Condition Account

(Levels 1 and 2)

Project: Advancing the SEEA
Experimental Ecosystem Accounting

United Nations
UNEP
Convention on Biological Diversity
NORWEGIAN MINISTRY OF FOREIGN AFFAIRS

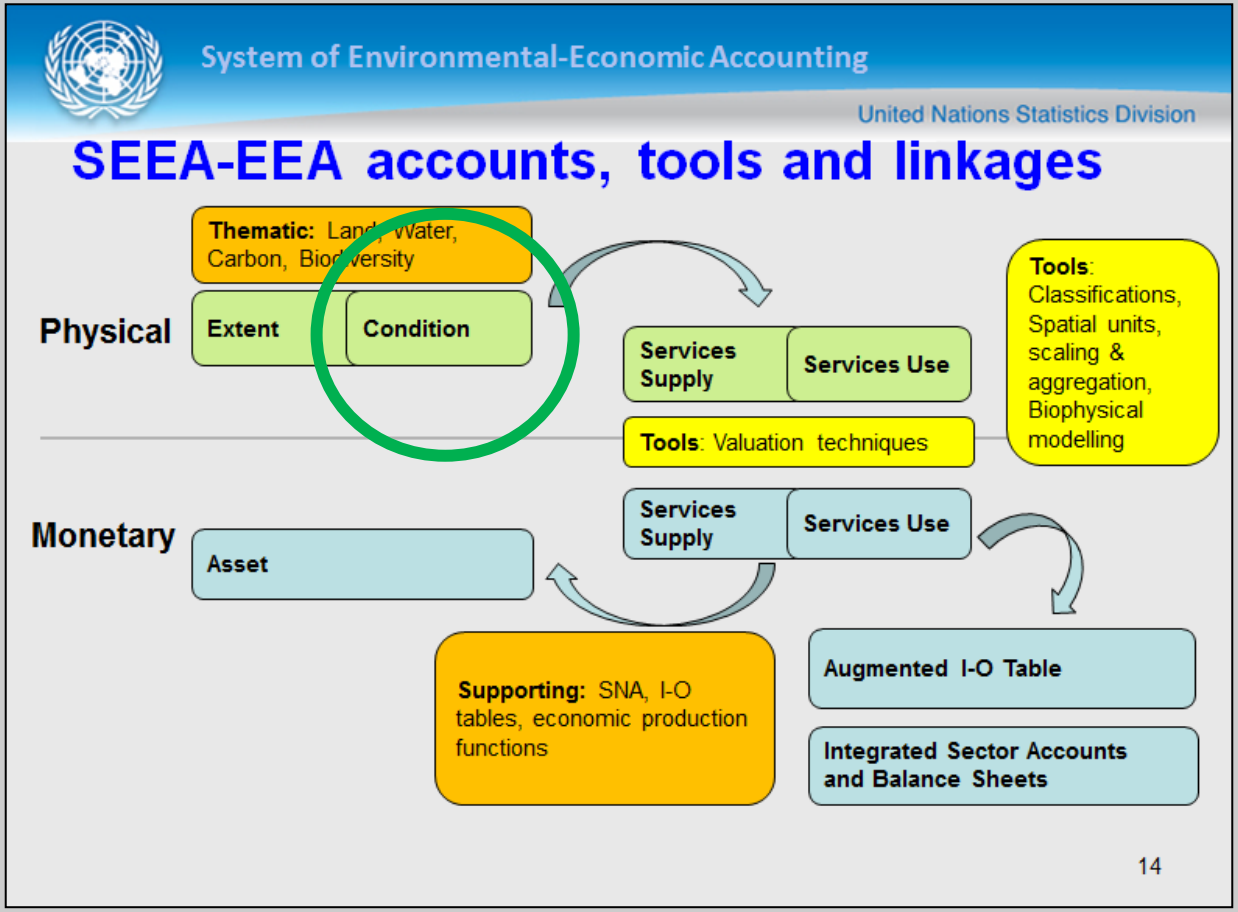
Overview: The Condition Account

1. **Learning objectives**
2. **Review of Level 0 (5m)**
3. **Level 1 (Compilers)**
   - Concepts (15m)
   - Group exercise & Discussion (30m)
4. **Level 2 (Data providers)**
   - Data options, examples & issues (15m)
   - Group exercise & Discussion (15m)
5. **Closing Discussion (10m)**

SEEA-EEA Training Levels 1 and 2

- **Learning objectives**
  - Level 1:
    - Understand the basic concepts of the Condition Account
    - Learn the steps of compiling a Condition Account
  - Level 2
    - Understand the data options and sources
    - Understand the important conceptual issues
    - Be aware of how other countries have approached measuring Condition

Account 2: Condition



Review of Level 0: Condition Account

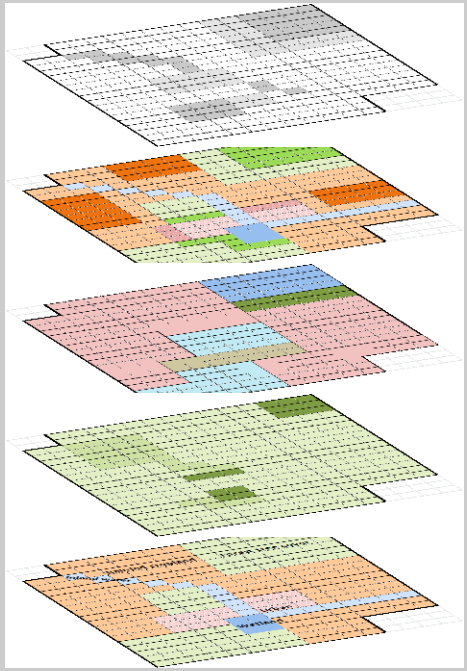
Level 0: Account 2: Condition

- **What?**
  - ***Ecosystem condition*** *reflects the overall quality of an ecosystem asset, in terms of its characteristics.* (SEEA EEA paragraph 2.34)
- **Why?**
  - Policies to limit degradation of natural heritage, rehabilitation of degraded ecosystems
  - Links to **capacity** to produce services (**Services Supply**)
  - Indicators:
    - Indices of condition ➔ change over time ➔ where changes
    - Good/bad condition (exceeding “safe” levels) ➔ where

Level 0: Account 2: Condition

- **What does a Condition Account look like?**

Maps



Tables

Ecosystem type	Ecosystem extent (ha)	Ecosystem condition					
		Vegetation biomass (tonnes)	Biodiversity Index	Soil Organic matter	Water Quality Index	Carbon Balance	Index
Urban and associated							
Rainfed herbaceous cropland							
Forest tree cover							
Inland water bodies							
Open wetlands							

Scaling & aggregation

Level 0: Account 2: Condition

- **What does a Condition Account look like?**
  - Spatially-detailed condition measures (quality or biophysical) for each characteristic:
    - Vegetation
    - Biodiversity (species abundance, diversity indices)
    - Soil
    - Water
    - Carbon
    - Air
    - Overall measures (e.g., heterogeneity)
  - **Selected** to reflect an area's **capacity** to generate services
  - Summarized in terms of an **index**
  - Accounts for changes over time (accounting period)
  - Attributes changes to **drivers** (natural and human)

Level 0: Account 2: Condition

- **What do you need to compile a Condition Account?**
  - Ecosystem Extent Account
  - Common spatial database (Spatial units)
  - **Data:**
    - Condition measures from satellite imagery and field studies over two periods of time
    - Environmental monitoring data (water, air, soil, species)
  - **Expertise:**
    - Ecologists (vegetation, soil, water)
    - Statisticians (methodologists to create indices, **Scaling, Aggregation**)
    - Environmental policy analysts (focus on relevant indices)
    - Geographers (GIS, remote sensing, integration)

Level 1: Account 2: Condition

Level 1: Account 2: Condition

- Concepts
  - Quality and other biophysical measures
  - Reference state
  - Creating indices

Level 1: Account 2: Condition

- Quality and other biophysical measures
  - Data are limited, so:
    - **Select** the most important and reliable condition measures
    - That link most directly to the services you are analysing
  - Examples:
    - Water quality measures → water purification
    - Air quality measures → air quality regulation
    - Biodiversity index → iconic species
    - Vegetation, soil types → carbon sequestration
  - Other biophysical measures are needed to interpret quality data
    - Stream flow rates → capacity to purify water & control floods
    - Slope → capacity for control erosion

Level 1: Account 2: Condition

- Reference state
  - Aggregates could be “arbitrary”
    - For example, average of water quality measures
  - Or, indexed to a “reference state”
    - For example, compare with “quality standard” for use (drinking, recreation, livestock, wildlife, irrigation…)
    - Can compare with past or “ideal” reference condition:
      - Pristine or Pre-development state,
      - Sustainable state (theoretical)
      - Earliest available information
    - Choice of reference state can affect interpretation
      - e.g., Are we experiencing short-term fluctuations or a long-term trend?

Level 1: Account 2: Condition

- Creating indices
  - "Up" may be **better** or **worse**
    - e.g., if pollutants increase this is usually **worse**
    - e.g., if biodiversity increases, this is usually **better**
  - "Up" or "Down" from ideal may be **worse**
    - e.g., pH of drinking water should be neutral
    - e.g., species may have an "optimal" abundance
  - Is there a need for weighting?
    - One measure may be more **important** than another
  - Is there a need for scaling?
    - One measure may representative of a larger area

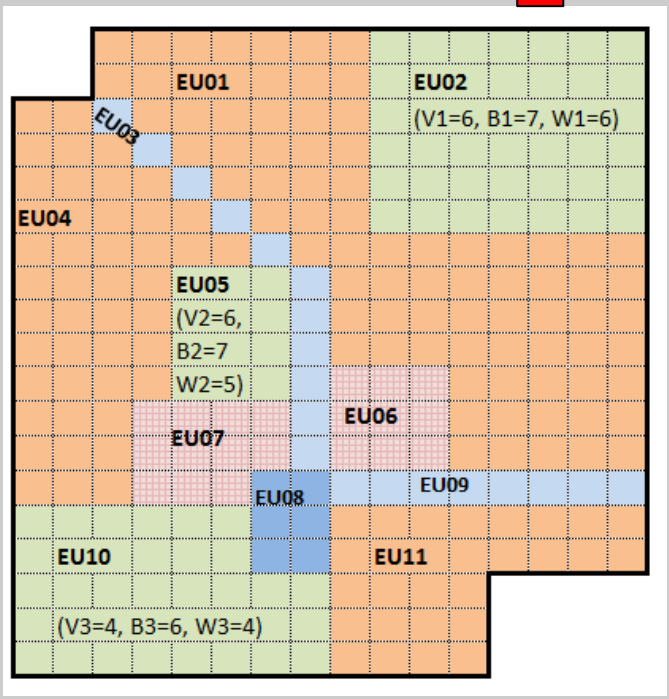
Level 1: Account 2: Condition

- Compilation Group Exercise (30m)
  - Situation:
    - Same EUs as defined in **Spatial Units**
    - Added environmental quality data (indices scaled 1-10)
    - "Reference state" is Opening Conditions
  - Objective (Groups of 3-5):
    1. Record quality data in appropriate cells in Condition Table
    2. Using formulas provided, calculate an unweighted index for each forested EU
       – For the **Opening Conditions**
    3. Calculate a summary for each indicator for **Tree Covered Area**
    4. Calculate and allocate changes to improvements or reductions in condition
    5. Report your results

Level 1: Account 2: Condition

Group Exercise: Step 1 – Transfer data for Tree Covered EUs

Opening Conditions



Condition table

Condition Table

EU	Extent (BSU)	(V) Vegetation	(B) Biodiversity	(W) Water	Index
EU01 = Herbaceous crops	80	4.00	3.00	5.00	4.00
EU02 = Tree covered areas	42				
EU03 = Inland water bodies	11	5.00	6.00	6.00	5.67
EU04 = Herbaceous crops	45	3.00	2.00	4.00	3.00
EU05 = Tree covered areas	12				
EU06 = Artificial surfaces (urban)	9	2.00	2.00	4.00	2.67
EU07 = Artificial surfaces (urban)	11	2.00	1.00	3.00	2.00
EU08 = Shrubs..regularly flooded (wetland)	6	5.00	7.00	5.00	5.67
EU09 = Inland water bodies	8	3.00	3.00	4.00	3.33
EU10 = Tree covered areas	36				
EU11 = Herbaceous crops	28	3.00	2.00	3.00	2.67
	288				

EU Type	Extent (BSU)	Vegetation	Biodiversity	Water	Index
Artificial surfaces (urban)	20	2.00	1.45	3.45	2.30
Herbaceous crops	153	3.52	2.52	4.34	3.46
Tree covered areas	90				
Inland water bodies	19	4.16	4.74	5.16	4.68
Shrubs..regularly flooded (wetland)	6	5.00	7.00	5.00	5.67
Total	**288**	**4.01**	**3.96**	4.57	4.18

Level 1: Account 2: Condition

Group Exercise: Step 2 – Calculate indices for each EU

Condition table

Condition Table

EU	Extent (BSU)	(V) Vegetation	(Biodiversi	(W) Water	Index
EU01 = Herbaceous crops	80	4.00	3.00	5.00	4.00
EU02 = Tree covered areas	42				
EU03 = Inland water bodies	11	5.00	6.00	6.00	5.67
EU04 = Herbaceous crops	45	3.00	2.00	4.00	3.00
EU05 = Tree covered areas	12				
EU06 = Artificial surfaces (urban)	9	2.00	2.00	4.00	2.67
EU07 = Artificial surfaces (urban)	11	2.00	1.00	3.00	2.00
EU08 = Shrubs..regularly flooded (wetland)	6	5.00	7.00	5.00	5.67
EU09 = Inland water bodies	8	3.00		4.00	3.33
EU10 = Tree covered areas	36				
EU11 = Herbaceous crops	28	3.00		3.00	2.67
	288				

EU Type	Extent (BSU)	Vegetation	Biodiv	Water	Index
Artificial surfaces (urban)	20	2.00		3.45	2.30
Herbaceous crops	153	3.52	2.52	4.34	3.46
Tree covered areas	90				
Inland water bodies	19	4.16	4.74	5.16	4.68
Shrubs..regularly flooded (wetland)	6	5.00	7.00	5.00	5.67
Total	**288**	**4.01**	**3.96**	4.57	4.18

Calculate index:
I = (V+B+W)/3

Prorate by area
- Multiply data value in each area by by number of BSU
- Sum the results
- Divide by total area

Level 1: Account 2: Condition

Group Exercise: Step 2 – Prorate area for each EU

Condition table

Condition Table

EU	Extent (BSU)	(V) Vegetation	(B) Biodiversity	(W) Water	Index
EU01 = Herbaceous crops	80	4.00	3.00	5.00	4.00
EU02 = Tree covered areas	42				
EU03 = Inland water bodies	11	5.00	6.00	6.00	5.67
EU04 = Herbaceous crops	45	3.00	2.00	4.00	3.00
EU05 = Tree covered areas	12				
EU06 = Artificial surfaces (urban)	9	2.00	2.00	4.00	2.67
EU07 = Artificial surfaces (urban)	11	2.00	1.00	3.00	2.00
EU08 = Shrubs..regularly flooded (wetland)	6	5.00	7.00	5.00	5.67
EU09 = Inland water bodies	8	3.00	3.00	4.00	3.33
EU10 = Tree covered areas	36				
EU11 = Herbaceous crops	28	3.00	2.00	3.00	2.67
	288				

EU Type	Extent (BSU)	Vegetation	Biodiversity	Water	Index
Artificial surfaces (urban)	20	2.00	1.45	3.45	2.30
Herbaceous crops	153	3.52	2.52	4.34	3.46
Tree covered areas	90				
Inland water bodies	19	4.16	4.74	5.16	4.68
Shrubs..regularly flooded (wetland)	6	5.00	7.00	5.00	5.67
Total	**288**	**4.01**	**3.96**	4.57	4.18

Prorate by area

BSU		V		
80	*	4	=	320
45	*	3	=	135
28	*	3	=	84
153			Total	**539**
			539/153=	3.52

Level 1: Account 2: Condition

Group Exercise: Step 3 – Finalize Condition Account

Condition Table (Opening Conditions)

Condition Table (Closing Conditions - Provided)

Calculate and allocate changes to Condition Account

Condition Account

	Extent (BSU)	Vegetation	Biodiversity	Water	Index
Opening Conditions	288				
Improvements in condition					
Reductions in condition					
Closing Conditions	288	3.99	4.03	5.32	4.45

Calculate and allocate changes
(Closing – Opening) + → improvement
- → reduction

Level 1: Account 2: Condition

- Is everyone clear on the objectives?
- 30 minutes group work
- Please ask questions
- Results:
  - Each group report:
    - Tree Cover Area Index result
  - Has condition been improved or reduced?
  - For which components?

Condition Table

EU	Extent (BSU)	(V) Vegetation	(B) Biodiversity	(W) Water	Index
EU01 = Herbaceous crops	80	4.00	3.00	5.00	4.00
EU02 = Tree covered areas	42				
EU03 = Inland water bodies	11	5.00	6.00	6.00	5.67
EU04 = Herbaceous crops	45	3.00	2.00	4.00	3.00
EU05 = Tree covered areas	12				
EU06 = Artificial surfaces (urban)	9	2.00	2.00	4.00	2.67
EU07 = Artificial surfaces (urban)	11	2.00	1.00	3.00	2.00
EU08 = Shrubs..regularly flooded (wetland)	6	5.00	7.00	5.00	5.67
EU09 = Inland water bodies	8	3.00	3.00	4.00	3.33
EU10 = Tree covered areas	36				
EU11 = Herbaceous crops	28	3.00	2.00	3.00	2.67
	288				

EU Type	Extent (BSU)	Vegetation	Biodiversity	Water	Index
Artificial surfaces (urban)	20	2.00	1.45	3.45	2.30
Herbaceous crops	153	3.52	2.52	4.34	3.46
Tree covered areas	90				
Inland water bodies	19	4.16	4.74	5.16	4.68
Shrubs..regularly flooded (wetland)	6	5.00	7.00	5.00	5.67
Total	**288**	**4.01**	**3.96**	4.57	4.18

Condition Account

	Extent (BSU)	Vegetation	Biodiversity	Water	Index
Opening Conditions	288				
Improvements in condition					
Reductions in condition					
Closing Conditions	288	3.99	4.03	5.32	4.45

Level 2: Account 2: Condition

Level 2: Account 2: Condition

- **Learning objectives (Level 2)**
  - Understand the data options and sources
  - Understand the important conceptual issues
  - Be aware of how other countries have approached measuring Condition

Level 2: Account 2: Condition

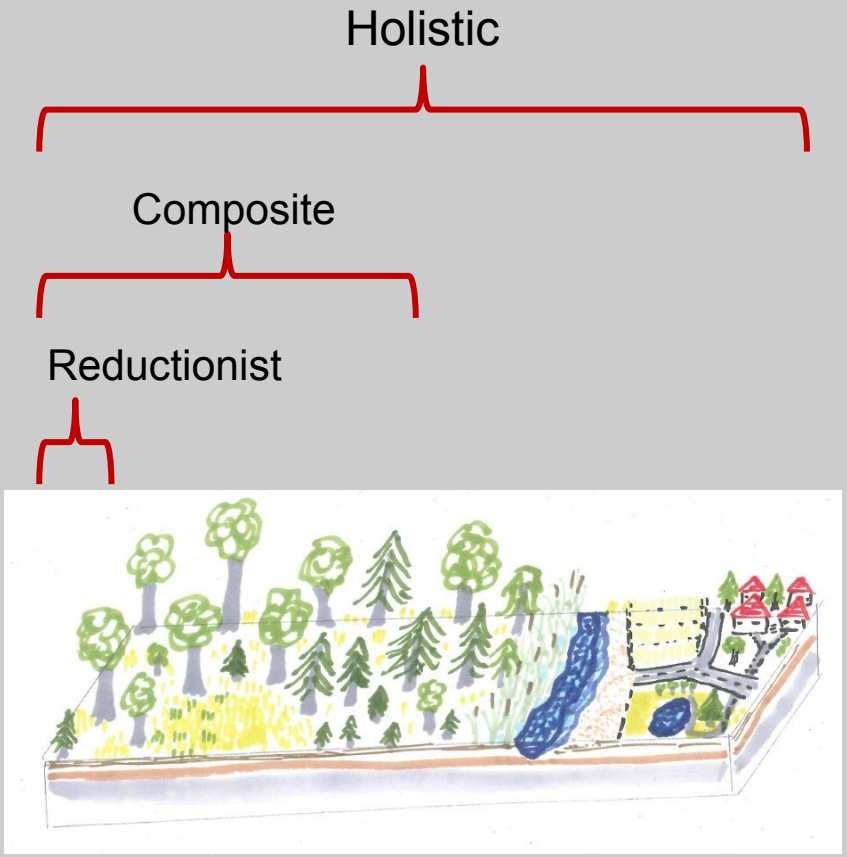
- Data Options
  - Types of condition data
  - Sources of national condition data
  - Estimating condition data
  - Selecting condition measures

Level 2: Account 2: Condition

- Types of condition data
  - There are many possible quality measures
    - **Water quality** is often an index based on selection of indicators (BOD, COD, pH, metals…) according to fitness for use (drinking, recreation, livestock, wildlife, irrigation…)
    - **Air quality** (Ozone, $PM_{2.5}$, NO_x, $SO_{2...}$) is often measured only in urban areas and indexed on effects on human health
    - **Soil quality** (moisture, texture, contaminants) should be available from soil inventories
    - **Ecosystem integrity** (fragmentation, heterogeneity) can be estimated from satellite and administrative data (e.g., roads)

Level 2: Account 2: Condition

- Types of condition data
  - Quality data may refer to different levels of "holism"
    - **Reductionist** = indicator species, ratios between organisms
    - **Composite** indicators = biomass, primary productivity
    - **Holistic** = diversity, resilience, thermodynamic capacity



Level 2: Account 2: Condition

- Types of condition data
  - For ecosystem accounting, it is not necessary to have all measures

  → link available data to **important** services

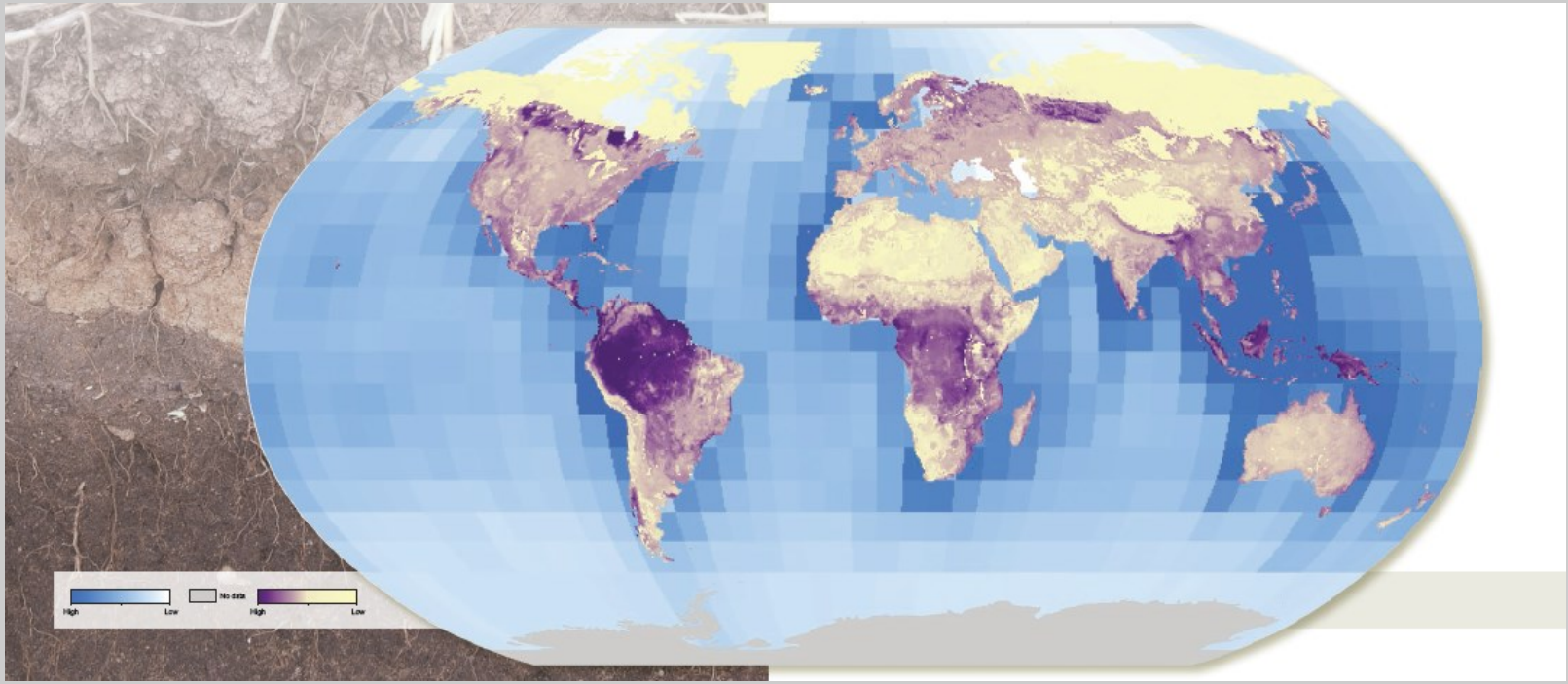
- Examples:
  - Water purification of wetlands: Type of wetland, flow rates, quality of inflow, quality of outflow (phosphorous? metals?)
  - Erosion control: Vegetation density, slope, soil type
  - Biomass for crops: Soil type, soil carbon, slope

Level 2: Account 2: Condition

- Sources of national condition data
  - **Departments of Environment**: Water quality, air quality, Species diversity indices
  - **Departments of Natural Resources**: Hydrology
  - **Departments of Agriculture**: Soil type, soil quality, farming practices
  - **Departments of Forestry**: Forest status, species mix, forest inventory, carbon balances
  - **Departments of Fisheries**: Coastal and marine water quality, species diversity
  - **International sources**:
    - FAO: land cover, soil, marine species distributions
    - IUCN: protected areas, red list of threatened species

Level 2: Account 2: Condition

- UNEP-WCMC Composite map of global ecosystem assets



Source: Dickson, Blaney et al. (2014)

Level 2: Account 2: Condition

- Recommendation:

→Conduct an **inventory** of available data in government, academia and NGOs

→Data inventories are inexpensive and have many benefits:

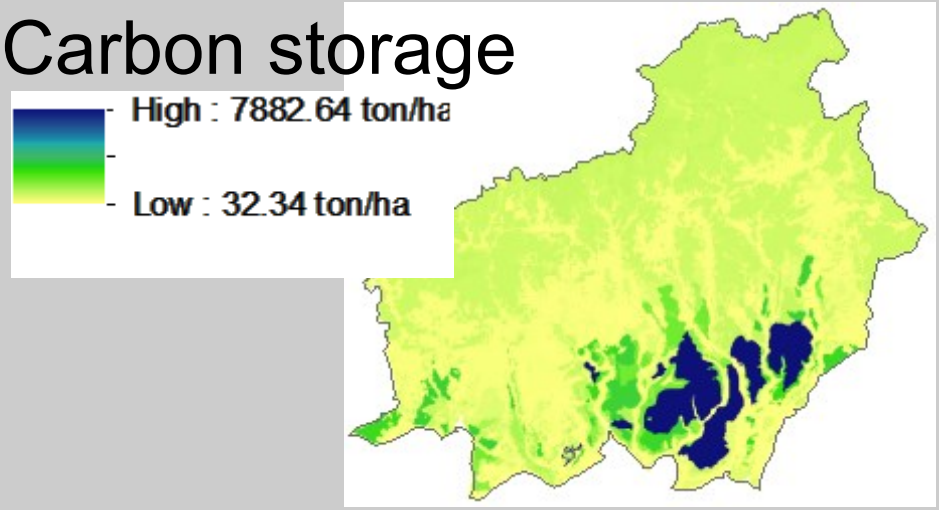
→Engage the data providers
→Improve metadata
→Improve use of existing data
→Suggest means of harmonizing existing data
→Identify data gaps

Level 2: Account 2: Condition

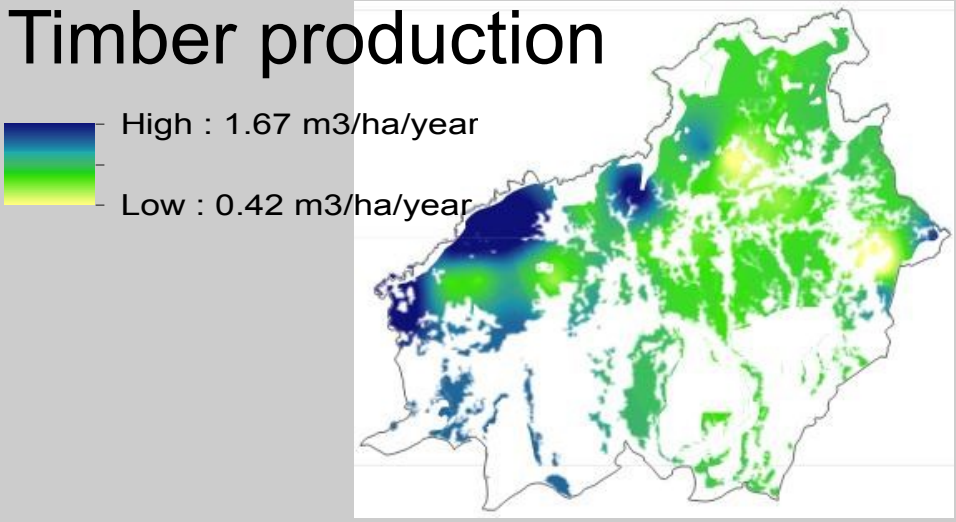
- Estimating condition data
  - Not all data need to be measured (or measured frequently)
  - Can estimate condition or services from other condition data using Biophysical Modelling
  - Examples:
    - Land cover class → carbon storage
    - Sampled data on forest growth → estimate for other areas
    - Forest cover, distance from roads, etc. → orangutan habitat
    - Primary production (from remote sensing) + soil respiration → carbon sequestration

Ecosystem services Central Kalimantan

Carbon storage



Timber production



Model used

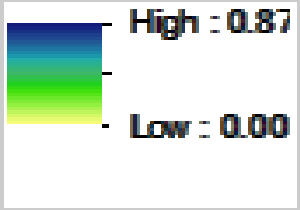
Look Up Tables (every land cover class is attributed a specific carbon storage value)

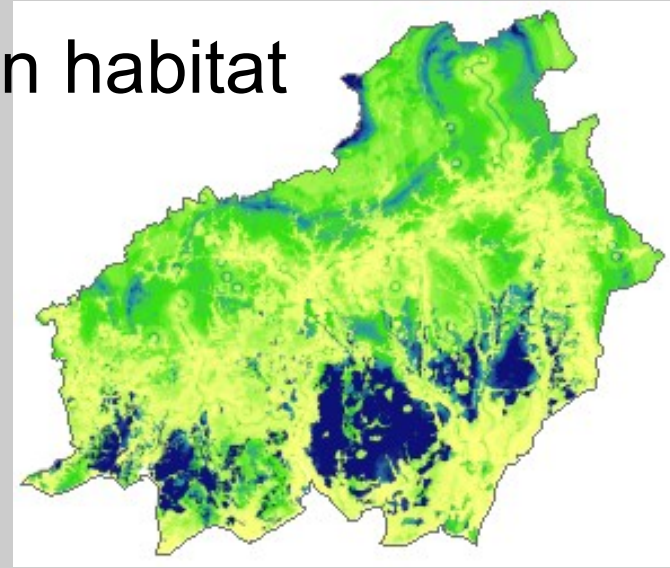
Kriging
(values are interpolated from samples)

Source: Sumarga and Hein, 2014

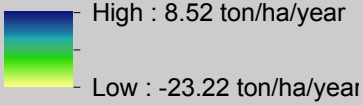
Ecosystem services Central Kalimantan

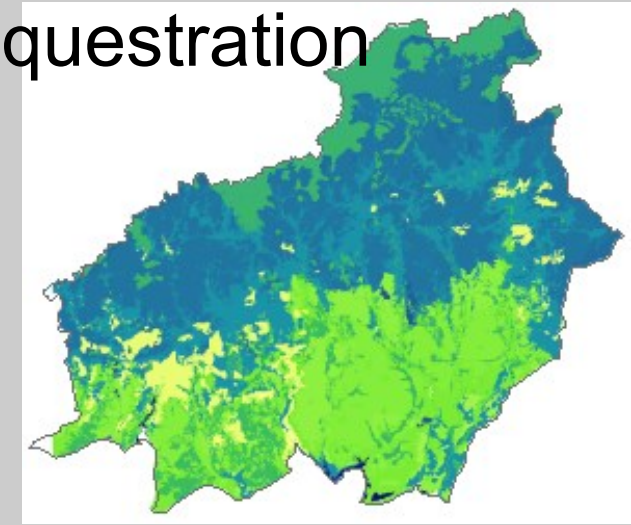
Orangutan habitat





Carbon sequestration





Model used:

Statistical model (Maxent) (habitat suitability predicted on the basis of forest cover, distance from road, etc.)

Process-based Model (primary ecosystem production minus soil respiration)

Source: Sumarga and Hein, 2014

Level 2: Account 2: Condition

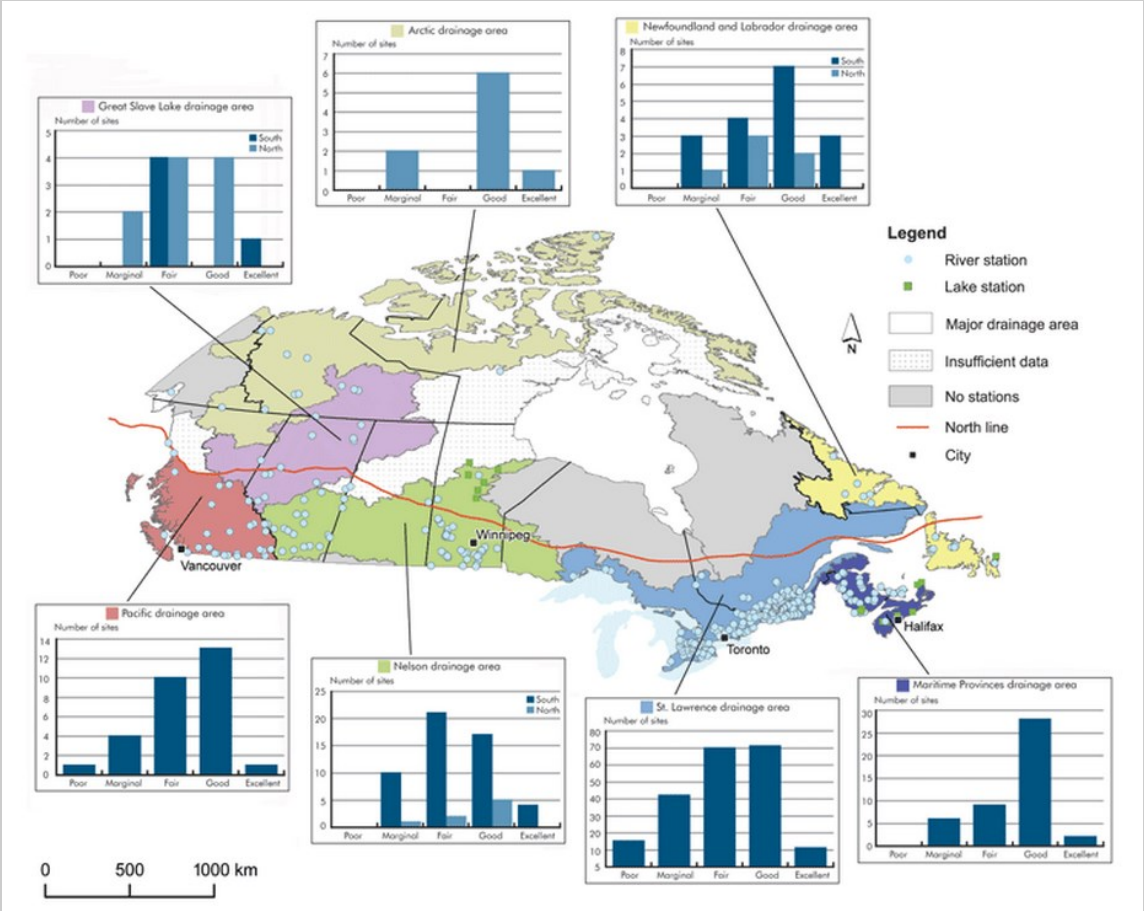
- Conceptual issues
  - Measurement
    - Are data representative?
      - Do monitoring sites represent all ecosystem types?
    - What is the quality of the data?
    - Are data consistent over time?
  - Linkage to services
    - Condition and services have a complex relationship
      - A small change in condition may have a large effect on services (e.g., change in coastal water quality on coral)
      - A large change in condition may have a small effect on services (e.g., change in coastal water quality on tourism)

Level 2: Account 2: Condition

Are data representative?

Canada example:

- Monitoring sites selected to identify "problems"
- Some areas and types of streams undersampled
- Populated areas oversampled
- Solution?



Source: Statistics Canada, 2007

Level 2: Account 2: Condition

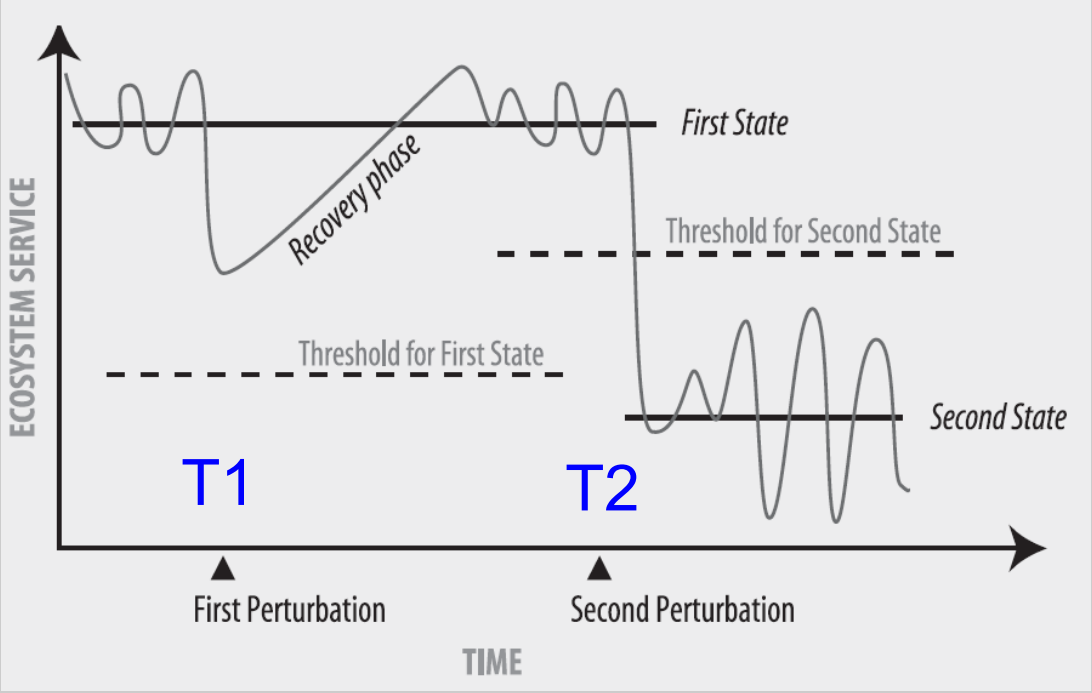
Linkage to services

- As some services increase (e.g., crops), quality (biodiversity, heterogeneity) may decrease
  - This is not good, since intensive and extensive cropping creates ecosystems that are less resilient to change.
- Some services (e.g., iconic species habitat) may be very sensitive to disturbance.
- Research on resilience is trying to understand how to better link conditions with services.

Level 2: Account 2: Condition

Linkage to services

- In this hypothetical example, an ecosystem changes over time.
- After T1, it recovered its level of services, since the change was below the first threshold.
- After T2, it could not recover, since the conditions changed to below the new threshold.
- The result was a permanent decrease in that service
- This is not easy to predict



Source: Millennium Ecosystem Assessment, 2005.

Level 2: Account 2: Condition

- Group exercise (15m) (Groups of 3-5)

1. Choose one **ecosystem type** and a **service** it provides (e.g., forests → flood protection)
2. Suggest **three** condition measures (quality and biophysical) that could inform the relationship between the **condition** and the **service**
3. Report:
   - The service and condition measures you selected
   - How are they related? (direction, importance)
   - Are **national** data available in your country for these condition measures?

Level 2: Account 2: Condition

- Concepts Group exercise (15m)

- Group reports
  - The service and condition measures you selected
  - How are they related? (direction, importance)
  - Are **national** data available in your country for these condition measures?
- Discussion
  - What other condition measures could you suggest?
  - What other data sources could you suggest?

Level 2: Account 2: Condition

- Discussion and questions
- Take home points:
  - Conduct an **inventory** of ecosystem condition data
  - Data may be limited, but can be **useful**
  - There are **no simple formulas** to calculate ecosystem condition indicators for all purposes
  - **Biophysical modelling** can be used to fill some gaps
  - Ecosystem condition and services supply are **non-linear**
  - **Testing** will provide a better understanding of data opportunities and constraints
  - Focus on **available data** and priority services

Level 2: Account 2: Condition

- References

- DIckson, B., Blaney, *et al*., 2014. Towards a global map of natural capital: Key ecosystem assets. DEW/1824/NA. Nairobi, Kenya: UNEP.
- Millennium Ecosystem Assessment, 2005. http://www.millenniumassessment.org/documents/document.300.aspx.pdf41
- Statistics Canada, 2007. Canadian Environmental Sustainability Indicators 2007. Cat. No. 16-251-x.
- Sumarga, E. And Hein, L., 2014. Mapping Ecosystem Services for Land Use Planning, the Case of Central Kalimantan. *Environmental management*, pp. 1-14.

- Further Information
  - SEEA Experimental Ecosystem Accounting (2012)
  - SEEA-EEA Technical Guidance (forthcoming)
    - Detailed supporting document on "Ecosystem Condition and Capacity" by Michael Bordt

Evaluation of the training module

- Please complete the online evaluation form for this module: http://tinyurl.com/pbopmy2
- For this module
  - What did you learn that you could apply in your work?
  - Was the presentation clear and informative?
  - Was it too simple? Too complex?
  - Was there anything you did not understand?
  - What additions or deletions would you suggest (recognizing that the unit is intended for a general audience)?
  - Do you have any suggestions as to how the SEEA-EEA may be improved (concepts, principles) in this area?

Acknowledgements

- This project is a collaboration of The United Nations Statistics Division, United Nations Environment Programme and the Secretariat of the Convention on Biological Diversity and is supported by the Government of Norway.

- Contact: seea@un.org

United Nations UNEP Convention on Biological Diversity NORWEGIAN MINISTRY OF FOREIGN AFFAIRS