Methodology for GBF Indicator A.2 using the ecosystem condition information

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Introduction

One of the headline indicators of the Kunming-Montreal Global Biodiversity Framework (GBF) is A.2 'Extent of natural ecosystems'. As suggested in the technical guidance (United Nations, 2024), the indicator is derived directly from ecosystem extent accounts compiled based on the SEEA Ecosystem Accounting framework. An ecosystem extent account tracks the extent (area) and changes in extent, for different ecosystem types within an ecosystem accounting area (such as a country). The indicator 'Extent of natural ecosystems' provides information about the area and proportion of natural and semi-natural ecosystem types relative to anthropogenic ecosystems. According to the guidance, this indicator does not aim to address the ecological condition or integrity of natural ecosystems meaning that ecosystems do not have to be in good ecological condition to be included in the indicator as natural or semi-natural.

However, since the ecological condition (reflected in the structure, composition and function of an ecosystem) can vary significantly within an ecosystem type, classifying an entire ecosystem type as 'natural' or 'semi-natural' may hide essential information on the deterioration and thus loss of ecologically valuable ecosystems, which in turn is reflected in the supply of a different set of ecosystem services.

The approach used in Estonia, which combines ecosystem extent and condition data, shows how within an ecosystem type there may be parts that have been so intensively modified by human activities that their classification as 'natural' or 'semi-natural' should be questioned.

Methodology

The methodology has been developed by the large group of scientists during the Estonian national MAES (Mapping and Assessment of Ecosystems and their Services) project ELME (Helm et al., 2021, 2023)[1] in 2018–2023, followed by the implementation, developments and reassessments by the Estonian Environment Agency. Country-wide methodology and spatially explicit map layers of terrestrial ecosystems' extent, condition and ecosystem services have been created during this work. Along with the biophysical values, socioeconomic (monetary) values of the ecosystem services have been assessed and mapped.

The extent mapping is mainly based on the MAES ecosystem typology (Maes et al., 2013). The condition of terrestrial ecosystems has been mapped and all ecosystem types have been classified into condition classes A–F according to the values of ecologically relevant and aggregated characteristics, which in the case of forests means the naturalness gradient, in the case of grasslands implies to the success of maintenance actions of semi-natural habitats, in the case of agricultural ecosystems is mainly related to the presence and amount of landscape features, and in the case of inland wetlands (bogs, fens, mires) is mainly related to the drainage impacts. The condition classes are further grouped into simple classes: good, moderate, poor

[1] Overview: https://loodusveeb.ee/en/countrywide-MAES-EE; map catalogue: https://arcg.is/WuW9

(and ‘not assessed’). See also a methodological overview of the MAES experiences in different countries, incl. the ELME project in Vári et al. (2024).

The connectivity of natural and semi-natural ecosystems has also been mapped and used based on the distribution and condition of ecosystems, adapting a method applied in the European Environment Agency (EEA) European forest connectivity analysis. The indicator measures connectivity from 0% (no connectivity) to 100% (full connectivity) within a local neighborhood area of 10 hectares, calculated as the per-pixel average of local ecosystem area density[2].

To further illustrate the relevance of considering condition and connectivity data, the application of these data in green network spatial planning is presented as one of the real-life use cases.

Data sources include different relevant national data sets, models and registers along with earth observation data, field data, ecological expert knowledge, the layers of green network from spatial plans, etc.

Results and discussion

Comparing the status of the main Estonian terrestrial ecosystem types (Table 1, Figure 1), the best condition is that of inland wetland ecosystems, with 53% being classified as having a good and 17% moderate condition. The large proportion of wetlands in good condition is related to the fact that most of Estonia’s large natural bogs are under protection. However, it is debatable whether inland wetland ecosystems classified as ‘poor’ (30% of the total area of the inland wetlands) should be considered natural/semi-natural ecosystems, as they include intensively managed or intensively drained wetlands, peat extraction sites, cut-over peatlands, and residual bogs.

Of the forest ecosystems, 11% are in good condition and 60% in moderate condition, reflecting the impact of forest management on their natural state. Of the grassland ecosystems, which are largely semi-natural in Estonia and require traditional management to maintain biodiversity, 21% are in good condition and 12% in moderate condition.

The poorest ecological condition assessments are found in agricultural ecosystems – only 2% of agricultural ecosystems are in good condition and 15% in moderate condition. This is explained by the fact that agroecosystems continue to be dominated by monotonous, intensively cultivated land. Agroecosystems are largely considered to be intensively modified by human activities and are therefore excluded from natural and semi-natural ecosystems.

[2] https://www.eea.europa.eu/en/analysis/indicators/forest-connectivity-in-europe?activeAccordion=309c5ef9-de09-4759-bc02-802370dfa366

Table 1. Proportions of different terrestrial ecosystems by condition classes.

General ecosystem type	detailed condition class	% of the area of the ecosystem type	generalized condition class	% of the area of the ecosystem type
grassland	A	13	good	21
	B	8		
	C	12	moderate	12
	D1	40	poor	65
	D2	25		
	not assessed	2	not assessed	2
inland wetland	A	53	good	53
	B	17	moderate	17
	C	13	poor	30
	D	8		
	E	9		
	not assessed	1	not assessed	1
forest	A	11	good	11
	A–B	0.02	moderate	60
	A–C	7		
	B	12		
	C	41		
	D	12	poor	25
	E	11		
	F	2		
	not assessed	4	not assessed	4
agricultural ecosystems	A	2	good	2
	B	15	moderate	15
	C	29	poor	73
	D	44		
	not assessed	11	not assessed	11

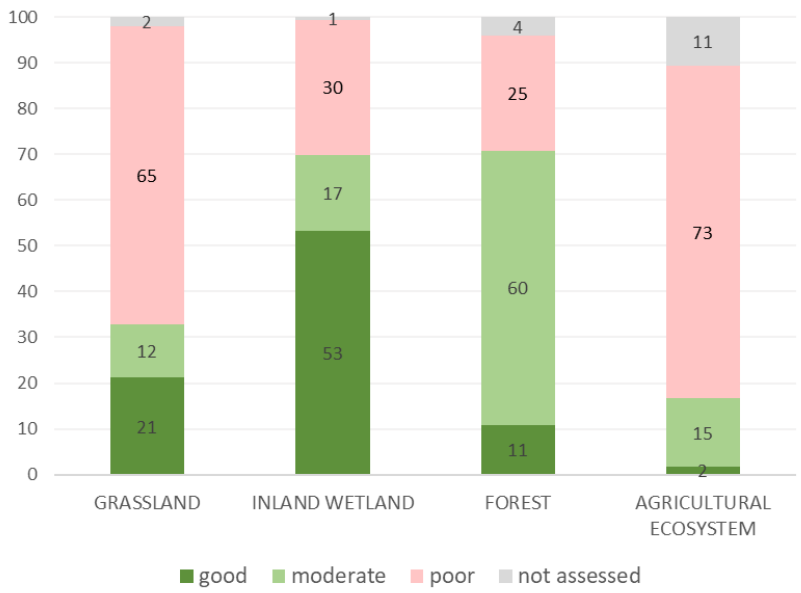

Figure 1. Proportions of different terrestrial ecosystems by condition classes.

Since the indicator 'Extent of natural ecosystems' addresses Goal A and Target 1 of the GBF, which aims to contribute to maintaining the integrity, connectivity and resilience of ecosystems (United Nations, 2024), the following real-world spatial planning use case is presented.

These layers have been used to analyze the functionality, condition and actual habitat connectivity of the green network as it has been designated in spatial plans of different levels (local government, county, state). The results show that the ecological condition is much better within the green network than outside it (Figures 2 and 3). Table 2 reveals the situation if the condition and connectivity data are combined – 1/3 of Estonia is covered by natural and semi-natural ecosystems that are simultaneously in poor condition and have poor connectivity.

Spatially explicit data on the ecological condition and actual connectivity of the planned network enable knowledge-based implementation of various spatial decisions, including planning the implementation of restoration measures if necessary.

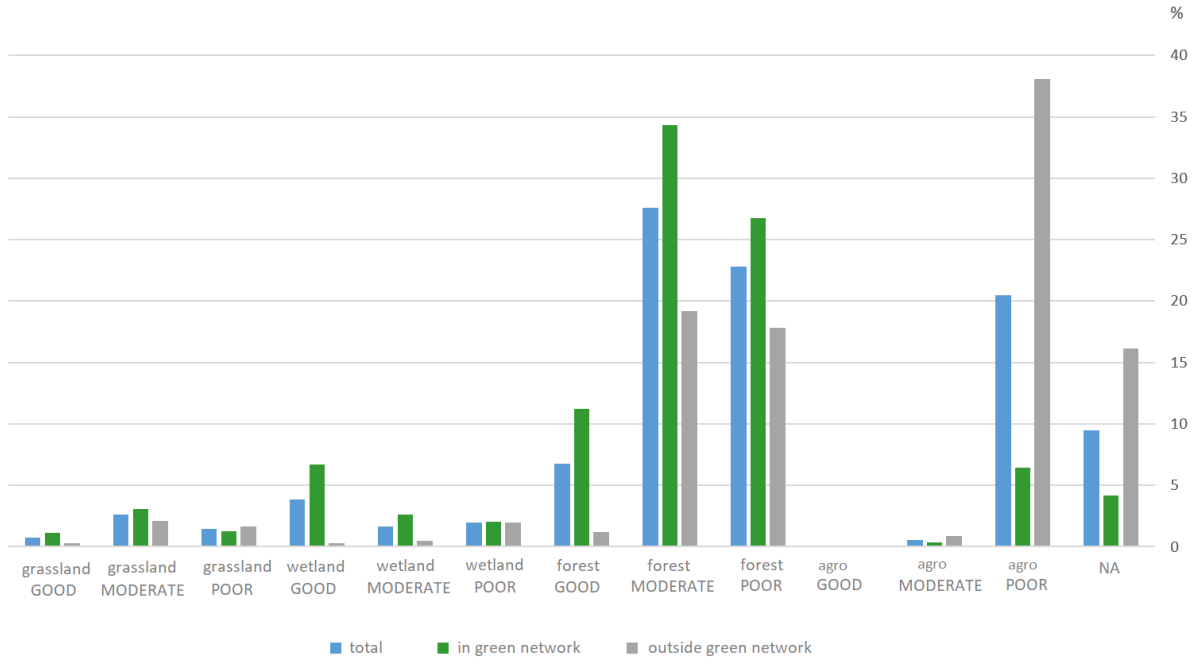

Figure 2. Proportions of terrestrial ecosystem types by generalized condition classes within and outside the green network and considering the entire area of the ecosystem type. NA – not assessed.

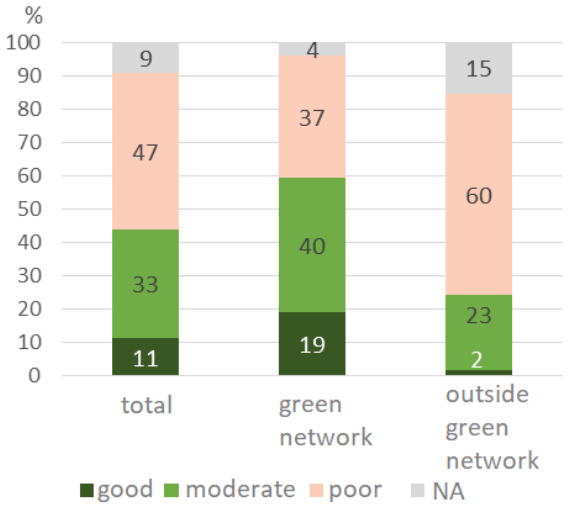

Figure 3. Proportions of generalized condition classes within and outside the green network and considering the total area of Estonia's main natural and semi-natural terrestrial ecosystem types (forests, grasslands, inland wetlands). NA – not assessed.

Table 2. Proportions (%) of different combinations of condition and connectivity classes within and outside the green network and considering the total area of Estonia's terrestrial ecosystems.

Ecosystem condition / connectivity	total	in green network	outside green network
good condition / good connectivity	5.9	10.5	0.1
good condition / moderate connectivity	4.5	7.3	1.0
moderate condition / good connectivity	2.3	4.1	0.1
moderate condition / moderate connectivity	14.1	20.2	6.5
good condition / poor connectivity	0.9	1.2	0.6
poor condition / good connectivity	1.0	1.6	0.1
moderate condition / poor connectivity	16.0	16.0	16.0
poor condition / moderate connectivity	12.6	15.7	8.8
poor condition / poor connectivity	33.6	19.5	51.3

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Acknowledgements

The ELME project ('Establishment of tools for integrating socioeconomic and climate change data into assessing and forecasting biodiversity status, and ensuring data availability') was funded by the EU Cohesion Fund and the foundation Environmental Investments Centre. Many thanks to the entire team mentioned in the ELME reports and to those currently working on ecosystem assessments.