Applying the Ecological Endpoint Approach to Freshwater Ecosystem Services Projects:

Notes From the Field

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ACES and Ecosystem Markets 2012
Ft. Lauderdale, FL, 12 December 2012
Main take-home messages

• Many ecosystem service (ES) projects measure the wrong outputs
• Prevents meaningful performance assessments (cost-effectiveness/return on investment)
• Obstacle to more investment in ES projects
• We know how to correct this: shift to “ecological endpoints” combined with counterfactuals
• Feasibility varies across ES. Not an excuse for not trying!
The obvious...

Why we do ES projects:
Increase provision of things people derive value from: “final ecosystem services”

“Components of nature directly enjoyed, consumed or used to yield human well-being” (Boyd and Banzhaf, 2007)

→ To assess project performance:
Need to measure *increased* in *final services attributable* to project
The problem...

1) Most studies don’t measure final services
   Instead measure some project input or output whose quantitative relation to final services is generally poorly known

2) Few studies control for the counterfactual
   Simply monitor service flows, not changes in flows attributable to the project

→ We measure the wrong things, and we measure them incorrectly

Why this matters...

- Prevents valid performance assessments (ROI)
- Inhibits improvements in project design
  \[ \rightarrow \] Poor use of scarce resources

- Reduces investment in ES projects, especially private investment
  - ROI??? Output metrics not intuitively meaningful
  - Prevents comparison of “green” with “gray” alternatives
  \[ \rightarrow \] Loss of potential cost-savings and co-benefits
Why this state of affairs?

Why is the “Ecological Endpoint—Counterfactual” framework not widely adopted?

- Lack of awareness of problem?
- Resistance to change (new analysis techniques)
- It’s complicated (and sounds complicated!)

....complicated, or infeasible?
The “Endpoint-Counterfactual” Approach in practice:

What does it take?

• Metrics
• Monitoring
• Modeling
Case study:
The Nature Conservancy’s Latin American freshwater PES projects

Why?
Endpoint approach allows systematic identification of full suite of services and benefits
Impact on metrics and monitoring

• Focus on Endpoints affects measurement targets, metrics and locations
**Ecosystem structure (inputs)**

**Ecosystem function**

**Service-related output**

**Service provision**

**Other drivers**

**Example:**

**Riparian reforestation**

**Riparian vegetation**

**Soil retention**

**Sediment input from parcel x into surface waters**

**Attenuation (in-stream processes)**

**Sediment concentration in water at municipal water intake plants**

**On-site impact of intervention**

**Attenuation between intervention site and location of service provision**

**Impact of intervention and other drivers on target service flows**
Ecosystem structure (inputs) → Ecosystem function → Service-related output → Service provision

Example:

Intervention: Riparian reforestation

Riparian vegetation → Soil retention → Sediment input from parcel x into surface waters

Land use (other parcels), climate, …

Impact of intervention and other drivers on target service flows

On-site impact of intervention

Sediment concentration in water at municipal water intake plants

Attenuation (in-stream processes)
Impact on metrics and monitoring

- Also affects the number of monitoring targets

Before: Sediment *export* (kg yr\(^{-1}\)) at *intervention site*
Now: sediment *load* at *sites of service provision*

<table>
<thead>
<tr>
<th>Service (benefit-specific)</th>
<th>Service metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced sediment load at municipal drinking water plant intakes;</td>
<td>mg TSS L(^{-1}) in water at municipal drinking water intake points</td>
</tr>
<tr>
<td>Reduced sediment input in hydropower reservoirs</td>
<td>mg TSS yr(^{-1}) entering reservoir(s)</td>
</tr>
<tr>
<td>Reduced sediment input in storage reservoirs</td>
<td>mg TSS yr(^{-1}) entering reservoir(s)</td>
</tr>
<tr>
<td>Reduced sediment load in irrigation channels</td>
<td>mg of TSS L(^{-1}) in water entering irrigation canals</td>
</tr>
</tbody>
</table>
Impact on metrics and monitoring

Sediment reduction: 1 mt/yr

Output

Wetland removes 70% of all TSS

Service

Sediment reduction: 400 mg TSS/L

Sediment reduction: 0.3 mt/yr
Impacts on modeling

Why modeling?

Monitoring itself tells us little about impacts of project on service flows

– Variability and trends in other drivers
Impacts on modeling

1) Modify ES production functions
   – Incorporate attenuation of *output* into *service*

   • Literature
   • Experiments (BACI)

2) Then develop counterfactuals to estimate ES gains from project
   – Data availability?
Feasibility

Potentially massive undertaking (time & cost)

• Focus on highest-value services
• Focus on lowest-hanging fruit
  Services that are:
  – well-researched
  – easiest to monitor and model

Ambitious? You bet.
Feasible? Stay tuned...