Linking condition to services

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• Working definition:
  – **ecosystem condition**: those characteristics of the ecosystems *that are not services per se, but affect the availability of multiple services*

• This suggests an operative way forward:
  – find characteristics that influence ES (→ systematic review)
  – put them into a large database
  – identify (groups of) „influential characteristics”
  – compare them to existing proposals for condition indicators, find gaps, redundancies, etc.
Data source

- OpenNESS (Task 3.1, „Contribution of natural capital to ES flows“)
  - systematic review of **12 ES** with **60 papers** for each (→ 720 papers altogether)
  - first results published (Smith et al. 2017, Ecosystem services)
  - database available for further reanalysis

- We filtered the papers, and did a more detailed analysis:
  - kept only **10 ES**
  - **only European papers** (the task was to support EU policies)
  - only kept **primary studies testing statistical relationships** between EC and ES
  - randomly selected **10 papers for each ES** (→ 100 papers altogether)
• Timber production
• Freshwater fishing
• Pollination
• Pest regulation
• Carbon sequestration
• Erosion protection
• Flood protection
• Water quality regulation
• Air quality regulation
• Recreation (aesthetics)

• Urban
• Cropland
• Grassland
• Woodland and forest
• Heathland and shrub
• Sparsely vegetated land
• Wetlands
• Rivers and lakes
• Marine inlets and transitional waters
• Coastal
• Shelf
• Open ocean
• What kind of characteristics to consider?
  – reasonably variable (*constant or extremely variable* is not OK!)
  – can be linked to a location (mapped)
  – can (potentially) be covered by data sources over large areas
  – can indicate a state
    • Biodiversity
    • Abiotic ecosystem attributes
    • Landscape pattern
    • Management intensity

• What to exclude? (examples)
  – persistent/constant characteristics (e.g. geology)
  – extremely variable characteristics (but their annual means can be OK)
  – „micro-characteristics” of ecosystems (no chance for data)
  – climate
  – ecosystem extent, ecosystem services
  – changes of state (get the state itself instead)
• 5 reviewers in 2 countries
• a google sheets database
• a detailed and regularly updated manual
N of relationships vs ES

- Aesthetic landscapes (aesth)
- Air quality regulation (a.qual)
- Water quality regulation (w.qual)
- Water flow regulation (flood)
- Mass flow regulation (erosion)
- Atmospheric regulation (carbon)
- Pest regulation (pest)
- Pollination (pollin)
- Freshwater fishing (fish)
- Timber production (timber)

Legend:
- Positive
- Negative
- Mixed
N of relationships vs ET

- Open ocean
- Shelf
- Coastal (coast)
- Marine inlets and transitional...
- Rivers and lakes (water)
- Wetlands (wet)
- Sparsely vegetated land (SVL)
- Heathland and shrub (heath)
- Woodland and forest (forest)
- Grassland (grass)
- Cropland (crop)
- Urban (urban)

Legend:
- Blue: positive
- Red: negative
- Green: mixed
relationships vs characteristic types

- Diversity of a species group
- Abundance of a species (group)
- Functional traits of a species group
- Age of site / community
- Primary productivity
- Biomass at the site
- Site structure
- Soil characteristics
- Water availability / quality
- The extent (abundance) of an ecosystem (sub)type
- The co-existence / proximity of two ecosystem types
- Landscape diversity
- Landscape structure
- Management / disturbance intensity
Extent of ecosystem (sub)types

- crop, grass, wet, forest, heath, urban, water, trans
- crop, grass, urban
- crop, grass, wet, forest, heath

![Graph showing the extent (abundance) of an ecosystem (sub)type]

- The extent (abundance) of an ecosystem (sub)type
- any seminatural feature (hedgerows, treerows, roadsides, oldfields)
- washland (regularly flooded land)

- pest, w.qual, flood, pollin, erosion, recr, fish, carbon, a.qual
- pest, pollin, recr, w.qual
- flood, fish
Management intensity

- Management intensity impact on: recr, erosion, pest, flood, pollin, timber, fish, carbon, w.qual
- Forest: timber, flood, recr
- Grass: pollin, carbon

Data categories:
- Management / disturbance intensity
  - Soil disturbance frequency
  - Forest use intensity (clearcutting)
  - Fire frequency
  - Grazing intensity

**Forest, crop, grass, heath, urban, SVL, water, wet**

**Crop, grass, forest, heath, urban, SVL**

**Forest**

**Grass**
Grasslands
- dry grasslands
- mesic grasslands
- wet grasslands
- alpine grasslands
- inland salt steppes
- sparsely wooded grasslands

Ecological & environmental quality
- Biodiversity
  - Grassland butterflies (needs refinement)
  - Farm/grassland birds (needs refinement)
- Biomass / productivity
  - NDVI cycle properties
- The presence of shrubs / trees
  - Density of semi-natural vegetation
  - (or) HNV farmlands
- Landscape diversity / connectivity
  - Landscape diversity index (new)

Human use intensity (pressures)
- Farming intensity
  - Intensification / extensification
  - Share of fallow land
- Grazing intensity
  - Livestock density

Fodder provision
- Pollination
- Pest control
- Carbon sequestration
- Water quality regulation
- Erosion control
- Flood control
- Recreation
General lessons

• Condition is not “uni-dimensional”: for most ETs there are several characteristics that matter:
  – That are more or less independent
  – That should be distinguished (a typology!!!)

• Condition can meaningfully integrate a broad variety of relevant ecosystem/landscape/use characteristics
  – including biodiversity, pressures, abiotic ecosystem attributes, etc.

• Linking E characteristics to ES: can be an external „anchor” for the concept of ecosystem condition
Advantages of linking EC to ES “early in the process”

• Meaningful groups of characteritics („condition aspects”) can be selected and prioritized
  – a core set of condition aspects (for each ET)
  – more parsimonious & more coherent sets of indicators
  – better (more meaningful) aggregation will be possible

• A direct “a priori” link to ES
  – more relevant, more justifiable indicators („rooted in science”)
  – easier to communicate ("good condition means services, which means money")
  – an easier integration of condition indicators into ES capacity models