System of Environmental Economic Accounting

Session 4: Ecosystem extent

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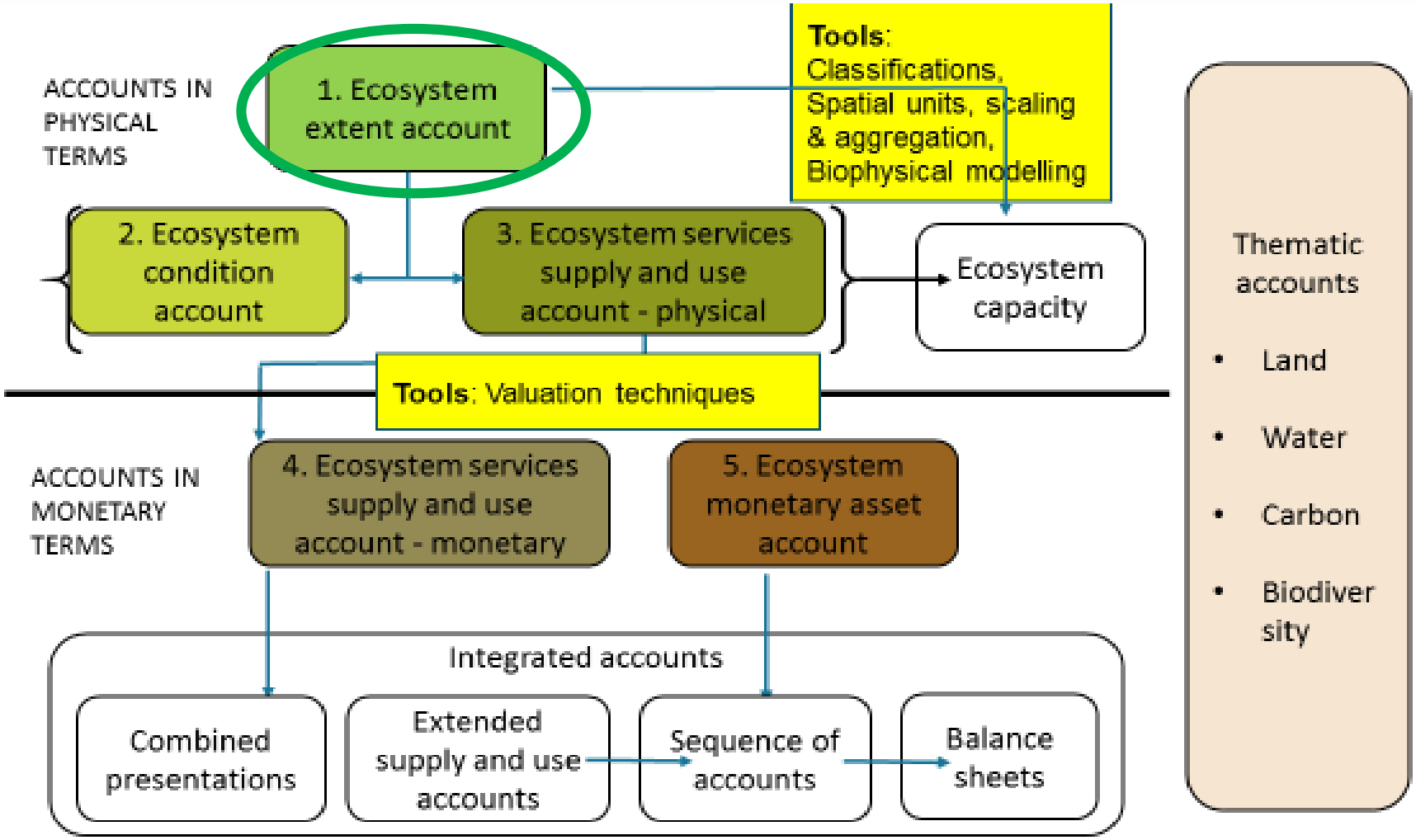
United Nations

Overview: Ecosystem Extent

- Ecosystem extent overview
  - > Basic definitions
  - > Spatial units
  - > Classifications
  - > Extent account structure
- Examples of ecosystem accounts
- Group exercise

SEEA EEA accounts, tools and linkages



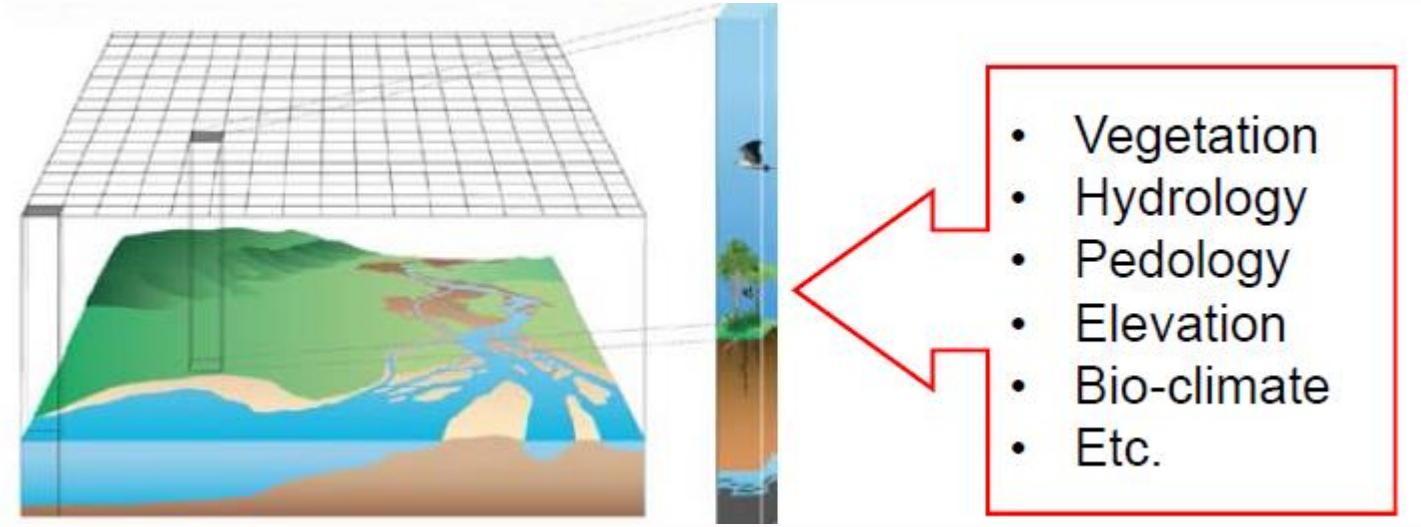
Extent account overview

- **What?**
  - ***Ecosystem assets*** *are spatial areas containing a combination of biotic and abiotic components and other characteristics that function together* (SEEA EEA Sections 2.31, 4.1)
  - **National** coverage of terrestrial, freshwater, coastal and marine areas
  - Mutually exclusive and exhaustive coverage

- **Why?**
  - Land management, conservation policies
  - Spatial foundation for other accounts
    → basis for allocating macro data to spatial units
  - Builds on SEEA CF (land, forest, water)

Extent account - characteristics

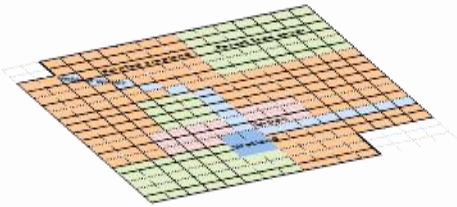
- **What does an Extent Account look like?**
  - Based on ecosystem assets and ecosystem types
  - Based on ecological principles and ecosystem classification
  - Spatial Units need to be clearly defined
  - Units: hectares
  - For two or more periods (change over time): records opening stocks, closing stocks, additions, reductions



Extent account - structure

What does an Extent Account look like?

Maps



Ecosystem type

Spatial units
Classifications

	Proxy ecosystem type (based on land cover)															
	Artificial surfaces	Herbaceous crops	Woody crops	Multiple or layered crops	Grassland	Tree-covered areas	Mangroves	Shrub-covered areas	Regularly flooded areas	Sparse natural vegetated areas	Terrestrial barren land	Permanent snow and glaciers	Inland water bodies	Coastal water and inter-tidal areas	Sea and marine areas	TOTAL
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Opening extent																
Additions to extent																
Managed expansion																
Natural expansion																
Upward reappraisals																
Reductions in extent																
Managed regression																
Natural regression																
Downward reappraisals																
Net change in extent																
Closing extent																

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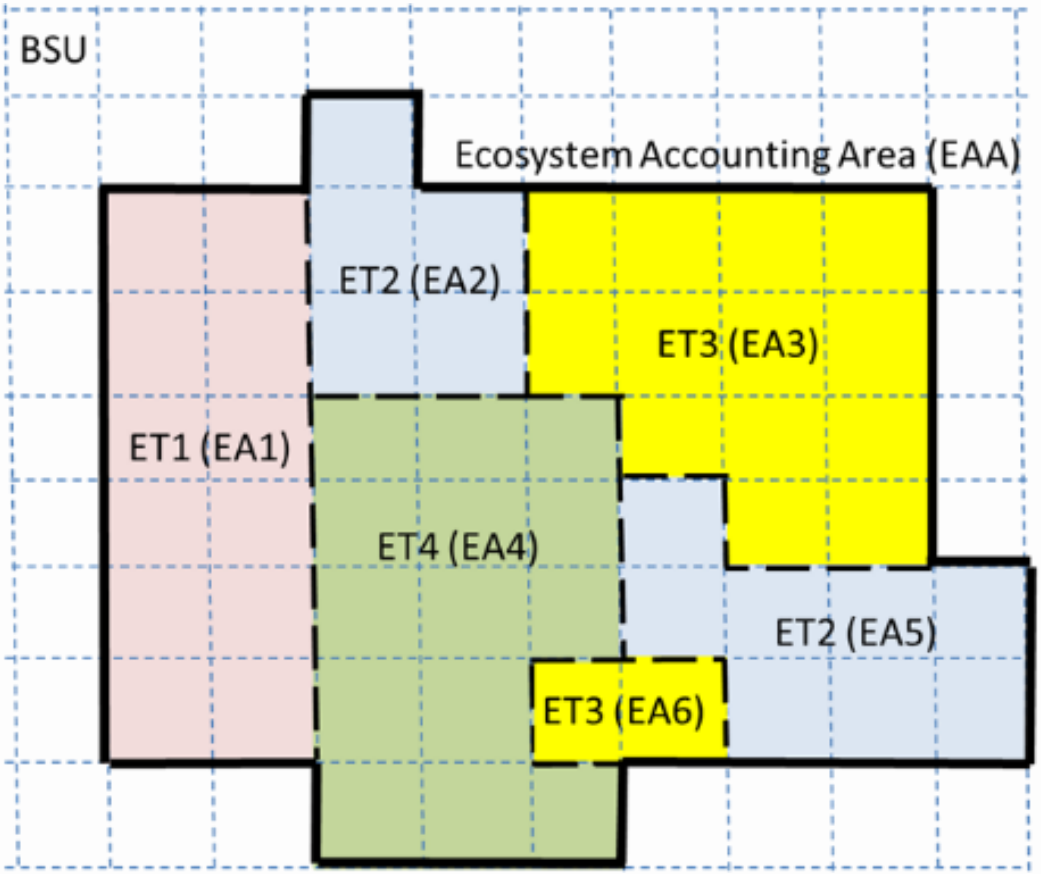
Spatial units

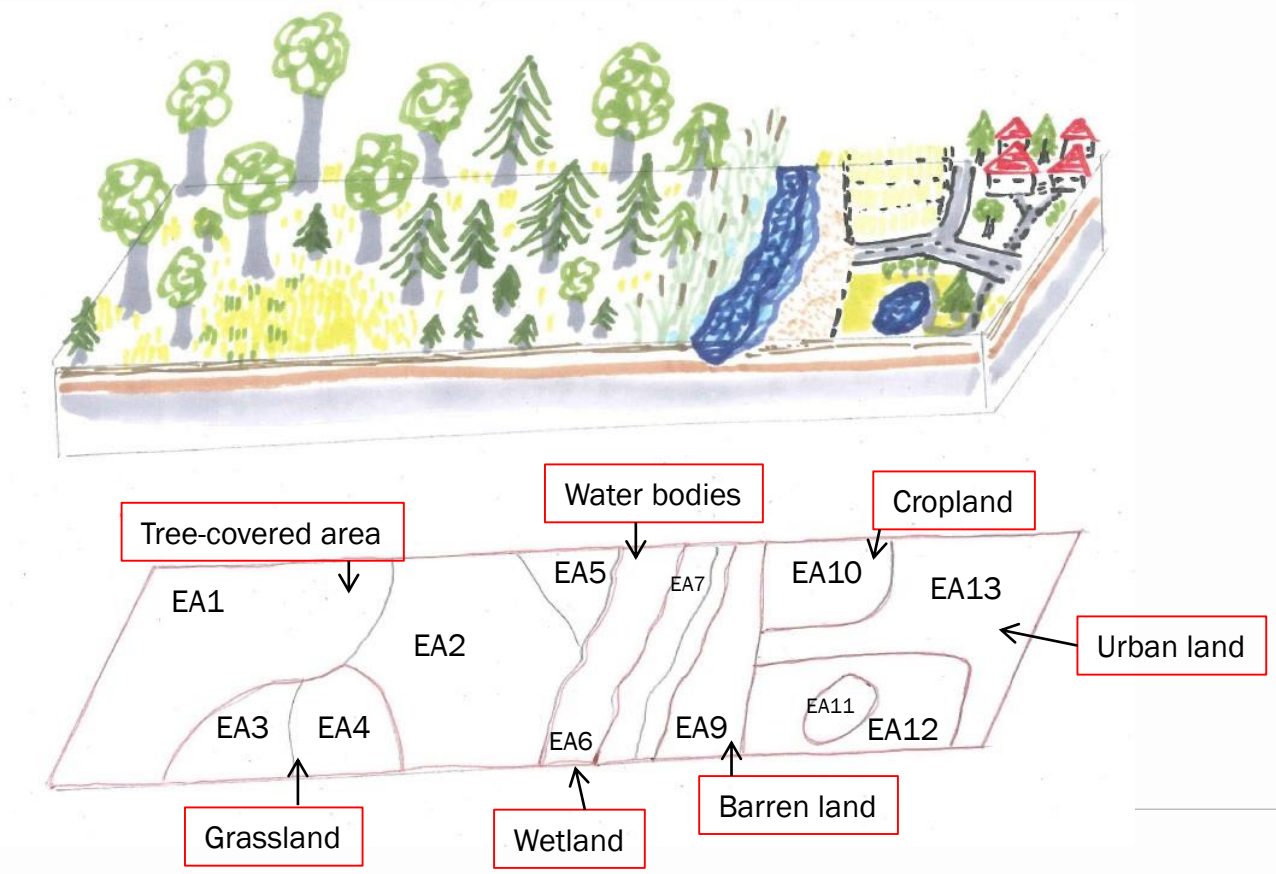
4 types of units:

- Basic spatial units (BSU)
- Ecosystem asset (EA)
- Ecosystem type (ET)
- Ecosystem Accounting Area (EAA)



Spatial units

Ecosystem types can be derived from ecological classifications



Delineation of spatial units

- Ecosystem type (ET): a specific class of ecosystem assets of comparable ecology and ecosystem use
- In practice: start with a classification of ecosystem types in order to delineate ecosystem assets
  - > Initial focus on ecological principles
  - > But also relevant to consider services supplied -> high degree of commonality in ES supply within an ET
  - > Intermediate solution: produce detailed land cover and use maps that distinguish vegetation types at the level of community (e.g. with dominant species) – using satellite imagery

Land cover & use classifications

- Land cover, land use and land ownership

Land cover classification (SEEA-CF, Table 5.12, p.178)

1 Artificial surfaces (incl. urban and assoc. areas)
2 Herbaceous crops
3 Woody crops
4 Multiple or layered crops
5 Grassland
6 Tree-covered areas
7 Mangroves
8 Shrub-covered areas
9 Shrubs and/or herb. veg., aquatic or reg. flooded
10 Sparsely natural vegetated areas
11 Terrestrial barren land
12 Permanent snow and glaciers
13 Inland water bodies
14 Coastal water bodies and intertidal areas

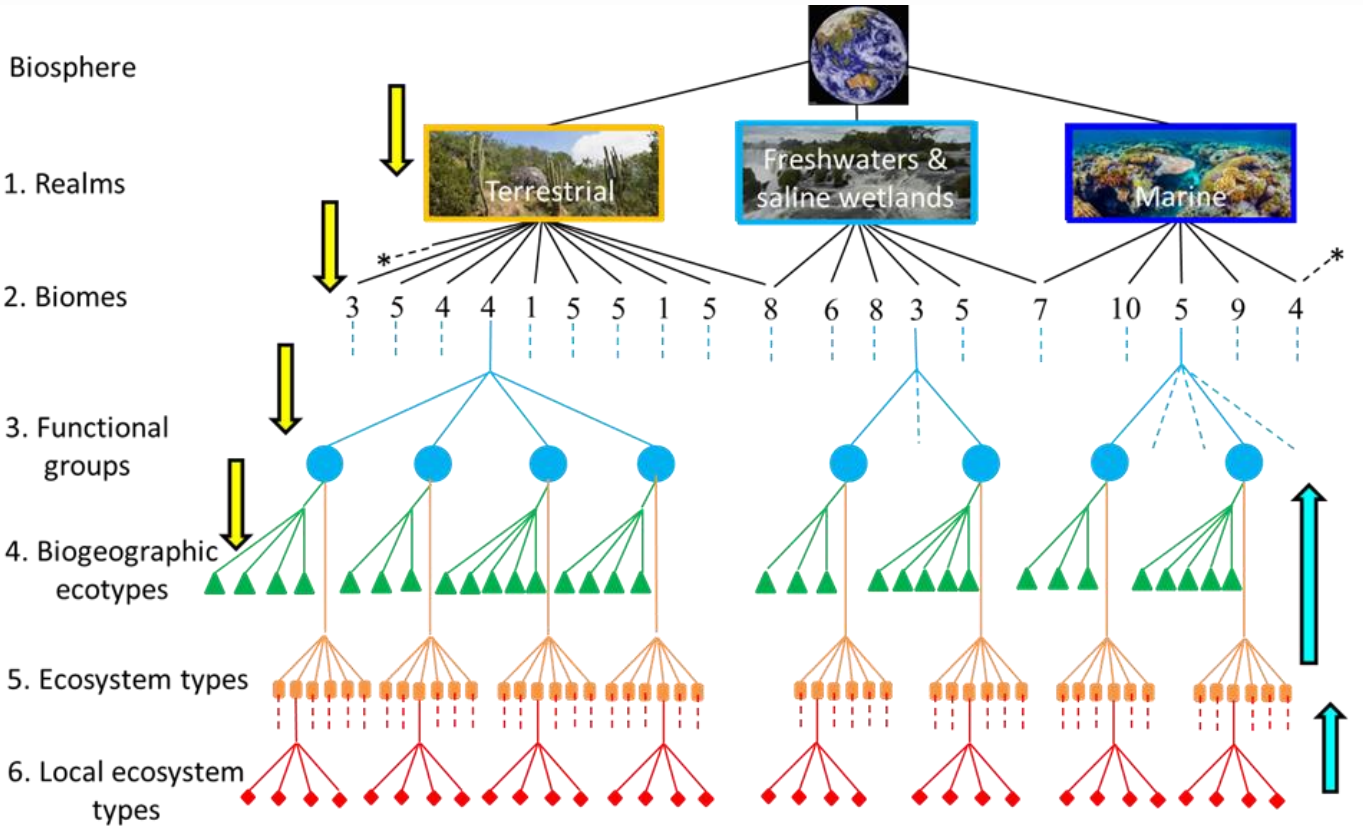
Land use classification (SEEA-CF, Table 5.11, p. 176)

1.1 Agriculture
1.2 Forestry
1.3 Land used for aquaculture
1.4 Use of built-up and related areas
1.5 Land used for maintenance and restoration of environmental functions
1.6 Other uses of land n.e.c.
1.7 Land not in use
2.1 Inland waters used for aquaculture or holding facilities
2.2 Inland waters used for maintenance and restoration of environmental functions
2.3 Other uses of inland waters n.e.c.
2.4 Inland waters not in use

Land ownership: by industry (e.g. agriculture, mining) or by sector (e.g. public or private)

IUCN Global Ecosystem Typology

- units represent ecosystems (derived from and characterized by ecological properties);
- comprehensive across environmental domains (terrestrial, freshwater, and marine);
- spatially delineable;
- mutually exclusive;
- exhaustive.



SEEA

Realms & biomes

Realms	RLE Biomes
Terrestrial	T1 Tropical–sub-tropical forests
	T2 Temperate–boreal forests & woodlands
	T3 Shrublands & shrub-dominated woodlands
	T4 Savannas and grasslands
	T5 Deserts and semi-deserts
	T6 Polar/alpine (cryogenic)
	T7 Intensive anthropogenic terrestrial systems
Freshwater	F1 Rivers and streams
	F2 Lakes
	F3 Artificial Wetlands
Marine	M1 Subtidal shelfs and shelf-breaks
	M2 Pelagic ocean waters
	M3 Deep sea floors
	M4 Artificial marine systems
Transitional	FT1 Palustrine wetlands
	FM1 Transitional waters
	MT1 Shoreline systems
	MT2 Coastal vegetation
	MT3 Artificial shorelines
	MFT1 Brackish tidal systems

Level 3: ecosystem functional groups

Defined by shared ecological traits & key ecological processes & functions

100 groups across 4 realms & their transitions,

86 natural/seminatural, 14 anthropogenic across all biomes & realms

Terrestrial

T1 Tropical-subtropical forests	T1.1Tropical/Subtropical lowland rainforests
T1 Tropical-subtropical forests	T1.2 Tropical/Subtropical dry forests and scrubs
T1 Tropical-subtropical forests	T1.3 Tropical/Subtropical montane rainforests
T1 Tropical-subtropical forests	T1.4 Tropical heath forests
T2 Temperate-boreal forests & woodlands	T2.1 Boreal and montane needle-leaved forest and woodland
T2 Temperate-boreal forests & woodlands	T2.2 Temperate deciduous forests and shrublands
T2 Temperate-boreal forests & woodlands	T2.3 Cool temperate rainforests
T2 Temperate-boreal forests & woodlands	T2.4 Warm temperate rainforests
T2 Temperate-boreal forests & woodlands	T2.5 Temperate pyric humid forests
T2 Temperate-boreal forests & woodlands	T2.6 Temperate pyric sclerophyll forests and woodlands
T3 Shrublands & shrub-dominated woodlands	T3.1 Seasonally dry tropical shrublands
T3 Shrublands & shrub-dominated woodlands	T3.2 Seasonally dry temperate heaths and shrublands
T3 Shrublands & shrub-dominated woodlands	T3.3 Cool temperate heathlands
T3 Shrublands & shrub-dominated woodlands	T3.4 Rocky pavements, screes and lava flows
T4 Savannas and grasslands	T4.1 Trophic savannas
T4 Savannas and grasslands	T4.2 Pyric tussock savannas
T4 Savannas and grasslands	T4.3 Hummock savannas
T4 Savannas and grasslands	T4.4 Temperate wooded savannas
T4 Savannas and grasslands	T4.5 Temperate grasslands
T5 Deserts and semi-deserts	T5.1 Semi-desert steppes
T5 Deserts and semi-deserts	T5.2 Thorny deserts and semi-deserts
T5 Deserts and semi-deserts	T5.3 Sclerophyll deserts and semi-deserts
T5 Deserts and semi-deserts	T5.4 Cool temperate deserts
T5 Deserts and semi-deserts	T5.5 Hyper-arid deserts
T6 Polar/alpine	T6.1 Ice sheets, glaciers and perennial snowfields
T6 Polar/alpine	T6.2 Polar/alpine rocky outcrops
T6 Polar/alpine	T6.3 Polar tundra
T6 Polar/alpine	T6.4 Temperate alpine meadows and shrublands
T6 Polar/alpine	T6.5 Tropical alpine meadows and shrublands
T7 Intensive anthropogenic terrestrial systems	T7.1 Croplands
T7 Intensive anthropogenic terrestrial systems	T7.2 Sown pastures and old fields
T7 Intensive anthropogenic terrestrial systems	T7.3 Plantations
T7 Intensive anthropogenic terrestrial systems	T7.4 Urban and infrastructure lands

Freshwater & transitional

F1 Rivers and streams	F 1.1 Permanent upland streams
F1 Rivers and streams	F 1.2 Permanent lowland rivers
F1 Rivers and streams	F1.3 Freeze-thaw rivers and streams
F1 Rivers and streams	F 1.4 Monsoonal upland stream
F1 Rivers and streams	F 1.5 Monsoonal lowland rivers
F1 Rivers and streams	F 1.6 Arid episodic lowland rivers
F2 Lakes	F2.1 Large permanent freshwater lakes
F2 Lakes	F2.2 Small permanent freshwater lakes
F2 Lakes	F2.3 Seasonal freshwater lakes
F2 Lakes	F2.4 Freeze-thaw freshwater lakes
F2 Lakes	F2.5 Ephemeral freshwater lakes
F2 Lakes	F2.6 Permanent inland salt lakes
F2 Lakes	F2.7 Ephemeral salt lakes
F2 Lakes	F2.8 Artesian springs and oases
F2 Lakes	F2.9 Geothermal wetlands
F3 Artificial wetlands	F3.1 Large reservoirs
F3 Artificial wetlands	F3.2 Constructed lacustrine wetlands
F3 Artificial wetlands	F3.3 Rice paddies
F3 Artificial wetlands	F3.4 Freshwater Aquafarms
F3 Artificial wetlands	F3.5 Canals and storm water drains
FM1 Transitional waters	FM1.1 Deepwater coastal inlets
FM1 Transitional waters	FM 1.2 Permanently open riverine estuaries and bays
FM1 Transitional waters	FM 1.3 Intermittently closed coastal lagoons
FT 1 Palustrine wetlands	FT 1.1 Tropical flooded forests and peat forests
FT 1 Palustrine wetlands	FT 1.2 Seasonal floodplain marshes
FT 1 Palustrine wetlands	FT 1.3 Subtropical/temperate forested wetlands
FT 1 Palustrine wetlands	FT 1.4 Episodic arid floodplains
FT 1 Palustrine wetlands	FT1.5 Boreal, temperate and montane peat bogs
FT 1 Palustrine wetlands	FT1.6 Boreal and temperate fens
MFT1 Brackish tidal systems	MFT 1.1 Coastal river deltas
MFT1 Brackish tidal systems	MFT1.2 Intertidal forests and shrublands
MFT1 Brackish tidal systems	MFT 1.3 Coastal saltmarshes

Subterranean

S1 Lithic subterranean systems	S1.1 Aerobic caves
S1 Lithic subterranean systems	S1.2 Endolithic systems
S2 Subterranean freshwaters	S2.1 Underground streams and pools
S2 Subterranean freshwaters	S2.2 Groundwater aquifers
S3 Tidal subterranean systems	S3.1 Anchialine caves
S4 Anthropogenic subterranean systems	S4.1 Subterranean excavations
S4 Anthropogenic subterranean systems	S4.2 Water pipes and subterranean canals

Marine & transitional

M1 Marine shelves	M1.1 Seagrass meadows
M1 Marine shelves	M1.2 Kelp forests
M1 Marine shelves	M1.3 Photic coral reefs
M1 Marine shelves	M1.4 Shellfish beds and reefs
M1 Marine shelves	M1.5 Marine animal forests
M1 Marine shelves	M1.6 Subtidal rocky reefs
M1 Marine shelves	M1.7 Subtidal sandy bottoms
M1 Marine shelves	M1.8 Subtidal muddy bottoms
M1 Marine shelves	M1.9 Upwelling zones
M2 Pelagic ocean waters	M2.1 Epipelagic ocean waters
M2 Pelagic ocean waters	M2.2 Mesopelagic ocean waters
M2 Pelagic ocean waters	M2.3 Bathypelagic ocean waters
M2 Pelagic ocean waters	M2.4 Abyssopelagic ocean waters
M3 Deep sea floors	M3.1 Continental and island slopes
M3 Deep sea floors	M3.2 Marine canyons
M3 Deep sea floors	M3.3 Abyssal plains - soft substrate
M3 Deep sea floors	M3.4 Seamounts, ridges and plateaus
M3 Deep sea floors	M3.5 Deepwater biogenic beds
M3 Deep sea floors	M3.6 Hadal trenches and troughs
M3 Deep sea floors	M3.7 Chemosynthetically-based ecosystems
M4 Artificial marine systems	M4.1 Submerged artificial structures
M4 Artificial marine systems	M4.2 Marine aquafarms
MT1 Shoreline systems	TM 1.1 Rocky Shores
MT1 Shoreline systems	TM 1.2 Muddy Shores
MT1 Shoreline systems	TM 1.3 Sandy Shores
MT1 Shoreline systems	TM 1.4 Boulder/cobble shores
MT2 Coastal vegetation	TM 2.1 Coastal shrublands and grasslands
MT3 Artificial shorelines	TM 3.1 Artificial shores

Ecosystem Extent Account

Compiling Extent Accounts (hectares)

	Proxy ecosystem type (based on land cover)															
	Artificial surfaces	Herbaceous crops	Woody crops	Multiple or layered crops	Grassland	Tree-covered areas	Mangroves	Shrub-covered areas	Regularly flooded areas	Sparse natural vegetated areas	Terrestrial barren land	Permanent snow and glaciers	Inland water bodies	Coastal water and inter-tidal areas	Sea and marine areas	TOTAL
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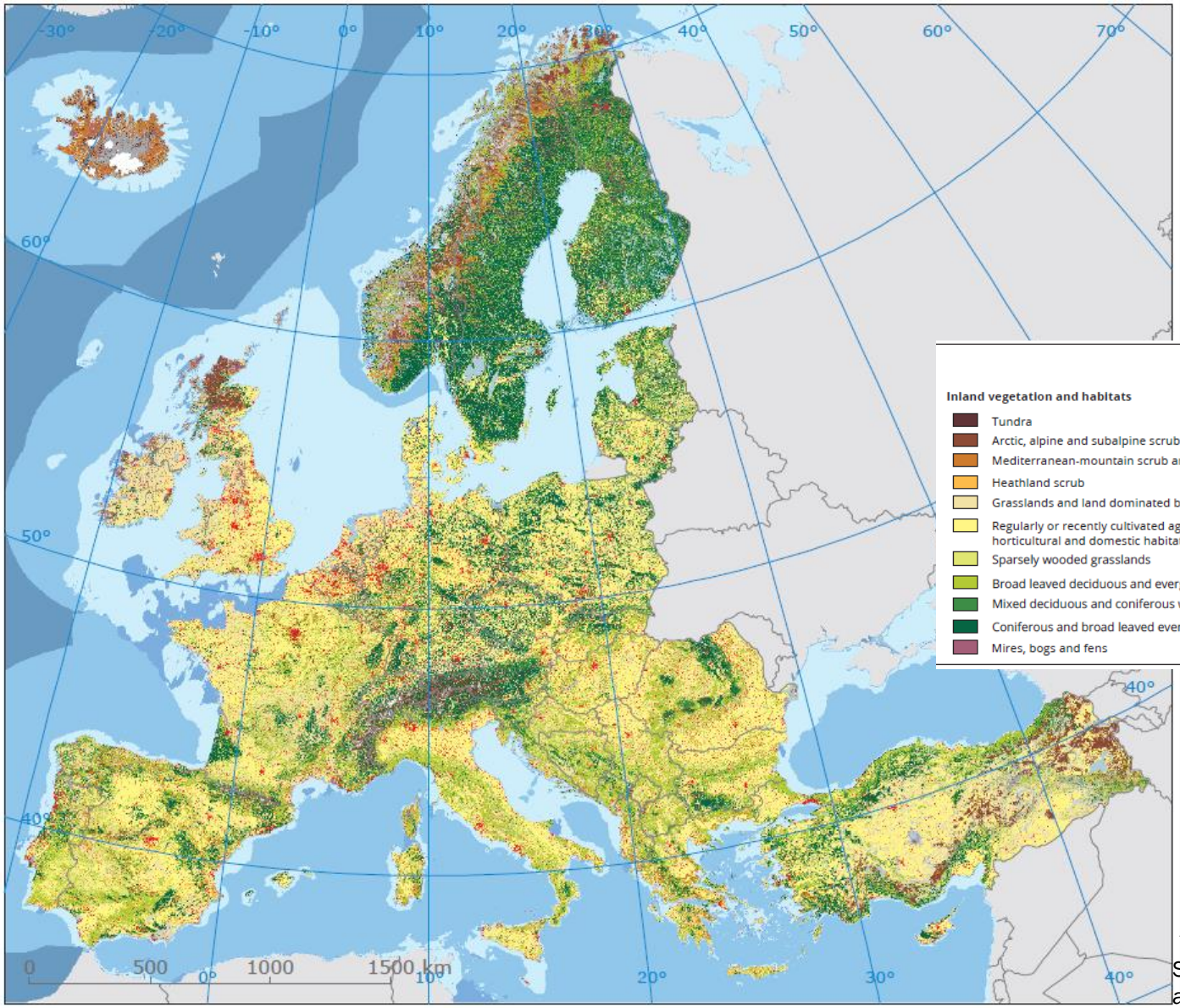
Extent account examples

Ecosystem map of Europe



Ecosystem map (aggregated)

Marine waters
- European regional seas
- Open waters

Marine seabed and coastal habitats
- Sublittoral sediment
- Infralittoral and circalittoral rock and other hard substrata
- Marine habitats
- Coastal habitats

Inland surface waters
- Inland waters and shores

Inland vegetation and habitats
- Tundra
- Arctic, alpine and subalpine scrub and grassland
- Mediterranean-mountain scrub and brushes
- Heathland scrub
- Grasslands and land dominated by forbs
- Regularly or recently cultivated agricultural, horticultural and domestic habitats
- Sparsely wooded grasslands
- Broad leaved deciduous and evergreen woodland
- Mixed deciduous and coniferous woodland
- Coniferous and broad leaved evergreen woodland
- Mires, bogs and fens

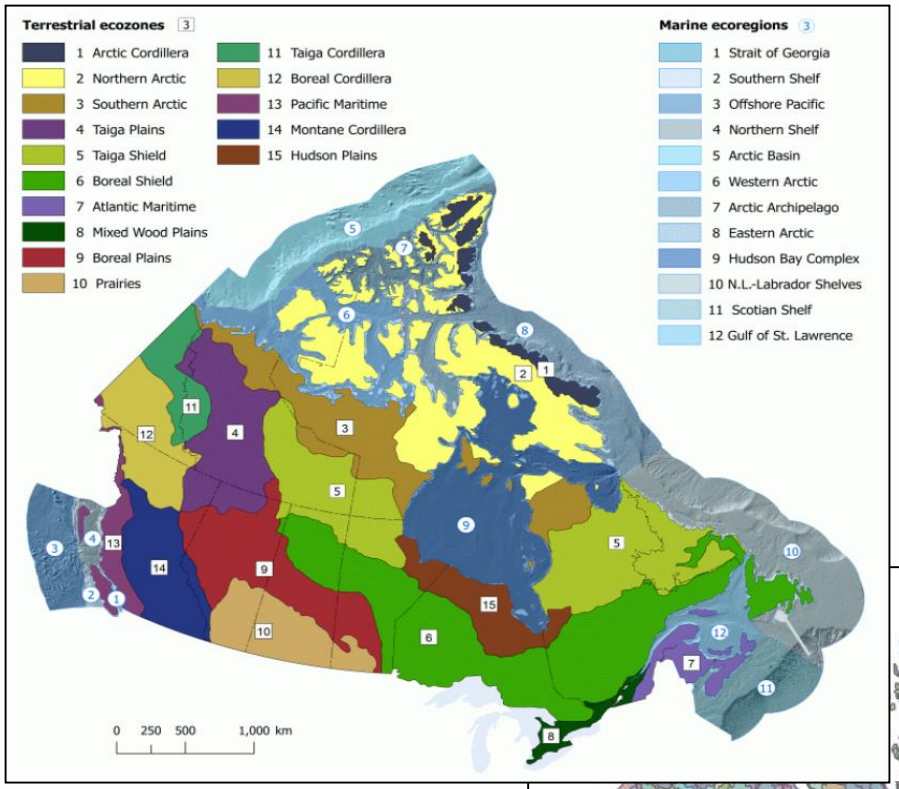
Inland unvegetated or sparsely vegetated habitats
- Screes, inland cliffs
- Snow or ice-dominated habitats
- Miscellaneous inland habitats with very sparse or no vegeation

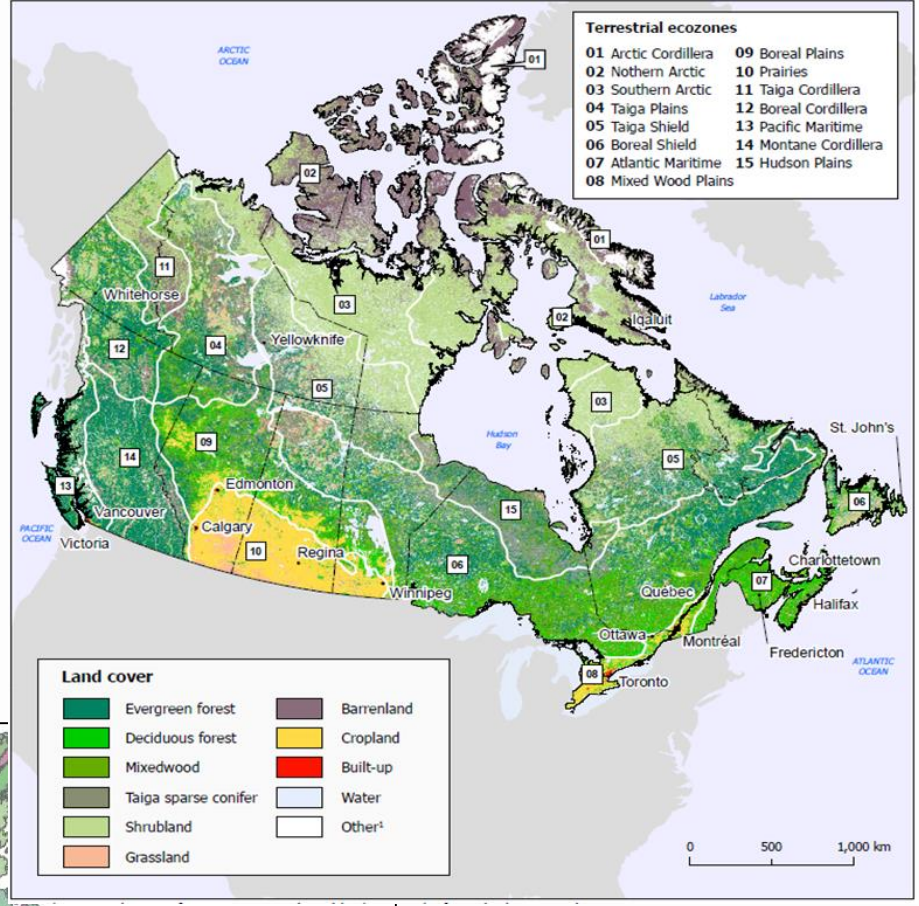
Human made constructions and habitats
- Constructed, industrial and other artificial habitats

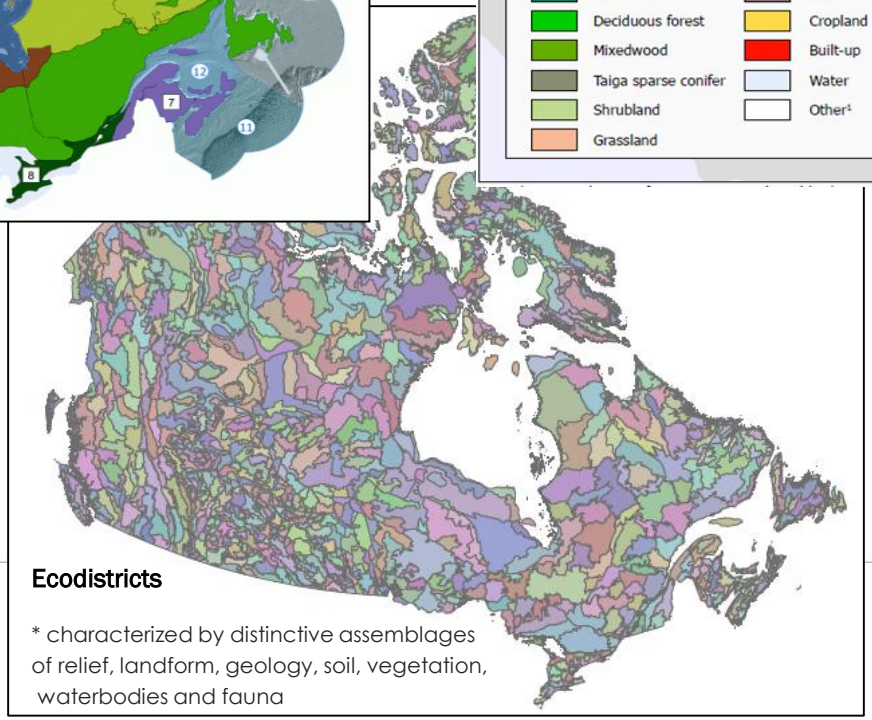
Non classified areas
- Unclassified areas
- Outside area of interest

Source: EEA, 2015a, *European ecosystem assessment: Concept, data, and implementation,* EEA Technical Report No 6/2015, European Environment Agency

Example: Canada







Ecodistricts

* characterized by distinctive assemblages of relief, landform, geology, soil, vegetation, waterbodies and fauna

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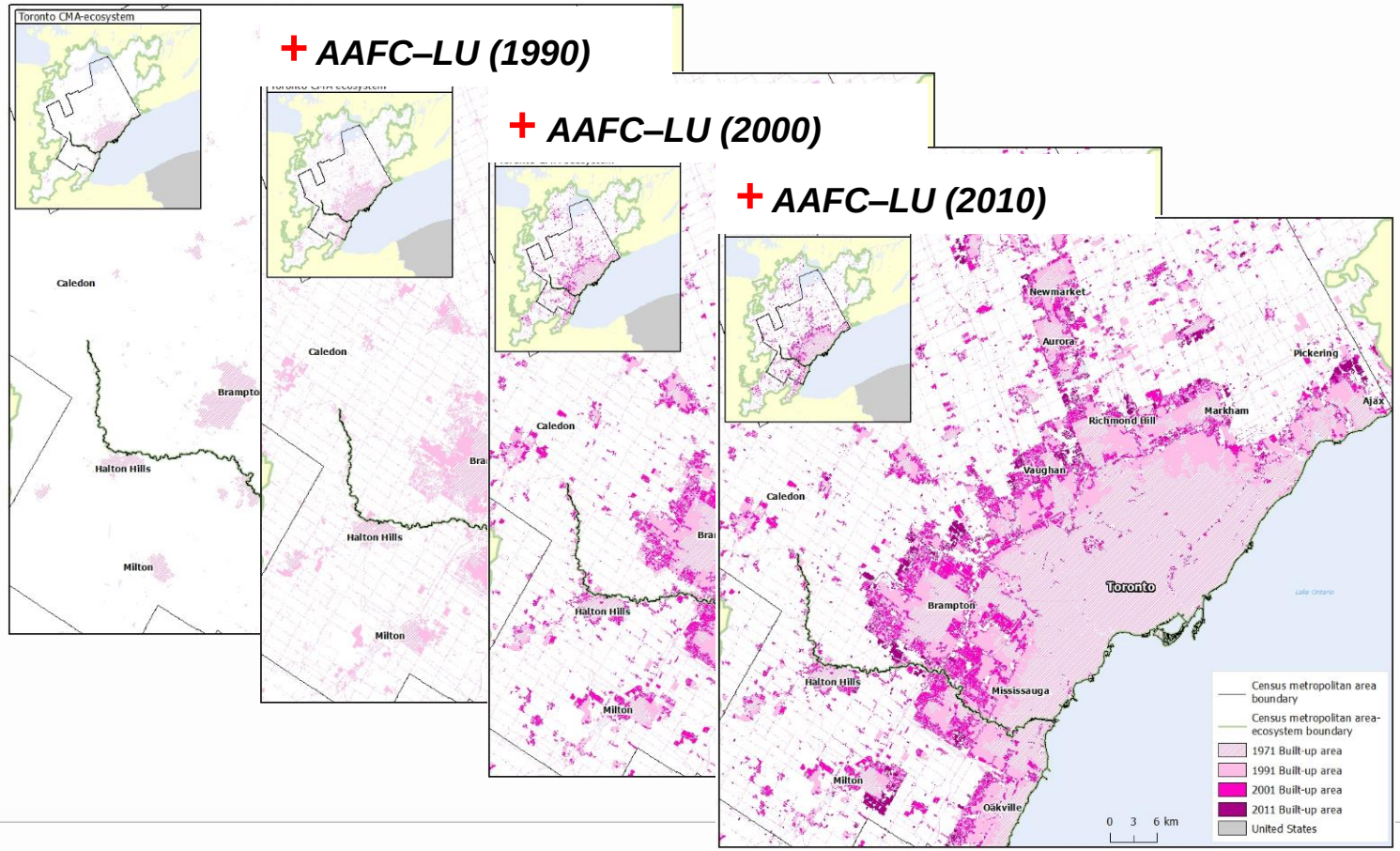
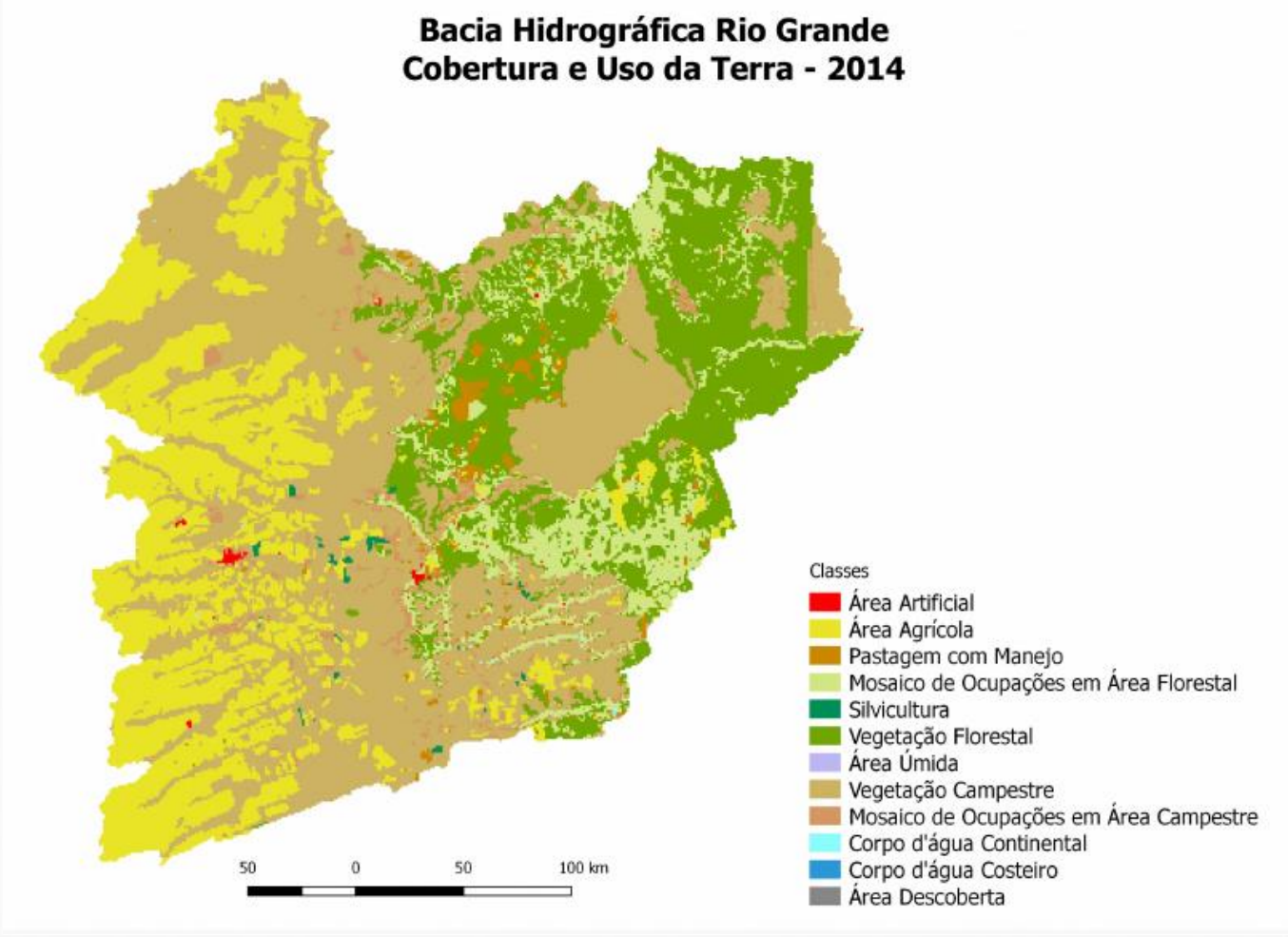
Example: Canada

Built up and artificial surfaces

CLI–LU and CLUMP (1971)

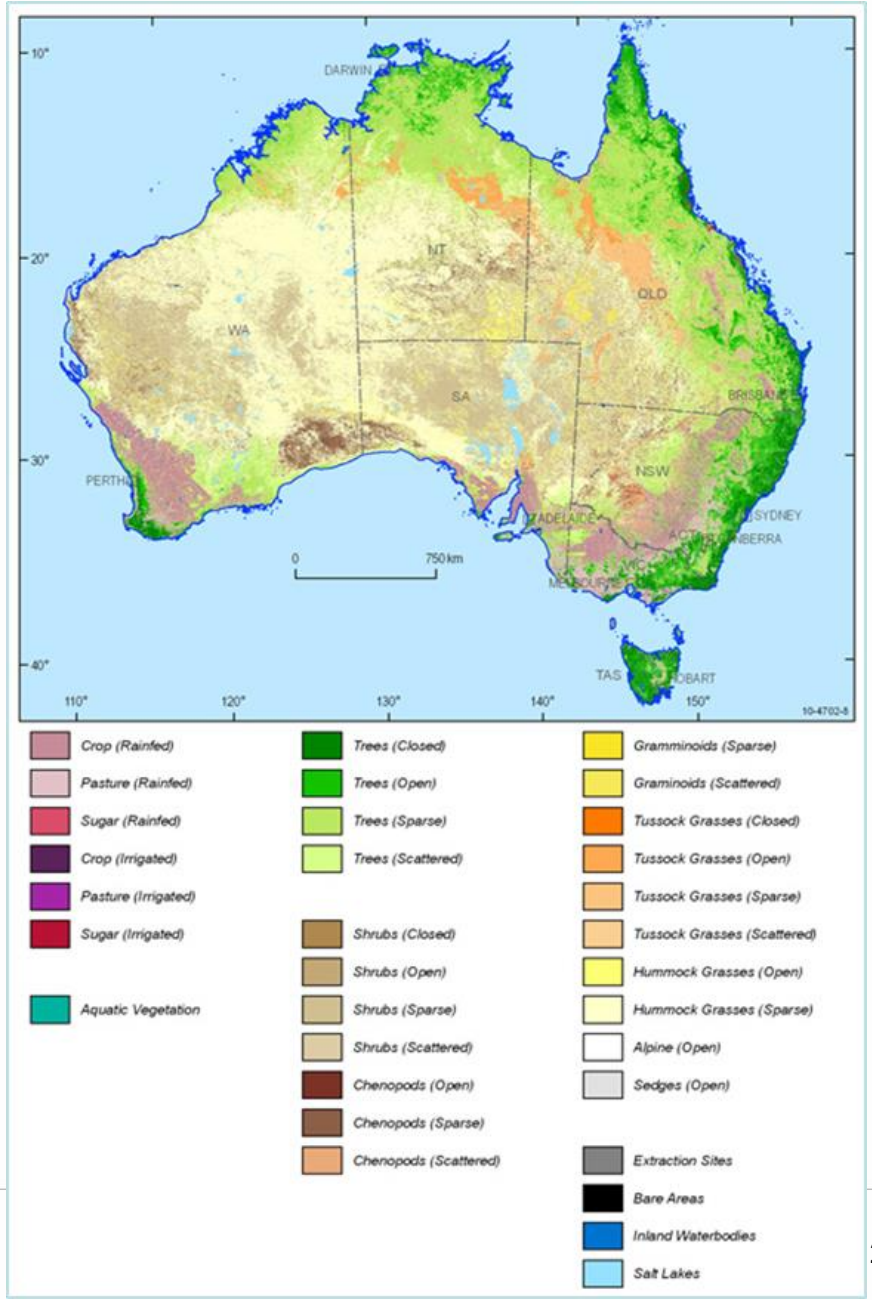


Example: Brazil



Example: Australia

- Australia's Land Accounts
- Based on MODIS 250m Land Cover, aggregating 25 classes to seven categories



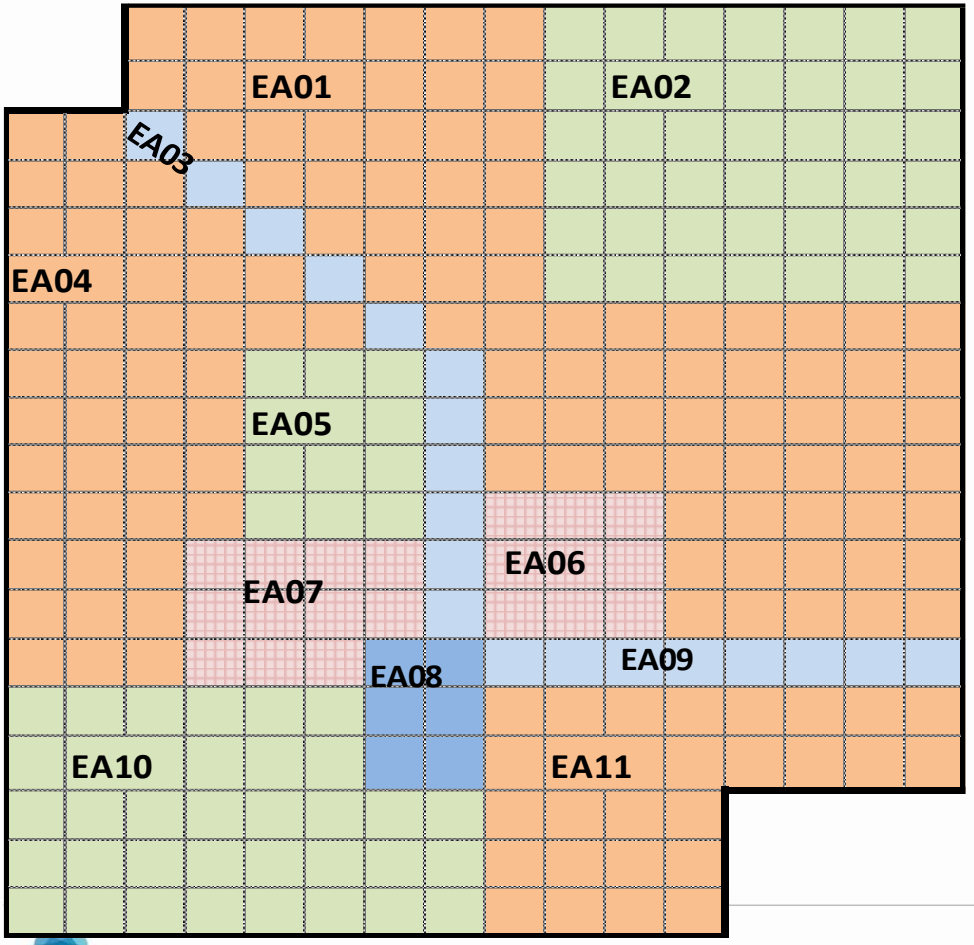
Group exercise

Compilation Group Exercise

- Compilation Group Exercise in groups of 2-4:
  - Exercise 1: Calculate area of each EA (ecosystem asset) and ET (ecosystem type)
  - Exercise 2: Compile an ecosystem extent change matrix
  - Exercise 3: Compile an ecosystem extent account

Exercise 1: EAs & ETs

Calculate area of each EA (ecosystem asset) and ET (ecosystem type)



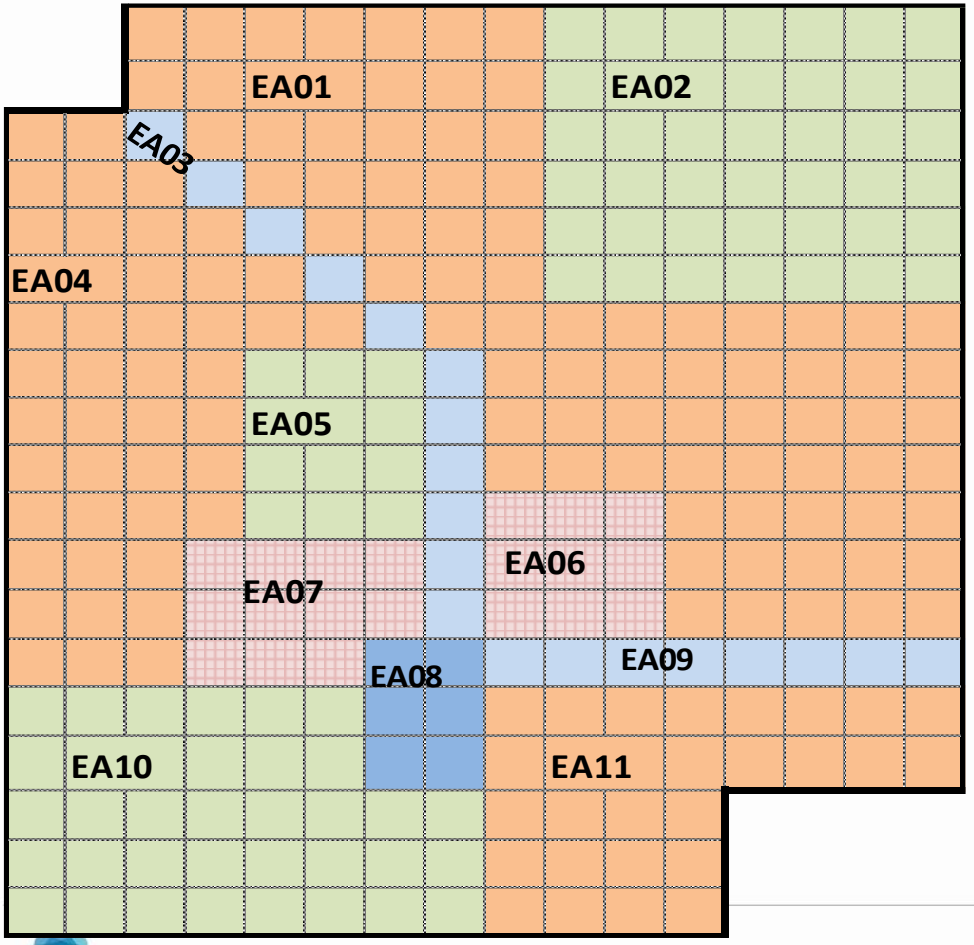
EA Table

Ecosystem Asset (EA)	ha
EA01 = Herbaceous crops	80
EA02 = Tree covered areas	42
EA03 = Inland water bodies	
EA04 = Herbaceous crops	45
EA05 = Tree covered areas	
EA06 = Artificial surfaces (urban)	
EA07 = Artificial surfaces (urban)	
EA08 = Shrubs..regularly flooded (wetland)	
EA09 = Inland water bodies	
EA10 = Tree covered areas	
EA11 = Herbaceous crops	
Total	**288**

Summary Table

Ecosystem Type (ET)	ha
Artificial surfaces (urban)	
Herbaceous crops	
Tree covered areas	
Inland water bodies	
Shrubs..regularly flooded (wetland)	
Total	**288**

Exercise 1: EAs & ETs - solution



EA Table

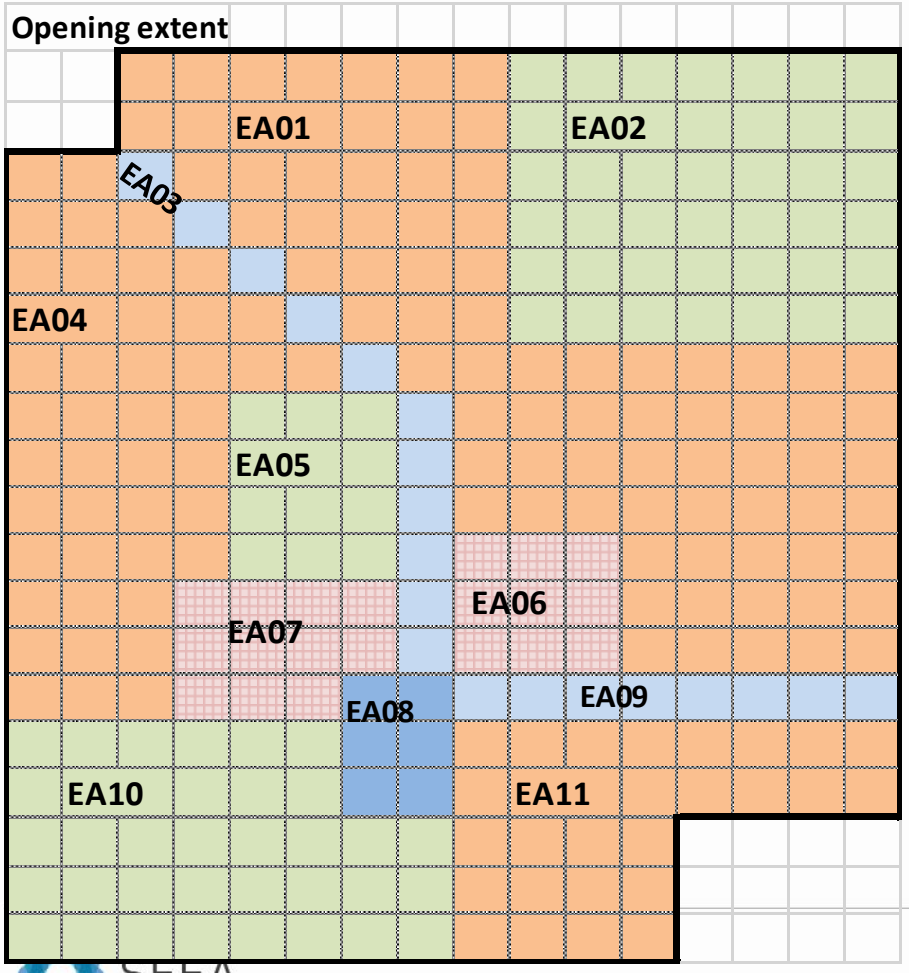
Ecosystem Asset (EA)	ha
EA01 = Herbaceous crops	80
EA02 = Tree covered areas	42
EA03 = Inland water bodies	11
EA04 = Herbaceous crops	45
EA05 = Tree covered areas	12
EA06 = Artificial surfaces (urban)	9
EA07 = Artificial surfaces (urban)	11
EA08 = Shrubs..regularly flooded (wetland)	6
EA09 = Inland water bodies	8
EA10 = Tree covered areas	36
EA11 = Herbaceous crops	28
Total	**288**

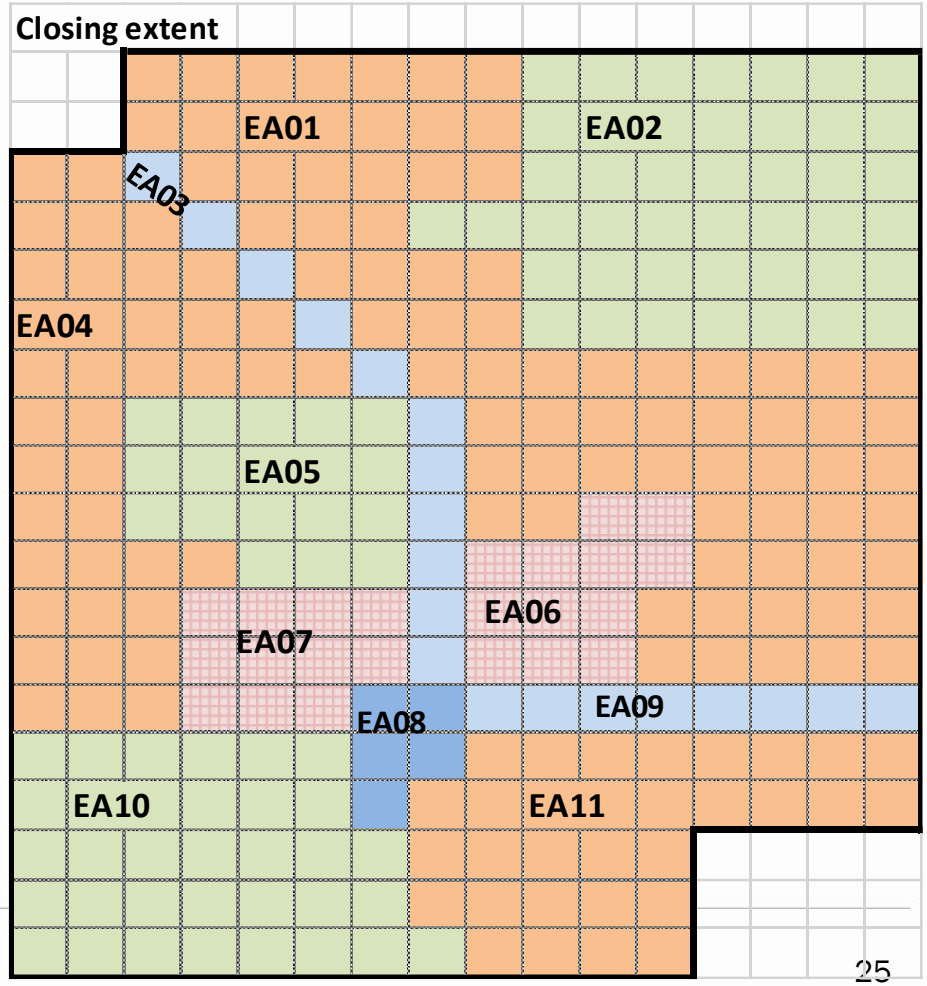
Summary Table

Ecosystem Type (ET)	ha
Artificial surfaces (urban)	20
Herbaceous crops	153
Tree covered areas	90
Inland water bodies	19
Shrubs..regularly flooded (wetland)	6
Total	**288**

Exercise 2: change matrix

Opening and closing extent maps





Exercise 2: change matrix

Compile an ecosystem extent change matrix

Ecosystem Extent Change Matrix (hectares)							
	Closing Land Cover						
	Artificial surfaces (urban)	Herbaceous crops	Tree covered areas	Inland water bodies	Shrubs..regularly flooded (v	Other	**Opening**
Opening Land Cover							
Artificial surfaces (urban)	20	0	0	0	0	0	**20**
Herbaceous crops	3						
Tree covered areas	0						
Inland water bodies	0						
Shrubs..regularly flooded (wetla	0						
Other	0						
Closing	**23**						**288**

Exercise 2: change matrix - solution

Compile an ecosystem extent change matrix

Ecosystem Extent Change Matrix (hectares)							
	Closing Land Cover						
	Artificial surfaces (urban)	Herbaceous crops	Tree covered areas	Inland water bodies	Shrubs..regularly flooded (v	Other	**Opening**
Opening Land Cover							
Artificial surfaces (urban)	20	0	0	0	0	0	**20**
Herbaceous crops	3	142	8	0	0	0	**153**
Tree covered areas	0	2	88	0	0	0	**90**
Inland water bodies	0	0	0	19	0	0	**19**
Shrubs..regularly flooded (wetla	0	1	0	0	5	0	**6**
Other	0	0	0	0	0	0	**0**
Closing	**23**	**145**	**96**	**19**	**5**	**0**	**288**

Exercise 3: extent account

Compile an ecosystem extent account

Ecosystem extent account							
	Artificial surfaces (urban)	Herbaceous crops	Tree covered areas	Inland water bodies	Shrubs..regularly flooded (w	Other	**Total**
Opening Stock	**20**						
Additions to Stock	3						
Reductions in Stock	0						
Closing Stock	**23**						

Exercise 3: extent account - solution

Compile an ecosystem extent account

Ecosystem extent account							
	Artificial surfaces (urban)	Herbaceous crops	Tree covered areas	Inland water bodies	Shrubs..regularly flooded (w	Other	**Total**
Opening Stock	**20**	**153**	**90**	**19**	**6**	**0**	**288**
Additions to Stock	3	3	8	0	0	0	**14**
Reductions in Stock	0	11	2	0	1	0	**14**
Closing Stock	**23**	**145**	**96**	**19**	**5**	**0**	**288**

THANK YOU

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Group exercise 2

- Concepts group Exercise (15m)
- Group reports:
  - National **data and classifications** for Ecosystem Extent already available for your country
  - Alternative sources of data for Ecosystem Extent Accounts? (Global databases?)
- Discussion
  - Who would need to participate in creating a pilot Ecosystem Extent Account?