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How to Evaluate the Ecological Conditions of Ecosystems and Their Relationship to **Ecosystem Services**

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Programme of the 7th ClimEd training on Developing skills to use climatic information and services for various climate-dependent branches of economy

Lecture outline

- Overview of the concept of Ecosystem Services
- How to map and evaluate Ecological Conditions and Ecosystem Services, Estonian case study
- App "Rohemeeter" (Greenmeter)



Definations of Ecosystems

Ecosystems are the combined interactions of:

 Biological / living (plant, animal and microorganism communities) components of environment

and

 Physical / non-living components (air, water, soil and the basic elements and compounds of the environment)



Definition of Ecosystem Services

- Ecosystem services (ES) are contributions of ecosystem structure and function (in combination with other inputs) to human wellbeing
- The **benefits** we, as a society, obtain from nature.
- Some natural capital assets provide people with free goods and services, often called ecosystem services. All of these underpin our economy and society, and thus make human life possible
- Natural Capital=Natural Resources+ecosystem services



Burkhard, de Groot, Costanza, Seppelt, Jørgensen & Potschin, 2012. Solutions for sustaining natural capital and ecosystem services . Ecological Indicators, 21: 1 – 6

Costanza, R., de Groot, R., Sutton, P., van der Ploeg, S., Anderson, S.J., Kubiszewski, I., Farber, S., Turner, R.K. (2014): Changes in the global value of ecosystem services. Global Environmental Change 26: 152–158.

Why value Ecosystems services?

- Understand how much an ecosystem contributes to economic activity or society. For example, on average forests benefits in the Med region amount to about 1% of GDP
- Understand what are the benefits and costs of an intervention that alters the ecosystem (conservation investment, development project, regulation or incentive) and make ecosystem gods and services comparable with other investments
- How are costs and benefits of a change in ecosystem distributed?
- How to make conservation financially sustainable?
- Etc.

Milestones of the development of the Concept of ES

- The term 'ecosystem services' "ES" was first introduced in 1970 (SCEP, 1970; cf. Mooney et al., 1997)
- In 1990s a core publications of R. Groot, H. Daily, R. Costanza
- Millennium Ecosystem Assessment (MEA), in 2005
- Ecosystem Service Partnership, in 2008
- The Economics of Ecosystems and Biodiversity in (TEEB), in 2010
- Strategic Plan for BD 2011-2020, Aichi Targets, CBD, in 2010
- The EU Biodiversity Strategy to 2020, in 2011
- Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES) was established in 2012
- VivaGrass Project, 2014...2019
- SELINA EU Project, 2022-2027





Science and Policy for People and Nature



The first most significant publications



de Groot (1992)



Daily (1997)



Costanza et al. (1997) The value of the world's ecosystem services and natural capital. Nature, 387: 253-260



The Millennium Ecosystem Assessment



- The study lead by the United Nations, involving 1360 international experts
- Implemented from 2001 to 2005
- Assessment of human impacts on ecosystems and consequences in relation to human well-being

http://www.millenniumassessment.org

Concludes that 60% of all ES in the world are degraded or used unsustainably.

Source: Millennium Ecosystem Assessment (2003, 2005)



Common International Classification of Ecosystem Services (CICES)

Provisioning services

Products directly used by people

Food:

- Crops, wild plants, tea, honey etc.
- Reared and wild animals and their outputs

Materials:

- Timber, hey, fibbers, herbs for medicine etc.
- Genetic material

Energy:

Biomass for energy

Regulating services

Related to the way ecosystems regulate environmental media or processes

Mediation of waste, toxics and other nuisances

Filtration, accumulation

Mediation of flows

 Erosion control and water flow maintenance

Maintenance of nature processes

- Lifecycle and habitat maintenance;
- Water conditions, soil formation, climate control etc.

Cultural services

Related to the cultural or spiritual needs of people

Physical and intellectual interactions

- Recreation
- Educational and scientific value
- Landscape, cultural heritage

Spiritual, symbolic interactions

- Symbols and traditions
- Existence and bequest value





Unmanaged nature

Intensively managed cropland



TARGET 2/ ACTION 5

"By 2014 MS will

- map and assess the state of ecosystems and their services in their national territory"
- assess the economic value of such services, and promote the integration of these values into accounting and reporting systems at EU and national level by 2020."
- to support policy, land use planning, and sustainable development

Physische Geographie und Landschaftsökologie





ESMERALDA MAES Barometer updated regularly together with MAES WG meetings





Benjamin Burkhard, Joachim Maes, Sylvie Campagne, Ina Sieber

Role of ES concept in policy making

Ecosystem services are acknowledged as an important concept for policy and decision making, because it:

- provides a holistic view on interactions between nature and humans
- address conflicts and synergies between environmental and socioeconomic goals
- offers a framework for trade-off analysis between competing land uses
- helps to facilitate planning and development decisions across sectors, scales and administrative boundaries

Applying of the EU Biodiversity Strategy 2020 Action 5 outputs in different policy sectors



Source: Maes et al., 2014

Methods for mappig and assessment of ecosystem services

BIOPHYSICAL METHODS

Biophysical quantification

Indicators

Models

ES supply, demand and ecosystem condition

SOCIAL METHODS

Social needs and preferences

Participatory

Provisioning, regulating and cultural

ECONOMIC METHODS

Quantify welfare

Monetary terms



Agroecosystems



Foto: Kadri Aan





- 1) Ecosystem Map created
- 2) Methodology for assessing and mapping baselines of ecosystem conditions and benefits worked out
- 3) Assessment and mapping to be carried out.
- Spatiality (+detail)
- Country-wide
- Values can be viewed on a site-by-site basis
- > Appropriate aggregate assessments can be made
- Knowledge of the status of ecosystems and benefits
- Baseline for assessing changes

(ENVIRONMENTAL) DECISION SUPPORT:EIA, resource and land use planning, green network planning, reporting, environmental accounting, environmental decision-making, development and monitoring of measures, implementation of strategic objectives (including input to indicators).



Wetland

Grassland

Forest

Agroecosystems

Ecosystem	CREATING METHODOLOGY	ASSESSMENT AND MAPPING
EXTENT	Which ecosystem types are to be distinguished? How to distinguish the types? Data? Methods?	BASE MAP – MAP OF ECOSYSTEMS
CONDITION	What is condition? How to define and delineate classes? How to (spatially) determine it? Data? Indicators? Methods?	MAP OF THE CONDITIONS OF ECOSYSTEMS
ECOSYSTEM SERVICES	Which services are important? Data? Indicators? Methods?	SPATIAL ASSESSMENTS AND MAPS OF ECOSYSTEM SERVICES
	 Country-wide Spatially explicit (+detailed) Accesibility (data, results) 	

- Replicability
 Undersstandability
 Ecological relevance

DATA & KNOW-HOW

- (National) databases (EELIS, PRIA, Forestry Register, ETAK, Plutof, soil map)
- Raw/intermediate data
- Remote sensing (LiDAR, radar, satellites, orthophotos)
- Models
- Open data
- Research work
- Environmental Agency (KAUR)
- Other public authorities
- Research institutes
- Volunteers
- European/world experience
- Nationwide assessment-mapping, more detailed methodology testing in pilot areas
- ✓ 10 × 10 m
- Assessment-mapping results will be made publicly available
- ✓ Recommendations for further data collection.



CONDITION CLASSES

A scale of "naturalness" or strength of human impact
 Historical continuity of habitats, logging, maintenance, drainage, degradation, restoration, etc
 4-6 classes (A...F) depending on the ecosystem



Distribution:

- > **Providing services** tangible good, goods, services from nature
- Regulating services asic benefits that are necessary for the functioning of ecosystems and are therefore the basis of human existence
- > Cultural services benefits that provide mental, spiritual, spiritual, aesthetic peace

* CICES vs 5.1– **C**ommon International **C** lassification of **E** cosystem **S**ervices, <u>www.cices.eu</u>

DEFINING AND MAPPING ECOSYSTEM CONDITION

GRASSLANDS, 5 classes:

- ✓ Protection status
- ✓ Validity of data
- Nature protection value estimation, preservation of functions, structure
- ✓ Maintenance: mowing, grazing
- Historical habitat continuity
- ✓ Overgrowth rate
- ✓ Restoration status/potential

AGRO-ECOSYSTEMS, 4 classes:

- ✓ Landscape elements on and bordering the field
- ✓ Organic/non-organic farming
- ✓ Presence of grasslands in good condition in the vicinity
- ✓ Environment-friendly management, subsidies
- ✓ Etc.

WETLANDS, 5 classes:

- ✓ Protection status
- ✓ Distance to the nearest drainage system
- ✓ (Rate of) human impact (cutting, mowing, grazing)
- ✓ Restoration status/potential

FORESTS, 6 classes:

- ✓ Protection status
- ✓ Validity of data
- ✓ Nature protection value estimation
- ✓ Historical habitat continuity
- ✓ Cutting information
- ✓ Drainage
- ✓ Stand composition
- ✓ Alien tree species
- ✓ Deadwood
- ✓ Age

GRASSLANDS CONDITION ASSESSMENT

CONDITION CLASS	Class characterization	
А	Representative and well-maintained heritage meadows. Maintenance areas. It is not overgrown, the tree-shrub coverage is characteristic	B
В	Heritage meadows in average condition, heritage meadows maintained from time to time. Other grasslands in the historic meadow distribution area are in good condition.	
С	Heritage meadows in poor condition (overgrown, impoverished) Other grasslands and habitats located in the distribution area of historic meadows. The presence of protected meadow species raised class B. Open communities in the historical meadow distribution area, which have become marshy due to the effects of drainage.	D1
D1	Heritage meadows in strong need of restoration (overgrown or forested areas).	
D2	Other grasslands of unknown condition status. The presence of protected species raised the class to C.	D3
D3	Open areas on newly abandoned mining areas	



Condition of Estonian terrestrial ecosystems

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Q.

Conditions of Terrestial Ecosystems



https://rohemeeter.ee/



Rohemeeter

Rohemeeter maastike elurikkuse hindaja

Saa teada, kui loodussõbralik on sind ümbritsev maastik ning mida saad ümbruskonna elurikkuse heaks teha



Greenmeter

- Rohemeeter (Greenmeter) is an application developed by the Macroecology Group of the Institute of Ecology and Geosciences and the Landscape Biodiversity Group of the University of Tartu
- Greenmeter helps to assess the support of landscapes for biodiversity considering environmental conditions, landscape structure and ecological indices.

Maastiku sobivus elurikkuse püsimiseks:





Rohemeeter (Greenmeter)

- Rohemeeter is an application that measures the support of Estonia's rural and urban landscapes for the biodiversity characteristic of their ecosystems.
- The app assesses different landscape parameters within a 500-metre radius around each point on the Estonian mainland using an algorithm developed at the University of Tartu.
- Rohemeeter identifies and then visualizes the areas of the landscape that are less or more supportive of biodiversity in 100x100 metre analysis squares
- Provides a score from 0 to 100 and gives explanations.







Q

100

Ümbruskonnas on valdavalt metsad. Maastiku sobivust siinsetele elupaikadele omase elurikkuse säilimiseks hindab Rohemeeter siin väga heaks. Siin on Lahemaa rahvuspark. Siin on leitud looduskaitsealuseid liike (võldas). Mis on • hästi ja mis • murettekitav:

 Osaliselt või tervikuna asuvad siinsed metsad põlisel metsamaal ehk piirkonnas, mis on metsaga olnud kaetud juba vähemalt eelmise sajandi esimesest poolest. Järjepideval metsamaal olevad vanad metsad on väga tähtsad elurikkuse hoidjad.

• Siinses maastikus paikneb ka väärtuslik üleeuroopalise tähtsusega elupaik, mis on

.....





Mõõtmiseks vali kaardil asupunkt

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Ümbruskonnas on põllumaad ning metsad. Maastiku sobivust siinsetele elupaikadele omase elurikkuse säilimiseks hindab Rohemeeter siin mõõdukaks.

Mis on • hästi ja mis • murettekitav:

 Vaadeldava piirkonna metsades on hiljuti tehtud lageraieid. Lageraiete pindala on Eesti metsades viimase 10 aasta jooksul kasvanud, seades sellega ohtu vanadele ja häirimata metsadele iseloomuliku elurikkuse säilimise.

 Tavapärane intensiivselt haritav maa ei ole elurikkuse säilimise seisukohast kuigi soodne, eriti kui põllumajandusmaastikku rikastavad elemendid - niidud,

põllusaared, puudetukad - puuduvad.

 Ümbruskonna põllumajandusmaastik on liiga ühetaoline ja vähe liigendatud. Selline maastik ei soosi elurikkust, kuna elupaikasid nii tolmeldajatele,

põllukahjurite looduslikele vaenlastele kui ka mullaviljakust toetavale mullaelustikule napib.

Siinset põllumajandusmaastikku







Maastiku sobivus elurikkuse püsimiseks:



Valitud asukoht: Mäo küla, Paide linn, Järva maakond 58.902 N, 25.627 E

Aeg: 01.04.2025

Ümbruskonnas on põllumaad ning metsad. Maastiku sobivust siinsetele elupaikadele omase elurikkuse säilimiseks hindab Rohemeeter siin mõõdukaks.



Mis on * hästi ja mis * murettekitav

* Vaadeldava piirkonna metsades on hiljuti tehtud lageraieid. Lageraiete pindala on Eesti metsades viimase





Mõõtmiseks vali kaardil asupunkt

Ümbruskonnas on valdavalt tehismaastikud. Maastiku sobivust siinsetele elupaikadele omase elurikkuse säilimiseks hindab Rohemeeter siin murettekitavaks. Siin on leitud looduskaitsealuseid liike (ahtalehine ängelhein).

Mis on • murettekitav:

• Piirkonnas on turbakaevandusalad, mille asemel ajalooliselt laiusid sood. Sood (rabad, madalsood, siirdesood) on elurikkuse säilimise, kliima tasakaalu, puhta vee olemasolu ja paljude teiste looduse hüvede seisukohast väga väärtuslikud ökosüsteemid. Soode kuivendamisel ning turba kasutamisel vallandub atmosfääri tuhandete aastate jooksul turbasse salvestunud süsinik ning sooliikidele vajalik elupaik hävib. Turbatootmisala vajab kindlasti soo ökosüsteemi taastumiseks inimesepoolset kaasaaitamist. Ilma aktiivse korrastamiseta võivad kaevandatud turbaväljad jääda aastakümneteks taimestikuvabaks.

