perceived as an unbiased source (as compared to the mill owners, who could have financed the process but would not have been viewed as neutral by other participants). Because DEP convened the process and EPA supported it financially, the nascent process became possible and legitimate.

Citizens and agencies considered initial NOCC meetings to be confrontational and unproductive, so EPA secured the assistance of a professional facilitation team from the Consensus Building Institute. The involvement of this neutral party satisfied a critical JFF component. Fulfilling another core tenet of JFF, the team began the process with a conflict assessment that identified eight major stakeholder groups that were invited to the table: state and federal agencies; local government; small and large businesses; organized labor; interested citizens; health care providers; environmental advocacy groups; and state nongovernmental organizations concerned with public health and the environment.

Meeting another JFF component, the facilitation team drafted a broad set of protocols for stakeholders to ratify at the outset of the process. At first, stakeholders did not recognize the importance of the ground rules and signed them with little discussion to get to work on substantive issues. After a year of meetings, however, participants identified problems with the process and revised the rules. For example, they instituted a time-out system to control domineering participants and developed a disagreements list that allowed the group to document contentious topics and move on without getting bogged down in pointless conflict. These revisions allowed stakeholders to take ownership of the process guidelines and their enforcement, increase participation, and keep discussions on track, creating more open and productive deliberations. The importance of building ground rules through experience and taking ownership of these protocols became a lesson for both the stakeholders and the professional neutral.

After identifying key stakeholders and establishing and revising process guide-

STEP 3 **DEFINE** **the most appropriate methods of analysis**	STEP 4 **CONDUCT THE STUDY**	STEP 5 **EVALUATE** **the results of JFF**	STEP 6 **COMMUNICATE** **the results of the JFF process**
Assist parties in translating general questions into researchable questions.	Undertake the work as appropriate. Ensure the credibility and transparency of the process by consistently checking in with the parties and staying in touch with the constituencies.	Use sensitivity analysis to examine the overall significance of assumptions, data variability, and outcomes.	Jointly present findings and answer stakeholder and policymaker questions about how the work was done.
Identify relevant methods of information gathering and analysis; highlight the benefits and disadvantages of each.	Draw on expertise and knowledge of stakeholders (including non-experts) as needed.	Compare findings to the published literature.	Scientists communicate JFF results to various constituencies and policymakers via (for example) face-to-face discussions, fact sheets, presentations, and/or panels to be sure findings are understood.
Determine costs and benefits of alternative information collection strategies and "the expected value" of further study.	Review drafts of the final joint fact-finding reports.	Analyze the findings to determine what they mean. Assist parties in translating findings into a menu of possible policy responses.	Assist stakeholders in determining if further JFF is necessary.
Determine whether proposed data collection and technical studies will enable stakeholders to meet their interests.		Assist in determining whether and how the results of the JFF process have (or have not) answered the questions key to the consensus-building effort.	

lines, NOCC moved forward with the "real issues." Stakeholders identified the critical areas of uncertainty that they wanted to address, data that needed to be collected, goals they would try to meet, and a timeline for achieving these objectives. These timelines and goals had to be revised along the way, however, as stakeholders realized they had been overly optimistic at the outset. Such overreaching is a common challenge in consensus-building processes, and the neutral facilitators involved in this case noted that their role included expectation management. They created a work plan with NOCC stakeholders to keep the group on task and continually revisited it in light of data availability and reconsideration of goals.

Similar to the Guadalupe River example, the broader NOCC formed technical subcommittees to address specific questions such as cancer incidence and air quality. One subcommittee's goal was to perform an epidemiological study to determine whether the four towns were experiencing an abnormally high cancer rate. This task was very challenging because few stakeholders had experience conducting scientific investigations. Further, the task was highly sensitive and controversial because it involved sickness and death; stakeholders either adamantly supported or opposed the hypothesis that the area might have above-average cancer incidence. After incomplete disclosure issues threatened the neutrality of potential experts, the technical subcommittee finally reached agreement on an epidemiologist to help them evaluate cancer incidence.

Scoping the cancer incidence study proved more difficult than stakeholders and facilitators imagined. After the epidemiologist outlined various techniques and study questions, it became apparent that stakeholders disagreed on the questions they wished to address. Some wanted to evaluate whether cancer rates in the area varied from elsewhere in the state, while others wanted to explore causality. NOCC agreed to focus on cancer incidence rather than cause. The assistance of a stakeholder possessing epidemiologic experience who represented groups in favor of exploring causation helped to ensure this agreement. The facilitators learned that partisan as well as neutral expertise could be critical to achieving stakeholder consensus.

NOCC members hit another obstacle when the epidemiologist completed his study and the group attempted to interpret the results. Stakeholders could not agree on what conclusions to draw, and they turned to peer review for advice. Peer reviewers, however, also failed to agree on conclusions. Stakeholders had to abandon their initial goal of resolving their scientific disagreement, although they learned more about uncertainty and realized that they could not rely on science to provide conclusive results. At the facilitation team's urging, they chose to describe a range of possible interpretations of the epidemiological findings. NOCC also heeded the epidemiologist's advice and identified follow-up studies and cancer-screening and detection programs. The group had trouble agreeing on a final report, and the technical subcommittee finally issued a report based on a consensus of only nine out of ten members. The tenth member submitted a letter explaining his concerns.

Scoping the cancer incidence study proved more difficult than stakeholders and facilitators imagined.

NOCC formed another subcommittee to draft its final report, the process's ultimate deliverable. The subcommittee allowed the professional neutral to produce the first draft of the single text document due to time constraints and the contentious nature of deciding which words to put on paper. Where disagreement on specific language proved particularly difficult, NOCC included a range of interpretations. The final report took the form of a newsletter that was distributed to all households in the four-town area. This step officially ended the NOCC process, but a Healthy Communities Coalition was formed to continue addressing local public health issues using the remaining NOCC funds. In the end, the NOCC process never confirmed or refuted the charges that a cancer cluster existed or that the mill was the source of whatever increase in cancer rates had occurred in the area. However, it educated the stakeholders, created an ongoing coalition to address public health issues, and increased the community's capacity to work through problems cooperatively rather than adversely. It also led to the implementation of a series of steps designed to reduce cancer risks (such as efforts that encourage smoking reduction, offer free health screening on an annual basis, and subsidize radon detection and reduction programs for homeowners).

The NOCC example offers several lessons for stakeholders and professional facilitators. First, it illustrates the importance of establishing ground rules and allowing stakeholders to take ownership of these guidelines throughout the process. The case also highlights the importance of expectation management by neutral facilitators. Part of this duty involves using a work plan that keeps stakeholders on task and is continually revisited to reflect available data and realistic outcomes. Third, the NOCC experience demonstrated the value of selecting an expert who was credible and trusted by all stakeholders, as well as the importance that NOCC listen to and accept objections by particular stakeholders to certain expert candidates. This experience built trust and allowed NOCC to more readily accept the epidemiologists' findings. Although NOCC failed to produce conclusive results, it increased the community's capacity to address public health issues.

CALFED Bay-Delta Program's Independent Review Panel

Situated at the juncture of the Sacramento and San Joaquin Rivers at the mouth of San Francisco Bay, the Bay-Delta represents the largest estuary on the west coast

of North and South America.[23] The Delta supports a variety of plants, migratory birds, endangered fish species, and many other animals, and it also supplies water for agriculture, the high-tech industry, and 22 million California residents. The CALFED Bay-Delta Program (CALFED) consists of 16 federal and state agencies that convened in 1995 to restore the Bay-Delta estuary. CALFED was charged with addressing water use efficiency, levee rehabilitation, water transfers, and ecosystem restoration. The basic problem it sought to address was the reduction of agricultural water use, particularly during drought periods. Initial attempts to address agricultural water use efficiency disbanded without any resolution. Facing a critical deadline in 1998, CALFED sought a neutral facilitation team to assist with revisiting the program's agricultural water use elements.[24]

The neutral facilitator from Berkeley-based environmental conflict resolution firm CONCUR convened an Independent Review Panel on Agricultural Water Conservation Potential that consisted of five nationally esteemed scientists with expertise in conservation practices, hydrologic and hydraulic connections between problem areas and CALFED solutions, and aquatic ecology. It also included technical advisors aligned with various stakeholder groups. Prior to assembling the panel, the facilitation team worked closely with influential stakeholders and important decisionmakers to seek agreement on reference and recruiting criteria, venue selection, and assurance that the panel results would be delivered in a time frame and format that would readily allow incorporation into CALFED's broader Water Use Efficiency Program. Stakeholders also had an opportunity to nominate technical advisors and panel candidates as well as partake in the process's strategic planning. Furthermore, the facilitation team convened a one-day scoping session for panelists and stakeholders to better understand the purpose of the deliberations, identify key areas in need of resolution, and formulate the questions for the panel to address. This panel selection and scoping process, facilitated by a professional neutral, reflects key JFF components.

The panel convened for two-and-a-half days at the end of 1998. Short but intense, the deliberations succeeded in identifying and narrowing the areas of scientific uncertainty and disagreement and producing new information that explained causal relationships relevant to managing the resource. The panel generated a revised approach to water conservation that relied on incentives and objectives rather than best management practices. The panel also identified areas in need of further data collection and analysis.

Similar to the previous examples, the neutral facilitator drafted a single-text document summarizing the panel's findings with input from all panelists. The report's major finding was that agricultural water management should shift from advocating for best management practices to implementing an incentive-based approach to water conservation. The report also specified areas in need of further research. This report became a source for ongoing deliberations by a 14-member program steering committee. In turn, the steering committee was critical in formulating CALFED's revised Water Use Efficiency Program that was accepted by a wide range of stakeholders and policymakers.

Although a shorter process than the Guadalupe River and NOCC examples, the CALFED case still demonstrates multiple key components of JFF. Facilitated by a professional neutral, the process resulted in the co-production of policy-relevant, technical information accepted by a range of stakeholders—an outcome that many believed would be impossible after the failure of initial attempts to address agricultural water use.[25] Stakeholder involvement during the scoping and selection process, transparency of the panel's deliberations, and production of a single text of recommendations all contributed to the salience and credibility of the panel's findings.

Common Threads

The three successful examples of JFF processes share multiple components. They all addressed scientific disputes related to environmental problems. Each involved the assistance of a professional and neutral facilitator. Furthermore, the processes allowed relevant stakeholders to scope areas requiring necessary research and provided input on the choice of technical experts to conduct necessary analyses. All processes created a single text document summarizing findings and recommendations and identified areas where differences remained. Finally, each example increased the capacity of previously disparate stakeholders to co-produce salient and credible analyses with direct policy implications. These examples demonstrate the importance of a trusted and non-partisan facilitator, clear process guidelines, and the value of scoping a conflict beforehand to keep stakeholders on task and encouraging them to produce relevant deliverables.

Graduate Programs in

Environmental Studies

Building Capacity and an Institutional Framework

In most instances it is necessary for government agencies to modify at least to some extent their institutional framework, procedures, practices, and philosophy of governance to incorporate JFF and collaborative processes into decisions about natural resource management and environmental policy.[26] The U.S. Department of the Interior, comprised of eight bureaus, is the nation's principal natural resource management agency. Two principal challenges drive a commitment to collaboration within that department:

• the challenge of turning the conflicts generated by the contentious debates surrounding environmental and natural resources issues into a way of moving forward; and

• the challenge of finding answers to the complicated environmental and natural resource management questions that concern and perplex our society. [27]

According to the Interior Department's FY 2003–2008 Strategic Plan, it intends to meet these two challenges through partnerships and science. Both have recently been identified as critical competencies for dealing with uncertainty and preparing for an unpredictable future. Science informs Interior's resource management and environmental policy decisions and lies at the heart of its mission and programs. The big worry, however, is that the stated federal commitment to collaboration will not meet the minimum requirements for effective consensus building.

A look at some of the specific concerns facing Interior underscores the complexity and imporance of meeting the two challenges. A few examples of what the department is grappling with includes the questions of

• how to continue to permit oil and gas development on public lands while restoring healthy ecosystems and preclude listing of species, such as the sage grouse, to the endangered species list;

• how to allocate and manage increasingly scarce water resources in the face of mounting human demands and the overarching implications of climate change;

• how to address the values conflict surrounding the management and reintroduction of large carnivores such as grizzly bears and wolves; and

• how to reconcile disputes over the use of off-road vehicles in federal lands.

As was pointed out above, the complex nature and widespread implications of these and other scientific issues the United States faces will require an integrated, interdisciplinary approach. Moreover, because these issues lie at the nexus of human social systems and natural ecosystems, it will be important to include social science as part of an integrated approach. Interior must also partner with citizens to define shared goals and integrate local knowledge to help resolve environmental disputes and make more effective natural resource management decisions. With other departments and agencies, Interior is striving to address these challenges; for example, the Interagency Cooperative Conservation Team is exploring ways to improve communication and collaboration among the agencies and to implement collaborative approaches to policymaking.[28] Yet there are many barriers to overcome in an institutional culture that is built largely upon top-down command-and-control regulation and an institutional framework of disconnected, "stove-piped" bureaus and agencies.

The agencies need to develop a culture of collaboration as a way of doing business by building collaborative capacity among their personnel. Interior alone offers more than 250 courses with the words "collaboration" or "partnering" in their titles. Most, however, are not required training. Typically, the personnel who select these courses are managers and not scientists. The impact, if any, that these courses have had on helping to achieve a culture of collaboration has not been quantified and is questionable.[29]

As a way to focus specifically on building collaborative capacity among scientists (and science managers) to implement joint fact finding, the U.S. Geological Survey (USGS), as Interior's principal science bureau, has partnered with the Massachusetts Institute of Technology (MIT) to establish the MIT-USGS Science Impact Collaborative (MUSIC).[30] USGS works with Interior's resource management bureaus to develop and coordinate science strategy within Interior. MUSIC collaborates with the bureaus to provide training opportunities and document effective practice to better enable Interior personnel to work with a full range of stakeholders, thereby helping to implement Interior's objective of having "Department personnel . . . see themselves as facilitators, utilizing talents of an entire community in pursuit of shared goals . . . to create a Nation of stewards, and creating a climate of environmental innovation and imagination."[31] In partnership with bureaus, citizens, policymakers, and a great many stakeholders, MUSIC is undertaking projects to test and refine alternative approaches to the use of science in collaborative processes, thereby addressing Interior's recognition that continued outreach to "its customers, partners, other policymakers, and

the public will be equally critical to the direction of our science initiatives . . . [and] help us define needs and set priorities."[32] The results of these projects will be reported in forthcoming articles and reports. To help develop a culture of collaboration within the agencies, MUSIC is preparing a new generation of scientists and applied social scientists familiar with the tools and techniques of collaboration who are potential Interior (and other agency) employees.

Conclusions

The prescriptive framework of laws and regulations traditionally used to ensure compliance with environmental policy is no longer adequate because of the increasingly contentious nature of environmental disputes. No one is questioning whether environmental laws and regulations are needed. Indeed, in many instances they have been very effective. However, the top-down approach that calls upon government to tell people what to do without meaningfully consulting them can cause resentment and generate obstacles to creative solutions and durable policy because it exacerbates rather than reduces conflict. Collaborative approaches to natural resource management and environmental policy are being seen as potentially more productive than the "top-down" approach of the past.[33] Collaborative approaches are those in which citizens meaningfully participate with government agencies in policymaking. In this model of shared or collaborative governance, laws and regulations are not circumvented, and government agencies do not relinquish their authority; instead, they work together with citizens to generate innovative solutions to vexing and complex environmental dilemmas.

Collaborative governance is an essential corollary to an ecosystems approach to natural resources management decisions. "Informing these decisions with science insights and information is important, indeed, critical to our ability to maintain healthy lands and thriving communities," wrote P. Lynn Scarlett in 2004 when she was Interior's Assistant Secretary for Policy, Management and Budget.[34] Collaborative governance requires joint fact finding because it is the only way to connect scientists, citizens, and policymakers in crafting the decisions that surround contentious natural resources disputes. The power of collaborative governance over regulatory governance is, according to Todd A. Bryan, a resource policy and behavior researcher at the University of Michigan, that of "'shared ownership' of our larger and more complex problems and challenges."[35] Although citizens do not have the authority to make final decisions, by empowering them to participate as equal partners in a collaborative problem-solving process, agencies will be more effective in their missions.[36] Through collaboration it is expected that more creative and innovative solutions will emerge and that agencies will implement them.[37]

Compliance-based approaches to environmental policy and natural resource management foster a culture of winners and losers—of a "you against me" dichotomy. If I acknowledge that your viewpoint and my viewpoint are both legitimate, we can reframe the debate by asking how can we work together to shape a solution that satisfies both (all) viewpoints (values and preferences). By proceeding in this way, we can create added value beyond that which any one person (viewpoint) brings to the table. The rapidly increasing number of community-based groups interested in engaging in collaborative problem solving is another indication that the regulatory model of the last 100 years, which has gotten us far, is no longer adequate.[38]

Need for a Collaborative Relationship

Because of the ever-increasing stress put on the environment by human activity, it is even more critical now than it was 100 years ago to inform environmental and natural resources decisions with good science. Science will help us to understand the consequences of our activities and inform choices among decision options. In recognition that science is needed now more than ever to inform societal decisions, politicians, government and nongovernmental agencies, and citizens have been asking with a mounting sense of urgency for scientists and science organizations to make their research more relevant to society's needs and to become involved in policymaking.[39] Yet even as scientists heed this call, more often than not, they still find themselves and their work ignored, marginalized, or misrepresented in deeply contentious environmental policy debates. This happens because their science is being used within the context of the traditional adversarial process that minimizes the value of science for informing decisions, and, worse, fosters its misuse.

An essential premise advanced here is that when people have a say in the design, analysis, and application of scientific inquiry—a collaborative problem-solving process—they are more likely to value and use it. And, a necessary condition of this premise is that scientists need to engage in that process and not remain aloof from it. Without proper process considerations, the substance of science will not be effectively communicated. By bringing scientists, citizens, and politicians together to talk with each other and share their knowledge as a step in a consensus-seeking effort, joint fact finding is a better way than confrontational, adversarial processes to ensure that good science is used in value-laden decisions and contributes to stable and effective public policy.

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ers and senior managers of the Program on Negotiation at Harvard Law School, founder of the not-for-profit Consensus Building Institute (www.cbuilding.org), and co-director of MUSIC. He is one of America's most experienced environmental mediators and is author or coauthor of several award-winning books that deal with consensus building in the public arena, including *Breaking the Impasse* (Basic, 1987), *Dealing with an Angry Public* (Free Press, 1996), *Environmental Diplomacy* (Oxford, 1995), *Negotiating Environmental Agreements* (Island Press, 1999), *The Consensus Building Handbook* (Sage, 1999), *Transboundary Environmental Negotiation* (Jossey-Bass, 2003) and *Breaking Robert's Rules* (Oxford, 2006) His current research focuses on the prospects for mediating science-intensive policy disputes. Katherine H. Wallace is enrolled in the Master of City Planning program in MIT's Department of Urban Studies and Planning and is a MUSIC intern. She is interested in the roles of science, stakeholder participation, and alternative policy tools in natural resource management. As part of her MUSIC research, she evaluated a water allocation dispute in Maui and assessed the appropriateness of a joint fact finding approach.

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