Natural Resource Damage Determination

Estimating the Magnitude of Damages

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- 1. How Big is the Case?

Need for Quick Initial Estimates

- Damages small enough for quick resolution w/o formal assessment (CNTS value > assessment cost)?
- Damages small enough for cooperative assessment w/o realistic threat of litigation?
- Damages large enough that interest on damages can fund lobbyists and litigation?
- How likely public and expert demands for action (precise assessment, complete compensation)?

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Preliminary Estimate of Damages (Informal)

- “Back of envelope”
  - Volume/quantity of release (big or small?)
  - Speed/immediacy of release (recent/quick or old/slow?)
  - Affected area (large/long time or small/short time?)
  - Injury likelihood (complete destruction or subtle effects?)
  - Likelihood that experts, elected officials, and public know and care?
  - Likelihood that problem can be fixed quickly/cheaply?
  - Routine leakage ↔ pipeline break ↔ Exxon Valdez

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Preliminary Estimate of Damages (Formal)

- One of the initial steps for a formal Assessment Plan
- Purpose to ensure assessment costs < damages
- Methods (more than back of envelope)
  - Resource equivalency: lost 5 nests; cost of 5 platforms
  - Habitat equivalency: lost 5 acres; cost to restore 5 acres
  - Benefits transfer: valuation literature applied to local situation
  - Comparison to other sites

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2. Concepts for Calculating Damages

NRDA Concepts

- Fundamental purpose of NRDA is to make the public whole
- Restoration gains offset injury losses
- Technical assessment must link objective measures of:

  Release ↔ Pathway ↔ Exposure ↔ Injury/Losses ↔ Restoration/Gains

- Art and science of NRDA is determining which measures are meaningful, relevant, reliable, practical, and inter-related

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NRDA Concepts

- Injuries/losses and restoration/gains have various levels of importance (value) to public, experts, agencies
- Must either assume or measure values throughout entire technical assessment
  - Which injuries are relevant to damages?
  - Which service losses are relevant to damages?
  - Will damages be quantified as projects, costs, or values?

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Economic Valuation Concepts

- Active use values
  - Values related to one's direct use of the injured resources
    - Fishing, viewing, hunting, harvesting, etc.
  - Potential future use of the injured resources (option value)

- Passive use (nonuse) values
  - Values unrelated or indirectly related to one's own use of the injured resources (e.g., bequest and existence values)
  - Public and ecological services provided by natural resources (e.g., carbon sequestration, nutrient cycling)

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Economic Valuation Concepts

- Revealed preference methods and data
  - Relies on actual behavior to determine values
  - Often preferred by responsible parties
    - Because passive values cannot be measured?
    - Because behavior is more reliable than hypothetical statements?
- Stated preference methods and data
  - Relies on surveys and hypothetical scenarios
  - Willingness to pay (WTP), trade, or accept

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3. Methods for Calculating Damages

NR Damage Computation Methods

Methods	**Can measure active use values**	**Can measure passive use values**
Market price, factor price, and replacement cost (**revealed preference**)	Yes	No
Recreation demand modelling (**revealed preference**)	Yes	No
Property values (**revealed preference**)	Yes	No
Contingent valuation, conjoint analysis, value equivalency (**stated preference**)	Yes	Yes
Benefits transfer from literature (**revealed or stated preference**)	Yes	Yes
Habitat/Resource/Service Equivalency (**neither**)	Assumes value equivalency; and assumes meaningful metrics	

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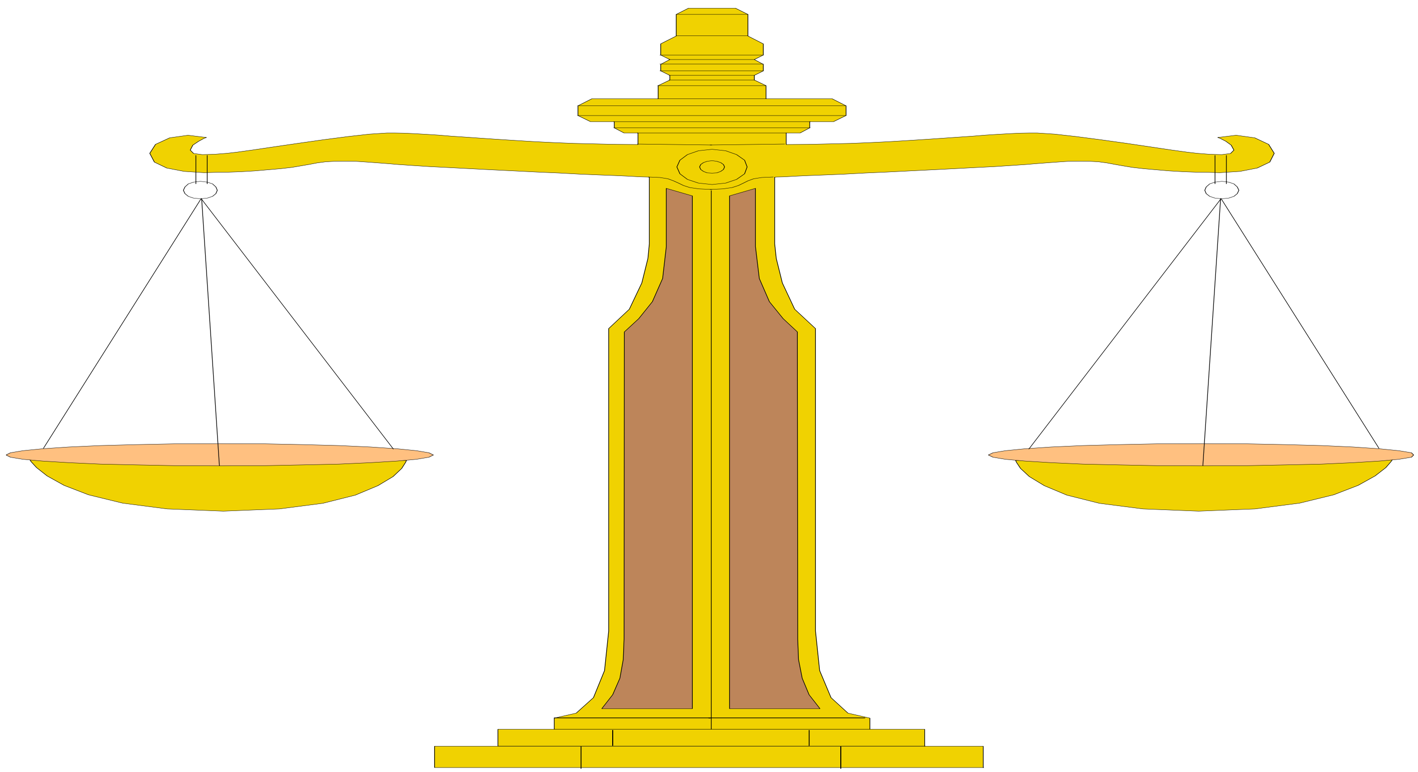
Calculating Damages: Benefits Transfer

- BT uses wide range of peer-reviewed valuation estimates for natural resource service flows
- BT valuation estimates may include active and/or passive use values for resource service flows
- BT requires careful consideration of similarities/ differences between the original study and the situation being valued

Calculating Damages: Equivalency Methods

- Scale NR Injuries/Losses with Restoration/Gains

Losses from Injuries **Gains from Restoration**



Calculating Damages: Equivalency Methods

- Value Equivalence
  - Relevance and relative value of restoration options determined by public
  - Restoration provides similar (but not the same) or dissimilar resources and services that cannot be scaled solely on ecological criteria
  - Use survey methods to obtain value scaling between injuries and restoration

Calculating Damages: Equivalency Methods

- Habitat/Resource/Service Equivalence
  - Relevance and relative value of restoration options assumed (or chosen by experts)
  - Restoration provides same or similar resources and services at same or similar sites
  - Adjust for magnitude as well as spatial and temporal extent of injury and restoration impacts on service flows
  - Assume replacement values then equal injured values (and covers all relevant active and passive values)

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Calculating Damages: Equivalency Methods

- Scaling alternatives to achieve this offset include:
  - Resource-to-resource (5 bald eagles lost; 5 gained)
  - Service-to-service (5 angler days lost; 5 gained)
  - Value-to-value ($5 worth of NR lost; $5 worth gained)
  - Value-to-cost ($5 worth of NR lost; $5 spent on NR)

4. Habitat Equivalency Analysis

Calculating Damages with HEA

- Calculates the present value of the service flow loss (debit) resulting from the injury
- Calculates the present value of the increase in service flows provided by the restoration actions (credit)
- Calculations of HEA debit and credit account for
  - Spatial extent of injuries and restoration
  - Degree of injury and restoration
  - Temporal extent of injury and restoration

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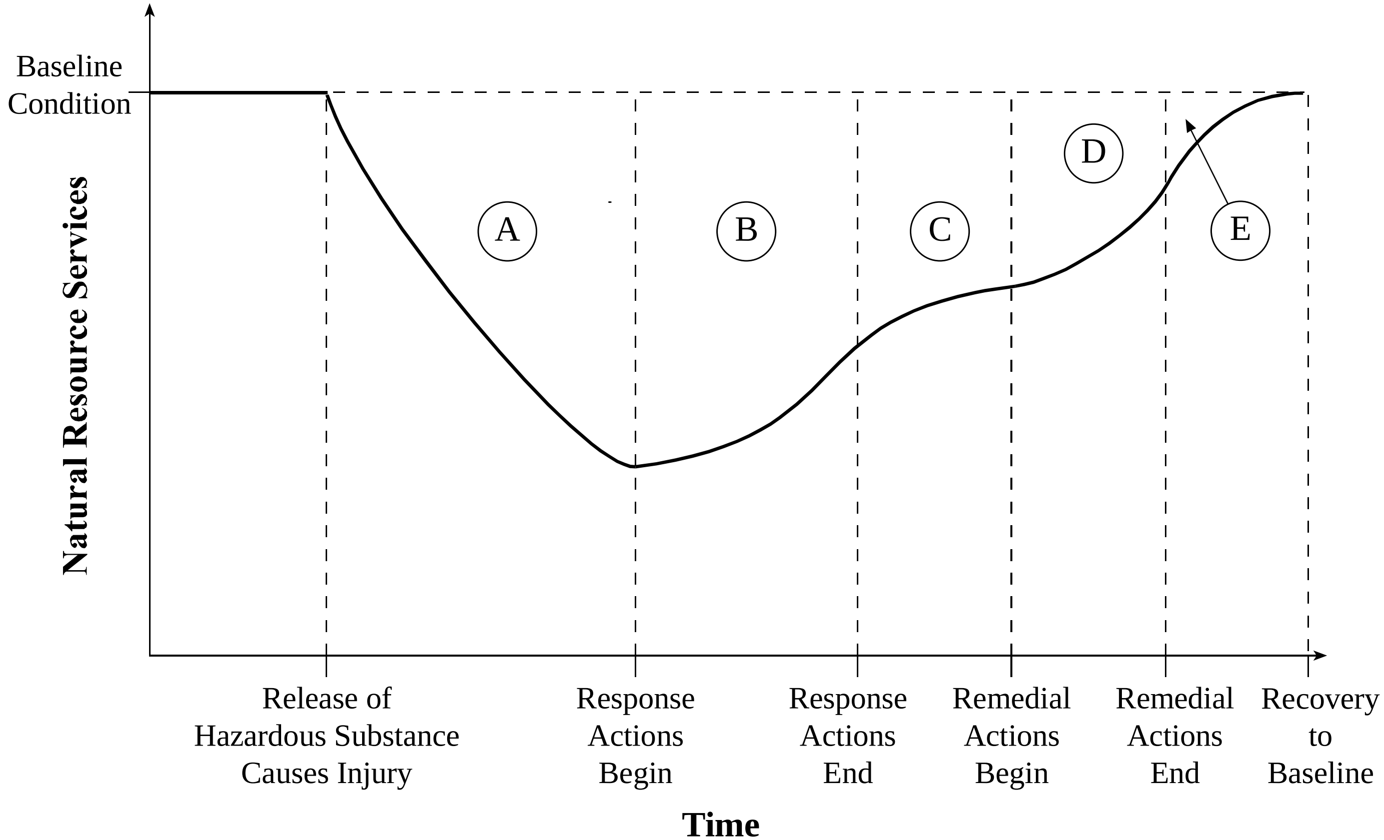
Natural Resource Injury/ Service Losses



HEA Debit Calculation with Fixed Inputs

- Service losses from injury
  - % of baseline services 1980-2000: 13%
  - % baseline services 2000-2020: linear increase from remediation from 13% to 75%
  - % baseline services 2020-2120: 75% (no further improvement after remediation)
- Extent of injury
  - 50 acres
- Discount rate:
  - 4%
- Present value of debit: 1,915 acre/years

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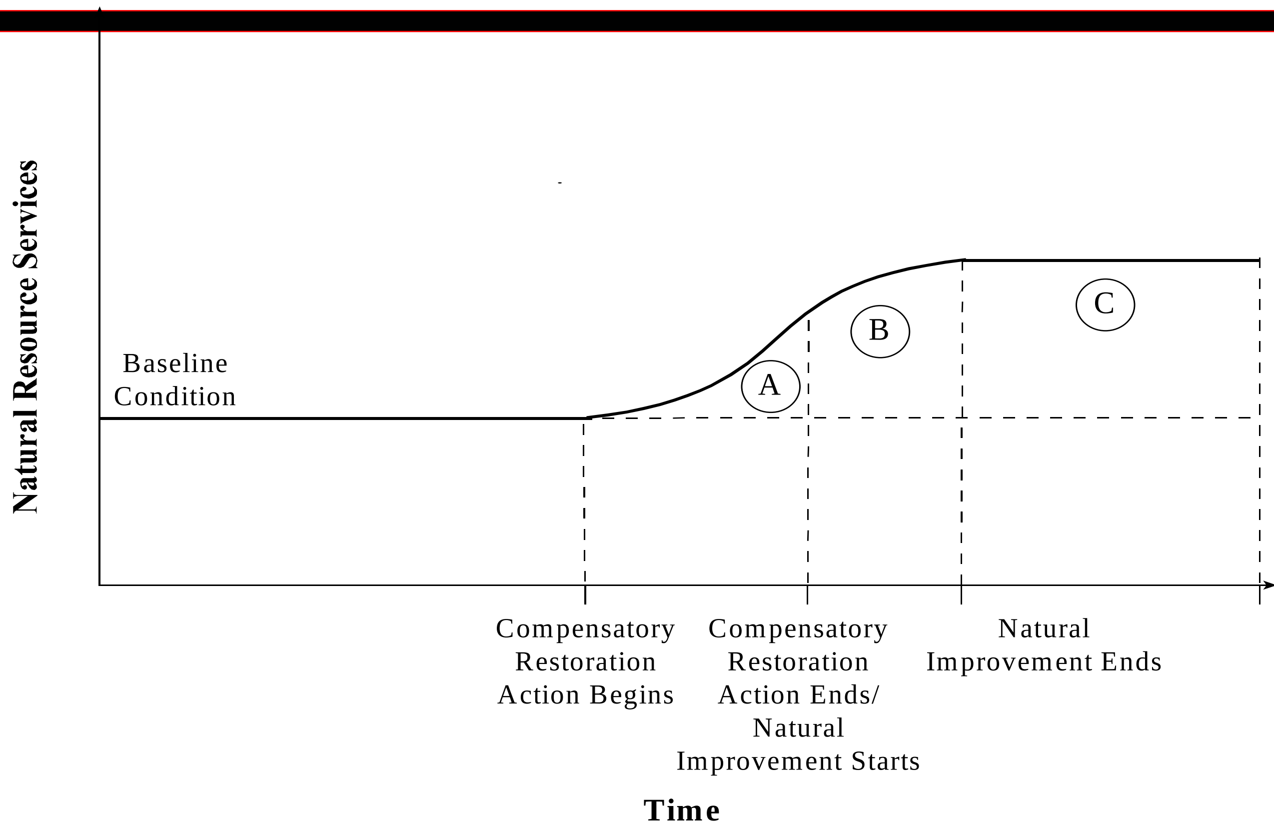
Service Improvements from Restoration



HEA Credit Calculation with Fixed Inputs

- Service gains from restoration
  - % of baseline services at start of work in 2007: 120%
  - % of baseline services at end of restoration work in 2027: 173%
  - % of baseline services from 2027 to 2127: 173% (no improvement once restoration work stops)
- Unit of restoration
  - 1 acre
- Discount rate:
  - 4%
- Present value of credit: 9.7 acre/years

HEA Restoration Scaling

- Scale of restoration determined from present value results for HEA debit and credit
  - Units of required restoration = HEA debit / HEA credit
- Required units of restoration
  - 1,915 present value acre/years (debit)
  - 9.7 present value acre/years (credit)
  - 1,915 / 9.7 = 198 acres
  - Can be monetized by calculating the cost of restoring 198 acres

Monte Carlo HEA Example

- Incorporate uncertainty into debit assumptions
  - % baseline services 1980-2000: 0%-25% (uniform distribution)
  - % baseline services 2000-2020 with linear increases: 50%-100% (uniform distribution)
  - % baseline services 2020-2120: 50%-100% (uniform distribution)
- Incorporate uncertainty into credit assumptions
  - % service increase in restored area: 45%-95% (triangular distribution, 80% as mode)
  - increase occurs from 2000 to 2020, linear change
- Incorporate uncertainty into discount rate:
  - 2%-6% (uniform distribution)

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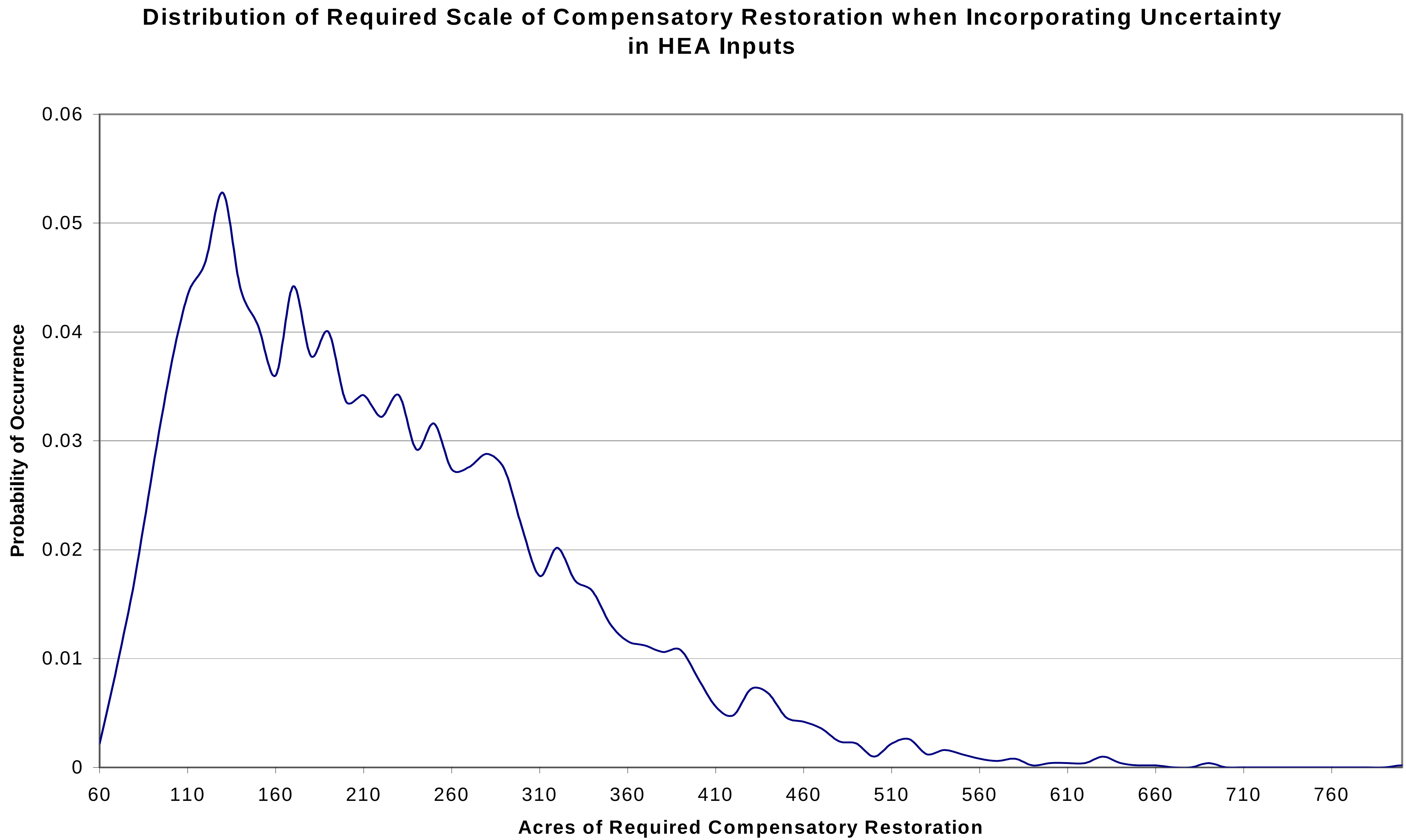
Monte Carlo HEA Results

- Monte Carlo analysis run with 5,000 simulations (i.e., draws)
- Results for required scale of restoration (rounded to nearest 10 acres):
  - Minimum: 60 acres
  - Median: 200 acres
  - Mean: 220 acres
  - Maximum: 800 acres
  - Fixed inputs result: 198 acres


Distribution of Required Scale of Compensatory Restoration when Incorporating Uncertainty in HEA Inputs
Probability of Occurrence
0.06
0.05
0.04
0.03
0.02
0.01
0
60
110
160
210
260
310
360
410
460
510
560
610
660
710
760
Acres of Required Compensatory Restoration

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5. Total Value Equivalency

Green Bay (WI/MI) Example

- Economic study of public values and attitudes (stated preference)
- Value to public of increased environmental quality through restoration is balanced against the value lost from continuing PCB injuries
- This determines “how much is enough,” with the flexibility to consider different project mixes

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Green Bay Example

- Written survey, conducted in 10 counties in Green Bay area
- Conducted using rigorous survey and economic methods
- Designed to quantify how the public balances ongoing PCB injuries against improved environmental quality

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Green Bay Example

- Economic model constructed from survey results
  - 20, 40, 70, or 100 years of PCB-caused injuries
  - Nonpoint source runoff control (net increase)
  - Wetland preservation and restoration (net increase)
  - Park improvements (not adding new parks)
  - Tax increases
- Less PCB remediation ↔ more restoration required
- Straight restoration trades had less variance in responses than WTP; diminishing marginal utility in restoration categories

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Green Bay Example

PCB cleanup scenario	Wetlands		Increase in bay water clarity from runoff control	Improvement in existing parks
	Acres preserved	**Acres restored**		
Intensive (injuries gone in 20 years)	8,700	2,900	+2”	10%
	6,900	2,300	+6”	5%
Intermediate (injuries gone in 40 years)	9,900	3,300	+4”	10%
	8,700	2,900	+8”	10%

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Green Bay Example

Cost > Value	Cost ≅ Value	Cost < Value
Additional trustee sediment restoration: $111 billion	Habitat restoration cost: $111-268 million	Ft. James recreational facility cost: $7 million
Total value for additional trustee sediment restoration (stated preference): $610 million	Total value of habitat restoration (stated preference): $254-610 million	Ft. James recreational facility value (revealed preference): $55 million

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Green Bay Example

- In theory, trustees could seek $111 billion to restore (additional to cleanup) sediments of Green Bay…

  …but less authority than cleanup, and cost 180x value

- In theory, a popular park could be cheap and valuable…

  …but merry-go-rounds are not natural resources

- Therefore, look for cost-effective, relevant natural resource restoration that can be fairly and accurately valued

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Conclusions

- The level of proof required is directly related to the total damages (cost) that the PRPs must bear
- For small damage claims (absolute, and relative to their perception of the value of a CNTS), PRPs may accept extrapolations and “back-of-the-envelope” estimates
- For large damage claims (absolute, and relative to their perception of their ability to pay), PRPs will challenge even highly credible analyses

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Conclusions

- Many damage calculation methods can be useful
  - First, convince yourself of the likely magnitude of damages using available information and techniques (e.g., HEA, REA, benefits transfer)
  - If the damages appear significant, refine the analyses, collect additional data, and apply additional techniques
  - If the interest on the damages are enough to fund litigation, do not rely on backs of envelopes!

Conclusions

- All techniques can be attacked
  - A CVM without high response rates, and very carefully worded and tested surveys, is unlikely to prevail in expert negotiations or litigation
  - A HEA without real measures of how injuries and restorations truly interact, and without any regard to cost versus value, is also unlikely to prevail in expert negotiations or litigation
  - Any technique that does not account for response/cleanup is unlikely to prevail

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