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Session 7. Units and scaling of the accounts

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what do you see?

… timber, trees, a habitat, a landscape element, a beautiful view, shade, water filtration system, carbon reservoir, gene bank, iconic forest, weeds, a bushwalking opportunity, fire hazard …

Image: Wolfgang Glowacki

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emergent properties

- The concept of emergence was coined to designate properties of groups that cannot be entirely explained by their individual components (Mayr, 1982)
- Emergent properties of landscape mosaics (Bennet et al 2007)
  - the extent of habitat: area
  - composition of the mosaic: proportion of elements
  - spatial configuration of elements: heterogeneity associated with diversity
- Proposed SEEA Carbon account classification: “system level properties” (Mackey 2012 in Ajani paper)
  - Canopy density, energy use, nutrient cycling, resilience, adaptive capacity
- Key message: the units are not ecosystems

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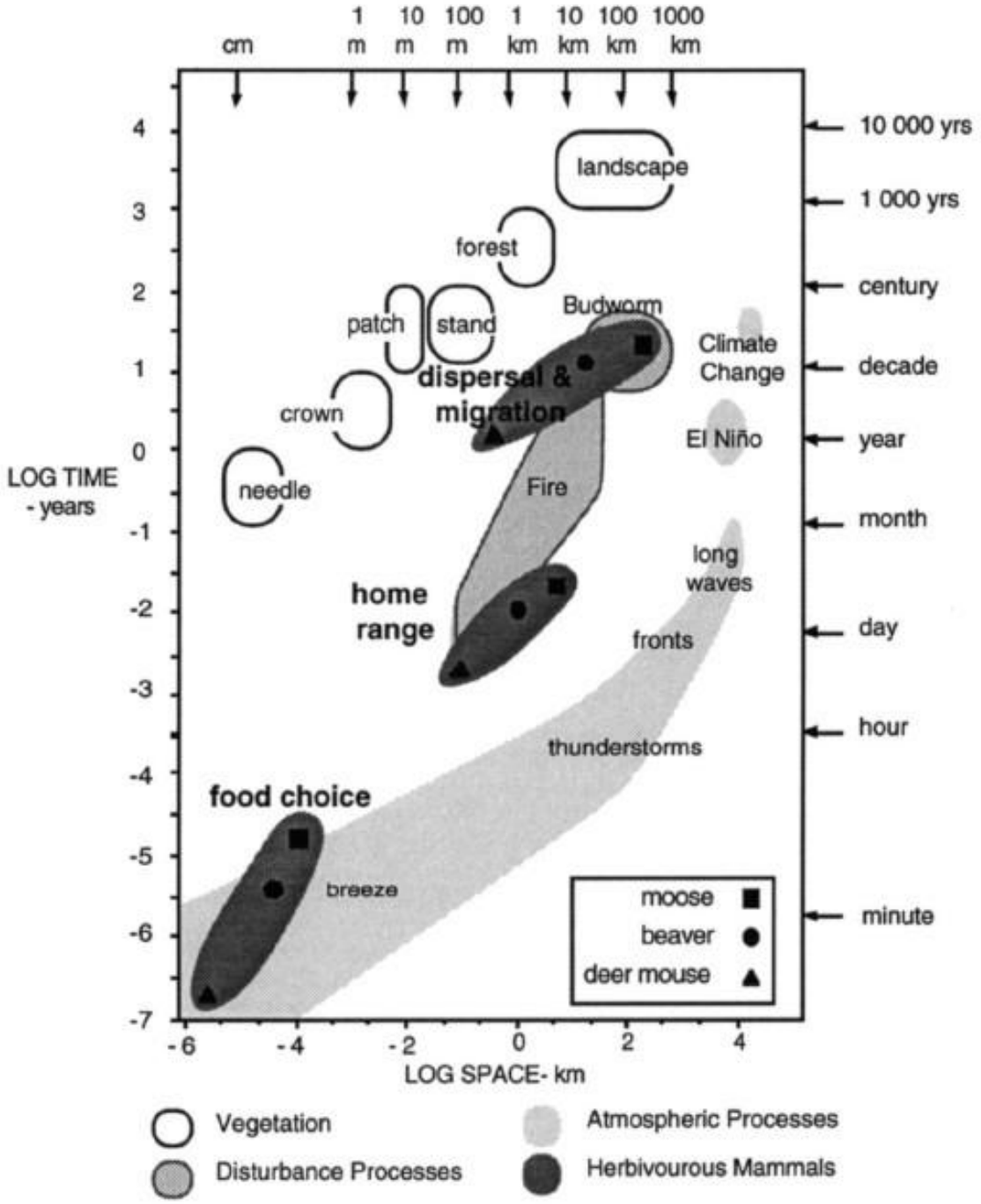
- Ecosystems are nested at multiple scales
  - Small and large
  - Fast and slow
  - More and less of an infinite number of variables
  - Diagram: Stommel
- Sweet spots (Harris)
  - “It depends…”
  - regional



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Review of Issue Paper

- Assumption: that a spatial approach is useful basis
- Terminology
  - “statistical units”, “aggregation units”
- Simplification, flexibility, accuracy
  - Must be applied at varying scales; ecosystems are inherently scaleless; choice of scale is related to purpose of account and nature of phenomena (“**scale matching**”)
- Ecosystem accounts are a “**platform technology**”
  - Supports analyses, enables collection and organisation of data
- Delineation vs. attribution
  - Statistical unit like business register (basic info), then
  - Additional attributes obtained by survey (data collection)

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Review of Issue Paper (2)

- Definitions
  - Statistical units
    - are the contiguous land, freshwater and marine surface areas to which information is attributed and which provides the basis to aggregate this information to regional, national and global levels.
    - Statistical units “belong” to an ecosystem, usually consisting of more than one statistical unit i.e. aggregations can make up a larger ecosystem.
  - Size of statistical units
    - The smallest statistical unit is based on observable core biophysical characteristics such as land cover, elevation (or depth in the case of water) and climate.
    - This information should be available for the entire country and available consistently for multiple time-periods at a resolution appropriate for the expected level of aggregation.

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Review of Chapter 2 draft

- SEEA EEA Objective: “The objects of measurement – the ecosystems – need to be defined from a statistical perspective”
  - P2.22 “there must be a clear focus for measurement”
  - P2.24 “… targeted at the macro level of analysis …”
  - P2.35- 2.29 Linking to economic units
  - P2.48-2.56 integration across scales
- P2.1 “In the SEEA, ***ecosystems are areas containing a dynamic complex of biotic communities (for example plants, animals and micro-organisms) and their non-living environment interacting as a functional unit.”***
  - P 2.10 **single** ecosystem can produce a range of ES
  - P2.22 “Further, ecosystems may be very small or very large and operate at different spatial scales”
  - P2.43-2.47 Ecosystem dynamics: Multiple states, irreversibility, complexity, lag effects, resilience

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Review of Chapter 2 draft (2)

- **P2.23 "A statistical unit in ecosystem accounting is the contiguous areas of [similar ecosystem characteristics, such as] land cover (e.g. forest, wetland), to which information is attributed and which provides the basis to aggregate information to larger spatial areas, including at the regional, national and global levels."**
  - P2.25 "… starting point … Land Cover Units or LCU." by land cover plus…
  - P2.26 "… information on the characteristics of LCUs should be available for an entire country and available consistently for multiple time-periods at a resolution appropriate for the expected levels of aggregation.."
  - P2.27 "LCU should be formed as contiguous areas of the same land cover type." Suggest FAO LCC v3. CO: "more elaboration needed."
  - P2.33 formation of "landscape units" – many ways to do it, including LC type.
  - P2.51 "Ideally, it would be possible to construct a register of land cover units containing standard information about these units. "
  - P2.52 "In statistical terms different "strata" of ecosystem would be designed and the characteristics would also form the basis for aggregations"

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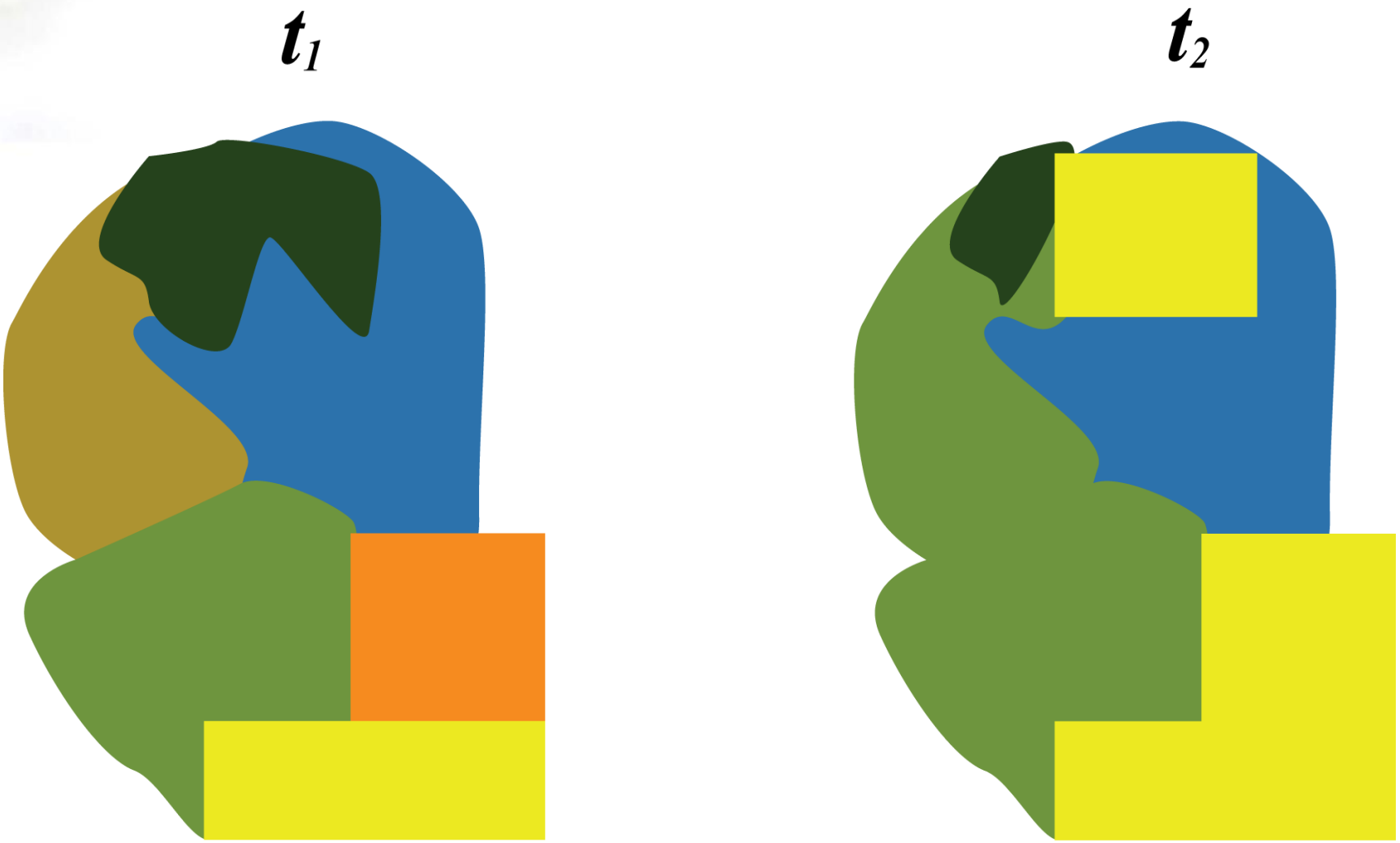
using land cover for ecosystem accounting



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“classification of land cover units for ecosystem accounting”

1. SEEA Part 2 Ch2 draft:
   - FAO LCCS 3.0 (land cover types),
   - but further elaboration required
2. Proposal from Di Gregorio (FAO), Jaffrain (IGN-FI) and Weber (EEA)
   - “In SEEA volume 2, the classification process of land cover functional units for ecosystem accounting starts from the land cover types of Volume1
   - First step:
     - detailed land cover types
   - Second step:
     - definition of land cover flows and
     - land cover functional units”

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Table 5. First sketch of aggregated Land Cover Functional Units (LCFU) classification

01 Urban and associated developed areas

02 Medium to large fields rainfed herbaceous cropland

03 Medium to large fields irrigated herbaceous cropland

04 Permanent crops, agriculture plantations

05 Agriculture associations and mosaics

06 Pastures and natural grassland

07 Forest tree cover

08 Shrubland, bushland, heathland

09 Sparsely vegetated areas

10 Natural vegetation associations and mosaics

11 Barren land

12 Permanent snow and glaciers

13 Open wetlands

14 Inland water bodies

15 Coastal water bodies

16 Sea (per memory)

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Back to basics…

- Sampling frame
  - Is a list of the “elements” (entities) within a population that can be sampled
  - “Units”, or “observational units”, refers to one member of a set of entities being studied.

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Ideal sampling frame

- An ideal sampling frame will have the following qualities:[1]
  - all units have a logical, numerical identifier
  - all units can be found - their contact information, map location or other relevant information is present
  - the frame is organized in a logical, systematic fashion
  - the frame has additional information about the units that allow the use of more advanced sampling frames
  - every element of the population of interest is present in the frame
  - every element of the population is present *only once* in the frame
  - no elements from outside the population of interest are present in the frame

Sarndal et al, 2011

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Application to ecosystems?

- For a population of ecosystems?
- Challenges
  - Ecosystems are multi-scaled, even scaleless e.g. Stommel
  - Ecosystems have complex emergent properties
  - **Cost**: available data is at particular scales

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Key questions and issues

1. To what extent should statistical units be defined in relation to individual ecosystem services (which may operate at different spatial scales)?
2. At what level of specificity should the smallest statistical unit be defined and what information is needed to delineate this unit (is land cover sufficient)?
3. Should there be aggregations of statistical units and, if so, for what purpose and can any specific methods be recommended?
4. How should marine ecosystems and the atmosphere be considered in ecosystem accounting?
5. How should statistical units for ecosystems be linked to economic units?

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ES as basis for selection

- The selection of the accounts [and their spatial units] should be based on the basis of what are the most powerful general proxies that underpin a relevant bundle of services for each unit.

Capacity account 1: Land cover distribution

	Spatial unit 1	Spatial unit 2	…
Opening capacity = distribution of land cover types			
Change = net changes for each type (forest, agriculture,…)			
Closing capacity = distribution of land cover types			

Capacity account 3: Carbon

	Spatial unit 1	Spatial unit 2	…
Opening capacity = stock of organic carbon in vegetation			
Change = additions (NPP) minus removals (harvest, grazing, natural disasters)			
Closing capacity = stock of organic carbon in vegetation			

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Identification of an ecosystem statistical unit

- Spatial constructor approach
  - Spatial tessellation (e.g. standard grid cell, 1 Ha, 1 Km)
  - 3D tessellation (e.g. GOESS)
  - Then add thematic attributes; “I belong to … ecosystem”
- Ecosystem thematic attribute approach
  - Fixed habitat: Land cover, functional unit, LCFU, SELU
  - Dynamic habitat: “hotspots”; marine (“key ecological features”), estuaries/rivers, air
  - Non-contiguous fixed habitat: groundwater dependent ecosystems (oases)
  - Non-contiguous dynamic ecosystems: migratory birds, pelagic fisheries
  - Cross-habitat ecosystems: salmon, eels, rock lobster,
- Ecosystem service/s driven attribute approach
  - For particular bundle/set of ES, identify all ecosystems with capacity to supply
  - Doesn’t need specific spatial attributes
- Ecosystem capital statistical unit
  - Quantity: may be spatial, but not only spatial (e.g. fish stocks)
  - Quality: condition may be highly complex and specific to account purpose and ecosystem
  - Capacity: is ES related, ecosystem understanding related, objective/target related

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Defining an ecosystem “statistical unit”

- Solutions??
  - **Spatial constructors** (“statistical assemblies”) can be used to construct ecosystem units
  - **Ecosystem statistical units** are constructed according to the population of interest as determined with criteria informed by the purpose of the account:
    - Ecosystem services (single, set (bundle))
    - Ecosystem capital
    - Low cost default: land cover and function based units
    - Other examples (including administrative aggregations)
      - SEQ via social process
      - Vic DSE via ecological modelling and economic criteria
      - SELU as socio-ecological criteria
      - MDBA sites of significance

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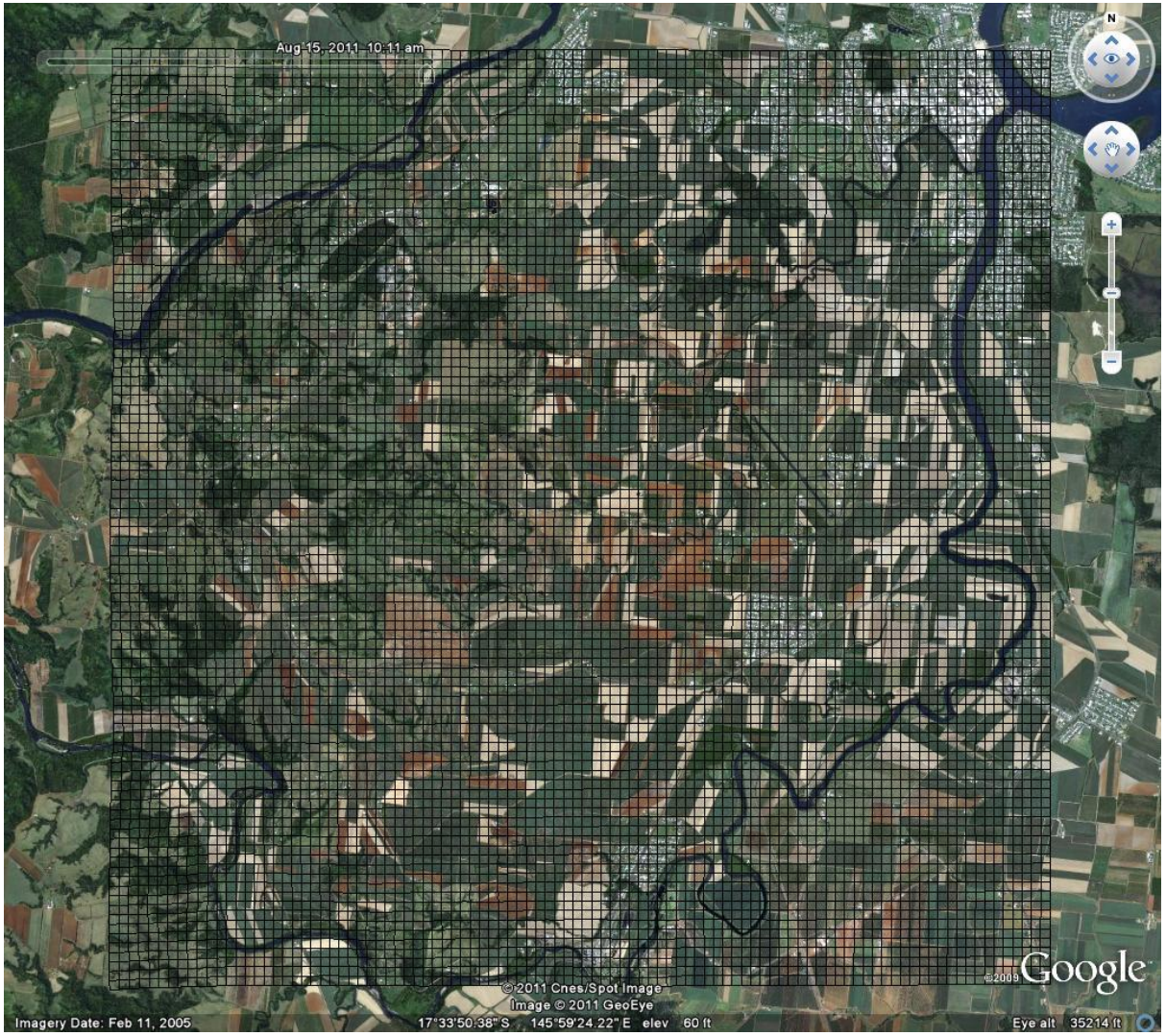
Spatial constructor (tessellation)



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Marine and coastal

- Linear shorelines with the intertidal zone as the central concept and then people extend landwards or seawards as they see fit
  - geomorphic (form and fabric) classification is basic unit (rather than land cover) i.e. soft/hard; then
  - muddy/sandy/gravelly/boulders/rocky;
  - then add life forms: mangroves, saltmarsh, seagrass, macroalgae
- Then subtidal areas can be split into
  - The **benthos (the bottom),** which can be treated like land cover i.e. habitat mapping including via geomorphology (silt, sand, gravel, boulders, rock/coral) and
    - "Structural Macro Biota" (SMB), which are the living life forms that modify the surface (e.g. coral, sponges/filter feeders, seagrass etc.).
    - At broader scales there is a cascade of biogregions and provinces and biomes etc.
  - The **water column** including upwellings, eddy's etc. – i.e. a 3D volumetric measure of some sort.

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Cadastre based – connection to economic units

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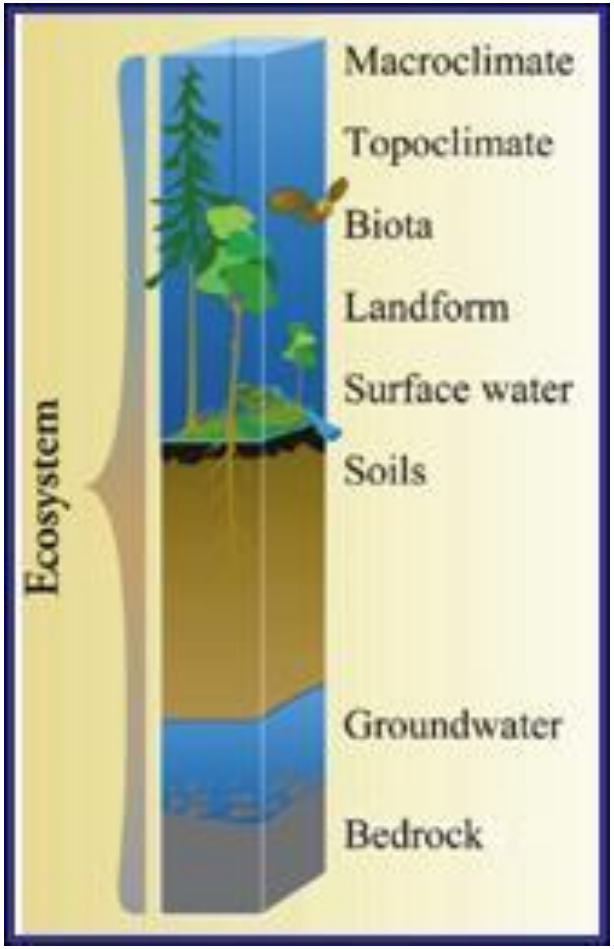
GEOSS – Group on Earth Observation System of Systems



- Almost every definition of ecosystems regards them as essentially scaleless, that is, they can range in size from a grain of soil, a pond, a forest, the tundra biome, even to the earth itself. The scaleless nature of ecosystems has created a basic ecosystem conundrum—researchers and managers interested in a particular ecosystem will always "custom" delineate the shape, size, and location of the ecosystem according to the particular research or management application.

http://rmgsc.cr.usgs.gov/ecosystems/method.shtml

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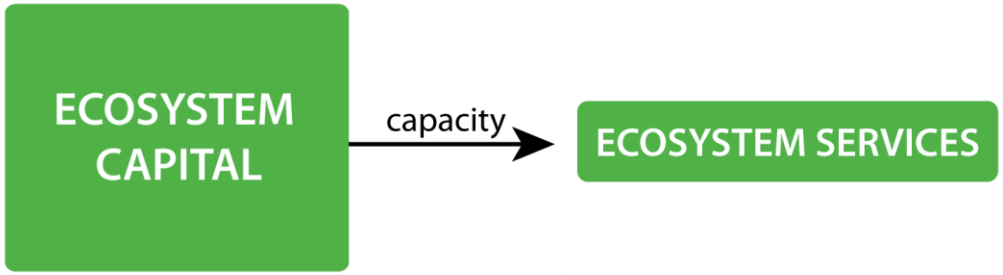

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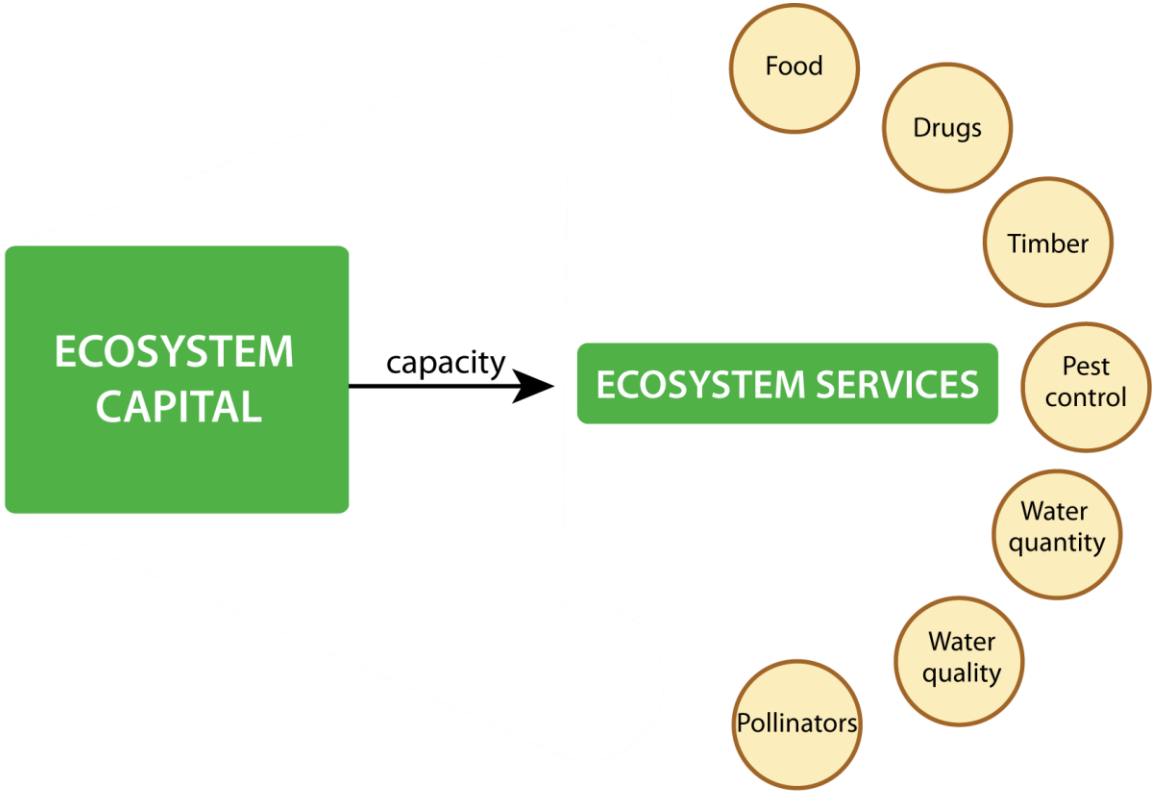

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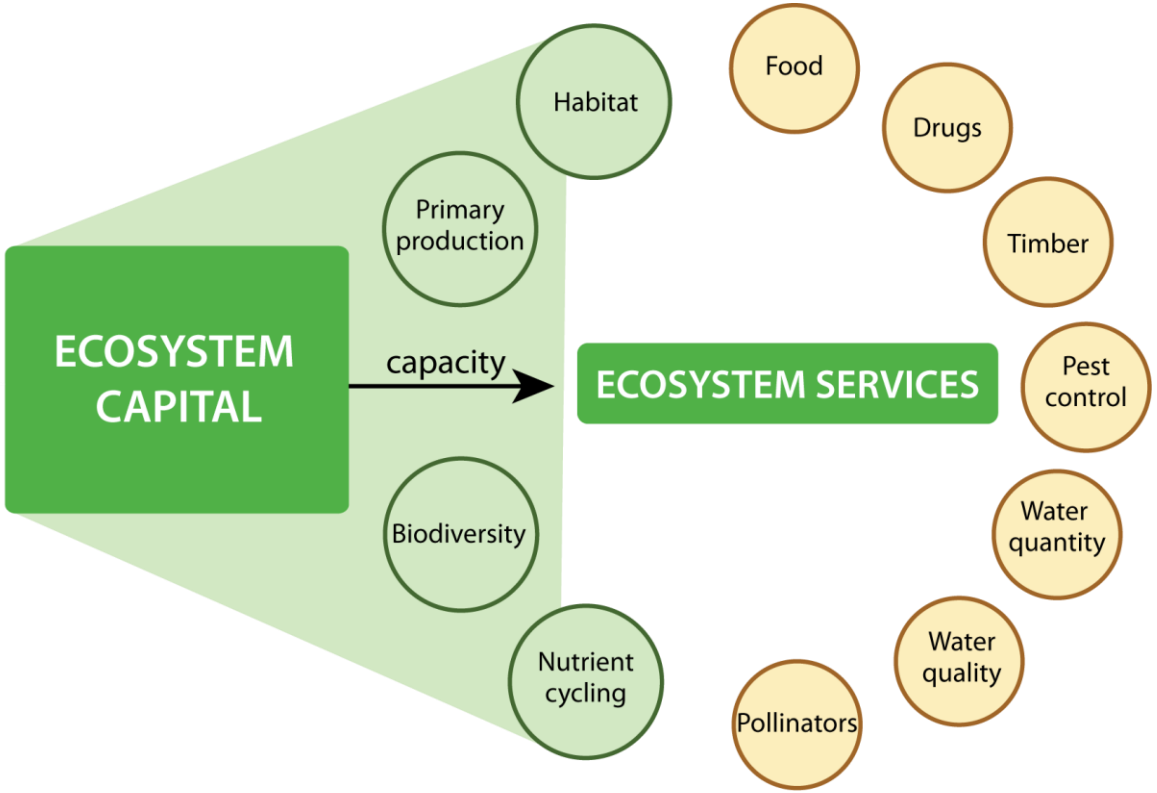

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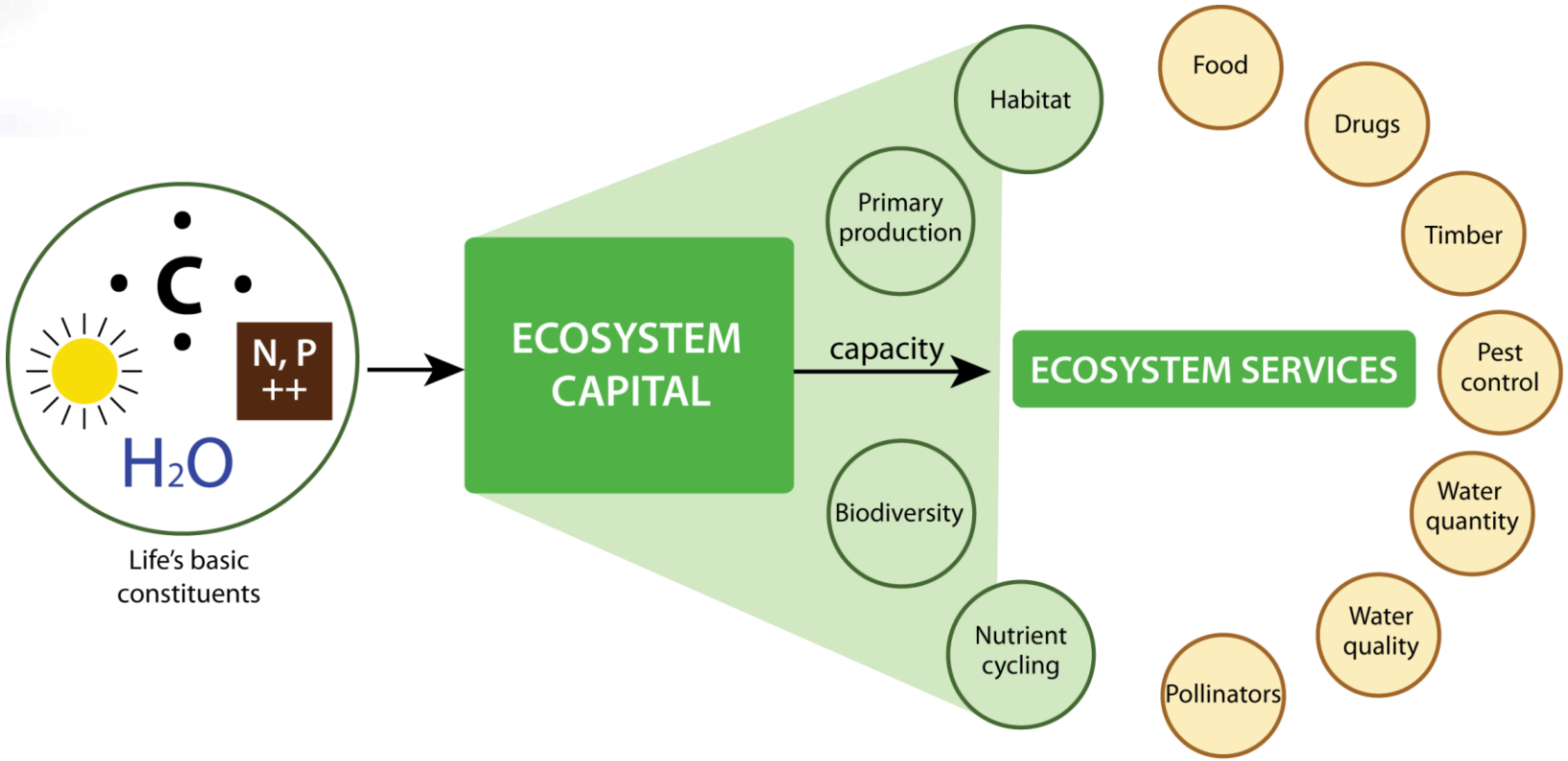

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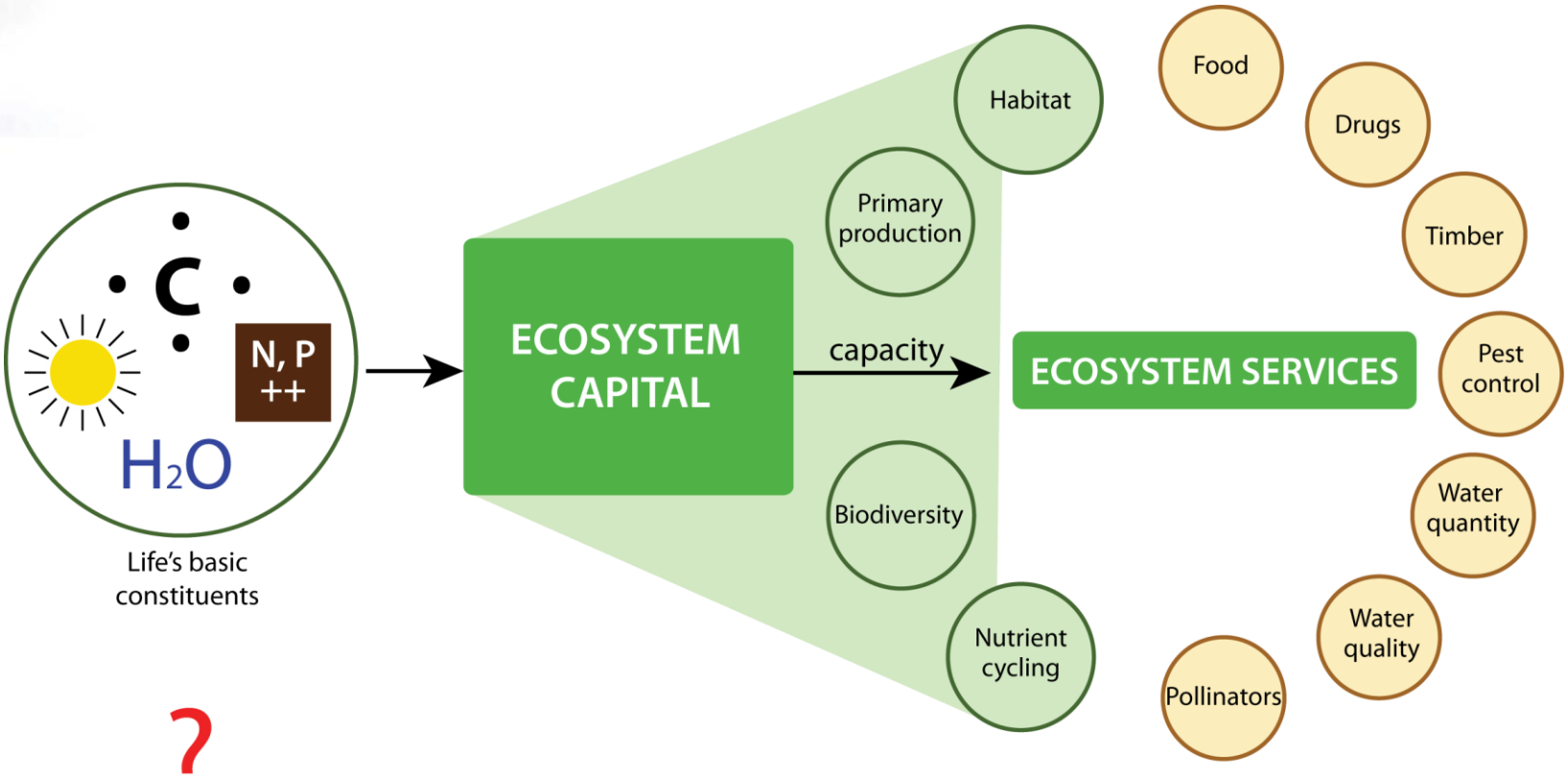

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Can measuring these....

...help us to account for these?

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