Assessing the Non-Market Values of Ecosystem Services provided by Coastal and Marine Systems

Revealing a monetary baseline for coastal and marine markets

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Presentation

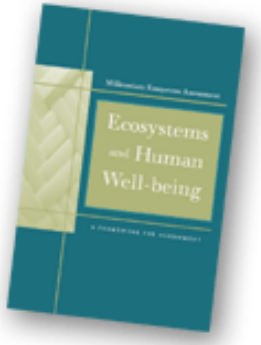
1. **Valuing Ecosystem Services as a Baseline for Establishing Viable Market Exchanges in Coastal and Marine Systems**

2. **Existing Non-Market Coastal Studies and Value-Transfer Methodology**

3. **Coastal Case Study**
   - **King County, WA. Maury Island Project**

4. **Conclusions—Challenges and Opportunities**

The Value of Coastal Ecosystem Services



Ecosystem services are critical to the functioning of coastal systems and also contribute significantly to human wellbeing, representing a significant portion of the total economic value of the coastal environment. The best available data suggest that substantial positive economic values can be attached to many of the marketed and nonmarketed services provided by coastal systems.

(Agardy et. Al. 2005, p533).

http://www.millenniumassessment.org

Agardy, Tundy; Jackie Alder, Paul Dayton, Sara Curran, Adrian Kitchingman, Matthew A. Wilson, Alessandro Catenazzi, Juan Restrepo, Charles Birkeland, Steven Blaber, Syed Saifullah, George Branch, Dee Boersma, Scott Nixon, Patrick Dugan, Charles Vörösmarty. **2005**. Coastal Systems and Coastal Communities, in *Millennium Ecosystem Assessment: Conditions and Trends, Volume I*. Washington DC: Island Press. Pp.513-543.

Millennium Assessment (MA) 2003 Typology of Ecosystem Goods and Services

Provisioning	**Regulating**	**Cultural**
Goods produced or provided by ecosystems • food • fresh water • fuel wood • genetic resources	Benefits obtained from regulation of ecosystem processes • climate regulation • disease regulation • flood regulation	Non-material benefits from ecosystems • spiritual • recreational • aesthetic • inspirational • educational
Supporting Services necessary for production of other ecosystem services • Soil formation • Waste Treatment and Nutrient cycling • Primary production		

Adapted from Millennium Ecosystem Assessment *Ecosystems and Human Well Being* (2003)

Non-Market Valuation Techniques

Revealed-preference approaches

- **Travel cost:** Valuations of site-based amenities are implied by the costs people incur to enjoy them (e.g., cleaner recreational lakes).
- **Market methods**: Valuations are directly obtained from what people must be willing to pay for the service or good (e.g., timber harvest).
- **Hedonic methods**: The value of a service is implied by what people will be willing to pay for the service through purchases in related markets, such as housing markets (e.g., open-space amenities).
- **Production approaches**: Service values are assigned from the impacts of those services on economic outputs (e.g., increased shrimp yields from increased area of wetlands).

Cost-based approaches

- **Replacement cost**: The loss of a natural system service is evaluated in terms of what it would cost to replace that service (e.g., tertiary treatment values of wetlands if the cost of replacement is less than the value society places on tertiary treatment).
- **Avoided cost:** A service is valued on the basis of costs avoided, or of the extent to which it allows the avoidance of costly averting behaviors, including mitigation (e.g., clean water reduces costly incidents of diarrhea).

Stated-preference approaches

- **Contingent valuation**: People are directly asked their willingness to pay or accept compensation for some change in ecological service (e.g., willingness to pay for cleaner air).
- **Choice modeling**: People are asked to choose or rank different service scenarios or ecological conditions that differ in the mix of those conditions (e.g., choosing between wetlands scenarios with differing levels of flood protection and fishery yields).

See: National Research Council 2005. Valuing Ecosystem Services: Toward Better Environmental Decision-Making The National Academies Press, Washington D.C.

Current Research: Non-market, Peer-Reviewed Valuation Studies of Coastal and Marine Systems

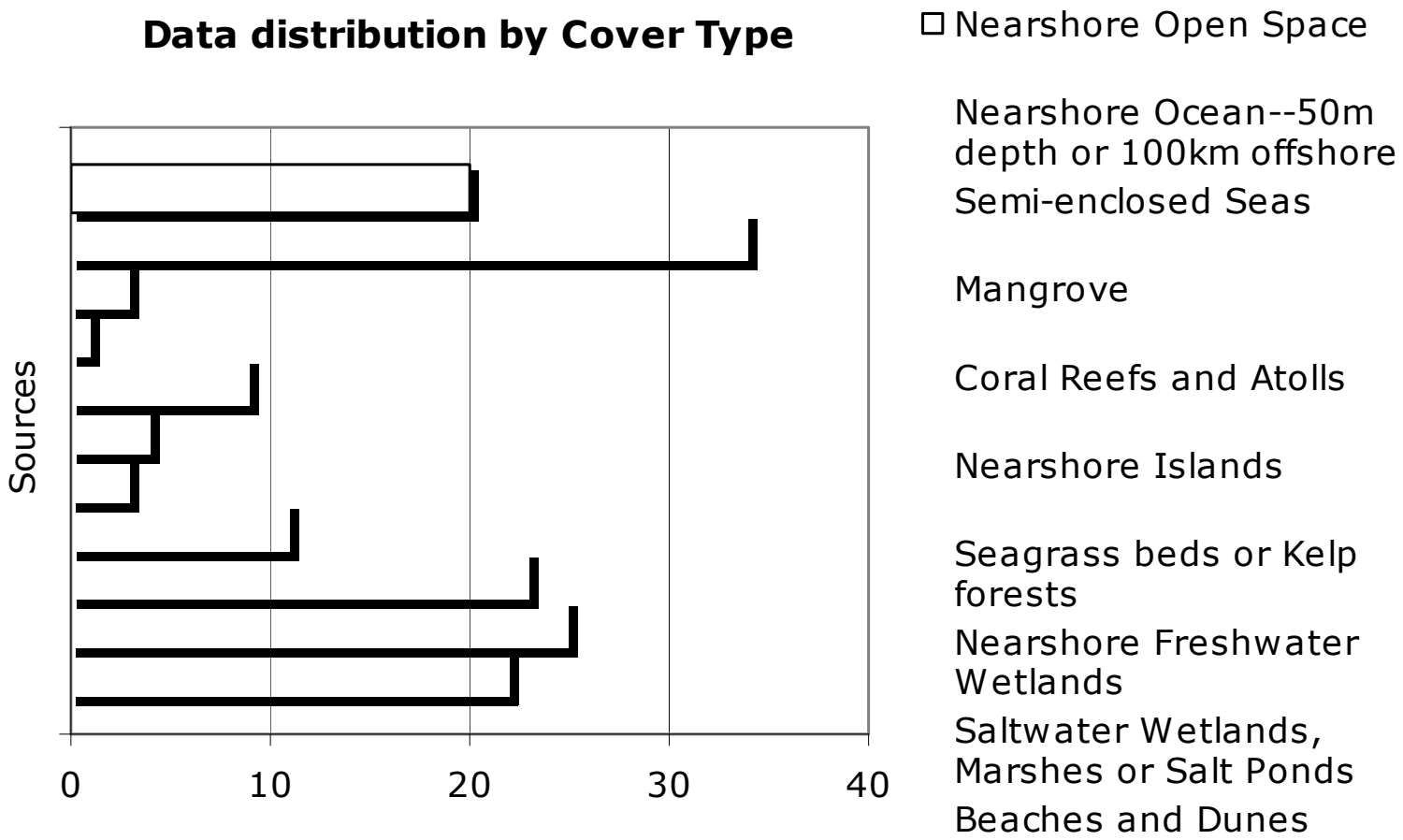
	Nutrient cycling	Net primary production	Pollination and seed dispersal	Habitat	Hydrological cycle	Gas and Climate regulation	Disturbance Regulation	Biological regulation	Water regulation	Soil retention	Waste regulation	Nutrient regulation	Water supply	Recreation	Aesthetic	Science and education	Spiritual and historic
Estuaries and Lagoons				2									9	6	5		
Beaches and Dunes				1			2						7	11	1		3
Saltwater Wetlands		1		3			2						4	9	3		1
Nearshore Freshwater Wetlands							1		3				1	5	1		
Seagrass or Kelp beds				1				1							1		
Nearshore Islands				2			1							1			
Coral Reefs and Atolls													1	8			
Mangrove				1													
Semi-enclosed Seas				2											1		
Open Ocean																	
Nearshore Ocean				4									5	24	1		
Nearshore Open Space				1									4	13	2		

Total Studies: 70
Data Entries: 155

Sample Raw Data

Land Cover	Ecosystem Service	Citation	Valuation Method	Lower Bound	Upper Bound	Mean/Median	Valuation Unit
Estuaries and Lagoons	Habitat	Bell (1997)	MPE			$1,843.98	Per acre
		Bell (1997)	MPE			$12,163.53	Per acre
	Water supply	Bockstael et al (1989)	CV	$71.43	$227.44		Per person year
		Hayes et al (1992)	CV	$69,924,812.03	$133,646,616.54		Per year
		Hayes et al (1992)	CV	$74,248,120.30	$115,413,533.83		Per year
		Le Goffe (1995)	CV	$38.43	$39.41		Per household year
		Le Goffe (1995)	CV	$52.05	$52.30		Per household year
		Leggett and Bockstael (2000)	HP	$4,609,489.05	$24,940,389.29	$14,774,939.17	
		Whitehead et al (1995)	CV	$73.93	$106.32		Per household year
		Whitehead et al (1998)	CV	$280.69		$351.39	Per household year
		Whitehead et al (2000)	CRS			$43.59	Per household season
	Recreation	Kaoru et al (1995)	TC	$5.51	$102.56		Per trip per party
		Kaoru et al (1995)	TC	$11.44	$54.24		Per trip per party
		Kaoru et al (1995)	TC	$2.13	$11.60		Per trip per party
		Nunes et al (2004)	CV	$0.29	$0.41		Per person year
		Whitehead et al (2000)	CRS			$154.53	Per household season
		Whitehead et al (2000)	CRS			$198.13	Per household season
	Aesthetic	Earnhart (2001)	CV			$230,493.94	
		Earnhart (2001)	HP			$8,736.49	
		Parsons and Wu (1991)	HP	$456.86	$1,027.45		Per house
		Parsons and Wu (1991)	HP	$12,849.02	$15,456.86		Per house
		Parsons and Wu (1991)	HP	$146,594.12	$189,552.94		Per house

Non-Market Valuation Data Distribution



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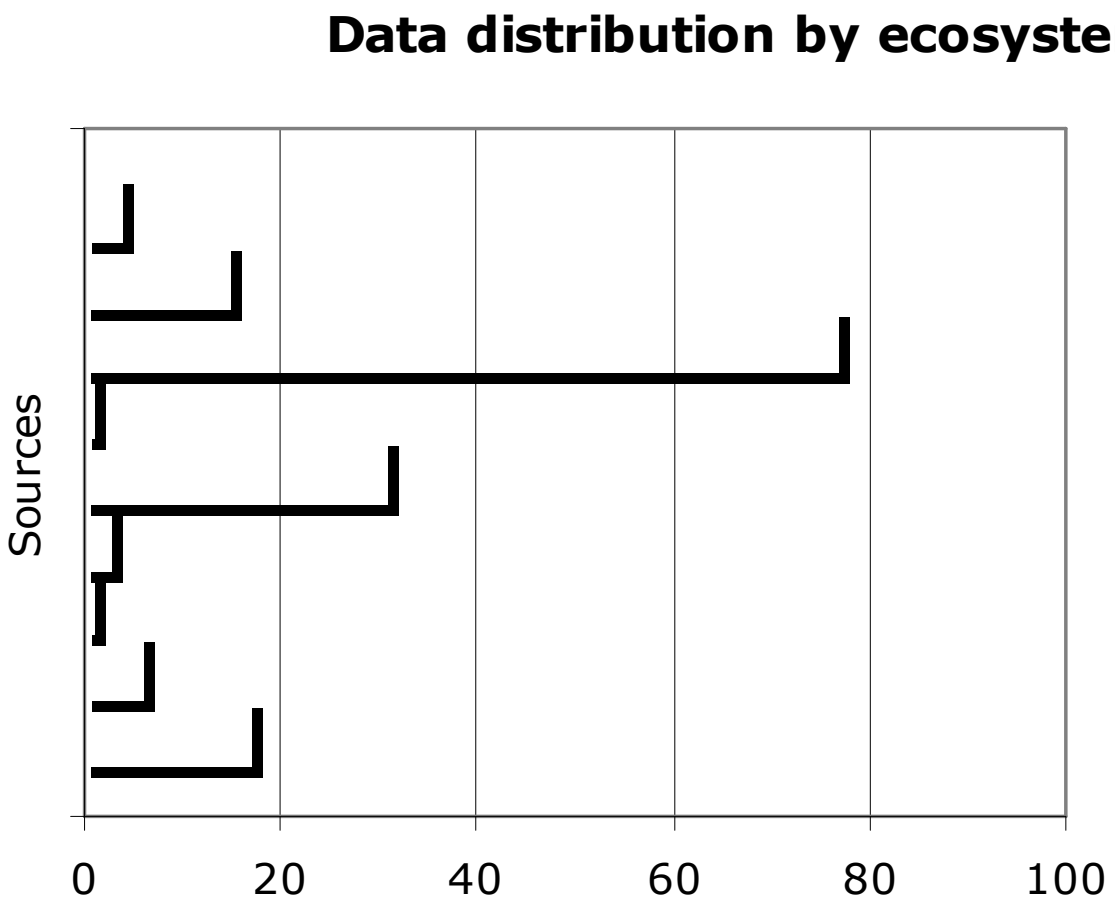

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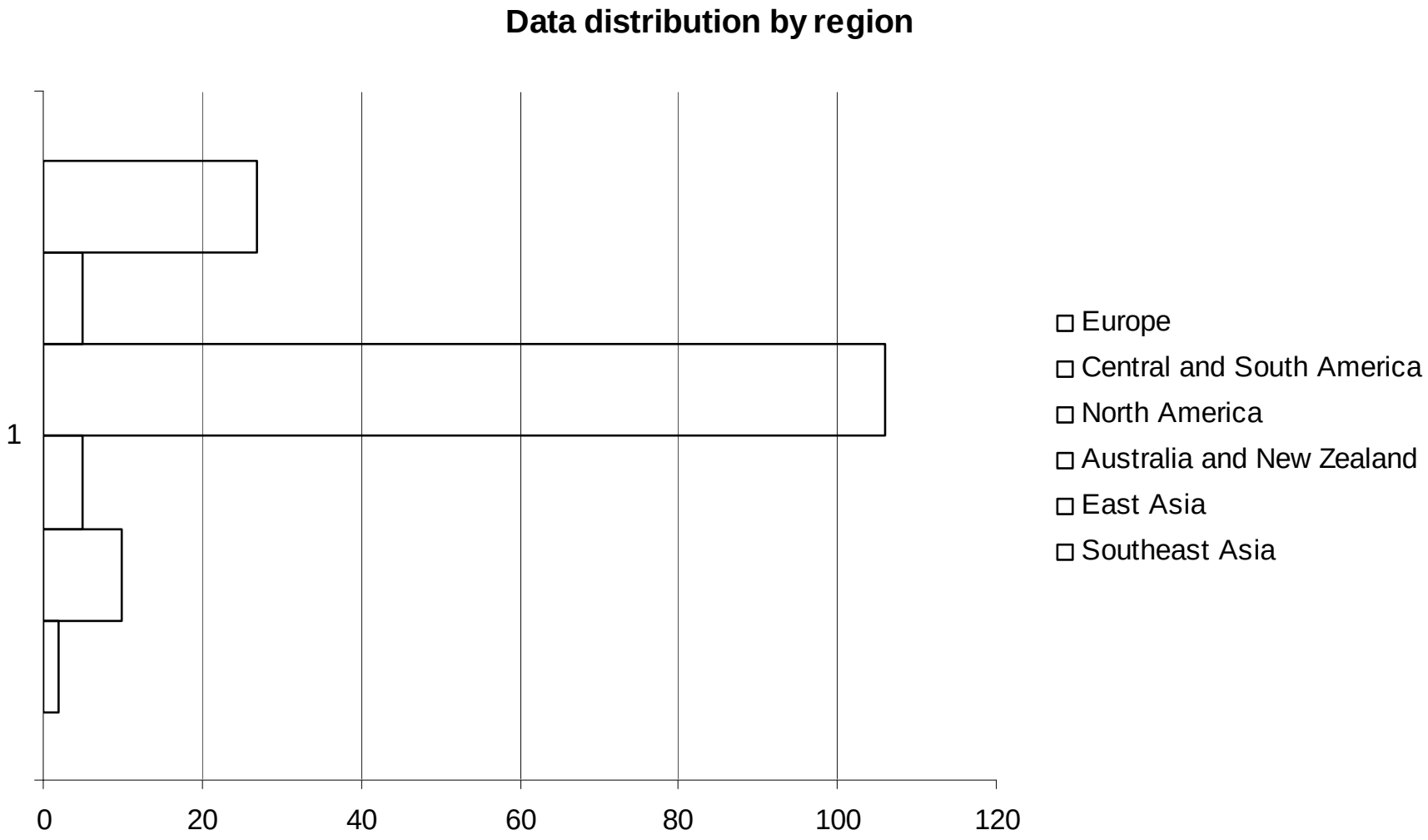


Environmental Value Transfer

Value transfer is an economic methodology which obtains an estimate for the economic value of non-market goods or services through the analysis of a single study, or group of studies, that have been previously carried out to value similar goods or services.

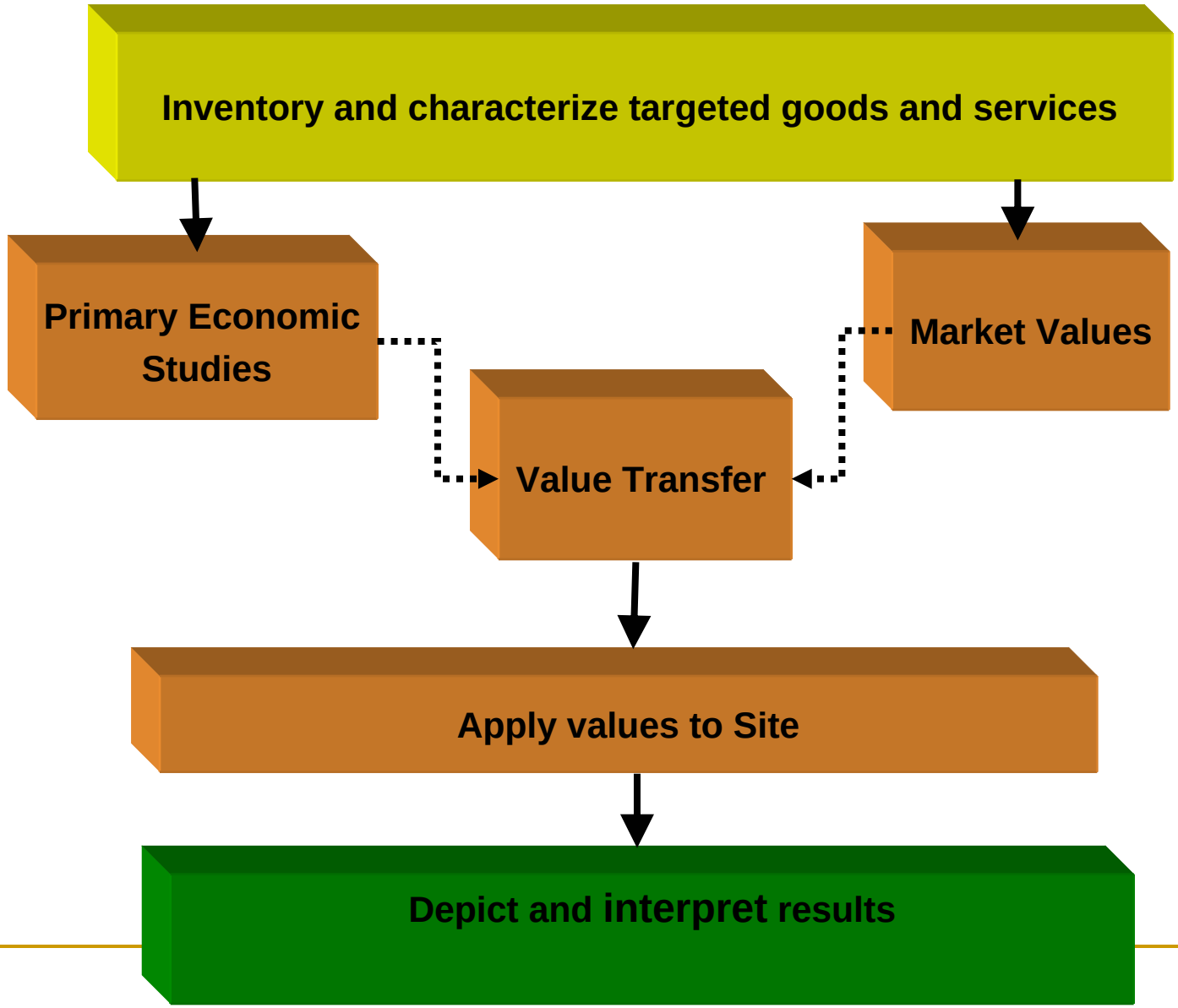
- The 'transfer' itself, refers to the application of empirical economic value estimates and other information from the original 'study site' to a 'policy site'.

- The critical underlying assumption of the value transfer approach is that the economic value of ecosystem goods or services at the study site can be inferred with sufficient accuracy from the analysis of existing valuation studies.

- As the level of information increases within the source literature, the accuracy of the value transfer likewise improves.

Wilson, Matthew A. and John Hoehn **2006**. Introduction to the Special Issue on Environmental Benefits Transfer. In M. Wilson and J. Hoehn (eds.) Environmental Benefits Transfer: Methods, Applications and New Directions *Ecological Economics*.

Spatially Explicit Value Transfer



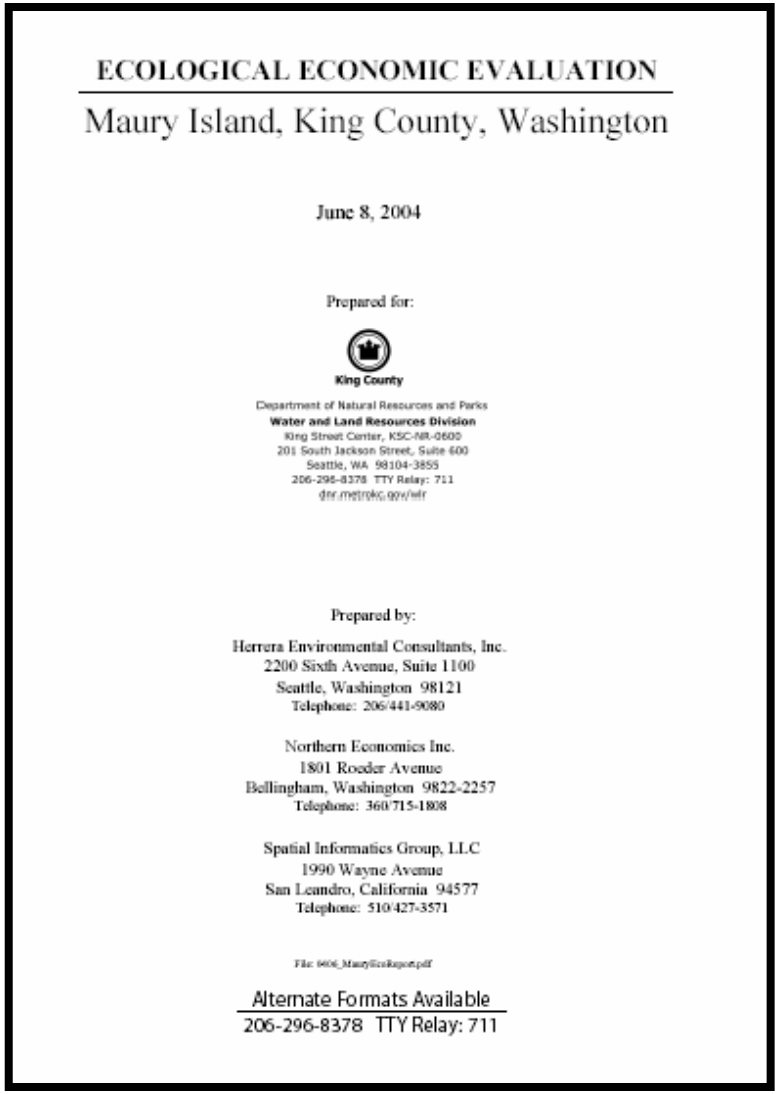
Case Study

Practical Challenges and Experiences linking GIS and Spatial Value-Transfer

Maury Island, King County, WA.

- In 2004, the spatial value transfer method was used by members of the Ecovaluation Group www.ecovaluation.com to analyze the value of the Maury Island's natural capital, including nearshore habitat.

- In addition to wanting know about the value of the island's natural capital, King County DNR Policy Makers wanted to know about the potential effect of a proposed expansion of a gravel mine.



ECOLOGICAL ECONOMIC EVALUATION

Maury Island, King County, Washington

June 8, 2004

Prepared for:

King County

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Alternate Formats Available
206-296-8378 TTY Relay: 711

Report Available: http://dnr.metrokc.gov/wlr/watersheds/puget/maury-eco-evaluation.htm

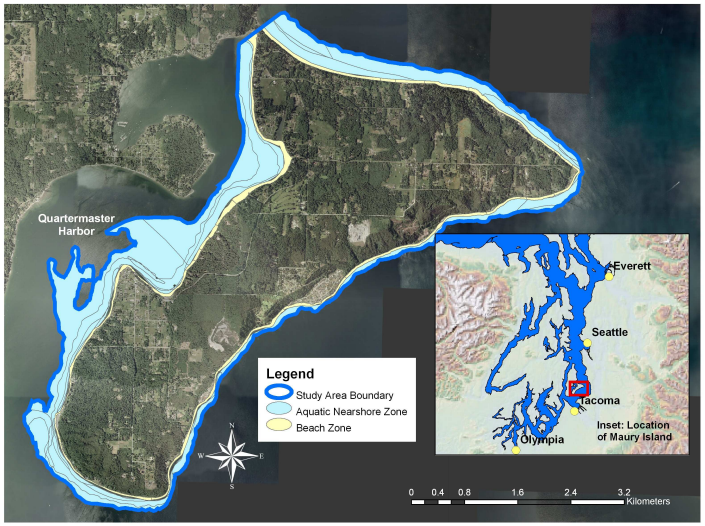
A Decision Framework for Spatial Value-Transfer

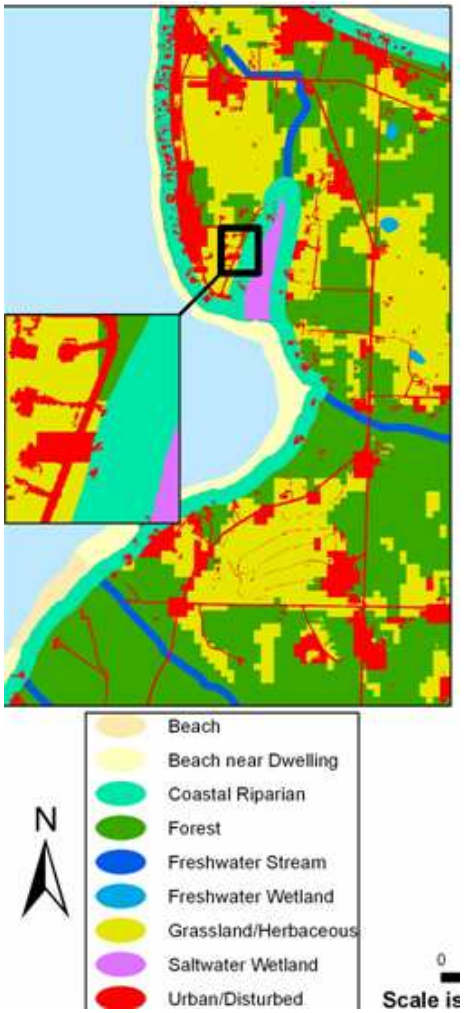
1. Study Area Definition
2. Land Use/Land Cover Typology Development
3. Valuation Literature Search and Analysis
4. Ecosystem Service Value (ESV) Calculation
5. GIS Mapping and Geographic Summaries
6. Scenario Analysis (Optional)

Source: Troy, Austin and Matthew A. Wilson **2006**. Mapping Ecosystem Service Values using Geographic Information System (GIS) and Value Transfer Techniques. In M. Wilson and J. Hoehn (eds) Special Issue: Environmental Benefits Transfer: Methods, Applications and New Directions *Ecological Economics*. Accepted and forthcoming.

Deriving a Unique Land Cover Typology

- This project involved a process of combining coarser land use and ecological data with finer scale data on impervious surfaces, nearshore habitat and polygons digitized from aerial imagery and field surveys





Valuation Literature Search

Example Decision rule for selecting economic studies for Maury Island:

- Published in peer-reviewed journals or books
- Limited to results that can readily be translated into spatial equivalencies—(i.e, per acre)
- Focused on regions in North America and Europe
- Focused primarily on non-consumptive resource use and ecosystem services

Ecosystem Service Value Calculation

Value of Ecosystem Services ($ ha^{-1} per year):

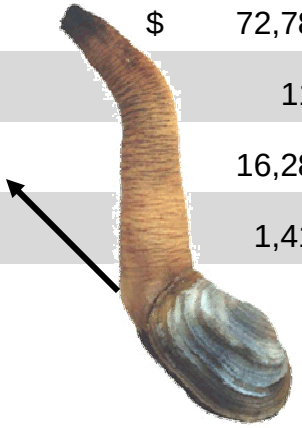
$$V(ES_i) = \sum_{k=1}^{n} A(LU_i) \times V(ES_{ki})$$

Where $A(LU_i)$ = Area of land use/cover type (i)

and $V(ES_{ki})$ = Annual value per unit area for ecosystem service type (k) generated by land use/cover type (i).

Results by Land Cover Type: Maury Island, WA.

Land Cover	Ave. $/ha/yr	Lower bound	Upper bound	Area (ha)	Total ESV flow 2001
Disturbed and urban	$ -	$ -	$ -	253	$ -
Beach	$ 88,204	$ 77,016	$ 99,391	27	$ 2,371,006
Beach near dwelling	$ 117,254	$ 140,505	$ 94,004	65	$ 7,575,825
Coastal Riparian	$ 9,396	$ 5,542	$ 13,248	132	$ 1,244,665
Forest	$ 1,826	$ 511	$ 3,142	1,044	$ 1,906,410
Freshwater Stream	$ 1,595	$ 1,231	$ 939	41	$ 66,059
Freshwater Wetland	$ 72,787	$ 32,947	$ 96,095	4	$ 269,089
Grassland/Herbaceous	118	$ 118	$ 118	321	$ 37,833
Nearshore Aquatic Habitat	16,283	$ 4,630	$ 27,935	565	$ 9,204,633
Saltwater Wetland	1,413	$ 854	$ 1,972	7	$ 9,527
TOTAL				**2,460**	**$ 22,685,047**

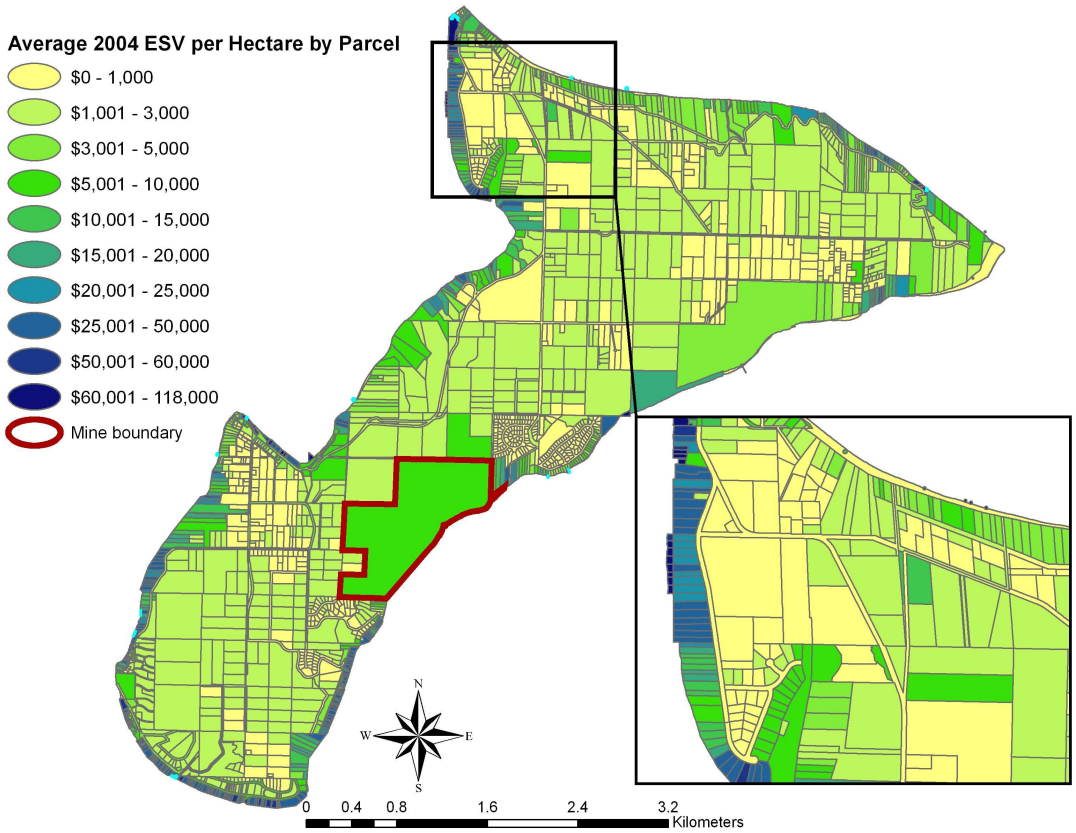


Geoduck

Source: Troy, Austin and Matthew A. Wilson **2006**. Mapping Ecosystem Service Values using Geographic Information System (GIS) and Value Transfer Techniques. In M. Wilson and J. Hoehn (eds) Special Issue: Environmental Benefits Transfer: Methods, Applications and New Directions *Ecological Economics*. Accepted and forthcoming.

Results: GIS Mapping by Parcel

- In addition to valuing the nearshore (photic) zone, the team was able to break down ecosystem service values on the island by individual parcels



Conclusions

Challenges and Opportunities

Challenges

- **Coastal and Marine Ecosystem Services definitely appear to have significant monetary values associated with them.**

But…

- **Considerable variability in quality and availability of economic and biophysical data worldwide still exists**
  - Growing, but still sparse economic estimates from developing regions
  - Unclear land cover/land use definitions—e.g., ‘beach’, nearshore habitat, saltwater wetland.
  - Need for consistency in the use of ecosystem service terminology

- Due to their complexity, coastal and Marine systems provide services that are “bundled” together and not easily broken out into sub-services (i.e., carbon, biodiversity).

Opportunities

- **Non-Market valuation data can now serve as a meaningful baseline for new environmental markets**
  - Payment for Ecosystem Services (PES) strategies can ‘set’ their payment guidelines using empirical data.
  - Initial lower bound and upper bound bids can be calibrated for new cap and trade systems using value transfer data

- **Need to establish contextual similarity between pilot marketplaces and baseline source data**
  - Biogeophysical similarity of the policy site and the study site
  - Socioeconomic characteristics
  - Scarcity of the ecosystem service

Thank You!

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