ASSESSING ENVIRONMENTAL LOSSES: JUDGMENTS OF IMPORTANCE AND DAMAGE SCHEDULES*

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I. INTRODUCTION

The growing recognition of environmental value and the consequent demands to take such value into account in public resource allocation decisions and assessments of damages have prompted extensive efforts to develop accurate monetary measures of environmental value. However, though a very limited range of environmental values can now be assessed with some degree of confidence, the research of the past four decades has not provided reliable methods to measure the economic values of most of the nonpecuniary environmental assets—those that do not have observable market prices—involved in damage claims and allocation decisions. Current valuations are, for the most part, limited in scope and accuracy and, in addition to being expensive, may well be misleading.[2]

The limitations of existing valuation methods have been particularly apparent in assessments of environmental damages. For example, although some U.S. statutes require that those who cause environmental harms pay compensation,[3] post hoc evaluations have

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1. This research was, in part, supported by the U.S. Forest Service and the Social Sciences and Humanities Research Council of Canada, and has benefited from discussions with Mark Jaccard.

2. *See infra* Part III.B.

3. *See, e.g.*, Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. § 9607(a)(4)(C) (1994 & Supp. 1996) [hereinafter CERCLA]; Oil Pollution Act, 33 U.S.C. § 2702(b)(2)(A) (1994 & Supp. 1996) [hereinafter OPA].

often been expensive and contentious.[4] While these assessments often give the illusion of precision, they are widely regarded as providing only the roughest approximation of actual values, and may well provide a simple indication of concern rather than the desired monetary values comparable to those derived from market exchange.[5] It is unrealistic to expect that damage assessments based on such estimates will accurately achieve social objectives such as deterrence and restitution.

The disappointing performance of most current post-incident economic valuation methods has stimulated interest in alternative means of assessing, or otherwise dealing with, environmental losses.[6] One commentator suggests that, in view of the inadequacies of the most prominent current measurement technique,[7] a better alternative could be to base damage assessments on a pre-established fixed schedule of loss values—a damage schedule.[8] In this Article we explore that alternative.

Damage schedules provide predictability and enforceability by specifying *in advance* the payments that will be required in the event of a loss, rather than waiting until the damage has taken place. Thus, the large transaction costs associated with the typical

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4. *See, e.g.*, Laura Geselbracht & Richard Logan, *Washington's Marine Oil Spill Compensation Schedule—Simplified Resource Damage Assessment*, PROCEEDINGS: 1993 INTERNATIONAL OIL SPILL CONFERENCE (PREVENTION, PREPAREDNESS, RESPONSE) 705, 705. *See also* Note, *"Ask a Silly Question . . . ": Contingent Valuation of Natural Resource Damages*, 105 HARV. L. REV., 1981, 1998–2000 (1992) (arguing that damage assessments based on contingent valuation methodology are so unreliable that they should be rejected by the courts). The 1985 Arco Anchorage crude oil spill in Washington State serves as a striking example of disproportionate cost: the environmental assessment cost approximately $245,000 but damages were assessed at only $32,930. *See* Thomas A. Grigalunas & James J. Opaluch, *Assessing Liability for Damages Under CERCLA: A New Approach for Providing Incentives for Pollution Avoidance?*, 28 NAT. RESOURCES J. 509, 512 (1988).

5. *See* Daniel Kahneman & I. Ritov, *Determinants of Stated Willingness to Pay for Public Goods: A Study in the Headline Method*, 9 J. RISK & UNCERTAINTY 5 (1994). The lack of comparability of contingent valuation responses to market prices is a particular concern in numerous cases involving conflicting uses of resources, when the value of one use is based on market prices while the other is based on such hypothetical assessments, as, for example, when the use of old growth forests for timber is compared with their use for wilderness.

6. *See* Geselbracht & Logan, *supra* note 4.

7. The contingent valuation method, which involves asking those who are affected by a loss how much they would be willing to pay to accept the loss, or to acquire the undamaged resource. *See infra* Part III.B.5.

8. *See* John M. Heyde, *Is Contingent Valuation Worth the Trouble?*, 62 U. CHI. L. REV. 331, 353 (1995). Heyde suggests two other alternatives as well, namely using the cost of restoring the resource or some multiple of the portion of the damages that can be accurately measured. *See id.*

post-incident assessment are minimized, and the advance knowledge of the consequences provides a greater deterrence incentive for the actions of others. Plante et al. compare such environmental damage schedules to liquidated damages clauses,[9] which are used occasionally in commercial contracts to establish in advance the damage payments that will be required in the event of a breach. For environmental damage schedules, as for contractual liquidated damages clauses, the need for an ex ante specification arises in part because it is difficult or expensive to determine the actual value of the losses.[10]

Accurate post-incident valuations—or even rough valuations, if consistent and reliable—would be preferable to the use of damage schedules, because valuations would make trade-offs more explicit, encourage preventative measures that are cost-justified, and generally provide the socially "correct" incentives and disincentives to action. However, for most environmental losses, such valuations are not currently a realistic option.[11] Damage schedules offer an attractive alternative, at least on an interim basis. Damage schedules may provide most of the advantages of valuation, with minimal sacrifice.

Damage schedules can reflect citizens' judgments of the relative importance of different losses, without requiring them to assign monetary values directly to the losses. While people appear to be unable to provide consistent monetary measures of environ-

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9. *See* Kenneth J. Plante et al., *Florida's Pollutant Discharge Natural Resource Damage Assessment Compensation Schedule—A Rational Approach to the Recovery of Natural Resource Damages*, PROCEEDINGS: 1993 INTERNATIONAL OIL SPILL CONFERENCE (PREVENTION, PREPAREDNESS, RESPONSE) 717, 718.

10. *See* Kenneth W. Clarkson et al., *Liquidated Damages v. Penalties: Sense or Nonsense*, 1978 WIS. L. REV. 351, 367 (discussing the justifications for contractual liquidated damages clauses, including, among others, cases where damages cannot be proven, and where they can be proven but it would be costly to prove them). See *infra*, Part III.B, for a discussion of the difficulty of measuring non-pecuniary environmental losses. There are other similarities between damage schedules and commercial contracts:

> Inherent in the relationship between the state, as trustees over the natural resources through and over which commercial shipping occurs, and shipowners and vessel masters is an implied contract. In return for the consideration of the ability to ply the state's waters, shipowners agree to conduct their activities in such a manner as to minimize the impact on the environment, and, in the event that such activities damage the state's natural resources, to offer reasonable compensation.

Plante, *supra* note 9.

11. *See infra* Part III.

mental losses,[12] they may well be able to provide the far less demanding indications of the relative importance of different losses.[13] To the extent that people can rate the relative importance of different environmental changes, this would provide empirical support for the design of allocation policies and assessments of damage claims that reflect community values. Empirical choices could yield a better mirror of social objectives than current attempts at monetary valuation, negotiations between policy makers and interested parties, or the often arbitrary and inconsistent "resolutions" imposed by fiat or by tribunals.[14] The use of schedules based on empirical assessments of relative importance might well go a considerable way towards achieving the purposes for which valuations are desired.[15]

As described below in Part V, assessments of the relative importance of different adverse environmental outcomes or events—for example, the death of a certain number of sea birds resulting from an oil spill or the loss of a particular area of moose habitat—can be obtained by asking people to make a series of pair-wise comparisons. Each person is asked to compare each outcome to

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12. *See infra* Part III.B.5.

13. *See infra* Part V.

14. *See infra* Part VI.A.

15. See *infra* Part II for a discussion of purposes for which environmental valuations are desired. Although our focus in this paper is on environmental losses and damage schedules, we also consider the potential usefulness of rankings of the relative importance of environmental changes (gains as well as losses) in broader policymaking contexts.

Whether a negative change should be assessed as a loss or as a foregone gain, and whether a positive change is best regarded as a gain or as a reduction of a loss, is an important issue. *See* Jack L. Knetsch, *Reference States, Fairness, and Choice of Measure to Value Environmental Changes*, *in* ENVIRONMENT, ETHICS, AND BEHAVIOR: THE PSYCHOLOGY OF ENVIRONMENTAL VALUATION AND DEGRADATION 13 (Max H. Bazerman et al. eds., 1997). As the magnitude of the value associated with a given change may vary dramatically depending on whether the change is characterized as a gain rather than a reduction of a loss in the case of an improvement, or is seen as a loss or a foregone gain in the case of a deterioration, the choice of the correct characterization is crucial. *See id.*; *infra* Part.III.A. Empirical evidence indicates that the correct measure of value depends on the "reference point" from which the environmental change is evaluated. *See* Knetsch, *supra*, at 15–16. Most environmental changes are currently assessed as if they were gains. For example, contingent valuation questions designed to assess environmental damage after it has occurred will often ask questions such as, "What would you be willing to pay to prevent X from occurring?" thereby categorizing the change as a gain, or benefit, from the existing damaged state. *See* Report of the NOAA Panel on Contingent Valuation, 58 Fed. Reg. 4601, 4603 (1993) [hereinafter USNOAA Panel Report]. However, the appropriate reference point is the situation that the valuer considers to be the normal or expected state. For many changes affecting environmental assets this reference will be the "natural" or "undamaged" state of affairs, strongly implying that the change should be evaluated as a loss or as a reduction or avoidance of a loss. Thus, our focus here on losses.

each other outcome and to choose the most important one in every case. A scale of relative importance can then be derived from the choices made by a group of respondents, and the scale can be related to characteristics found empirically to have significant impacts on assessments of the relative importance of each occurrence.[16] The scale value assigned to each loss would represent the relative importance of that particular combination of characteristics.

Initial scale values of only a few environmental losses could be expanded to include other losses as they are encountered, by interpolating or extrapolating from those previously scaled, so that an increasingly comprehensive profile of relative importance gradually evolves. Such an importance scale would not provide an absolute assessment of economic values. Nevertheless, the scale could be used to structure the remedies prescribed in an "interim" damage schedule,[17] by assigning to each environmental harm a remedy appropriate to its importance in comparison with other harms.[18]

In order to explore the potential for this approach to damage assessment and allocation decisions, Part II reviews reasons why society would want accurately assessed values for environmental assets. Part III discusses why it is so difficult to produce accurate assessments for nonpecuniary environmental assets. Part IV looks

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16. These determinants of relative importance might include qualitative and quantitative descriptions of different losses, or "consequences" (such as the death of 50 marine birds of a particular species, or the loss of one hundred sea otters), and characteristics of the environmental "events" that cause losses (such as an oil spill, or a landslide caused by logging road construction).

17. The term "interim" is used to suggest that the schedule would be adjusted with developing valuation information and changing circumstances.

18. The suggestion that environmental damages be assessed on the basis of a fixed schedule is not a new idea, as demonstrated by the fact that several U.S. states have already implemented schedules of compensation for some types of environmental losses. *See, e.g.*, Preassessment Screening and Oil Spill Compensation Schedule Regulations, WASH. ADMIN. CODE §§ 173–183 (1997) [hereinafter Preassessment Screening Rule]. In Washington State, damages arising from small spills of oil or other hazardous substances are assessed under an administratively prescribed damage schedule, in which compensation awards are specified in advance, and vary with the size of spill, the type of substance spilled, and the geographic location of the damage. *See id.* Similar schedules have been adopted in other U.S. jurisdictions. *See* Part IV.C.2 *infra*. Proponents claim that, although somewhat arbitrary, these "environmental damage schedules" can produce simplified, less expensive, more predictable, and more enforceable calculations of compensation amounts than is possible with post-incident valuations. *See, e.g.*, Geselbracht & Logan, *supra* note 4, at 708 ("[i]t is anticipated that the oil spill compensation schedule will significantly improve the state's ability to recover"); Plante et al., *supra* note 9, at 718 ("it was determined that assignment of a specific value would, at a minimum, eliminate the speculative nature of the damages and provide a basis for [sic] which monies . . . would be channeled into the environment as expeditiously as possible").

at some existing and proposed schedules of compensation for nonpecuniary losses to show how these initiatives have been developed in practice. Part V reports the results of an empirical demonstration of individuals' judgments of the relative importance of non-pecuniary environmental losses, and illustrates a simple method of aggregating and interval-scaling their preference responses. Part VI explains how such preference data could be used to construct an interim damage schedule. Finally, the Conclusion discusses how well the resulting scale and schedule could serve the policy objectives for which accurately assessed values are generally thought to be required.

II. Environmental Values: Efficiency and Other Goals

This section discusses three functions of assessed values: allocating resources efficiently, creating appropriate incentives, and assessing damages in order to provide corrective justice and solace for the injured. Each of these functions has different implications for the importance of accurate valuation of the assets under consideration.

Market prices provide useful measures of the economic value of market goods and services, and supply important incentives to buyers and sellers to use resources consistent with these values. The environmental goods at issue here, however, do not trade in markets, for various reasons having to do with market failures (such as externalities and common property problems) and community rejection of market outcomes (based, for example, on inequitable distribution of environmental goods).[19] Consequently, the values of these goods are not revealed in market prices. Nonpecuniary environmental assets[20] are no less economically valuable than goods traded in markets, as people are clearly willing to sacrifice other goods and services in order to acquire, maintain, or transfer them. The willingness to sacrifice other goods and services in order to obtain or retain something defines economic value. In the case of nonpecuniary environmental goods, however, this willingness cannot be expressed through the market.[21]

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19. For background on nonpecuniary goods, see David W. Pearce & R. Kerry Turner, Economics of Natural Resources and the Environment (1990).

20. Those that do not have market prices.

21. The value of environmental assets can also be separated into "use" value and

This absence of ready and conspicuous monetary measures of environmental values results in a propensity to treat them as having little or no economic worth. This gives rise to problems in at least three areas related to the efficient use of resources: (i) allocating public resources in ways that are consistent with their importance to the community; (ii) providing appropriate incentives to individuals who use or may harm the resources; and (iii) assessing damages when environmental resources are harmed or degraded by an unexpected event, such as an oil spill, or an intentional activity, such as waste discharge.

More accurate assessment of environmental values will presumably contribute to more appropriate public and private resource allocation decisions. For example, if the true values (including nonpecuniary values) of wilderness areas were known, policies could be better designed to protect the socially optimum amount of wilderness, without overly restricting other uses of such natural resources. Similarly, just as waste and over-use are encouraged when nonpecuniary resources are treated as having no value, requiring payment that more appropriately reflects social values would provide incentives to use such resources at more socially desirable levels. Such correct prices, if generally known, would also reduce uncertainty in determining permissible use levels and would reduce transaction costs as consumers and producers adjusted automatically to the announced prices. This would allow more efficient planning of public and private activities. Also, in the case of environmental losses, as the costs became more predictable, liability insurance might become more readily available at lower rates.[22]

"non-use," or "passive-use" value. *See* USNOAA Natural Resource Damage Assessments: Notice of Proposed Rulemaking, 59 Fed. Reg. 1062, 1073 (1994). Although exact classifications vary, it is generally agreed that the main component of use value is the value arising from direct use of an environmental asset. *See id.* This includes consumptive activities, such as fishing and hunting, as well as activities normally considered to be non-consumptive, such as bird-watching. *See id.*

Passive-use or non-use value generally includes all value that does not involve direct use of an environmental asset, including value attributable to the mere knowledge of the existence of the asset ("existence value"). *See id.*; PEARCE & TURNER, *supra* note 19, at 129–32. Passive or non-use value, which may be very large for some assets, poses the greatest difficulty for quantitatively assessing damages to the environment.

22. Given the present uncertainty of damage assessments, it may be more difficult for actuaries to predict the monetary value that will be assigned to an environmental loss than it is for them to assess the likelihood and expected magnitude of the loss. The availability and cost of insurance is an important issue, as expanded liability for environmental harm is of limited use if judgments are not recoverable.

The absence of ready measures of value has also created difficulties for environmental damage assessment, although the importance of accurate monetary valuation of nonpecuniary harms may vary depending on the social purpose that the award of damages is expected to serve. Three common reasons for requiring those who harm the environment to pay damages are: (i) to compensate individuals affected by the loss, (ii) to pay for environmental restoration, and (iii) to deter future incidents.[23] Each of these can be satisfied by internalizing externalities (in other words, ensuring that all of the costs of an action are borne by the parties responsible for bringing those costs about). The standard economic analysis indicates that if the costs are properly measured in terms of full social value and are charged to those responsible, then the amount that those individuals will expend to avoid or minimize environmental damage will equal the value that society places on avoiding the environmental loss.[24] Thus, accurate and predictable damage awards can achieve the same effects as correct prices for environmental goods.

Compensation payments for nonpecuniary harms can, however, serve other social purposes. These have been more extensively analyzed in connection with personal injury losses, where nonpecuniary damages are well recognized.[25] Radin, for example, recognizes "corrective justice" as an objective of compensation payments for nonpecuniary personal injuries:

> [T]o make required changes in an unjustified state of affairs between an injurer and a victim, when the injurer's activity has

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23. *See* Emery N. Castle et al., *Natural Resource Damage Assessment: Speculations About a Missing Perspective*, 70 LAND ECON. 378, 380 (1994).

24. *See* PEARCE & TURNER, *supra* note 19. Castle et al. go on to question whether accurately measured environmental values are needed to achieve the deterrence functions commonly attributed to environmental damages, and whether damages really act as deterrents in this context in any event. *See* Castle et al., *supra* note 23, at 384.

25. The similarity between compensation for nonpecuniary environmental harms and compensation for nonpecuniary personal injuries has been noted elsewhere. *See, e.g.*, Jeffrey C. Dobbins, *The Pain and Suffering of Environmental Loss: Using Contingent Valuation to Estimate Nonuse Damages*, 43 DUKE L.J. 879 (1994) (arguing that the broad legal acceptance of damage recovery for pain and suffering losses in tort law justifies allowing recovery of nonpecuniary environmental damages); Katherine K. Baker, *Consorting with Forests: Rethinking Our Relationship to Natural Resources and How We Should Value Their Loss*, 22 ECOLOGY L.Q. 677, 697 (1995) (suggesting that tort law—specifically the doctrines of dignitary torts, nominal damages, and pain and suffering—rather than property law, provides the proper parallel for the kind of loss that is suffered when the natural environment is damaged).

> caused the injustice, so that such changes bring about a just state of affairs between them, and one that is related in a morally appropriate way to the status quo ante. A shorthand way of saying this is that corrective justice restores moral balance between the parties.[26]

Moral balance may be achieved by restoring the parties to their original circumstances prior to the incident (restitution), or by restoring the parties to a situation that is morally equivalent to those circumstances (rectification).[27] Moral balance may also be restored by redress:

> Requiring payment is a way both to bring the wrongdoer to recognize that she has done wrong and to make redress to the victim. Redress is not restitution or rectification. Redress instead means showing the victim that her rights are taken seriously. . . . In this conception of compensation, neither the harm to the victim nor the victim's right not to be harmed are commensurate with money. They are not conceptually equated with fungible commodities.[28]

Thus, to make redress does not require assessment of an exact monetary value for a loss.

Another possible justification for paying compensation to those who suffer nonpecuniary harms is to provide solace to the injured party:

> Since it is almost impossible in any modern legal system to award compensation in any form other than money, it follows that giving compensation for 'losses' which cannot be replaced by money (such as pain and suffering or loss of amenity) must have a different purpose from that involved in giving compensation for things that can be replaced by money. The object here cannot be to replace what has been lost by some equivalent, but to enable the victim to obtain a substitute source of satisfaction or pleasure, or alternatively to comfort him (provide him with solace) for what has happened.[29]

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26. Margaret Jane Radin, *Compensation and Commensurability*, 43 DUKE L.J. 56, 60 (1993).

27. *See id.*

28. *Id.* at 61.

29. PETER CANE, ATIYAH'S ACCIDENTS, COMPENSATION AND THE LAW 474 (1987).

As with redress, then, solace does not require accurate monetary assessment of values, because it does not require a payment that is equal to the exact value of the loss. Indeed, the Supreme Court of Canada has used this lack of accuracy, or of need for accuracy, as one justification for imposing an overall cap on damages for pain and suffering in personal injury cases: "The sheer fact is that there is no objective yardstick for translating non-pecuniary losses, such as pain and suffering and loss of amenities, into monetary terms."[30] Although there may be no objective yardstick for translating nonpecuniary losses directly into monetary terms, we argue in Parts IV and V, below, that it is possible to rate the relative severity of non-pecuniary losses and then to assign monetary damage amounts that vary in accordance with the severity of the losses.

III. Measuring Values of Non-Pecuniary Environmental Assets

Three major issues complicate the measurement of nonpecuniary environmental values: determination of the appropriate measure of value, the limitations of existing economic measurement techniques, and the possibility of incommensurable values.

A. The Appropriate Measure of Value

The economic value of a gain or a loss, including the enhancement or degradation of an environmental asset or amenity, is what people are willing to sacrifice to obtain or prevent it. As Michelman states, the economic measures of gains and losses are determined from distinct perspectives: "benefits are measured by the total number of dollars which prospective gainers would be willing to pay to secure adoption, and losses are measured by the total number of dollars which prospective losers would insist on as the price of agreeing to adoption."[31] The appropriate measure of an environmental loss is, therefore, not the maximum amount people

30. Andrews v. Grand & Toy [1978] 2 S.C.R. 229, 261. *Accord* Arnold v. Teno [1978] 2 S.C.R. 287; Thornton v. Prince George Sch. Bd. [1978] 2 S.C.R. 267.

31. Frank I. Michelman, *Property, Utility, and Fairness: Comments on the Ethical Foundations of "Just Compensation" Law*, 80 Harv. L. Rev. 1165, 1214 (1967).

would be willing to pay ("WTP") to prevent it, but is instead the minimum compensation that individuals would require to accept it (the willingness to accept, or "WTA").

Although minimum compensation, or WTA, is the agreed appropriate economic measure of losses, assessments of environmental losses are in practice nearly universally made in terms of people's maximum willingness to pay to avoid such losses—the WTP measure. The United States National Oceanic and Atmospheric Administration ("USNOAA") noted, for example, that in assessing damages of specific environmental losses "virtually all previous CV [contingent valuation] studies have described scenarios in which respondents are asked to pay to prevent future occurrences of similar accidents."[32]

A major reason for the continued use of the WTP measure to assess losses is the assertion of traditional economic theory that the valuations of gains and of losses are for all practical purposes fully equivalent; that "[a]ccording to utility theory, the amount subjects would be willing to pay to clean up a site should be the same as the compensation they would be willing to accept to allow someone to pollute the site (except for a minor income effect)."[33] The conventional assumption that the WTP and WTA measures lead to equivalent values, except for an agreed minor disparity due to income or wealth effects or constraints, is one of long and enduring standing.[34] No exploration or accounting for any difference is in practice made or thought to be necessary because of the belief that "[a]s a practical matter it usually does not make much difference which of these two . . . is adopted."[35] As a result, the allegedly more conveniently measured WTP has become the measure of choice for both environmental gains and losses.[36]

Although the equivalence assertion continues to be used to justify present valuation practice, it has little empirical support.

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32. USNOAA Panel Report, *supra* note 15, at 4603.

33. Carl V. Phillips & Richard Zeckhauser, *Contingent Valuation of Damage to Natural Resources: How Accurate? How Appropriate?*, 4 Toxics Law Rep. (BNA), 520, 527 (Oct. 4, 1989).

34. "We shall normally expect the results to be so close together that it would not matter which we choose." A.M. Henderson, *Consumer's Surplus and the Compensation Variation*, 8 REV. ECON. STUD. 117, 121 (1941).

35. STEVEN E. RHOADS, THE ECONOMIST'S VIEW OF THE WORLD: GOVERNMENT, MARKETS, AND PUBLIC POLICY 125 (1985).

36. *See* USNOAA Panel Report, *supra* note 15, at 4603.

Instead, the empirical evidence overwhelmingly shows that WTA significantly exceeds WTP for the identical good. This evidence has been mounting both in experimental settings[37] and in observations of everyday human behavior.[38] Reading the empirical work

37. *See, e.g.*, JUDD HAMMACK & GARDNER M. BROWN, WATERFOWL AND WETLANDS: TOWARD BIOECONOMIC ANALYSIS (1974) (asking duck hunters to value marsh area); Rebecca R. Boyce et al., *An Experimental Examination of Intrinsic Values as a Source of the WTA-WTP Disparity*, 82 AM. ECON. REV. 1366 (1992) (pricing small pine trees); Steven J. Kachelmeier & Mohamed Shehata, *Examining Risk Preferences Under High Monetary Incentives: Experimental Evidence from the People's Republic of China*, 82 AM. ECON. REV. 1120 (1992) (pricing lotteries); Daniel Kahneman et al., *Experimental Tests of the Endowment Effect and the Coase Theorem*, 98 J. POL. ECON. 1325 (1990) (pricing small items such as coffee mugs and pens); Jack L. Knetsch & J.A. Sinden, *Willingness to Pay and Compensation Demanded: Experimental Evidence of an Unexpected Disparity in Measures of Value*, 99 Q.J. ECON. 507 (1984) (pricing lottery tickets). Both earlier survey studies and later, more persuasive, real exchange experiments consistently show systematic and large valuation disparities between WTA and WTP that are independent of transaction costs, repetition of trade offers, and income or wealth constraints. For example, Kachelmeier and Shehata found that the same individuals would be willing to pay about half as much to acquire an entitlement to a 50% chance to win $20 as they would require to give up the same prospect. *See* Kachelmeier & Shehata, *supra*, at 1132. The compensation measures (WTA) are typically from two to five or more times larger than the payment measures (WTP) for what are otherwise the same entitlements. *See* Kahneman et al., *supra*, at 1327. Although some studies suggest that repeated trials might lead to reductions in (or elimination of) the WTA/WTP disparity, *see* Jason F. Shogren et al., *Resolving Differences in Willingness to Pay and Willingness to Accept*, 84 AM. ECON. REV. 255, 260 (1994), further tests attribute the reductions observed in those studies to the use of the Vickrey auction design, which may fail to accurately reveal people's valuations, *see* Daniel Kahneman et al., The Endowment Effect and the Vickrey Auction (1995) (unpublished manuscript, on file with the *Harvard Environmental Law Review*).

38. Larger valuations of losses relative to gains in people's actual behavior in making real choices have been documented in a variety of cases. *See* Daniel Kahneman et al., *The Endowment Effect, Loss Aversion and Status Quo Bias*, 5 J. ECON. PERSP. 193 (1991). Frey & Pommerehne note that collective endowment effects clearly motivate the asymmetric treatment accorded the acquisition and retention of national art treasures. *See* Bruno S. Frey & Werner W. Pommerehne, *International Trade in Art: Attitudes and Behavior*, 34 RIVISTA INTERNAZIONALE DI SCIENZE ECONOMICHE E COMMERCIALI 465, 477–83 (1987). The valuation disparity, and the consequent reluctance to sell at a loss, have also been evident in the greater volume of house sales when prices are rising and in the similar smaller volume of sales of securities that have declined in price relative to those for which prices have increased. *See* Hersh Shefrin & Meir Statman, *The Disposition to Sell Winners Too Early and Ride Losers Too Long: Theory and Evidence*, 40 J. FIN. 777, 786 (1985). Consistent with these dealings, the magnitude of change in the prices of securities is greater after dividend payments are omitted than after such dividends are initiated. *See* Roni Michaely et al., *Price Reactions to Dividend Initiations and Omissions: Overreaction or Drift?*, 50 J. FIN. 573 (1995). New risks are typically more stringently regulated than equivalent old risks. *See* Cass R. Sunstein, *Endogenous Preferences, Environmental Law*, 22 J. LEGAL STUD. 217, 230–34 (1993). Further examples of differences in valuations of gains and losses are the observed strong reluctance to give up a default automobile insurance option when an attractive choice is readily available, *see* Eric J. Johnson et al., *Framing, Probability Distortions, and Insurance Decisions*, 7 J. RISK & UNCERTAINTY 35, 46–48 (1993), and the greater protection accorded losses over foregone gains by judges, *see* David Cohen & Jack L. Knetsch, *Judicial Choice and Disparities Between Measures of Economic Values*, 30 OSGOODE HALL L.J. 737, 749–69 (1992).

suggests that "[i]t is now well established that individuals value possible gains much differently than they value possible losses."[39]

A direct consequence of the continued practice of using WTP measures to assess environmental damages is that such losses will be consistently and significantly understated, leading to distortions of incentives, misallocation of resources, and undercompensation of losses.[40]

B. Limitations of Existing Economic Measurement Techniques

Methods used to estimate the values of non-pecuniary environmental assets rely either on indirect measures based on related market purchases or on direct survey responses to hypothetical questions. The former approach includes the restoration cost, replacement cost, hedonic price, and travel cost methods. The latter is often called the contingent valuation method. The techniques vary both in their applicability and in the validity of the resulting valuations.

1. Restoration Cost

This measure is simply the cost of restoring an environmental asset which has been destroyed or damaged.[41] It has several problems as a measure of value. First, restoration cost can only be estimated when it is possible to restore the damaged environmental asset, which may not be the case because of bio-physical limitations or insufficient knowledge. Second, restoration cost does not measure the value lost during restoration (which, given the common reliance on long-term natural processes that are a major part of many environmental restoration efforts, may be a substantial loss),[42] nor does it take account of any remaining loss if the resto-

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39. Daniel W. Bromley, *Property Rights and Natural Resource Damage Assessments*, 14 ECOLOGICAL ECON. 129, 133 (1995) (citations omitted).

40. *See* Jack L. Knetsch, *Environmental Policy Implications of Disparities between Willingness to Pay and Compensation Demanded Measures of Values*, 18 J. ENVTL. ECON. MGMT. 227 (1990).

41. *See* Frank B. Cross, *Natural Resource Damage Valuation*, 42 VAND. L. REV. 269, 298–302 (1989).

42. Theoretically, the value lost during the recovery period could be compensated by charging interest on the full final cost from the time of the loss until restoration or replacement is effected. However, determining the rate of interest that will exactly compensate for the loss is problematic.

ration is an imperfect substitute for the original.[43] Third, although it can be used to set damages, restoration cost is not a measure of environmental loss at all. Indeed, the actual value of the loss may fall short of or exceed the restoration cost.

2. Replacement Cost

Replacement cost is the sum required to provide a substitute that would yield an equivalent flow of goods and services.[44] Adopting replacement cost as the measure of value, like using restoration cost, avoids the necessity of actually measuring the environmental loss at issue. Replacement cost has the additional advantage of considering substitutes in determining the cost of ameliorating the damage. However, many environmental resources do not have close substitutes. Hatchery programs designed to rebuild salmon stocks on the west coast of Canada and in the Pacific Northwest of the United States provide an illustration. Although hatchery-bred fish were originally used as replacements for lost natural stocks, and would appear to provide a logical measure of the replacement value of damaged natural stocks, it has been found that hatchery fish lack the genetic diversity, disease resistance, and overall strength of wild fish.[45] Also, as with restoration cost, replacement cost measures do not capture the value lost during the replacement period, nor is replacement cost an appropriate measure of damage when the value of the loss is less than the cost of providing the substitute.

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43. *See* Colorado v. United States Dep't of the Interior, 880 F.2d 481, 490 (D.C. Cir. 1989) (confirming that the Type "A" damage assessment regulations under CERCLA must take into account the ability of the ecosystem or resource to recover).

44. *See* Cross, *supra* note 40, at 298.

45. *See* CHARLES F. WILKINSON, CROSSING THE NEXT MERIDIAN: LAND, WATER, AND THE FUTURE OF THE WEST 217–18 (1992); Michael V. McGinnis, *On the Verge of Collapse: The Columbia River System, Wild Salmon and the Northwest Power Planning Council*, 35 NAT. RESOURCES J. 63, 72–73 (1995). In addition, as gains seem to be valued differently from losses, "people's willingness to accept one resource gain as a substitute for the loss of another resource, may be more constrained than is usually presumed." Jack L. Knetsch, *Environmental Valuation: Some Problems of Wrong Questions and Misleading Answers*, 3 ENVTL. VALUES 351, 355 (1994). With respect to damage assessment, this implies that rectification (restoring the parties to a situation that is morally equivalent to their circumstances prior to the incident) may be possible only through full restoration of the damaged asset, or true replacement with an identical asset (in the rare cases where this is possible)—in other words, through restitution (restoring the parties to their original circumstances prior to the incident). If the funds paid as damages are not actually used to repair or replace the asset, restitution will not be achieved.

3. Hedonic Price Method

The hedonic price method provides an estimate of a nonpriced value by determining the extent to which it contributes to the price of a marketed asset.[46] The value of a scenic view, for example, might be determined by the difference in prices of otherwise similar houses with and without such a view.

Although reasonably straightforward in terms of the necessary calculations, one difficulty is that in most applications only a value at the margin is provided. That is, because market prices form the basis of the estimate, it is only appropriate for individuals at the margin of buying or selling the priced asset. The method does little to account for the possibly larger values of intramarginal owners who may value the amenity well above its contribution to the price, because they regard other houses (for example) as imperfect substitutes for their own. Rough adjustments can be made to take some account of these larger values,[47] but these are usually much less precise.

A more important limitation of the method is that it cannot be used to assess very many environmental losses. For an environmental loss to be subject to valuation using the hedonic method, the loss must be common and persistent enough to affect the existing price of a market good. For example, persistent pollution levels that vary throughout a region may affect housing prices. Many environmental losses, however, are episodic, and others, even if common and persistent, do not directly affect the price of a market good.

4. Travel Cost Method

The travel cost method is another valuation technique that relies on observed market behavior to infer a nonpecuniary value—in this case the value of a site that people must travel to in order to enjoy, such as a recreational facility. Based on the observed proportions of populations living at varying distances from a recreation area who are willing to incur their respective costs of

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46. *See* ANTHONY E. BOARDMAN ET AL., COST-BENEFIT ANALYSIS: CONCEPTS AND PRACTICE 318–24 (1996).

47. *See id.* at 321–22.

traveling to and from the site, an estimate can be made of how many would be willing to pay various additional amounts to gain access to the recreation area.[48]

Problems in using the travel cost method include: (i) allocating joint costs of travel if the recreation site of interest was not the only destination of the trip; (ii) accounting for the value (or cost) of travel time in the estimate of travel cost; and (iii) choosing the most appropriate functional form for expressing the relationship between cost and visit rate. However, as in the case of the hedonic price method, the greatest limitation is the method's severely restricted range of applicability. At best, the method yields an estimate of the use value of a facility or site. The method does not provide any indication of non-use value or of the values of environmental assets that are not attributable to people's incurring costs to gain proximity. The method also yields a WTP measure, not a WTA measure, and while it is therefore appropriate for valuing gains, it is not an appropriate means to assess damages or reductions in losses.

5. Contingent Valuation Method

By far the most common approach used to estimate the monetary value of environmental losses is the contingent valuation method ("CVM"). Rather than rely on indirect inference from market choices, CVM assessments are derived directly from responses to questions asking people how much they would be willing to pay to acquire an entitlement or to prevent the loss of one.[49] CVM was first demonstrated in 1963[50] and over two thousand CVM studies have now been recorded.[51]

Contingent valuation methods have been endorsed by court approvals, at least in the United States, and by a profusion of early

48. *See* MARION CLAWSON & JACK L. KNETSCH, ECONOMICS OF OUTDOOR RECREATION 48–92 (1966).

49. *See* USNOAA Panel Report, *supra* note 15, at 4603; PEARCE & TURNER, *supra* note 19, at 148–53.

50. *See* Robert Kenneth Davis, The Value of Outdoor Recreation: An Economic Study of the Maine Woods (1963) (unpublished Ph.D. dissertation, Harvard University) (on file with the Harvard University Library). Davis's study was intended to assess the more tractable use value of a resource rather than the passive value of a resource, such as that due to its known existence.

51. *See* RICHARD T. CARSON ET AL., A BIBLIOGRAPHY OF CONTINGENT VALUATION STUDIES AND PAPERS (1995).

favorable reports in professional journals.[52] However, the extent to which survey responses can be taken as fully comparable to economic valuations stemming from voluntary market exchanges, as intended, is now subject to serious doubt, particularly for those goods with which people have the least amount of market experience, such as collectively owned nonpecuniary environmental services.

A major difficulty is that CVM surveys are least reliable when used to elicit how much compensation people would demand to agree to a loss (the WTA measure).[53] The alternative WTP measure will often be inappropriate and understated for the reasons discussed in Part III.A.

A further worry, which has recently received increased attention, is that responses to hypothetical questions may not accurately reflect individuals' actual valuations.[54] An example of the difference is the recent report of a median $30 average hypothetical willingness to pay for an antique map for which the median value people would actually pay was only $5.[55]

Another problem with CVM surveys is the demonstrated susceptibility of respondents to anchoring biases. For example, the proportions of different groups of respondents who said that they would be willing to pay $50 to preserve particular fish populations varied from 18% to 63%, depending entirely on their being asked to pay a higher or a lower sum immediately before being asked about paying $50.[56]

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52. *See* William H. Desvousges et al., *Measuring Natural Resource Damages With Contingent Valuation: Tests of Validity and Reliability*, *in* CONTINGENT VALUATION: A CRITICAL ASSESSMENT 91 (Jerry A. Hausman ed., 1993); John F. Daum, *Some Legal and Regulatory Aspects of Contingent Valuation*, *in* CONTINGENT VALUATION: A CRITICAL ASSESSMENT, *supra*, at 389.

53. *See* USNOAA Panel Report, *supra* note 15, at 4603.

54. *See* Boyce et al., *supra* note 36; Thomas C. Brown et al., *Which Response Format Reveals the Truth About Donations to a Public Good?*, 72 LAND ECON. 152 (1996); Ronald G. Cummings et al., *Homegrown Values and Hypothetical Surveys: Is the Dichotomous Choice Approach Incentive-Compatible?*, 85 AMER. ECON. REV. 260, 265 (1995) (finding that 42% of respondents indicated a willingness to pay $3.50 for a box of chocolates, but only 4% actually paid when confronted with a real rather than hypothetical exchange); Mary Jo Kealy et al., *Accuracy in Valuation is a Matter of Degree*, 64 LAND ECON. 158 (1988); John Loomis et al., *Improving Validity Experiments of Contingent Valuation Methods: Results of Efforts to Reduce the Disparity of Hypothetical and Actual Willingness to Pay*, 72 LAND ECON. 450 (1996).

55. *See* Helen R. Neill et al., *Hypothetical Surveys and Real Economic Commitments*, 70 LAND ECON. 145, 151–53 (1994).

56. *See* Knetsch, *supra* note 44, at 358.

In response to such findings, many advocate the use of a dichotomous choice (yes/no) approach in which people are asked if they would or would not pay a single sum, with this amount varied among respondents.[57] However, the proportions willing to pay often do not decrease much at higher sums, giving rise to a serious upward bias to WTP estimates.[58]

Embedding is perhaps the most serious problem.[59] As has now been repeatedly demonstrated, people usually indicate very different valuations for a particular entitlement depending on whether it is valued alone or first in combination with others. In one demonstration of this pattern, respondents indicated they would pay $123 to help provide "rescue equipment and trained personnel to deal with emergencies," if this was asked alone, but would value the same service at only $14 if derived from how much they would allocate to this purpose from a sum they had initially said they would pay for a larger bundle of services.[60]

There is also a problem of defining the "extent of the market"; in other words, determining the population to which the average WTP estimate derived from a CVM survey is to apply.[61] Given the non-use (or passive use) characteristic of much of the value of many environmental resources, defining whether people living in different areas at varying distances from the environmental resource at issue do or do not value it may be quite arbitrary. The final WTP estimate is, of course, likely to be very sensitive to this definition.

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57. *See* USNOAA Panel Report, *supra* note 15, at 4603.

58. *See* Brown et al., *supra* note 53; William H. Desvousges et al., *supra* note 53; Mary Jo Kealy & Robert W. Turner, *A Test of the Equality of Closed-Ended and Open-Ended Contingent Valuations*, 75 AM. J. AGRIC. ECON. 321 (1993).

59. For a general discussion of embedding, see Daniel Kahneman & Jack L. Knetsch, *Valuing Public Goods: The Purchase of Moral Satisfaction*, 22 J. ENVTL. ECON. MGMT. 57, 58–64 (1992).

60. *See id.* at 60–61; *see also* Thomas C. Brown & John W. Duffield, *Testing Part-whole Valuation Effects in Contingent Valuation of Instream Flow Protection*, 31 WATER RESOURCES RES. 2341 (1995) (finding that respondents were willing to pay more to protect a single river's instream flow when they were only asked about one river than when they were asked about five); Robin Gregory et al., *How Precise Are Monetary Representations of Environmental Improvements?*, 71 LAND ECON. 462 (1995) (assessing how much individuals would be willing to spend for proposed environmental projects).

61. *See* William D. Schulze, *Use of Direct Methods for Valuing Natural Resource Damages*, *in* VALUING NATURAL ASSETS: THE ECONOMICS OF NATURAL RESOURCE DAMAGE ASSESSMENT 204, 210 (Raymond J. Kopp & V. Kerry Smith eds., 1993).

The empirical evidence suggests that CVM studies are not successful at yielding even reasonably approximate or consistent estimates of environmental values, with the accuracy appearing to be worse for the kinds of resources for which such valuations are most needed. Institutional demands for "a number" have prompted improved techniques and more extensive—and expensive—tests, but results are increasingly viewed as indicative of good feeling about contributing to a public good rather than as a measure of economic value.[62]

C. Incommensurable Values

The preceding discussion focused on the technical difficulties of current valuation techniques. There is, however, the further issue of the willingness and ability of people to value some environmental gains or losses in monetary terms (in other words, the extent to which people's valuations of components of the natural environment are commensurable with money). Definitions of incommensurability differ, but in this context the main issues are the degree to which individuals can make trade-offs, especially between particular environmental changes and money, and the extent to which people can express environmental values in terms of a monetary metric.

Raz outlines a conception of incommensurability that offers little hope for reasoned choices among incommensurables: "A and B are incommensurate if it is neither true that one is better than the other nor that they are of equal value."[63] He argues that incommensurability is displayed when people are intransitive in their

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62. A fairly tacit acknowledgment of the difficulties stemming from a combination of the use of the WTP rather than the WTA measure to assess losses, and from the use of hypothetical questions to elicit such values, was given in the nearly comical official proposal of USNOAA, which, after much study and debate, recommended "that the respondents' stated values be divided by two, unless trustee can justify an alternative calibration factor for the specific case." DAMAGE ASSESSMENT REGULATIONS TEAM, U.S. DEP'T OF COMMERCE, NATURAL RESOURCE DAMAGE ASSESSMENT WORKSHOP MATERIALS 12 (1994). *Accord* Natural Resource Damage Assessments: Proposed Rules, 59 Fed. Reg. 1062, 1183 (1994). Of course, to the extent that the use of the WTP measure to assess losses, rather than the more appropriate WTA measure, results in a greater understatement of the sought-after value than any overstatement due to hypothetical bias, the suggestion should call for multiplication instead of division by a number greater than one.

63. JOSEPH RAZ, THE MORALITY OF FREEDOM 322 (1986).

choices among options;[64] in other words, he argues that intransitivity does not necessarily imply irrationality or hidden preferences, but instead may "reveal belief in incommensurability":[65] a belief that some things cannot be directly compared.[66]

However, incommensurability need not be so absolute. Richard Warner attributes incommensurability to an unwillingness to accept certain justifications for specific actions.[67] For example, people may consider a need (or desire) for money to be an acceptable justification for working at a job, but not for selling a body part or betraying a trust. Similarly, some people may not consider money, or the things that money can buy, to be justifiable compensation for allowing aspects of the environment to be damaged or destroyed, or to be necessary payment to preclude such damage or destruction.[68] Warner suggests, however, that sometimes it may be possible for an individual to make choices between incommensurables by changing evaluative attitudes, or deciding "what to allow and disallow as a reason for action."[69]

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64. "Intransitive" choices are internally inconsistent, such as when *A* is chosen as superior to *B*, and *B* is chosen as superior to *C*, but *C* is chosen as superior to *A*.

65. RAZ, *supra* note 63, at 325.

66. In a somewhat related argument, David explains intransitive responses to psychological preference surveys by suggesting that people may not have the cognitive ability to consistently compare some multi-dimensional objects. *See* H.A. DAVID, THE METHOD OF PAIRED COMPARISONS 3–4 (Alan Stuart ed., 1988) (citation omitted). David notes that the:

> simplest explanation is that the judge is at least partially guessing when declaring preferences. The judge may be guessing because of incompetence or because the objects are in fact very similar . . . . But guessing is not the only explanation, for there may be no valid ordering of the three objects when they differ markedly. Their merit may depend on more than one characteristic, and it is then somewhat artificial to attempt an ordering on a linear scale. Under these circumstances, the judge must mentally construct some function of the relevant characteristics and use this as a basis for comparison. It is not surprising that in complicated preference studies the function is vague and may change from one paired comparison to the next, especially when different pairs of objects may cause the judge to focus on different features of the objects.

Id.

67. *See* Richard Warner, *Incommensurability as a Jurisprudential Puzzle*, 68 CHI.-KENT L. REV. 147, 158 (1992).

68. *See* Sunstein, *supra* note 37, at 248–53. Among other things, this provides a possible explanation of why some people respond to environmental valuation questionnaires with protest answers—they are not willing to consider the comparisons or tradeoffs proposed. *See id.*

69. Warner, *supra* note 64, at 168.

Others argue that observed difficulties in making certain types of comparisons do not necessarily imply that values are incommensurable. Regan, for example, suggests that a refusal to consider trading off a given entity for money may simply be based on a judgment that the value of the entity is very much greater than money, rather than incommensurable with money.[70] In other words, the entity could be placed on a monetary metric of value, but it is worth *so* much that people resist expressing its value in monetary terms or contemplating a trade-off for money.

The existence and nature of incommensurability between values for nonpecuniary environmental assets and money is significant in examining the potential of using judgments of importance to guide deterrence, to design allocation policies, and to compensate individuals who suffer harms. In particular, if comparisons among environmental losses cannot be made at all, then there is little chance that meaningful guidance about deterrence and compensation can be provided. However, if losses can at least be consistently compared—in terms of importance or severity, for example—then we will be able to go the first step toward a useful scaling of these losses. For this, it is not necessary that people be willing or able to either equate a loss with a monetary amount, or to trade off one loss against another.

Sunstein recognizes this distinction between comparability and commensurability, and is optimistic about the chances of meaningful comparisons:

> We might also believe that goods are comparable without believing that they are commensurable—that is, we might think that choices can be made among incommensurable goods, and that such choices are subject to reasoned evaluation, without believing that the relevant goods can be aligned along a single metric. Incommensurability need not entail incomparability[71] . . . . Both people and societies do make choices among incommensurable goods, and they do so on the basis of reasons.[72]

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70. *See* Donald H. Regan, *Authority and Value: Reflections on Raz's* Morality of Freedom, 62 S. CAL. L. REV. 995, 1058–59 (1989).

71. Cass R. Sunstein, *Incommensurability and Valuation in Law*, 92 MICH. L. REV. 779, 798 (1994) (citation omitted).

72. *Id.* at 811.

Many people may well feel that environmental values are, at least to some degree, incommensurate with other private and public goals and objectives, in the sense that they are unwilling to consider giving up one to get the other. Nevertheless, these same people may be willing and able to compare those same items, if the comparison does not require trade-offs and does not require them to express their values in dollar terms. Incommensurability may pose a severe limitation on attempts to estimate monetary measures of environmental values, without precluding the development of useful measures of the relative importance of different losses, thereby allowing "reasoned evaluations" to be better expressed in allocation guides and damage awards.

The existence and extent of incommensurability of environmental values is, of course, largely an empirical matter, and is the topic of Part VI. But first, we consider some examples of the existing use of damage schedules.

IV. Existing Damage Schedules

Various forms of compensation schedules or damage schedules are presently being used to deal with non-pecuniary losses. Although lacking some of the advantages that would stem from accurate monetary assessments of losses, if such were available, such schedules appear to offer advantages of their own—such as predictability, lower costs, and general tractability. Their existence and proliferation suggest that they enjoy a considerable measure of community acceptance. Standardized damage assessments for non-pecuniary losses are hardly new,[73] nor are the issues and problems with schedules unique to environmental valuations.

A. Workers' Compensation Schedules

Under the typical workers' compensation scheme, the compensation that employees can recover for permanent workplace injuries

73. See, for instance, the definition of the term "wergild" in Webster's Third New International Dictionary of the English Language 2597 (Philip Babcock Gove ed., 1981) ("[T]he value set in Anglo Saxon and Germanic law upon the life of a man in accordance with a fixed scale increasing from the churl to the king and paid as compensation to the kindred or lord of a slain person or as a fine for some serious crime . . . .").

is limited to "scheduled" amounts, which vary with the severity of the injuries suffered.[74] Although most workers' compensation schedules are intended to compensate primarily for economic losses such as lost wages and medical expenses, in many jurisdictions they also include, implicitly or expressly, compensation for non-pecuniary losses such as pain and suffering.[75]

The transaction costs and incentive mechanisms of the tort liability system are replaced by an administrative system which encourages workplace safety and, in some cases, regulates compliance with safety standards.[76] Financial incentives and deterrents for employers can be, and often are, provided by adjusting employer premium requirements in accordance with workplace safety records, using "experience ratings" based on the history of actual claims attributable to different industrial groups or firms.[77]

Because workers' compensation schedules are designed principally to compensate pecuniary loss,[78] they cannot be compared directly to non-pecuniary environmental damage schedules. However, the broad acceptance of workers' compensation schemes suggests that it is not unreasonable, in some cases, to set monetary damages for extremely difficult-to-value losses on the basis of the

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74. *See* THE REPORT OF THE NATIONAL COMMISSION ON STATE WORKMEN'S COMPENSATION LAWS 33 (1972). As an illustration, the damage schedule established by the Workers' Compensation Board in British Columbia, Canada awards 2.5% of a specified maximum for the loss of a little finger; 15% for the loss of a kidney; and 35% for a frozen (immobile) shoulder. *See* WORKERS' COMPENSATION BOARD, REHABILITATION SERVICES AND CLAIMS MANUAL A4-1 to A4-3, A4-8 (1993).

75. *See* MONROE BERKOWITZ & JOHN F. BURTON, JR., PERMANENT DISABILITY BENEFITS IN WORKERS' COMPENSATION 6–8, 20–22 (1987); THE REPORT OF THE NATIONAL COMMISSION ON STATE WORKMEN'S COMPENSATION LAWS 38 (1972); C. ARTHUR WILLIAMS, JR., AN INTERNATIONAL COMPARISON OF WORKERS' COMPENSATION 16–21 (1991).

The tradeoffs inherent in workers' compensation schemes are extensive. Generally, the employee gives up the right to sue an employer or fellow worker for personal injuries suffered at the workplace, and the right to have an ad hoc assessment of the value of injuries, in return for guaranteed, "no-fault," administrative recovery of an amount specified in the damage schedule. *See* THE REPORT OF THE NATIONAL COMMISSION ON STATE WORKMEN'S COMPENSATION LAWS 31–35 (1972). Similarly, the employer gives up the ability to defend individual claims on the basis of fault, but gains by avoiding expenses of defending claims, by being protected against windfall decisions, and by being able to participate in what is effectively a group insurance program. *See id.*

76. *See* THE REPORT OF THE NATIONAL COMMISSION ON STATE WORKMEN'S COMPENSATION LAWS 92–98.

77. *See id.* at 93–98. But see the comments of CANE, *supra* note 28, at 535–36, as to the questionable effectiveness of workers' compensation premiums as incentives.

78. *See* THE REPORT OF THE NATIONAL COMMISSION ON STATE WORKMEN'S COMPENSATION LAWS 38.

relative importance of the losses.[79] Inherently, the compensation figures set by the workers' compensation schedules are based on perceptions of average losses and are, therefore, acknowledged to be inaccurate for any particular case. However, the gains from predictability, efficiency, and dependability apparently outweigh the losses from not tailoring awards to the specifics of individual cases.

B. Other Tort Reform Initiatives

Schedules of personal injury losses have been used as a remedy for torts in other areas: for example, as a component of no-fault automobile insurance schemes.[80] Brown and Seto describe the schedules that have been implemented in Canadian jurisdictions that provide no-fault compensation for non-pecuniary losses:

> [T]hese no fault schemes provide benefits only for objectivity [sic] ascertainable impairment. This is done chiefly to reduce uncertainty and disputes (and thereby costs), but it is also probably true that in many cases the degree of impairment is a fair reflection of the relative pain, suffering and loss of enjoyment.
>
> The device used is a detailed schedule of impairment or disfigurement which assigns to each form of such impairment or disfigurement a percentage thereby indicating the degree of impairment of the whole body it is deemed to represent. That percentage is applied to a given maximum to determine the amount of the award.[81]

New Zealand took personal injury damage scheduling considerably further by replacing common law rights of action for such injuries with a statutory compensation scheme, including a compensation schedule encompassing non-pecuniary losses.[82]

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79. *See id.* at 66–70 (1972).

80. *See* JOSEPHINE Y. KING, NO FAULT AUTOMOBILE ACCIDENT LAW (1987).

81. CRAIG BROWN, NO-FAULT AUTOMOBILE INSURANCE IN CANADA 125 (1988).

82. *See* Accident Compensation Act, 1972 (N.Z.). The range of injuries and losses covered under New Zealand's statutory scheme was scaled back in 1992. *See* Margaret A. McGregor Vennell & Joanna Manning, *Accident Compensation*, 1992 N.Z. RECENT L. REV. 1.

Tort reform in the United States has been less dramatic.[83] However, the high transaction costs of the existing approach—in some areas more money may be spent in assessment and recovery than is paid to victims[84]—provide pressure for further changes to the personal injury damages system.[85] In addition, the extreme variability of jury-determined awards for non-pecuniary harm has been questioned:

> Legal reformers have long argued that present law, when combined with jury discretion, inflates damage awards and creates problematic outcome variability. The open-ended and unpredictable nature of tort exposure has, in turn, threatened the liability insurance system that funds most tort compensation. Determination of awards on an ad hoc and unpredictable basis, especially for "non-economic" losses, also tends to subvert the credibility of awards and hinder the efficient operation of the tort law's deterrence function.[86]

Bovbjerg et al. recommend three alternatives for standardizing non-economic personal injury awards: (i) specify an award matrix (or fixed damage schedule) for non-economic losses; (ii) provide juries with "injury scenarios" describing a range of typical injuries and the appropriate amounts to be awarded for each, to be used as boundary lines to assist jury discretion; or (iii) establish a series of caps and floors on injury awards, based on severity of injury classes.[87] Each of these alternatives is intended to ensure that inju-

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83. Possibly due to constitutional restrictions. *See* Randall R. Bovbjerg et al., *Valuing Life and Limb in Tort: Scheduling "Pain and Suffering,"* 83 NW. U.L. REV. 908, 969–74 (1989).

84. *See* JOHN G. FLEMING, THE AMERICAN TORT PROCESS 19 (1988).

85. *See id.* at 21.

86. Bovbjerg et al., *supra* note 80, at 908 (citations omitted). Note that for personal injury pain and suffering losses, juries in the United States must make value assessments without the benefit of expert evidence or reference to previous cases, whereas for environmental losses expert value testimony is permitted. This creates pressing demand for economists to measure environmental losses, without a corresponding demand for economists to measure the value of pain and suffering losses. The practice of personal injury award determination differs in some other countries. *See, e.g.*, JOHN G. FLEMING, THE LAW OF TORTS 236–37 (1992); KEN COOPER-STEPHENSON, PERSONAL INJURY DAMAGES IN CANADA 512–14 (1996).

87. *See* Bovbjerg et al., *supra* note 80, at 938–39. For other proposals to standardize personal injury awards, see James F. Blumstein et al., *Beyond Tort Reform: Developing Better Tools for Assessing Damages for Personal Injury*, 8 YALE J. ON REG. 171 (1991); Frederick S. Levin, *Pain and Suffering Guidelines: A Cure for Damages Measurement "Anomie,"* 22 U. MICH. J.L. REFORM 303 (1989).

ries that are relatively equivalent in terms of severity receive relatively equivalent compensation.[88]

C. Environmental Value Schedules

1. Replacement Cost Tables and Civil Penalties

Scheduling initiatives aimed at standardizing natural resource damage assessments and reducing assessment costs are not uncommon in the United States. For example, a survey of state fish and game departments and state Attorneys General conducted about fifteen years ago found that nine states had formally adopted fish damage schedules based on replacement cost calculations, and an additional thirteen states used tables of replacement cost as informal guides for assessing damages.[89] The pre-established and standardized sums of these replacement cost tables, to be charged on a per organism basis, made damage assessment easy, effective, and less costly.[90]

The same survey revealed that some jurisdictions did not rely on a notion of value such as replacement cost. Instead, they set monetary charges for lost fish and wildlife that were rather arbitrarily anchored to dollars. For example, in the case of civil penalties for illegally taking wildlife in South Dakota and Wisconsin, "The amount charged . . . generally does not purport to represent any actual 'value' of a given species."[91]

The use of such civil penalties and replacement cost tables for wildlife losses seems to be expanding, at least in the United States. The 1993 version of the *State Wildlife Laws Handbook* notes:

> In addition to criminal penalties, over one-third of the states have civil liability provisions of some kind . . . . Although it is

88. The personal injury award matrix proposed by Bovbjerg et al. resembles that proposed herein for environmental losses, but their matrix is based on past awards rather than on judgments of relative importance. *See* Bovbjerg et al., *supra* note 80 at 939–53. If part of the variability in jury awards is due to difficulty in expressing non-pecuniary values in dollar terms, then a matrix based on past awards may institutionalize errors, rather than progressing toward a representation of real values.

89. Faith Halter & Joel T. Thomas, *Recovery of Damages by States for Fish and Wildlife Losses Caused by Pollution*, 10 ECOLOGY L.Q. 5, 6 n.9, 19 nn.87–88 (1982).

90. *See id.* at 20.

91. *Id.* at 21.

> difficult to assess the value of wildlife, half the state legislatures have assessed a value of wildlife for civil liability purposes. These states list the value of various important wildlife species and require the violator to pay restitution to the state for the value of each such animal taken.[92]

In some states these pre-established charges for environmental harms are based on measures of value that are more extensive than replacement cost. For example, Texas has ranked species pursuant to a set of eight criteria of value (such as recreational, aesthetic, economic and ecological role), and then converted the rankings to a monetary liquidated damages scale.[93]

2. *More Extensive Damage Schedules*

Damage schedules are also being used to assess environmental losses arising from spills of oil or other harmful liquids. However, these schedules typically do not set out the compensation charges on a per organism basis, but instead attempt more broadly to quantify and standardize the expected damage from a given spill in a given area. Generally, damage assessment formulae are specified in terms of the type and volume of liquid spilled and the type of environment affected. Some approaches attempt to incorporate non-pecuniary values into the assessment. At least five examples of volume-based damage valuation schedules exist or have been proposed in the United States: (i) the compensation formulae that were proposed by USNOAA in 1994 for use under OPA (and subsequently abandoned);[94] (ii) the federal "Type A" assessment computer models established under CERCLA;[95] (iii) the compensation schedule under Florida's Pollutant Discharge Prevention and Control Act;[96] (iv) Washington's Preassessment Screening and Oil

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92. RUTH S. MUSGRAVE & MARY ANNE STEIN, STATE WILDLIFE LAWS HANDBOOK 30 (1993).

93. *See* 31 TEX. ADMIN. CODE § 69.22 (West 1996).

94. *See* Natural Resource Damage Assessments: Notice of Proposed Rulemaking, 59 Fed. Reg. 1062 (1994). The proposed USNOAA compensation formulae were eventually abandoned in favor of an approach based principally on restoration or replacement. *See* Natural Resource Damage Assessments: Notice of Proposed Rulemaking, 60 Fed. Reg. 39,803 (1995); Carol A. Jones, *The New Restoration-based Measures of Compensation in Natural Resource Damage Assessment Regulations: Methodological Challenges*, 16 AERE NEWSLETTER 5, 5–6 (May 1996).

95. *See* CERCLA, *supra* note 3.

96. FLA. STAT. ch. 376.121 (1995 & Supp. 1996).

Spill Compensation Schedule Rule;[97] and (v) a volume-based damage assessment statute proposed in New York in 1994, but not approved.[98]

The U.S. federal volume-based assessment schedules have not attempted to express all values for environmental assets. The compensation formulae originally proposed by USNOAA, for example, were designed to provide "an estimate of damages per gallon taking into account average restoration costs, plus average lost direct use values pending restoration."[99] Passive use values were not included because "at the time of their development, NOAA determined that sufficient information did not exist concerning average passive use values applicable to the compensation formula approach."[100] The original CERCLA Type A damage assessment computer models also omitted non-use values.[101] In addition, the direct use values expressed in the federal schedules may have incorporated inaccuracies by relying on contingent valuation surveys.[102]

The drafters of Florida's oil spill compensation schedule accepted that assigning dollar figures to non-pecuniary losses is largely an arbitrary process:

> As elected officials, it was the legislature's collective opinion that they were in the best position to assign a monetary value to the state's natural resources. Recognizing that such a value may not represent the true value of the resources, it was determined that assignment of a specific value would, at a minimum, eliminate the speculative nature of the damages and provide a basis for which monies needed to restore natural

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97. *See* Preassessment Screening Rule, *supra* note 18.

98. *See* An Act to Amend the Environmental Conservation Law and the State Finance Law, in Relation to Enacting the Pollutant Discharge Prevention & Control Act of 1994, 215 General Assembly 2nd Reg. Alaska has also established volume-based charges for oil spills, but the charges are expressed as civil penalties, and it is not completely clear whether those penalties are intended to represent environmental values. *See* ALASKA STAT. § 46.03.758 (Michie 1997); Oil and Hazardous Substances Pollution Control, ALASKA ADMIN. CODE. tit. 18, § 75.605–.670 (1997). This may, however, be a device to discourage legal challenges to the "valuation" methodology.

99. DAMAGE ASSESSMENT REGULATIONS TEAM, U.S. DEP'T OF COMMERCE, OVERVIEW OF THE PROCESS 13–14 (1994).

100. Natural Resource Damage Assessments: Notice of Proposed Rulemaking, 59 Fed. Reg. 1062, 1119 (1994).

101. *See* Grigalunas & Opaluch, *supra* note 4.

102. *See, e.g.*, Michael Welsh et al., *Fish and Wildlife Economic Model and Data, in* DAMAGE ASSESSMENT REGULATIONS TEAM, U.S. DEP'T OF COMMERCE, 2 COMPENSATION FORMULA FOR NATURAL RESOURCE DAMAGE ASSESSMENT UNDER OPA: OIL SPILLS INTO ESTUARINE AND MARINE ENVIRONMENTS 3–11 (1993).

> resources would not be tied up in seemingly endless litigation, but would be channeled into the environment as expeditiously as possible.[103]

The Florida schedule sets out a compensation formula which takes into account the volume spilled, the location of discharge, the aerial or linear coverage of impacted habitat, the habitat impacted, and the type of pollutant.[104] The formula is intended to substitute for a broad spectrum of environmental values: "The compensation schedule . . . is based upon the cost of restoration and the loss of ecological, consumptive, intrinsic, recreational, scientific, economic, aesthetic, and educational values of the injured or destroyed resources."[105] As with the criteria used by Texas for valuing wildlife species,[106] the recognition of different categories of value allows the expression of aspects of the importance of environmental assets that typical monetary estimates may not identify. However, the multipliers used in the Florida schedule are based on "restoration cost and market value-based loss of use."[107] To the extent these were the only measures of value considered in developing the dollar figures used in the schedules, significant components of value may still have been missed.

Washington's compensation schedule seems to abandon links to conventional economic valuation models entirely, and instead categorizes spills on the basis of two main components: "resource vulnerability ranking," which considers the relative sensitivity of the receiving environment, and "oil effect ranking," which indicates the relative severity of environmental harm that the type of oil spilled is likely to cause.[108] The derivation of the "rankings" is complex, but generally the resource vulnerability measure incorporates ratings (on a scale of 1 to 5) of habitat, marine birds, marine fisheries, shellfish, salmon, marine mammals, and recreation.[109] The oil effect measure incorporates five-

103. Plante et al., *supra* note 9, at 718.

104. *See* FLA. STAT. ch. 376.121(4) (1995 & Supp. 1996). The damages total also includes compensation for the death of endangered or threatened species, and the cost of the assessment. *See id.*

105. FLA. STAT. ch. 376.121(2) (1995 & Supp. 1996).

106. *See* Plante et al., *supra* note 9, at 717.

107. Plante et al., *supra* note 9, at 720.

108. Geselbracht & Logan, *supra* note 4, at 705; *see* WASH. ADMIN. CODE § 173-183-330 (1997).

109. *See* WASH. ADMIN. CODE § 173-183-400 to -865 (1997).

point ratings of acute toxicity, mechanical injury, and environmental persistence.[110] The damage schedule combines measures of these two components in a multi-term formula that is scaled to produce compensation figures ranging from one to fifty dollars per gallon of spilled oil.[111] The Washington categories and "rankings" are based more on ecological importance and sensitivity than on traditional estimates of monetary value.[112]

Washington's damage schedule scheme uses scores of relative importance to assess damages, but the Washington schedule focuses more on physical and biological importance than on social importance. For example, the recreational value rating contributes only one-seventh of the overall spill vulnerability score, and the six other variables are all biologically oriented (although the marine fisheries score has commercial significance).[113] The schedule may not fully reflect how the public would weigh the different categories involved, or would weigh the different losses within each category.[114]

V. Judging Non-Pecuniary Losses

The compensation figures set out in the existing environmental damage schedules discussed above were set in accordance with judgments of physical and biological importance made by government staff, experts and interest groups, or were derived from contingent valuation surveys or other valuation methods that have

110. *See id.* § -340(2).

111. *See id.* § -320.

112. For example, the marine fisheries vulnerability scores are assigned by geographic subregion and season "based on habitat preference, population status, abundance, fecundity, and sensitivity of life stages." *Id.* § -430(2).

113. *See id.* § -400.

114. Arguably the amount charged for damage to a public asset should bear a relationship to the aggregate *social* value of the loss. The Washington formula was established by experts and interest groups, including federal and state resource agencies, Indian tribes, affected industries, and environmental organizations. *See* Geselbracht & Logan, *supra* note 4, at 718. Similarly, Florida's system was developed by researchers and staff from the Florida Department of Natural Resources, using a nominal group technique. *See* Plante et al., *supra* note 9, at 718. It may be that government staff, experts, and interest groups can estimate aggregate social value, but this is far from generally accepted or agreed upon. Nor is it clear that government staff, experts, and representative members of the community will agree on scores of relative importance. Part V, *infra*, discusses this point in more depth.

limited applicability or provide at best questionable indications of value. Such approaches—especially to the extent that they are able to rely on measures such as replacement cost, restoration cost, hedonic pricing, and travel cost methods—may be useful for assessing values in limited circumstances. However, these schedules could be made more useful and more appropriate if supplemented with methods that capture other components of value and that more clearly reflect aggregate changes in social well-being associated with the loss or change in environmental quality. If consistent judgments of environmental importance can be elicited directly from the public, a damage schedule based on those judgments might provide more accurate and acceptable signals of community values.

This section discusses the results of a survey in which respondents were asked to make choices between pairs of non-pecuniary environmental losses. The survey examined the ability of individuals to choose consistently between pairs of reasonably familiar non-pecuniary environmental losses of similar type, in a single context.[115] The results were used to construct an aggregated interval level scaling of the relative importance of these losses, in a form that could be used to develop an interim damage schedule.

A. Methodology

A questionnaire was mailed to 102 alumni of the graduate program in Resource and Environmental Management at Simon Fraser University ("REM graduates"). Responses were received from 52 REM graduates.[116]

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115. In a previous paired comparison survey of university students judging a mix of public goods (such as creation of a wildlife refuge or a spring festival), private goods (such as clothing or a meal), and sums of money, conducted by Peterson & Brown, the overall coefficient of consistency for the sample of 330 respondents was 92%, and half of the respondents had a coefficient of consistency of at least 94%. *See* George L. Peterson & Thomas C. Brown, *Economic Valuation by the Method of Paired Comparison, with Emphasis on Evaluation of the Transitivity Axiom*, 106 LAND ECON. (forthcoming May 1998) (manuscript at 11–13, 23, Table 1, on file with the *Harvard Environmental Law Review*).

116. The response rate for this survey was 51%. However, as the study was not intended to obtain a representative "sample" of the students, the response rate is not especially relevant. The group of respondents that actually returned completed questionnaires was, for the purposes of the study, a full population. Accordingly, the study results should not be interpreted as representative of REM graduates as a whole, but only as representative of the group of REM graduates who completed and returned questionnaires.

The questionnaire focused on four different environmental losses resulting from oil spills. The four losses were presented in pairs and respondents were asked to choose the loss in each pair for which the greater amount of compensation should be paid. All possible pairs of the four losses were presented, resulting in six comparisons, following common procedures of the method of "paired comparisons."[117]

The method of paired comparisons is a well-established psychometric method for ordering preferences among the elements of a choice set.[118] Given a set of objects, the method presents them independently in pairs as discrete binary choices. Pair-wise comparison reveals inconsistent choices as circular triads, that is, choices that imply A>B>C>A. If the respondent produces no circular triads, the result will be a perfect rank ordering of the objects. A choice must be made even if the respondent is indifferent between the two objects in a pair. Across respondents, or across repetitions of the choice for the same respondent, indifference is indicated by an equal number of selections of each object in the pair. However, a lack of consistency in choice may not be due to indifference, but rather to systematic intransitivity, which is also identified by the paired comparison method.[119]

Respondents were given the following instructions:

> Oil spills cause environmental damage. In some cases damage payments will be paid, and the amount of these payments may vary according to the relative seriousness of the environmental damage caused by the spill.
>
> For each pair of publicly owned locations described below, select the one for which you feel that greater damage payments should be made in the event of a spill of 100,000 litres of crude oil in mid-summer. Assume that commercial and recreational fisheries are *not* affected by the spills, and that it takes approximately two years for all oil to dissipate or be removed from the environment.
>
> Do not indicate a dollar amount, just put a check beside the

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117. *See generally* H.A. DAVID, THE METHOD OF PAIRED COMPARISONS (Alan Stuart ed., 1988) (presenting a comprehensive introduction to the method); PETER DUNN-RANKIN, SCALING METHODS 55–67, 77–85 (1983); J.P. GUILFORD, PSYCHOMETRIC METHODS 154–77 (1954); Louis L. Thurstone, *A Law of Comparative Judgment*, 34 PSYCHOL. REV. 273 (1927).

118. *See supra* note 116.

119. *See supra* notes 65–67 and accompanying text (discussing intransitivity).

> spill location for which you think that greater damage payments should be made.[120]

The following oil spill damage scenarios were described:

> 1. An area at the mouth of a river with mixed sand and mud beaches and low marshes. Marine bird populations are high, marine mammal populations are high, and recreational use of the area is low.
> 2. A deep bay at the mouth of a river. Marine bird populations are low, marine mammal populations are moderate, and recreational use of the area is high.
> 3. A sandy ocean beach close to a city. Marine bird populations are low, marine mammal populations are low, and recreational use of the area is high.
> 4. An area of open ocean on the outer continental shelf. Marine bird populations are low, marine mammal populations are low, and recreational use of the area is low.[121]

All six possible pairs of the four loss scenarios were presented for choice in random order,[122] and respondents selected one from each pair of losses as being more important, in the sense that a larger amount of compensation should be paid for it than for the other.

The descriptions of oil spill sites used in the questionnaire, and the parameters used to describe oil spill damage, were loosely based on the Washington compensation schedule.[123] The Washington system was used as a model because it includes marine and estuarine conditions that are similar to those in British Columbia (where the REM graduates had attended university), and it does not use site descriptions that depend on locally defined terms, such as "special management areas."[124] In order to make the questionnaire less complex than the Washington State classification scheme, respondents were given only a brief written description of each

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120. Murray B. Rutherford et al., Survey on Preferences and Choices (Summer 1994) (survey on file with the *Harvard Environmental Law Review*).

121. *Id.*

122. The ordering of paired comparison "stimuli" may be arranged in accordance with Ross's Matrix to minimize space and time biases. *See* Robert T. Ross, *Optimal Orders in the Method of Paired Comparisons*, 25 J. EXPERIMENTAL PSYCHOL. 414 (1939). However, randomization is also valid if both the order of the pairs and the position of the objects in the pairs is randomized, *see* DUNN-RANKIN, *supra* note 112, at 16.

123. *See* Preassessment Screening Rule, *supra* note 18.

124. Used in Florida's Pollutant Discharge Prevention and Control Act, *supra* note 93.

spill site and of the relative magnitude of three characteristics of resource vulnerability: marine bird populations, marine mammal populations, and recreational use. The oil spill settings were hypothetical, but realistic, and could be assigned approximate numerical rankings similar to those under the Washington State scheme for comparison.[125]

Several other factors, such as spill size (100,000 liters), oil type (crude), season (mid-summer), dissipation time (two years), and effect on commercial and recreational fisheries (none), were held constant among the choices. The intent in simplifying and standardizing oil spill and habitat descriptions was to provide sufficient information for informed choices without overloading respondents or forcing them to make variable assumptions. Written descriptions of spill sites were included in order to evoke feelings of intrinsic values, and to encourage respondents to do more than just add up the verbal "low," "medium," or "high" rankings of resource vulnerability. Vulnerability rankings were given in words rather than numbers for the same reasons. The spills were framed as "damage" to "publicly owned locations" in order to evoke a sense of loss, and to elicit non-use as well as use values within the given parameters.

B. Results

1. Simple Rankings

One of the simplest ways to evaluate paired comparison data is to derive from each set of consistent choices a ranking for the "stimuli" being evaluated.[126] For example, if a respondent selected "marsh" in three questions, "deep bay" in two questions, "ocean beach" in one question, and did not select "outer shelf" in any question, the ranking would be: marsh, deep bay, ocean beach, outer shelf (progressing from highest importance to lowest). Since each loss in the questionnaire was paired exactly once with each other loss, each loss had an equal chance of being selected zero, one, two, or three times by each respondent.

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125. *See infra* note 125 and accompanying text.

126. *See* DUNN-RANKIN, *supra* note 112, at 93; Peterson & Brown, *supra* note 110 (manuscript at 23–29, Tables 2, 3).

Ninety-six percent of the respondents made consistent choices between all pairs of oil spill losses presented. The most commonly selected rank order, from most important to least important, was: marsh, deep bay, ocean beach, outer shelf.

2. *Scale Values*

Paired comparison data can also be aggregated and scaled using psychometric scaling methods. For the purposes of this preliminary survey, simple aggregate scalings were calculated on the basis of relative dominance, using the "variance stable rank method" proposed by Dunn-Rankin.[127]

To apply the variance stable rank method, the total number of times that each loss is selected by all respondents is divided by the maximum number of times that it could have been selected, and the result is multiplied by 100. This gives an ordering of the losses on a scale of 0 to 100, with a mean value of 50. This ordering approximates an interval scale measure, rather than a ratio scale measure.[128] Thus, for example, zero does not represent a complete absence of value or importance.[129]

Table 1 shows the survey data scaled pursuant to the variance stable rank method. Table 1 also shows rough estimates of how each of the oil spill scenarios used in the survey might score in terms of relative severity under the Washington compensation schedule.[130]

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127. *See* DUNN-RANKIN, *supra* note 112. Peterson and Brown used a technique similar to the variance stable rank method. *See* Peterson & Brown, *supra* note 110, at 13. DUNN-RANKIN, *supra* note 112, at 56, notes that similar techniques have been proposed by others. *See* Frederick Mosteller, *The Mystery of the Missing Corpus*, 23 PSYCHOMETRIKA; GUILFORD, *supra* note 112, at 160–74; RUDOLPH J. RUMMEL, AN INTRODUCTION TO RESEARCH PROCEDURES IN EDUCATION (1964).

128. Differences between values on an interval scale have significance. For example, we know that if three losses (*A*, *B*, and *C*) are assigned scale values of 1, 2, and 3 respectively, we know not only that loss *C* is a greater loss than loss *B*, but also that the difference in importance between losses *B* and *C* is identical to the difference in importance between losses *A* and *B*. And if *A*, *B*, and *C* are assigned respective values of 1, 2, and 25, we know that the difference in importance between losses *B* and *C* is much greater than the difference in importance between losses *A* and *B*. For a classification of nominal, ordinal, interval, and ratio scales of measurement, see S.S. Stevens, *Measurement, Psychophysics, and Utility*, *in* MEASUREMENT: DEFINITIONS AND THEORIES 18, 25 (C. West Churchman & Philburn Ratoosh eds., 1959).

129. Similarly, in the Celsius scale of temperature the zero point does not represent a complete absence of temperature or heat.

130. In order to allow a rough comparison of the REM graduates' survey results to

Table 1.
Oil Spill Damage Scalings

	Scale Values from Sample	Washington Compensation Schedule Approximate Score
Marsh	91	11
Deep Bay	57	9
Ocean Beach	48	7
Outer Shelf	4	3

C. Discussion

The overwhelming majority of the respondents were able to choose consistently among all pairs of oil spill losses presented. This implies, at least for this sample group,[131] that rational and internally consistent choices can be made among these types of non-pecuniary losses, at least when the losses are familiar and of a similar type, the assets are broadly spaced in the overall spectrum of individual values, and the information given concerning the damage and the attributes of each asset is simple and easy to understand. The results are similar to those of Peterson and Brown.[132]

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the Washington compensation schedule, the verbal descriptions of habitat vulnerability used in the survey were assigned numerical values corresponding to the Washington scheme. Under the Washington scheme, all of the resource vulnerability rankings use a one to five rating scale, where a score of five represents the most vulnerable condition and a score of one represents the least vulnerable condition. *See* WASH. ADMIN. CODE § 173-183-400 to -500 (1997). Similarly, for the verbal site descriptions used in the present survey, five points were assigned to "high," three points were assigned to "moderate," and one point was assigned to "low," and the resulting figures were summed to give an aggregate score for each spill. For example, the spill into a deep bay at the mouth of a river was assigned one point for marine bird populations (low), three points for marine mammal populations (moderate), and five points for recreational use (high), for an aggregate score of nine. *See id.* § -400.

131. The ability of the REM graduates to make consistent choices may have been due in part to their graduate-level education and relative expertise in natural resource issues. Further empirical studies are needed to test the abilities of less expert groups to make such choices.

132. *Cf.* Peterson & Brown, *supra* note 110. Two differences between the current study and that of Peterson & Brown should be noted. First, in the present survey, respondents were able to "check back" against previous answers, which would be expected to improve consistency. Peterson & Brown used a computer program to administer the paired comparison choices, so that subjects could not go back to previous choices. *See id.* at 12–13. Second, the current survey included only four elements in the choice set, as opposed to 21 in the Peterson & Brown study. *See id.* at 11. The more elements in the

It is likely that individuals would have more difficulty being consistent in choosing between non-pecuniary losses if the losses were closer together in relative value, more complex or unfamiliar, or from more divergent dimensions of value (for example, oil spill damages compared to personal injuries). Inconsistency may, as indicated earlier, simply indicate closeness in relative value; across numerous respondents, such closeness is indicated by closeness in scale values. Inconsistency may also indicate systematic intransitivity.[133] If inconsistency is due to the confusion generated by complex or unfamiliar loss scenarios, it can be dealt with to some degree by carefully designing the way in which information is conveyed to respondents. In the present survey, for example, oil spill losses were described mainly in terms of simple physical and biological characteristics. However, if questions included more variation in the type of hazardous substance spilled, in spill size, or in other factors that would alter the relative effect on different resources, losses might instead be described in terms of changes in service flows or impacts (based on expert evaluations) to help subjects understand those effects.

Intransitivity caused by inability to make comparisons across divergent dimensions of value, to the extent that such an inability exists, is a more difficult problem. The extent to which rational choices can be made across contexts and dimensions of value is a fundamental issue in the construction of value scales, as it determines which types of assets or losses can be reliably compared and represented in one scale of relative importance, and which must be separated into unique scales. This topic deserves further empirical investigation.

VI. Developing an Interim Damage Schedule

A. Establishing Preference Judgments

The first step in constructing an importance scale and interim environmental damage schedule based on people's preferences—

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set, the less likely it is that respondents can rely on memory of prior choices as an aid in making a given choice. Nevertheless, in the Peterson & Brown study the overall coefficient of consistency across the 330 respondents was 92%. *See id.* at 23.

133. *See supra* notes 61–63 and accompanying text (discussing intransitivity).

rather than arbitrarily set by administrative fiat or by legislative deal-making—is to establish the relative importance of the non-pecuniary assets or losses under consideration. The survey reported in Part V explored one promising technique for doing this. Other approaches include using a rating technique or conjoint analysis.[134]

Two additional interrelated issues arise in establishing social preference judgments for environmental losses: (i) What sample of respondents best reflects community assessments of the relative importance of different losses? and (ii) What characteristics (or attributes) of activities and losses should be taken into consideration? A major concern is the choice between respondents who have particular expertise, but may weigh alternatives differently from other members of the community, and respondents who may better reflect community values but lack the knowledge or information necessary to make informed choices. A number of factors may cause divergence in the judgments of these two groups, particularly with respect to perceptions of risk and the activities that may cause losses.[135]

Risk assessment studies have demonstrated that experts often assess the significance of events in ways that differ markedly from the assessments of lay people.[136] Experts strongly focus on the magnitude of an expected loss (the probability of occurrence multiplied by the value of the loss if it occurs) in assessing relative importance. Non-experts tend to consider this as only one attribute, and in addition weigh characteristics such as whether a risk is assumed voluntarily or imposed, whether it affects future generations or not, and the extent to which it is controllable by the

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134. Rating techniques ask respondents to assign their judgments to a scale of values on which at least the end points are labeled. For example, 1 might indicate the least preferred option and 10 the most preferred option. Respondents choose the number that best reflects their judgment. *See generally* GUILFORD, *supra* note 112, at 263; WARREN S. TORGERSON, THEORY AND METHODS OF SCALING 67 (1958).

For an introduction to conjoint analysis, see Paul E. Green & V. Srinivasan, *Conjoint Analysis in Consumer Research: Issues and Outlook*, 5 J. CONSUMER RES. 103 (1978); Paul E. Green & V. Srinivasan, *Conjoint Analysis in Marketing: New Developments with Implications for Research and Practice*, 54 J. MARKETING 3 (1990); USNOAA Natural Resource Damage Assessments: Notice of Proposed Rulemaking, 60 Fed. Reg. 39,804, 39,826 (1995).

135. For a detailed analysis of this issue in the context of risk regulation, see Richard H. Pildes & Cass R. Sunstein, *Reinventing the Regulatory State*, 62 U. CHI. L. REV. 1, 43–95 (1995).

136. *See* Paul Slovic, *Perceptions of Risk*, 236 SCIENCE 280 (1987).

individuals affected.[137] Such differences may result from different information, or interpretations of facts; from different subjective calculations, particularly concerning the reluctance of many people to disregard even low probability events; or from different levels of trust that cleanup activities will be as thorough or as speedy as suggested.

The preferences of non-experts are not necessarily irrational or uninformed when they differ from those of experts. In some cases the lay public may be confused, or may base their choices on erroneous facts or interpretations. However, in many cases they may simply look beyond the narrower calculations of probabilities and expected losses on which expert judgments are largely based to particular dimensions or characteristics of losses or potential events that are important to them. In other words, lay people's preferences may express important attributes of value and perspectives toward risk that are not taken into account by experts. This point is illustrated by the finding that people may be willing, on average, to spend three times as much to prevent a cancer death as to prevent an immediate death from other causes.[138]

In the assessment of social values, lay preferences are important when real differences in valuation, rather than confusion, cause variations from the preferences of experts. As Pildes and Sunstein suggest:

> If lay assessments rest on factual misinformation, or on cognitive distortions in the way inferences are drawn from the known facts, they need not be credited. But to the extent that they reflect different valuations of risk, such as concern for how equitably distributed a risk is, or whether the processes by which the risk is imposed and managed are fair, they are the kind of citizen preferences, backed up by legitimate reasons and values, that democracies should take seriously.[139]

Such citizen preferences about risk, and about other characteristics of losses, can be reflected in judgments of the relative importance of different environmental losses if the potential losses are described in terms of the activities involved, the assets potentially affected, and the types and probabilities of harm. The preferences might then express not only the relative social importance of the

137. *See id.*
138. *See* Pildes & Sunstein, *supra* note 130, at 73.
139. *Id.*

environmental losses, but also social perceptions about the relative significance of the risks involved.

A related issue is the extent to which the cause of a loss (independent of its effect on perceptions of the risk involved) should influence the relative weight of the loss. People may well feel that the death of 20,000 seabirds is more serious if caused by the negligence or deliberate action of individuals than if caused by natural events. The loss, in terms of physical or biological consequences, may be the same, but the impact on people's well-being may be quite different, and again the judgments of experts and lay people may vary. As with risk, the appropriate policy should probably reflect the degree to which an accounting for cause better serves the allocation, deterrence, and compensation objectives of loss assessments.

Given that the preferences of lay people are important, but are more difficult to elicit than those of experts, one alternative is to select respondents from a collection of interest groups involved in environmental issues, or so-called stakeholders. However, even when selected from a broad array of interests, stakeholders may fail to represent a complete or proportionate sampling of all of the attitudes and preferences of society with respect to such issues, and characteristically do little to adequately represent the more diffuse interests of the wider community. Moreover, the preferences of the representatives of any given interest group may fail to accurately express the preferences of the members of the group itself. There is certainly no reason to expect that the importance attributed to an asset by the representatives of an interest group will reflect a statistically weighted summation of the importance that would be attributed to it by each member of the group. The preferences of the representatives may differ even from the preferences of the majority of the group's members, due to organizational incentives acting upon group leaders. Consequently, interest group representatives may not be the best or most accurate source of aggregate social preference information.

The potential for variation among the assessments of interest groups, experts, and lay people suggests that, when possible, the importance scales might best be based on preferences elicited directly from non-expert members of the public, who bear the consequences of decisions based on these weight-

ings.[140] However, some effort does need to be made to minimize the distorting effects of confusion in non-expert judgments. A variety of methods exist for determining lay preferences, from simple surveys or opinion polls to lengthy exchanges between experts and lay people in which factual and cognitive errors are directly addressed. The paired comparison survey discussed in Part V falls somewhere between these extremes, as some degree of scientific information about the consequences of specific losses can be conveyed to respondents. It has the additional advantage of making possible the easy identification of internally inconsistent answers, providing a direct post-survey assessment of the "quality" of the sample's responses.

The point of any elicitation procedure is to gather relatively accurate rankings of the social importance of adverse environmental consequences of an event or activity: for example, the importance of a temporary loss of a stretch of beach resulting from a spill relative to the decrease in fish populations in a stream brought about by runoff from urban construction. Even when the immediate losses to be compared are taken as certain, there may well be uncertainty over other possible consequences. The decrease in fish populations, for example, may or may not have an impact on birds or mammals in the area. An appropriate role for experts might be to provide information about the consequences of the environmental harms to be considered, and the uncertainties involved, so that non-experts can base their choices about relative importance on the best available information.[141]

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140. This does not mean that lay preferences must always be followed. The objective of determining social rankings of importance is to provide decision makers with accurate information about social values and preferences, not to replace political decision making processes with public opinion polls. There may be circumstances in which decision makers will elect not to abide by lay preferences, but they should not have to guess at what those preferences are.

141. For an example of expert classification of environmental assets on the basis of the environmental functions (or "goods and services") that they provide, see RUDOLF S. DE GROOT, FUNCTIONS OF NATURE: EVALUATION OF NATURE IN ENVIRONMENTAL PLANNING, MANAGEMENT AND DECISION MAKING (1992); and for an example of a system used to weigh the relative significance of areas for wildlife conservation, see WILDLIFE CONSERVATION EVALUATION (Michael B. Usher ed., 1986). The extensive research on risk communication, *see, e.g.*, William Leiss, *Three Phases in the Evolution of Risk Communication Practice*, 545 ANNALS AM. ACAD. POL. & SOC. SCI. 85 (1996), might be used to design the mode for communicating this type of scientific information to lay people.

B. Developing the Importance Scales

Once the relative importance of the several environmental losses under consideration has been empirically established, the weighting of each individual loss can then be related to the factors that influence these weightings. In addition to the more controversial "type of risk" and "nature of the cause of loss" characteristics discussed above, these factors might include some measure of physical impact, location, time of year, use of the area, and severity of the consequences of the individual harms.[142] The factors might be set out along a scale, with particular points on the scale corresponding to the relative importance of a loss described by the combination of characteristics associated with that loss.

The use of such a scale of importance can be illustrated with the scale value of 91 given by the survey respondents to oil spilled at an area of "sand and mud beaches and low marshes." The 91 would appear on the scale as the relative importance of: a crude oil spill; 100,000 litres; mid-summer; river mouth with mixed sand and mud beaches and low marshes; no commercial fisheries; no recreational fisheries; high marine bird populations; high marine mammal populations; and low recreational use. In contrast, the scale value of 48 would appear on the importance scale representing the characteristics: crude oil spill; 100,000 litres; mid-summer; sandy ocean beach close to a city; no commercial fisheries; no recreational fisheries; low marine bird populations; low marine mammal populations; and high recreational use.

The principal advantage of expressing preference results in a scale of importance is that the community judgments of the importance of particular losses is seen to depend on specific variables. Further, as all possible losses could not possibly be assessed in the same survey, an initial scale with a few specific losses would provide a framework of reference points to establish the relative importance of other harms. As other harms are encountered, their relative importance can be estimated by interpolation and extrapolation from those previously assessed. For example, if the initial scale included the scale value described above for a crude oil spill

142. In comparison, the matrix proposed by Bovbjerg et al., *supra* note 80, at 944, for assessing non-economic losses arising from personal injuries uses the criteria of age of the injured party and severity of the injury.

at a sandy ocean beach, and in fact an identical crude oil spill occurred in an area with similar characteristics except for the presence of a moderately high population of marine birds, the unassessed spill might be assigned a higher importance than the previously assessed spill. If, instead, the spill were in a similar area with low marine bird populations and low recreational use, the new spill might be assigned a lower importance than the assessed spill. In either case, the importance assigned to the new spill would then provide an additional point within the ranking scale for use in later comparisons.[143]

C. Developing the Interim Damage Schedule

To construct an environmental damage schedule from the importance scale, the scale value scheme would be assigned a "location" within the overall range of policy measures and dollar values designed to provide the desired incentives and remedies. As in the case of existing damage schedules,[144] this might be done by legislative or administrative bodies. The level of sanction, deterrence, or compensation facing those responsible for environmental losses would vary in keeping with the relative severity of the loss.

Damage awards of varying levels would no doubt be included among the instruments, but these would likely best be used along with prohibitions and other lesser restrictions and remedies. Losses judged to be of the greatest importance might, for example, justify absolute prohibitions on particular activities in particular areas. For example, oil tankers might be prohibited in areas where their presence, and the consequent possibility of a spill, would put particularly sensitive and very important environmental assets at risk. At the other end of the spectrum, losses judged to be of minor importance might call for minimal deterrence in the form of small damage awards, or small charges for use, or the absence of any restriction.

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143. This process of continuing interpolation and extrapolation appears to be characteristic of the existing personal injury damage schedules reviewed earlier. The present rich detail of individual harms seems to be the product of years of cases that were somewhat like and somewhat different from previous cases, and new damages were established accordingly.

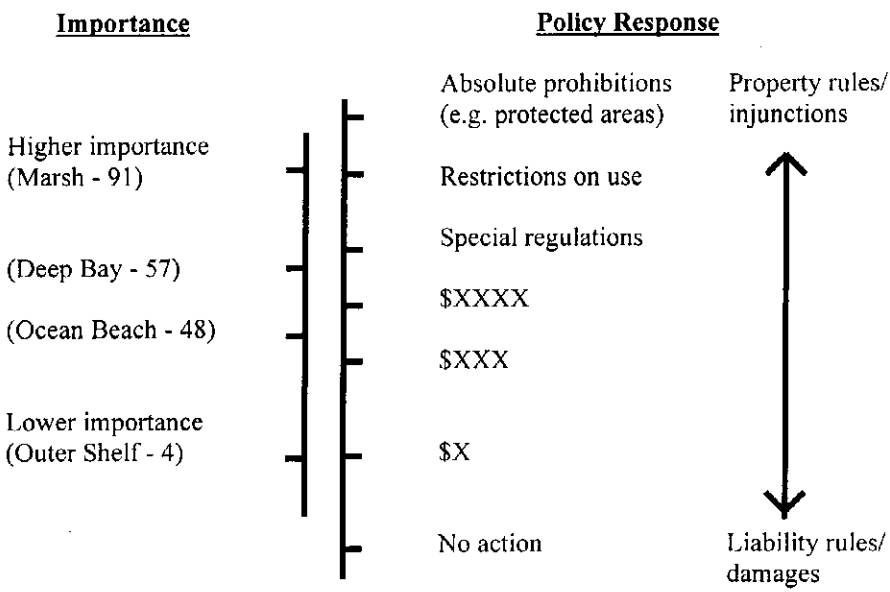
144. *See supra* Part IV.

Figure 1 provides a schematic representation of how a selection of potential policy responses might be located along an importance scale. In the center of the figure the available policy responses are laid out, ranging from the least severe at the bottom to the most severe at the top. In this case, the less severe responses involve liability rules, requiring the payment of damages for harms. The more severe responses impose property rules, protected by absolute prohibitions on use, backed by injunctive remedies. On the left side of the diagram the scaled values of the survey respondents in the oil spill survey are set out. Based on those values, the least severe remedy would be assigned to the Outer Shelf oil spill location and damage description, and the most severe remedy would be assigned to the Marsh oil spill location and damage description.

The initial assignment along the array of possible remedies would necessarily be somewhat arbitrary.[145] While assigning a range of remedies corresponding to the various rankings of the relative importance of losses appears feasible, it seems likely that initial assignments might best be seen as "interim" and subsequently adjusted in accordance with experience, shifting social values, and credible new value information. While sharp changes to the schedule would lessen the predictability advantage of the damage schedule approach, the changes are more likely to evolve at the slower pace typical of changes in most legal remedies, and thus to have limited effect on the predictability of damages. The damage schedule is acknowledged to represent only approximations of cardinal measures of social "worth" of environmental losses, but it does allow policy responses, incentives, and compensation remedies to be tied to internally consistent community judgments of the relative costs or importance of various environmental losses.

145. In Washington State, for example, the legislature imposed a range of $0 to $50 per gallon spilled, which was then applied to an established ranking scheme. *See* WASH. ADMIN. CODE § 173-183-320 (1997).

Figure 1.
Assigning Policy Responses to the Importance Scale



Two kinds of damage schedules could be created: a schedule for consequences (or losses), and a schedule for events (or activities). The consequence damage schedule would assign damage payments for specific losses, measured after the occurrence of a particular event. Its application would require field measurement of the exact losses caused by the event. Examples of losses include area of beach oiled to the extent that it is unusable for recreation, numbers of seals killed, elk killed, old growth Douglas fir trees lost, and kilometers of trout habitat reduced from pristine quality to a specified impaired quality. The total damage payment for an event would be the sum of the damage payments indicated by the schedule for the full set of losses measured for the activity that gave rise to this array of injuries.

In contrast, the event damage schedule would assign damage payments on a more aggregated basis for types of events, such as liters of a certain kind of oil spilled in a certain kind of area at a certain time of year, kilometers of stream affected by a certain kind of stream-flow reduction, or square kilometres of a certain kind of forest burned. The hypothetical damage schedule set out in Figure 1 is a greatly simplified event damage schedule for oil spills. This kind of schedule would be created based on experts' judgments of the most likely consequences (losses) resulting from any of the events. It would be used regardless of the specific consequences caused by a particular event. That is, there would be no effort to go out and measure the specific losses following a certain event, but rather the event would be assessed the standard damage payment specified by the schedule for such an occurrence.

A damage schedule of either kind could be based on public assessments of the relative importance of specific losses, and, if desired, could incorporate perceptions of the relative importance of the causes of loss and the risks involved. The consequence damage schedule would incorporate that information via actual on-site measurement of the consequences, and application of the remedies specified in the damage schedule for those consequences. The event damage schedule would incorporate that information via experts' ex ante judgments of the most likely consequences of particular activities, and public assessment of the relative significance of those consequences.

It is still unclear whether a consequence schedule, an event schedule, or some combination of the two would be preferable. If damage assessments are to be based on a consequence schedule, the scheduled losses must be separable. Only if they do not overlap will it be possible to add the different assessments up to produce an accurate total response for a given event.[146] For complex losses, therefore, an event schedule might be more practical. Because of its specificity, however, deriving a comprehensive event schedule

146. In addition to the requirement that the losses be mutually exclusive, it is also necessary that people's judgments of the relative importance of the losses when presented individually be consistent with their judgments of relative importance for the losses when presented as an aggregation—in other words, that their judgments are not subject to the problem of embedding, which has plagued the contingent valuation method, *see supra* note 57 and accompanying text.

might be substantially more expensive than deriving a comparable consequence schedule.

VII. Conclusion: The Damage Schedule and Policy Objectives

In the nineteenth century John Stuart Mill complained of the courts in England: "the procedure of the tribunals is so replete with delay, vexation and expense, that the price at which justice is at last obtained is an evil outweighing a very considerable amount of injustice . . . ."[147] Much the same might easily be said of many modern environmental damage assessments, though it may be less clear that "justice is at last obtained." Assessments of the relative importance of different environmental losses, and their use as an empirical basis for the design of schedules of damages, may offer advantages in dealing with problems of delay, vexation and expense; and such schedules might do more by conveying relatively reliable information on social preferences.

An importance scale and damage schedule strategy for dealing with environmental losses is expected to offer advantages over present procedures in correctly and cheaply dealing with allocation, deterrence, moral justice, and compensation issues. Even if people's judgments of the importance of losses and implementation of damage schedule remedies will not necessarily lead to optimal deterrence and maximum efficiency in the allocation of environmental resources, the alternative is not an accurate assessment of values, but an absence of credible valuations and a plethora of often self-serving assertions.

This approach seems likely to provide desired incentives, solace to injured parties, and corrective justice consistent with community objectives at lower cost than commonly encountered with present ex post valuations, but at the expense of other objectives such as sensitivity to variability among individual cases. The approach is similar to that currently used in workers' compensation schemes, where workers receive compensation that no one suggests is equal to the true monetary value of the harm they suffered, and

147. John Stuart Mill, Principles of Political Economy, Books IV and V, 243 (Donald Winch ed., Penguin Books 1970) (1848).

the level of employers' safety investment encouraged by the scheme is unlikely to equate exactly to the added cost and added benefit of reduced injuries. Similarly, people harmed by environmental losses would receive damage awards that provide solace and recognition that their entitlement is taken seriously, and those considering activities that pose environmental risks would be motivated to take such losses more fully into account in considering the nature and location of such potentially harmful actions. Further, just as workers are assured of receiving larger damage awards for more serious injuries, all parties would be on notice that more serious environmental losses would call for greater damage payments and more severe sanctions. This is a more modest objective than promised by complete and accurate valuations, but it is one that appears more realistic and achievable. The empirical basis is the less demanding judgments of the relative importance of losses, which people are more likely to be able to provide. Losses are mapped to specific penalties in the damage schedule, providing guidance needed to deal effectively and fairly with environmental values.

An importance scale of environmental losses would provide information required to weigh non-pecuniary environmental assets in accordance with aggregate social perceptions of their importance, in much the same way as market prices or explicit valuations, when such are available, do. More comprehensive scales should evolve with time and experience. To the extent that the importance scales credibly reflect public perceptions, allocation decisions would be more defensible, and conflicts might be reduced. Environmental management, restoration efforts, and industrial development could all be more appropriately targeted with respect to their relative impacts on environmental quality.

There also appear to be several significant cost and procedural advantages offered by the importance scale and damage schedule strategy. A damage schedule could greatly mitigate the difficulties of post-incident valuation by providing pre-incident damage information. Current valuations are costly and unlikely adequately to deter environmental harms.[148] Just as producers and consumers can-

148. After the fact *valuation* (discussed here), involving assessment of the *values* of losses, should not be confused with after the fact assessment of the magnitude of biophysical harm, which would still be required with a "consequences" damage schedule (although not required with an "event" damage schedule: see the discussion in Part V.C). Although a "consequences" damage schedule would require after the fact assessment of

not rationally respond to price signals if prices are only revealed after the relevant decisions have been made, proponents of potentially environmentally harmful developments, shippers of hazardous materials, and dischargers of wastes can hardly be expected to take optimum account of the full costs of their activities if they are only vaguely aware of sanctions that may or may not be imposed on them.

Not only might assessment costs vary, but transaction costs of imposing sanctions—and thereby having them taken into account—can be expected to be far less with a damage schedule procedure. The nature of the sanction is known in advance, and implementation is much more a matter of imposing a posted price on the loss (or on the event, as the case may be) than it is one of producing varied estimates of the value of damages, attempting to discredit opposing methodologies, and forcing procedural delays.

The deterrence function of damages is compromised to the extent that awards fail accurately to reflect actual costs imposed on injured parties. However, it may well be that responses are quite insensitive to how finely environmental damage assessments are tuned.[149] To the extent that this is the case, assessments based mainly on relative values, of which much more is known, may provide much of the deterrence and allocative benefit that would be provided by assessments based on absolute values.

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the nature and magnitude of each of the specific biophysical harms suffered, the remedies (whether damage payments or otherwise) to be assigned to each harm would be specified in advance by the schedule.

149. The usefulness of traditional assertions of optimality conditions and the consequent effectiveness of damages as a deterrent in these cases has been questioned by Castle et al., *supra* note 22, and others. For example, McManus argues that the deterrent effect of damages assessed under environmental legislation in the United States will be undermined by the magnitude of other costs faced by polluters, such as:

> [C]olossal clean-up costs, the costs of elaborate studies and EPA's [the United States Environmental Protection Agency's] oversight and implementation of longer-term remediation, private damage claims, civil and criminal penalties (including, in the case of Section 311 of the Clean Water Act, jail time for a negligent discharge), internal costs and bad publicity. In other words, trustees' claims for injuries to natural resources can be expected to have virtually no deterrent effect.

Robert J. McManus, *Why the Ohio Case Shouldn't Matter*, 34 NAT. RESOURCES J. 109, 118 (1994). For a similar argument with respect to personal injury damages, see CANE, *supra* note 28, at 9. The expected response to the imposition of varied sanctions for causing environmental harm is an under-researched and poorly understood relationship. It now appears that many of the substantial investigative resources that have been devoted to environmental valuation efforts might have been more productively employed in exploring this relationship between sanctions and behavior.

The sacrifice of accuracy inherent in pre-incident standardization may be even less important for the corrective justice function of damages. As long as the standardized figures fall within general bounds perceived to reflect social values fairly, a damage schedule based on relative values would ensure (especially if posted in advance) that losses the public considers to be more severe are given more compensation than those that it considers to be less severe. Equity and fairness are largely prescribed on grounds of equal treatment in equal circumstances, and the clear embodiment of this principle in a pre-established damage schedule might in itself compensate for some sacrifice of accuracy. For similar reasons, awards based on a damage schedule might provide more appropriate solace, as the degree of comfort provided by an award should be strongly influenced by conceptions of fairness and the expectations created by social norms.

The certainty of assigned damages would also enable actuaries better to estimate the probable costs of environmental losses, making environmental liability insurance more feasible. This, combined with less disputable damage assessments, should result in more successful recovery of environmental losses.[150]

One concern that has been raised about proposals to schedule personal injury damages is that such proposals do not adequately consider the influence of law on social norms. Generally, the argument is that by assigning dollar figures to entities whose values are not properly expressible in monetary terms, damage schedules may erode incommensurability and lead to increased commodification.[151] In contrast, by requiring that non-pecuniary losses be individually assessed, the law demonstrates that each such loss is important to society, perhaps more important than the dollar amount of compensation awarded. This argument has two apparent weaknesses. First, experience with existing personal injury schedules, such as those used in workers' compensation, indicates that valuation processes are not so easily influenced. Certainly there is no apparent emerging belief that components of the human body are "worth" the amounts specified in workers' compensation schedules as compen-

150. Washington State's damage schedule appears to have led to more successful damage recovery. *See* Telephone Interview with Richard Logan, Washington State Department of Ecology (May 1994).

151. *See* Radin, *supra* note 25, at 83–86; Sunstein, *supra* note 68, at 820–24.

sation for their loss. People seem to be quite capable of maintaining a distinction between the true value of a loss and what society deems to be an appropriate charge or payment for that loss. Second, by placing so much emphasis on individual cases, this argument may be an example of, and may itself encourage, what Kahneman and Lovallo call "isolation error": the cognitive tendency to treat situations as unique.[152] From a wider view, perhaps the normative message conveyed by a legal system that mandates ad hoc assessment of non-pecuniary damages is that process is more important than predictability, consistency or fairness, and that it is appropriate to allocate substantial resources to the large transaction costs of assessing compensation (including, not incidentally, the fees of lawyers and economists) that might otherwise be allocated to compensation itself.

As a final point, in one respect a damage schedule offers an important advantage over current assessments in its potential for greater accuracy in the assessment of losses. Using the method we have proposed would allow for greater recognition that losses are more accurately reflected by WTA measures than by the WTP measures presently used in assessments. To the extent that changes in economic welfare resulting from an environmental loss, or the perceived reduction of an environmental loss, are more properly assessed by the compensation that injured parties would require to accept the loss (or to forego a reduction in a loss), the ability to more nearly capture this usually much larger value and thereby overcome the serious distortion inherent in current assessments is perhaps one of the most significant advantages.

In summary, a damage schedule would necessarily be somewhat arbitrary. However, especially given the indeterminacy of the methods currently used to assess non-pecuniary environmental values, it might in practice be less arbitrary and more equitable than ad hoc measurement. Furthermore, switching to a damage schedule approach would likely result in greater certainty, better enforceability, reduced transaction costs, and a better reflection of community assessments of losses.

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152. *See* Daniel Kahneman & Dan Lovallo, *Timid Choices and Bold Forecasts: A Cognitive Perspective on Risk Taking*, 39 MGMT. SCI. 17 (1993) (discussing the effects of isolation error on choices involving risk).