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Definition

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

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

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. *



* Fish, R., Church, A., Winter, M., 2016 Conceptualising cultural ecosystem services: A novel framework for research and critical engagement. Ecosystem Services, Volume 21, Part B, 2016, Pages 208-217, ISSN 2212-0416, https://doi.org/10.1016/j.ecoser.2016.09.002

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



Evaluation of nature education spaces based on the potential educational values *

Criteria for the evaluation of the didactic value of nature sites	Importance				
A. With regard to educational value					
1. Use for educational purposes	2				
2. Availability of infrastructure for access	2				
3. Supporting educational products and services (maps, information materials, printables, website)?	1				
4. Existing learning infrastructure products (signposts, trails, boardwalks, information boards)	1				
5. Approval for educational use	0				
B. Criteria for defining scientific and didactic value:					
1. Rarity (ecosystem, landscape type), I, II and III category species' permanent habitat	1				
2. Representativeness (ecosystem, landscape type), belongs to national parks, landscape protection					
areas					
3. Diversity (the composition of different ecosystem types, species), national reserves	1				
4. Level of scientific knowledge, monitoring sites	1				
5. Useful for describing ecosystem processes	1				
6. Paleogeographic value	0				
7. Recognition	0				
C: Criteria for other educational significance					
1. The protected area is part of major tours and routs	0				
2. Recognition	0				

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 2 Spatial units relevant for nature education service
Spatial units that are relevant for provisioning nature education
SFMC recreational areas with study opportunities (three subclasses
according to NATURA and protection level)
SFMC nature education program areas (three subclasses according to
NATURA and protection level)
Nature education centers (three subclasses according to NATURA and
protection level), Environmental Board
Nature education centers, other
Study trails; hiking routes with educational purpose
School gardens, parks; used for education
University study centers, field bases
Other nature (three subclasses according to NATURA and protection
level)

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Nature education provisioning sites /Dimension of educational value	Site specification	Educatio nal products and services	Learning Infra- structure , products	Rarity	Repres entativ eness	Diversit y	Scientif ic knowle dge	Ecosyst em process es	Use rate
Scale		0-5	0-5	0-5	0-5	0-5	0-5	0-5	0-10
SFMC: recreational									
areas with study									
opportunities	Located fully on	5	3	4	4	4	3	4	10
	NATURA or other protected areas	-	-			-	-		
	Located partially on NATURA or other protected areas	5	3	3	3	3	2	3	10
	Not located on NATURA or other protected areas	3	2	1	1	2	1	2	10
SFMC: nature education program areas									
	Located fully on NATURA or other protected areas	5	5	4	5	4	3	4	7
	Located partially on NATURA or other protected areas	4	5	3	4	3	2	3	7
	Not located on NATURA or other protected areas	3	5	1	2	2	1	2	7
Nature education centers, Environmental Board		5	4	4	4	3	3	4	6
Nature education centers other		5	4	4	4	3	2	4	TBA
Hiking routes with educational purpose		3	3	3	3	3	1	3	TBA
School gardens, parks, used for education		2	4	3	3	2	1	4	TBA
Universities study centers field bases		4	4	4	4	5	5	5	TBA
Other nature	Located fully on NATURA or other protected areas	1	1	4	4	4	3	4	ТВА
	Located partially on NATURA or other protected areas	1	1	3	3	3	2	3	ТВА
	Not located on NATURA or other protected areas	0	0	1	1	1	1	2	TBA
TBA- to be agreed									

Nature education as ecosystem service, data sources and survey

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	Expenditures for the maintenance of nature education sites/tracks	Revenue from/expendi ture for the provisioning of the nature education	Number of lessons given	Number of students	Time spent on nature studies directly in ecosystems	GIS data
Owners of the						
nature education						
sites/nature tracks:						
State forest	Bookkeeping	Admin data	Admin data	Admin	Admin data	Received
Management	data			data		map layer
Center						
Environmental	Admin data	Admin data	Admin data	Admin	Admin data	Manually
Board				data		allocated
Others	Survey data	Survey data	Survey data	Survey	Survey data	Manually
				data		allocated
Service providers	not relevant	Survey data	Survey data	Survey	Survey data	Manually
who do not manage		/imputed/	/imputed/	data		allocated
nature objects		extrapolated	extrapolated			

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

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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.

Nature education service value = a * b * 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= 130000000/(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

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

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 valution 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.

*-Barton, D.N., Obst, C. Discussion paper #10 Recreation services. SEEA Experimental Ecosystem Accounting: Revision 2020. Research papers on Individual Ecosystem Services. Version 7.1. 17th December 2018

Travel cost approach Students' travel costs are attributed to the ecosystem

Nature education service value = a * b

- a average travel costs for one student (\in) (17.3=43.25*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 million EUR x 3.5% = 0.072 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 million EUR x 15% = 0.304 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.**

Ecosystem service	Average score	Total points	%	WTP
	in Likert scale	received		(thousand
				EUR)
Habitat conservation for biological species	3.72	1258	13.9	2610.7
Climate control	4.80	1622	10.8	2024.8
Photosynthesis (production of oxygen)	4.88	1651	10.6	1989.2
Ensuring landscape diversity	5.16	1740	10.1	1887.5
Maintaining soil fertility	5.18	1751	10.0	1875.6
Provision of genetic and medical resources	6.27	2118	8.3	1550.6
Enabling pollination and honey harvesting	6.31	2134	8.2	1539.0
Supply of agricultural produce	6.81	2302	7.6	1426.7
Flood protection	6.99	2364	7.4	1389.3
Enabling nature education	7.64	2583	6.8	1271.5
Provision of tourism and leisure services	8.10	2738	6.4	1199.5
TOTAL		22 261	100.0	18764.4



Comparison of the methods for the valuation of nature education ecosystem service, correspondence to criteria (short list)

Method/criteria	Expenditure transfer approach	Expenditure based approach	Contingent valuation	Travel cost approach	Time use based approach
Description	Education costs are attributed to the ecosystems (on the bases of hourly lesson prices)	Expenditures to provide nature education are calculated and ecosystems contribution is found	Willingness to pay for education service	Students travel costs are attributed to the ecosystem	Value of the time spent in contact with ecosystem studying is attributed to the ecosystem
Conceptual consistency	Low, two-step assumption	High, based on real expenditures	High, classical application	Low, non-classical application	Low
Challenges	Can public expenditures per education unit be used to calculate the education service value of ecosystems?	Is it right to attribute the profit of nature education service to ecosystems? Or count all expenditures made as ecosystem service?	Linking stated preferences to SNA.	Which part of the transportation costs can be attributed to ecosystems, profit?	What can be used as equivalent for expressing students' time value in calculations?

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

Whole service value was attributed to ecosystems

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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.

Whole service value was attributed to ecosystems

Blue boxes: The values calculated with these approaches increase GDP

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

	Eco-	Corporations				General government			NPISH	Final consumption of	Total		
	systems	A.02	H.49	L.68	M.74_75	P.85	R.93	0.84	P.85	R.90_91	S.94	households	TOLAI
Expenditure transfer approach													
Supply													5.12
Ecosystem service - nature	5.12												5.12
Nature education	5.12												5.12
													5.12
Ecosystem service - nature													5.12
education													
Nature education												5.12	5.12
Value added (supply-use)	5.12												5.12
Expenditure based approach													
Supply													1.58
Ecosystem service - nature education	0.27												0.27
Nature education		0.65		0.00	0.00	0.00	0.01	0.03	0.07	0.41	0.13		1.31
Use													1.58
Ecosystem service - nature education		0.20		0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.01		0.27
Nature education												1.31	1.31
Value added (supply-use)	0.27	0.45		0.00	0.00	0.00	0.01	0.03	0.06	0.37	0.12		1.31
Travel cost based approach													
Supply													2.02
Ecosystem service - nature education	0.30												0.30
Nature education			1.72										1.72
Use													2.02
Ecosystem service - nature education			0.30										0.30
Nature education												1.72	1.72
Value added (supply-use)	0.30		1.42										1.72
Willingness to pay method													
Supply													1.27
Ecosystem service - nature education	1.27												1.27
Nature education													
Use													1.27
Ecosystem service - nature education												1.27	1.27
Nature education													
Value added (supply-use)	1.27												1.27

Spatial distribution of nature education service

- Calculated nature education ecosystem service values can be mapped by the methodrelevant 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

- 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 ?



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