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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And The Gund Institute for Ecological Economics
University of Vermont

**The Gund Institute for Ecological Economics
University of Vermont
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
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.


http://www.millenniumassessment.org

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

<table>
<thead>
<tr>
<th>Provisioning</th>
<th>Regulating</th>
<th>Cultural</th>
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<td>Goods produced or provided by ecosystems</td>
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<td>- climate regulation</td>
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<td>- fuel wood</td>
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<td>- aesthetic</td>
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<tr>
<td>- genetic resources</td>
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<td>- inspirational</td>
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</table>

**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).

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

<table>
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<th></th>
<th>Nutrient cycling</th>
<th>Net primary production</th>
<th>Pollination</th>
<th>META</th>
<th>Dispersal</th>
<th>Habitats</th>
<th>Hydrological cycle</th>
<th>Carbon cycle</th>
<th>Regulation</th>
<th>Disturbance</th>
<th>Regulation</th>
<th>Tidal</th>
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**Total Studies: 70**

**Data Entries: 155**
### Sample Raw Data

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<th>Citation</th>
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<th>Upper Bound</th>
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<td>$146,594.12</td>
<td>$189,552.94</td>
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</table>
Non-Market Valuation Data Distribution

Data distribution by Cover Type

- Nearshore Open Space
- Nearshore Ocean--50m depth or 100km offshore
- Semi-enclosed Seas
- Mangrove
- Coral Reefs and Atolls
- Nearshore Islands
- Seagrass beds or Kelp forests
- Nearshore Freshwater Wetlands
- Saltwater Wetlands, Marshes or Salt Ponds
- Beaches and Dunes
Non-Market Valuation Data Distribution

Data distribution by ecosystem service

- Spiritual and historic
- Aesthetic
- Recreation
- Net primary production
- Water supply
- Water regulation
- Biological control
- Disturbance regulation
- Habitat
Non-Market Valuation Data Distribution

Data distribution by region

- Europe
- Central and South America
- North America
- Australia and New Zealand
- East Asia
- Southeast Asia
**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

- Inventory and characterize targeted goods and services
- Primary Economic Studies
- Market Values
- Value Transfer
- Apply values to Site
- Depict and interpret results
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](http://www.ecovaluation.com) to analyze the value of the Maury Island’s natural capital, including nearshore habitat.

In addition to wanting to 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.

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)

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.
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.

<table>
<thead>
<tr>
<th>Land Cover</th>
<th>Ave. $/ha/yr</th>
<th>Lower bound</th>
<th>Upper bound</th>
<th>Area (ha)</th>
<th>Total ESV flow 2001</th>
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</thead>
<tbody>
<tr>
<td>Disturbed and urban</td>
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<td>-</td>
<td>-</td>
<td>253</td>
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<td>Beach</td>
<td>$ 88,204</td>
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<td>Beach near dwelling</td>
<td>$ 117,254</td>
<td>$ 140,505</td>
<td>$ 94,004</td>
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<td>$ 7,575,825</td>
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<td>Forest</td>
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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
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!

Matthew A. Wilson PhD.

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