Delineation of spatial units in Ecosystem Accounting

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The spatial approach to ecosystem accounting

“The Ecosystem assets that are the basis for ecosystem accounting are spatial areas. Consequently the delineation of spatial areas within a country is a fundamental part of ecosystem accounting” (Technical guidance 2015, 2.4 Key boundary and conceptual issues, 2.4.2 The spatial approach to ecosystem accounting.)

The idea is to provide is to provide a comprehensive picture of ecosystem assets and the services they supply across the country without gaps and overlaps in measurement.

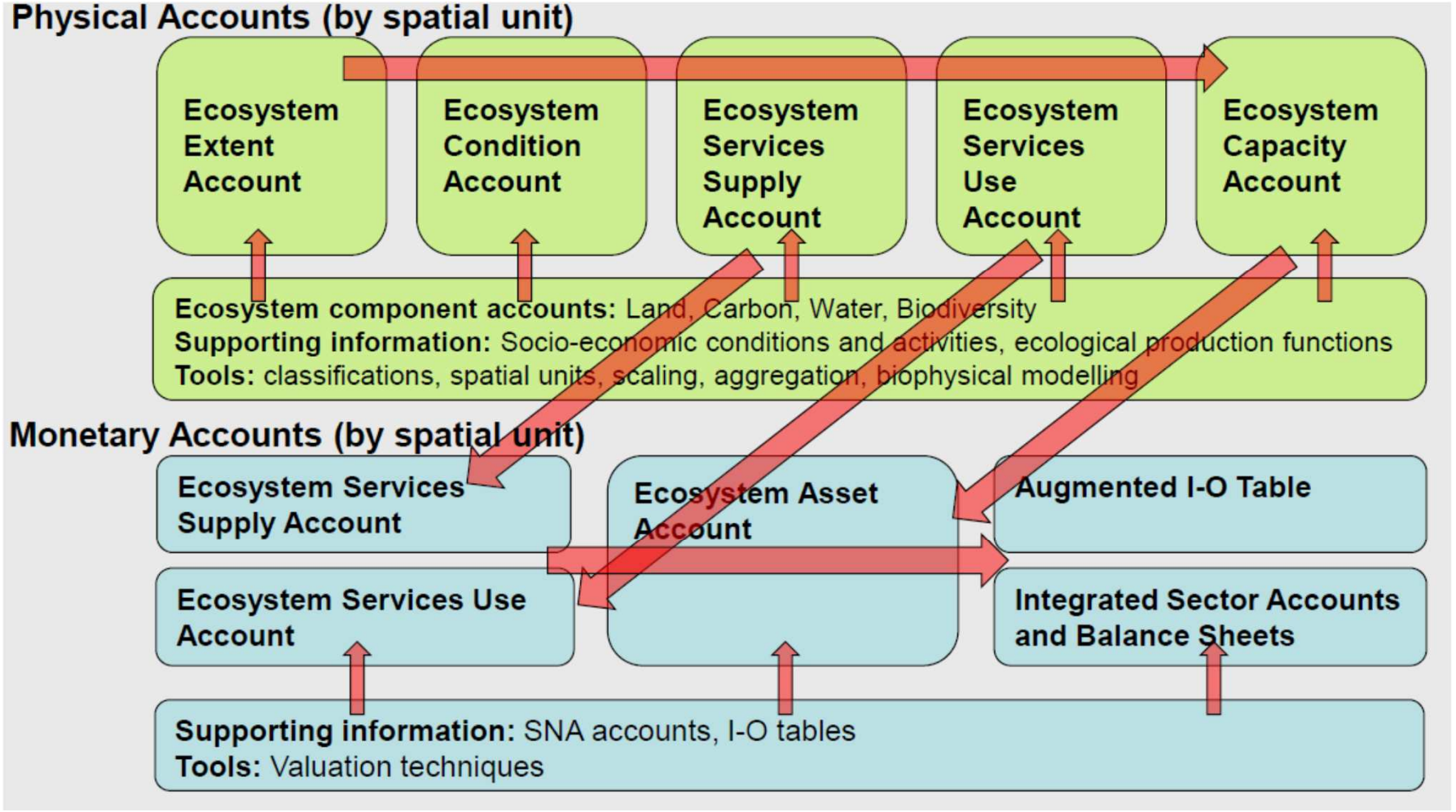
There are a number of issues to be resolved in a broad units model:

- The appropriate scale for analysis;
- Defining the relationship between the delineation of spatial areas (and hence ecosystem assets) and the generation of ecosystem services, particularly regulating services which may be generated over spatial areas that cross ecosystem types;
- Connecting the spatial units relevant for measuring the generation of ecosystem services with the location of beneficiaries of those services;
- The problem of up and downscaling to find the relevant level for aggregation and communication

Technical guidance suggests: These broad units should then be used in a number of accounts.

This presentation will discuss this issue: It seems reasonable that we will use different geographical delineations and spatial borders for registration, analysis and reporting.

Steps in compilation of ecosystem accounts



The Physical Accounts and challenges

- The extent account (table 4.2 of Technical Guidance) has 6 classes of land cover (LCEU) specified in terms of government and private, opening stock, changes and closing stock.
- Ecosystem condition (table 4.3) is specified by Ecosystem type, ecosystem extent and condition measures for vegetation, biodiversity, soil, water, carbon and an index.
- Ecosystem services supply (table 4.4) is specified in terms of land cover (LCEU) and types of services (CICES)
- Ecosystem services use account is specified by service type(CICES), ecosystem type and type of users. Here it is especially mentioned that the users may not be located in the area (LCEU) which is used.
- To have one spatial unit model for all the accounts of extent, condition, supply and use seems difficult enough, but if we are going to deal with capacity, competing baskets of services and policy analysis of trade offs it seems quite unrealistic.

Ecosystem capacity account

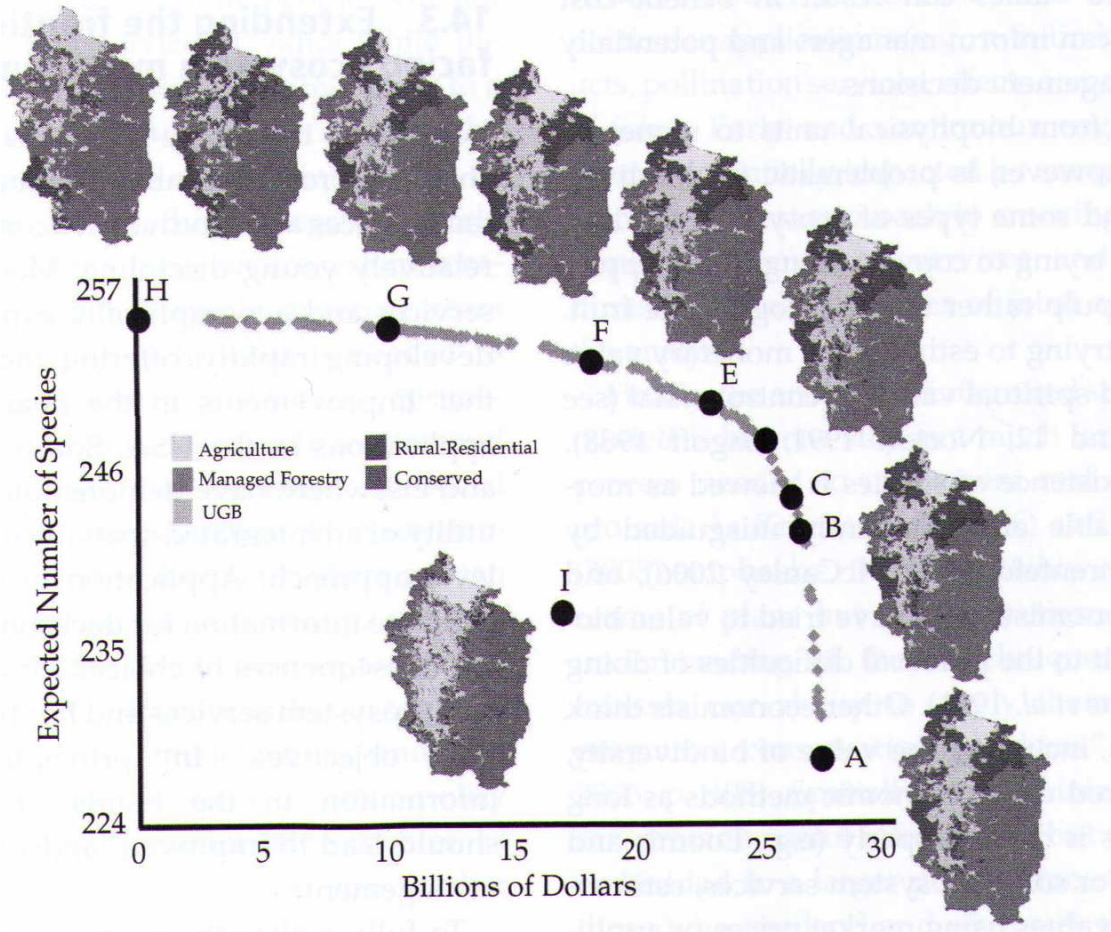
- Biophysical
- Capacity concept necessary for sustainability—capacity depends on the current basket of ESS production but also on the capacity to produce different baskets of ESS in the future

- Ecosystem Capacity account
  - Capacity a function of extent and condition
  - Reference condition (pristine? managed?)
  - Capacity accounts will be central to the analysis of trade-offs between different services.

Where to put things? Spatial land management to sustain biodiversity and economic return. Stephen Polasky et al (2008)

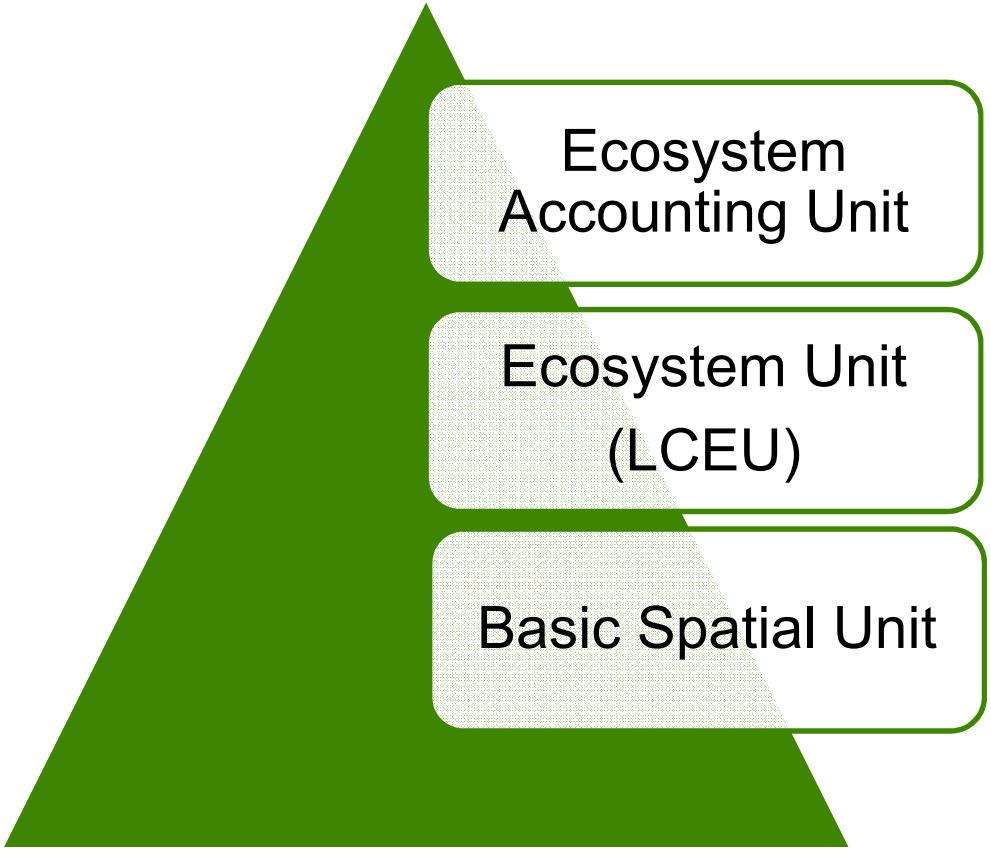
- A spatially explicit biological model that incorporates habitat differences, area requirements and dispersal ability betweeen habitat patches for terestrial vertebrate species to predict the likely number of species that will be sustained by the landscape.
- A spatially explicit economic model that incorporates site characteristics and location for a variety of land use (4 types of agriculture, timber production, residential housing, conservation use).
- State of Oregon, 10 000 km2, 10 372 parcels, 30*30 m for 2196 parcels
- Optimization of Economic value or Biodiversity to create an Efficiency frontier

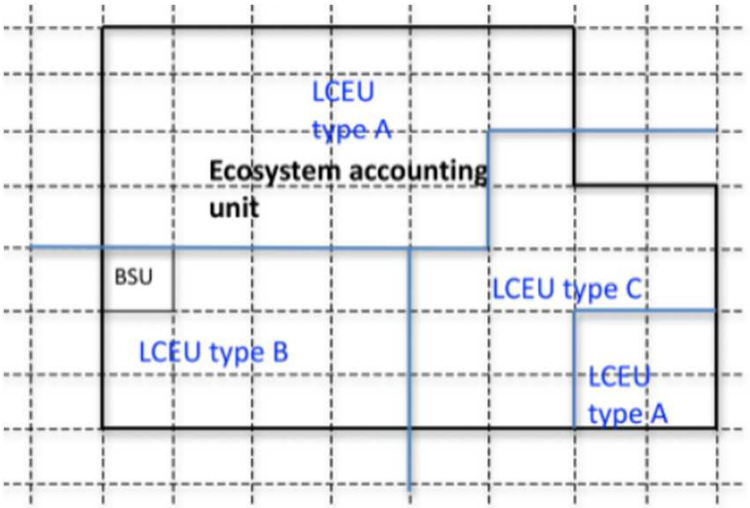
Efficiency frontier showing maximum feasible combinations of economic returns and biodiversity scores

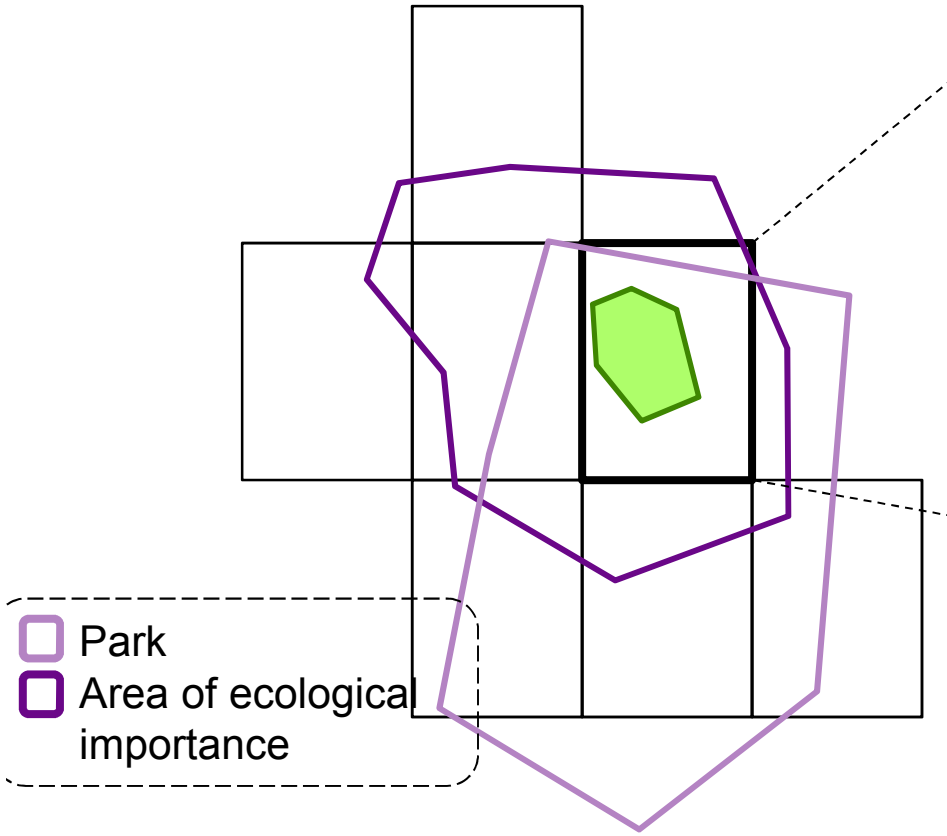


Source: Polasky et al (2008)

The Spatial Unit Hierarchy

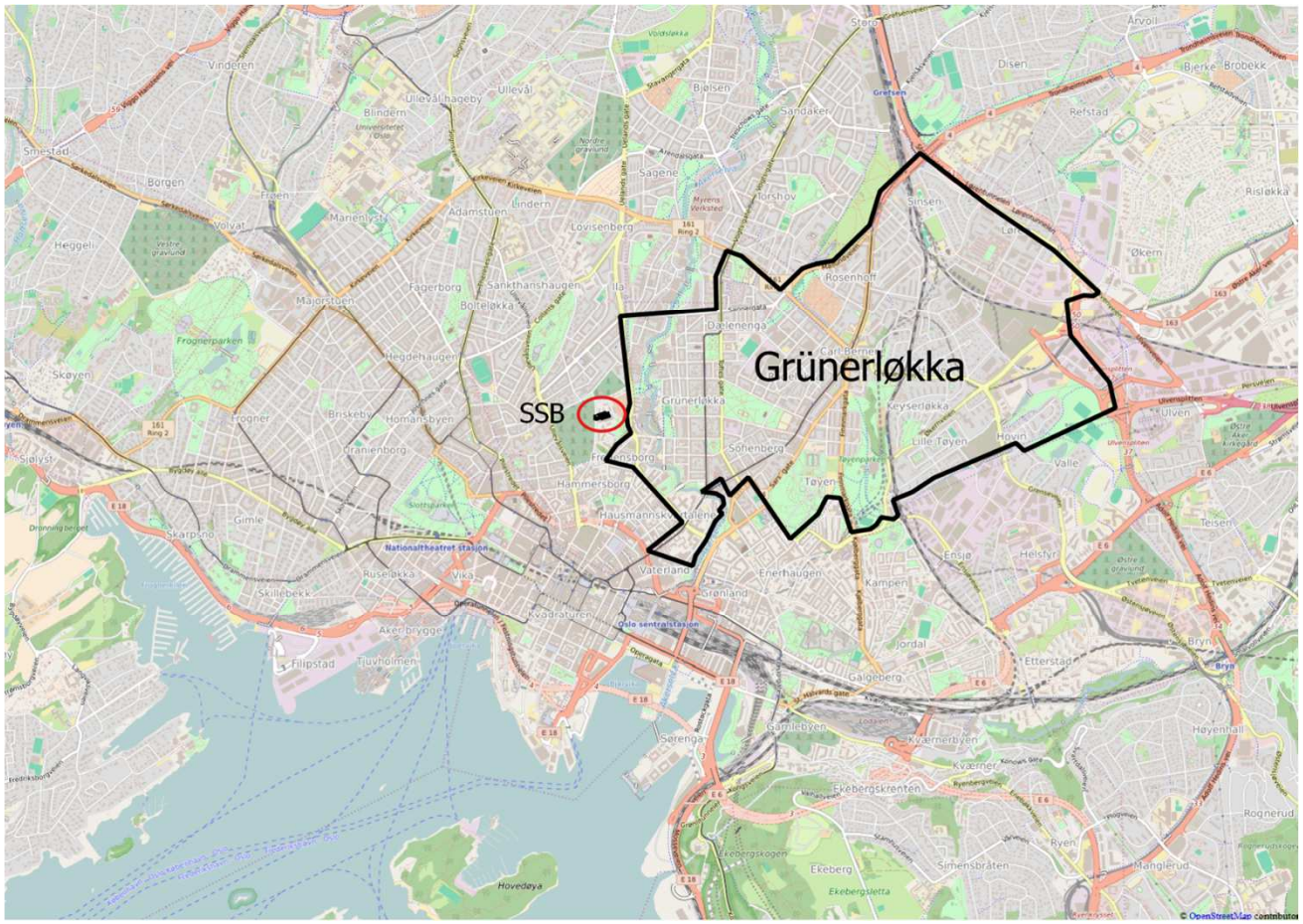






BSU size	100x100m
Park area	50 000m^2
Park quality	Medium
Area of ecological importance	IUCN Category II
Waterbody area	2500m^2
Waterbody type	Pond

Grid allows combination of different resolution data and different data types (qualitative/quantitative)



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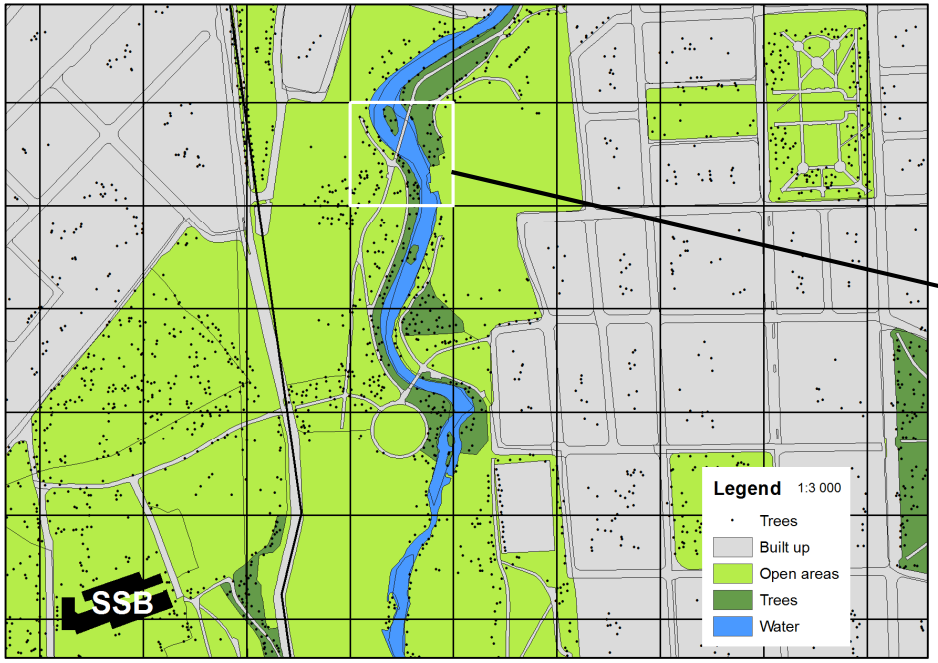
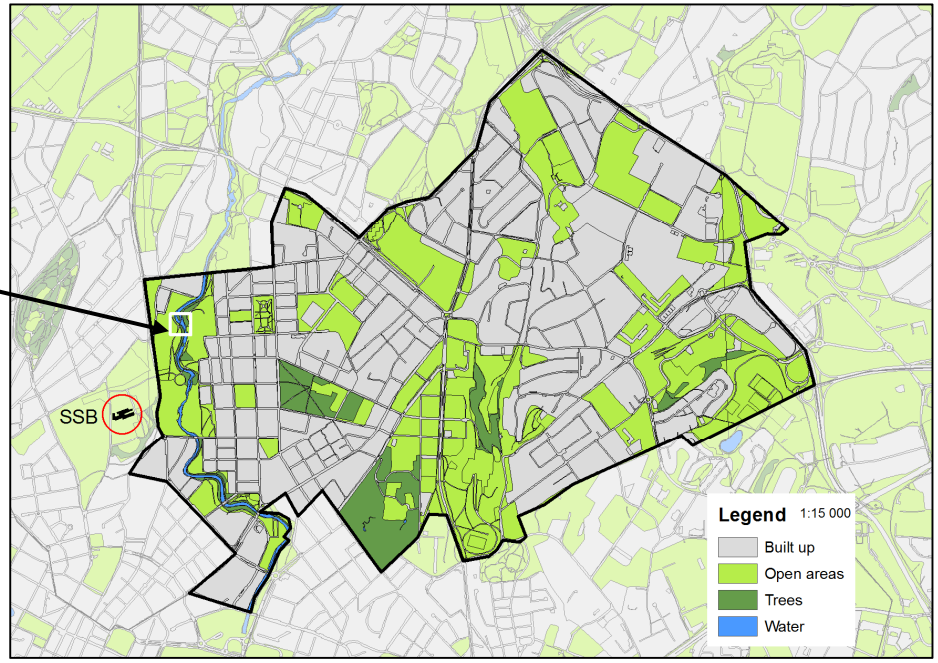
Basic Statistical Unit (BSU)



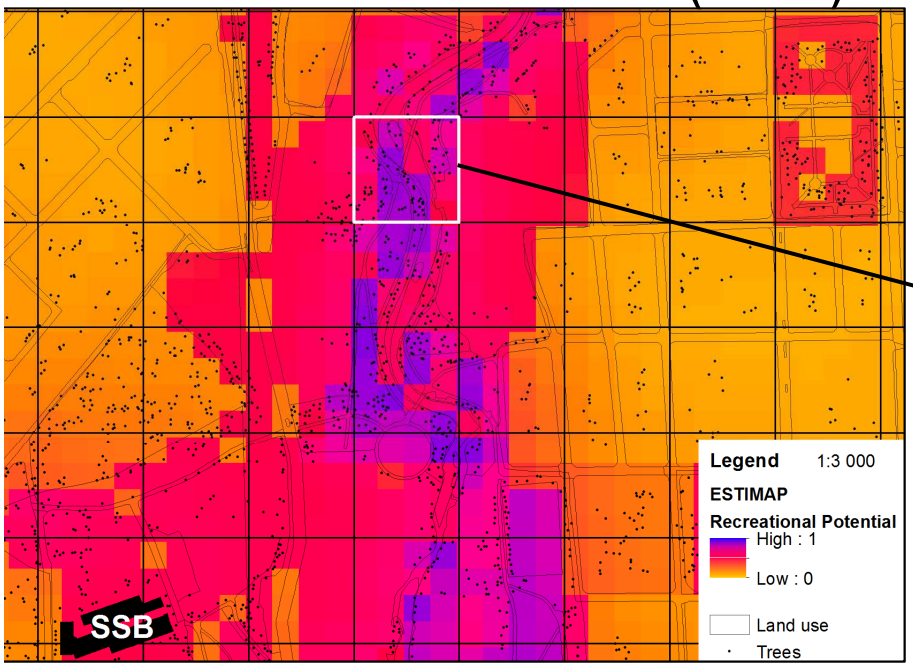
AAU ID	3
BSU ID	14
Unit area (m²)	10000
Number of trees	85
Built up (m²)	719,04
Open area (m²)	5109,76
Trees (m²)	1882,72
Water (m²)	2288,48

Ecosystem Accounting Unit (EAU)



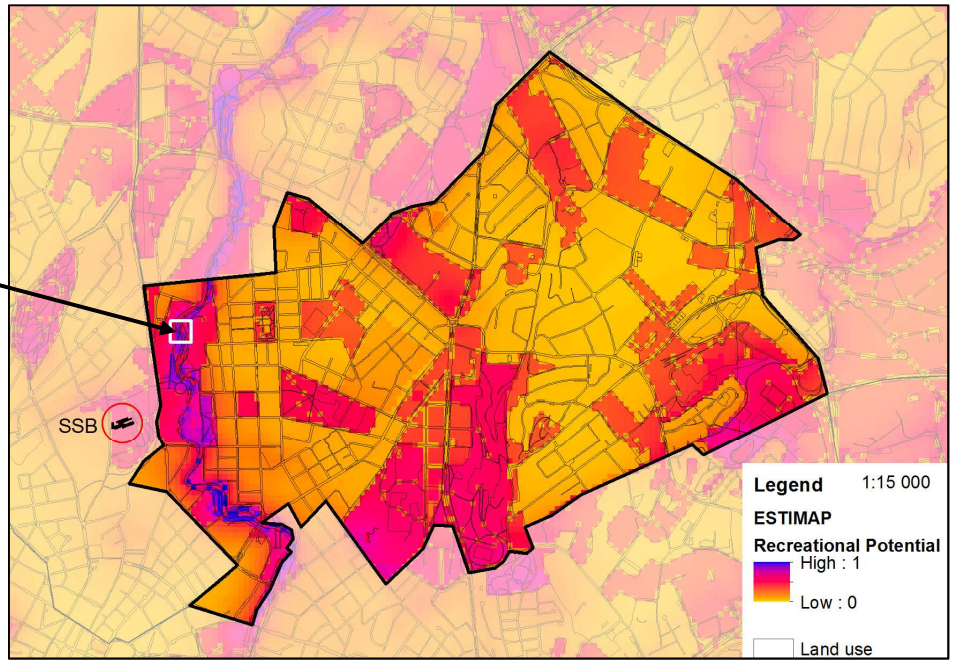
AAU ID	3
Unit area (m²)	4804452
Number of trees	13564
Built up (m²)	2998599,36
Open area (m²)	1534009,28
Trees (m²)	240735,04
Water (m²)	31088,64

Basic Statistical Unit (BSU)

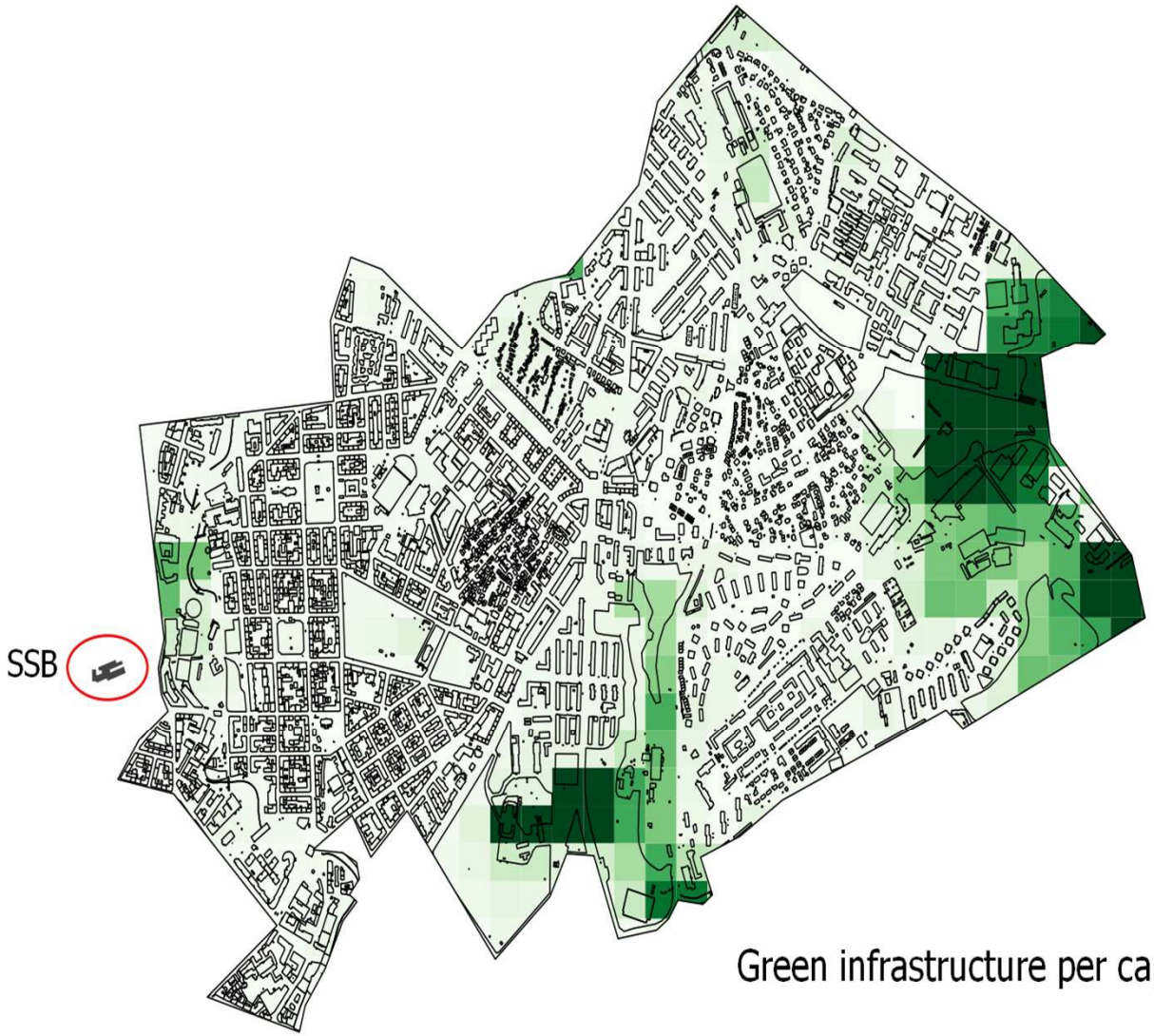


AAU ID	3
BSU ID	14
Unit area (m²)	10000
Mean Recreational Potential	0,6903
Number of trees	85
Built up (m²)	719,04
Open area (m²)	5109,76
Trees (m²)	1882,72
Water (m²)	2288,48

Ecosystem Accounting Unit (EAU)



AAU ID	3
Unit area (m²)	4804452
Mean Recreational Potential	0,2274
Number of trees	13564
Built up (m²)	2998599,36
Open area (m²)	1534009,28
Trees (m²)	240735,04
Water (m²)	31088,64



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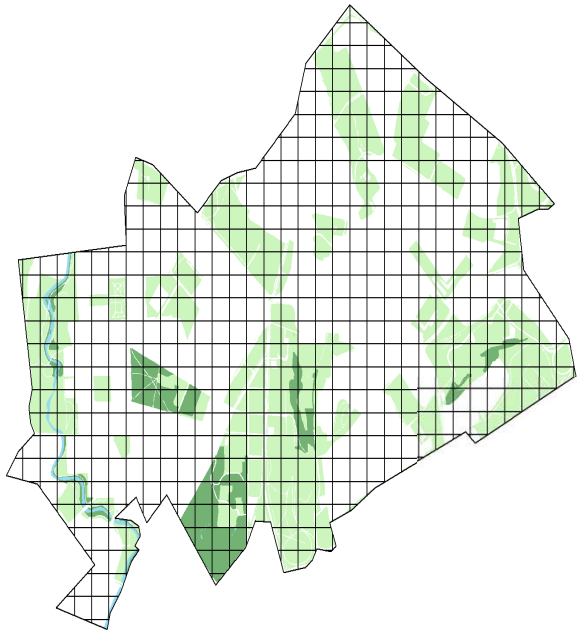
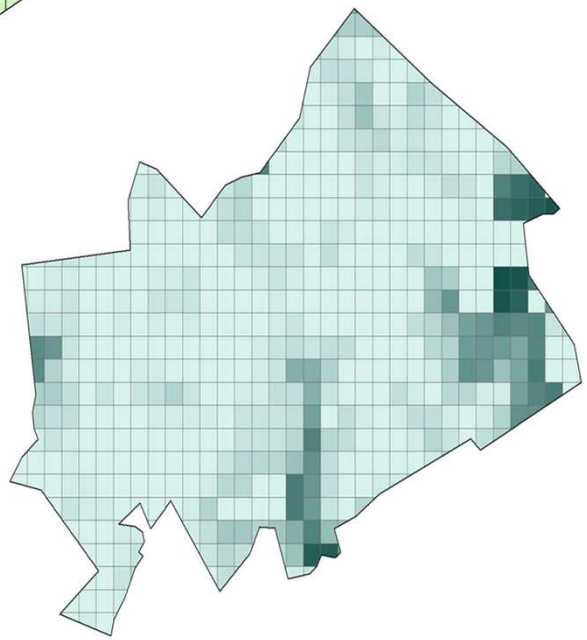
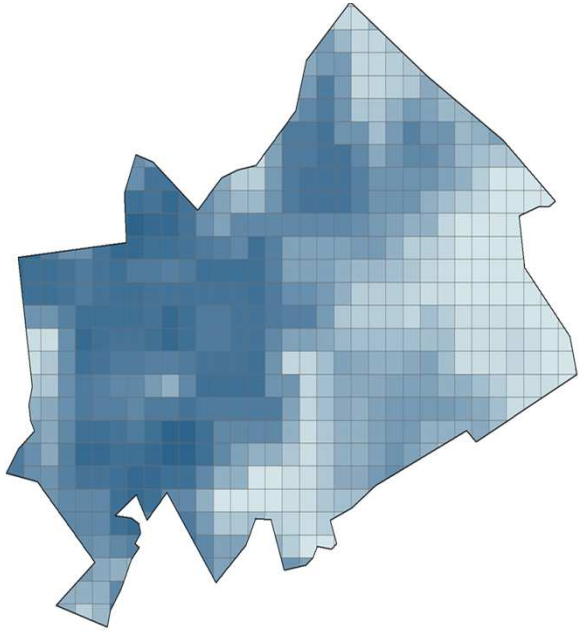
Darker green means a higher score



Land cover



Green Infrastructure per Capita



Population

INDICATOR CREATION FROM ECOSYSTEM COMPONENTS

Solution to the spatial Problem: Fixed vs. Flexible spatial units?

- A more flexible approach is called for.
- The underlying data structure may be polygons, geographical sampling and modeling, and originally registrations of data will be preserved.
- The first step is to determine amount of services in an area and who are using these services.
- The next step is to perform a prioritized analysis of trade offs and policy choices and select a reporting unit, matched by maps to the public and the management agencies.
- Analysis may be based on some sort of a grid (hot spots, different combinations of services, users and ecosystem conditions and trade offs). The analysis may involve different degrees of complexity. As very well demonstrated in NATURAL CAPITAL, Theory and Practice of Mapping Ecosystem Services, Peter Kareiva et al Oxford 2011.
- This flexibility in spatial units will also make it easier to use the large amount of new GIS and satellite data as well as big data platforms.
- Reporting units can be of different categories, for example an ecosystem type within an administrative area or within a watershed area.
- Over time the ecosystem may change in both extent, condition, supply of services etc. We may then change the reporting unit to illustrate the most important changes. This type of recalculation to another base level is not uncommon in the production of statistics, and quite feasible with today's computer power.
- Different purposes gives rise to choice of different geographical scales: There will be differences in resolutions and accuracy, depending on the specific purpose (overview vs. management)