Scaling Compensatory Restoration

Overview

- Habitat Equivalency Analysis: A Brief History
- Current HEA Methods
  - Measuring Resource Services
  - Discounting Through Time
  - Resource-to-Resource Conversions
- Stated Preference Methods
- Scaling Recreational Services

A Brief History of HEA

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1. CERCLA Regulations (1986): In addition to the cost of projects to promote resource recovery, damages may include lost value from interim reductions in resource services
2. Recognizing the high cost of valuing resource services, the assumption of equal value per acre-year is proposed. Habitat Equivalency Analysis (HEA) compares the net present value of gains and losses in habitat acre-years [Unsworth, *et al*., *Ecological Economics*, (1994)].

(A Brief History of HEA)

3. The use of HEA to quantify damages is upheld in two court cases involving ship groundings in the Florida Keyes [Salvors (1997); Great Lakes Dock and Dredge (1999)]
4. “Service-acre-years” are defined more precisely based on the quality and function of a habitat [e.g. Fonseca, *et al.*, *Ecological Engineering* (2000); Strange, *et al.*, *Environmental Management* (2002)]

(A Brief History of HEA)

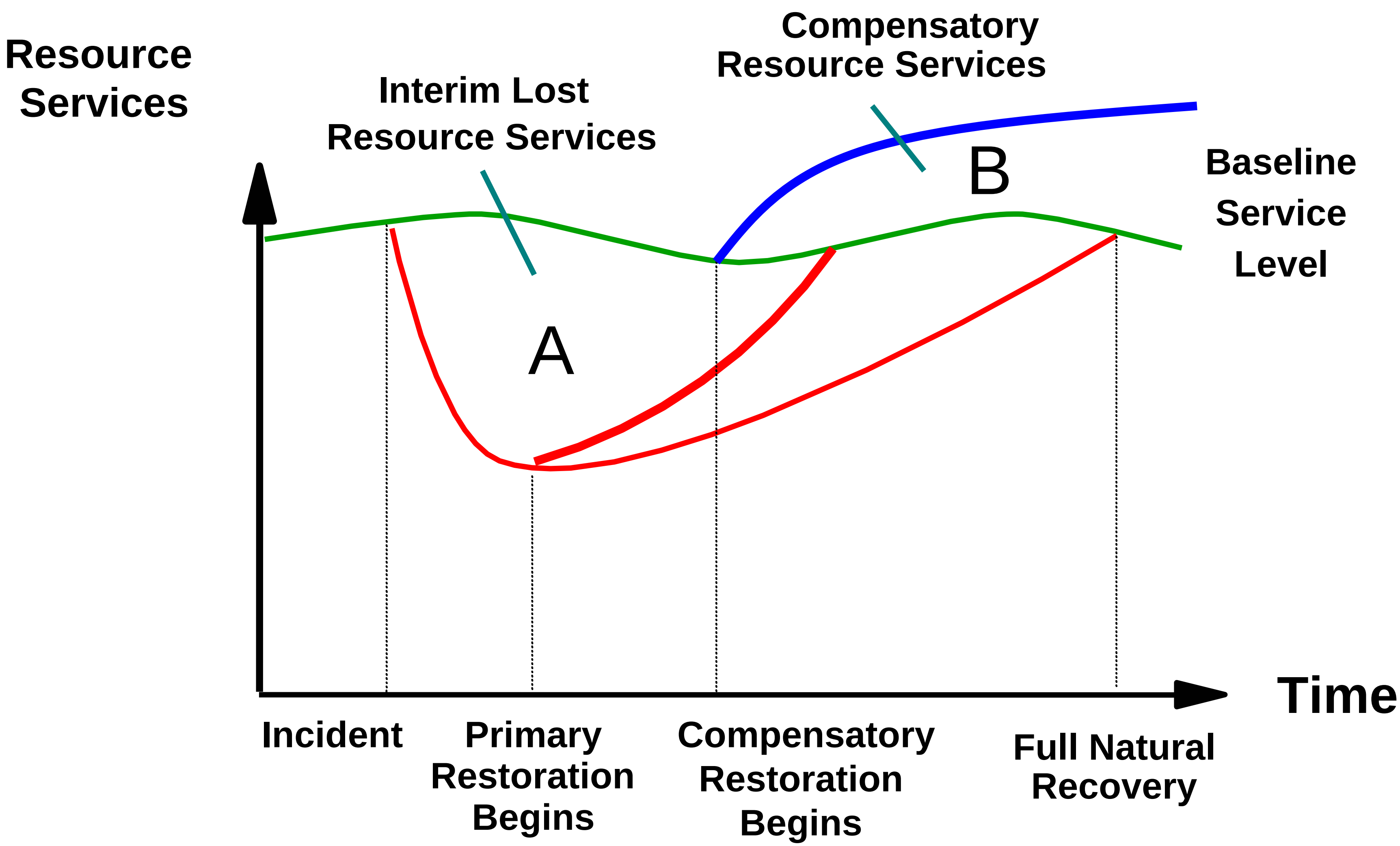
5. The HEA “balance sheet” is expanded to include injuries to specific resources such as birds or fish, which are connected to habitat restoration through food production [e.g. Penn, *et al.*, *Environmental Management* (2002)].
6. Out-of-kind resource trade-offs are developed based on a suite of habitat services and their importance to key species (e.g., the Hylebos damage assessment in Puget Sound).

(A Brief History of HEA)

7. The host of assumptions and analytical relationships in current HEA scaling, such as constant value through time and linear habitat function-value relationships, are examined [Dunford, *et al.*, *Ecological Economics* (2004)]
8. Topics central to the effective application of HEA, such as appropriate measures of injury and and the use of resource trade-offs, are the subject of continuing discussion [SETAC (2004), etc.]

Current HEA Methods

Habitat Service Flows



HEA Methods

- Measuring Resource Services
  - How big are areas A and B?
- Discounting Through Time
  - How do we compare A and B despite differences in the timing of service flows?
- Resource-to-Resource Conversions
  - How do we compare A and B when the resources are different?

Measuring Resource Services

- Losses from injury and gains from restoration must be quantified
- Metrics may be selected to represent resource function
  - E.g., stem height and density of Spartina in an oiled or restored marsh; abundance of benthic organisms in contaminated sediments
- Injury may be quantified directly (e.g. bird mortality)

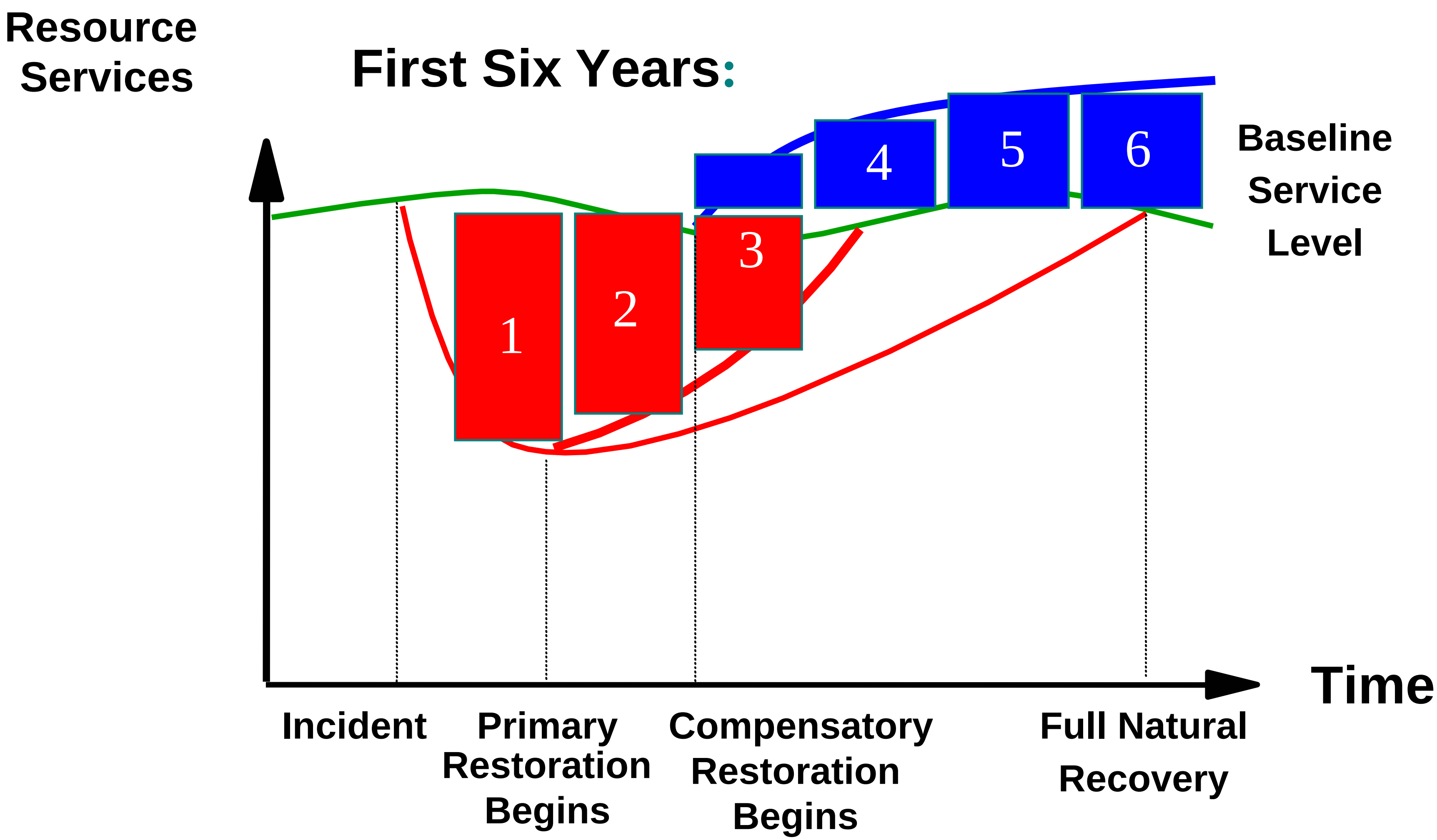
Scientific Transfer for Common Scenarios

- Example: Degree of oiling → Percent services loss
  - Moderate oiling of marsh leads to 100 percent initial loss, 3-year recovery period
  - Lake Barre; Chalk Point
- Example: Success of restored habitat
  - Predicted path to full function for created oyster reef, marsh, sea grass

Discounting Through Time

- If someone borrows a dollar today, he must pay me $1.03 next year
- If someone takes an acre of marsh from the environment today, they must provide 1.03 acres next year

Annual Service Flows



Discounted Service Flows

		A		B		
		Interim Lost Resource Services		Compensatory Resource Services		A+B
Year	Discount Adjustment	Actual	Discounted	Actual	Discounted	Total Discounted Service Flows
1	1.00	-5.0	-5.0			-5.0
2	1.03	-4.5	-4.4			-4.4
3	1.06	-3.5	-3.3	1.5	1.4	-1.9
4	1.09			2.0	1.8	1.8
5	1.13			2.5	2.2	2.2
6	1.16			2.5	7.2	7.2
Total			-12.7		12.7	0.0

* Year six includes the terminal value.

Resource-to-Resource Conversions

Flexibility enhances restoration value, reduces restoration cost

- Losses can be offset with high-priority ecological enhancements
- In-kind restoration may not be available at a reasonable cost, especially for large losses
- Certain habitats are most valuable in combination, e.g. marsh and oyster reef

Resource-to-Resource Conversions

- Acre of marsh lost ←→ Acre of marsh gained
- 100 birds killed ←→ 100 birds created ← 5 acres of marsh nesting habitat
- 10 acres sandy bottom lost → 1000 kg of bivalves lost ←→ 1000 kg of bivalves gained ← creation of 0.5 acre oyster reef

Strengths of HEA

- Highly successful in achieving restoration settlements
- Upheld in two court cases
- Systematic framework to develop consensus and foster compromise

Stated Preference Methods

Stated Preference Techniques

- Unlike HEA, directly addresses issue of resource value
- Focuses on most important resource characteristics
- Commonly applied in market and non-market settings (e.g. product development and resource valuation)

Stated Choice Example

EXAMPLE	Alternative A	Alternative B	Alternative C	Alternative D
Brand	McCain's	Old South	Generic	NONE OF THESE PRODUCTS
Grade	A	C	C	
Sweetness	Unsweetened	Sweetened	Sweetened	
Sale Offer	Package of 4	Unit	Unit	
Total Price/Package	$3.75	$1.75	$1.00	
I Would Purchase.... (✓Check Only One)	☐ ⇓	☐ ⇓	☐ ⇓	☐
How Many of the Selected Product?	______ packages of 4	______ cans	______ cans	

Sample Survey Question

18 **If you had to choose, would you prefer Alternative A or Alternative B?** *Check one box at the bottom.*

	Alternative A ▼	Alternative B ▼
Wetlands Acres	63,800 acres (10% more)	60,900 acres (5% more)
PCBs Years until safe for nearly all fish and wildlife	20 years until safe (80% faster)	70 years until safe (30% faster)
Outdoor Recreation Facilities at existing parks	0% more	0% more
Acres in new parks	4,300 acres (5% more)	8,600 acres (10% more)
Runoff Average water clarity in the southern Bay	20 inches (current)	34 inches (70% deeper)
Excess algae days in lower Bay. .	80 days or less (current)	40 days or less (50% fewer)
Added cost to your household Each year for 10 years	$50 more	$25 more
Check (✔) the box for the alternative you prefer →	☐	☐

Obtaining an Estimate of Value

- Econometric model fits payments and environmental characteristics to a statistical distribution
- Loss can be expressed in monetary terms, or in units of required restoration
- A variety of potential restoration scenarios can be evaluated

Scaling Recreational Services

Scaling Recreational Services

- Travel Cost Models estimate the value of recreational sites and site characteristics
  - Exploit analogy to market behavior
  - Price, Quantity, Consumer Surplus
- Benefits Transfer borrows information from previous analysis

The Travel Cost Method

If people drive 75 miles to get to a resource, and the cost of driving is $1.00 per mile in time and expense, the trip must be worth at least $150

75 miles

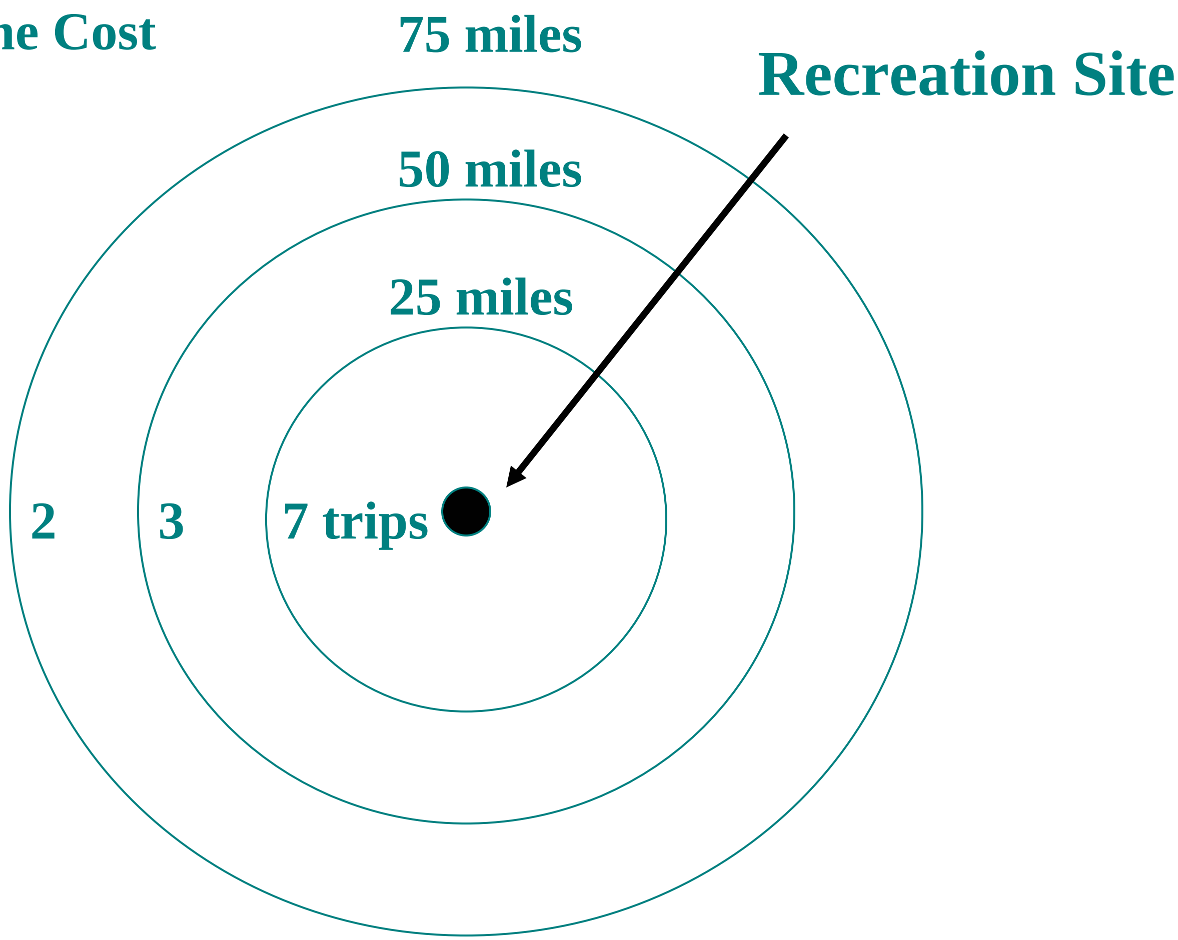
Recreation Site

Those who travel only 25 miles are getting surplus value of $150 – $50 = $100.

25 miles

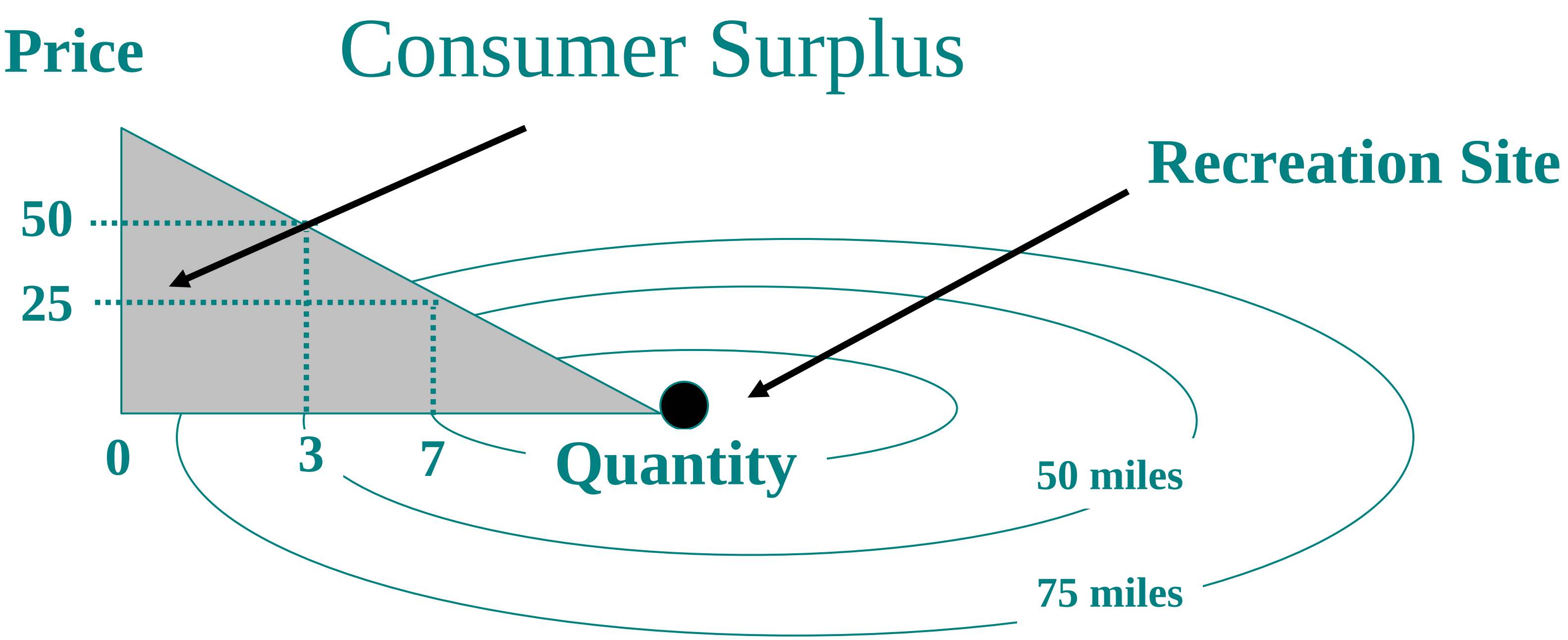
The Travel Cost Method

Price = f(distance)
= Out-of-Pocket Travel Cost
+ Time Cost



Quantity = Average Trips per Person per Season

The Travel Cost Demand Curve



Obtaining an Estimate of Value

- Estimate consumer surplus values for many sites
- Compare (using regression analysis) site values to site characteristics
- Estimate value of characteristics (e.g. urban environment, fish consumption advisories)

Benefits Transfer

- Valuation short-cuts using existing data
- Previous studies are applied to new problems
- Some measure of impact at the affected site is required, usually involving observed levels of recreational activity

Conclusions

Concluding Remarks

- Restoration scaling has evolved to accommodate a wide variety of impacted environments and restoration goals
- Public preferences, scientific expertise and economic principles are combined to generate fair and consistent outcomes

Additional Resources

- Restoration Scaling Bibliography
- Visual HEA: Automated discounting of service flows (NSU Coral Institute)
- Benefit Transfer of Outdoor Recreation Use Values (USDA)
- www.darp.noaa.gov
- restoration.doi.gov