# THE ROLE OF SCIENTIFIC AND TECHNICAL EXPERTS IN ENVIRONMENTAL MEDIATION

BY

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ABSTRACT

Scientific and technical analyses are at the heart of many environmental disputes. There are three ways mediators can use scientific and technical expertise to assist disputants in reaching an "informed" consensus. First, mediators can help disputants use experts to understand how the natural or technical system central to the dispute functions. Second, mediators can use experts to help disputants understand how alternative agreements are likely to affect them. Third, mediators can help disputants understand the reasons why the experts disagree. In each situation, the mediator's role is to facilitate communication either among experts or, between experts and less technically-skilled disputants.

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# INTRODUCTION

Growing attention is focusing on the field of dispute resolution. One important subset of this field is mediation. I am interested in the ways in which mediation can be used to help disputants move from competitive relationships (in which they narrowly define their interests) to joint problem solving. My particular focus is on environmental mediation, situations in which decisions must be based, at least in part, on scientific and technical judgements.

Others have explored the characteristics of science-intensive environmental policy disputes (Bacow & Wheeler; Ozawa & Susskind; Bingham). This thesis is an extension of their work. It focuses on the roles scientific expertise plays in environmental mediation, particularly on the ways in which mediators facilitate communication among experts and less technically-skilled negotiators.

Effective mediation presumably leads to consensus (Fisher & Ury; Goldberg, Green & Sanders). Consensus occurs when all the disputants can "live with" a proposed resolution of their differences (Susskind & McMahon). This, in turn, occurs when all parties involved in a dispute believe that their most important concerns will be met (Raiffa). In the strictest sense, consensus occurs when disputants sign an agreement.

Scientific and technical experts can become part of an mediated process under several scenarios. The experts may be working for the disputants in what I will refer to as scenario A. In scenario B, the experts may be independent of the disputants but, associated with the mediator. Lastly, the experts may not be associated with either the disputants or the mediator and join the process because they are interested in the issue. This last situation will be referred to as scenario C. As I introduce each hypothesis, I will indicate under which of the scenarios the hypothesis is more likely to be relevant. The hypotheses apply equally to situations in which there is a genuine debate about technical issues and when technical issues are being put forth to mask non technical concerns.

## HYPOTHESES

I believe there are three ways environmental mediators can use scientific and technical expertise to assist disputants in reaching an "informed" consensus. First, mediators can help disputants use scientific experts to understand the function of the natural or technical system central to the dispute. Negotiating parties are more likely to reach an informed consenaus when they have this basic knowledge. For instance, without an understanding of the ways in which ecological systems work, disputants are not likely to invent solutions that will have the outcomes they expect. Comprehension is critical to the long-term stability of any commitments contained in an agreement. The experts explaining the system are typically associated with

## THESIS STRUCTURE

Chapter I begins with a brief review of the traditional framework for scientific inquiry and explains the tension between the scientists' and the policy makers' use of and need for technical information. The sources of experts' disagreements set the stage for my three hypotheses.

Each of the hypotheses is then explained in a separate chapter. Most of the illustrations and examples I present are drawn from secondary sources, although some (noted in the text) build on my first-hand experiences as a practitioner.

This thesis is written primarily for environmental mediators. As such, I conclude by summarizing my specific suggestions to assist environmental mediators use scientific expertise. The advice, however, should also be useful to any individual likely to participate in mediated environmental disputes.

# CHAPTER I
# USING SCIENTIFIC AND TECHNICAL INFORMATION IN POLICY DISPUTES

Scientific and technical choices are at the heart of most environmental disputes (Bacow & Wheeler). Policy makers at the federal, state and local level must rely on scientific analyses in making "informed" policy, to justify their policy choices to the public, and to satisfy legal prohibitions against "arbitrary and capricious" (Nelkin & Pollak; Brooks). Yet, the ethos of scientific inquiry is often inconsistent with the needs of policy makers.

Scientific experts are trained to pursue hypotheses through experimentation and debate among their peers until they achieve an acceptable level of certainty (Kalberer,Jr., Haun). Policy makers, in contrast, often must select a solution without either sufficient analysis or debate.

## THE NATURE OF SCIENTIFIC INQUIRY

The ethos of scientific inquiry requires systematic experimentation and peer review. J. Williams Haun describes the scientific method as a five step process:

1. Form a hypothesis.
2. Experiment to test the hypothesis.
3. Document the experiment.
4. Replicate the experiment.
5. Confirm or reject hypothesis (Haun, p.47).

This sequence allows experts to discover how, for example, an ecological system functions. Then, using the traditional peer review approach experts, in open meetings question each others' experimental findings and conclusions. The result, presumably, is an agreement on the validity of the findings and the inferences drawn.

Today, refereed journals are the forum in which such peer reviews generally occur (Kalberer, Jr.) Articles submitted for publication are reviewed (anonymously) by respected referees who judge the submitted work on the quality of the experimentation and the conclusions. Ultimately, the conventional wisdom is challenged, reframed, and challenged again. At any point in time, the experts may converge around a prevailing view (Kalberer, Jr.).

There are, however, limitations to this method that restrict pursuing truth. First, scientists by nature of their training tend to focus on existing ideas and theories, rather than offering new formulations. Thomas Kuhn, a scholar of scientific history believes normal science aims to refine, extend, and articulate paradigms in existence (Kuhn). Other commentators suggest that it may not be in the expert's interest to put forth ideas that contradict the prevailing view. Experts may find it advantageous to "go along" with those in positions of authority (Kuhn).

Like most of us, scientists require extremely persuasive evidence to reject the status quo. Doing so, however, means admitting that we might have been in error before. Young experts may find this particularly difficult because they must often defend their hypotheses in debates with individuals who helped train them (Kuhn). It may thus be hard for both the junior and the senior scholars to deal with challenges to the conventional wisdom.

An additional complication is the high cost of research equipment which frequently compels scientists to rely on government, corporate and foundation funding. Many funding sources are prone to support scientists pursuing ideas that extend but, do not reject the dominant theories (Haun). If an expert advocates a radical view, he or she may risk loosing funding (Haun). Thus, experts are often confined by their training, their relationships with other analysts, and their sources of funding to build upon but, not to challenge the accepted theories. This reality, to an extent, flys in the face of the pure scientific method which seeks to accurately describe how our environment behaves.

THE NEED FOR SCIENTIFIC ANALYSIS IN POLICY DISPUTES

Agencies charged with protecting public health and environmental quality, like the Environmental Protection Agency (EPA) and the Occupational Health Safety Administration (OSHA), review scientific and technical studies as part of the process of generating policies to satisfy legislative mandates. Experts, be they "in-house" or outside consultants, provide analysis but, do not make the policy decisions. The policy makers who weigh the scientific advice are ultimately responsible for policy decisions.

The EPA must, for example, make the government's policy on acid rain. The analyses considered in preparing this policy range from studying the cause-effect relationship between midwestern fossil fuel plants' emissions and acid deposition in New England lakes, to estimates of the effects that mining low sulfur coal would have on a state with active high sulfur mines. Though numerous environmental groups believe scientists now know enough to justify a decision limiting sulfur dioxide emissions from fossil fuel plants, EPA staff and President Reagan still contend that we do not understand enough about the nature of long range transport of pollutants to take action. While the Agency contracts for, and conducts studies to gather and to analyze the most current data, it still retains control over the policy decision.

Given the highly politicized nature of many environmental disputes, policy makers need credible scientific analyses to back up their decisions. Declining distrust in decision-making authority and expertise is one motivating factor that leads citizens to question reasons for decisions affecting their health and safety (Nelkin & Pollak).

In 1976 residents and city officials in Cambridge, Massachusetts, for example, were concerned about the possible public health risks from recombinant DNA research at Harvard University. In response to great anxiety over possible accidents and mistrust of the guarantees submitted by Harvard University and federal government health experts, the Mayor created a citizen's review board to assess the safety and monitoring procedures outlined by the National Institutes of Health (NIH). Board members included a former mayor, a nurse, a community activist, a university professor of urban policy, a former city councillor, a physician, and a social worker. Board members heard seventy-five hours of testimony from experts associated with

Harvard, NIH, and other institutions; read articles; and visited laboratories before reaching a decision. Though the Board began its hearings assuming that the research should be precluded, by the end of six months of wading through reams of analyses, provided by the experts, they all agreed research should continue. In its decision, the Board accepted the NIH guidelines which outlined the types of substances that could be used, responsible testing procedures, and emergency responses. The Board however, specified additional monitoring procedures including broader public participation on university biohazard committees (Nelkin, 1978).

In this case, the Mayor and citizens of Cambridge did not trust the evidence offered by Harvard experts to show that their procedures would be safe. The public thus demanded, and got greater access to the decision making process. They learned for themselves exactly what would be involved in testing recombinant DNA and reached a decision regulating the testing which they could live with.

According to Harvey Brooks, the public at-large is more likely to be persuaded by arguments employing statistics because these statements will be perceived as more "scientific " than less tangible strategic and political arguments (Brooks). Nuclear power proponents appear to subscribe to this view. The nuclear industry made a strategic choice in the 1970's to shift the nuclear power debate from a question of ideologies to a technical debate about the estimated engineering risks associated with plant operations (Starr). Industry officials believed statistics demonstrating that nuclear plants would be as safe as activities like, driving your car would convince citizens to accept these power plants (Schwing & Albers; Starr; Lindrell & Earl; Slovic, Fischoff & Lichtenstein). Presumably a portion of the population was swayed by these statistics.

Lastly, agencies complete scientific and technical analyses to fend off court challenges. Regulations and standards must be based on a plausible body of evidence or argument so as not to be deemed "arbitrary and capricious" (Brooks). Defensible standards must be based on a rationale analysis supporting the final regulatory decision. In 1983, the OSHA benzene standard was overturned as being "arbitrary and capricious" because OSHA could not cite sufficient technical analyses justifying workplace exposure standards (Nyhart & Carrow).

The need for scientific expertise is clear. Policy makers want to make informed decisions. In most cases that requires conducting technical studies. Within the past decade however, the public has come to mistrust technically-intensive policy decisions (Nelkin & Pollak). To overcome their fears, citizens demand access to the policy making processes and the studies decision makers are likely to use to support their actions (Nelkin & Pollak). In reviewing complex environmental disputes, however, the lay public is more easily swayed by statistics than ideological arguments (Brooks). The appeal of numbers to citizens combined with the agencies' desires to produce legally defensible regulatory decisions leads policy makers to request scientific analyses (Nyhart & Carrow).

## SOURCES OF DISAGREEMENT AMONG EXPERTS

As I described above, policy makers in technically-intensive disputes rely on experts' analyses. However, in many cases while the policy makers are seeking a consensus expert view, they receive a wide range of conflicting opinions (Brooks; Ozawa & Susskind). Frequently no expert consensus exists to conclusively lead policy makers to a particular decision or, show citizens that the policy choice is either unequivocally right or misguided.

Drawing on a recent categorization of the sources of scientific disagreement presented by Connie Ozawa and Lawrence Susskind. I will discuss four categories of disagreement: 1) rhetorical presentations 2) differences in the design of inquiry, 3) errors in the analysis, and 4) conflicting interpretations of similar analyses (Ozawa/Susskind).

### Rhetorical Presentations

Experts representing opposing interest groups are likely to disagree and muster rhetorical devices or present information in different forms to bolster their arguments. Rhetorical presentations may occur both when experts are representing their interests or when technical issues are being used to prolong a conflict. Alan Mazur describes how experts participating in debates over fluoridation and nuclear power used rhetorical devices to support their positions (Mazur). Both issues focused on questions of harmful effects, if any, from long-term exposure to low doses of fluorine and radiation (Mazur).

In the fluoridation debate, experts attempted to discredit the opposing view with statements like "no evidence has ever been produced that 1.0 part per million of fluoride in drinking water has or, will harm any living person or thing." This type of all inclusive denial of the opposing experts' view also occurred during the nuclear power debate "no evidence exists for such an effect (i.e. differential harm depending on the rate of radiation delivery) on cancer or leukemia induction by radiation in man" (Mazur, p.238). By using the phrase "no evidence" the experts obscured questions on the true impacts of either fluoride or nuclear power. In these cases," no evidence" did not indicate that the substance was not harmful, but rather that no investigator tried to document the impacts (Mazur). The impacts may exist. Regardless of the actual effects, interpretations of the crucial "no evidence" phrase could clearly sway public opinion in favor of a technology or substance that might be harmful if investigated (Mazur).

In other cases, experts trying to bolster their cause may present the same facts in different formats. Harvey Brooks describes the debate over the effects of nuclear fallout that preceded the atmospheric test ban treaty of 1963. Experts supporting testing estimated health damages in terms of the increased chances of cancer for each individual exposed to the fallout. The increases, expressed in a fraction, were extremely small. Critics of the testing conversely, expressed the same information in terms of extra deaths occurring worldwide in fifty years. These figures were extremely high, especially when compared to the other fatalities occurring randomly in life (Brooks, p.39).

Differences in The Design of Inquiry

Differences in the design of inquiries may also lead experts to disagree. Though "scientific inquiry" is a rigorous technique to test hypotheses, inescapable subjective choices influence the results. Researchers must frame their hypothesis, specify their assumptions, select their data base, and describe their impact area. Each such "value" choice affects the results of the analysis (Brooks; Ozawa & Susskind). In other words, the experts own values shape their analyses (Nelkin 1978).

Consider the affect of framing the hypothesis. Using the same data base two researchers evaluating the impacts posed by a hazardous waste treatment facility could arrive at vastly different conclusions. One researcher representing community groups may frame the question to select a site that minimizes impacts to the community while, a second researcher may ask which site affords the greatest economic gain for waste generators. The second analyst may be motivated by her background in economics or, like her colleague, be conducting the analysis on behalf of a client with a narrow interest.

Specifying different assumptions can also cause experts to disagree. Alan Mazur description of the dispute over expected deaths from the Atomic Energy Commission's

(AEC's) nuclear power programs is a good example. Two groups of scientists' estimates of the likely cancers per year varied by three orders of magnitude. Yet both sets of scientists used the same methodology. Each multiplied the risk, by the dose per year, by the number of individuals exposed. The source of the discrepancy can be traced to the different estimates of dose per year (Mazur). One expert assumed that the value was based on the permissible level of exposure, while the second expert based his/her value on the actual average exposure to the population. Since the actual exposure level is smaller than the permissible level, it explains the different estimates of cancers per year (Mazur, p. 250).

Selecting a data base can lead scientists addressing the same question to reach contradictory conclusions. During the fluoride controversy, scientists frequently dismissed as invalid data that did not support their hypotheses (Mazur, p.255).

Errors in Analysis

Errors in the analysis may also lead experts to conflicting conclusions. During the Agent Orange debate, a study suggesting that the chemical might create malformations and tumors caused considerable controversy. But further examination of the study revealed an erroneous analysis. Yet, the work sparked heated debate among interest groups representing affected interests (Wessel, p.49).

Conflicting Conclusions

Finally, even if scientists share the same ideology, agree on the design of the inquiry, and do not make errors in their analysis, they may interpret the results differently thus, reaching conflicting conclusions (Mazur, p.255-256). Consider recent attempts to regulate carcinogens. Existing experiments test the effects of possible carcinogenic substances on animals. Some scientists infer from these experiments that a substance causing tumors in animals can be extrapolated to show a similar causal link in humans (Nyhart & Carrow, p.71) Others reject the validity of extrapolating from animal experiments to humans and, thus, do not endorse the policy implications supported by the first group of scientists (McGarity).

Ozawa and Susskind describe a situation in which two geologists are asked to review historical seismic activity data to forecast the likelihood of an earthquake. The existence of a geological fault line in a seismically inactive area with but no perceptible tremors in 40,000 years, could be the basis of two interpretations. One geologist might feel the data suggests that a future earthquake is highly unlikely, while a colleague may conclude the fault line forebodes an earthquake (Ozawa & Susskind, p. 14).

DEALING WITH DISAGREEMENTS

Given the many reasons experts are likely to disagree, it is not surprising that environmental policy makers can become frustrated (Nelkin). The various sources of expert disagreement spelled out here indicate the numerous reasons why experts will present conflicting conclusions to policy makers.

In environmental policy disputes, mediators can play a key role in helping policy makers and other stakeholders use scientific expertise to reach consensus.

A dispute over the siting of a proposed resource recovery facility illustrates that even when disagreement among experts and uncertainty over technical information persists, a mediator can help disputants produce constructive strategies that will guide future policy choices. In this case the mediator worked with experts both associated with the disputants (scenario A) and independent experts (scenario C).

Brooklyn, New York Resource Recovery Dispute

Siting a resource recovery facility at the Brooklyn, New York Navy Yard involved a controversy over smokestack emissions. At the center of the dispute was the New York City's Board of Estimates (BOE) decision regarding constructing and operating a resource recovery plant at the Brooklyn Navy Yard. The BOE is responsible for approving a plan to handle the City's 20,000 ton per day solid waste stream (Konkel).

The New York Academy of Sciences convened a policy dialogue to help resolve the disagreement over the public health impacts from plant operations (Block). The Academy selected Lawrence Susskind, Professor at the Urban Studies Program at the Massachusetts Institute of Technology to facilitate the dialogue. His responsibilities at the meeting included moderating discussion and questions; maintaining a visual record of key points, particularly points of scientific agreement and disagreement; and outlining a future research agenda to resolve the remaining scientific questions (Ozawa & Susskind). The 65 dialogue participants included: a panel of five experts not personally associated with the controversy, representatives from city agencies, interested citizens, organizations and scientists associated with the disputants (Academy).

The dialogue helped all participants to recognize that the experts had different levels of confidence their descriptions of how dioxins and furans are formed and in their forecasts about how these emissions would effect human health (Ozawa & Susskind). Discussing the experts' views helped the parties understand why two risk assessments, one prepared for the City's Department of Sanitation and a second, prepared for a local citizens group reported such radically different conclusions (Ozawa & Susskind; Konkel). The City's report, completed by Fred C. Hart and Associates, Inc., estimated that six additional cases of cancer could be expected for every million people exposed to plant smokestack emissions over a 70 year lifetime (Konkel). The Hart researchers judged this risk to be acceptable. The Barry Commoner report, prepared on behalf of local citizens, in contrast, estimated an additional 1430 cancers per million people exposed to plant emissions, creating an unacceptable public health risk (Konkel).

The mediator helped disputants trace the source of the different reports' conclusions by focusing the dialogue on the reports' assumptions (Konkel). The participants (experts and lay persons) realized that what they originally perceived as a theoretical disagreement about how dioxins are formed and transported, clearly emerged as a difference in the prescribed design of the risk assessment studies (Ozawa & Susskind). The Hart consultants estimated the likely public health impacts from only one plant. Commoner's analysis was based on likely emissions from a series of plants. Commoner asserted if the City approved one plant it would create a precedent to approve the additional plants. His study therefore, evaluated the impacts from a series of resource recovery facilities' emissions (Ozawa & Susskind).

The mediator also asked the experts to explain their assumptions about the level of emissions likely to come from one plant. This questioning revealed to the participants that the Hart researchers assumed emissions would be lower, based on monitoring data from cleaner plants than the Commoner report relied on (Konkel). Once the dialogue participants were able to understand the reasons for the range of experts' opinions, they were able to devise strategies to cope with the uncertainty and the likely effects of smokestack emissions. With the mediator's assistance the participants agreed to pursue further research to improve monitoring procedures, explore the advantages and limitations of recycling and separating solid waste, and to explore insurance options that would protect the community against unanticipated events from the facility operations (Block). Disputants and the Academy staff believe that clarifying the reasons for the different risk assessment estimates and experts' confidence in existing monitoring procedures helped policy makers from the BOE clarify the confusing technical information as they were being asked to make decisions over whether to license resource recovery facility (Block).

The City decided to go ahead and construct the first plant, but the Request for Proposals required the project developers to prepare a detailed emissions monitoring program and to accept the liability for shutdowns if certain operating criteria were not met (Susskind). Both specification grew out of the dialogue session.

## HOW MEDIATORS CAN HELP

Because mediators do not hold a stake in environmental disputes and are interested in designing a fair process, they can facilitate communication both among the experts and between the experts and the disputants. As the New York resource recovery cases shows, a mediator may convene experts to dissect the underlying reasons for their conflicting views. Uncovering the sources of the experts' disagreement can, in turn, make it easier for experts to communicate and for disputants to understand the diversity of experts' views. During such dialogue sessions mediators may ask probing questions to help experts uncover the sources of their disagreement. In the NY case revealing the sources of disagreement only occurred when the experts were asked to explain their risk assessments to the other participants (experts and lay people). Mediators can also keep track of the key points on wall notes visible to all participants. Susskind generated these wall notes which helped participants shape strategies to monitor plant operations. Even if all the points of disagreement are not resolved at negotiations, the mediators can assist disputants build contingency plans allowing them to adapt their policies as new information becomes available. The NY monitoring plans and strategies to use insurance to protect residents against specified emissions levels were both contingency type plans that come out of the dialogue session.

It is easier for mediators to help when the disputants want to be at the negotiating table. Disputants will come to the negotiations only if they have no better alternative to a negotiated agreement (BATNA) (Fisher & Ury). The BOE alternative to participating for instance, was to continue to bear scathing public outcries against the facility. And, citizens groups could only turn to the court and media. Disputants must also be willing to accept the experts participation. If, for example, members of the BOE had not met with experts contending different views, they would have been less likely to understand the reasons behind the vastly different risk assessments -- Commoner and Fred C. Hart Inc.. Experts too must be open to discussing their views. They must agree, like the disputants, that the motivation behind their dialogue is to reach consensus on an environmental policy.

CONCLUSION

In essence policy makers must realize that the scientific analyses they request may often be in conflict. The sources of the experts' disagreements range from agreeing on analyses but presenting the information differently to, fundamental differences in the design of the research question. In either case, it is easier for policy makers, or any individuals involved in a negotiation, to interpret conflicting technical information if they know why the experts disagree. If the disputants recognize the difficulty they are having interpretating opposing experts' views they may choose to call in a mediator, who as a non partisan individual will not represent any disputant. The mediator offers assistance in focusing discussions on why the experts disagree. He or she can push experts to explain the basis for their concluding statements and reveal assumptions that shaped their studies.

# CHAPTER II
# HELPING DISPUTANTS GAIN A SHARED UNDERSTANDING OF THE NATURAL SYSTEM

In environmental disputes, I believe it is important for disputants to hold a shared understanding of the water, air, and land use system at the heart of the controversy. Mediators can help the disputants achieve a better understanding of such systems by working with experts associated with the disputants (scenario A) or independent analysts (scenario C) to explain how the systems work. Shared understanding occurs when all the disputants have at least the same basic knowledge about the natural or technical system.

Roger Fisher and William Ury in Getting To Yes indicate that diagnosing a problem, what I have called explaining the relevant natural system, is a key ingredient to inventing options that satisfy the disputants' interests. They point out that, all too often negotiators fail to reach agreements maximizing the gains for all parties because they did not share the diagnosis of the problem. Thus, if the disputants understand the systems central to the dispute, they are more likely to invent options which expand the combined gains to all parties (Fisher & Ury).

## MODELING THE NATURAL SYSTEM

Support for this idea is offered by C.S. Hollings, in Adaptive Environmental Management. He contends that policy design should begin with a description of the natural system. A model is frequently an effective descriptive device. Ideal models of a natural system must be: specific, inclusive and transferable (Hollings). Hollings applied his views as a technical expert hired to model the way forest resources are affected by outbreaks of the spruce budworm (Hollings).

Spruce Budworm Dispute

In the budworm case, Hollings and his colleagues developed a model to help less technically oriented policy makers understand the factors affecting a forest resource system (Hollings). The experts were called in by policy makers and did not represent any individuals or organizations involved in the dispute. The environmental policy question facing parties in New Brunswick, Maine was how to effectively manage the spruce budworm. Periodic outbreaks of the budworm had defoliated large areas of North American forests. During one such outbreak, a substantial proportion of the mature softwood forest was destroyed (Hollings).

In response to concern over damage to forest resources and regional economic viability, the Canadian government undertook a spraying program to control the spruce budworm. Although the spraying program minimized tree mortality, it produced incipient outbreaks of the budworm over an even greater area than before (Hollings). This occurred because the spraying also killed the budworm's natural predators. Policy makers, lumber industry representatives, environmentalists, and scientific experts questioned whether spraying was the appropriate technique to maximize timber harvests and control the worms (Hollings).

To help policy makers and interested citizens improve their understanding of the budworm's lifecycle, the government asked scientific experts, including Hollings, to prepare an ecological model of the forest resource system (Hollings). The experts were careful to incorporate in their model any variable that had a major influence on the ecosystem, thus making the model inclusive. The experts initially included over 200 variables before categorizing them into four groups: host trees, weather, and natural enemies of the budworm (Hollings).

The resulting model was also specific because it included trees native to the New Brunswick region and local meteorological conditions (Hollings). Had the experts adopted a general model of insect cycles they might have overlooked unique local conditions such as the budworm's natural predators living in the New Brunswick area.

To make the model transferable, the experts prepared a 4 minute motion picture describing their analyses. Workshops were also held with other scientific experts, policy makers, and environmentalists to discuss the accuracy of the model (Hollings). The experts used these two media-- a film and workshops -- to communicate the information in their model to individuals interested in the problem. A successful transfer occurred because, the non experts end up with a shared working knowledge of the natural system (Hollings).

This case depicts the ingredients of a useful model describing the natural system. In a negotiated setting, similar descriptions could help disputants create agreements which would maximize their joint gains. Not all models adhere to Hollings criteria and may in turn be less valuable to disputants.

## NOT UNDERSTANDING THE NATURAL SYSTEM

A dispute over the operating procedures of several existing and one proposed nuclear power plant along New York's Hudson River illustrates how employing a model that is neither specific nor inclusive can prevent disputants from reaching agreement (Talbot). Without a knowledge of the river's ecology, the disputants found it difficult to agree on appropriate operating practices for nuclear power plants (Talbot).

### Hudson River Dispute

The primary parties to the dispute over power plant licenses were environmental organizations, utilities, and the EPA. Environmentalists were represented by Scenic Hudson, the Natural Resources Defense Council (NRDC), and the Hudson River Fisherman's Association. These groups were concerned about the potential impact of plant operations on fisheries, particularly striped bass. They suspected warm water discharges and the absence of screens to prevent fish from being sucked into cooling intake pipes were killing many of the river's fish (Talbot).

Five utilities were involved in the dispute (Talbot). Consolidated Edison and the New York State Power Authority each owned a nuclear power plant at Indian point. Two new and two older oil fired plants along the same 25 mile stretch of the river were owned by a combination of: Central

Hudson Gas and Electric, Niagara Mohawk, Consolidated Edison, and Rockland Utility. Consolidated Edison was also proposing an additional nuclear power plant at Storm King on the Hudson. Because of its size and involvement in all the proposed or recently built Hudson River plants, Con Ed emerged as the lead utility (Talbot). In general, Con Ed and the other utilities hoped to minimize plant construction costs and operating costs. They were, however, willing to alter their plans to protect the fisheries as long as the existing plants remained profitable and the proposed nuclear plant at Storm King would be profitable (Talbot).

EPA was responsible for assessing the combined effect of all the plants when it assumed responsibility for curbing pollution into the Hudson River, under the Federal Clean Water Act.

After ten years of legal battles over power plant operations on that stretch of the Hudson river, the parties agreed to participate in a mediated negotiation (Talbot). Russel Train, former EPA Administrator and President of the World Wildlife Fund was selected by the parties to mediate the dispute (Talbot).

At one point during the negotiations Train suggest a technical subcommittee of experts, selected by the parties, be formed to clarify the sources of fish mortality. The experts were all representing disputants (scenario A). These experts focused their research on the impacts to fish from warm water discharges and cooling intake pipes, but did not consider other possible causes of fish mortality. The disputants found the subcommittee's description of the way fisheries were affected by river activities.

They contended that being sucked into a cooling intake pipe or being exposed to warm water were only two of many potential dangers to fish. Larger predators threaten fish life. The availability of food, levels of pollution, and the amount of rainfall also affect fish mortality (Talbot). The subcommittee's work was rejected primarily because their description of the natural system did not included these factors (Talbot). Committee members felt that the experts' model minimized the complexity of the factors affecting fish mortality (Talbot).

In response to the Committee members concerns, the mediator added non-experts to the technical subcommittee and asked them to redesign a more comprehensive description of the factors likely to cause fish mortality. The new subcommittee accepted a more complex and inclusive model developed by one of their members, who was a consultant to the US Department of Interior. The consultant programmed his computer to account for a variety of power plant operations, including water runoff and pipe intakes; fish population cycles; the level and direction of river flows; and water temperature. The revised description was accepted by the disputants and proved to be an important basis for the final agreement (Talbot).

The mediator's response to modify the subcommittee membership and suggest a new look at the problem helped maintain a problem solving momentum. Without his push, the negotiations might have stalled.

BENEFITING FROM A SHARED UNDERSTANDING OF THE NATURAL SYSTEM

The Patuxent river water quality dispute illustrates how a greater understanding of the natural system at the heart of the dispute helped negotiators reach consensus. This decade-long dispute over how to manage the river's water quality was resolved after the technical experts representing the disputants (scenario A) agreed on a description of the Patuxent's hydrology. Prior to mediation, the disputants were unable to agree on a water pollution control strategy because, in part, their experts disagreed on what to include in the hydrological model.

This vignette highlights how the mediator helped experts debate the elements of their hydrological model and why this debate was a necessary pre-condition to the experts reaching consensus. The Patuxent dispute is also a good example of how mediators can improve communication between experts and disputants with minimal scientific backgrounds.

<u>Patuxent River Dispute</u>

The Patuxent river travels 110 miles from the rapidly growing Baltimore/Washington suburbs through several rural counties until it empties into the Chesapeake Bay. For over a decade the fishing, farming and tourism interests along the southern portion of the river were at odds with the growing northern suburbs over water quality (Clark-McGlennon (CMA)). Southern counties objected to the explosive economic growth in the northern counties, which they believed degraded water quality in the southern portion of the river. Northern counties were concerned that the southern counties' proposals to restrict nutrient discharges from Sewerage Treatment Plant's (STP's) would constrain economic growth (CMA). Both sides had marshalled scientific experts to challenge the other's hydrological model and associated water pollution control strategies (CMA).

The 1977 Clean Water Act Amendments to the Federal Water Pollution Control Act required EPA to raise the quality of the water in the country's rivers to a "fishable and swimmable" level. Regional Water Quality Management Plans (208 plans), describing how these objectives would be met were required for every river basin. Federal funding for water quality improvement projects was tied to completion of a 208 plan (CMA).

The Patuxent River 208 plan was the subject of considerable debate. Disagreement over a nutrient control strategy placed their $29 million federal grant in jeopardy (CMA). The state Office of Environmental Programs (OEP), however, managed to reserve the funds by agreeing to submit a scientifically defensible, publicly acceptable water pollution control strategy to EPA by January 15, 1982 (CMA).

OEP Assistant Secretary William Eichbaum believed mediation could help the disputants reach agreement. The 43 parties to the negotiation included: state OEP officials; the state's consultants; and scientific experts and laypersons representing both the northern and southern counties. Clark-McGlennon Associates (CMA), a private consulting firm with experience in environmental dispute resolution was called in by Eichbaum to mediate (CMA).

The mediator scheduled two meetings - a technical workshop and a larger negotiating session -- called a charrette. The goal of the technical workshop was to reach agreement on how the river functioned (CMA). The mediator hoped that the scientific consensus would give the parties at the subsequent charrette a shared understanding of the Patuxent River's hydrology. The mediator also believed that such a shared understanding would, in turn, help the parties evaluate the ecological implications of alternative nutrient control strategies (CMA).

Eighteen scientific experts participated in the day-long technical workshop. They were selected to represent the state's, northern counties', and southern counties' views (CMA). Prior to the workshop, these technical experts had never been asked to produce an agreement on how the river's hydrological system operated (Sachs).

During the first part of the workshop, the mediator asked the experts to focus on what they felt were the key technical issues (Sachs). The experts recognized that before they could discuss a hydrological model they had to agree on basic assumptions (Sachs). They therefore discussed and reached agreement on a data base of existing pollutant levels, acceptable water quality thresholds, and sources of pollution (Sachs). In the afternoon, the experts analyzed how pollutants moved within a specific section of the river. The emerging consensus contradicted traditional views. The experts agreed that nitrogen was at least as damaging a pollutant as phosphorous (CMA). Until the workshop, the state had been using a hydrological model that focused on phosphorous and excluded nitrogen (CMA). Phosphorous was traced to effluent from sewerage treatment plants (STP's) located on the northern section of the river. Runoff from the southern counties' farm fertilizer (and manure) was judged by the experts to be the primary source of nitrogen (CMA). The revised description was ultimately more specific to the Patuxent region than the previous state sponsored model, since it incorporated the farming activity along the southern river banks.

Three aspects of the scientific consensus influenced the final action plan agreed upon by the disputants.

1. The river has a "carrying capacity" which limits the amount of phosphorous and nitrogen it can accept,
2. nitrogen is a more harmful offender than phosphorous and should be removed from the river, and
3. non-point sources of nitrogen and sediment (i.e. fertilizer and manure runoff) are responsible for at least as much damage as point sources (i.e. phosphorous).

At the conclusion of the meeting, the mediator worked with the experts to write a working paper for the less technically-skilled disputants describing the experts' definition of water quality and their suggestions about how best to manage and to maintain water quality (CMA).

Participants at the follow-up charrette relied on the consensus document to help them develop an acceptable nutrient control strategy (CMA). In this case, there are at least two reason why the consensus document effectively conveyed the experts' knowledge of the natural system to the other negotiating parties. First, the technical agreement was written in ordinary language making it easier for non experts to understand (CMA). Second, the mediators requested several of the experts who participated in the technical workshop attend the charrette to answer questions raised by the participants (CMA).

At the end of the 3 - day charrette, the negotiators agreed on a water quality plan that satisfied the southern counties' concerns over water quality, and the northern counties' concerns over growth management. Since the plan also met EPA requirements the Agency released the federal grant money to support pollution control activities along the Patuxent (CMA).

HOW MEDIATORS CAN HELP

Without a mediator, experts may find it difficult to communicate their analyses of complex systems to non technical disputants. Mediators for example, can encourage experts to use plain English in their descriptions, making it easier for the disputants to digest technical information. When they judge the disputants will benefit from a discussion of the scientific issues, mediators may suggest a meeting with the experts. As a new intervenor to often long standing disputes, mediators bring fresh spirit to the negotiations. Their encouragement can spark experts and disputants to continue trying to reach agreement.

Reducing Jargon

Experts describing a natural or technical system are likely to use a specialized vocabulary which may be as difficult to learn as a foreign language. This was true for experts involved in the Patuxent River dispute. The mediator however, realized the level of jargon the non-experts disputants would be able to comprehend because he had discussed the technical issues with the disputants prior to the negotiations (CMA). The mediator suspected technical language would be most troublesome when the experts explained the results of their technical workshop to the disputants. Therefore at the conclusion of the technical workshop, the mediator suggested the experts prepare a document describing their consensus on the river's hydrology in ordinary language. The mediator reviewed each sentence with the technicians to ensure it was written in plain English (Sachs).

Though there was no mediator in the Spruce Budworm dispute, the experts were particularly sensitive to using confusing language. Because these experts were aware of how lay people would react to ecological models they took the time to think out a way of presenting their analysis in comprehensible terms. Their solution was to develop a film, in ordinary language, to explain the model and hold a series of workshops during which individuals could question the experts' about how they designed their model (Hollings).

<u>Suggesting Meetings With Experts and Disputants</u>

Mediators can suggest that the disputants request the experts' attendance at negotiating sessions thus, avoiding situations when the disputants must rely on the experts' written reports to explain complex technical ideas. In the Patuxent dispute the mediator suggested that that technical experts participate in not only the technical workshop but, be present at the charrette to discuss their views on the river's hydrology (CMA). The disputants agreed. The experts participation proved instrumental in helping disputants internalize the written description of the Patuxent's hydrology (Sachs).

<u>Bringing A Fresh Problem Solving Spirit</u>

Both the Patuxent and Hudson River disputes were more than a decade old before a mediator joined the process. The mediator offered new momentum and a different approach to help resolve long lived controversies. In the Patuxent dispute, the mediator suggested a set of meetings and a schedule that helped disputants envision an end to their dispute. The mediator in Patuxent was also aided by a court imposed deadline to reach consensus. Environmentalists, utility and EPA representatives involved in the Hudson River dispute were worn out by ten years of litigation and no solution. They viewed mediated negotiation as a preferable alternative to continued court battles.

According to a lawyer representing the utilities "It (the legal battle) was getting boring" (Talbot, p. 13). The environmentalists' attorney believed "no one would benefit by continuing what amounted to a stalemate" (Talbot, p.13). Thus, both sides' lawyers were ready for the intervention of a mediator who, offered a new process, negotiation, and who, they hoped, would kindle a problem solving spirit (Talbot).

# CHAPTER III
# HELPING DISPUTANTS UNDERSTAND THE CONSEQUENCES OF PROPOSED AGREEMENTS

My second hypothesis is that consensus is more likely when disputants understand the effects that proposed agreements are likely to have on them. Experts, typically associated with the mediator (scenario B), can be asked to forecast the consequences of various proposals. If parties to the negotiation do not comprehend the consequences of alternative agreements, they may reject the proposals simply because they do not trust the other disputants' motivations. Even if disputants are confident that a proposal is offered in good faith, they may still find it confusing to visualize the results over time. Examining the long term effects to the disputants is particularly useful in environmental disputes, characterized by their complexity, technical uncertainty, and impacts on future generations (Susskind). Finally, using experts' forecasts, based on a common set of assumptions, provides disputants with a mutual picture how the agreement could be implemented. Without a shared forecast, disputants may reject a proposal because they misinterprete a part of the agreement or because they adopt inaccurate assumptions. Mediators can oversee experts who are devising forecasts that will help disutants reach a non partisan, long run, and common understanding of the consequences of agreements.

## COMPUTER MODELS AS FORECASTING TOOLS

Since many environmental disputes are multi-party and involve complex natural systems (Bingham), it may be difficult to understand the consequences of proposed agreements. Experts with specialized knowledge can assist disputants envision how their interests will be affected by alternative agreements. Often experts use computer-based models to make forecasts. Computer models offer the possibility of modifying components of possible agreements to explore how such changes might affect disputants. Using a computer model accepted by all disputants also allows these negotiators to disassociate the proposed agreement from the individual who suggests it.

The mediators role in these situations is to be sure that the experts recognize the disputants' concerns so that their models estimate how proposed agreements will affect the disputants' interests. Mediators are therefore, often involved in selecting independent experts and structuring their forecasts to be both credible to disputants and responsive to their concerns.

FORECASTING THE CONSEQUENCES OF AGREEMENTS

Disputants involved in the U.S. Environmental Protection Agency's (EPA's) first negotiated rulemaking project relied on a computer model to overcome their bias towards a particular proposal and to consider other proposals which would satisfy their concerns. The expert's forecast also aided disputants trying to envision how the impacts from the agreement would change over time. In this case an expert worked with the mediator (scenario B), though he was tangencially associted with EPA.

There are at least two reasons why the expert was able to create a helpful forecast. First, he realize what the disputants cared about since the mediator had pushed disputants to articulate their interests and then focused the negotiations on fulfilling the stakeholders' concerns. The expert's model was, in turn, developed to demonstrate how each proposal affected the disputants' primary interests. Second, the mediator encouraged the expert to be accessible to the disputants to discuss the assumptions behind his model.

Noncomformance Penalties - Negotiated Rulemaking

In 1982, the U.S. Environmental Protection Agency (EPA) decided to test the usefulness of face-to-face negotiations as a supplement to its existing rulemaking procedure (Kirtz). In its first negotiated rulemaking demonstration, EPA chose to negotiate Nonconformance Penalties (NCP's) (Susskind & McMahon). As part of the project the Agency hired a mediator to improve communication among disputants by convening and facilitating the negotiations (Schneider & Tohn).

Under the Clean Air Act, EPA must set emission standards for heavy-duty engines based on the performance of the most "advanced" manufacturers. Section 206(g) of the Act requires EPA to issue certificates of conformity to any class or category of heavy-duty vehicles or engines that exceeds an allowable emission level (Susskind & McMahon). The nonconformance penalty (NCP) should be designed to cost the engine manufacturer at least as much as compliance with the standard and create financial disincentives for continued noncompliance. Though the Clean Air Act amendments were passed in 1977, by late 1983 the Agency had not yet developed NCP's (Susskind & McMahon).

David Doniger, an attorney with the Natural Resources Defense Council (NRDC), suggested that the EPA select NCP's for its first negotiated rulemaking demonstration. EPA agreed (Susskind & McMahon). In April 1984, EPA announced its intent to Form an Advisory Committee of negotiate NCP's (Susskind & McMahon). A 22-member negotiating Committee was created under the Federal Advisory Committee Act (FACA) (Susskind & McMahon). Committee members included representatives from the automobile and truck manufacturing industries, state air quality agencies, EPA's Manufacturers Operations Division (MOD), and NRDC. ERM-McGlennon Associates were hired by EPA to convene and facilitate the negotiating sessions (Schneider & Tohn). The mediators (actually a team of up to three people, including myself) believed their role included: identifying potential stakeholders and understanding their concerns about NCP's; scheduling training and negotiating sessions; facilitating communication among disputants to help them reach consensus; and suggesting ways the disputants think about using technical experts (Schneider & Tohn).

At the first negotiating session, the mediator asked the Committee members to separate the NCP issues into categories. The disputants came up with three groups:

1. application of NCP's,

2. penalty structure, and
3. administration and enforcement (Susskind & McMahon).

The mediator then suggested working groups, with representatives from the manufacturing and environmental communities, be formed to address each issue (Schneider & Tohn). The penalty structure working group was saddled with the task of devising a penalty formula acceptable to the disputants. Representatives of the California Air Resources Board, NRDC, EPA, Ford Motor Company and International Harvestor served on the working group (Schneider). A mediator was present at several working group meetings to keep abreast of the issues the group was discussing so, that he could explain the basis of the proposed formulas to other negotiators (Susskind & McMahon).

Wayne Leiss, an Office of Management and Budget (OMB) observer to the negotiations, volunteered to help the working group. OMB was observing the negotiations to ensure that EPA complied with an executive order requiring agencies to make cost effective regulations. Leiss was interested in the penalty formula, had a background in business administration, and was familiar with computer-based spreadsheets. After reviewing the proposed EPA penalty structure, Leiss decided to develop a spreadsheet that would help both the working group and full committee evaluate alternative formula's (Leiss). In this case Leiss was a cross between an expert associated with a mediator (scenario B) and one associated with a disputant (scenario A).

Having observed all previous negotiating sessions, Leiss had listened to the disputants express their concerns. It was relatively easy for him to pick up on these concerns since the mediator had structured the negotiations to help parties affected by the NCP's create a rule that satisfied their interests (Schneider). At the negotiating sessions the environmental representatives explained that they were most concerned about the percentage of the industry that would choose not to comply with the emissions standard and thus, continue to pollute (Susskind & McMahon). Manufacturers who might not be able to meet the new emissions standard explained that they were concerned that the penalty rates not force them out of business (Susskind & McMahon).

Because Leiss recognized the disputants concerns he was able, with the help of Bill Heglund from EPA, to create a computer spreadsheet to assist disputants to estimate the percentage of manufacturers unlikely to comply with the new standard and the penalty these non-compliers would have to pay. The model was developed using Lotus 123, a user friendly spreadsheet software for a personal computer (Leiss). The spreadsheet showed participants how alternative formula's and altering basic assumptions, such as engine costs impacted their concerns -- the percentage of non-compliers and the penalty rate (Susskind & McMahon). Disputants representing both sides found the spreadsheets useful because they forecasted how many manufacturers would likely to not comply and the rate these manufacturers would be asked to pay (Susskind & McMahon).

Leiss's model was more helpful to disputants than a prior EPA model which only showed how agreements would affect the percentage of non-compliers. The EPA model essentially, did not aid manufacturer's trying to evaluate whether the agreement meet their concerns (Leiss).

Another advantage to Leiss's spreadsheet was that it presented forecasts for years one through five. Environmentalists were particularly concerned that the formula assess manufacturers who continued to pollute increasingly large penalties thus, encouraging them to build engines that would meet the emissions standard (Susskind & McMahon).

The mediator mailed the experts' computer outputs forecasting the impacts of at least five formulas to all Committee members (Leiss). A sensitivity analysis, showing how the percentage of non-compliers and penalty rates would change using different parameter assumptions was presented for each alternative. Disputants could therefore, observe how each formula would affect them, given varying estimates of the engine and the compliance costs (Susskind & McMahon).

The participants and mediator asked Leiss to bring his personal computer to the final negotiating session. Until this point, the negotiators only had access to computer outputs produced by Leiss. They had not personally experimented with changes in the formula (Susskind & McMahon). One reason the parties took advantage of the computer capability was that Leiss was accessible to the disputants. He attended each full negotiating session and participated in the penalty rate working group meetings (Susskind & McMahon). Regular contact with the negotiators and mediator, as well as Leiss's interest in the formula, made it easy for the negotiators to suggest he provide them the chance to use his spreadsheet.

Two groups took advantage of the computer capability at the final session (Susskind & McMahon). Representatives of EPA, several states and NRDC caucused to discuss EPA's estimates of engine costs. With access to the spreadsheet, the group representing the environmentalists discovered that they could achieve their goals using a variety of formulas. Prior to the final session, the environmentalists focused on a specific formula and appeared unwilling to consider alternatives (Schneider).

Doniger and Tom Cackette, of the California Air Resources Board caucused to devise a new set of parameters and to run their proposed penalty structure on the computer. Prior to the final session, Doniger and Cackette supported a specific flat rate formula that ensured manufacturers not complying with NCP's, so called "economic laggards", to pay additional penalties (Susskind & McMahon). With the spreadsheet accessible to the parties, Doniger and Cackette were able to compare the impacts of their formula with other alternatives. The computer forecasts helped Doniger and Cackette to devise a solution that escalated penalty fees each year a manufacturer did not comply with the emissions standard but, where the first year's penalty was acceptable to the manufacturers (Susskind & McMahon).

One small manufacturer also relied on the spreadsheet to determine the results of the penalty rate on his engine costs. He was concerned that the penalty might be more than he could afford. The computer output showed him that the penalty was acceptable (Susskind & McMahon).

By the end of the final negotiating session, Leiss had "run the numbers" for over 30 possible penalty structures (Leiss). The impacts of each forecast were kept track of by the mediator. The forecasts helped Doniger and Cackette to overcome their previous distrust of the manufacturers' proposals. The model revealed to the environmentalists that there were a variety of formulas that would penalize economic laggards (Schneider). Manufacturers also learned that several of the proposal would not create penalties forcing them to discontinue their production (Susskind & McMahon).

The "11.37 a.m. scenario", (the time that the computer printed out the final penalty structure), was accepted by all the participants. The final rule adopted by EPA includes the agreed upon formula (Schneider & Tohn).

This case illustrates how when the mediator helps the expert recognize the disputants' concerns he or she is able to develop forecasts that the disputants can use to assess whether a proposal is suitable. The mediator met with the parties to help them articulate their interests. During the initial stakeholder interviews the mediator specifically asked the disputants to describe their primary concerns (Schneider & Tohn). But, the disputants tended to state their positions -- I can not accept a penalty above $X. During several interviews, the mediators had to explain the difference between positions and interests before the disputants could articulate their concerns. Positions describe what you want, while, interests describe why you want it (Fisher & Ury).

The disputants' interests framed the negotiations (Schneider). Environmentalists were willing to accept an NCP as long as it minimized the number of manufacturers who continued to exceed the emissions standards and provided significant economic disincentives to continue paying the penalty (Susskind & McMahon). Manufacturers were open to an agreement if it did not set penalties that would put them out of business (Susskind & McMahon). The expert's model was thus, developed to help both interest groups envision how alternative penalty formulas would impact their concerns. The mediator also encouraged Leiss to explain the assumptions behind his model to the disputants before they evaluated the computer outputs and asked Leiss to run alternative forumlas at the final session (Schneider). A similar spreadsheet computer model was developed by experts called in to assist a mediator working to resolve a sewerage treatment financing question.

<u>Camden Country Sewage Plan Dispute</u>

In Camden County, New Jersey a dispute over financing the regional sewage treatment system demonstrates how disputants can benefit from a <u>common</u> expectation of how an agreement will be implemented. The forecast gave the disputants a shared interpretation of how the agreement, which was written to reflect principles the disputants accepted, would translate into sewage disposal rates (Center). Several municipalities relied on the technical experts to help them gauge the agreement's long term financial implications. The experts in this case were managed by the mediator and did not represent any of the disputants (scenario B). Without a credible estimate of how the agreement would change their rates several disputants were not willing to move ahead in negotiations (Center). The mediator played a critical role in suggesting the disputants use independent technical experts, helping design the rate forumula, and working closely with the experts to make sure their forecast gave the disputants useful information.

Under the Clean Water Act, the 37 municipalities in Camden County were forced to upgrade their sewerage treatment facility. A new regional system was proposed. But the municipalities that would be served by the system realized that their sewage disposal rates would increase. The issue was how to allocate the costs of a new system among the 37 municipalities in the region (Center).

The dispute came before the New Jersey Superior Court. After hearing initial testimony, Judge Lowengrub appointed a special master to help disputants resolve their differences. The New Jersey Center for Public Dispute Resolution (Center) was selected by Judge Lowengrub to manage the mediation process (Center). The Center selected Dr. Lawrence

Susskind, Executive Director of the Program on Negotiation at Harvard Law School and Professor at the Massachusett's Institute of Technology's Urban Studies Department to mediate (Center).

The Center followed an eleven step process:

1. selected a mediator,
2. met with municipal representatives and other parties with an interest in the dispute,
3. drafted an initial set of principles to serve as the basis for an agreement,
4. convened the negotiating parties to discuss the draft principles (June 10, 1985),
5. revised and finalized the principles,
6. conducted a statewide comparative survey of regional utility and sewerage authorities' rate setting procedures,
7. developed a computer model, based on the negotiated principles, forecasting municipal sewerage rates,
8. gathered baseline data on each municipality,
9. ran municipal data through the computer model to forecast municipal rates under several scenarios,
10. completed follow-up conversations with the municipalities to discuss the principles, municipal data and computer forecasts, and
11. summarized the municipalities' views of the proposed agreement in principle (Center).

Many disputants reserved judgement on the proposed agreement "in principle," developed in steps 1 - 5, until they saw how the principles would affect their sewage disposal costs (Center). The municipalities' needs to understand how the agreement might be converted into disposal rates indicates how very difficult it may be for disputants to envision how a complex agreement will be implemented. The agreement in principle was open, municipalities felt, to various interpretations (Center).

The mediator therefore, suggested and the disputants agreed to hire independent technical experts to develop one computer model for all the parties to estimate the likely sewage disposal rates (Center). Without the experts' forecast the disputants might have rejected the proposal simply because they thought it would result in inaffordable rates.

The Center contacted several potential analysts with experience in modeling water supply and disposal systems before they contracted with the New Jersey Institute of Technology's Center for Information Age Technology (NJIT) (McGuire). NJIT professors respected for their water quality modeling experience were selected to develop the computer spreadsheet estimating likely modeling sewage disposal rates (McGuire). Though the parties did not have an opportunity to suggest alternative technical people, none objected to the selection of the NJIT staff (Center).

Because the agreement in principle could be interpretated in a variety of ways, the mediators asked that the model be designed to forecast household rates for each municipality (Center). The estimated rates were believable to disputants, in part, because the Center gave them a chance to review the baseline data on sewage flow and strength; population; and number of households (steps 8 & 10). The NJIT professors' reputations for previous water supply work also enhanced the legitimacy of the forecasts (McGuire).

The Center directed the experts to forecast rates for households in each of the 37 communities under four different funding scenarios, since all were possible under the proposed agreement (Center). The NJIT staff was also asked by the Center to specify how the rates would change in the first, second, and fourth years of operation. The long term forecast addressed municipalities concerned about how much they might pay for the system before the section servicing their area came on line (Center). The Center's staff was in regular contact with NJIT to be sure that the experts were creating a forecast that responded to the disputants concerns -- household rates as each system component came on line.

The NJIT computer forecasts revealed that municipal rates would probably be much lower than many municipalities expected, but higher than one or two of the communities felt they could afford (Center). A strong effort was made by the Center to describe how NJIT came up with the forecasted rates. The Center mailed the results of the forecasts to all municipalities (Center). The mailing also included a summary of the data used and a list of the modeling assumptions to help explain to the disputants how the experts arrived at the estimated rates.

Having seen the forecasts and the municipalities' reactions, the mediation team -- Susskind and the Center's staff-- believed that other solutions not originally considered in the eleven step mediation process would be needed to respond to several parties' concerns over the disposal rates (Center). The judge concurred and agreed to extend the duration of the mediation process by about 8 weeks. By the end of the extension the parties, with the help of the mediator had negotiated a revised cost allocation scheme (Center). The new formula was not based on the quantity and quality of sewage flow, but on a much simpler flat household rate. The revised rate was calculated by dividing the total billing units (households) by the total system operating costs to yield a uniform household rate (Olick). Industry and multi-family units could determine their rates by using equivalent household charts which transform non-residential uses to the equivalent single family dwelling units. Municipalities were thus, able to estimate their future rates under this revised formula without a computer spreadsheet (Olick).

Judge Lowengrub accepted the revised agreement in October 1985. The 37 municipalities are now negotiating individual service agreements with the regional sewage authority (Olick).

In this case the technical experts' forecast was helpful because it responded to the disputants concerns and was believable. The model's credibility was improved because the mediators and experts gave the municipalities an opportunity to confirm baseline data and provided municipal representatives with an explanation of how the computer model was developed. Without the documented NJIT forecast, the municipalities might have arrived at different interpretations of how the proposed agreement would affect household sewerage disposal rates. These conflicting opinions could have created a roadblock to future negotiations. Instead, the experts' forecast became a mutual base from which the disputants worked to create an acceptable plan to finance the new regional system.

As it was the forecast showed that the rates were generally more affordable than many municipalities anticipated, but above the maximum rate one particular community could pay (Center). The subsequent negotiations focused on devising a formula to support the new treatment system that all municipalities could afford (Center).

One key to the successful use of the forecast was the participation of the mediator. The mediator suggested that the disputants use a technical analyst to forecast the rates under the proposed agreement (Center). The Center assumed responsibility for hiring and managing the NJIT professors. This included almost daily contact (I worked with the Center as a liason with NJIT) with the NJIT professors to go over municipal data on population and sewage flow being collectd by the Center and to update the experts on the likely funding scenarios which would impact the forecasts. The funding scenarios were prepared by consultants to the regional sewage authority. The Center also documented the assumptions underlying the NJIT model in a format disputants would be able to understand. A step by step description of how the experts arrived at the municipal rates and a summary of the municipal data used in the model was prepared by the Center and mailed out with all computer outputs.

An international negotiation over how to structure a system to mine sea resources required a far more complex computer model. Yet the impact of the experts' forecast was much the same as in the NCP and Camden cases. The forecasts gave negotiators a common understanding of how alternative agreement might affect them. This case offers an additional illustration of how a common understanding of agreement consequences helped delegates consider and accept a proposal offered by perceived adversaries. Though there was no offical mediator one delegate, in a quasi-mediator role, encouraged the experts to explain their model thus empowering disputants, as in the NCP case to invent agreements. As in Camden case, the perceived objectivity and credibility of the experts and their model made the delegates more willing to believe the forecasts and use the model.

Law of the Sea Negotiations

In 1973 the United Nations General Assembly convened the Third United Nations Conference on Law of the Sea (UNCLOS). Delegates representing 150 countries were charged with developing a plan to ensure all countries maintained an equitable share of the benefits likely to be realized from commercial mining of copper, cobalt, nickel, and manganese from the ocean floor (Sebenius 1984).

By 1978 the LOS negotiators reached agreement on 90% of the contentious issues (Sebenius 1984). Two of the remaining issues were financial. First, the delegates could not agree on a system of payments,(including fees, royalties, and profit shares) private mining operations would pay to other countries supporting the international mining system (Sebenius 1984). Second, the delegates were concerned over how to finance the operations of the organization they hoped to create to manage all seabed mining activities (Sebenius 1984).

A negotiating group was created to tackle these financial issues. Singapore's Ambassador to the United Nations, Tommy T.B. Koh, chaired the group (Sebenius 1984). One of Koh's first actions was to establish a group of "financial experts" to help less technical delegates in the group understand the financial issues. In one of Koh's reports about the negotiation he stated:

> In the group of financial experts we were immediately confronted with the need to agree on a set of assumptions. Without an agreed framework of assumptions it would not have been possible for us to carry on with our deliberations. We agreed that the best study to date was that undertaken by MIT, entitled, "A Cost Model of Ocean Mining and Associated Regulatory Issues" (Sebenius 1984, p.97).

Koh's remarks indicate that the experts played a vital role from the outset and that the mediator and the disputants, as in the Camden case, decided to call in independent experts to explain how proposed agreements would financially affect each country.

The model chosen by the group was designed by a team led by J.D. Nyhart, a Massachusetts Institute of Technology (MIT) Professor at the Sloan School of Management and the Department of Ocean Engineering. The team received support from the Sea Grant Program, a maritime educational branch of the Department of Commerce to develop a computer model that could compare a hypothetical deep ocean mining systems under various conditions (Raiffa 1982).

In contrast to the NCP and Camden County negotiations, the model was not developed initially for the negotiations (Sebenius 1984). A second distinction was that the MIT model was far more complex than either of the two used in the NCP or Camden County disputes. Those spreadsheets were developed on Lotus 123 and run on a personal computer. The MIT model was specifically programmed and run on a larger main frame computer (Sebenius 1981). The model permitted a quantitative comparison of the outcomes assuming different physical, engineering, financial, and regulatory conditions (Sebenius 1981). For example, the model was used to determine how altering the royalties miners would pay to the international community, or changing the discount rates would affect the rate of return individual mining operations could expect (Sebenius 1981).

Nyhart's team derived and documented independent estimates of more than 150 principal parameter values to specify a baseline case (Sebenius 1981). The estimates included costs for research and development; prospecting and exploration; capital investment in mining, transportation, processing; and operating costs. Together these inputs were used to derive the mining rates of return and the costs to each nation of participating in the mining operation which were the primary financial concerns the that delegates were evaluating proposals against (Sebenius 1984).

Despite the highly charged political atmosphere of the UNCLOS negotiations, the model was credible to the negotiating parties (Raiffa 1982). There are at least three explanations (Sebenius 1984).

First, the model was not originally designed for the UNCLOS negotiations (Sebenius 1984). In fact, the technical report accompanying the model made scant reference to the UNCLOS negotiations. Non association with UNCLOS tended to reinforce the delegates' perceptions that the model was not a political tool of any one party (Sebenius 1984).

Second, the model underwent critical peer review at two previous professional conferences (Sebenius 1984). Academics, technical representatives of all the major mining consortia, and assorted U.S. government scientists offered their comments on the model's structure, equations, and parameter values. The MIT team incorporated these comments into a revised model (Sebenius 1984).

Third, when the first run of the model at the UNCLOS negotiations pleased no delegation, the model's credibility was further enhanced (Sebenius 1984). The baseline 18% profitability rate contradicted persistent claims by developed countries that their miners would be unable to pay suggested fees and royalties. The profitability rate also crushed developing countries' hopes that seabed mining would generate vast revenues for the world community (Sebenius 1984).

At Koh's urging the MIT experts explained their model at an informal seminar for members of the financial negotiating group (Sebenius). These session marked the first time that the delegates began to experiment with and trust the results of the forecasts (Sebenius 1984). The seminar was held under Quaker and Methodist auspices, on neutral ground. Attendees questioned the model's assumptions, in particular its baseline values. MIT team members responded to queries by explaining the basis for their assumptions and by demonstrating the model's sensitivity to each factor under discussion (Sebenius 1984).

To demonstrate the model's capabilities Norway's delegate suggested that they run his proposal (Sebenius 1984). The expert team constructed several economic and technical scenarios under which Norway's proposal would actually produce profitability rates that would be unacceptable to Norway (Sebenius). Not surprisingly the demonstration induced the Indian delegate to ask what the results of his proposal would be (Sebenius 1984). Having already analyzed the Indian proposal, the MIT team was able to show that profitability under the Indian proposal would also drop at least as much as under the Norwegian proposal (Sebenius 1984). These test runs pushed both the Norwegian and Indian delegates to modify their initial proposals (Sebenius 1984).

Between 1978 and 1979 Koh encouraged the delegates to meet with the MIT experts to learn more about seabed economics and their financial model (Sebenius 1984). These ongoing meetings gave delegates regular opportunities to use the complex model which they were beginning to feel more comfortable with (Sebenius 1984). After two years of meetings, Koh offered a compromise proposal on financial arrangements. The delegates were now knowledgeable enough about the consequences of a variety of complex financial arrangements to recognize an acceptable proposal (Sebenius 1984). By this time the delegates also trusted the MIT model enough to rely on the model's estimates as a primary evaluation tool (Sebenius 1984).

Delegates from both developed and developing countries believed that the Koh compromise satisfied their interests (Sebenius 1984). Developed countries were concerned about their access to seabed mining resources and the rate of return on country sponsored mining operations (Sebenius 1984). Developing countries were wanted to be sure that they maintained control over international mining even though their countries would probably not have the experience and finances to actually mine resources. Like developed countries, these third world countries were also concerned about the money that they might expect from international mining (Sebenius 1984). According to James Sebenius,

> The results of two years of education made the technical elements of Koh's compromise seem quite clear to a large number of key delegates in the regional groups. Although there were angry rumblings from India and the European Economic Council (for opposite reasons), the main elements of the new Koh proposal survived widespread debate in the 1979 and the subsequent 1980 sessions (Sebenius 1984, p.39).

The hurdle posed by the differing financial intentions was surmounted. The MIT model helped the delegates develop and jointly test the outcomes of proposed financial plans. It is hard to overestimate the effect of this model had on the financial deliberations of the negotiating group (Sebenius 1984).

Although the United States eventually presented a long list of objections that prevented it from signing the final

LOS convention, the financial terms were not an obstacle to the signing (Sebenius 1984).

The UNCLOS illustrates how technical experts can use a model the disputants find credible to evaluate proposals that might not have been considered because they were viewed as championing a political cause. The case also raises the possibility that disputants can learn enough about extremely complex models to use the computer to invent solutions, if the experts meet with them to discuss how the computer model works.

In this case there was no mediator, but a combination of the technical team and a lead delegate, Koh who assumed the mediator's responsibility for helping delegates understand how the model worked. Koh also arranged several training sessions in which delegates could ask MIT experts questions about seabed economics and about how the MIT model was developed. These sessions eventually gave the delegates enough confidence in judging alternative proposals to be able to recognize when a solution satisfied their interests (Sebenius 1984). Koh eventually offered the final solution that satisfied the disputants' interests. The technical team also played a key role. They were interested in helping the delegates reach agreement and applying their model to a real world controversy (Sebenuis 1984). The experts were thus, open to meeting with the delegates to discuss possible solutions to the financial issues facing UNCLOS.

HOW MEDIATORS CAN HELP

It is impossible to know whether the disputants in the three cases described above would have reached consensus without the use of the technical forecasting tools made available to them through the mediator (scenario B). Yet in the NCP, Camden and UNCLOS cases the parties were able to reach consensus, in part, because they got a clearer common understanding of how alternative proposals would affect them. I draw three conclusions from these cases that describe how having a mediator made the experts' forecasts useful to disputants.

Meeting With Disputants to Uncover Their Interests

First, the mediator met with disputants to help them describe their concerns. The disputants were, in turn, able to articulate these concerns to the experts and to insist that the forecasting models showed how proposed agreements were likely to affect the parties' interests. In the NCP negotiations, the expert was aware of the disputants' concerns partly because he had observed previous negotiating session in which the mediator framed the negotiating issues in terms of the parties interests (Susskind & McMahon). He, therefore, developed a model to show the environmentalists the number of manufacturers who would continue to pollute and to show the manufacturers the penalty rates they could expect to pay should they not meet EPA emissions standards (Susskind & McMahon). The computer forecast might have included less helpful indicators of the consequences had the mediator not insisted the disputants forthrightly articulate their needs for agreement.

Experts in the other two cases relied on the mediator or lead negotiator to describe the disputants' concerns. The NJIT professors met with the mediator to go over what the model should measure. As a member of the mediation team I regularly met with experts at the New Jersey Institute to review their computer outputs. My goal was to ensure that the experts' computer runs estimated household sewage disposal rates being served by the system before and after the municipality was hooked up to the new system (Center). Disputants at previous negotiating sessions and meetings with the mediator had identified these two points as their primary concerns (Olick). In the UNCLOS case, lead delegate Koh and the experts themselves assumed responsibility for checking with the disputants to be sure that the forecast was giving them useful information on how each proposal would likely affect mining returns for both developed and less developed countries (Sebenius 1984).

Encouraging Experts to Explain Their Analyses

Second, a forecast is more useful to the disputants when they believe the model is credible. In the Camden and UNCLOS cases and to a lesser extent in the NCP negotiations, the forecasts were acceptable to the disputants partly because the mediator encouraged the experts to explain their models' assumptions and provided the parties a chance to modify the basic data. If the disputants understand the basis for the forecast it will diminish the chances that a stakeholder will wonder how a number was arrived at or, that the stakeholder will find it difficult to explain to their constituents why the agreement fulfills the groups' interests.

During the final computer runs in the Camden case, a mediation team member helped the experts document the assumptions behind their model in language the disputants would understand. Each municipality was also given two opportunties to provide basic data that was input into the model (Center). Delegates to the UNCLOS negotiations were also provided an opportunity to review the data used in the much more complex MIT model (Sebenius 1984). And, lead negotiator Koh convened several sessions in which the MIT experts explained the way their model worked. The mediator in the NCP case did not insist that the expert clearly describe the underlying rationale for his model (Susskind & McMahon). Instead, they relied on his ability to explain the basis for the model in penalty working group meetings and that working group members would help their fellow negotiators understand the model (Susskind & McMahon).

<u>Helping Disputant Select Credible Experts</u>

The credibility of the models used at all three negotiations was further enhanced by the experts' reputations. The medatiator can play a critical role in selecting these experts. In the Camden County case, the mediator not only suggested the concept of using experts but, investigated the track record of potential anlaysts. Led delegate Koh in the UNCLOS dispute recommended that the delegates consider using the MIT model since, it had already undergone an outside peer review (Sebenius 1984). This type of independent critique however, is less likely to occur in smaller disputes where the models are developed on existing software.

Arranging Meetings To Learn About and Use the Computer

Finally, in two of the three cases the mediator arranged meetings in which the disputants were given the tools to use the model to invent solutions. After numerous working group meetings in the NCP case, and background sessions in the UNCLOS case, the disputants felt comfortable enough with the model to test the implications of new ideas without feeling committed to defend them. By drafting alternative financial approaches, disputants in the NCP and UNCLOS negotiations were able to overcome their distrust of particular proposals thus, facilitating agreement (Susskind & McMahon; Sebenius 1984).

# CHAPTER IV
# HELPING DISPUTANTS UNDERSTAND THE SOURCES OF EXPERTS' DISAGREEMENT AND UNCERTAINTY

Disagreement among experts per se is not an obstacle to making environmental policy. It is primarily when disputants do not understand the reasons for scientific uncertainty or the sources of the experts disagreement that they will find it difficult to reach consensus. Without a way of untangling the web of conflicting experts' views, disputants may find the technical issues critical to the debate unmanageable. Experts expressing conflicting opinions are often representing disputants (scenario A) or are part of a debate among experts that is separate from either the disputants or the mediator (scenario C). If disputants are willing to accept a mediator to help them understand why the experts can not agree, this non-partisan helper can assist them by: suggesting a process to discuss the disagreement, maintaining a visual record of the discussion, and then sorting issues into categories.

## IGNORING THE SOURCES OF DISAGREEMENT

Not exploring the sources the experts' disagreement hindered representatives from the EPA and the Tennessee Eastman company from reaching agreement on the specifications for a water pollution discharge permit (Bacow & Wheeler). One obstacle to consensus was that the parties disagreed on the causes of the river's weed problem (Bacow & Wheeler). Consensus might have been achieved if the experts from EPA and Eastman had explored why they held conflicting views.

Tennessee Eastman Dispute

To comply with the federal Clean Water Act (1972), the Tennessee (TN) Eastman Kodak company submitted an application that would allow the company to continue discharging waste water from its plant operations into the Holston river. Under the Clean Water Act, all discharges must be authorized by the EPA. In 1977 the EPA adopted a National Pollution Discharge Elimination System (NPDES) to permit discharges into the country's rivers and streams, as regulated under the Clean Water Act.

TN Eastman is a major chemical processor. Its plant in Kingsport, TN spans more than 400 acres and employs approximately 12,000 people. At the time of the permit review the plant discharged between 400 - 500 million gallons per day of treated waste water to the Holston River. An average city of 5 million people produces roughly the same amount of waste water discharges (Bacow & Wheeler).

At the center of the controversy over the discharge permit was a disagreement over the appropriate nutrient control limits (Bacow & Wheeler). EPA's analyst asserted that the company must meet strict nitrogen and phosphorous discharge limits. Experts hired by Eastman argued that EPA's water quality model did not consider all the relevant sources of nitrogen and phosphorous and, that the company was not the only significant source of these chemicals (Bacow & Wheeler).

Experts representing EPA met with TN Eastman's experts to try and iron out their differences (scenario A). One of the three issues on their agenda was the effects of nutrient discharges on weed growth. This was, in part, dependent on the amount of dissolved oxygen likely to be found in the water under various scenarios (Bacow & Wheeler). Let me explain why.

The level of oxygen in a river affects fish life. When waste enters a river in large quantities a river's oxygen supply becomes depleted. Microorganisms digest the waste, breaking it down into its essential elements -- generally nitrogen, phosphorous, and carbon. These microorganisms draw oxygen to digest waste. The more waste digested by microorganisms, the more oxygen is drawn from the stream. If the level of dissolved oxygen falls below three to five parts per million, fish are adversely affected. If the oxygen level drops to zero all fish life is killed and odorous gases are emitted (Bacow & Wheeler, p.79).

EPA's argument for restricting nutrient limits was based on a laboratory test of river water which suggested that point discharges of nitrogen and phosphorous were primarily responsible for the downstream weed problem. TN Eastman's consultants disagreed. They claimed that nutrients from nitrogen and phosphorous discharges could also be traced to river bottom deposits and river flows from the North Fork of the Holston River. Since these sources of nutrients were not likely to be regulated in the future, TN Eastman contended that it did not make sense for EPA to impose expensive discharge controls on the company. The unregulated sources would continue to produce weed problems, no matter what action TN Eastman took (Bacow & Wheeler).

The experts at the technical meeting tried to negotiate a middle ground compromising the EPA and Eastman positions (Bacow & Wheeler). But they did reach a compromise position (Bacow & Wheeler). And, the experts did not understand whether it was uncertainty over the sources of the nutrients, effects of the nutrients on weeds, or the validity of the laboratory tests on dissolved oxygen that lay at the heart of their disagreement.

At a subsequent public hearing, TN Eastman's experts presented over 70 pages of comments on the proposed discharge permit. TN Eastman's experts overpowered EPA and the Agency accepted TN Eastman's claims.

> In the end, senior EPA officials decided to settle (accept the TN Eastman water quality model) because the costs of continuing the dispute were just too great in light of the potential benefits (Bacow & Wheeler, p.89).

The negotiating parties -- company, environmentalists, and EPA -- never gave themselves the chance to agree on an acceptable discharge level, primarily because they did not clarify the reasons for their conflicting views. Had they explored why Eastman's experts asserted less strict nutrient control limits, or why they felt unsure about EPA's reliance on laboratory tests, they might have been able collaboratively to develop a research agenda to resolve remaining scientific questions or to develop contingency plans should certain expectations over the origins of pollution prove true. The disputants lack of consensus over the nutrient control strategy makes the decision vulnerable to challenge.

EXPLORING SOURCES OF UNCERTAINTY AND DISAGREEMENT

In many environmental disputes the available level of scientific knowledge is not sufficient to answer every question raised; scientific uncertainty and disagreement will come into play (Hollings; Douglass & Wildavsky). Scientists are always trying to gain a clearer understanding of how pollutants travel through the air, or how certain species of fish react to particular chemicals. They also are continuing to refine their estimates of the probability of harm coming to an individual from exposure to a substance or situation or, the likelihood of future events (Morgan; Ruckelshaus). Yet, parties to environmental disputes must make policy decisions without the benefit of conclusive scientific proof. Scientists as I pointed out in Chapter I may disagree, in part, because they have different levels of confidence in their analyses, because there is a research gap, or because there are differences in the design of their inquiry.

Since uncertainty and disagreement among experts are likely to exist, the question is how to cope. I have selected two cases that illustrate ways of resolving environmental disputes in the face of inconclusive analyses and competing experts' opinions. Mediators in each case helped the experts either define a research agenda to resolve unanswered scientific questions or helped the experts see that their disagreement could be traced to different levels (one was more comprehensive than the other) of analysis. Only by exploring the reasons for the experts' disagreement were the mediators able to suggest ways for the disputants to use the technical information and reach consensus.

Scientific uncertainty over the impacts of oil drilling on fisheries in California's Santa Maria Basin fueled a long standing dispute between the fishing and oil industries. But the existence of uncertainty did not freeze the parties. Instead the mediator suggested that the disputants work with the experts to forge a joint research agenda which would address the scientific questions underlying the experts' uncertainty (Susskind & McCreary).

Santa Maria Basin Dispute

Since the late 1960's fisherman had complained that oil drilling activity reduced fish catches (Susskind & McCreary). Oil industry representatives contested these claims (Susskind & McCreary). To help resolve this dispute, representatives from both sides agreed to ask a mediator for help. As the mediation progressed, it became clear to the mediator and participants that the dispute hinged on the different expectations of risks from oil drilling (Susskind & McCreary). Actually, neither side had assessed the effects of oil drilling activities on fisheries. None of the disputants for example, had research in hand describing the effects of seismic surveys or boat traffic on fisheries (Susskind & McCreary).

To further explore the relationship between oil drilling and fish catches, the mediator suggested that the disputants convene a panel of experts on fish behavior and acoustics (Susskind & McCreary). The disputants agreed that the negotiations could not continue until the experts discussed how fish are truly affected by oil exploration. Thus, with the disputants approval, the mediator secured funding and invited participants to a 3-day workshop to prepare a detailed research plan. Participants included experts on various fish species, acoustics and several academic specializations, as well as representatives from both the fishing and oil industries. The workshop was facilitated by a mediator who assisted the participants keep track of their points of agreement and disagreement and, who coordinated the workshop schedule (Susskind & McCreary).

In this case the disagreement was overcome by reducing the level of uncertainty. By gathering experts and disputants together, the mediator was able to help them identify a gap in the existing research on seismic activity. The joint research agenda that came out of the mediated workshop answered questions over the effects of seismic activity of fish on which the dispute hinged (Susskind & McCreary). The disputants agreed to use the research results as the basis for state regulations governing oil exploration (Susskind & McCreary).

The mediator's suggestion to convene a workshop proved particularly helpful to the disputants. Out of the workshop came the research that ultimately shaped the regulatory policy (Susskind & McCreary). At the workshop itself the mediator continued to play an important role by maintaining a group memory of the key points. This common visual record assisted participants once they tried to generate the joint research agenda. Finally, it appears that the mediator offered a new problem solving approach.

Patuxent River Dispute

The Patuxent River dispute offers a different result from exploring the sources of the experts disagreement. A mediator involved in this long standing water quality controversy over Maryland's Patuxent river helped negotiators understand how discharges of nitrogen and phosphorous might affect the river's water quality. The disputants were able to devise a water quality management plan once the mediator helped the experts reached agreement on how to model the river's hydrological system (Clark-McGlennon (CMA) ). The mediator played a key role in this process by suggesting a separate session for technical experts to discuss their conflicting descriptions of how the river handled pollutants. Then at the session, the mediator kept track of the issues under discussion, proposed ways of disaggregating the components of the model, all with a goal towards honing in on why the experts disagreed.

Prior to mediation uncertainty over the probable effect of nitrogen and phosphorous on water quality had stalled previous attempts to develop a water pollution control strategy. At the mediator's suggestion, experts representing counties along the river participated in a technical workshop to analyze why they disagreed (scenario A) (CMA). During the session, they recognized that they held different views on the:

(1) sources of nitrogen and phosphorous,

(2) the way the river flows, and

(3) how the flow was affected by seasonal changes (Sachs).

The experts then debated the elements of the hydrological model and the baseline data which would be input into the model. They recognized that experts representing the northern counties previously omitted nitrogen discharges from their model because they did not have the resources to prepare a comprehensive study (Sachs). By the end of the meeting the experts reached agreement on the issues in all three categories. Their agreement was recorded in a consensus document written with the mediator and presented to the non-expert negotiators at a follow up session (CMA). Disputants were able to agree on the water quality management plan once the experts settled their differences (CMA; Sachs).

This vignette demonstrates that in some situations disagreement among experts can be resolved when a non partisan helper convenes experts with the goal of analyzing the reasons why they do not agree. Though the debate had been active for over a decade, it took the intervention of the mediator and a court imposed deadline to motivate experts representing the disputants (scenario A) to sit down and discuss their differences. The mediator encouraged these experts, listened to them discuss their views and record the issues in categories to highlight points of agreement and disagreement. At one point the mediator drew a spreadsheet and asked the experts to fill in their views under several headings which included: sources of pollutants, pollutant thresholds, and monitoring procedures (Sachs). By using this tool the mediator aided the experts in fractionalizing their disagreement. The chart showed them that the primary reason for their disagreement was a conflicting view on the sources of pollutants, a difference which was easily remedied (Sachs). One set of experts pursuaded the others that their analysis was more comprehensive and thus accurate, since it included both southern and northern counties discharges (CMA).

## HOW MEDIATORS CAN HELP

When the experts disagree, the challenge is to figure out why. In these situations, as illustrated by the Santa Maria Basin and Patuxent River disputes the mediators can be particularly important. Mediators can suggest ways of integrating technical analyses, moderate discussions by keeping visual track of the issues prompting both the experts and disputants to remember points which may become the basis for agreement. Aside from recording issues, mediators can also sort complex information into categories making it less confusing for participants to distinguish between points of disagreement and the reasons for the disagreement.

### Proposing Forums For Dialogue

Mediators in both the Santa Maria and Patuxent cases proposed a process in which experts could meet with the explicit purpose of understanding why they disagreed. A workshop was used in the Santa Maria case, while the mediator in the Patuxent dispute convened a technical session open only to experts (Susskind & McCreary; CMA). No matter the forum, the point to remember is that since the mediator assumes responsibility for the negotiation process, he or she is able to invent a setting that allows experts to realize why they are arguing opposing points.

<u>Creating Visual Group Records</u>

To record the issues being discussed, mediators commonly take notes on large pieces of paper tacked to the wall. These "wall notes" create a group memory. In the Patuxent River technical workshop the mediator created large spreadsheets visible to all experts (Sachs). These sheets were developed to show experts different ways of categorizing their disagreement. The mediator listened to the experts discuss the various aspects of the river system before suggesting the group consider tackling the issues one at a time. He then proposed a list of points for discussion that included: sources of pollutants, direction and rate of river flows, seasonal adjustments, water quality standards, and pollutant impacts on the these standards (Sachs). By disaggregating the larger issue -- the hydrological model -- the mediator got the experts to zero in on why they held different views. The experts eventually realized that the reason they could not agree was because they did not consider the same sources of pollutants (CMA).

A less extensive set of wall notes was used by the mediator in the Santa Maria Basin case who maintained a group record of workshop discussions. These records were, in turn, relied upon by the participants and mediator to summarize the three days of workshop sessions. The final research agenda, supported by the disputants was created during this workshop (Susskind & McCreary).

# CHAPTER V
# CONCLUSIONS

Environmental mediators can use technical expertise to help disputants deal with their differences. One challenge confronting mediators is how to facilitate communication both among the experts and between the experts and less technically-skilled disputants. The following recommendations will help mediators to use scientific and technical expertise to its fullest potential. I offer my suggestions under the three hypotheses put forth in this thesis.

## HELPING DISPUTANTS UNDERSTAND THE NATURAL SYSTEM

As illustrated in Chapter II, disputants are more likely to reach consensus if they understand the natural system at the heart of the controversy. Mediators can make it easier for experts to explain their analyses of such systems. Recall that the experts describing the system are most likely to be working for the disputants (scenario A) or be independent of either the disputants and the mediator (scenario C). My advice is offered to mediators hoping to improve communication among experts and disputants.

* Uncover potential gaps between the terminology experts are likely to use and the language familiar to disputants. If the gap is wide, consider ways to both improve disputants knowledge (i.e. technical workshop, glossary) and encourage experts to use ordinary language.
* Be sure the experts know the geographic bounds and political jurisdictions of the conflict. The experts'

descriptions and analyses will be more valuable to the disputants if they are consistent with these boundaries.

* If during the negotiation process you find yourself shuttling endlessly between the experts and the disputants, suggest a meeting be held in which the disputants pose their questions directly to the scientists.

HELPING DISPUTANTS UNDERSTAND THE CONSEQUENCES OF AGREEMENTS

Experts can also help disputants envision how proposed agreements are likely to affect them. The experts in this situation are typically associated with the mediator (scenario B). Mediators working with these experts should consider the following advice.

* Prior to negotiations, interview potential disputants and ask them to describe their true concerns. If they state their positions instead of their interests, try to explain the difference and encourage them to articulate their interests.

* If the disputants are having difficulty envisioning how proposals will affect them, consider recommending that the group contract with a non partisan expert to forecast the consequences of alternative agreements (scenario B). Having an independent forecast may also improve situations in which disputants are unwilling to evaluate solutions offered by negotiators they mistrust. If the disputants agree to use an expert, be sure to help them develop selection and funding criteria. Ask the disputants to

consider appointing a liaison between the expert and disputants. The mediator, as a non-partisan helper, is probably the most appropriate choice.

* Be sure the experts include issues important to the disputants in their forecasts.

* As the experts are constructing their forecast, insist that they give the disputants a chance to review the basic data. When the parties to the negotiation have access to the data, they are more likely to accept the results.

* Request that the experts document their data sources and describe the assumptions behind the model in simple language. This improves the likelihood that the disputants will understand and trust the experts' analysis. Consider helping experts prepare these explanatory notes to ensure that they are in a form the disputants will find useful.

* If the disputants ask to use the model to invent solutions, try to locate a meeting space that meets the experts' needs and one that is not associated with any of the disputants. This may mean finding access to specific computer hardware or devising a way of getting the experts' equipment to the session.

## HELPING DISPUTANTS UNDERSTAND THE SOURCES OF EXPERTS' DISAGREEMENT AND UNCERTAINTY

As I discussed in Chapters I and IV the experts, be they representing a disputant (scenario A) or independent of the disputants and the mediator (scenario C), may disagree. But, disputants can make decisions even when no scientific consensus exists. One key to moving ahead in spite of the disagreement is understanding why the experts hold conflicting views. Mediators can help disputants understand the reasons for the experts' disagreement, by following the below advice.

* If the disputants feel frustrated by the lack of expert consensus, try to convene a dialogue session to explore the reasons for the disagreement. This is only likely to be useful if the experts are willing to participate in the problem-solving process.
* When the experts are describing their analyses help people remember key points of the discussion by maintaining a visual record, such as a group memory.
* Another task during discussions is to help participants, be they experts or a mixture of experts and disputants, sort out issues. This disaggregation makes it easier for participants to incrementally build agreement. Agreement may mean resolving a previously disputed point, developing a plan to address specific scientific questions, or generating strategies that allow disputants to act in the face of uncertainty.

Finally, along with these techniques and skills, mediators should remember that they can bring energy to the negotiations. This momentum can spark disputants to resolve their differences.

## QUESTIONS RAISED BY THE RESEARCH

As I continue to think about using scientific and technical expertise in environmental mediation, I hope to pursue additional questions raised by this thesis. Under what circumstances for example, are my suggestions to mediators applicable across hypotheses ? Does the structure of the experts' involvement (i.e. scenarios A, B, and C) make it more likely for each of the hypotheses to be relevant. How much technical knowledge should the mediator possess before he or she intervenes ? Does having a specialization in the subject, for instance, make the mediator partisan ? Lastly, what forms of technical assistance can a mediator sponsor that are likely to help lay disputants understand complex environmental issues ?

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