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METHODOLOGICAL WORK SEEA Experimental ecosystem accounting, SUBSESSION 15

VALUATION OF THE ECOSYSTEMS NATURE EDUCATION SERVICE, VALUATION METHODS, PRESENT STATE AND WAY FORWARD, ESTONIA’S CASE STUDY

Kaia Oras

Kaia Oras (Statistics Estonia), Üllas Ehrlich (Tallinn Technical University), Kätlin Aun (Statistics Estonia), Argo Ronk (Statistics Estonia), Grete Luukas (Statistics Estonia), Kaja Lotman (Estonian Environmental Board, ELME project), Veiko Adermann (Statistics Estonia), Aija Kosk (University of Life Sciences), Katrin Vaher (Tallinn Technical University)
**Definition**

*Environmental education is classified under the cultural ecosystem services according to CICES V5.1.*

<table>
<thead>
<tr>
<th>CICES Code</th>
<th>Section</th>
<th>Division</th>
<th>Group</th>
<th>Class</th>
<th>Class type</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1.2.2</td>
<td>Cultural (Biotic)</td>
<td>Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting</td>
<td>Intellectual and representative interactions with natural environment</td>
<td>Characteristics of living systems that enable education and training</td>
<td>By type of living system or environmental setting</td>
</tr>
</tbody>
</table>

**Definition:** “The value of the ecosystem as an educational service provider is expressed by its ability to participate in (or enable) nature education.”
Overview of the relevant studies and concepts for defining nature education service provided by ecosystems in addition to UN SEEA EEA and TR

1. Böhnke-Henrichs et al. (2013) and Fish et al. (2016) argue that ecosystems and society participate both in ecosystem cultural services (including educational) and discuss the incorporation the distinctive contributions of society and ecosystems in case of cultural (and also education) ecosystem services.

Mocior, E. & Kruse, M. (2016), proposes criteria for evaluation of nature education potential of nature areas

The illustrative ecosystem service potential and flow matrices are well described in a study by Burkhard et al. (2014)
Incorporation the distinctive contributions of society and ecosystems in case of cultural (and also education) ecosystem services. *

Conceptual scope of the service (compiled based on the project working group discussions)

**Enabling factors**

**ASSET**
- Extent and conditions
  - Spaces:
    1. Nature areas (suitable ecosystem types)
    - Investing in infrastructure and nature education facilities in order to shape the service

**Economic inputs**
- Investments in roads, ecosystems restoration and facilities

**Methods**
1. Investments on education service enabling components
2. Point/scale measurement of ecosystem education service provisioning potential

**SERVICE**
- Spaces:
  1. Protected areas/nature reserves
  2. Study routes
  3. Hiking routes
  4. Gardens, parks

  Practices:
  1. Delivering curricula
  2. Nature trips
  3. Teaching specific skills
  4. Conducting research

  Expenditures on nature education

**BENEFITS**
1. Nature education benefits? Indicators?
2. Nature education received, nature related knowledge created

**BENEFICIARIES**
- Who receives the benefits: households, NACE ...? general government?
### Evaluation of nature education spaces based on the potential educational values *

<table>
<thead>
<tr>
<th>Criteria for the evaluation of the didactic value of nature sites</th>
<th>Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. With regard to educational value</td>
<td>2</td>
</tr>
<tr>
<td>1. Use for educational purposes</td>
<td>2</td>
</tr>
<tr>
<td>2. Availability of infrastructure for access</td>
<td>1</td>
</tr>
<tr>
<td>3. Supporting educational products and services (maps, information materials, printables, website)?</td>
<td>1</td>
</tr>
<tr>
<td>4. Existing learning infrastructure products (signposts, trails, boardwalks, information boards)</td>
<td>1</td>
</tr>
<tr>
<td>5. Approval for educational use</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Criteria for defining scientific and didactic value:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>B. Rarity (ecosystem, landscape type), I, II and III category species’ permanent habitat</td>
<td>1</td>
</tr>
<tr>
<td>2. Representativeness (ecosystem, landscape type), belongs to national parks, landscape protection areas</td>
<td>1</td>
</tr>
<tr>
<td>3. Diversity (the composition of different ecosystem types, species), national reserves</td>
<td>1</td>
</tr>
<tr>
<td>4. Level of scientific knowledge, monitoring sites</td>
<td>1</td>
</tr>
<tr>
<td>5. Useful for describing ecosystem processes</td>
<td>1</td>
</tr>
<tr>
<td>6. Paleogeographic value</td>
<td>0</td>
</tr>
<tr>
<td>7. Recognition</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Criteria for other educational significance</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>C: Criteria for other educational significance</td>
<td></td>
</tr>
<tr>
<td>1. The protected area is part of major tours and routes</td>
<td>0</td>
</tr>
<tr>
<td>2. Recognition</td>
<td>0</td>
</tr>
</tbody>
</table>

Mocior, E. & Kruse, M. (2016), criteria for evaluation of nature education potential of nature areas *
Evaluation of nature education spaces based on the potential educational values

<table>
<thead>
<tr>
<th>Spatial units relevant for nature education service</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. SFAMC recreational areas with study opportunities (three subclasses according to NATURA and protection level)</td>
</tr>
<tr>
<td>2. SFAMC nature education program areas (three subclasses according to NATURA and protection level)</td>
</tr>
<tr>
<td>3. Nature education centers (three subclasses according to NATURA and protection level), environmental board</td>
</tr>
<tr>
<td>4. Study trails; hiking routes with educational purpose</td>
</tr>
<tr>
<td>5. School gardens, parks, used for education</td>
</tr>
<tr>
<td>6. University study centers, field bases</td>
</tr>
<tr>
<td>7. Other nature (three subclasses according to NATURA and protection level)</td>
</tr>
</tbody>
</table>

Criteria for the evaluation of the didactic value of nature sites

A. With regard to educational value:
1. Use for educational purposes
2. Availability of infrastructure for access
3. Supporting educational products and services (maps, information materials, websites)
4. Existing learning/infrastructure products (signs, trails, boardwalks, information boards)
5. Approval for educational use

B. Criteria for defining scientific and didactic value:
1. Rarity (ecosystem, landscape type), I, II and III category species’ permanent habitat
2. Representativeness (ecosystem, landscape type, belongs to national parks, landscape protection areas)
3. Diversity of the composition of different ecosystem types (species), national reserves
4. Level of scientific knowledge, monitoring sites
5. Useful for decrying ecosystem processes
6. Paleogeographical value
7. Recognition

C. Criteria for other educational significance:
1. The protected area is part of major tours and trails
2. Recognition

Table 2: Spatial units relevant for nature education service

<table>
<thead>
<tr>
<th>Spatial units relevant for nature education service</th>
<th>Site description</th>
<th>Educational products/services</th>
<th>Learning Infrastructure</th>
<th>Rarity</th>
<th>Recognizability</th>
<th>Didactic</th>
<th>Scientific Value</th>
<th>Location on protected areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>SFAMC recreational areas with study opportunities</td>
<td>Located fully on Natura 2000 or other protected areas</td>
<td>5</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>SFAMC nature education program areas</td>
<td>Located partially on Natura 2000 or other protected areas</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Nature education centers</td>
<td>Located partially on Natura 2000 or other protected areas</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Study trails; hiking routes with educational purpose</td>
<td>Location partially on Natura 2000 or other protected areas</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>School gardens, parks, used for education</td>
<td>Located partially on Natura 2000 or other protected areas</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>University study centers, field bases</td>
<td>Not located on Natura 2000 or other protected areas</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>10</td>
</tr>
</tbody>
</table>

Natura education centers, Environmental Board

Natura education centers, Education Office

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Natra...
### Nature education as ecosystem service, data sources and survey

<table>
<thead>
<tr>
<th>Owners of the nature education sites/nature tracks:</th>
<th>Expenditures for the maintenance of nature education sites/tracks</th>
<th>Revenue from/expenditure for the provisioning of the nature education</th>
<th>Number of lessons given</th>
<th>Number of students</th>
<th>Time spent on nature studies directly in ecosystems</th>
<th>GIS data</th>
</tr>
</thead>
<tbody>
<tr>
<td>State forest Management Center</td>
<td>Bookkeeping data</td>
<td>Admin data</td>
<td>Admin data</td>
<td>Admin data</td>
<td>Received map layer</td>
<td></td>
</tr>
<tr>
<td>Environmental Board</td>
<td>Admin data</td>
<td>Admin data</td>
<td>Admin data</td>
<td>Admin data</td>
<td>Manually allocated</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>Survey data</td>
<td>Survey data</td>
<td>Survey data</td>
<td>Survey data</td>
<td>Manually allocated</td>
<td></td>
</tr>
<tr>
<td>Service providers who do not manage nature objects</td>
<td>not relevant</td>
<td>Survey data /imputed/ extrapolated</td>
<td>Survey data /imputed/ extrapolated</td>
<td>Survey data</td>
<td>Manually allocated</td>
<td></td>
</tr>
</tbody>
</table>
Nature education as ecosystem service: valuation

- Expenditure transfer approach
- Expenditure based approach
- *Time use based approach*
- Travel cost approach

- Contingent valuation study: willingness to pay (WTP) for ecosystem services of Estonian grasslands

- *Future benefit and avoided costs concepts in the context of nature education service*

- Integration of nature education as ecosystem service in supply and use tables
Expenditure transfer approach

Education costs are attributed to the ecosystems (on the bases of hourly lesson prices)

Here the value of education is considered proportional to the cost to society of providing education.

\[
\text{Nature education service value} = a \times b \times c
\]

\(a\) - average time spent on nature studies directly in ecosystems (h); (5)
\(b\) – number of students in nature education programs; (116 989)
\(c\) – cost of one student hour, €. Calculated based on public expenditure on institutional education per year, number of students in institutional education and average total number of lessons per student per year 8.75 = 1300000000/(220000*675)

Financial equivalent of nature education service value of Estonian ecosystems is EUR 5.12 million per year calculated by this method
Expenditure based approach

Expenditures to provide nature education are calculated and ecosystems contribution is found

<table>
<thead>
<tr>
<th></th>
<th>Expenditures on nature education service, calculated on the basis of sales revenue and other income</th>
<th>Current expenditures on educational programs and facilities</th>
<th>Value of nature education service</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Owners of the nature objects</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-market service providers</td>
<td>0.55</td>
<td></td>
<td>0.55</td>
</tr>
<tr>
<td>State Forest Management Center, market service provider but providing free nature education service</td>
<td>0.78</td>
<td></td>
<td>0.78</td>
</tr>
<tr>
<td><strong>Service providers (not owners)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-market service providers</td>
<td>0.23</td>
<td></td>
<td>0.23</td>
</tr>
<tr>
<td>Other market service providers</td>
<td>0.02</td>
<td></td>
<td>0.02</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0.25</td>
<td>1.33</td>
<td><strong>1.58</strong></td>
</tr>
</tbody>
</table>

For the owners of the nature objects the cost of production approach was used to calculate the value of nature education service. For the service providers who do not own a nature object sales revenue and other incomes were used to estimate the nature education service.

UN SEEA recommends decomposition of a market price into components (5.46). The profit is considered to be the residual component that could be handled as the contribution of the ecosystem.

Average profit was calculated on the basis of available profit and sales revenue of companies who offer market nature education service (17%). If to apply this share to the calculated value of the nature education service (1.58 million euro) then ecosystem contribution would be **0.3 million EUR**
Time use based approach

Value of the time spent in contact with ecosystem (studying) is attributed to the ecosystem

Time spent on an activity in a greenspace can be considered a measurable indicator of the benefit generated by the service to the welfare of the recipient. *Assumption for the valuation is that the alternative to the activity is work paid by the hour.*

According to our collected data, the recipients of nature education service are mostly students in different levels of compulsory education.

Considering that there is no alternative for time spent for studying for students it is not appropriate to apply this approach as the assumption of work paid by the hour does not stand. To try out this method, one might consider using other equivalent for expressing of students’ time value.

**Travel cost approach**

Students’ travel costs are attributed to the ecosystem

\[\text{Nature education service value} = a \times b\]

- **a** - average travel costs for one student (€) \(17.3 = 43.25 \times 8 / 20\)
- **b** – number of students in nature education programs (116989).

The total annual travel costs of providing institutional nature education in Estonia is **EUR 2,024 million**.

According to Estonian statistics the profit margin in the field of transporting and storage activities is 3.5%. 

\[2.024 \text{ million EUR } \times 3.5\% = 0.072 \text{ million EUR can be attributed to the ecosystems}\]

Alternatively the profit margin generated by occasional bus services were assumed to be around 15% by the expert opinion.

\[2.024 \text{ million EUR } \times 15\% = 0.304 \text{ million EUR can be attributed to the ecosystem.}\]
Willingness to pay

willingness to pay for the non-market environmental goods

CV survey was conducted in 2019 to find out willingness to pay (WTP) for ecosystem services of Estonian grasslands*. Annual WTP for “enabling nature education” provided by grasslands is 1.271 million EUR.

<table>
<thead>
<tr>
<th>Ecosystem service</th>
<th>Average score in Likert scale</th>
<th>Total points received</th>
<th>%</th>
<th>WTP (thousand EUR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat conservation for biological species</td>
<td>3.72</td>
<td>1258</td>
<td>13.9</td>
<td>2610.7</td>
</tr>
<tr>
<td>Climate control</td>
<td>4.80</td>
<td>1622</td>
<td>10.8</td>
<td>2024.8</td>
</tr>
<tr>
<td>Photosynthesis (production of oxygen)</td>
<td>4.88</td>
<td>1651</td>
<td>10.6</td>
<td>1989.2</td>
</tr>
<tr>
<td>Ensuring landscape diversity</td>
<td>5.16</td>
<td>1740</td>
<td>10.1</td>
<td>1887.5</td>
</tr>
<tr>
<td>Maintaining soil fertility</td>
<td>5.18</td>
<td>1751</td>
<td>10.0</td>
<td>1875.6</td>
</tr>
<tr>
<td>Provision of genetic and medical resources</td>
<td>6.27</td>
<td>2118</td>
<td>8.3</td>
<td>1550.6</td>
</tr>
<tr>
<td>Enabling pollination and honey harvesting</td>
<td>6.31</td>
<td>2134</td>
<td>8.2</td>
<td>1539.0</td>
</tr>
<tr>
<td>Supply of agricultural produce</td>
<td>6.81</td>
<td>2302</td>
<td>7.6</td>
<td>1426.7</td>
</tr>
<tr>
<td>Flood protection</td>
<td>6.99</td>
<td>2364</td>
<td>7.4</td>
<td>1389.3</td>
</tr>
<tr>
<td><strong>Enabling nature education</strong></td>
<td><strong>7.64</strong></td>
<td><strong>2583</strong></td>
<td><strong>6.8</strong></td>
<td><strong>1271.5</strong></td>
</tr>
<tr>
<td>Provision of tourism and leisure services</td>
<td>8.10</td>
<td>2738</td>
<td>6.4</td>
<td>1199.5</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>22 261</strong></td>
<td><strong>100.0</strong></td>
<td><strong>18764.4</strong></td>
</tr>
<tr>
<td>Method/criteria</td>
<td>Expenditure transfer approach</td>
<td>Expenditure based approach</td>
<td>Contingent valuation</td>
<td>Travel cost approach</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-------------------------------</td>
<td>---------------------------</td>
<td>----------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Education costs are attributed to the ecosystems (on the bases of hourly lesson prices)</td>
<td>Expenditures to provide nature education are calculated and ecosystems contribution is found</td>
<td>Willingness to pay for education service</td>
<td>Students travel costs are attributed to the ecosystem</td>
</tr>
<tr>
<td><strong>Conceptual consistency</strong></td>
<td>Low, two-step assumption</td>
<td>High, based on real expenditures</td>
<td>High, classical application</td>
<td>Low, non-classical application</td>
</tr>
<tr>
<td><strong>Challenges</strong></td>
<td>Can public expenditures per education unit be used to calculate the education service value of ecosystems?</td>
<td>Is it right to attribute the profit of nature education service to ecosystems? Or count all expenditures made as ecosystem service?</td>
<td>Linking stated preferences to SNA.</td>
<td>Which part of the transportation costs can be attributed to ecosystems, profit?</td>
</tr>
</tbody>
</table>

Could the results of the expenditure based methods be summed as they represent distinctive expenditures?
The supply and use of nature education service (million EUR), 2018; logic of the SEEA EEA TR table 8.1

<table>
<thead>
<tr>
<th>Expenditure transfer approach</th>
<th>Corporations</th>
<th>General government</th>
<th>NPiSh</th>
<th>Final consumption of households</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Ecosystem service - nature education</td>
<td>5.12</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Nature education</td>
<td></td>
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<tr>
<td>Use</td>
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<tr>
<td>Ecosystem service - nature education</td>
<td></td>
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<tr>
<td>Nature education</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Value added (supply-use)</td>
<td>5.12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Expenditure based approach    |             |                   |       |                               |       |
| Supply                        |             |                   |       |                               |       |
| Ecosystem service - nature education | 1.58       |                   |       |                               |       |
| Nature education              |             |                   |       |                               |       |
| Use                           |             |                   |       |                               |       |
| Ecosystem service - nature education |           |                   |       |                               |       |
| Nature education              |             |                   |       |                               |       |
| Value added (supply-use)      | 1.58        |                   |       |                               |       |

| Travel cost based approach    |             |                   |       |                               |       |
| Supply                        |             |                   |       |                               |       |
| Ecosystem service - nature education | 2.02       |                   |       |                               |       |
| Nature education              |             |                   |       |                               |       |
| Use                           |             |                   |       |                               |       |
| Ecosystem service - nature education |           |                   |       |                               |       |
| Nature education              |             |                   |       |                               |       |
| Value added (supply-use)      | 2.02        |                   |       |                               |       |

**Whole service value was attributed to ecosystems**

For expenditure based and travel cost based approaches attempt was made to distinguish contribution of economical sectors and ecosystems.

Values already included in SNA are partially reallocated (to ecosystem as a supplier). The use of ecosystem service by economic activities is distributed according to the share of profit.

**Green boxes:** The approaches applied allow distinguish economical sectors and ecosystem supply

**Blue boxes:** The values calculated with these approaches increase GDP
Spatial distribution of nature education service

1. Calculated nature education ecosystem service values can be mapped by the method-relevant indicator (for example expenditures) that is linked to the georeferenced locations in our database.

2. To get by the ecosystem types the contribution to service value provision, the value of education service can be divided by the respective proportion within the nature site.

How to determine the extent of the service supplying site (e.g. polygon radius based on trail length)?

2. Each nature education site which provides at least some level of ecosystem education service, are categorized according to the type of the site and the correspondence to the value of the criteria.

How important is it to consider the potential of the area which supplies nature education? How to include the potential in assessing nature education service flow?
Questions to the London Group

1. Is the conceptual framework (ecosystem plays the role of the “enabler” and society plays the role of the “shaper”) helpful when defining cultural ecosystem services, especially nature education service?

2. Can the number of visits and the number of contact hours be considered good indicators for measuring nature education service value?

3. How important is it to determine the area which supplies nature education? Are there acceptable criteria for assessing spatial units relevant for nature education service available?

4. What indicators of condition would be relevant for assessing the continuing capacity of the ecosystem to supply nature education services?

5. Is the assumption valid that the value of education is at least as big as expenditures made to obtain it?

6. How to find the share of the contribution of ecosystem from the total service value found with the non-market valuation methods? Is this a right logic altogether?

7. Should the consumption of nature education service in the use table be attributed to households or rather to the companies that supply the educational service to households?

8. Could the results of the expenditure based methods be summed as they represent distinctive expenditures?
Thank you!

Kaia Oras (Statistics Estonia), Üllas Ehrlich (Tallinn Technical University), Kätlin Aun (Statistics Estonia), Argo Ronk (Statistics Estonia), Grete Luukas (Statistics Estonia), Kaja Lotman (Estonian Environmental Board, ELME project), Veiko Adermann (Statistics Estonia), Aija Kosk (University of Life Sciences), Katrin Vaher (Tallinn Technical University)

https://www.stat.ee/
https://ec.europa.eu/eurostat/web/environment