Condition Account
(Levels 0, 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)

- **What** is it?
- **Why** do we need it?
- **What** does it look like?
- **Expertise** & **data** required
- **Links** to related training materials

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)

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SEEA-EEA Training Levels 1 and 2

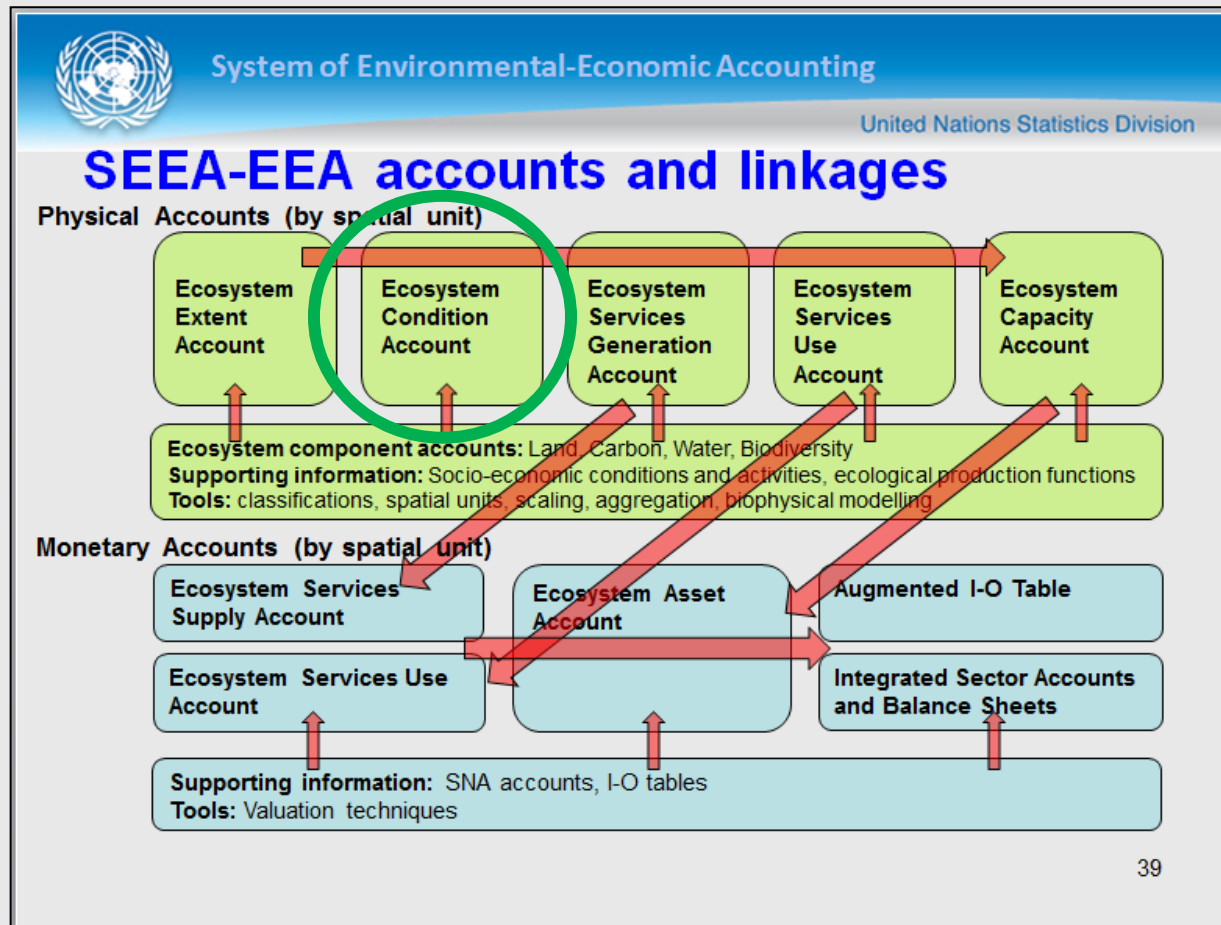- **Learning objectives**

  - 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

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?
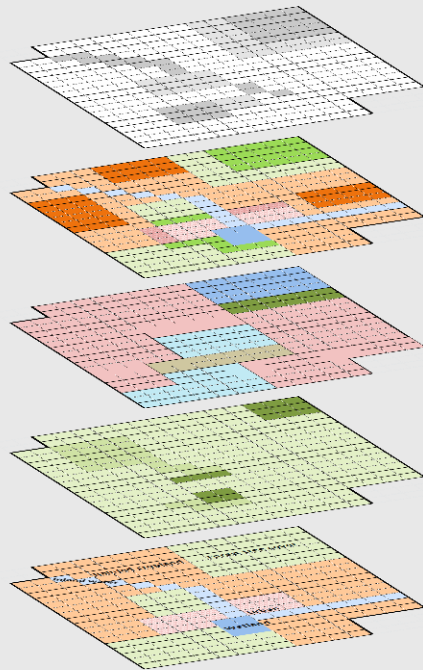   - Policies to limit degradation of natural heritage, rehabilitation of degraded ecosystems
    - Links to capacity to produce services (Services Generation)
    - Indicators:
        - Indices of condition ➔ change over time ➔ where changes
        - Good/bad condition (exceeding "safe" levels) ➔ where

Level 0: Account 2: Condition

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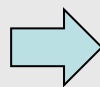
Maps

Carbon

Water

Soil

Biodiversity

Vegetation

Tables

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

Scaling & aggregation

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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)

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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

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

Level 1: Account 2: Condition

- Quality and other biophysical measures
  - Data are limited:
    - **Select** most and important and reliable condition measures
    - That link most directly to the services you are analysing
  - Examples:
    - Water quality measures → water quality index
    - Air quality measures → air quality index
    - Species ranges → biodiversity index
    - Vegetation, soil types → carbon balance
  - "Other biophysical measures" 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
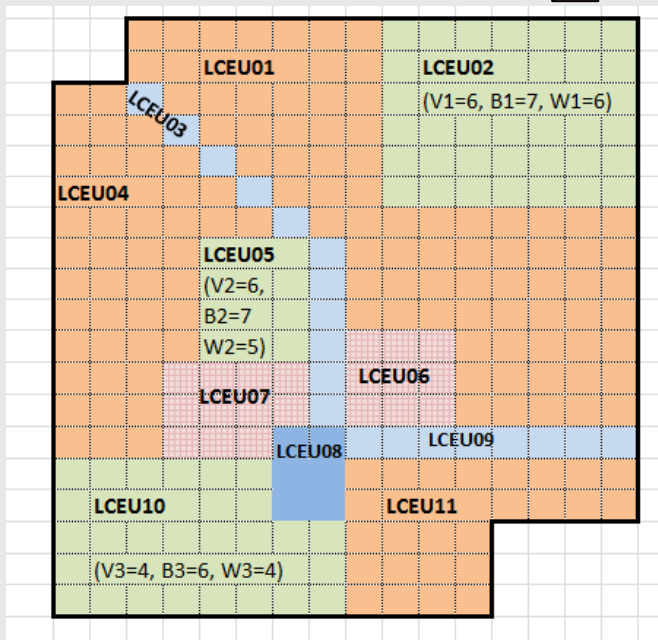
Level 1: Account 2: Condition

- Compilation Group Exercise (30m)
  - Situation:
    - LCEUs 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 LCEU
       – For the **Opening Conditions**
    3. Calculate a summary for each indicator for Forest Tree Cover
    4. Calculate and allocate changes to improvements or reductions in condition
    5. Report your results

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Level 1: Account 2: Condition

Group Exercise: Step 1 – Transfer data for Forest LCEUs

Opening Conditions

LCEU01
LCEU02
(V1=6, B1=7, W1=6)
LCEU03
LCEU04
LCEU05
(V2=6,
B2=7
W2=5)
LCEU06
LCEU07
LCEU08
LCEU09
LCEU10
LCEU11
(V3=4, B3=6, W3=4)

Condition table

LCEU	Extent (BSU)	(V) Vegetation	(B) Biodiversity	(W) Water	Index
LCEU01 = Rainfed herbaceous cropland	80	4.00	3.00	5.00	4.00
LCEU02 = Forest tree cover	42				
LCEU03 = Inland water bodies	11	5.00	6.00	6.00	5.67
LCEU04 = Rainfed herbaceous cropland	45	3.00	2.00	4.00	3.00
LCEU05 = Forest tree cover	12				
LCEU06 = Urban and associated developed	9	2.00	2.00	4.00	2.67
LCEU07 = Urban and associated developed	11	2.00	1.00	3.00	2.00
LCEU08 = Open wetlands	6	5.00	7.00	5.00	5.67
LCEU09 = Inland water bodies	8	3.00	3.00	4.00	3.33
LCEU10 = Forest tree cover	36				
LCEU11 = Rainfed herbaceous cropland	28	3.00	2.00	3.00	2.67
	288				

LCEU Type	Extent (BSU)	Vegetation	Biodiversity	Water	Index
Urban and associated	20	2.00	1.45	3.45	2.30
Rainfed herbaceous cropland	153	3.52	2.52	4.34	3.46
Forest tree cover	90				
Inland water bodies	19	4.16	4.74	5.16	4.68
Open wetlands	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 LCEU

Condition table

LCEU	Extent (BSU)	(V) Vegetation	(B) Biodiversity	(W) Water	Index
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LCEU05 = Forest tree cover	12				
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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

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Level 1: Account 2: Condition

Group Exercise: Step 2 – Prorate area for each LCEU

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Prorate by area

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

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Level 1: Account 2: Condition

Group Exercise: Step 3 – Finalize Condition Account

Condition Table (Opening Conditions)

Condition Table (Closing Conditions - Provided)

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

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Level 1: Account 2: Condition

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

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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
  - 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
  - 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
  - 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: Density of vegetation, slope, soil type
  - 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
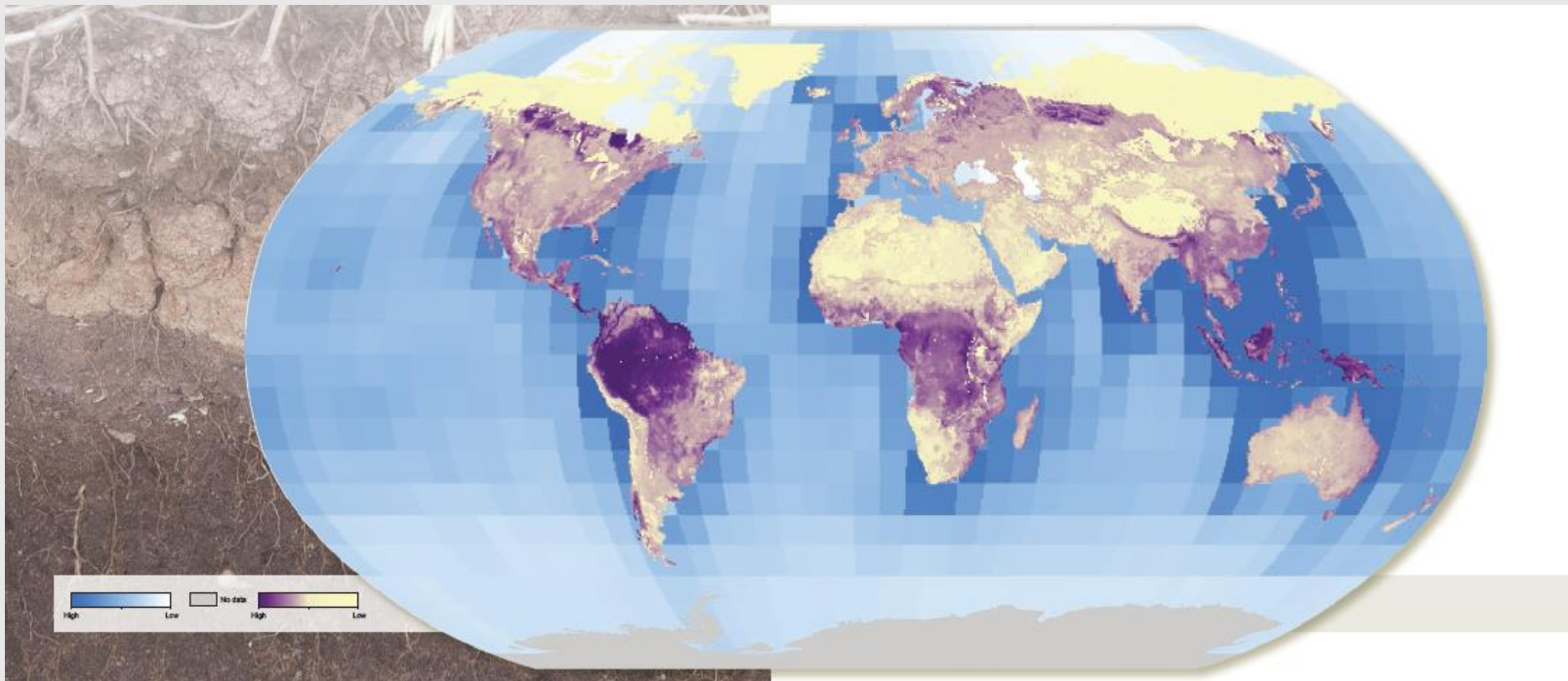
Source: Dickson, Blaney et al. (2014)

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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
  - →Improving metadata
  - →Improving use of existing data
  - →Suggesting means of harmonizing existing data
  - →Identifying 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 production → 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

High : 7882.64 ton/ha

Low : 32.34 ton/ha

Timber production

High : 1.67 m3/ha/year

Low : 0.42 m3/ha/year
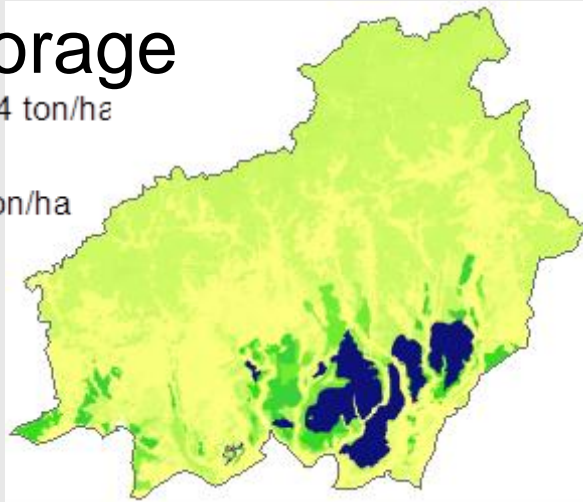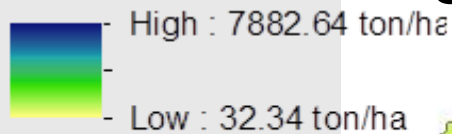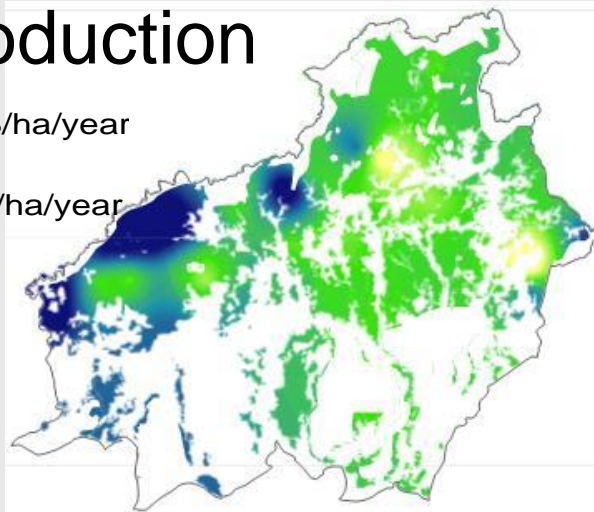
Model used

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

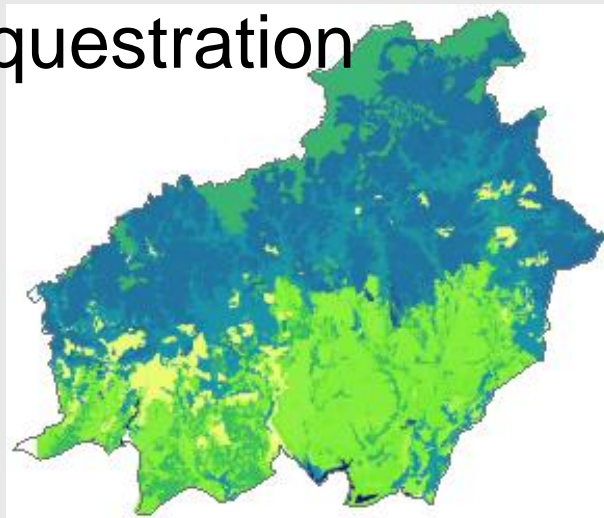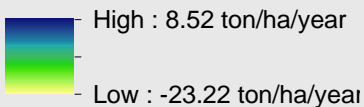**Kriging** (values are interpolated from samples)

Source: Sumarga and Hein, 2014

Ecosystem services Central Kalimantan

Orangutan habitat

High : 0.87

Low : 0.00

Carbon sequestration

High : 8.52 ton/ha/year

Low : -23.22 ton/ha/year
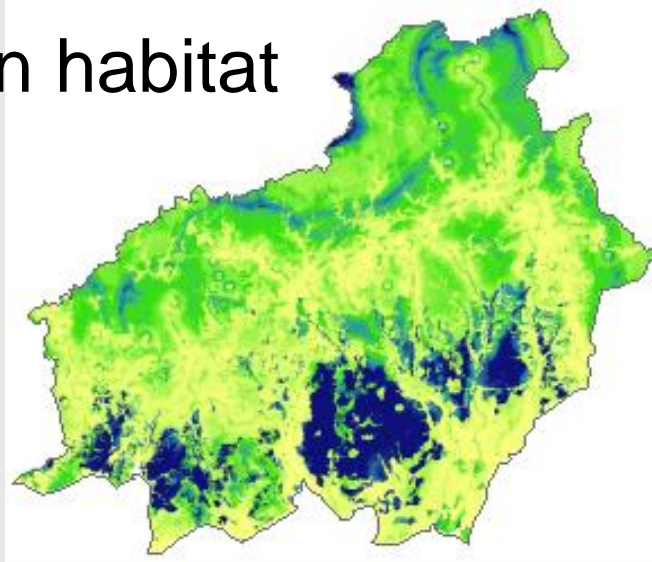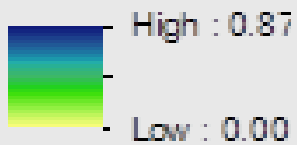
Model used:

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 it 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)
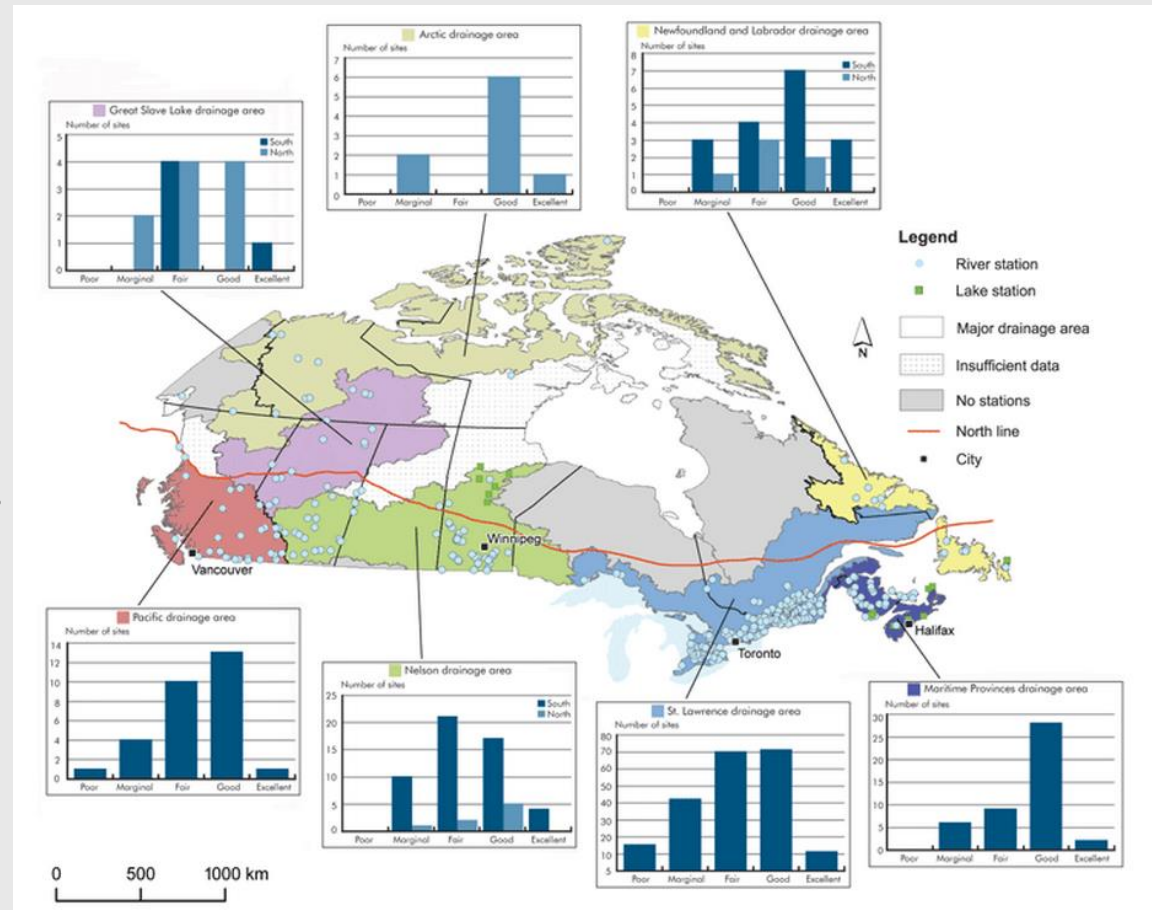
Level 2: Account 2: Condition

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

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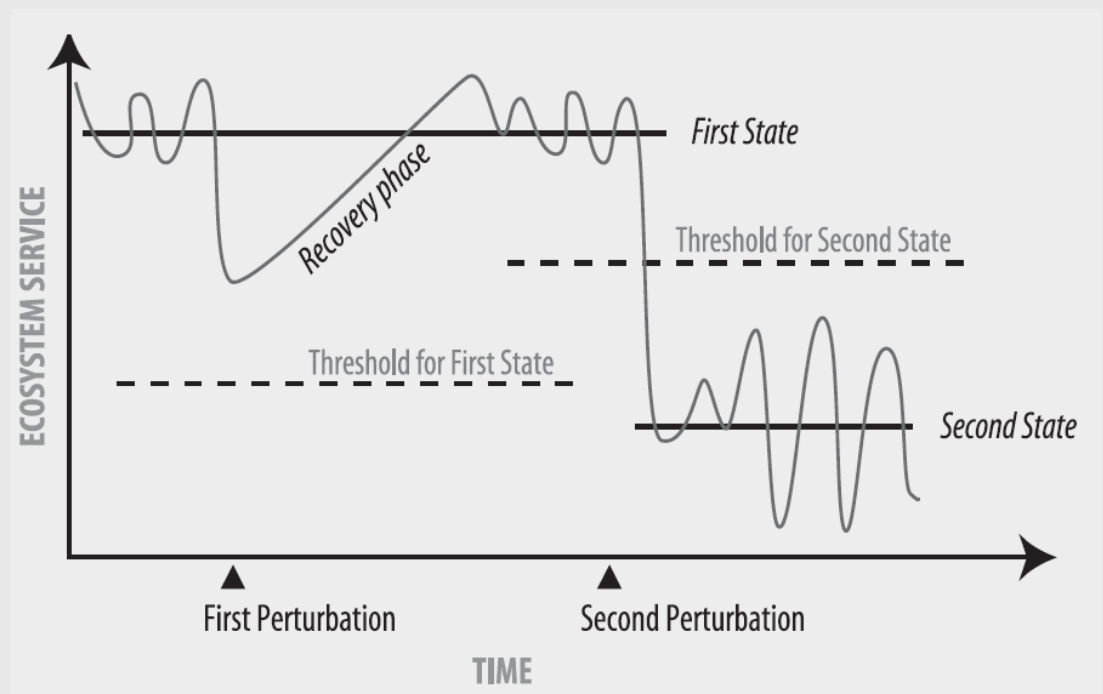# Level 2: Account 2: Condition

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 encountering changes in condition.

- It recovered its level of services, since the change was below the first threshold.

- After the second perturbation, it could not recover, since the conditions changed to below the new threshold.

- The result was a permanent decrease in that service

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?

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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
  - Data on ecosystem condition may be limited, but much can still be used in ecosystem accounting
  - There are no simple formulas to calculate ecosystem condition indicators for all purposes
  - 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.pdf37
- 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 evaluation form for this module
- ▪ 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.