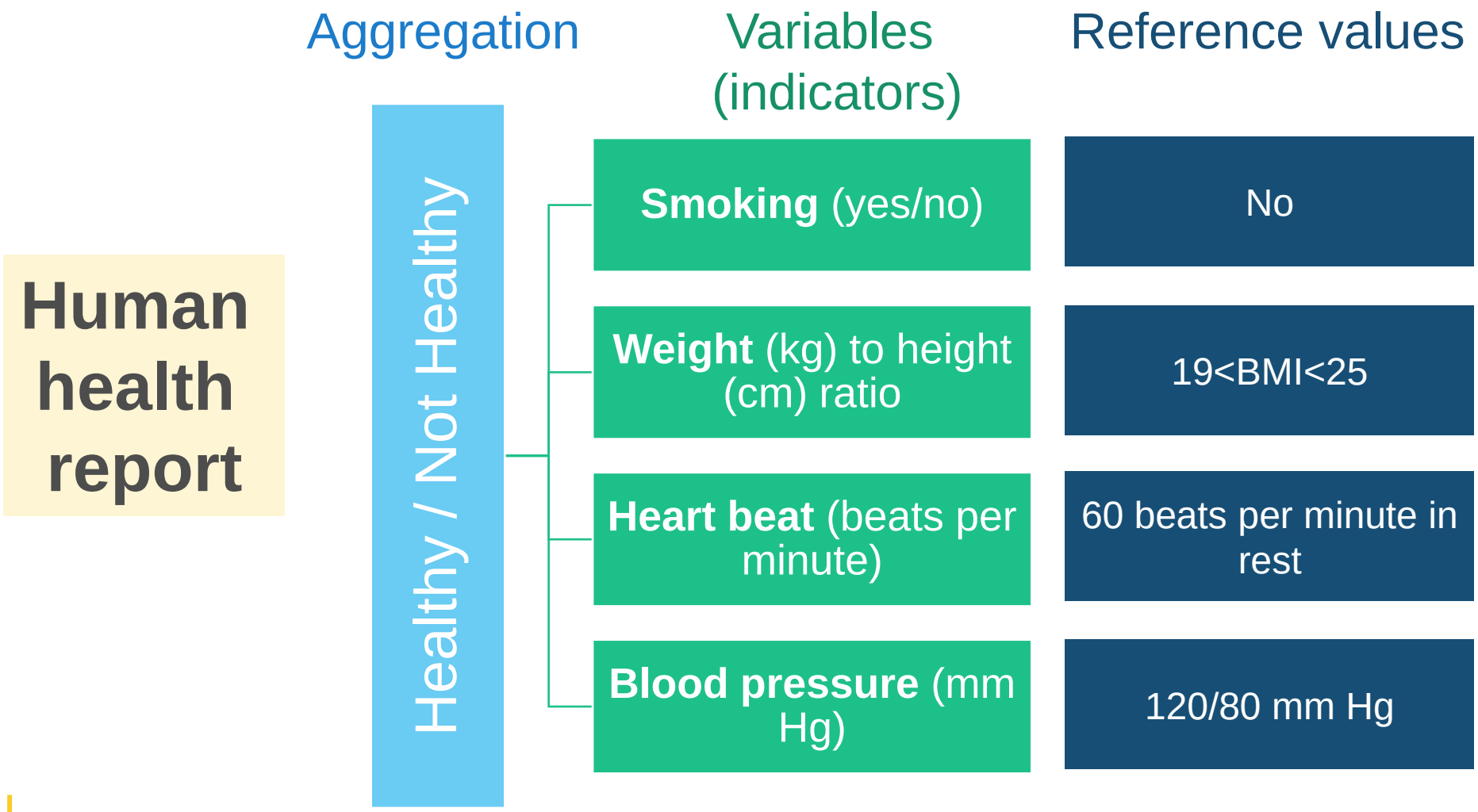
SEEA EA Ecosystem condition accounts

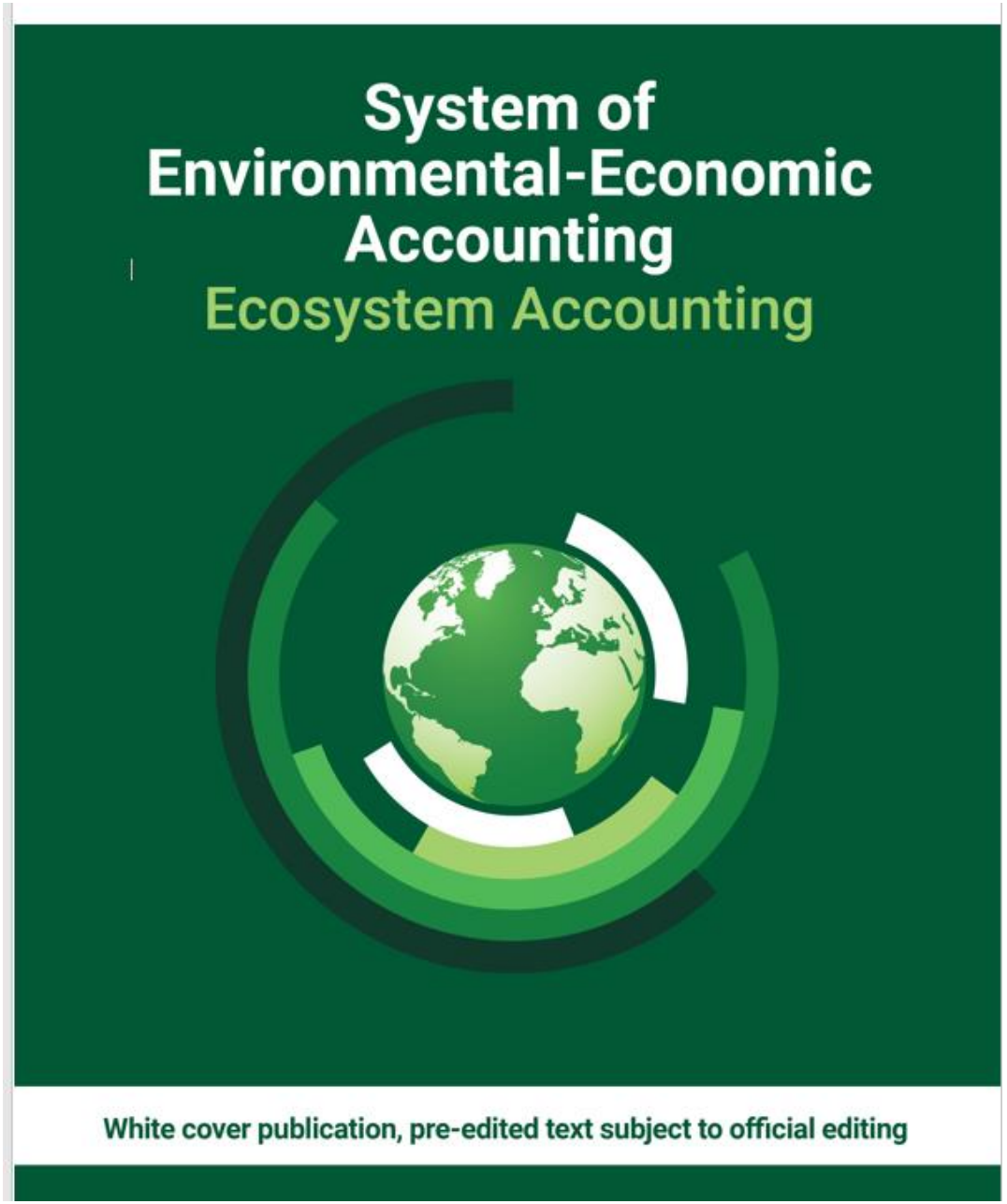
Third Webinar for System of Environmental Economic Accounting-Ecosystem Accounting , 28 April 2022

Joachim Maes

European Commission

Measuring ecosystem condition is very similar to measuring human health





Chapter 5. Accounting for ecosystem condition

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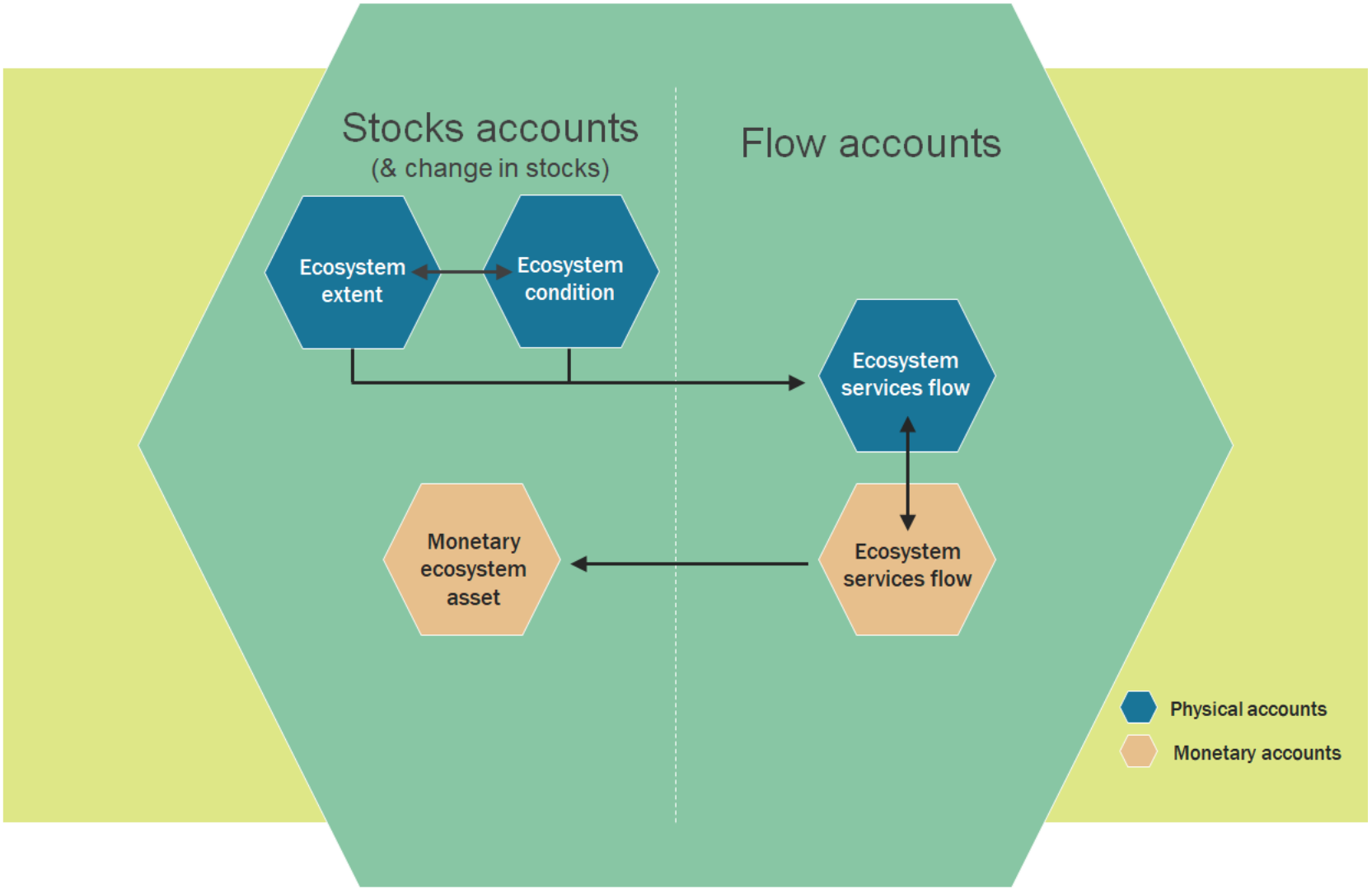
Ecosystem condition accounts in the SEEA EA framework



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Ecosystem condition: definitions

Ecosystem **condition** is the quality of an ecosystem measured in terms of its **abiotic** and **biotic** characteristics.

Ecosystem **integrity** is the ecosystem's capacity to maintain it characteristic **composition**, **structure**, **functioning** and self-organisation over time within a natural range of variability.

Measuring and reporting ecosystem condition

1. **Select appropriate ecosystem variables to measure ecosystem condition**
2. Define a reference condition, reference levels, and rescale ecosystem variables to ecosystem condition indicators
3. Aggregate the indicators to a single ecosystem condition index

Ecosystem characteristics

Ecosystem characteristics are the system properties of the ecosystem and its major abiotic and biotic components (water, soil, topography, vegetation, biomass, habitat and species).

SEEA Ecosystem Condition Typology

The SEEA ecosystem condition typology (ECT) is a hierarchical typology for organizing data on ecosystem condition characteristics

Table 5.1: The SEEA Ecosystem Condition Typology (ECT)

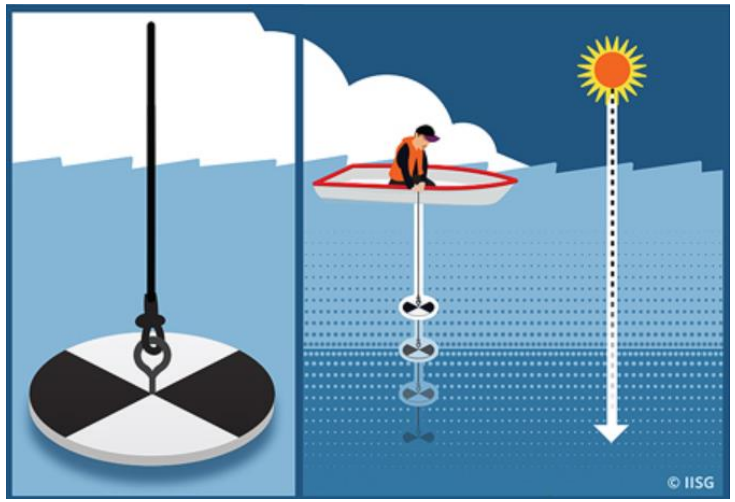
ECT groups and classes
Group A: Abiotic ecosystem characteristics
Class A1. Physical state characteristics: physical descriptors of the abiotic components of the ecosystem (e.g., soil structure, water availability)
Class A2. Chemical state characteristics: chemical composition of abiotic ecosystem compartments (e.g., soil nutrient levels, water quality, air pollutant concentrations)
Group B: Biotic ecosystem characteristics
Class B1. Compositional state characteristics: composition / diversity of ecological communities at a given location and time (e.g., presence / abundance of key species, diversity of relevant species groups)
Class B2. Structural state characteristics: aggregate properties (e.g., mass, density) of the whole ecosystem or its main biotic components (e.g., total biomass, canopy coverage, annual maximum normalized difference vegetation index (NDVI))
Class B3. Functional state characteristics: summary statistics (e.g., frequency, intensity) of the biological, chemical, and physical interactions between the main ecosystem compartments (e.g., primary productivity, community age, disturbance frequency)
Group C: Landscape level characteristics
Class C1. Landscape and seascape characteristics: metrics describing mosaics of ecosystem types at coarse (landscape, seascape) spatial scales (e.g., landscape diversity, connectivity, fragmentation)

Ecosystem condition variables

Ecosystem condition **variables** are quantitative metrics describing individual **characteristics** of an ecosystem asset

Water clarity = **characteristic**

Secchi disk depth (meter) = **variable**



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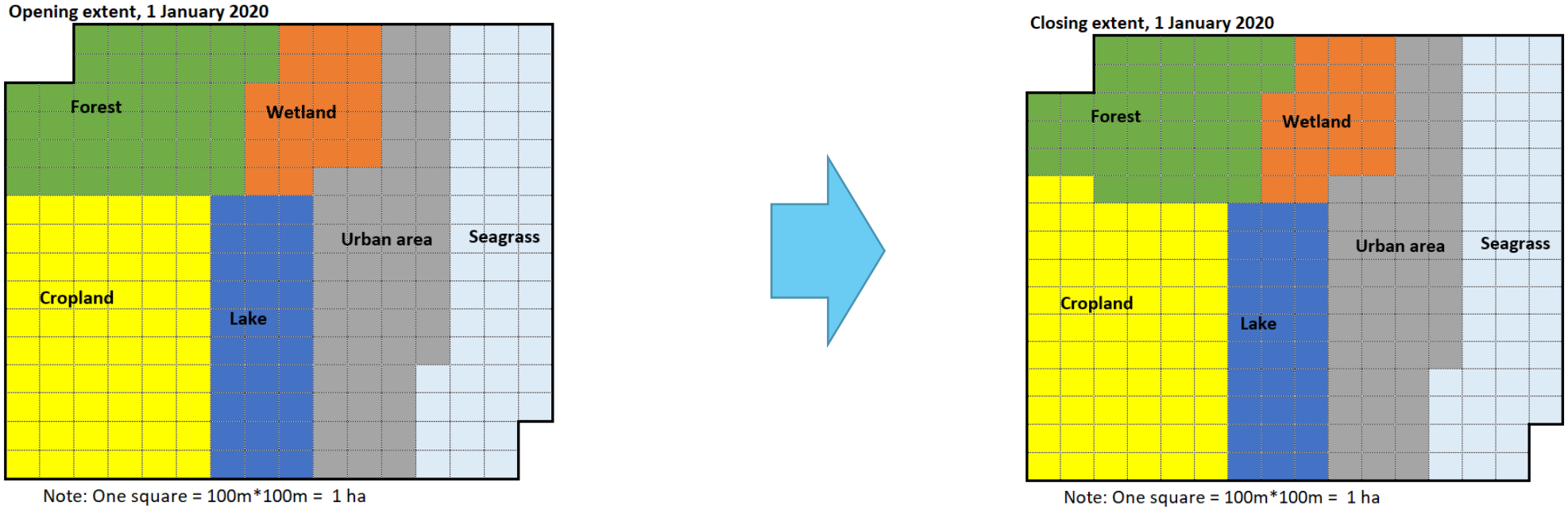
Example for “SEEA land”

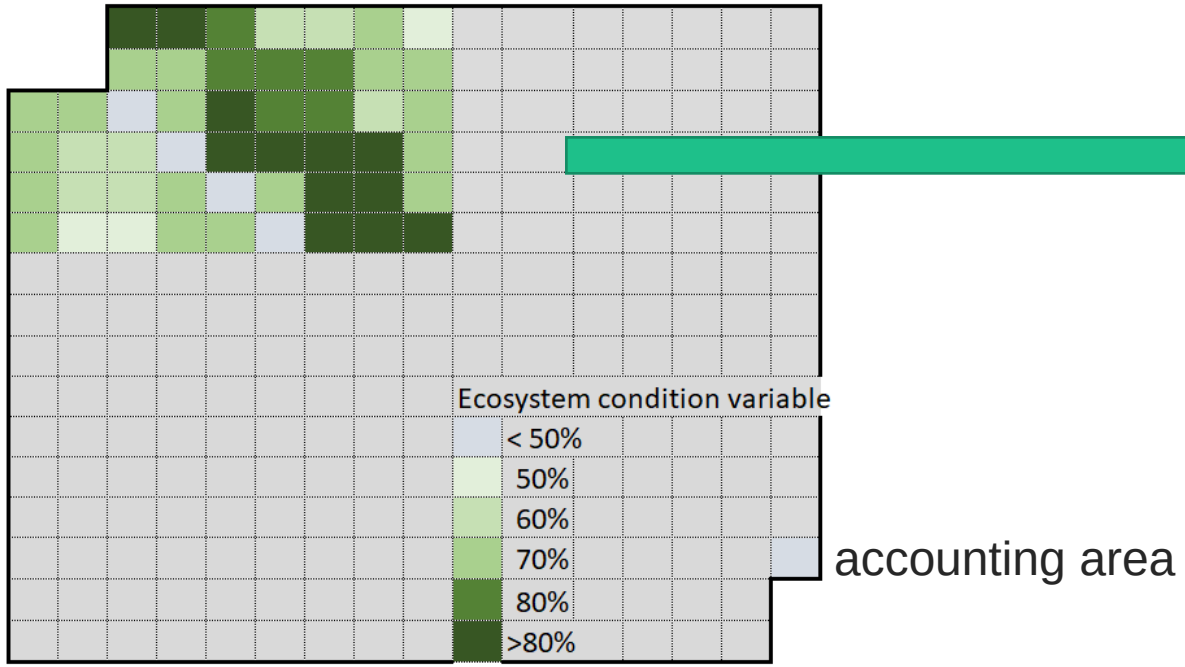


Scenario: In *SEEAland* natural ecosystems have experienced increasing pressures reflected in (managed) conversions from forest to cropland and general intensification of ecosystem use.

Key principle of condition accounting

Ecosystem condition variables are measured for every grid cell (or every ecosystem asset) – Map

Report the spatially weighed average value over the accounting area in the table



Average: 75%

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Forest (stage 1 condition account)						
SEEA Ecosystem Condition Typology		**Variable descriptor**	**Measurement**	**Variable values (observed)**		
				Opening	Closing	Change
Abiotic characteristics	Physical state					
	Chemical state	Soil organic carbon stock	tC/ha	100	95	-5
Biotic characteristics	Compositional state	Tree species richness	number	6	5	-1
	Structural state	Tree cover	%	81	75	-6
	Functional state					
Landscape/ seascape characteristics						

Stage 1 condition accounts: conclusion

- Several forest condition variables are **declining**.
- Is this a problem? How does the forest in SEEA land compare with a reference forest?

Measuring and reporting ecosystem condition

1. Select appropriate ecosystem variables to measure ecosystem condition
2. **Define a reference condition, reference levels, and rescale ecosystem variables to ecosystem condition indicators**
3. Aggregate the indicators to a single ecosystem condition index

Key principle of condition accounting

The practical basis for assessing ecosystem condition is **to measure the similarity or distance** of a current ecosystem to a reference or least-disturbed ecosystem.

Reference condition

A reference condition is the condition against which past, present and future ecosystem condition is compared to in order to measure relative change over time.

How to choose a reference condition

First question? Natural ecosystem or managed ecosystem?

Possible reference conditions

Undisturbed or minimally-disturbed condition of an intact ecosystem. The condition of an ecosystem with maximal ecosystem integrity with no or minimal disturbance.

Possible reference conditions

Least-disturbed condition: the currently best available condition of an ecosystem.

Possible reference conditions

Historical condition: The condition of an ecosystem at some point or period in its history that is considered to represent the stable natural state (e.g., the pre-industrial period or pre-intensive agriculture).

(Historical observations and paleo-environmental data, models)

Possible reference conditions

Contemporary condition: The condition of an ecosystem at a certain point or period in its recent history for which comparable data are available. (e.g., the condition of an ecosystem in 1990, or the forest in best condition based on current monitoring)

Possible reference conditions

Best-attainable condition: the expected condition of an ecosystem under best possible management practices and attaining a stable socio-ecological state.

Reference level

An **upper reference level** is the value of an ecosystem condition variable measured at the reference condition

A **lower reference level** is the value of an ecosystem condition variable measured for a degraded or collapsed ecosystem

Forest (stage 2 condition account)								
Variable descriptor	**Measurement unit**	**Variable values (observed)**		**Reference level values**		**Indicator values (rescaled)**		
		Opening	Closing	Lower level	Upper level	Opening	Closing	Change
Soil organic carbon stock	tC/ha	100	95	0	250	0.40	0.38	-0.02
Tree species richness	number	6	5	0	10	0.60	0.50	-0.10
Tree cover	%	81	75	0	100	0.81	0.75	-0.06

Stage 2 condition accounts: conclusion

- Ecosystem condition indicators (rescaled ecosystem condition variables) can be compared.
  - Soil organic carbon stock is depleted.
  - Several tree species are missing
  - Tree cover density is still high but declining
- Can we come to a general conclusion of the condition of the forest?

Measuring and reporting ecosystem condition

1. Select appropriate ecosystem variables to measure ecosystem condition
2. Define a reference condition, reference levels, and rescale ecosystem variables to ecosystem condition indicators
3. **Aggregate the indicators to a single ecosystem condition index**

Aggregation to an ecosystem condition index

Commonly used aggregations

- (weighed) Arithmetic mean $\frac{\sum a_i x_i}{n}$ where a is the weight and x the indicator value
- (weighed) Geometric mean $\sqrt[n]{\prod a_i x_i}$
- One out $\rightarrow$ All out

Forest (Stage 3 condition account)					
Variable descriptor	**Indicator values (0 - 1)**		**Indicator weight**	**Index values**	
	Opening	Closing		Opening	Closing
Soil organic carbon stock	0.40	0.38	25%	0.100	0.095
Tree species richness	0.60	0.50	50%	0.300	0.250
Tree cover	0.81	0.75	25%	0.203	0.188
ECOSYSTEM CONDITION INDEX			100%	**0.603**	**0.533**

Stage 3 condition accounts: conclusion

- Forest condition decreased from 0.603 to 0.533 (on a scale between 0 and 1)
- A scale could be agreed upon (e.g. with the forest manager)

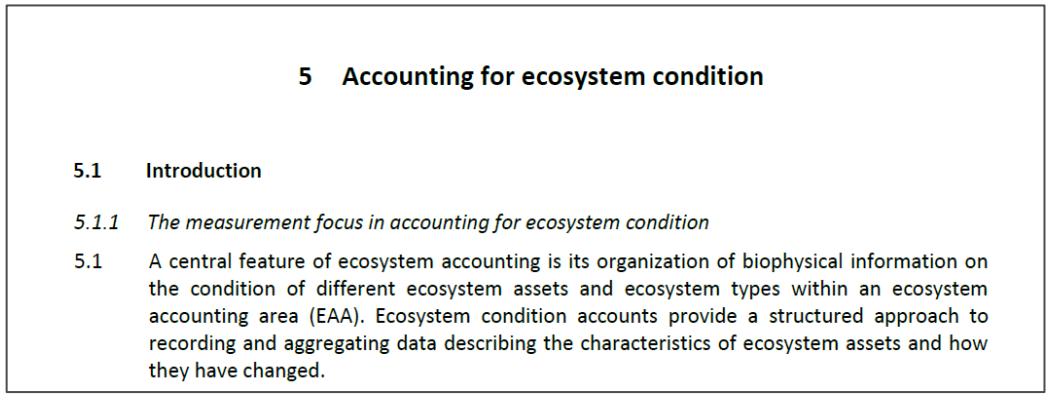
Scale		Ecosystem condition
[0.0 - 0.2]		bad
[0.2 - 0.4]		poor
[0.4 - 0.6]		medium
[0.6 - 0.8]		good
[0.8 - 1.0]		excellent

SEEA EA contains also guidance on:

- Examples of indicators per ecosystem type
- Using environmental data on pressures (land use change, pollution, nutrient enrichment, invasive species)
- Ecosystem conversions

Sources

SEEA EEA ecosystem condition working group: Joachim Maes, Heather Keith, Bálint Czúcz, Bethanna Jackson, Amanda Driver, Emily Nicholson, Simon Jacobsson, Octavio Maqueo

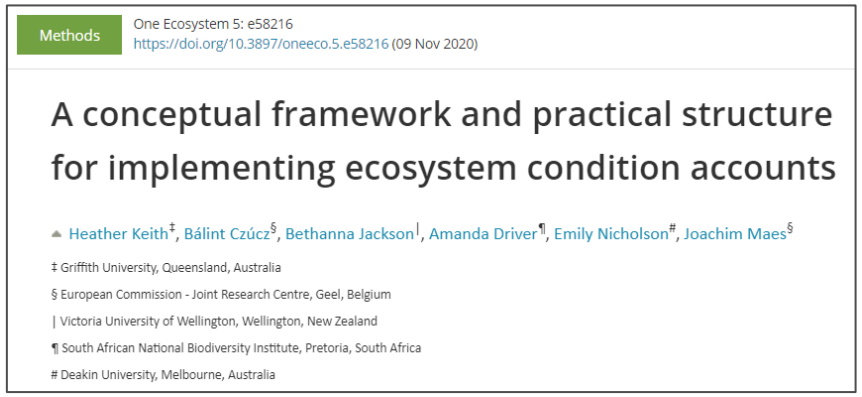


5 Accounting for ecosystem condition

5.1 Introduction

5.1.1 The measurement focus in accounting for ecosystem condition

5.1 A central feature of ecosystem accounting is its organization of biophysical information on the condition of different ecosystem assets and ecosystem types within an ecosystem accounting area (EAA). Ecosystem condition accounts provide a structured approach to recording and aggregating data describing the characteristics of ecosystem assets and how they have changed.



Methods One Ecosystem 5: e58216 https://doi.org/10.3897/oneeco.5.e58216 (09 Nov 2020)

A conceptual framework and practical structure for implementing ecosystem condition accounts

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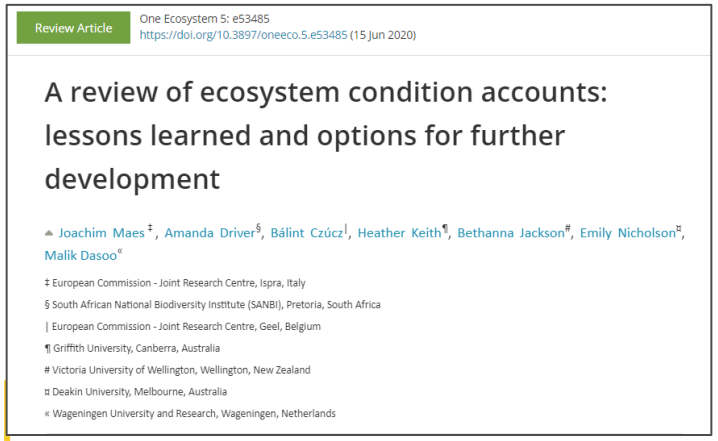

Review Article One Ecosystem 5: e53485 https://doi.org/10.3897/oneeco.5.e53485 (15 Jun 2020)

A review of ecosystem condition accounts: lessons learned and options for further development

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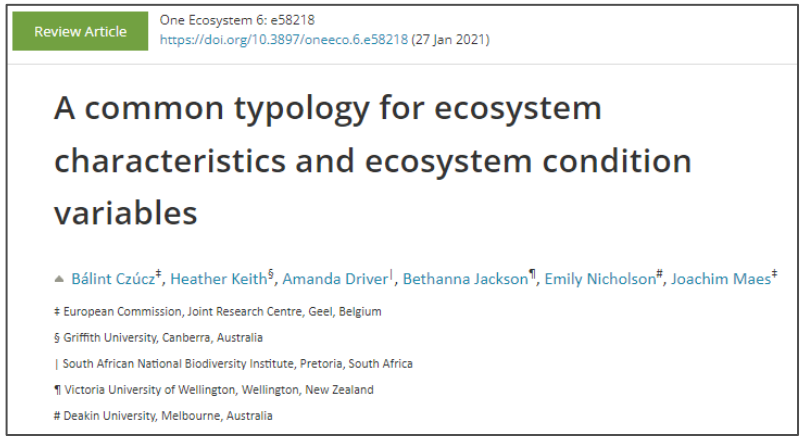

Review Article One Ecosystem 6: e58218 https://doi.org/10.3897/oneeco.6.e58218 (27 Jan 2021)

A common typology for ecosystem characteristics and ecosystem condition variables

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Ecological Indicators

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Selection criteria for ecosystem condition indicators

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Thank you

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