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I. **SESSION DESCRIPTION**

ID: T2

Quantifying the relationship between biodiversity and ecosystem services

	Title	Name	Organisation	E-mail
Host:		Peter van Bodegom	Leiden University	p.m.van.bodegom@cml.leidenuniv.nl
		Maria Felipe-Lucia	Helmholtz Centre for Environmental Research & German Centre for Integrative Biodiversity Research	Maria.felipe-lucia@idiv.de

Abstract:

The relationship between biodiversity and ecosystem services has been extensively debated in literature. Within the IPBES framework, they are increasingly set side by side. This has not been done only given the intrinsic values of biodiversity, but also because the actual relationship between biodiversity and ecosystem services is ambiguous. There seems to be a positive relationship between the two, but only at particular conditions. For instance, existing meta-analyses provide mixed evidence, frequently focus on ecosystem functions (which is not necessarily the same as ecosystem services) and miss particular categories of ecosystem services. Other analyses have emphasized the importance of biodiversity for stability, but do not always distinguish between resistance and resilience or how that relates to (specific) ecosystem services. There is thus a major need to answer questions like: For which category of ecosystem services does biodiversity matter most? Are particular functional diversity metrics more closely related to ecosystem services than e.g. species richness? How will relationships differ when analysing belowground biodiversity, plant diversity or animal diversity? Is the relationship more tight in e.g. freshwater environments, compared to marine or terrestrial ecosystems? For this session, we invite contributions to these and related questions and we will discuss opportunities for a meta-analysis dedicated to these questions.



Ultimately, such understanding will help optimizing our efforts to conserve biodiversity and optimizing the provisioning of ecosystem services simultaneously.

Goals and objectives of the session:

The objectives are to:

- re-activate TWG2 through this session and make a new start with the team
- stimulate discussion on the relationship between biodiversity and ecosystem services
- design and prepare a meta-analysis on the quantification of the relationship between biodiversity and ecosystem services aiming at better understanding the varying conditions and metrics for which the relationship holds or does not hold.

Planned output / Deliverables:

- an action plan for TWG2
- a meta-analysis that may ultimately be published in a high-impact journal

Related to ESP Working Group/National Network:

[Thematic working group: TWG 2 – Biodiversity & Ecosystem services](#)

II. SESSION PROGRAM

Date of session: Tuesday, 22 October 2019

Time of session: 16:30 – 18:00

Timetable speakers

Time	First name	Surname	Organization	Title of presentation
16:30–16:45	Maria	Felipe-Lucia	Helmholtz Centre for Environmental Research & German Centre for Integrative Biodiversity Research	Land-use intensification alters the structure of biodiversity-functioning-services networks
16:45–17:00	Marie	Perennes	Hannover University	Assessing and mapping the capacity of green infrastructure in agricultural landscapes to provide Ecosystem Services
17:00–17:15	Bálint	Czúcz	European Commission, Joint Research Centre	Functional relationships between ecosystem characteristics and ecosystem services: a systematic review



17:15–17:30	Julia	Osterman	Martin–Luther– University of Halle– Wittenberg	Managing the ecosystem service of pollination in agricultural landscapes
17:30–17:45	Elena	Bukvareva	Biodiversity Conservation Center	Correlations between biodiversity and ecosystem services at the national scale in the TEEB–Russia project: what do they mean to make decisions?
17:45–18:00	Panayotis	Dimopoulos	University of Patras	Plant diversity and ecosystem services in Greece: a regional scale assessment

III. ABSTRACTS

The abstracts appear in alphabetic order based on the last name of the first author. The first author is the presenting author unless indicated otherwise.

1. Type of submission: **Abstract**

T. Thematic Working Group sessions: T2 Quantifying the relationship between biodiversity and ecosystem services across landscape / seascape management intensification gradients

Correlations between biodiversity and ecosystem services at the national scale in the TEEB–Russia project: what do they mean to make decisions?

First author: Elena Bukvareva

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Recently, IPBES stated the current consensus about the key role of biodiversity in ecosystem functioning (EF) and ecosystem services (ES), although in the latter case causal relationships are less obvious.

The project TEEB–Russia (<http://teeb.biodiversity.ru/en/>) aims to analyze available data on biodiversity and EF/ES in Russia in order to develop a national system of accounting for ES and biodiversity and to optimize the simultaneous tasks of using ES and preserving biodiversity.



Indicators of natural conditions, anthropogenic disturbance, biodiversity (species richness of birds and vascular plants), EF (productivity and phytomass of ecosystems) and ES are considered at the national and sub-national scale (e.g. European Russia). Both negative (e.g. between species richness and water-regulating ES) and positive (e.g. between species richness and the degree of anthropogenic transformation of ecosystems) spatial correlations were revealed. The question arises, what is the managerial meaning of these correlations? For example, should we expect an increase in water regulating ES, if biodiversity declines or an increase in biodiversity if anthropogenic disturbance increases? The answer will be “no” for considered scale in Russia since in this case correlations do not reflect causal relationships between biodiversity, EF/ES and anthropogenic drivers, but detect only parallel changes in corresponding indicators along the gradients of natural conditions (mainly from north to south).

The causal relationship between biodiversity and EF/ES works at the level of individual habitats and landscapes and thus, biodiversity is a key indicator of EF/ES at each particular location of a region or a country. Declining trends in the average regional biodiversity indicate degradation of EF/ES. Besides, typical values of biodiversity and EF/ES indicators and patterns of dependence between them differ in different biomes as well as in intact and human-transformed regions. Thus, approaches to management decisions should be different in target regions and correctly reflect the scale of the considered area.

Keywords: relationship between biodiversity and ecosystem services



2. Type of submission: **Abstract**

T. Thematic Working Group sessions: T2 Quantifying the relationship between biodiversity and ecosystem services across landscape / seascape management intensification gradients

Functional relationships between ecosystem characteristics and ecosystem services: a systematic review

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To make their research more relevant for society, ecologists have increasingly embraced the concept of ecosystem services (ES) in the last two decades. Consequently, there is a substantial amount of primary research studies in ecology, which aims at identifying statistically significant relationships between the characteristics of a specific ecosystem (ecosystem characteristics, EC) and the supply of a specific service from that ecosystem.

Here we present the outcomes from a systematic review involving 100 primary research studies from Europe on 10 pre-selected ES. These papers have identified altogether 295 significant relationships, which link the characteristics of six main terrestrial ecosystem types to their capacity to supply ES. We synthesize these 'EC~ES' relationships following the essential biodiversity variables (EBV) typology, as well as a simple new ecosystem condition classification proposed in the context of the UN System of Environmental-Economic Accounting (SEEA EEA).

In terms of ES provision, the most important aspects of biodiversity involve the "classic" compositional diversity of major species groups (plants, birds...) and the abundance (biomass) of vegetation. Furthermore, variables directly describing the intensity of ecosystem management (fertilizer use, grazing intensity...) also have been identified as key determinants of ES supply. Most of the relationships are positive (more diversity and/or biomass means more services), but an increased management intensity generally leads to a reduced availability of services. Biomass exerts most influence on the majority of regulating ES (e.g. flood control, carbon sequestration, water quality regulation), whereas species diversity typically affects



provisioning and cultural ES, as well as a few 'species-based' regulating services (pollination, pest control).

The presented exercise creates an evidence-based 'map' linking ecosystem characteristics to ecosystem services. If we want to convince people on the importance of maintaining the condition of ecosystems, then arguments of this kind can be of major importance.

Keywords: ecosystem condition, biodiversity, species diversity, evidence-based conservation

3. Type of submission: **Abstract**

T. Thematic Working Group sessions: T2 Quantifying the relationship between biodiversity and ecosystem services across landscape / seascape management intensification gradients

Plant diversity and ecosystem services in Greece: a regional scale assessment

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Aiming to investigate the role of biodiversity for the long-term maintenance of multiple ecosystem services, in the framework of the LIFE IP 4 NATURA project, we explore the patterns of taxonomic plant diversity in Greece (total, endemic, range-restricted, unique diversity per phytogeographical region), as well as of the functional diversity profile for the unique endemics of Peloponnese. Distribution data for the Greek flora, empirical models and applied spatial analysis techniques have been used to determine the patterns of taxonomic- (alpha- and beta- diversity) and functional- diversity indices and their variations along main gradients of ecosystems condition in Greece. The analysis resulted in: (I) assessment and mapping of "hot spot" areas in the 13 phytogeographical regions, considering a) their plant diversity, b) the quantitative representation of taxon richness in different habitat/ecosystem categories, c) the actual- and the potential- supply of ecosystem services, (II) establishment of a typology that assigns the habitat classes of each plant taxon to the different MAES categories and types of ecosystems (III) correlation of taxonomic indices (total-, endemic-, range-restricted species



richness) with the main ecosystem services per region, (IV) functional diversity attributes, as a case example for the unique endemics in the region of the Peloponnese, (V) the implementation of a case study with the ecosystem services provided by the aromatic and pharmaceutical endemic plants in Greece. The diversity indicators and their spatial correlation with habitats and ecosystem types per phytogeographical region a) describe the dominant trends and document each region's significance as a basis for quantitative interpretation of actual and potential provision of ecosystem services, b) provide spatial data with concise information on ecosystem services at the scale of Greece through the regional scale analysis as supporting tools for the implementation of management plans where biodiversity conservation and ecosystem services will be integrated.

Keywords: Biodiversity hot spots, Taxonomic diversity, Functional diversity, Endemism, Aromatic plants

4. *Type of submission: Invited speaker abstract*

[T. Thematic Working Group sessions: T2 Quantifying the relationship between biodiversity and ecosystem services across landscape / seascape management intensification gradients](#)

Land-use intensification alters the structure of biodiversity–functioning–services networks

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The relationships between biodiversity, ecosystem functioning and ecosystem services are complex because different trophic groups affect ecosystem functions in distinct ways and several functions can combine to supply a number of ecosystem services. Despite the complexity of analysing these relationships, understanding the linkages between these three aspects of ecosystems rather than just looking at their effects on isolated pairs can provide critical information on the consequences of biodiversity change for the functioning of ecosystems and ultimately human wellbeing. One way to tackle this complexity is using correlation networks, that is, considering each trophic group, ecosystem function and service



as a node and using the correlation coefficient between each pair of elements (i.e., species richness of a given trophic group, the level of a particular ecosystem function or an ecosystem service), as the link or edge. We exemplify this approach by using a unique dataset including 300 plots distributed along a land use intensity gradient in forests and grasslands with extensive data collection including species richness of 21 trophic groups, 10 ecosystem functions and 14 ecosystem services. In particular, we analysed the effect of increasing land use intensification on i) network structure (density, modularity and evenness); ii) the composition of modules of highly correlated nodes, and iii) the identity of the hubs. We found that land use intensification affects ecosystem structure by altering all metrics studied and also the identity of the hubs in both habitats, markedly in forests. Our work has implications for ecosystem stability and resilience and can inform policy makers about the ecological consequences of different land use intensity levels.

Keywords: ecosystem services, ecosystem functions, biodiversity, land use intensification, correlation networks

5. *Type of submission: Abstract*

[T. Thematic Working Group sessions: T2 Quantifying the relationship between biodiversity and ecosystem services across landscape / seascape management intensification gradients](#)

Managing the ecosystem service of pollination in agricultural landscapes

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Pollination services are provided by a mix of commercial pollinators, most prominent honey bees, and wild pollinators including wild bees, butterflies, flies, bats and birds. Recent concerns over global pollinator declines have serious consequences, representing a threat for the stability of the ecosystem service of pollination. To mitigate yield losses in pollinator-dependent crops, one solution might be to more actively manage the provision of pollination services. We will present current trends in the number of managed pollinators as well as review their rising species diversity. Even though one can actively promote the number and diversity



of pollinators through appropriate land-management practices, agri-environmental policies such as subsidising the cultivation of oilseed rape (OSR), a mass flowering crop, might interfere with these endeavors by attracting pollinators from other co-blooming plants, like apple. We tested this idea that competition for pollinators by OSR may reduce the pollination of co-flowering crops. Using twelve independent apple orchards, each with a neighboring OSR field in the landscape, we investigated if OSR competes for pollinators and how this impacts the pollination of apple, an obligate insect-pollinated crop, when both are grown in the vicinity. Our preliminary results show that the diversity of flying insects and the number of flower-visiting honey bees in apple orchards dropped with an increasing percentage of OSR in the landscape. In contrast, the number of wild bees visiting apple flowers remained stable. Our results suggested that these two crops, OSR and apple, compete for honey bee pollinators, while wild bees in apple orchards do not seem to be affected. Pollination service provision (fruit set) in apple orchards remained stable and was independent of the area of OSR around an orchard. Our results underscore the importance of wild bees as efficient pollinators and highlight the need for land management practices that support their populations.

Keywords: Ecosystem service of pollination, agricultural landscape, agricultural intensification, managing an ecosystem service, agri-environmental measures

6. *Type of submission: Abstract*

[T. Thematic Working Group sessions: T2 Quantifying the relationship between biodiversity and ecosystem services across landscape / seascape management intensification gradients](#)

Assessing and mapping the capacity of green infrastructure in agricultural landscapes to provide Ecosystem Services

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As agricultural landscapes are both major providers and beneficiaries of ecosystem services (ES), there are growing calls for these landscapes to be managed as multifunctional systems,



i.e. landscapes that are able to deliver a broad range of ES. Indeed, the production of food and fiber relies on ES provided by natural, semi-natural and purely anthropogenic elements, including maintenance of soil structure and fertility, nutrient cycling, pollination and biological pest control. The inherent trade-offs and synergies between provisioning and other ES makes land use management recommendations for agricultural systems particularly strenuous. Delivering guidance supporting a sustainable land use management at the local scale requires (1) a spatial explicit assessment and (2) understanding the causal mechanisms through which different natural and semi-natural elements support ecological processes and provide ES. The main challenge lies in finding/applying methods for comprehensible and reliable assessments, which yet remain feasible. Using the case study site of Bornhoved in northern Germany from the EU BiodivERSA project "IMAGINE", we compare three levels of ES assessment using the ES matrix approach by Burkhard et al. (2009). The ES matrix approach has become popular for decision support in sustainable resource management as it is highly adaptable, easily accessible and allows for an efficient and fast comprehensible assessment. Nevertheless, one of the main issues of the ES matrix approach is that, depending on the geospatial input data, it tends to be too coarse to catch spatial variability within for instance individual land cover classes and between landscapes. We try to tackle this critic by comparing different assessment methods with distinct levels of detail, using two different Land Use Land Cover (LULC) data sets (1st and 2d assessment levels) as well as biodiversity, biophysical and integrity indicators (3d level). The first and the second assessment level differ in terms of spatial resolution; the third increases the data complexity. We aim at exploring how different levels of assessment impact the outcomes and whether a more complex approach delivers more robust outcomes or increases the applicability of the resulting recommendations.

Keywords: agro-ecosystems, ecosystem services, local assessment, expert judgments, biodiversity indicators