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CHALLENGES IN THE MEASUREMENT OF NATURE IN OFFICIAL STATISTICS
SESSION 1. From environmental and territorial statistics to ecosystem accounting

SOME CHALLENGES OF ECOSYSTEM SERVICES MEASUREMENT: DATA GAPS AND CONCEPTUAL ISSUES

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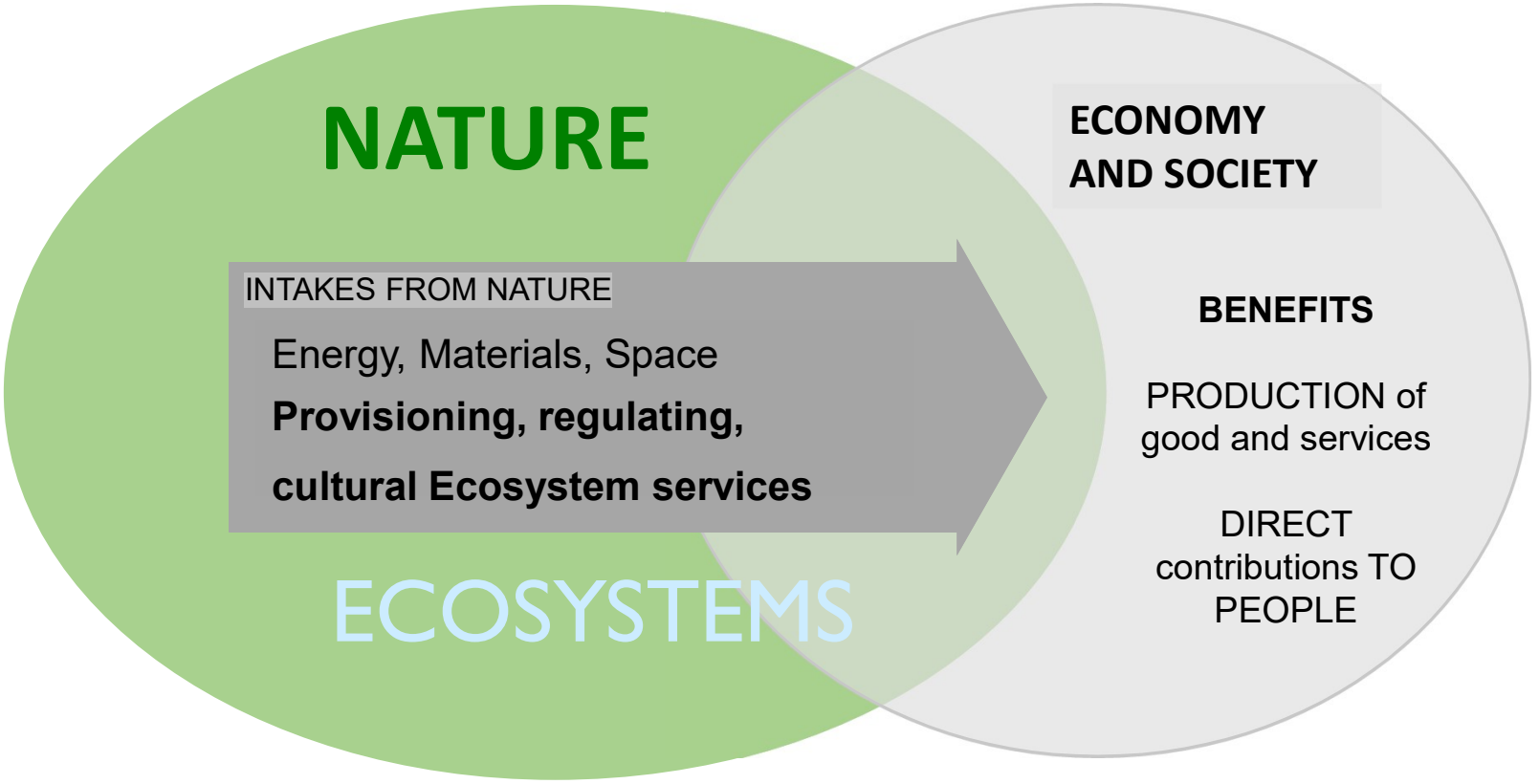
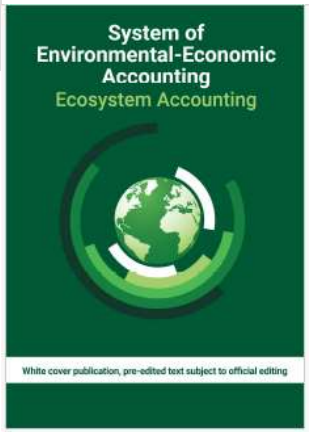
Outline

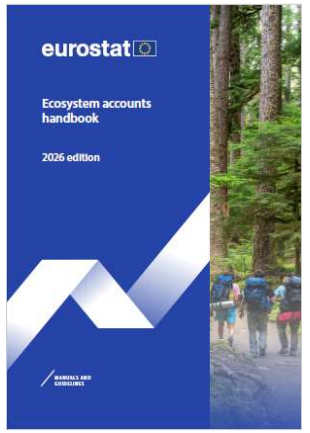
- Some words on ecosystem services and their measurement in general
- Methodological challenges of a basic conceptual nature
  - The “ecosystem contribution” challenge (an elusive concept)
  - What do we actually measure (indicators)
  - How do we actually measure what we measure (reliance on models and assumptions)
  - What determines the actual flow of ecosystem services? (What does change signal?)
- Methodological challenges of a more practical nature
  - lacking or insufficient data sources
  - solutions adopted or searched for
- …illustrated with examples from the seven ES in the European Regulation
- Conclusions

Ecosystem services in the manuals

"the **contributions** of **ecosystems** to **benefits used in economic and other human activities"** (SEEA EA 2.14; Eurostat manual Chapter 4).

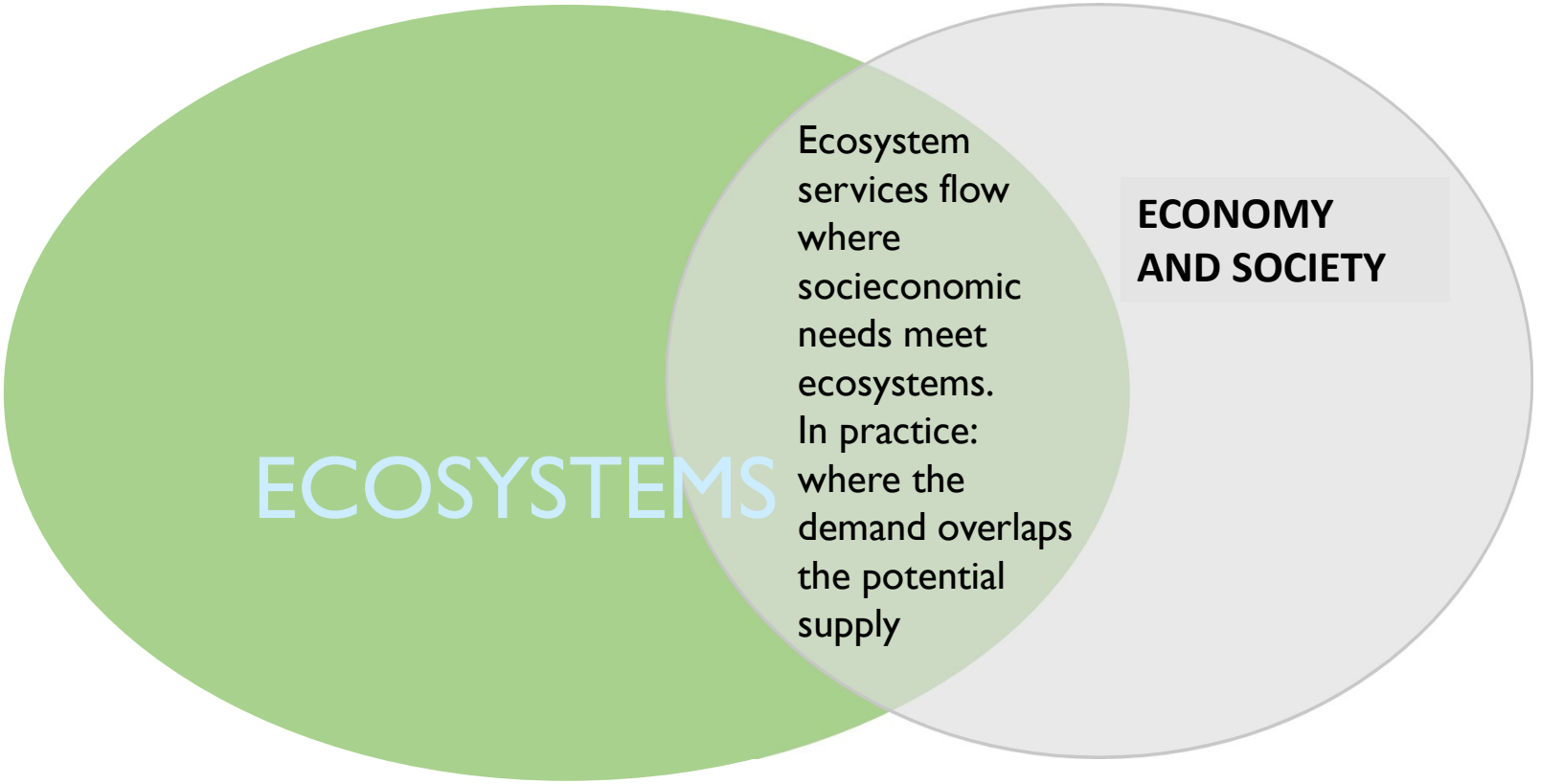




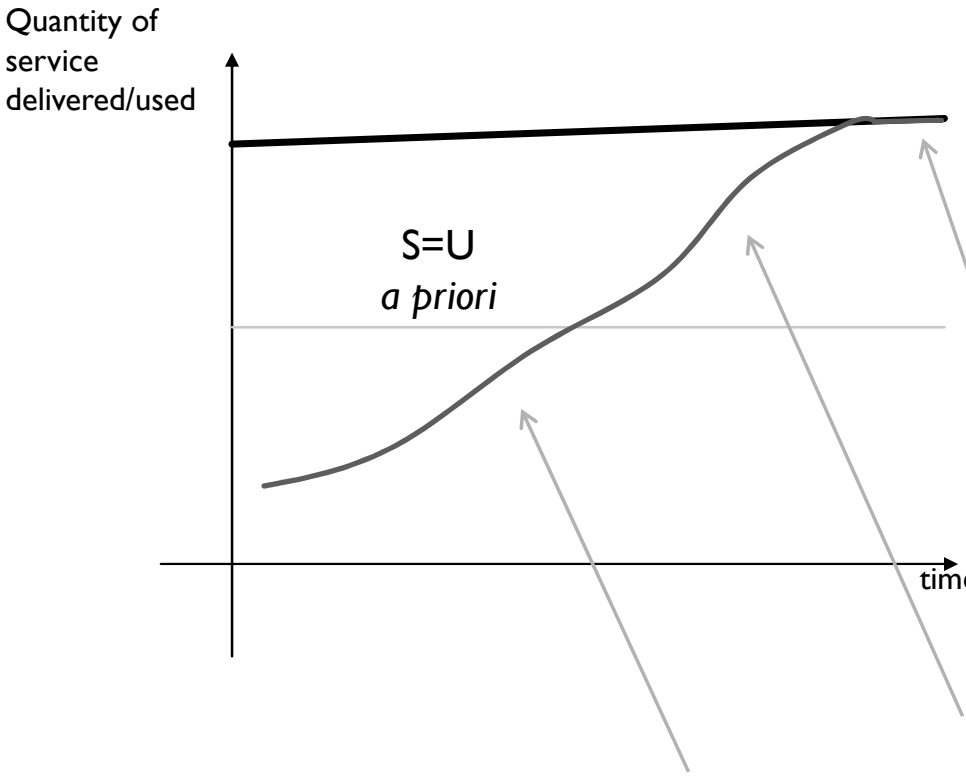


How do we measure ecosystem services?

"the **contributions** of **ecosystems** to **benefits used in economic and other human activities"** (SEEA EA 2.14; Eurostat manual Chapter 4).



Who drives the dance?



Saturation point of Ecosystem's ability to deliver the services

Unsustainable use

Sustainability threshold (capacity)

Sustainable use

ES change signals change in Ecosystem's ability to deliver them only when saturation has been reached.

In this case, use may already be unsustainable

As long as saturation has not been reached, a change in the measured ES level only signals change in demand/use.

Provisioning ecosystem services in the Regulation

CONCEPTS:
Crop provision: ‘the ecosystem contributions to plant growth’
Wood provision: ‘the ecosystem contributions to the growth of trees and other woody biomass’

What is precisely the ecosystem **contribution**?
No provisioning service would exist without nature’s ability to combine elements as to give crops or wood.

METRICS:
=> Crops: “as *approximated* by the amount of harvested crops for different uses” (in Material Flow Accounts)
=> Wood: “net increment as defined in Annex VII [i.e. the Forest Accounts module] in thousand m^3 overbark”

- “**Contribution**” is recognised **as a non-exclusive concept**, it does not refer to % of “merit”.
  (non-marginalist, rather physiocratic approach)

- **Products’ quantities** provide an **indication** of ES importance.

Pollination

- A regulation Ecosystem Service in the SEEA EA, "may be recorded as a final or intermediate service“
- Restricted to the pollination **of crops** in the EU Regulation and handbook (i.e. the part of the Ecosystem contribution to crop provision that can be attributed to wild pollinators)

  => «of which» of crop provision, final «of which» of SEEA EA pollination.

Main theoretical challenge: the INCA tool provides estimates based on two assumptions:

1. That every ecosystem type able to support (nesting and foraging) wild pollinators is actually inhabited by them. One crucial factor are the *conditions of the habitats, e*.g. pesticide pollution.
2. That the flowers of the cultivated plants in reach of wild pollinators, based on suitable habitats (≡ pollinators presence) and flight range, are actually visited by the pollinators.

The first of these assumptions is particularly strong. A solution fit for official statistics would be to “go and see”… not much practiced, as far as we know.

The practical challenges (data requirement for the application of the *model*) concern the mapping of both the potential supply (presence of pollinators based on detailed extent map, linear positive and negative features) and of the demand (spatial location of pollination-beneficiary crops).

Air filtration

The main **data** challenges for the application of the given model concerns **national** data inputs:

- Of course, as for all other services, the ecosystems map. For this service, level 2 of the EU tipology is sufficient for use in the tool. The maximum possible resolution level will be used (10 m).
- Air pollution raster (PM10 and PM 2,5 concentration maps – possibly monthly data): the default input's (Copernicus CAMS air quality reanalysis) resolution is in the order of kilometers...
- Leaf Area Index map, coherent with the ecosystem map, and possibly at higher detail (the default has 300 m. resolution), and monthly frequency
- Wind speed raster data (optional) preferibly with monthly frequency.
- Net deposition coefficients applicable to each LAI / wind speed couple.

Some experts in the WP expressed skepticism concerning the **model** adopted in the Eu guidance itself: «urban canyons» (where a higher LAI implies PM entrapment), vertical air mobility, hot spots, need for higher detail in the ecosystem tipology. As for the data, there are substantial uncertainties on deposition velocity and PM concentration (ground-based data are different from CAMS).

Unfortunately, however, **no alternative model and dataset seems to be readily available for use at national level**

Local climate regulation

Measurement target: **air temperature** differential between the actual and the **reference situation**.

The model basically consists in a two-step regression.

- The first step connects **soil temperature** (observed) with ecosystem characteristics (TCD, Evapotranspiration).

=> It is necessary to establish the **counterfactual reference situation** «no service provider available» as for soil temperature.

- The second step connects soil temperature with **air temperature**. In the tool, this regression:

- has only «latitude» as a control variable;
- its parameters are estimated on the basis of american data!

In fact, it is a fixed linear relationship, given the latitude of the city (LAU).

Collecting, organising, plugging into the model/tool Italian data is a **strictly necessary** task which is being carried out by some WP members. Results will then have to be validated.

A worrying feature is that the effect of vegetation is in some cases estimated to be negative (observed soil temperature lower than what the model says it would be with no vegetation)!

Global climate regulation

Two components, whose sum boils down to the closing stock:

- Carbon sequestration during a year: LULUCF estimates: managed forest, grassland, cropland, wetland, settlements and other land
  => challenge: cross-tabulate these with ecosystem types (on a maps basis!)

- Carbon stored as opening stock: Eurostat-provided look up table, with stock of carbon per hectar by ecosystem type.
  => challenge: use national data. At the moment it seems that only the «Forest» model by ISPRA (most recent available data: 2023) is available. Llimited to forests, as the name tell
  => are look up tables good enaugh for official statistics? Do they not beg the question?

Nature based tourism

Definition: "*the ecosystem contribution, in particular through the biophysical characteristics and qualities of ecosystems, that enable people to use and enjoy the environment through direct, in situ, physical* ***and*** *experiential interactions with the environment. These contributions shall be reported in number of overnight stays in hotels, hostels, camping grounds, etc. that can be attributed to visits to ecosystems* "

⇒ A constituent element of the measurement target (in red) is inherently unobservable

⇒ Overnight stays are a perfect example of why we insist on "indicators, not measures of"

- Most suited source: "demand-side" survey on tourism (only cover a fraction of overnight stays)
- Model default: determine and use the "ecosystem attractiveness scores" to allocate overnight stays:
  - to ecosystems in general
  - to specific ecosystem types

Assumption of tourist presence similar to that for wild pollinators; attractiveness based on look up tables; impermeable territorial borders.

Pragmatic compromise =>

- Combined use of accommodation-side and household-side tourism statistics for NBT in general;
- Use of RPM for allocation to ecosystems
- Development of a national version of the "recreation Potential Map"

The limit of modelling: theory-laden observation

- Statistics should be based on observation
- OK… No observation ever is totally theory-free
- Theory-ladenness: if direct observation is substituted by models, the theories supporting them enter measurement as determinants of the data on the phenomenon measured. But it is theories that should in principle be assessed on the basis of observation, not vice versa! (Wikipedia: “akin to the informal fallacy of begging the question”)
- Assumptions are most of the time reasonable enough – but is “reasonable enough” enough for official statistics?
- Way out: more observation (longer term development objective)!

Conclusions

The measurements concerning ecosystem services still need a lot of refinement.

We are looking for solutions responding to official statistics' principles as much as possible.

We have seen:

- Methodological challenges of a basic conceptual nature
  - "ecosystem contribution" is most of the times inherently non-separable. Nature as **object** to which human activity applies, not as actor (=> consequences for production boundary extensions)
  - Indicators, sometimes rather indirect ones
  - Hypotheticals, counterfactuals and assumption-laden models => go for observation
  - Interpretation of indicators needs telling apart change in supply from change in demand
- Methodological challenges of a more practical nature
  - Develop data sources, when insufficient even for the given tools
  - Improve models
  - resources are needed for data search, elaboration and programming.

A final remark

Oftentimes we are confronted with a sort of moral blackmailing:

"If we (official statisticians) don't do it, others will, and it will be worse.

=> accept what's at hand, even if it is not optimal."

Sometimes however the solutions are so far from optimal that they fall under the threshold of acceptability. This means **reputational costs** for official statistics.

=> "Accept it anyway, we will have a basis for improvement. If we do not start, we will never get to good measures".

The balance between costs and benefits in the **repeated** reputational game crucially depends on whether the improvement promise is respected or not. My experience in environmental accounting is that it often is NOT, especially when it comes to information sources (time inconsistency).

An expert is someone who knows some of the worst mistakes that can be made in his subject, and how to avoid them

(Werner Heisenberg)

Thank you

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