NCU-W-92-004

LESSONS FROM THE NATURAL RESOURCES DAMAGE ASSESSMENT WORKSHOP 1992

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Conducted by the Resources and Environmental Economics Program, North Carolina State University, with assistance from the N.C. Division of Emergency Management; the North Carolina Office of Marine Affairs; the N.C. Cooperative Extension Service; College of Agriculture and Life Sciences, N.C. State University; and the College of Management, N.C. State University.

Published by North Carolina Sea Grant

Publication No. UNC-SG-94-09

Introduction

This report provides an updated summary of the law, regulations and practice of natural resource damage assessment. The original source of much of this material was a set of presentations by W. Michael Hanemann, K.E. McConnell and V. Kerry Smith at N.C. State University as part of a program organized by J.E. Easley Jr. to highlight emerging resource issues of interest to state policy-makers. It was part of the Resource and Environmental Economics Program's activities. In this overview, their comments have been supplemented by materials taken from papers written by each author. This summary draws with attribution from other published and unpublished materials.

Because the rules governing damage assessment have continued to evolve in the two years since the workshop, the summary has been expanded to take account of most recent developments.

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This work was partially supported by Grant NA90AA-D-SG062 from the National Sea Grant College Program, National Oceanic and Atmospheric Administration, to the North Carolina Sea Grant College Program.

Natural Resource Damage Assessment: Some Historical Background

Natural resource damage liability is commonly attributed to the 1980 Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). However, Breen [1989] traces the initial use of the concept to the 1973 Trans-Alaska Pipeline Authorization Act (TAPAA). This statute made the company holding the pipeline right-of-way strictly liable for all damages to natural resources arising from spills of Alaskan oil.[2] Today we understand natural resource damage liability to be a residual liability — after the requirements for cleanup have been met — from releases of hazardous substances or oil into the environment.[3] Responsible parties are liable for: (a) the costs of restoring injured natural resources (as a result of the release) to their original baseline (prerelease) condition;[4] (b) the full economic value of the loss in services between the time of the release and complete restoration or natural recovery (including use and nonuse values);[5] and (c) all the costs to assess the damage.

Depending on which resources are injured, specific trustees are responsible for seeking these damages and for spending that compensation to restore the resources and/or acquire services equivalent to what has been lost. Trustees can include federal government agencies, states or Indian tribes. Indeed, in many situations multiple trustees have interests in specific aspects of injured resources. This can lead to problems of coordination in seeking damages and ultimately in deciding how what is recovered will be used in restoration. This issue is described in more detail as part of the introduction to the examples of past damage assessments that are summarized here.

Notification that a potential natural resource injury exists begins a damage assessment. Next, the final rules issued under CERCLA and the proposed rules for the Oil Pollution Act require assessing whether an emergency situation exists. The designated trustee must prove that the situation warrants emergency action.

A preassessment screen follows notification. During the preassessment screen, the trustee must decide what natural resources have been injured. Once the injury is identified, the preassessment process continues with examination of the injury and determination of its importance vis-á-vis the cost of a full assessment. If this examination results in a decision to undertake a full assessment, the next step is development of a formal assessment plan and selection of methods for estimating natural resource damages. As part of the plan, the trustee must decide the type of assessment warranted — Type A or B — and notify the potentially responsible parties (PRPs) of the trustee's intention to perform an assessment. Type A assessments involve simplified evaluations for small incidents such as releases of small quantities of hazardous substances or oil. Type B assessments involve major cases where it is not possible to use desktop methods to appraise the damages. The focus of the workshop and this report is on procedures for the Type B assessments.

After this section's overview of the law and regulatory background for damage assessment, the remainder of the report highlights three areas that seem especially relevant to practitioners in state agencies that have the prospect of responding, as trustees, to the requirements for damage assessment in the future.

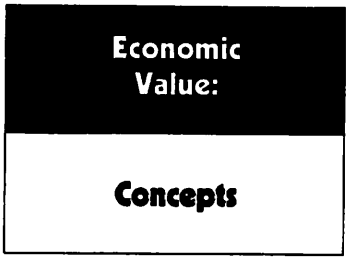
The first area involves the definition of economic value, which is often misunderstood outside economics. The concept of an economic value is critical in developing credible measurements for the monetary values of losses due to injuries to natural resources from releases of hazardous substances or oil. The second considers the lessons from past experience in doing damage assessments and their implications for agency planning. The last area discusses the informational needs for nonmarket valuation methods — including their strengths and weaknesses.

The 1989 Court of Appeals decision in *Ohio v. the United States Department of the Interior* and the Oil Pollution Act (OPA) of 1990 both held that natural resource damage liability requires full restoration. In responding to the original Department of Interior (DOI) rules for damage assessment under CERCLA and the Superfund Amendments and Reauthorization Act (SARA) of 1986, as well as the petitioners' challenges to these rules, the Ohio case observed that the costs of restoring the injured resource(s) to its (their) baseline conditions, along with any interim lost "use" values, provide the appropriate measure for natural resource damages.[6] This decision does acknowledge that CERCLA permitted damage assessment practices with some discretion, "...exempting responsible parties in some cases from having to pay the full costs of restoration of natural resources ..." (p. 21).

From the court's perspective, discretion over whether full restoration cost would be required depends on whether it can be established that these costs were grossly disproportionate. Unfortunately, the court does not offer a basis for how this determination should be made. Both DOI's final rules for Type B assessments and the National Oceanic and Atmospheric Administration (NOAA) proposals for these assessments under OPA have identified broad criteria that permit wide discretion. At present, it is probably fair to say that a more specific determination will likely await court rulings in specific cases.

For the present, most economic analyses have focused on measuring interim lost use values from the date of the outset of injuries until the resources return to their original baseline (or condition prior to injuries).

Interim lost use value corresponds to a monetary measure of the losses people experience because of the time profile of injuries to natural resources that is associated with a particular damage assessment. The term "use value" is sometimes confusing. It does not require *in situ* use of the resource to be eligible as an economic value. The Ohio case ruled that interim lost use values include use values and what the decision described as passive use values. The latter did not require any type of recreational or other observed use. To understand the significance of these terms as components of economic values, we need to consider the fundamental principles underlying the definition of economic values.



Most people naturally think of value as being like a price. If something sells for $6 in a market, then this must be its value. Thus, for these people, economic valuation is the science of market prices. Under this view, if something does not sell in a market, it cannot have a price, and therefore it must not have an economic value. Although this represents a commonly held view of the appropriate interpretation of economic values, it is not correct. The modern perspective on economics recognizes that economic values are not about markets per se but about people, their preferences and their choice-making behavior in relation to scarce resources. Thus, the central organizing principle for economic valuation is not the market but the choice made by a person.

The economic perspective is anthropocentric. When the term "consumer sovereignty" is used in economic discussions, it implies that our evaluations of the importance of different items are based exclusively on people's desires. The key to measuring people's preferences for commodities — any commodity, either market or nonmarket — is to measure their welfare in terms of their income, or rather, to measure changes in their welfare in terms of equivalent changes in their income.

Monetary measures of the values people place on goods and services are based on their choices, which economists assume are reflective of underlying preferences. Economists construct these measures from those choices together with a model of behavior. That model assumes individuals seek to do their best, within the constraints they face. In this context, "best" means that individuals seek the highest level of well-being feasible for them. If the choice situation is one where a person is to select one from a set of alternatives, then best means a person will choose his or her most preferred object from the set of objects available.

Monetary measures of value are derived from this behavior-based model. Value is not the basic concept determining people's choices, but rather value is derived from those choices. Economics does not require one to assume people have within their consciousness a monetized value for every possible good or service that can be effortlessly retrieved each time a choice is contemplated. An economic value constructs the monetary measure by reconstructing the elements involved in the choice.

The formal economic definition of this monetary measure must specify implied property rights. The issue of property rights derives from the fact that in economic choices, an individual is confronted with a decision that involves obtaining some object or losing some object. The former implicitly assigns the current rights to the object to someone else other than the individual. The latter presupposes that the individual has the right to the object and is entitled to receive some payment in lieu of having it. The first is usually described as a person's willingness to pay (WTP) and the second as willingness to accept (WTA).

WTP and WTA are the fundamental monetary measures of value in economics. All economic valuation can be shown to correspond to one or the other. Economists employ theoretically consistent methods for these concepts, for example, when they measure the impact on firms of some event that causes a loss of income or profit; when they measure the impact on consumers of a price reduction, an improvement in quality, or the appearance of a previously unavailable commodity; and when they measure the impact associated with a change in the availability of a nonmarket good, including a change in the quality of the natural environment.

The WTP/WTA concepts define what is now known in the literature as the total value for a specified change in the amount or the quality of an environmental resource. In the context of damage assessment, that change arises because of the injuries to natural resources due to the releases of hazardous substances or oil.

The concept of passive use traces its origins to John Krutilla [1967] and the term "existence values." Describing ways that natural environments, as natural assets, could contribute to people's well-being, Krutilla used existence value. His selection of terminology was drawn from the context motivating his original argument. That is, public decisions can involve situations where such assets may be transformed and the natural conditions irretrievably lost. Krutilla's argument was about recognizing what such natural assets provide to people when left undisturbed and being sure to count the losses of these contributions among the costs of that transformation.

Crucial to Krutilla's description was that the values for these natural assets be derived from people because those assets contribute to their well-being. They were

not inherent to the environmental resources, as some ecologists have suggested. Thus, his existence values are completely consistent with the basic economic model of valuation. Equally important, people did not have to undertake any trips or expend resources to be able to enjoy them. As Plourde [1975] and, later (independently), McConnell [1983] recognized, Krutilla had described a situation where the object of interest to people was a natural public good. Enjoyment could not be excluded and it was nonrival, in the sense that one person's experiencing the enhancements in well-being did not diminish what was available for others. By contrast, in the case of a private good, when I purchase and use a pair of shoes or eat a meal, those shoes or that meal cannot simultaneously be available for someone else.

Most of this literature has focused on how one would relate what could be observed through revealed preference to the total value concept. Observed use values were, by definition, incomplete; a variety of conceptual frameworks has been proposed to describe what is missing — the nonuse or passive use values.

Economic measures of required compensation for injuries associated with releases of hazardous substances or oil correspond to the amount of money, as a lump sum payment, that each individual would be willing to accept to permit those injuries as temporary impacts on the resources. They presume that a restoration plan developed as part of a damage assessment will ultimately assure there is complete restoration of those resources to their original or baseline conditions. The monetary compensation or WTA, relevant for damage assessment, is not a new concept. Rather, it is the total value defined in economics by Hicks [1943] more than 50 years ago. Debate in the recent literature over the appropriate components of value surrounding a damage case has lost a perspective for this development. Because measures of economic values were derived from a revealed preference perspective, the analysis implicitly started with choice situations where there are observable actions, even though such actions do not occur within markets. These observable actions give rise to use values. This focus on observability has led the economic literature to consider whether something has been missed and what that might be.

Nonuse (or passive use) values, as the missing constituent of total value, were always present in the original definition of total values. The restrictions used to estimate the use component of the total economic value from observed behavior tended initially to reduce the attention given to all the ways natural assets enhance people's well-being. This oversight was recognized by Krutilla [1967] and explained as existence or nonuse value. Much of the subsequent discussion has failed to recognize that Krutilla identified how measurement practices could lead to biased estimates. Instead, some recent discussions of passive use value have seemed to turn on their legitimacy (see Sagoff [1993] and Rosenthal and Nelson [1992]). In many respects, these discussions fail to recognize that the arguments have little to do with new sources of value and everything to do with the "public good" aspects that natural assets provide to people (see Kopp [1993] and Kopp and Smith [1993]). As such, passive use losses must count in determining the requisite compensation underlying interim lost use values.

Derived primarily as approaches for estimating the demands (or marginal willingness-to-pay schedules) individuals have for environmental resources, measurement methods are usually classified into two broad groupings — the indirect or observed behavior methods and the direct or survey methods. The first class includes travel cost demand, hedonic, factor income, and averting behavior models. In each case, these methods use information on the actions of individuals (or firms), along with assumptions about what motivates those actions, to estimate an individual's implied marginal value for an improvement in the resource. The specific assumptions used to recover these estimates vary with the modeling framework used, as well as the information available. The two most commonly used approaches in this class for natural resource damage assessments are the travel cost demand and hedonic property value models.

The travel cost model is the conventional approach for estimating the demand for recreation sites. Beginning with Harold Hotelling, this framework relies on a simple insight.[9] Visitors pay an implicit price for the use of a recreation site in the form of the travel and time costs associated with gaining access to the site. Thus, these costs, together with any entrance fees, serve (for a fixed length and single objective trip) as an implicit price for a site's services. By observing site usage from different distances, this method has proved to be exceptionally robust for estimating the demand for recreation sites of all types. Early applications involved data in aggregate form based on origin zones. More recently, on-site surveys of users have provided microdata on individuals' patterns of use of specific sites and their costs. However, these new data sets have created a new range of econometric issues by virtue of failing to observe individuals who decide not to visit each specific site. The actual modeling has largely been single-equation demand models. Yet some authors have used these types of data to estimate random utility models, treating each visit as a decision made independently from all previous trips.[10]

The second common indirect method for estimating the value of nonmarketed resources is the hedonic model. Usually, natural resource damage assessments have relied on variations of the hedonic property value model. Use of this framework relies on two key assumptions to estimate the marginal value of an increase in an environmental good or a decrease in a negative externality. The first assumption involves some clearly recognized (to market participants) technical association between the nonmarketed commodity (or a reliable proxy variable assumed to represent the commodity) and the property whose prices are being analyzed. The assumption is that the property market linked to the commodity (such as a scenic view or noisy highway) is sufficiently open to assure that housing trades will continue until prices provide no incentive for gain from any change in the allocation. Because the commodity involved (housing) is very heterogeneous, the model predicts that a set of prices will be required to generate an equilibrium matching of buyers and sellers. This set is usually assumed to be large enough to be approximated by a continuous function relating the equilibrium prices to the characteristics of each house.[11]

This equilibrium assures that the derivative of the price function with respect to each nonmarketed commodity will provide estimates of the marginal value of that commodity (expressed as the present value). Under certain circumstances, these marginal values can be used to estimate the full inverse demand function for this nonmarketed good.[12]

The remaining indirect approaches, the factor income and averting behavior methods, also use connections between the nonmarketed commodity and production or cost relationships to estimate the value of that nonmarketed resource. The specific details have varied with each situation. Implementing these methods has often proven difficult because analysts rarely have sufficient information on the expenditures individuals make to avoid the effects of an externality. Several studies have found empirical support for this type of behavior, but have been less successful in using them to develop estimates of how people would value avoiding the deteriorations in environmental quality that caused them to adapt these responses in the first place.[13]

All of the approaches categorized as indirect are unified by a common rationale. These approaches use a set of theoretical restrictions, combined with actual observations of individuals' behavior, to model one component of an individual's behavior in related decisions or markets. The resulting model is used to estimate a representative individual's value for a nonmarketed good.

In contrast, the direct approaches involve just that — direct questioning of individuals about the choices they would make if offered some change in the terms of access or quality of a resource. This process involves surveys of households using either personal interviews, telephone surveys or mailed questionnaires. The last two approaches are most frequently used (because of cost considerations). After more than two decades of experience, this method has gained more acceptance among conventional economists.

Indirect methods can measure only the use value as represented by the particular type of behavior captured in each type of method. By contrast, contingent valuation (CV) offers the prospect for measuring the total value a person would place on the commodity (or

change in a resource) as occurs in a resource-damaging event presented as part of CV's proposed choice. Damage assessments have raised the profile of the CV method. In 1992 at an Exxon-sponsored symposium, for example, a number of prominent economists argued that the CV method was incapable of measuring economic preferences (see Hausman [1993]). Since that time, the debate over CV has been extensive, with a variety of evidence being presented in support of and contrary to the method.

Because of this controversy, NOAA assembled a distinguished group of social scientists, including two Nobel Laureates in economics. The group included Kenneth Arrow, Robert Solow, Edward Leamer, Paul Portney, Roy Radner and Howard Schuman. They were asked to evaluate the reliability of CV methods for damage assessment. Reporting Jan. 15, 1993, they concluded the following.

> "... *CV studies can produce estimates reliable enough to be the starting point of a judicial process of damage assessment, including lost passive-use values ... .*
>
> *The Panel is persuaded that hypothetical markets tend to overstate willingness to pay for private as well as public goods. The same bias must be expected to occur in CV studies. To the extent that the design of CV instruments makes conservative choices when alternatives are available, as urged in Section IV, this intrinsic bias may be offset or even over-corrected. All surveys of attitudes or intentions are bound to exhibit sensitivity of response to the framing of questions and the order in which they are asked. No automatic or mechanical calibration of responses seems to be possible.*
>
> *The judicial process must in each case come to a conclusion about the degree to which respondents have been induced to consider alternative uses of funds and take the proposed payment vehicle seriously. Defendants will argue that closer attention to substitute commodities would have yielded lower valuations. Trustees will argue that they have already leaned over backwards to ensure conservative responses. Judges and juries must decide as they do in other damage cases. The Panel's conclusion is that a well-conducted CV study provides an adequately reliable benchmark to begin such arguments. It contains information that judges and juries will wish to use, in combination with other evidence, including the testimony of expert witnesses."*
>
> *(Federal Register, pp. 4610-4611)*

Though the group's overall judgment was favorable to CV, the requirements imposed on CV surveys pose a significant hurdle to meeting the criteria it identified for reliability. More specifically, the panel members propose in-person surveys; the use of the discrete, take-it-or-leave-it format for questions (where each person is presented a choice involving some change in a resource and a cost to him or her if the change occurs); large population surveys; careful attention to the framing of questions with focus groups and pretesting; and several specific conditions for survey designers to establish a level of reliability specific to their survey. These conditions were described as the burden of proof imposed on CV survey practitioners:

> *"Until such time as there is a set of reliable reference surveys, the burden of proof of reliability must rest on the survey designers. They must show through pretesting or other experiments that their survey does not suffer from the problems that these guidelines are intended to avoid. Specifically, if a CV survey suffered from any of the following maladies, we would judge its findings 'unreliable':*
>
> • *A high nonresponse rate to the entire survey instrument or to the valuation question.*
>
> • *Inadequate responsiveness to the scope of the environmental insult.*
>
> • *Lack of understanding of the task by the respondents.*
>
> • *Lack of belief in the full restoration scenario.*
>
> • *'Yes' or 'no' votes on the hypothetical referendum that are not followed up or explained by making reference to the cost and/or the value of the program."*
>
> *(Federal Register, p. 4609)*

To date, few contingent valuation surveys have fully met the NOAA panel's mandate. Only the study conducted for the State of Alaska as part of the state's preparation for litigation associated with the Exxon *Valdez* oil spill (see Carson et al. [1992]) would meet the majority of these requirements.

At this point, the most appropriate summary of the status of the evidence concerning the reliability of contingent valuation is that there is no conclusive evidence suggesting the CV method is inferior to the revealed preference approaches used historically to measure use-related values. Moreover, CV, if properly conducted, offers the prospect for a more complete assessment of the total economic value associated with losses from natural resource injuries.

Natural resource damage assessment is often very stressful. It tends to be adversarial and is most often done in a reactive mode. The situations that give rise to a natural resource damage assessment are of two basic types. One is the crisis situation mode, in which economists come in right after an incident such as an oil spill or release of pesticides into a river. Basically, the observers are right on the heels of an accident and in the midst of its chaos, response, adrenaline and emotions.

The other situation is one in which a lawsuit has been brought for damages because of some earlier release (e.g., mining wastes or the release of PCBs or BBTs into a harbor). Under CERCLA, one can only claim for releases or damage that occurred since 1980, the year the legislation passed, with one exception. If damages occurred before 1980, they had to have continued after 1980 for a claim to be valid.

Experience With Recent Damage Assessments

Background

There are three basic types of losses that may be incurred: interim losses, restoration costs and ultimate losses. Interim losses arise when there is some damage to the environment that is only temporary; an ultimate loss occurs when the environment can never reach the state it was in before the damage. Restoration costs depend on many things, such as how many activities are to be engaged in to restore the environment or how fast the restoration is to occur, if at all possible. Therefore, the end damages depend on the facts of recovery and on the restoration activities. So interim damages, restoration costs and ultimate losses all may be interrelated.

The concept to be measured is not necessarily well-defined because it depends on the restoration act and the facts of restoration. It is the result of a balancing of the interim losses, the restoration plan, an assessment of any ultimate limits to restoration and the associated losses. In many of the cases, particularly with oil spills, the assumption is that the resource will ultimately recover. So there is not an issue of ultimate loss, but rather how long it will take to recover, what restoration activities could be undertaken and how much they will cost. Then, how much are interim losses as a function of the ultimate time path to recovery? Essentially, for cases without ultimate losses, the issues to be resolved boil down to two items:

1. What is the restoration activity, and how much does it cost?

2. How complete does it work and, therefore, what magnitude of interim losses does it generate?

Consider a time line. It begins with the immediate crisis, followed by the immediate responses, and ultimately ends with the final responses, which involve cleanup and long-term restoration. Economists have, on the whole, absolutely nothing to do with the cleanup. They come in after the response; their role is the assessment. In lay terms, the assessment is divided into figuring out how many critters were hurt (i.e., the injury), and then placing a monetary value on the injury (i.e., the damage). In other words, injury is used for the biological and physical impact, and damage is used for the enumeration of the "impacts" into dollar amounts. As mentioned previously, part of this process is determining the restoration plan (i.e., what actions can be taken to bring back the resource), because that will affect the magnitude of the injuries, the interim losses, ergo, the overall cost.

The first step in the overall assessment is the injury determination, after which the damage assessment and restoration go somewhat hand in hand and interact with one another. At this point, there may be settlement, and there may be litigation. Obviously, the simplest way to do an assessment is to wait until the injury and damage are a matter of historical fact so that there is no uncertainty about what happened; in 10 years, it will be clear what happened and what recovered. Unfortunately, waiting is generally not a viable or attractive option. The parties involved want a settlement; they don't want to wait, and many times can't wait, until it is all over. Thus, the economist is put into the position of making predictions.

For example, say a spill occurred nine months ago and the parties want a settlement now. The plaintiff's beliefs are often that the effects are not all over and may even last for 10 years; meanwhile, the other side may believe that in a year, everything will be fine. So the analyst must assess how long restoration will take, how much it will cost and how effective it will be. The expert must decide those things before they are resolved since there isn't the luxury of waiting. This differs from many scientific studies, where the analyst can evaluate the implications of the outcome after an experiment is over. In most damages cases, the expert must predict the outcome of the equivalent of a natural experiment, i.e., the accident as an external disruption to a natural system, and write it up while it's still in progress.

The last item to discuss in this section is monitoring. Monitoring is not an item that appears conventionally in CERCLA or in the literature, but it is important. Since the analyst must accept these assessments — sometimes even litigating with them — before the results are known, it is important to reserve resources to monitor what happens. That is, the tasks require that one make assumptions as well as predictions (as scientists), and this is perfectly legitimate. Yet, the feedback is needed to determine if what has been predicted actually occurred. Then the next time around, scientists will have a better information base. In some cases, the settlement involves setting aside funds for monitoring.

A major challenge is integrating what can be done in the short run with what is going to happen later. If possible, it is pertinent to collect data, even during the response or cleanup phase, that will be useful in the damage assessment. One may not need an economist on the beach when the oil is being cleaned up. But the trustee will definitely want somebody there counting the people still recreating and obtaining information on what else people are doing.

A major hurdle to overcome, if not the highest, is chaos. Thus, to deal with the interrelationships between federal and state agencies, lawyers and outside experts, coordination must be eminent.

There are various types of coordination. The first is with the PRPs. The state has little money and very few resources and is not prepared to do a damage assessment. On the other hand, the responsible party has the money, has the resources and is off doing the damage assessment as soon as the spill is detected. The PRPs have hired experts, such as biologists, and have them collecting data and otherwise looking over the scene from the moment the spill is detected.

Similarly, agencies are used to working with limited resources and staff. They do certain things, such as analyze samples, in-house. But backlog can occur quickly. It may take six or nine months until there is a reading on the analyses and identification of the oil from some source. This lag occurs because there is only one lab that does such analysis, and this lab is backlogged with work. The agency may have only one analyst, and though perhaps a wonderful scientist, he or she will get around to it as soon as possible, which may be many months. The PRP, though, doesn't have to use its own scientist. If it has a large budget, which most oil companies do, it can hire 10 scientists and have access to 10 labs.

So, will the state try to pursue its own research or will it abdicate the responsibility to the PRP, which has money, resources and people already collecting data? It is interesting to contrast the state's approach with that of writing an environmental impact statement (EIS). In writing an EIS, the state undertakes a more sophisticated research activity than usual. It will typically hire a consulting company, and since it is putting up the money, is in the driver's seat and controls the pace. Often it may take a while for the agency to amass the money to do this, but the state is the client. In other words, when the state writes an EIS, it is not at the mercy of the PRP what data is to be collected and how. Each side's results and recommendations depend on the available data at hand.

Before, during and after the assessment, many environmental damage cases become bogged down in litigation. The pressures, standards of proof and challenges faced in litigation are absolutely different from those involved in an academic setting. Unless an economist is thoroughly prepared, he or she can be destroyed as an expert witness.

The standards of analysis — what constitutes a good journal article, good piece of research or good agency-authored EIS — are very different for litigation. In litigation, the expert can be challenged in any way; any "trick" is fine as long as it works. One is not required to have done the best analysis possible, but it is important to have pursued it. The expert must consider every other analysis that can be done and why, and if it produces a different and contrasting result, why that potentially contrasting evidence is not relevant. Irrelevance must be demonstrated. An answer such as, "This is what everyone does," is not credible because the judge or jury may not know that; they may be impressed with what the other side is presenting even though in an academic forum, it would set a precedent.

Case I:

The Shell Oil Spill[15]

On April 22 and 23, 1988, approximately 432,000 gallons of San Joaquin Valley crude oil drained from an above-ground storage tank at Shell's refinery. The oil flowed into Shell Marsh, a freshwater marsh adjacent to the refinery, and Peyton Slough; thence, it entered Suisun Bay and Carquinez Strait in the northern part of San Francisco Bay. In Peyton Slough, there was a layer of crude oil up to 18 inches thick for a length of more than one mile. In the bay, tidal and wind-driven currents spread oil slicks over a large area, including numerous smaller sloughs both east and west of Peyton Slough. Figure 1 shows the area affected. It is estimated that 50 miles of shoreline in Carquinez Strait, 110 acres of Shell Marsh and 50 acres of other tidal marshland were oiled. Birds and mammals were killed, and fish and other vertebrates and invertebrates were put at risk. Large, heavy oil slicks were observed in Carquinez Strait between Carquinez Bridge and Peyton Slough. Some oil sheening was seen on the surface of the water as far west as Point San Pablo in San Pablo Bay.

Under the provisions of the National Contingency Plan, the U.S. Coast Guard assumed responsibility as the on-scene coordinator of the spill response. Once the source of the spill was identified, Shell accepted full responsibility and initiated a vigorous remedial effort. It brought in Clean Bay Company, an oil spill cleanup cooperative headquartered in the Bay area, to work on containment and cleanup under the supervision of the Coast Guard and the California Department of Fish and Game. Booms were placed across the mouth of Peyton Slough and at the inlets of small sloughs, marinas and sensitive areas along the shoreline to prevent further spread of oil. To recover oil, six skimmer boats were deployed in open waters; up to 22 vacuum trucks worked in Peyton Slough and other sensitive areas. These efforts were hampered by wind, tidal and wave actions.

However, by April 26, further spread of the spill was largely contained; cleanup efforts then focused on recovering the free-floating oil held in the sloughs and marshes. By May 6, most of the free-floating oil had been recovered, and that day the Coast Guard re-opened the waterways in Suisun Bay that had been

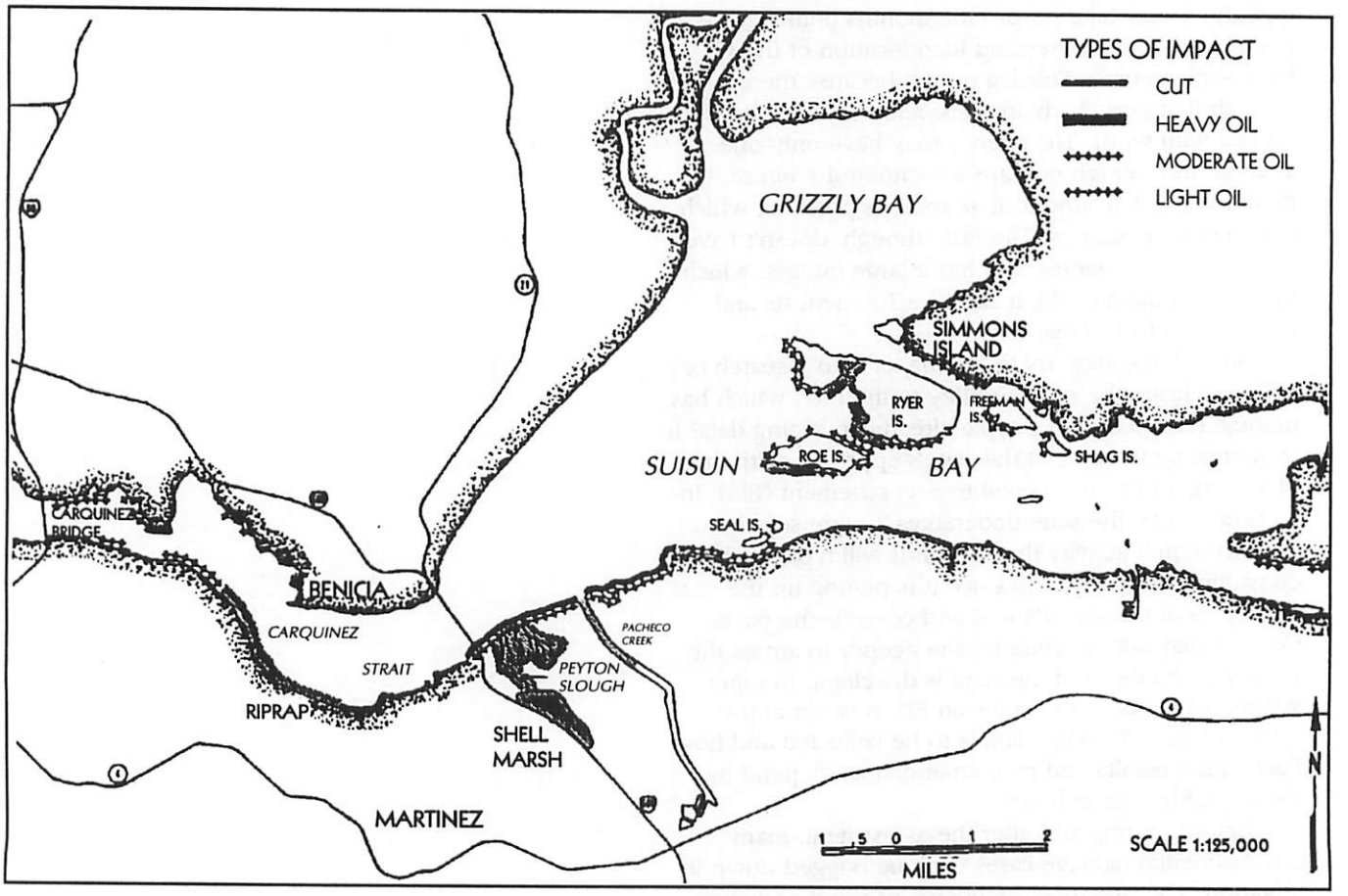


Figure 1. *Map of the shoreline area impacted by the Shell Oil spill. The distribution of each type of spill impact is shown. These impact types are used to determine natural resource damages. From* Valuing Natural Assets: The Economics of Natural Resource Damage Assessments, *written by Kerry Smith and Ray Koop.*

closed to private boat traffic since April 23. After May 6, cleanup efforts were largely focused on the shoreline and Shell Marsh. Rocks along the shoreline were steam-cleaned, and hundreds of cubic yards of soiled riprap were replaced along shoreline parks operated by the City of Martinez and East Bay Regional Park District. In addition, soiled boats at a number of marinas were cleaned. Cleanup activities continued through the end of June. It is estimated that about 290,000 gallons of oil were recovered in the course of the cleanup. Shell's expenditures on cleanup were said to have totaled about $8 million.

About three weeks after the spill, the California Attorney General's Office retained three consultants to assist with the natural resource damage assessment — economist W. Michael Hanemann and two natural scientists, Jacqueline Michel of Research Planning Inc., Columbia, S.C., and Terry Huffman of Huffman & Associates, Larkspur, Calif. This research team contacted agency personnel involved in dealing with the spill, examined data from agency and other sources, and formed an initial assessment of the potential natural resource damages for litigation/settlement purposes. This was based on "off-the-shelf" information and was conveyed to the attorney general's office in early October, almost six months after the spill.

At about this time, the attorneys representing the federal, state and local government agencies involved in the spill (see Table 1) began putting together a coordinated plan for negotiating a settlement with Shell. The settlement would cover compensation for agency costs incurred as a result of the spill, damages, civil penalties, and restoration or mitigation of the natural resource damages caused by the spill. It should be noted that the state and federal trustees had made no commitment to follow the CERCLA guidelines; indeed, at the time, the State of California was a co-plaintiff in the Ohio suit challenging the guidelines, which was still in process at that time. (The Court of Appeals ruling referred to earlier was not made until July 1989.) However, the attorneys chose an approach that was essentially equivalent to developing a restoration and compensation determination plan; that is, they identified a set of restoration program elements that were judged commensurate with the magnitude of the natural resource injuries and that all the trustees would agree to implement if the requisite funding was obtained. This plan was not made public. However, it was based on input from agency experts and on suggestions that were obtained from the public through presentations to local elected officials; two community meetings held in Benicia and Martinez at the end of September; and the distribution of a fact sheet on the Shell Oil spill inviting written comments on issues related to damage assessment, resource restoration and/or mitigation, monitoring and prevention.

Development of a restoration program, which would be the basis for a coordinated bargaining position, continued into the new year. At the beginning of January, a revised internal assessment of the natural resource damages was prepared. Early in March, the attorneys representing the federal, state and local agencies sent a letter to Shell containing their settlement demand. In April, Shell's attorney responded with a counteroffer, which was judged unsatisfactory. In May, the agency attorneys submitted a revised settlement demand. Before sending this letter, they had scheduled a meeting with Shell attorneys and Shell's economic consultant, Bill Desvousges of Research Triangle Institute Inc., at which the state's economist (Hanemann) was to discuss in general terms the economic methodologies that had been used to assess

Table 1
Governmental Agencies Involved in the Shell Spill

Regulatory
U.S. Environmental Protection Agency
San Francisco Bay Regional Water Quality Control Board
San Francisco Bay Conservation and Development Commission

Cleanup Response
U.S. Coast Guard
NOAA
California Department of Fish and Game

Natural Resource Trustees
California Department of Fish and Game
U.S. Fish and Wildlife Service
U.S. Navy
NOAA

Affected Landowners
State Lands Commission
State Department of Parks and Recreation
East Bay Regional Park District
Mountain View Sanitary District
U.S. Navy

Local Governments
City of Benicia
City of Martinez
Contra Costa County
Solano County

Legal
California Attorney General's Office
U.S. Department of Justice
Contra Costa County District Attorney
Solano County District Attorney

the natural resource damages. This meeting took place at the end of May. In June, Shell announced its acceptance of the agencies' settlement offer.

The details of the settlement were made public at the end of November after a consent decree was prepared and lodged with the U.S. District Court for the Northern District of California along with the filing of a complaint asserting claims under federal and state law arising from the oil spill. In a memorandum, the plaintiffs advised the court that, though they were not required to do so, they had provided the public an opportunity to comment on the proposed decree, and they asked the court to defer considering it until they had an opportunity to review these comments. Four comments were submitted during the 45-day public comment period. After reviewing the comments and responding to them, the agencies decided not to revise the proposed consent decree and requested the court's approval. The court approved the consent decree March 16, 1990, and judgment was entered April 6, 1990.

The settlement called for payments by Shell of $4.15 million in civil penalties to the United States and the State of California; $2.2 million in damages and penalties to local governments; $500,000 to federal, state and local agencies for response costs; and $12.9 million for natural resource damages, of which $1.3 million would be used for three studies designed to improve future responses to oil spills, $750,000 paid into a state account providing funds for cleanup and abatement of oil spills, and $10.8 million used for the restoration, rehabilitation and acquisition of natural resources, primarily the acquisition of about 1,000 acres of wetlands. At $19.75 million, this was said to be the largest settlement of a natural resource damage claim in the United States up to that time.

Lessons in Coordination

The most striking and unexpected aspect of experts' experiences in the Shell case was the lessons it taught about the importance of good organization and coordination in the success of litigation. The agency attorneys felt that dealing with their own side was the crucial challenge — even more so than dealing with the other side. They organized the management of the case accordingly, emphasizing a full flow of information from the agency personnel working on spill response and cleanup to those working on the damage assessment and litigation, coordinating effectively with their experts and developing a unified prosecution of the case.

The initial stages of an oil spill are an exercise in chaos. The shock of the spill and the rush to respond, contain the oil and clean it up are emotionally draining. By the time everyone gets around to the natural resource damage assessment, the chances are that everybody is exhausted. Therefore, one of the first hurdles for the attorneys and the experts working with them is to find out in a systematic manner what happened, who knows what, who has what data, and who said what to whom. In addition, there is a subtle change in the status of Department of Fish and Game (DFG) personnel as one moves from response to damage assessment: DFG personnel are in the driver's seat when it comes to supervising and approving the cleanup; when it comes to the natural resource damage assessment, they tend to take second place to the lawyers in the attorney general's office, who represent them in the litigation. This can pose delicate problems of coordination. In the Shell case, this was handled in part through the development of a questionnaire administered to all the agency personnel who had participated in the spill response and cleanup.

In addition to coordinating with their clients, the attorneys must coordinate with their experts. In California, this worked well. But in other cases there have been some rough patches at the outset of the relationship that were a function of the type of analysis required. In many cases, the economist involved in damage assessment is expected to conduct a relatively brief analysis based on off-the-shelf information for use by the attorneys for settlement/litigation purposes. In other cases, it has seemed likely from the beginning that the matter might go to trial and the analysis would have to be of sufficient detail and quality as to withstand scrutiny in open court. What was required, in short, was a full-scale, scholarly study — a research project that might involve a team of researchers and could require a commitment of significant support for some time. This was a novel experience for the attorneys involved — and not necessarily a welcome one. They were accustomed to dealing with the individual experts who could render an opinion based on their existing experience and knowledge without conducting a major research project. Initially, they were simply not prepared to offer the type of commitment that a research project required.

This was a hurdle that had to be overcome before the agency attorneys and the experts could forge a relationship. It is also symptomatic of something larger, namely a failure to appreciate the crucial role of research — indeed, academic research — in the damage assessment, which is widespread among agency personnel and attorneys who become involved with the assessment process. This arises, in large part, because in the course of their regular activities, agency personnel do not usually have the time or the funds to contemplate long-term research. They are constantly pressed for quick-and-dirty answers to the current questions, and then they must move on to the next crisis. For them, research is a luxury. For litigation, however, it is an absolute necessity.

Many parts of the assessment — determining that

an injury has occurred, proving that it was not caused by other factors besides the spill, quantifying the injury and placing an economic value on it — raise difficult and complex scientific questions. Being sure that you have the right answers and can defend them against sustained attack in court is extremely important. This may require a level of effort and a degree of sophistication in the analysis that are more typical of academic research than normal agency practice; but you dispense with these at your peril.

In the Shell case, the most challenging coordination was that among the government agencies with jurisdiction over the spill. Altogether, 16 federal, state and local agencies had jurisdiction in a regulatory capacity, as property owners or as trustees for natural resource damages. Of these, 14 sued together as plaintiffs in a unified action against Shell in the federal district court in San Francisco. The California Department of Fish and Game was recognized as the lead trustee, and the California Attorney General's Office was made the lead counsel and facilitator of the agency group.[16] The selection of a lead trustee and lead counsel notwithstanding, there were differences of opinion among the trustee and regulatory agencies, and working together was not effortless. Although it took only about three months of negotiation with Shell to reach an agreement in principle to settle the case, it had taken about five or six months of negotiation among the agency attorneys to develop a coordinated negotiating position. Those preparations included reaching a firm agreement ahead of time on how to allocate the funds that might be secured in a settlement. Developing a unified negotiating position required an enormous investment of time on the part of the lead attorneys, but this enhanced their effectiveness in the negotiations with Shell.

The Shell Oil case illustrated four aspects of damage assessment.

1. Early collection of information to document injuries, identify affected resources and establish how they relate to people will pay large dividends in facilitating the tasks involved with later damage assessment.

2. Coordination is central to the success of a damage assessment. Moreover, the coordination is not limited to paired interactions — lawyers with each type of expert. It implies that different trustees' lawyers will need to first assure their respective concerns are addressed as an ongoing component of the coordination with experts. The trustees' representatives cannot assume the role of "information highway" between different types of experts. It is essential that the economic experts have access to scientists with detailed knowledge of the resource injuries. These scientists need not be the experts directly involved in assessing the linkages from release to injury, but they must be familiar with the issues involved.

3. Given the current state of knowledge and diversity in objectives, it is difficult to conceive of mechanisms that would facilitate coordinated assessments linking PRPs and trustees in one or more aspects of the assessment process. This judgment seems a reasonable conclusion from the Shell experience, even though there was a settlement, and coordination would reduce costs and appear to be in all parties' interests.

4. And finally, the current research knowledge has evolved in ways that do not offer much help for quick or back-of-the-envelope damage assessments. Most applied valuation research is motivated by a specific profit evaluation or management decision. Primary research tends to focus on new methodologies or testing very specific hypotheses. It is not intended to develop general purpose applied results. Equally important, the professional reward system does not value replication of methods to the same resource applications. As a result, there are few incentives for academics to consider reapplication of methods to new resources to evaluate their economic value unless it is motivated by a specific decision.

Because the summary of the Shell case focused on the institutional aspect of damage assessment, this summary will consider differences in the methods used by defendants (PRPs) and plaintiffs (trustees).

This case was initiated before the DOI Type B rules were announced and was settled before the D.C. Circuit Court of Appeals ruling on the proposed revisions to DOI's rules. The case involved the Eagle Mine and a 5-mile section of the Eagle River between Gilman and Minturn, Colo. (See Figure 2.) The trustee (the State of Colorado) for the natural resources involved (public lands adjoining the river, the Eagle River and groundwater aquifers near this section of the river) contended that past operations of the mine had resulted in releases of hazardous substances into the river and the groundwater. Although the mine was no longer operating, the disposal of mine tailings and the condition of the old mine allowed continued releases to take place with alleged injuries to the natural resources.

Case II:

Eagle River — An Old Mine Site

Comparison of how the plaintiff's and the defendant's analysts estimated the natural resource damages from these releases illustrates the importance of judgment by analysts in applying valuation methodologies. Neither side attempted to develop comprehensive damage estimates for each of the natural resources alleged to have been injured by the releases, although the defendant's analysis is easier to associate with the two primary resources — the river and the groundwater. Each side's analysis will be considered in turn.

The plaintiff's analyst conducted two household mail surveys, one for the residents of Eagle County and the other for the entire state. The county survey collected information to implement three methods for measuring components of the damages. It asked:

- how many days each respondent would spend in fishing and nonwater-based recreation activities if the section of the river (identified on the map in figure 2) was restored to its "pre-mine" condition;
- how much each respondent would be willing to pay annually for 10 years to clean up this section of the Eagle River; and
- if respondents were homeowners, what the purchase price for their homes and the date of purchase had been. A brief description of the housing characteristics was also requested.

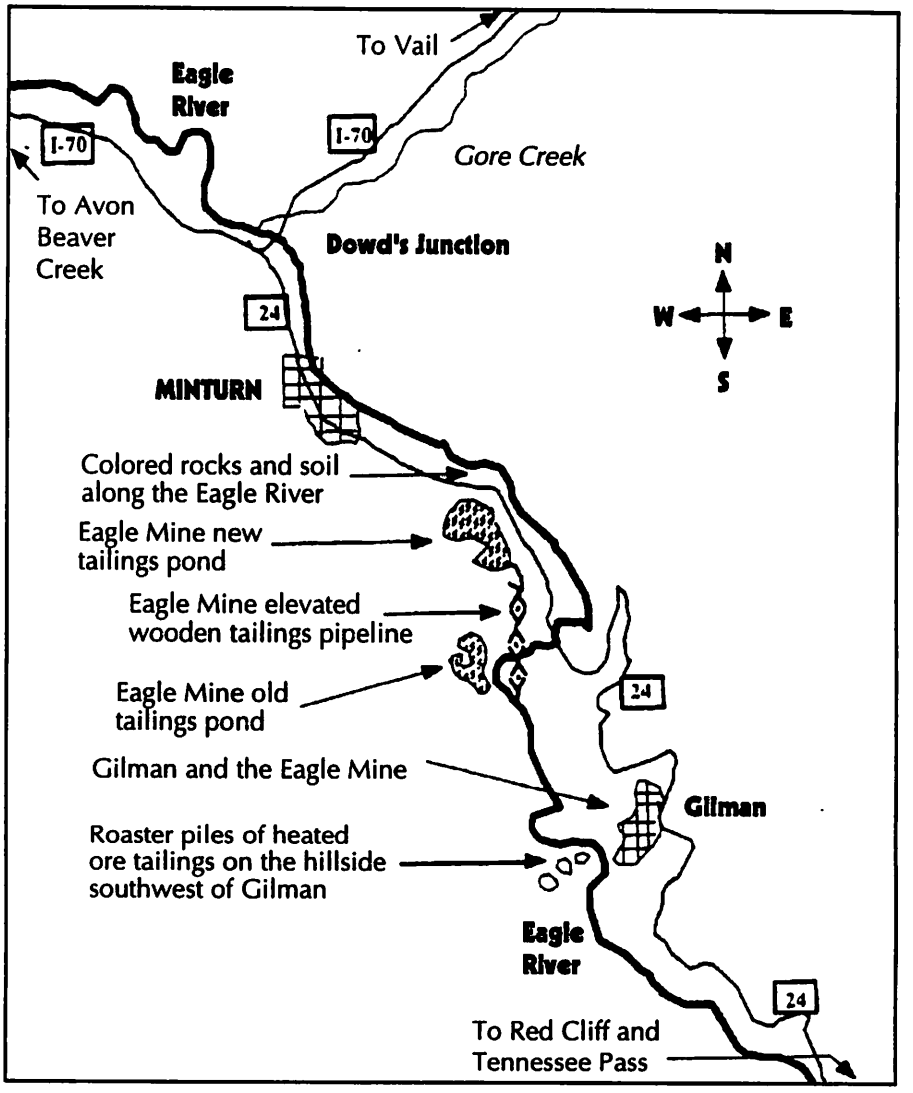


Figure 2. *Location of the Eagle Mine and Eagle River. From* Natural Resource Damages for Oil Spills in California, *written by W. Michael Hanemann.*

To estimate per-person annual use values, responses to the first question were combined with measures of current participation in water-based and nonwater-based activities and the U.S. Forest Service's unit-day values for these activities.[17] Responses to the second question provided estimates per person of planned (or *ex ante*) use and presumably nonuse values as a composite. The information on housing prices was used only for those individuals living within 25 miles of the river; a hedonic price function (using deflated prices)

was estimated. A qualitative variable indicating location within six miles of this section of the river was assumed to reflect the effects of the releases into the river. Thus, in terms of the taxonomy of methods described earlier, the plaintiff's analysis involved three different methods. Use values relied on the stated river usage (if restored to baseline conditions), less the previous year's participation in these activities. Increased use levels were valued with the unit-day values.

At the same time these were being measured, two different estimates of use and nonuse values were developed from the contingent valuation questions on the Eagle County and statewide surveys. Both estimated those values as a composite. This strategy was consistent with the revision of DOI's rules for Type B assessments. The statewide survey attempted to distinguish the value for restoring the Eagle River to baseline conditions from the values of other sites in Colorado, while the county survey focused exclusively on the river. The hedonic analysis relied on "sales prices" collected with the county survey and limited the market to a 25-mile area around the river. It illustrates the problems in establishing the link between the effects of hazardous waste on the resource and the site attribute included in the hedonic price equation. Distance to the impacted area of the river was used to measure these effects, and a somewhat arbitrary threshold of six miles was used to represent the distance at which the damage to the river had no effect on the property.

The analyst for the defendant (Gulf-Western Industries) developed a travel cost recreation demand model using the U.S. Fish and Wildlife's 1980 survey of hunting and fishing decisions. A subsample of individuals using fishing sites within a five-county region around the mine site was used to estimate the model. Although the specific estimates of demand functions were not present in the defendant's report on damages, sufficient information was reported to highlight several aspects of this strategy. Two important assumptions in the defendant's analysis followed from implicit assumptions in its sample and its characterization of how the release would affect potential fishing on this section of the river.

First, by combining all the fishermen who used sites anywhere in the five-county area around the mine, they implicitly assumed that all the sites in this area were perfect substitutes for each other. Second, the analysis maintained that when there is damage to the river's ability to support fishing, recreationists will go to the next best alternative — the river above the mine site. This would imply traveling a maximum of five miles farther each way. Thus, the loss of the site was described as a price change. However, the key assumption was that the choke price equaled the implied cost of traveling to what was treated as a "perfect substitute" site.[18]

By contrast, the plaintiff's analysis tended to highlight the uniqueness of the site by asking county residents about their increased use of it without asking where the increased use would come from and whether it represented new recreational trips. The valuation measures implied for site services (per unit) by each side's model were actually quite comparable. The unit-day values (in 1985 dollars) for water- and nonwater-based activities were $14 and $9 per day, respectively, while the consumer surplus from the defendant's travel cost demand models for each type of activity were actually higher at $21 and $32 per day.

Comparisons of the annual values from the WTP component of the survey were also similar — with the county survey's contingent valuation estimates of $73 per year for water-based and $51 per year for nonwater-based activities. The defendant's model estimated 6.18 days of fishing per season and 10 days for nonwater-based activities. Applying each to the average of the annual consumer surplus from fishing and nonwater-based activities, the defendant's analysis would imply values that exceed the contingent valuation estimates. However, the characterization of what was lost from the release is what distinguished the analysis at the level of an individual recreationist.

By treating the release as though it caused recreationists to use the next best alternative and incur only a price increase equivalent to traveling 10 miles farther, the per-individual loss from the defendant's travel cost model became $1.35 per day for fishing and 55 cents per day for nonwater-based activities (in 1985 dollars). What may be more surprising is that these estimates would still exceed the per-person annual values estimated by the plaintiff from the second contingent valuation survey, which was intended to be representative of the state population's valuation of the river's services. This second survey progressively focused the valuation tasks, first asking annual WTP for cleanup of all 200 potential problem sites (again for each of 10 years), then the percentage to be assigned to seven sites (including the Eagle River mine) specifically identified and described in the survey, and finally a percentage of that amount for the site identified as most important.

The average annual per-household values from the plaintiff's statewide contingent valuation survey included use and nonuse values. This estimate ($5.60) was less than the annual use values implied for fishing by the defendant's analysis ($1.35 x 6.18 days = $8.34) and very close to those for nonwater-based activities ($.55 x 10 days = $5.50).

Nonetheless, these comparisons offer a misleading impression of the disparity in each side's estimates of the present value of future losses if restoration did not take place. The plaintiff's estimates ranged from $15 million to $45 million, depending on which method was used to estimate per-person losses and the treatment of nonuse values. Even the lowest end of this

range was approximately 100 times the size of the defendant's estimate of $139,500 for fishing and nonwater-based activities. The difference cannot be attributed to the inclusion of nonuse values because these were already removed when the lowest estimate was selected. Moreover, the differences in discount rates, time horizon and real growth of these values do not explain this large disparity.

The disparities arise from one strategic assumption — each analyst's assumption about the extent of the market for the Eagle River. The plaintiff's analysis assumed that the market corresponded to every household in Colorado on the grounds that its statewide survey was intended to represent this group. The defendant's analysis implied that the recreationist assumed to be currently involved in fishing and nonwater uses of the area would experience a gain (in the form of the reduced price) from restoring this section of the river.

This observation is important because it establishes that the wide disparity between each side's estimates arises from differences in assumptions and not from inherent variability in valuation estimates across methods. In fact, there is remarkable consistency between the two sides' estimates when they attempt to value the same thing. In some respects, each side exploited the incomplete nature of economic research on those issues associated with defining the extent of the market for the services provided by nonmarketed natural resources.

The Eagle River case anticipated issues that have remained a persistent source of disagreement between defendants and trustees in damage assessments:

(a) What are the legitimate components of the economic values used in damage assessments?

(b) Which methods will be considered to provide a reliable basis for valuation?

(c) Who is treated as having a reason to be counted in the appraisal of the compensation due for natural resource damages?

When the case was undertaken, the focus was on a measure of economic value of the full losses due to the injuries rather than the interim lost use value focus of today's litigation. Nonetheless, the discrepancies in the two side's views about nonuse values, contingent valuation and the extent of the market have increased in the years since the assessment was undertaken and the respective sides reported their analyses.

Recommendations for State Agencies

In evaluating the staff and information necessary to meet a state's responsibilities as one of the trustees in future damage assessments, there are some lessons that can be drawn from the experience to date.

In most damage assessments, it is not the case that only a single assessment is done; it's somewhat of a continual process. At periodic intervals, lawyers want to know a best guess about a settlement during their discussion with the other side. They need to know the best estimate deliverable at any particular time. Thus economists must be continually updating their assessments as new data arrives.

Both sides must recognize that the assessment at any particular time may be based on something that is completely independent of what the economist is asking the plaintiff, lawyer or whomever is in charge of the trustee to support. As far as requirements for litigation, the number arrived at through the assessment is not usually something that an expert would come forward and say he or she believes in; it is only the best current assessment from the available information. The expert would be wise to provide error bounds on that estimate.

The importance of the lead trustee and coordination cannot be overemphasized. As mentioned earlier, there is likely to be a plethora of agencies with different operating styles and interests. Together, an effective team can be formed to negotiate with, but the cost is the time consumed in getting everybody on board and in agreement. This is something that could be handled before something actually occurs. For example, a memorandum of understanding could be developed that identifies a lead trustee and what roles would be given to agencies that can't be trustees but that should be involved. These are all things that could be thought through in advance. When combined with the precedents in other areas, they can save valuable time.

As part of the dress rehearsal, agencies should consider a data review. They should imagine some possible event and then ask, "What do we know about the biology, the species involved, etc.? Who would we go to as expert witnesses or researchers who know about these things?" The pressure from an incident can cause seemingly small tasks to be excruciating. Once again, prior agreements and planning can save valuable time.

In litigation, the obligations for analysis are very different than from normal science. In normal science, one can choose what will be explained or analyzed. In litigation, the analyst is responsible for all aspects of the story. If somebody asks, "How do we know that the drought wasn't causing this," the analyst cannot say, "Well I never thought of that." Instead one has to have a much more comprehensive understanding of all aspects of the resource so that it is possible to explain what is being done, and more importantly, ward off attacks from any angle. This requires a more comprehensive and sophisticated knowledge than one would normally develop for agency policy matters. The way to be prepared is to have a data set as complete as possible.

Data routinely collected may well be biased, when they are considered under the rigorous screening of a

damage assessment. For example, in most coastal states there are ample data on marine fishing because the National Marine Fisheries Service has been very energetic in collecting. By contrast, there is very little on freshwater fishing. Thus, an assessment involving freshwater fishing is lacking because there are far more freshwater fishing sites compared to saltwater sites. To complicate matters more, since there are many lakes and streams, the question of substitute sites is even more important for valuing freshwater fishing than for saltwater fishing.

Another example involves the Park Service's count of cars and its estimate of the number of people per car to define a user population. Questions have been raised as to why the Park Service's estimate of the number of people per car varies from one site to another and how anyone can vouch for the quality of this figure. If once a year, the Park Service made an effort to do a careful count and documented the procedures by which it did this count, then it would be much easier five years later to vouch for the quality of the data.

To the extent that substitutes and science are issues, it would be helpful to have a periodic outdoor recreation census or survey of the state. Since the issue of substitutes revolves around how much visitation occurred at a particular site and how much visitation occurred at all the other sites that might be substitutes for a damaged site, it would be much more efficient to do a household survey. That is, find out from people where they all went rather than trying to calculate at each individual site the number of visitors and their origin.

Finally, there is no substitute for communication — among agencies, the agencies and the academic community involved in damage assessment, and more generally with the community at large involved in damage assessment. There are periodic conferences and information sessions sponsored by public (e.g., NOAA) and private groups. It is highly desirable for state agencies to allocate sufficient resources to allow at least one person to participate in some of these activities each year. If this is done, new developments, case precedents and emerging issues can be recognized before the press of an actual case requires a catch-up process that can ultimately affect the credibility of a state's activities when it is most needed.

Footnotes

[1]A portion of this material draws upon Kopp and Smith [1989], p. 595. Thanks are due Kurt Schwabe for integrating the discussion from the original workshop and Joan Grimes for typing several drafts of this manuscript.

[2]Breen [1989] notes that TAPAA could be read to have a somewhat limited perspective on damages noting that: ... apart from the scope of the resources covered, TAPAA can be read to limit the measure of damages to actual cleanup costs plus humans' economic losses. ... This measure of damages is substantially narrower than true make-whole relief for the environment (p. 855).

Appendix

Footnotes and References

[3]For a more detailed discussion, see Chapter 8 in Ward and Duffield [1992] and Brown [1993].

[4]It is possible that the baseline condition could imply an improving resource, as Mazzota et al. [1993] suggest. This would imply that restoration would seek to restore the resource to its growth path.

[5]For the case of old sites involving hazardous substances, the time period for losses does not extend earlier than 1980 for time divisible losses. Judge Young's ruling in the Acushnet River and New Bedford Harbor case identified this distinction. All indivisible losses can be part of the damages. See Kopp and Smith [1993] for more detail.

[6]The court decision cited the House of Representatives report on CERCLA in responding to the Department of Interior's original "lesser" rule included in its initial regulations. The Court of Appeals decision concluded that: "The House report thus explicitly assumes that damages 'contemplated by CERCLA' will normally include restoration costs at a minimum, plus interim lost use value in appropriate cases" (p. 45). Furthermore, the decision suggests: ... Congress intended trustees in some cases be permitted to recover damages greater than the sum required to restore the resource. The excess would represent interim use value, the value of the lost uses from the time of the spill until after the completion of the restoration project. At the same time, Congress required that all the funds nonetheless be spent on restoration, replacement or acquisition of an equivalent resource (p. 45).

[7]This portion draws upon unpublished papers prepared by W. Michael Hanemann and Raymond J. Kopp and V. Kerry Smith on the conceptual issues in defining measures for economic values.

[8]This section is a revision to an Appendix in Kopp and Smith [1989], pp. 608-609.

[9]See H. Hotelling, 1947, Letter to National Park Service in *An Economic Study of the Monetary Evaluation of Recreation in the National Parks*, U.S. Department of the Interior, National Park Service and Recreational Planning Division, 1949.

[10]For reviews of these methods and their performance, see V. Kerry Smith, [1989], "Travel Cost Recreation Demand Models: Theory and Implementation," and Smith and Kaoru, "Signals or Noise?"

[11]Jan Tinbergen, [1956, "On the Theory of Income Distribution," *Welwertschaftliches Archiv*, 77:155-175] was one of the first to analytically derive an expression for this price function in the context of a labor market equilibrium.

[12]For a description, see Timothy J. Bartik, 1987, "The Estimation of Demand Parameters in Hedonic Price Models," *Journal of Political Economy*, 95 (April): 81-88.

[13]One of the earliest examples of a paper describing an empirical model intended to describe households' avoidance of responses to pollution is William D. Watson and John A. Jaksch, "Air Pollution: Household Soiling and Consumer Welfare Losses," *Journal of Environmental Economics and Management*, 9 (September, 1982): 248-262. In the context of hazardous waste, see V. Kerry Smith and William H. Desvousges, "Averting Behavior: Does It Exist?," *Economic Letters*, 20 (1986):291-296.

[14]This section draws upon the transcript of Michael Hanemann's presentation, his paper summarizing the activities associated with the Shell oil spill (Hanemann [1992]) and Chapter 1 of Kopp and Smith [1993].

[15]Hanemann, W. Michael. 1992. "Natural resource damages for oil spills in California." In *Natural Resource Damages: Law and Economics*, ed. K.M. Ward and John W. Duffield. New York: John Wiley & Sons.

[16]The attorneys coordinating the legal effort included Sara Russell and Michael Neville of the California Attorney General's Office, and Walker Smith and Valerie Lee of the U.S. Department of Justice. In addition to these two agencies, almost all of the other agencies listed in Table 1 had their own attorneys who participated in the development of a negotiating position.

[17]Unit-day values have been developed by a variety of agencies. They were intended to represent experts' judgments about a representative person's average willingness to pay for a day of a specific type of recreation activity. A range of suggested values is proposed by a resource agency, and analysts can use them as approximations for the values associated with the relevant activities at specific resources. Unfortunately, the process of developing these values has varied widely, and their relationship to a theoretically consistent measure can also be questioned. Some agencies developing unit-day values have relied on entrance fees at private facilities. The U.S. Forest Service undertakes periodic reviews of the travel cost and contingent valuation literature to estimate a consumer surplus per day. None of the approaches for

estimating these values provides a theoretically valid measure of the marginal value of a unit of the activity.

[18]The choke price is the price at which there will be no more demand for use of the resource, such as a particular recreation site.

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