Measuring The Ecosystem Value of National Natural Heritage Investments

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Presentation Objectives

- Provide background
- Describe a new metric
- Summarize advantages & disadvantages
Background
USACE Authority/Policies

• The U. S. Army Corps of Engineers has:
  – Economic development authority
  – Ecosystem restoration authority

• It must quantify ecosystem service benefits
  – Must monetize service benefits when possible
  – Other benefits must be quantified in nonmonetary terms

• It must justify project investments
  – Monetary benefit-cost analysis for development
  – Nonmonetary cost-effectiveness for restoration
Values Served By The Corps

• Economic development
  – Is for use value
  – Use value is measured in monetary terms

• Ecosystem restoration
  – Ecosystem restoration is for nonuse value
  – Nonuse monetization is controversial
  – Corps forbids nonuse monetization
Restoration Metric Issues

- No metric identified as exclusively suitable
- Different metrics have proliferated
- Metric relationships to value is often unclear
  - Confuses cooperation and coordination
  - Impedes achievement of national goals
  - Causes inefficiency in program achievement
- The Corps seeks improved restoration metrics
  - A review was done to inform improvement
  - A new metric was developed for Corps consideration
Review
Nonmonetary Measurement of Environmental Benefits

• In Government
  – Public value is established in statutory goals
  – Goals indicate desire for more or better service

• In Non-government Organizations
  – Value is established in organization mission
  – Goals indicate desire for more or better service

• Overall
  – Achievement (benefit) is indicated diversely
  – Indicators often include use and nonuse values
  – Such indicators are not useful for the USACE
Nonuse Value Focus

Heritage is the typical form of nonuse value identified:

• In goals of certain Federal laws
  – The National Environmental Policy Act
  – The Endangered Species Act
• By implication, in conservancy missions
• Rarity, distinctiveness, and risk of loss are the usual indicators of heritage value
USACE Objective Achievement

- Targets national heritage
  - Cultural heritage (protection)
  - Natural heritage (protection & restoration)
- Specifically indicates:
  - “More biologically desirable species”
  - Maintenance of high native biodiversity
  - Ecosystem support for “desired outputs”
Metric Development
Biodiversity Security Index
Metric Development Assumptions

- Benefit is indicated by objective achievement
- Needs to conform with authorities/policy
- Needs to be consistent with science & logic
- Needs to be stakeholder acceptable
- Needs to be practical
  - Uses widely available data sources
  - Practitioners can be trained to use it
  - Addresses needs broadly
<table>
<thead>
<tr>
<th>Security Status</th>
<th># Viable Population Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>GX</td>
<td>Presumed Extinct</td>
</tr>
<tr>
<td>GH</td>
<td>Possibly Extinct (Watch)</td>
</tr>
<tr>
<td>G1</td>
<td>Greatly Imperiled</td>
</tr>
<tr>
<td>G2</td>
<td>Imperiled</td>
</tr>
<tr>
<td>G3</td>
<td>Vulnerable</td>
</tr>
<tr>
<td>G4</td>
<td>Generally Secure (Watch)</td>
</tr>
<tr>
<td>G5</td>
<td>Secure</td>
</tr>
</tbody>
</table>
Potential biodiversity security is indicated by species security status and distinctiveness:

$$BSI = \sum_{S=1}^{n} \frac{((wD)(wG_{x-5}))_s}{C}$$

- $wG = \text{policy weighted security status (} G_{x-5} \text{)}$
- $wD = \text{policy weighted distinctiveness (0-1)}$
- $S = \text{indicator species; } n = \text{total number}$
- $C = \text{Cost of feasibility study}$

* For reconnaissance and project feasibility study ranking
### TABLE 1. Example of basic calculations to determine BSI score.

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>SECURITY STATUS</th>
<th>G POLICY WEIGHT</th>
<th>DISTINCTIVENESS</th>
<th>D POLICY WEIGHT</th>
<th>SPECIES SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPECIES 1</td>
<td>GH</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPECIES 2</td>
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<td>10.080</td>
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<tr>
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<td>0.005</td>
<td>1</td>
<td>0.080</td>
</tr>
<tr>
<td>SPECIES 4</td>
<td>G2</td>
<td>16</td>
<td>0.500</td>
<td>1</td>
<td>8.000</td>
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<tr>
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<td>0.020</td>
<td>1</td>
<td>0.080</td>
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<tr>
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<td>0.440</td>
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<tr>
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<td>0.009</td>
<td>1</td>
<td>0.009</td>
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<tr>
<td>SPECIES 8</td>
<td>G5</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPECIES 9</td>
<td>G5</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**BSI SCORE** 18.689
TABLE 2. Policy weighting examples for different policies.

<table>
<thead>
<tr>
<th>STATUS</th>
<th>Secure in proportion to need</th>
<th>Secure any native species</th>
<th>Secure the most Imperiled</th>
<th>Secure the less imperiled</th>
</tr>
</thead>
<tbody>
<tr>
<td>GX</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>GH</td>
<td>0</td>
<td>12</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>G1</td>
<td>48</td>
<td>12</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>G2</td>
<td>16</td>
<td>12</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>G3</td>
<td>4</td>
<td>12</td>
<td>0</td>
<td>50</td>
</tr>
<tr>
<td>G4</td>
<td>1</td>
<td>12</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>G5</td>
<td>0</td>
<td>12</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>69</td>
<td>72</td>
<td>70</td>
<td>70</td>
</tr>
</tbody>
</table>
Metric form used to estimate increment of ecosystem security added:

\[ \text{BSI} = \sum_{s=1}^{n} \left( h(wR)(wD)(wG_{x-5})(A_1 - A_0) \right)_s \]

\[ \frac{1}{C} \]

- \( A_1 \) = final number of viable population units
- \( A_0 \) = initial number of viable population units
- \( wG \) = policy weighted security status (Gx-5)
- \( wD \) = policy weighted distinctiveness (0 to 1)
- \( wR \) = risk (probability of success; 0 to 1)
- \( S = \text{species, (n = total number)} \)
- \( h = \text{threat source (0 for no and 1 for yes)} \)
- \( C = \text{cost of implementation} \)

*Project feasibility study & implementation ranking*
BSI Advantages/Disadvantages

- **Advantages Compared to Existing Metrics**
  - Indicates desired outputs consistent with national goals
  - Direct indicator of a heritage sustainability objective
  - Comparable across all projects in program
  - Metric is theoretically based in conservation science
  - Addresses risk factors

- **Disadvantages Compared to Existing Metrics**
  - Data needs and costs are higher
  - Potential conflict with Corps cultural predisposition
  - New is “strange” and often judged “impractical”
Summary and Conclusions

• Not all ecosystem service value can be acceptably monetized

• National natural heritage value is a key example

• The Corps has a natural heritage objective

• Nonmonetary measurement of benefit is required

• The BSI appears to fulfill the needs of the Corps

• The BSI needs to be more fully evaluated