Linking Ecosystems and Biodiversity

Solutions for Sustaining Natural Capital and Ecosystem Services
Salzau/Kiel, June 7th-11th, 2010

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• “THE RELATION OF BIODIVERSITY AND ECOSYSTEMS IS STILL VERY MUCH AN OPEN QUESTION.

• Thank you for your attention.”

As this is a bit short, we decided to go for version 2. It does not provide new data but suggests a structure for analysis.
Terminology

• ESS are outputs of ecosystems (goods or services) recognised as such and valued by humans.

• Thus the definition of ESS is per se an anthropocentric one.

• As flows, they can be measured.

• ESS can be essential or not, ubiquitous or localised, abundant or scarce.
In the latter case, and if

- by their character
- or through social or legal provisions

exclusive use is possible,

the value humans attribute to the respective service can be monetised.

- ESS are social constructs, and so is their value.
Ecosystem Functions

Ecosystem functions are biogeochemical characteristics of ecosystems and their
• (i) development dynamics and
• (ii) emergent properties on different system levels,
relevant for the ecosystem, its functioning and development itself.
Ecosystem Functions

Ecosystem functions in this sense are
• not social constructs
• but system characteristics.

Since they are defined by humans, they are obviously *anthropogenic*, but not necessarily *anthropocentric*.

They are *functions of* the system, not *functions for* something.
Biodiversity

• **Biodiversity is a natural phenomenon.**
• The term summarises the *diversity* (composition of elements and their spatial and temporal arrangement) of *system elements*, the systems being gene pools, organisms, populations, species or ecosystems.
• It includes the *diversity of resources* (materials, energy flows, organisms) and their *consumers* on and between different system levels.
Anthropogenic definition

As a result of the definition of diversity (based e.g. on the Shannon Index), in any observation point in time and space

- the number of system elements of the same class (e.g. organisms of the same species) decreases with higher biodiversity,
- while there is an increase in the number of observable classes.
Services by objects

• Individual system elements (organisms, species, varieties/races, populations) can be directly consumed, e.g. by hunting, gathering (including modern “gene hunting”), or the consumption for cultural purposes (aesthetic, ritual and others).

• In these cases the occurrence of and the access to the system elements can be considered a direct ecosystem service of the bio-geochemical systems.
Simultaneously

As long as alive and in place

- they can provide services (non-consumptive direct use like wool and milk from domestic animals) and

- they can contribute to ecosystem functions which may as well be valuable to humans (indirect use – e.g. grazing sheep stopping natural succession in a heather landscape used as bumble bee forage).
Conflicts and Trade-offs

• A **conflict of interest** between consumptive direct use and preserving the non-consumptive direct resp. the indirect use potential can emerge.

• All these uses constitute ecosystem services with a positive value for humans, but due to the trade-offs, each of them can if pursued turn into a disservice for those in demand of a competing service.
Diversity vs. Service

Due to the antagonistic tendencies of diversity and density of each element, the more diverse the respective ecosystem is, the more efforts are needed in reaping any specific fruit.

For every specific service, higher diversity tends to decline the yield, while the number and kind of functions (i.e. potential services) tends to increase.
• This is not necessarily the case, however, for broader defined services: a high level of ESS is possible if the service is defined as not specifically derived from a certain system element (e.g. a species).

• The link between biodiversity and ESS is dominated by the anthropogenic definition of the respective ESS.
Classifying Organisms by Services

1. The accessibility of the organism itself is directly or indirectly providing the service. In the process of service provision
   (i) the organism is consumed,
   (ii) the organisms offspring and/or their habitat is transformed or
   (iii) the organism is protected (in case of non-consumptive use in situ).
Classifying Organisms by Services

2. The organism
• co-produces a **recognised service**, together with other ecosystem elements, and
• is **recognised as doing so**. This includes minimising disservices from other organisms.
3. The organisms provide no known contribution to recognised ESS. This may be because

(i) the beneficial role of a certain ecosystem function which is (co-)generated by the organism has not been recognised as beneficial, i.e. as a service so far (supporting services),
(ii) the usefulness of a function has been recognised, but not the role of the organism in providing it,

(iii) the organism does not contribute to ecosystem services

(majority of species? Or more or less all involved in supporting services, a residual category?).
Research Needs

• In case (1) the open questions concern **measurement and valuation**.

• Better understanding cases (2) is a core issue of **ecosystem research**, including socio-economic (including cultural) valuation and – where appropriate - monetisation.

• Case (3) is the one causing problems.
Research Needs: 3(i)

- Recognition is a complex social process, and what is acknowledged as a service depends on culture, technology and population group.
- **All these factors are dynamic.**
- What is deemed negligible today may be essential under tomorrow’s service definitions.
Research Needs: 3(ii)

• particular problems if the service under investigation is an emergent property on the respective system level, which on lower levels requires a certain minimum of diversity to emerge (irrespective of threshold phenomena or more or less linear correlations are involved).
• Maybe the biggest challenge, as it refers to a situation of ignorance:
  • neither are all functions known (or will ever be),
  • nor will it be possible to identify all contributors to any given function, across all system levels.