Key attributes of ecological production functions

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“Ecosystem Services, Environmental Stressors and Decision Making”

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- Special Series, *Integrated Environmental Assessment and Management*

<table>
<thead>
<tr>
<th></th>
<th>Authors</th>
<th>Title</th>
<th>DOI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Maltby et al.</td>
<td>Ecosystem services, environmental stressors, and decision making: How far have we got?</td>
<td>10.1002/ieam.1796</td>
</tr>
<tr>
<td>2</td>
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<td>Identifying and assessing the application of ecosystem services approaches in <em>environmental policies and decision making</em></td>
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</tr>
<tr>
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<td>Using <em>ecological production functions</em> to link ecological processes to ecosystem services</td>
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</tr>
<tr>
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<td>Ecosystem services as assessment endpoints for <em>ecological risk assessment</em></td>
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</tr>
<tr>
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<td>Application of ecosystem services in <em>natural resource management</em> decision making</td>
<td>10.1002/ieam.1838</td>
</tr>
</tbody>
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How are EPFs defined?

- Land cover?
- Biological indicators?
- Dynamic processes?
- Stressors?
- Management actions?

Ecosystems → ecological production functions → Ecosystem Services

- Intermediate services?
- Final services?
“Usable expressions (i.e., models) of the processes by which ecosystems produce ecosystem services, often including external influences on those processes...”
EPFs in an environmental management context

Source: Van Wensem et al. 2016
EPFs and decision support systems

Source: Van Wensem et al. 2016
EPFs and decision support systems

- Ecosystems
- Intermediate Services
- Final Ecosystem Services
- Human Well-Being
Nine desired attributes of EPFs

Based on:
- Literature reviews
- Models abstracted in EPA’s EcoService Models Library (beta version at https://esml.epa.gov/epf_l/public/signup)
 Desired attributes of EPFs

1. Estimate indicators of **final ecosystem services**
   - Intermediate services useful for management
   - Final services amenable to valuation, decision-making
2. **Quantify** ecosystem service outcomes
   - Qualitative $\rightarrow$ scoping, mapping
   - Quantitative $\rightarrow$ trade-offs

- **Nine desired attributes for EPFs**

- **Ecosystems**
  - Intermediate services
    - **ecological production functions**
  - Final ecosystem services
Nine desired attributes for EPFs

3. Respond to ecosystem condition
   - EPFs based land-use/land cover alone are limited in application
Nine desired attributes for EPFs

4. Respond to stressors or management scenarios
   - Include variables, processes relevant to actions
9. Nine desired attributes for EPFs

- Ecosystems
- Intermediate services (ecological production functions)
- Final ecosystem services

5. ‘Right’ level of complexity
   - Nonlinearities, feedbacks ↔ easily understood
6. Rely on data with broad coverage
   - Can be widely applied
   - For example, begin with complex model (high data demands), then simplify

- Nine desired attributes for EPFs
- Nine desired attributes for EPFs

7. Shown to perform well
   - Functionally validated in relevant settings
8. Practical to use
   - Moderate computing power and expertise
Nine desired attributes for EPFs

- Open and transparent
  - Well documented, adaptable
Greater need for EPFs in the assessment of chemicals in environmental management: agricultural pesticides as an example.
**EPFs**
- Ecological literature
- EPA research
- Online tools
- Mapping methods

**EcoService Models Library**
- Model discovery
- Model analysis
- Ecosystem service classification

**Users**
- Regulatory impact analysis
- Community assessments
- Decision tool development
EcoService Models Library (ESML)

A searchable database of ecological models for estimating the production of ecosystem goods and services.

https://esml.epa.gov/epf_l/public/signup