

SEEA Ecosystem Accounting and Climate Change

Sokol Vako

United Nations Statistical Institute for Asia and the Pacific

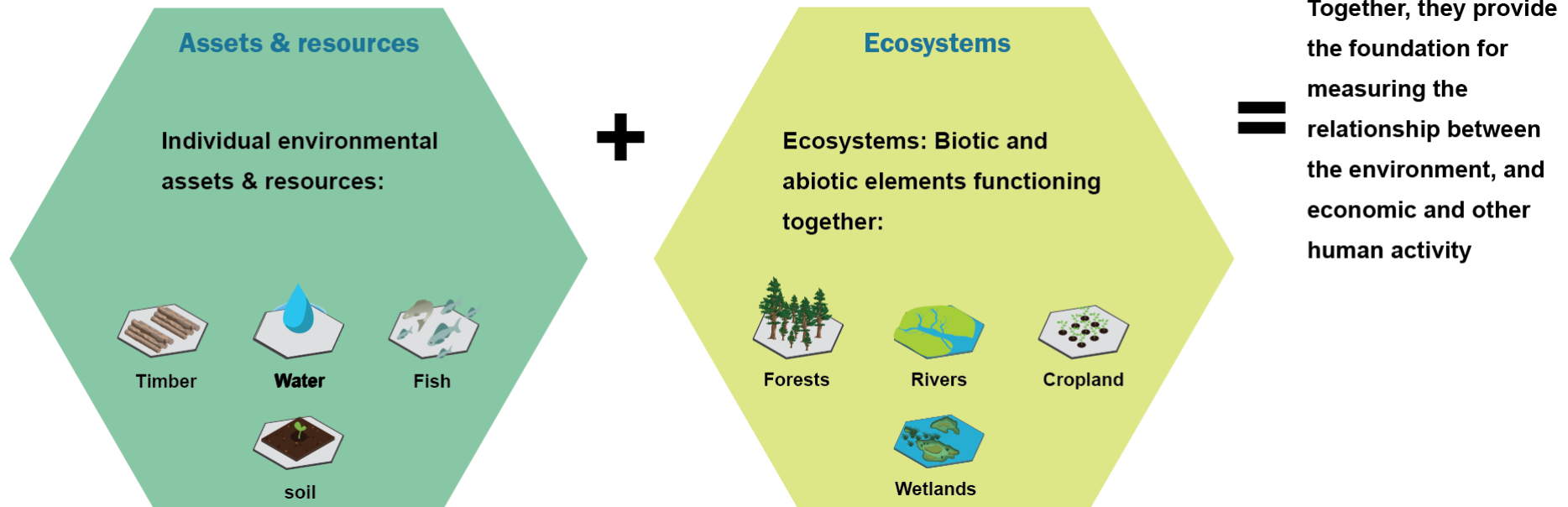
13 April 2023

Outline

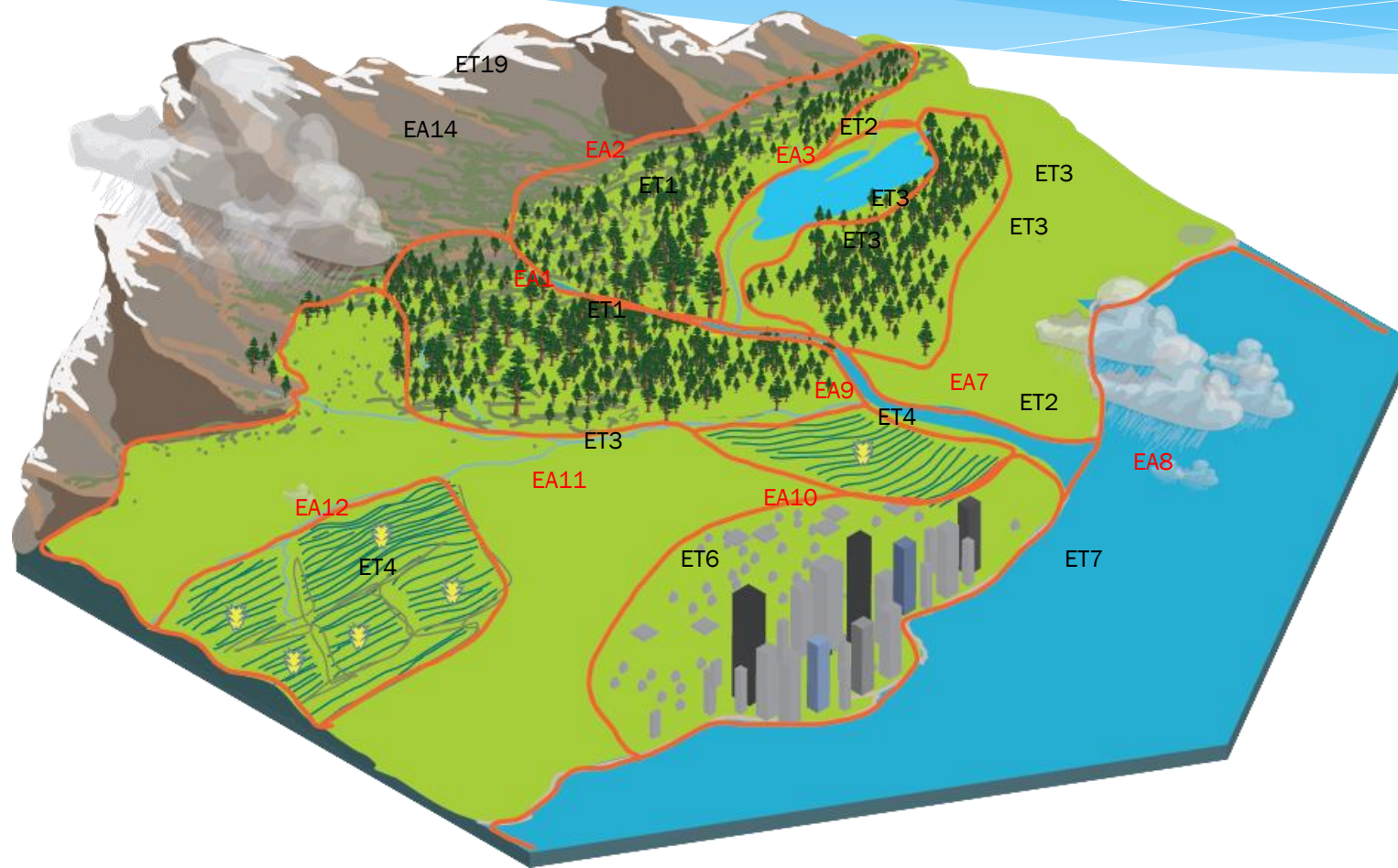
- * Introduction to SEEA EA
- * Some details around extent accounts and links to climate change (bulk of presentation will focus on this)
- * Some details around condition accounts and links to climate change
- * Some details around services accounts and links to climate change
- * Some potential indicators (focused on extent)
- * An exercise on ecosystem extent (mainly)

- * Presentation based on inputs from Sjoerd Schenau (CBS), Joachim Maes (EU) and Alessandra LaNotte (also EU)
- * Will not cover thematic accounts here

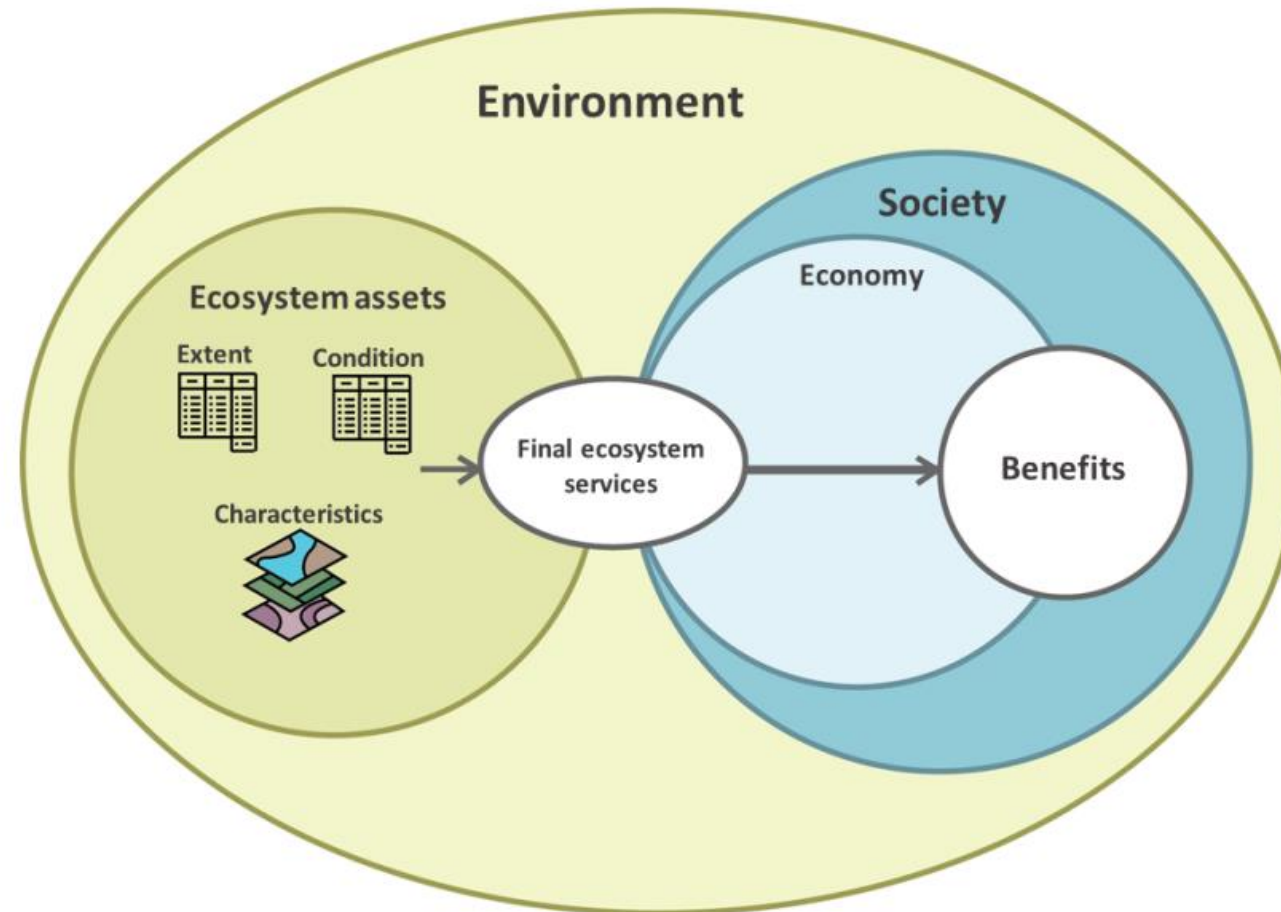
The economic contributions of nature



Ecosystem accounting approach

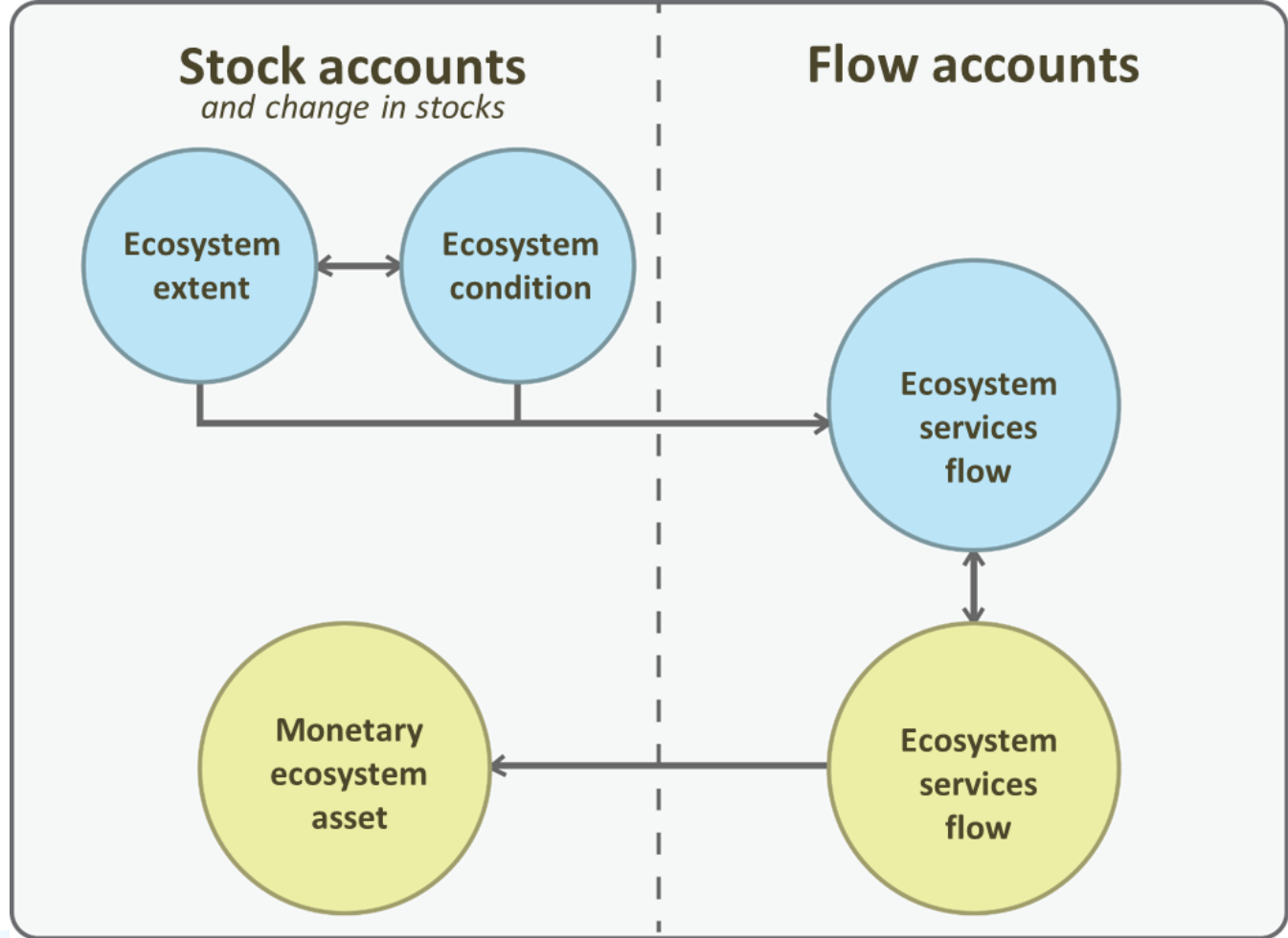


Ecosystem accounting framework



Illustration

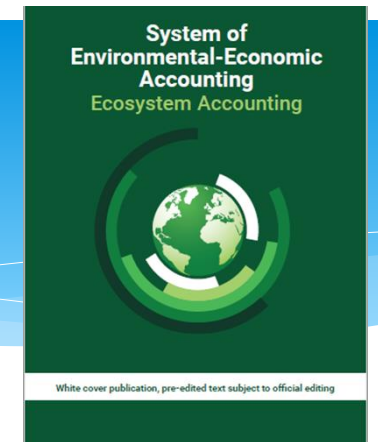




- Physical accounts
- Monetary accounts

Extent accounts (in some detail)

SEEA EA extent account - overview



What?

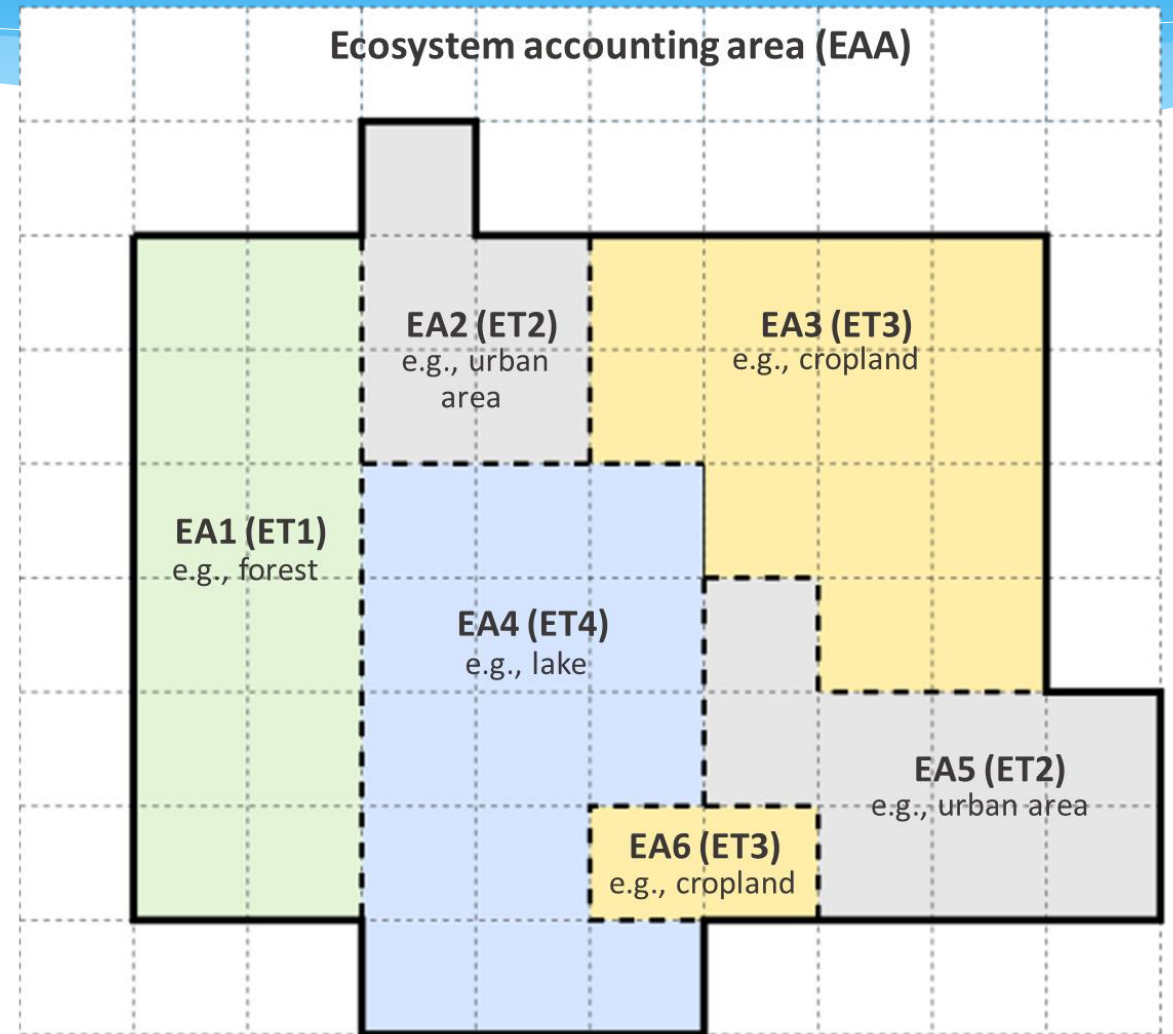
- Starting point for ecosystem accounting
- Records the areas of different ecosystems, and changes in the areas
- National coverage of terrestrial, freshwater, coastal and marine areas
- Mutually exclusive and exhaustive coverage

Why?

- Input for **land management, conservation policies**
- Supports the derivation of coherent **indicators** of deforestation, desertification, agricultural conversion, urbanization, ecosystem diversity etc.
- **Spatial foundation for other accounts**
→ basis for allocating macro data to spatial units

Spatial units in SEEA EA

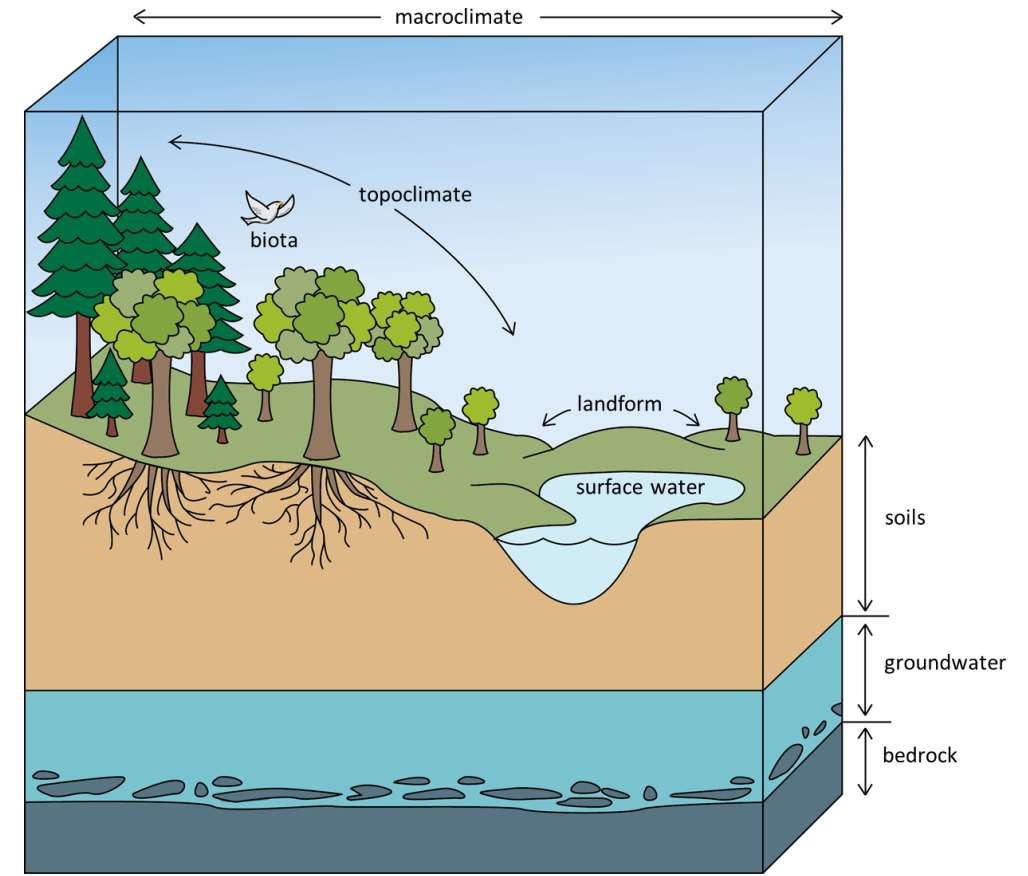
- General approach for delineation of ecosystem assets well established
- **Three types of units:**
 - Basic spatial units (BSU)
 - Ecosystem Accounting Area (EAA)
 - Ecosystem asset (EA)



Ecosystem assets

Ecosystem assets (EAs) are contiguous spaces of a specific ecosystem type characterized by a distinct set of biotic and abiotic components and their interactions

Ecosystem assets are classified by ecosystem type (ET)



Principles of ecosystem asset delineation

Ecosystem assets should represent ecosystems

Alignment with CBD ecosystem definition
consideration of organisms, their environmental setting and
ecosystem processes.

Keep it realistic: perfect is the enemy of good

Ecosystem assets should be capable of being mapped.

Location; size; shape

Ecosystem assets should be geographically and conceptually exhaustive across ecological realms.

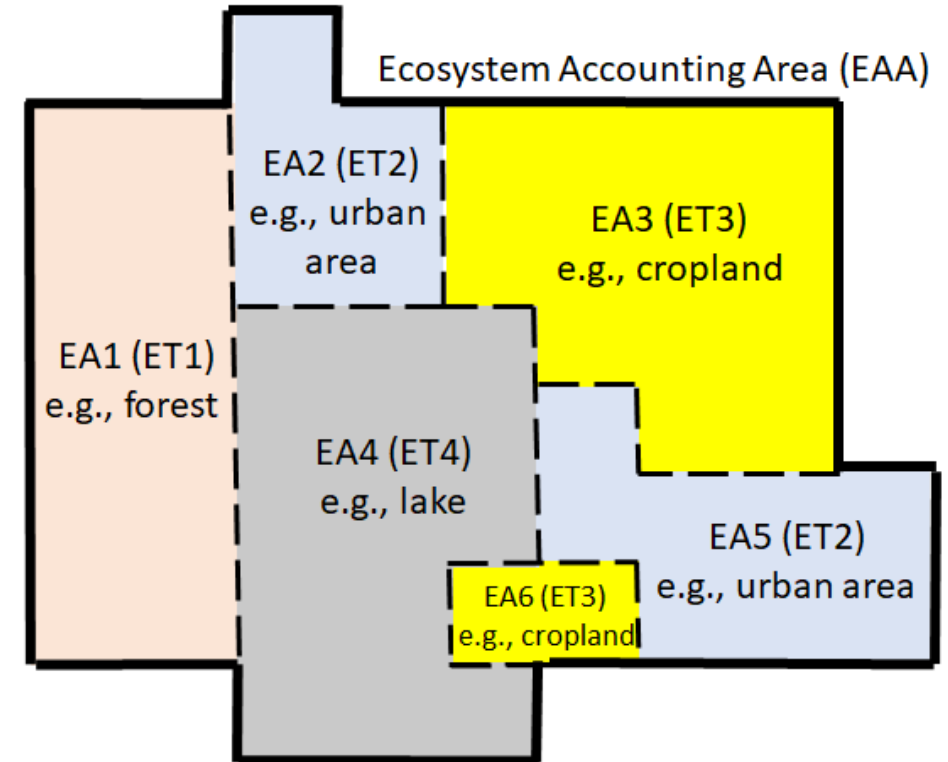
Spatially comprehensive (no gaps)

Conceptually comprehensive

Ecosystem assets should be mutually exclusive

Conceptually (single ecosystem type)

Geographically (no overlaps between e.g. land and ocean).



Common forms of EAA

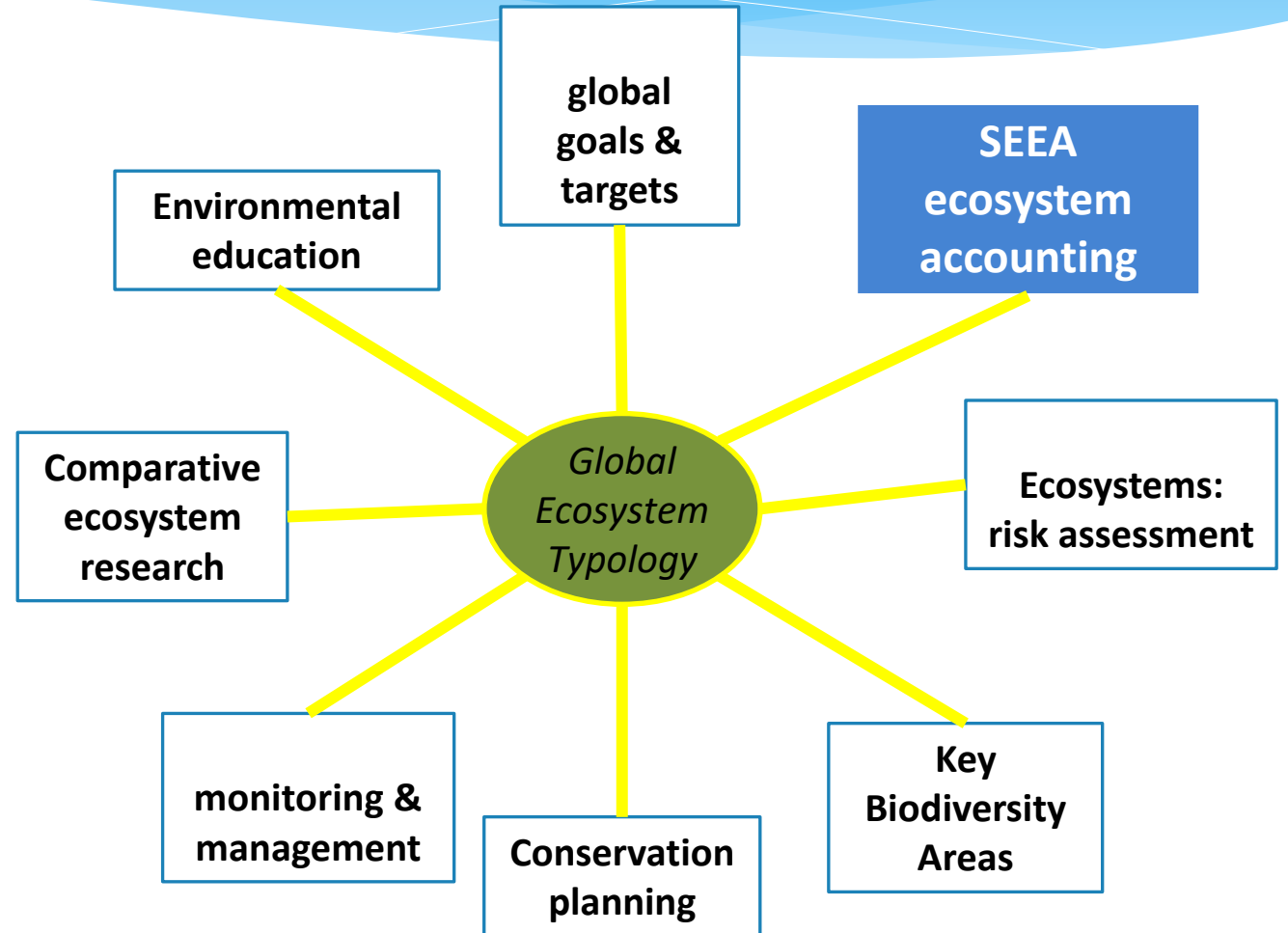
- **National jurisdictions / groups of countries**
- **Subnational administrative areas**
 - (e.g., state, province);
- **Environmentally defined areas within a country**
 - (e.g., water catchments, ecoregions)
- **or across countries**
 - (e.g., regions defined by river systems such as the Amazon, the Mekong and the Nile);
- **Other areas of policy or analytical interest such as**
 - protected areas
 - areas owned by specific industries or sectors, e.g., government-owned land
 - or areas outside national jurisdiction, e.g., open oceans and high seas

An ecosystem type classification for SEEA EA

- A classification describing the ecosystem types and a map are **essential components** of ecosystem accounting
- It is expected that countries will use their national ecosystem maps and classifications as the basis for SEEA ecosystem accounting.
- However, for international comparability, these classifications should be linked to a **reference classification**.
- **A key revision issue** for SEEA EA was to develop a proposal for a reference classification that better represents the concept and coverage of ecosystems
- **SEEA EA endorses the IUCN GET as the international reference classification**

IUCN Global Ecosystem Typology

- * Ecosystems are defined by their **biotic** and **physical** components and the **ecological processes** that sustain them
- * Ecosystem accounts require assets that reflect:
 - * Ecological functions (the basis for ecosystem services)
 - * Biological composition (biodiversity)
- * **IUCN Ecosystem Typology**
 - * A hierarchical framework combining both components



Three ways to to compile ecosystem type maps

- 1) Use existing national ecosystem classification / maps
→ *cross walk to IUCN classification*
- 2) Use existing global maps
→ ARIES, WES, IUCN, etc.
- 3) Construct your own ecosystem classification / maps

The SEEA extent account

Realm	Selected ecosystem types (based on Level 3 - EFG of the IUCN Global Ecosystem Typology)																			TOTAL	
	Terrestrial							Freshwater			Marine				Transitional						
	Tropical-subtropical lowland rainforests	Boreal and temperate montane forests and woodlands	Seasonally dry tropical shrublands	Trophic savannas	Semi-desert steppes	Ice sheets, glaciers and perennial snowfields	Croplands	Permanent upland streams	Large permanent freshwater lakes	Large reservoirs	Seagrass meadows	Epipelagic ocean waters	Continental and island slopes	Submerged artificial structures	Tropical flooded forests and peat forests	Deepwater coastal inlets	Rocky shores	Coastal shrublands and grasslands	Artificial shores		Coastal river deltas
Selected Ecosystem Functional Group (EFG)	T1.1	T2.1	T3.1	T4.1	T5.1	T6.1	T7.1	F1.1	F2.1	F3.1	M1.1	M2.1	M3.1	M4.1	TF1.1	FM1.1	MT1.1	MT2.1	MT3.1	MFT1.1	
Opening extent																					
Additions to extent																					
Expansions																					
Managed expansion																					
Natural expansion																					
Upward reappraisals																					
Reductions in extent																					
Regressions																					
Managed regression																					
Natural regression																					
Downward reappraisals																					
Net change in extent																					
Closing extent																					

General principles

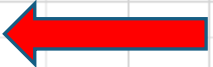
- ***Ecosystem extent is the size of an ecosystem asset.***
- It is usually measured in terms of spatial area but may also be measured in terms of length or volume
- Provide an overview of the composition (mix/combination) of, and changes in, ecosystem types within an EEA.

Extent account - structure

Realm	Selected ecosystem types (based on Level 3 - EFG of the IUCN Global Ecosystem Typology)																				TOTAL	
	Terrestrial							Freshwater			Marine				Transitional							
Selected Ecosystem Functional Group (EFG)	Tropical-subtropical lowland rainforests	Boreal and temperate montane forests and woodlands	Seasonally dry tropical shrublands	Trophic savannas	Semi-desert steppes	Ice sheets, glaciers and perennial snowfields	Croplands	Permanent wetlands	Large permanent lakes	Large reservoirs	Seagrass meadows	Epipelagic	Continental shelves	Submerged aquatic vegetation	Peat bogs	Tropical floodplains	Deepwater	Rocky shores	Coastal shrublands and grasslands	Artificial shores	Coastal river deltas	
	T1.1	T2.1	T3.1	T4.1	T5.1	T6.1	T7.1	F1.1	F2.1	F3.1	M1.1	M2.1	M3.1	M4.1	TF1.1	FM1.1	MT1.1	MT2.1	MT3.1	MFT1.1		
Opening extent																						
Additions to extent																						
Expansions																						
Managed expansion																						
Natural expansion																						
Upward reappraisals																						
Reductions in extent																						
Regressions																						
Managed regression																						
Natural regression																						
Downward reappraisals																						
Closing extent																						

Ecosystem classification

Opening extent



Additions in extent



Reductions in extent

Closing extent

ET change matrix

The ET change matrix shows :

- the area of different ecosystem types at the beginning of the accounting period;
- the increases and decreases in this area according to the ecosystem type it was converted from or to;
- the area covered by different ecosystem types at the end of the accounting period.

Realm		Selected ecosystem types (based on Level 3 - EFG of the IUCN Global Ecosystem Typology)														Opening					
		Closing Extent																			
		Terrestrial						Freshwater			Marine										
Biome	T1 Tropical-subtropical forests						T2 Temperate-boreal forests and woodlands			...	T7	F1	...	FM1	M1	...	MFT1				
Selected Ecosystem Functional Group (EFG)	Tropical-subtropical lowland rainforests	Tropical-subtropical dry forests and scrubs	Tropical-subtropical montane rainforests	Tropical heath forests	Boreal and temperate high montane forests and woodlands	Deciduous temperate forests	...	...	...	...	...	Derived semi-natural pastures and old fields	Permanent upland streams	...	Intermittently closed and open lakes and lagoons	Seagrass meadows	...	Coastal saltmarshes and reedbeds			
	T1.1	T1.2	T1.3	T1.4	T2.1	T2.2	...	T2.6	...	...	...	T7.5	F1.1	...	FM1.3	M1.1	...	MFT1.3			
Terrestrial	T1 Tropical-subtropical forests	Tropical-subtropical lowland rainforests	T1.1																		
		Tropical-subtropical dry forests and scrubs	T1.2																		
		Tropical-subtropical montane rainforests	T1.3																		
		Tropical heath forests	T1.4																		
	T2 Temperate-boreal forests and woodlands	Boreal and temperate high montane forests and woodlands	T2.1																		
		Deciduous temperate forests	T2.2																		
																			
	T7	...	...																
		Derived semi-natural pastures and old fields	T7.5																		
																			
Freshwater	F1	Permanent upland streams	F1.1																		
																		
	FM1	Intermittently closed and open lakes and lagoons	FM1.3																		
Marine	M1	Seagrass meadows	M1.1																		
																		
	MFT1	Coastal saltmarshes and reedbeds	MFT1.3																		
		Closing																			

Ecosystem extent and climate change indicators

- *What do you think are some potential indicators/aggregates that can be compiled from the extent account that can inform climate change?*

Condition accounts (briefly)

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 its 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

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)

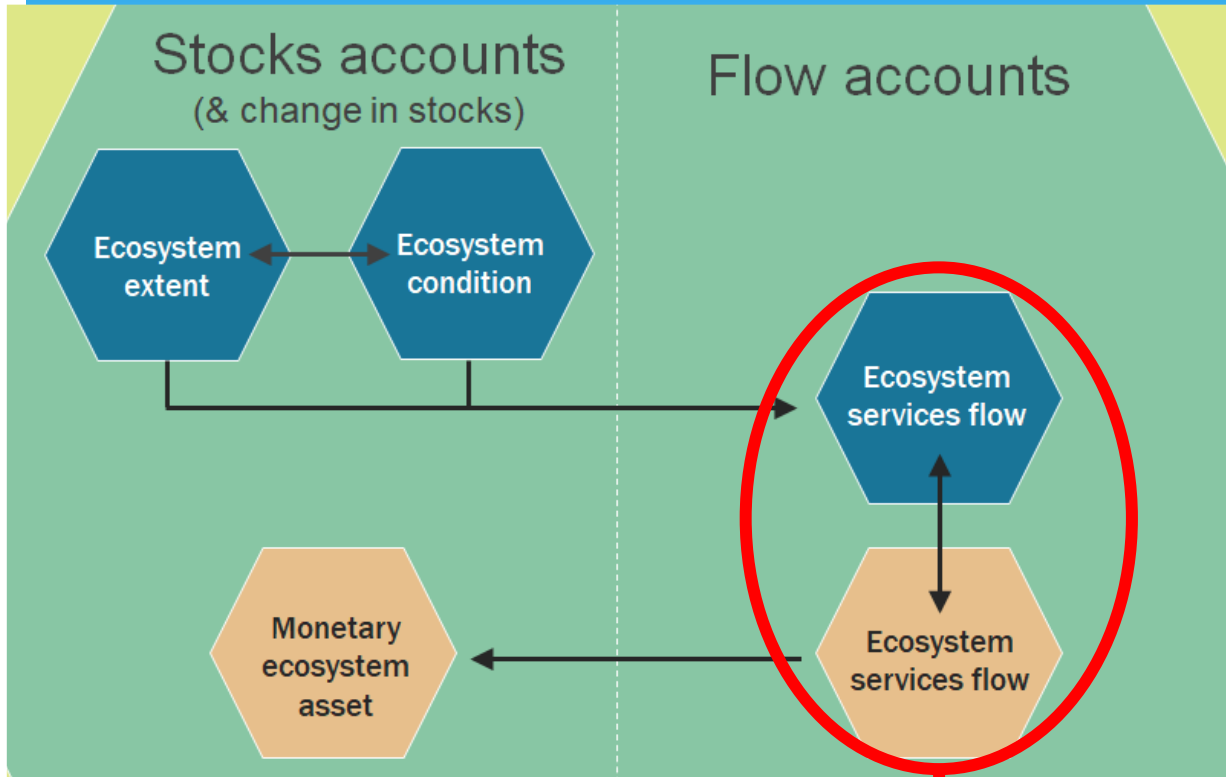
Forest (stage 1 condition account)						
SEEA Ecosystem Condition Typology	Variable descriptor	Measurement	Variable values (observed)			
			Opening	Closing	Change	
Abiotic characteristics	Physical state					
	Chemical state	Soil organic carbon stock	tC/ha	100	95	-5
Biotic characteristics	Compositional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

Ecosystem condition and climate change indicators

- ***Will depend on ecosystem type***
- ***Linking condition to climate change impacts***
- ***For the forest example we just had:***
 - *Stock of organic soil carbon*
 - *Carbon stock*
 - *Changes in tree cover*
 - *Link to services, including climate regulation services*

Services accounts (not as briefly)

What are Ecosystem Services in accounting terms?



the flow of ecosystem services is a “transaction” between Ecosystem Types and Economic Units

Ecosystem Types

Economic Units

Supply table	ET 1	ET 2	...	Use table	Primary	Secondary	...
ES 1				ES 1			
ES 2				ES 2			
ES ...				ES ...			

Red arrows indicate the flow of data from the Supply table to the Use table, specifically from ES 1 to ES 2 and from ES 2 to ES

What do we need to know about Ecosystem Services?

- *meaning of ecosystem services
- *classification of ecosystem services
- *relationship between the “supply” and “actual flow” (use) of ecosystem services

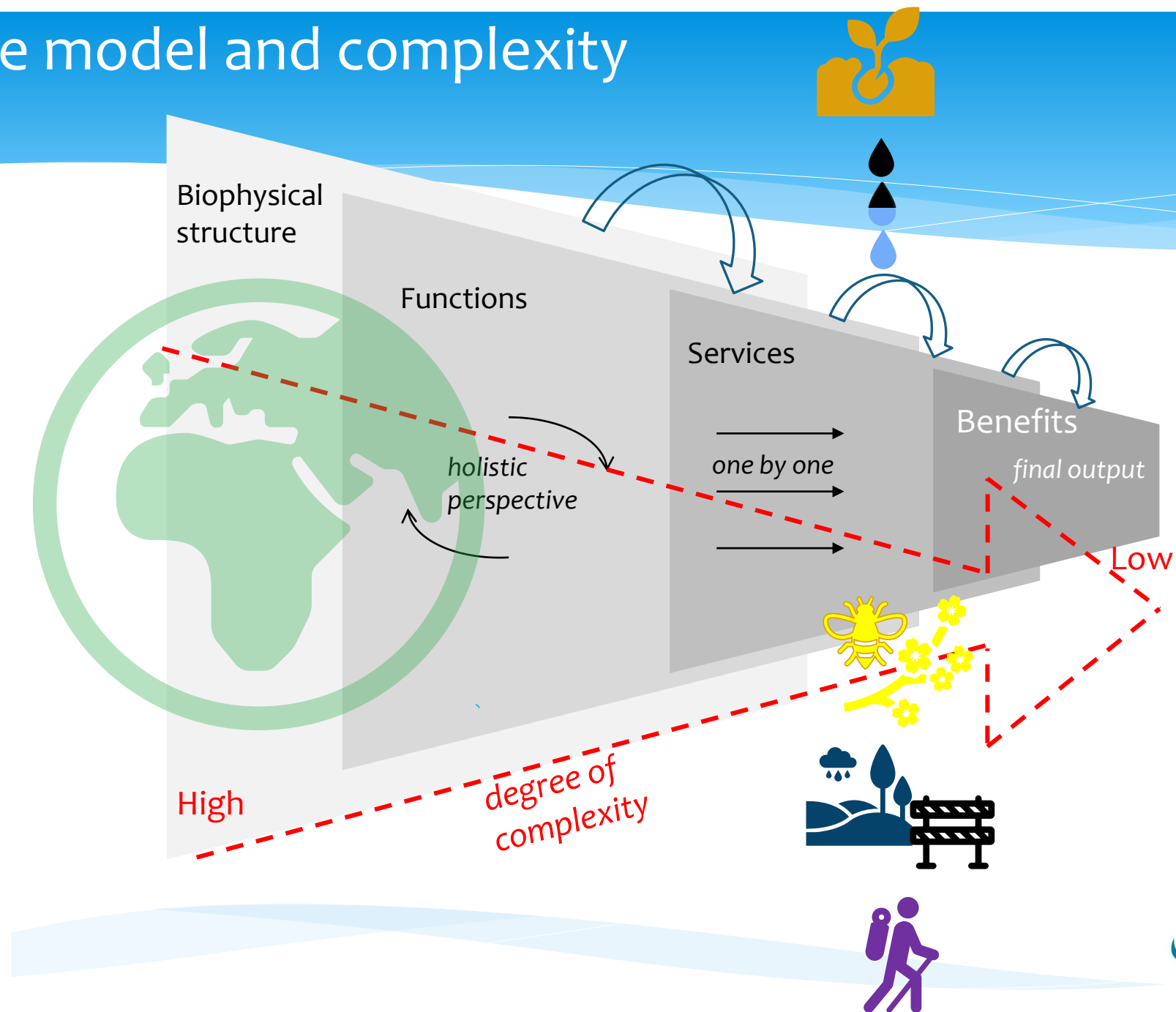
Meaning of ecosystem services



Main service-types		Section	Division	Group
PROVISIONING SERVICES		Provisioning	Nutrition	Biomass
1	Food (e.g. fish, game, fruit)			Water
2	Water (e.g. for drinking, irrigation, cooling)		Materials	Biomass, Fibre
3	Raw materials (e.g. fiber, timber, fuel wood, fodder, ...)			Water
4	Genetic resources (e.g. for crop improvement and medicinal purposes)		Energy	Biomass-based energy sources
5	Medicinal resources (e.g. biochemical products, medicinal plants)	Mechanical energy		
REGULATING SERVICES		Regulation & Maintenance	Mediation of waste, toxics and other nuisances	Mediation by biota
6	Ornamental resources (e.g. artisan work, decorative products)			Mediation by ecosystems
REGULATING SERVICES			Mediation of flows	Mass flows
7	Air quality regulation (e.g. capturing (fine)dust, chemical pollutants)			Liquid flows
8	Climate regulation (incl. C-sequestration, influence on weather patterns)			Gaseous / air flows
9	Moderation of extreme events (e.g. storm protection, flood regulation)		Maintenance of physical, chemical, biological conditions	Lifecycle maintenance, habitat and gene pool protection
10	Regulation of water flows (e.g. natural drainage, irrigation)			Pest and disease control
11	Waste treatment (especially water purification)			Soil formation and composition
12	Erosion prevention			Water conditions
13	Maintenance of soil fertility (incl. soil formation)			Atmospheric composition and climate regulation
HABITAT SERVICES		Cultural	Physical and intellectual interactions with ecosystems and land-/seascapes [environmental settings]	Physical and experiential interactions
16	Maintenance of life cycles of migratory species (incl. pollinators)			Intellectual and representational interactions
17	Maintenance of genetic diversity (especially gene pools)		Spiritual, symbolic and other interactions with ecosystems and land-/seascapes [environmental settings]	Spiritual and/or emblematic
CULTURAL SERVICES				Other cultural outputs
18	Aesthetic information			
19	Opportunities for recreation & tourism			
20	Inspiration for culture, art and design			
21	Spiritual experience			
22	Information for cognitive development			

...from «benefit» to «ecosystem contribution»

Cascade model and complexity



Provisioning services

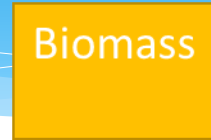
Examples

Selected ecosystem services (reference list)

Provisioning services		
	Biomass provisioning	Crop provisioning
		Grazed biomass provisioning
		Livestock provisioning services
		Aquaculture provisioning services
		Wood provisioning services
		Wild fish and other natural aquatic biomass provisioning services
		Wild animals, plants and other biomass provisioning services
	Genetic material services	
	Water supply	
	Other provisioning services	



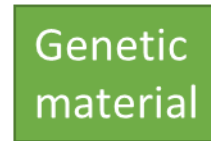
cultivated plants



wild plants and animals



reared animals



from plants



from animals

Regulating and maintenance services

Examples

Regulating and maintenance services

Global climate regulation services
Rainfall pattern regulation services
Local (micro and meso) climate regulation services
Air filtration services
Soil quality regulation services
Soil and sediment retention services
Solid waste remediation services
Water purification services
Water flow regulation services
Flood control services
Storm mitigation services
Noise attenuation services
Pollination services
Biological control services
Nursery population & habitat maintenance services
Other regulating and maintenance services

mediation of wastes

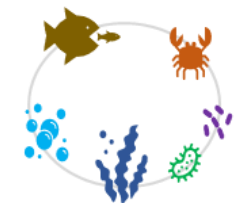


Transformation of biochemical (and physical) inputs to ecosystems

regulation of flows



Regulation of baseline flows and extreme events



Lifecycle maintenance, gene pool protection

Cultural services

Examples

Cultural services	
	Recreation-related services
	Visual amenity services
	Education, scientific and research services
	Spiritual, artistic and symbolic services
	Other cultural services

Direct, in-situ interactions
with living systems



Physical and experiential
interactions

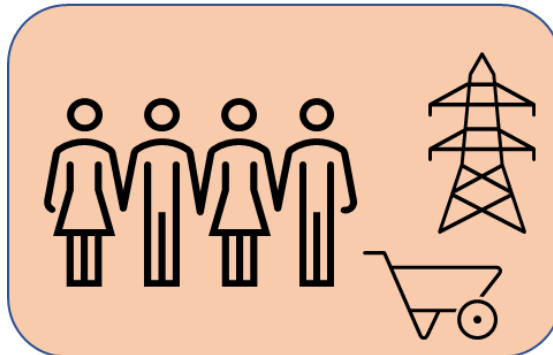


Intellectual and
representative interactions

Ecosystem «supply» and ecosystem «actual flow»

what ecosystems can provide

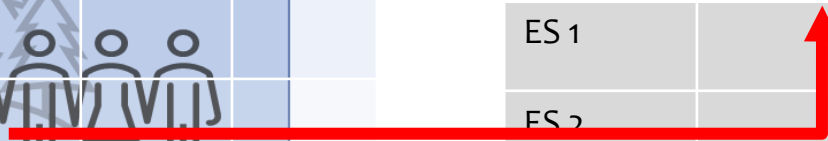
what humans (economy and society) need



Ecosystem Service Actual Flow

Supply table	ET 1	ET 2	...
ES 1			
ES 2			
ES ...			

Use table	Economic units		...
ES 1			
ES 2			
ES ...			



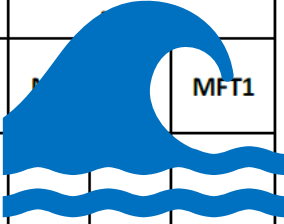
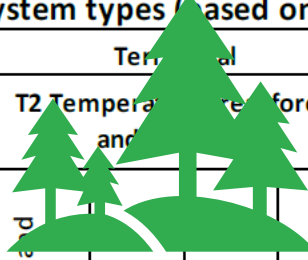
Ecosystem Types and Ecosystem Services

		Ecosystem Type					
		Agricultural land	Forest	Wetland	...	Inland waters	Σ per ecosystem service
Ecosystem services	pollination						
	flood control						
	water purification						
	...						
	recreation						
	Σ per ecosystem asset						

Supply Table

Selected ecosystem types (based on Level 3 - EFG of the IUCN Global Ecosystem Typology)																
Terrestrial										Freshwater		Marine				
T1 Tropical-subtropical forests				T2 Temperate-boreal forests and woodlands				T7		F1	FM1	M1	MFT1			
Tropical-subtropical lowland rainforests	Tropical-subtropical dry forests and scrubs	Tropical-subtropical montane rainforests	Tropical heath forests	Boreal and temperate high montane forests and woodlands	Deciduous temperate forests	...	Temperate pyric sclerophyll forests and woodlands	Derived semi-natural pastures and old fields	Permanent upland streams	...	Intermittently closed and open lakes and lagoons	Seagrass meadows	...	Coastal saltmarshes and reedbeds
T1.1	T1.2	T1.3	T1.4	T2.1	T2.2	...	T2.6	T7.5	F1.1	...	FM1.3	M1.1	...	MFT1.3
Total Supply resident ecosystem assets																
Supply from non-resident ecosystem assets - Imports																
Total Supply ecosystem services																
TOTAL SUPPLY																

Selected ecosystem types (based on Level 3 - EFG of the IUCN Global Ecosystem Typology)																
Terrestrial										Freshwater		Marine				
T1 Tropical-subtropical forests				T2 Temperate-boreal forests and woodlands				T7		F1	FM1	M1	MFT1			
Tropical-subtropical lowland rainforests	Tropical-subtropical dry forests and scrubs	Tropical-subtropical montane rainforests	Tropical heath forests	Boreal and temperate high montane forests and woodlands	Deciduous temperate forests	...	Temperate pyric sclerophyll forests and woodlands	Derived semi-natural pastures and old fields	Permanent upland streams	...	Intermittently closed and open lakes and lagoons	Seagrass meadows	...	Coastal saltmarshes and reedbeds
T1.1	T1.2	T1.3	T1.4	T2.1	T2.2	...	T2.6	T7.5	F1.1	...	FM1.3	M1.1	...	MFT1.3
Total Supply resident ecosystem assets																
Supply from non-resident ecosystem assets - Imports																
Total Supply ecosystem services																
TOTAL SUPPLY																



Use Table

USE	UNITS OF MEASURE	Selected economic units											Selected ecosystem types (based on Level 3 - EFG of the IUCN Global Ecosystem Typology)										Total use resident ecosystem assets	Exports - intermediate services	Total Use by ecosystem assets	TOTAL USE							
		Selected industries											Terrestrial					Freshwater			Marine												
		Agriculture	Forestry	Fisheries	Mining and quarrying	Manufacturing	Electricity, gas, steam and air conditioning supply	Water supply; sewerage, waste management and remediation activities	Services	Other industries	Total Industry	Government consumption	Household consumption	Total use by resident economic units	Exports - final ecosystem services	Total Use by economic units	T1	T2	T3	T4	T5	T6					T7	F1	F2	F3	M1	M2	M3
																	T1.1	T1.2	T1.3	T1.4	T2.1	T2.2					T2.3	T2.4	T2.5	T2.6	T7.1	T7.2	T7.3
Selected ecosystem services (reference list)		Selected economic units											Selected ecosystem types																				
Provisioning services		Selected industries											Selected ecosystem types																				
Biomass provisioning		Agriculture											T1.1																				
Crop provisioning		Forestry											T1.2																				
Grazed biomass provisioning		Fisheries											T1.3																				
Livestock provisioning services		Mining and quarrying											T1.4																				
Aquaculture provisioning services		Manufacturing											T2.1																				
Wood provisioning services		Electricity, gas, steam and air conditioning supply											T2.2																				
Wild fish and other natural aquatic biomass provisioning services		Water supply; sewerage, waste management and remediation activities											T2.3																				
Wild animals, plants and other biomass provisioning services		Services											T2.4																				
Genetic material services		Other industries											T2.5																				
Water supply		Total Industry											T2.6																				
Other provisioning services		Government consumption											T7																				
Regulating and maintenance services		Household consumption											F1																				
Global climate regulation services		Exports - final ecosystem services											F1.1																				
Rainfall pattern regulation services		Total Use by economic units											F1.2																				
Local (micro and meso) climate regulation services		Total Use by resident economic units											F1.3																				
Air filtration services		Exports - intermediate services											FM1																				
Soil quality regulation services		Total Use by ecosystem assets											FM1.1																				
Soil and sediment retention services		Total Use by ecosystem assets											FM1.2																				
Solid waste remediation services		Total Use by ecosystem assets											FM1.3																				
Water purification services		Total Use by ecosystem assets											M1																				
Water flow regulation services		Total Use by ecosystem assets											M1.1																				
Flood control services		Total Use by ecosystem assets											M1.2																				
Storm mitigation services		Total Use by ecosystem assets											M1.3																				
Noise attenuation services		Total Use by ecosystem assets											MFT1																				
Pollination services		Total Use by ecosystem assets											MFT1.1																				
Biological control services		Total Use by ecosystem assets											MFT1.2																				
Nursery population & habitat maintenance services		Total Use by ecosystem assets											MFT1.3																				
Other regulating and maintenance services		Total Use by ecosystem assets											MFT1.3																				
Cultural services		Total Use by ecosystem assets											MFT1.3																				
Recreation-related services		Total Use by ecosystem assets											MFT1.3																				
Visual amenity services		Total Use by ecosystem assets											MFT1.3																				
Education, scientific and research services		Total Use by ecosystem assets											MFT1.3																				
Spiritual, artistic and symbolic services		Total Use by ecosystem assets											MFT1.3																				
Other cultural services		Total Use by ecosystem assets											MFT1.3																				

Ecosystem services and climate change indicators

- *Any indicators you think would be of high relevance?*
- *What about monetary valuation?*
- *And what about linking to Energy and Air Emission accounts?*

Some indicators that can be derived from the extent account

Forests fulfil a number of functions that are vital for humanity.

- Target 15.1: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests.
- **SDG Indicator 15.1.1: Forest area as a proportion of total land area**
- Forest is defined as land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use.

15 LIFE
ON LAND



Wetlands and other water related ecosystems are critical for the supply ecosystem services.

- Target 6.6: By 2020 protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes
- **SDG indicator 6.6.1: Change in the extent of water-related ecosystems over time**
 - Wetlands
 - Open waters
 - Artificial water bodies
 - Vegetated wetlands

6 CLEAN WATER AND SANITATION



The productive potential of land must be increased to deliver the goods and services required by a growing population.

- Target 15.3: By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world
- **SDG Indicator 15.3.1: Proportion of land that is degraded over total land area**
 - Land cover
 - Land productivity
 - Carbon stock

15 LIFE
ON LAND



Description of SDG 15.3.1.

- SDG 15.3.1 is grounded in three sub-indicators:
 1. Evaluation of land cover and land cover changes
 2. Analysis of land productivity status and trends based on net primary productivity.
 3. Determination of carbon stock values and changes
- An area of land is degraded if it is assessed as being degraded on any one of these three sub-indicators
- Baseline is from 2000 to 2015. LDN means no further net degradation between 2015 and 2030. Trends reported every 4 years to UNCCD (See SDG 15.3.1 Good Practice Guidance*).
- The SEEA can support calculating this indicator
 - > Informing on land cover flows (Ecosystem Extent or Land Cover Accounts)
 - > Providing spatial data infrastructure for integrating information on land productivity and carbon stock (Ecosystem Condition Accounts)