



BOOK OF ABSTRACT

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I. SESSION DESCRIPTION

ID: T2b

Linking land management and biodiversity change to ecosystem services.

Hosts:

	Title	Name	Organisation
Host:	Dr.	María Felipe-Lucia	University of Bern, Switzerland
Co-host(s):	Profs.	Markus Fischer, Eric Allan	University of Bern, Switzerland

Abstract:

Land use intensification is one of the major drivers of global change, and its effects on the biodiversity of many different groups of organisms are likely to play an important role in driving changes to ecosystem functions and ecosystem services supply. Understanding how land management and biodiversity changes are currently affecting ecosystem functions and services across a range of habitat types is an important question to address if we are to promote multifunctional landscapes and biodiversity conservation.

Although the relationship between biodiversity and ecosystem functions has been tested experimentally, very few observational studies have analysed these interactions and yet fewer have made the link to ecosystem services and human well-being.

In this session, we will provide a broad overview of different approaches to understanding the relationships between biodiversity and ecosystem services across gradients of land use intensification in real world ecosystems. We will also debate the measurement of ecosystem multifunctionality and discuss how it can be maximized within managed landscapes. In the first part of the session we will present the knowledge learned through the +10 years of research in the Biodiversity Exploratories project, with a focus on the most recent findings and advances. The second part of the session will be open to other studies exploring these relationships. We will reflect on what we have learnt from the different approaches presented to identify potential caveats and launch new discussions that could enrich future research.



Goals and objectives of the session:

The overall goal of this session is to stimulate discussion regarding our understanding of the relationships between biodiversity and ecosystem services, and how land use intensification, as one of the major drivers of global change, mediates such relationships.

Objective 1. To show examples of relationships between biodiversity and ecosystem services in real-world ecosystems.

Objective 2. To understand the effects of biodiversity change in mediating land use intensification – ecosystem services relationships.

Objective 3. To open a room for discussion about the different approaches to analyse biodiversity –ecosystem services relationships and identify common findings.

Planned output / Deliverables:

At the end of the session we will try to agree on conclusions to communicate to the TWG 2 – Biodiversity & Ecosystem services.

Related to ESP Working Group/National Network:

[Thematic Working Groups: T2 – Biodiversity & Ecosystem services](#)

II. SESSION PROGRAM

Date of session: Thursday, 18 October 2018

Time of session: 8:45 – 16:00

Timetable speakers

Time	Surname	First name	Organization	Title of presentation
8:45–9:00	Felipe–Lucia; Fischer; Penone	María Markus Caterina	University of Bern	Introduction to session T2b – The Biodiversity Exploratories – Approaches to quantify land use intensity in forests and grasslands
9:00–9:15	Felipe–Lucia	María	University of Bern	Using correlation networks to infer effects of land use intensification on the linkages between biodiversity,



Time	Surname	First name	Organization	Title of presentation
				ecosystem functions and ecosystem services
9:15–9:30	Penone	Caterina	University of Bern	Effects of forest management on biodiversity and ecosystem services
9:30–9:45	Schenk	Noëlle	University of Bern	Effects of multitrophic β -diversity and land-use intensity on grassland multifunctionality
9:45–10:00	Rindisbacher	Abiel	University of Bern	How do land-use intensification and biodiversity loss affect the resilience of ecosystem functioning? – A meta-analysis of manipulative experiments
10:00–10:15				Discussion 1
11:30–11:45	Beckmann	Michael	Helmholtz Centre for Environmental Research – UFZ	Land-use intensification effects on species richness and production: A global meta-analysis
11:45–12:00	Manning	Peter	Senckenberg Biodiversity and Climate Research Centre	Redefining ecosystem multifunctionality
12:00–12:15	Le Clec'h	Solen	ETH Zürich	Revealing hotspots and coldspots of ecosystem services provision in agricultural grasslands across a gradient of management intensity
12:15–12:30	Helm	Aveliina	University of Tartu	Time-delayed dynamics of ecosystem services in



ESP EUROPE

2018 REGIONAL CONFERENCE

Ecosystem services in a changing world:
moving from theory to practice

SAN SEBASTIÁN, SPAIN

15-19 OCTOBER 2018

Time	Surname	First name	Organization	Title of presentation
				disappearing grasslands
12:30-12:45	Lavorel	Sandra	CNRS - Université Grenoble Alpes	Interactions between vertebrate biodiversity and outdoor recreation in two French National Parks
12:45-13:00				Discussion 2
14:30-14:45	Crouzat	Emilie	UFZ / iDiv	Being in or out: characterizing the influence of National Park management on ecosystem services
14:45-15:00	Castellano	Clara	Pyrenean Institute of Ecology (IPE- CSIC)	Assessment of Soil Ecosystem Services in two Mediterranean Subwatershed with Intensive Agricultural Land Uses
15:00-15:15	Lecina-Diaz	Judit	CREAF	Are protected areas an effective tool for preserving ecosystem services?
15:15-15:30	Molina Venegas	Rafael	University of Bern	Linking plant evolution and human well-being: ecosystem services along elevation and land-use at Mt. Kilimanjaro, Tanzania
15:30-15:45	Daniels	Silvie	Hasselt University - Center for Environmental Sciences	Valuing the Invaluable: a functional role-based approach for the valuation of functional biodiversity
15:45-16:00				Discussion 3



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: T2b Linking land management and biodiversity change to ecosystem services

Land–use intensification effects on species richness and production: A global meta–analysis

First author: Michael Beckmann

Other author(s): Katharina Gerstner, Morodoluwa Akin–Fajiye, Silvia Ceaușu, Stephan Kambach, Nicole L. Kinlock, Helen R. P. Phillips, Willem Verhagen, Jessica Gurevitch, Stefan Klotz, Tim Newbold, Peter H. Verburg, Marten Winter, Ralf Seppelt

Affiliation, Country: Helmholtz Centre for Environmental Research – UFZ, Germany

Land–use intensification is increasingly being used to boost agricultural production and is recognized as a major threat to biodiversity. However, little is known about the simultaneous effects of land–use intensification on biodiversity and yield. To determine the responses of species richness and yield to intensification, we conducted a global meta–analysis synthesizing 115 studies which collected data for both variables at the same locations. We extracted 449 cases that cover a variety of areas used for agricultural (food, fodder) and silvicultural (wood) production. We found that, across all production systems, intensification is successful in increasing yield (grand mean +20.3%), but it also results in a loss of species richness (–8.9%). The larger the steps of land–use intensification, the greater are the gains in yield while losses in species richness persist. For example, intensification from low to medium, increased yield by 6% and from low to high by 28.8%. Simultaneously, species richness was reduced by 7.7% and 12.1% respectively. Small intensification steps within low intensity systems did not affect yield (–0.7%) or species richness (–0.8%), while within high–intensity systems species loss (–6.1%) and yields gains (+15.2%) were detected. Intensifying within medium intensity systems revealed the highest yield increase (+84.9%) and showed the largest loss in species richness (–22.9%). Production types differed substantially in their magnitude of richness response, with silvicultural systems showing the smallest (–1.6%) and crop systems the largest losses (–21.2%). Across all sub–analyses, the unexplained variation remained high, which underlines a lack of quantitative studies that simultaneously measure richness and yield. These findings suggest that, in many cases, land–use intensification drives



the trade-off between species richness and production, even in already intensively used areas. As such, this global synthesis highlights, that the increase of agricultural yields through land-use intensification might hamper achieving global targets of preserving life on land.

Keywords: land management, conservation, crop production, wood production, green fodder, grasslands

2. *Type of submission:* **Abstract**

T. Thematic Working Group sessions: [T2b Linking land management and biodiversity change to ecosystem services](#)

Assessment of Soil Ecosystem Services in two Mediterranean Subwatershed with Intensive Agricultural Land Uses

First author: Clara Castellano

Other author(s): Comín, Francisco A., Felipe-Lucia, María R., Allan, Eric; Jimenez, Juan José

Affiliation, Country: Department of Biodiversity Conservation and Ecosystem Restoration, Pyrenean Institute of Ecology (IPE), Spanish National Research Council (CSIC), Spain

Agroecosystems occupy 40% of the global terrestrial surface. Transformation of natural ecosystems into agroecosystems is leading to major environmental degradation and loss of ecosystem services (ES). Soils are essential sources of a wide diversity of ES, so assessing soil ES is key to make effective decisions in the management of agroecosystems. We collected soil samples in two Mediterranean subwatersheds intensively used for irrigated agriculture, in a grid of 79 plots and 64 plots, respectively, across different land-use types, including both agricultural and natural habitats. In each plot we measured proxies of three soil ES: nutrient cycle regulation (NO_3^- , NH_4^+ , total N, available P, cation exchange capacity -CEC- and microbial biomass); climate regulation (soil C stock and soil organic matter -SOM-); and flood control (hydraulic conductivity, sorptivity and saturation humidity). We measured the effects of the different land-use types on the three soil ES. Natural land-uses (riparian forest, conifer forest and shrubland) had larger values of both nutrient cycle and climatic regulation (i.e. C stock, SOM, NH_4^+ , total N and CEC) than agricultural land-uses, and preliminary analyses show similar results for flood control. However, most agricultural land-uses had larger values than natural land-uses for some nutrient cycle regulation proxies (i.e. NO_3^- and available P). This suggests that these variables are not good indicators of nutrient cycle regulation, since these high values are due to the use of fertilizers. Uncultivated crops,



especially barren crops, had very low values for most proxies. Finally, the degraded riparian forest had lower values of SOM and total N than mature and restored riparian forests. Our results suggest that at the landscape scale, ecological restoration of riparian forests can enhance the supply of soil ES and that at the patch scale, agricultural crops should be managed more sustainably to reduce the loss of soil ES.

Keywords: soil ecosystem services, agroecosystems, nutrient cycle regulation, climate regulation, flood control

3. *Type of submission:* **Abstract**

T. Thematic Working Group sessions: [T2b Linking land management and biodiversity change to ecosystem services](#)

Being in or out: characterizing the influence of National Park management on ecosystem services

First author: Emilie Crouzat

Other author(s): Grescho Volker, Buermann Andrea, Bonn Aletta

Affiliation, Country: UFZ / iDiv, Germany

The presence of protected areas influences the range and intensity of human activities that can be developed in a given setting. In the context of the ECO-POTENTIAL H2020 project, we characterized the ecosystem services provided over the territory of three mountain National Parks (the Swiss National Park, the Austrian Kalkalpen National Park and the Portuguese Peneda-Geres National Park), as well as on those provided out of their boundaries, in their surroundings. Information was gathered through workshops with the National Park teams and local experts, and further completed by surveys with Park visitors during summer 2018. The assessment explicitly distinguished the services in and out of the Parks' boundaries, so as to highlight the consequences of this specific management on the supply and use of a diversity of ecosystem services. Our results include a ranking of key ecosystem services, the participatory mapping of ecosystem service hotspots and the identification of main drivers for cultural ecosystem services. Contrasted patterns were identified in and out of the National Park territories, as well as between the three Parks assessed. These results reveal features of management interest that we currently discuss with the National Park teams.

Keywords: ecosystem services, participatory assessment, national park, management intensity



4. *Type of submission: Abstract*

T. Thematic Working Group sessions: T2b Linking land management and biodiversity change to ecosystem services

Valuing the Invaluable: a functional role-based approach for the valuation of functional biodiversity

First author: Silvie Daniels

Other author(s): Daniels Silvie, Bellmore James Ryan, Benjamin Joseph, Witters Nele, Vangronsveld Jaco, Van Passel Steven

Affiliation, Country: Hasselt University – Center for Environmental Sciences, Belgium

An important issue in biodiversity valuation is gaining a better understanding of how biodiversity conservation affects economic activities and human welfare. Quantifying the economic benefits of biodiversity for human well-being is not straightforward. Here, we expand the ecosystem service cascade by (i) attributing a methodology to the different steps of the cascade to assess the effects of changes in functional group diversity on economic activities; (ii) including multiple attributes for defining functional diversity and (iii) integrating a dynamic ecological model simulating complex interactions and feedbacks between species with an economic model assessing the effects of changes in functional group diversity for gross revenues. The stepwise methodological framework integrates a production function approach with a market price-based approach in order to investigate the indirect use value of functional group diversity based on the ecological role of species in the ecosystem. The methodology is applied to estimate the relationship between the gross economic value of Chinook salmon (Pacific Northwest, United States) and the diversity of freshwater macroinvertebrates. The results of our analysis emphasize the importance of biological diversity for sustaining ecosystem goods and services. The analysis provides a tractable framework for quantitatively exploring the economic consequences of changes in functional group diversity.

Keywords: functional biodiversity, group diversity, methodological framework



5. *Type of submission: Invited speaker abstract*

T. Thematic Working Group sessions: T2b Linking land management and biodiversity change to ecosystem services

Using correlation networks to infer effects of land use intensification on the linkages between biodiversity, ecosystem functions and ecosystem services

First author: María R. Felipe-Lucia

Other author(s): Eric Allan

Affiliation, Country: University of Bern, Switzerland

Biodiversity is important for maintaining ecosystem functions and supplying ecosystem services to society, however, these relationships are complex, with multiple trophic groups interacting with each other and multiple synergies and trade-offs between ecosystem functions and services. In addition, land-use intensification might affect these interactions by disrupting certain links or enhancing others. Experimental research has shown the role of some of these links and how they change with increasing land use intensification. However, testing each individual link between species across multiple trophic groups, multiple ecosystem functions and multiple services, would require of unfeasible experiments. Here, we provide a first approach to disentangle the effects of land intensity on the resilience of the ecosystem by analysing correlations between biodiversity, ecosystem functions and services as a proxy of their relationships. We use data collected on 300 grassland and forest plots distributed across a gradient of land use intensity, calculate how both positive and negative correlations between biodiversity, ecosystem functions and services change and identify the key trophic groups important for ecosystem functioning, and the ecosystem services most dependent on biodiversity and other functions. Our results show that while the key trophic groups, ecosystem functions and services were only weakly affected by increasing land use intensity, the properties of the network changed drastically. Increasing land use intensification tended to reduce connectance, increase the nestedness and reduce the modularity of the network. However, each habitat showed particular trends with different implications for ecosystem resilience. Our work illustrates how this novel approach can be useful to unravel the role of biodiversity, ecosystem functions and services, detect thresholds of land-use intensity before a compositional shift, and identify keystone groups or functions that should be maintained in order to supply ecosystem services.

Keywords: correlation networks, resilience, complex systems, biodiversity-ecosystem functioning, ecosystem services



6. *Type of submission: Abstract*

T. Thematic Working Group sessions: T2b Linking land management and biodiversity change to ecosystem services

Time-delayed dynamics of ecosystem services in disappearing grasslands

First author: Aveliina Helm

Other author(s): Elisabeth Prangel

Affiliation, Country: University of Tartu, Estonia

Number of important ecosystem services are tightly related to biodiversity. Biodiversity, in turn, is highly dependent on landscape composition and environmental conditions of habitats. Impact of changing landscape and environmental conditions can trigger time-delayed responses of biodiversity, leading to extinction debt in given habitats. However, time-delayed response of biodiversity can also lead to the delay in the response of related ecosystem services. Existence of such time-delayed responses can lead to serious underestimation of the impact of occurred changes on sustainable provision of ecosystem services. We studied the effects of landscape structure and changing environmental conditions on provision of important ecosystem services related to grassland ecosystems in Estonia. Over past 70 years, studied grasslands have lost more than 80% of their area and the historically open landscapes with grasslands have now been replaced by landscapes with juniper shrublands or pine forests. Vast changes in landscape structure and in environmental conditions as a result of grasslands overgrowing or being afforested had large impacts on the sustainable supply of ecosystem services in studied landscapes, particularly on pollination, pest regulation and cultural appreciation of habitats. We also detected existence of time-lags in the response of biodiversity and related ecosystem services to past landscape changes, being more pronounced for the ecosystem services related with plant and soil biodiversity (e.g. supply of medicinal plants, supply of agriculturally important symbionts such as arbuscular mycorrhizal fungi). Time-delay in response of biodiversity and ecosystem services to landscape changes also provides an opportunity – ecosystem restoration, if carried out in time, can help to reverse the ongoing processes and avoid the “payment” of extinction debt of biodiversity and related ecosystem services.

Keywords: extinction debt, land-use change, pollination, mycorrhizal fungi, grassland



7. *Type of submission: Abstract*

T. Thematic Working Group sessions: T2b Linking land management and biodiversity change to ecosystem services

Interactions between vertebrate biodiversity and outdoor recreation in two French National Parks

First author: Sandra Lavorel, Pierre-Louis Rey

Other author(s): Mégane Zawada, Coline Byczek

Affiliation, Country: Laboratoire d'Ecologie Alpine, CNRS – Université Grenoble Alpes, Grenoble, France

Wildlife – recreation interactions are a critical stake for the design and management of protected areas. These can be addressed on the ground by visitor counts and tracking, social surveys of attraction factors and analyses of physiological, demographic and behavioural impacts on species. However necessary, such analyses are resource-intensive and results may not become available to natural area managers and recreationists in the short term. Spatial modelling offers an alternative and complementary method for targeting critical areas of interaction or lack thereof. We propose that the representation of factors that influence wildlife species distribution or outdoor recreation can capture their patterns of co-occurrence or exclusion. Distributions of terrestrial vertebrates with high conservation value and of mountain sport activities were modelled for two French national parks (Ecrins and Vanoise), considering summer (43 species) and winter (21 species) separately. We hypothesised that: (1) there are greater areas where vertebrate habitat is undisturbed by recreationists in winter than in summer; (2) summer practices increase wildlife disturbance potential because of their more diffuse spatial distribution; (3) less dense but spatially spread recreation (Ecrins) increases interference with wildlife as compared to a greater but more concentrated activities (Vanoise). Overall we found strong interactions between recreation and wildlife, especially in winter where potential interference with high mountain species are strong. In summer interactions differ across three types of habitats: (1) high altitude habitats which favour both highly-valued species and recreation; (2) forests, grasslands and water which are critical habitats with a less strong protection status; (3) valley habitats of limited value for wildlife but where recreation could expand. In Ecrins, forests offer quiet areas for wildlife whereas in Vanoise the proximity between ski resorts threatens wildlife conservation objectives.

Keywords: vertebrate biodiversity, outdoor recreation, French national parks



8. *Type of submission: Abstract*

T. Thematic Working Group sessions: T2b Linking land management and biodiversity change to ecosystem services

Revealing hotspots and coldspots of ecosystem services provision in agricultural grasslands across a gradient of management intensity

First author: Solen Le Clec'h

Other author(s): Robert Huber, Nina Buchmann, Lukas Hörtnagl, Robert Finger

Affiliation, Country: ETH Zürich, AECG Group, Switzerland

Agri-environmental measures (AEM) are supposed to reduce the negative impact of high-intensive grassland management on ecosystem service provision. To further improve the design and implementation of effective AEM, we propose an integrative assessment of the provision of grassland ES in space and over time and apply this framework to a case study region in the Canton of Solothurn (Switzerland). We reveal hotspots and coldspots of ES provision in grasslands under specific consideration of the variability of multiple ES provision across a gradient of management intensity. We use plot based empirical data in combination with spatially explicit census data to characterize ES provision. For each regime and intensity level, we first calculated ES provision from various field measurements. Next, we used regression analysis and observed grassland management intensities to map the estimated ES values in our case study region. Finally, we combined all individual-ES indicator maps into an aggregated ES score. Using the quartiles of the distribution of each ES indicator as thresholds, we summed up the individual scores for each parcel to a global ES value. Our results reveal interrelations between ES as well as their spatial variability based on management types. This constitutes a first important step in a more policy-oriented analysis of the impact of land-use intensification on ES supply. This contribution is, to our knowledge, the first attempt to combine plot based empirical data for multiple ES with spatially explicit census data on land-use intensities. The results of our study reduce the uncertainties in designing AEM and constitute an important basis to overcome some of the limitations in choosing between different design features for AEM and to help farmers to direct the choice of management strategies.

Keywords: agri-environmental measures,, grasslands, management strategy, mapping, tradeoffs and synergies



9. *Type of submission: Abstract*

T. Thematic Working Group sessions: T2b Linking land management and biodiversity change to ecosystem services

Are protected areas an effective tool for preserving ecosystem services?

First author: Judit Lecina–Diaz

Other author(s): Albert Alvarez, Miquel de Cáceres, Jordi Vayreda, Sergi Herrando and Javier Retana

Affiliation, Country: CREAM, E08193 Bellaterra (Cerdanyola del Vallès), Spain

Research on ecosystem services has become a major approach to assess ecosystems and their contribution to human well-being. Under current land use intensification, the protection of natural areas might be a good opportunity to preserve ecosystem services and biodiversity. At the same time, global concern on the protection of natural areas has increased substantially over the past 25 years. However, it still remains unclear to what extent protected areas with different protection status (from more strict – where land-use change is prevented – to low-protected areas – where human activities are allowed) are being effective in maintaining ecosystem services. In our study, we determined the effectiveness of protected areas in the provision of ecosystem services and biodiversity in Catalonia, considering two main protection levels: intermediate (e.g. Natural Parks, where human-activities are more controlled) and low (e.g. Natura 2000, where human-activities and nature co-exist). Specifically, we aim (1) to quantify and compare the provisioning ecosystem services (carbon stocks and water provision) and biodiversity inside and outside protected areas; (2) to know whether the differences in ecosystem services and biodiversity inside protected areas depend on their protection status (intermediate and low); and (3) to quantify the degree of spatial overlap of areas of high values (hotspots) of ecosystem services and biodiversity outside protected areas and inside protected areas with different protection status. In both intermediate and low levels of protection, we found more biodiversity inside than outside protected areas. In addition, intermediate levels of protection had more carbon storage and bird biodiversity than low protection levels. This study provides an essential framework to the debate on defining conservation strategies that combine both biodiversity and human well-being.

Keywords: biodiversity, carbon storage, Mediterranean, protected areas, water provision.



10. Type of submission: **Invited speaker abstract**

T. Thematic Working Group sessions: T2b Linking land management and biodiversity change to ecosystem services

Redefining ecosystem multifunctionality

First author: Peter Manning

Affiliation, Country: Senckenberg Biodiversity and Climate Research Centre, Germany

Recent years have seen a surge of interest in ecosystem multifunctionality, a concept that has developed in the largely separate fields of biodiversity–ecosystem function and land management research. In this talk I will discuss the merit of the multifunctionality concept, the advances it has delivered, the challenges it faces and solutions to these challenges. This involves the merging of concepts from these two fields and the redefinition of multifunctionality as a property that exists at two levels: ecosystem function multifunctionality and ecosystem service multifunctionality. I will discuss this framework and demonstrate how the multifunctionality of ecosystem services can be quantified at both plot and landscape scales. Finally, I will discuss the potential of these measures to inform the management of biodiversity and the ecosystem services it underpins.

Keywords: Multifunctionality, ecosystem services, landscapes, management, ecosystem function

11. Type of submission: **Abstract**

T. Thematic Working Group sessions: T2b Linking land management and biodiversity change to ecosystem services

Linking plant evolution and human well-being: ecosystem services along elevation and land-use at Mt. Kilimanjaro, Tanzania

First author: Rafael Molina Venegas

Other author(s): Markus Fischer, Nduvoto Piniel Mollel, Andreas Hemp

Affiliation, Country: Institute of Plant Sciences, University of Bern, Switzerland

Evolution is the source of all living organisms and hence the foundation for the ecosystem services that are directly supported by biodiversity. Yet, explicit connections between evolutionary processes and human well-being are barely explored. Here, we focused on ethnobotanical data from the Kilimanjaro region to identify “evo-service domains”, this is,



segments of the phylogeny that include a significantly high number of species providing a certain type of service, and further characterized the phylogenetic structure of usage guilds (i.e. cattle forage, building material, fuelwood, food, ornamental/shading and traditional medicine) using classical metrics and phylogenetic scaling methods (regional assessment). Moreover, we propose a new bootstrapping approach that allows to identify the nested subclades that contribute the most to define evo-service domains. Finally, we explored how species and phylogenetic richness of usage guilds varied along the elevation gradient of the Kilimanjaro and between natural and anthropized ecosystems (local assessment). All in all, our results point that the inhabitants of the Kilimanjaro rely on multiple and deeply rooted clades that specifically provide a certain type of service, although a few lineages (i.e. *Acacia* s.l. and Sapindales) provided multiple benefits. Phylogenetic richness of most of the guilds showed hump-shaped curves along the elevational gradient of the mountain, revealing a local phylogenetic hotspot of usable plants in the upper-montane forests of the Kilimanjaro, while species richness followed either negative-linear or hump-shaped relationships. Anthropogenic disturbance had a moderate negative effect on the phylogenetic richness of some of the guilds, and particularly for medicinal plants. Our findings outline an alarming scenario for the preservation of the upper-montane reservoir of phylogenetic richness of usable plants in the Kilimanjaro, which may experience substantial shrinking within the next decades due to climatic change-induced shifts of adjacent vegetation zones.

Keywords: ethnobotany, evolution, global-change, phylogenetic domains, phylogenetic richness.

12. Type of submission: **Abstract**

T. Thematic Working Group sessions: T2b Linking land management and biodiversity change to ecosystem services

Effects of forest management on biodiversity and ecosystem services

First author: Caterina Penone, María Felipe-Lucia

Other author(s): Eric Allan, Markus Fischer

Affiliation: University of Bern, Switzerland

Most European forests have been or are currently managed and we need a better understanding of the effects of management practices on biodiversity and ecosystem services. Previous studies analysing such effects have typically focused on comparing broad management categories and have rarely included a large range of taxa and services. To



better understand the ecological mechanisms by which management affects biodiversity and comprehensively evaluate how it affects service supply we focused on management-related forest features. We analysed the effects of 11 forest features on the biodiversity of 13 trophic groups of plants, animals, fungi and bacteria, and 16 ecosystem services. We found that the drivers of biodiversity and ecosystem functions differed: biodiversity was mostly increased by changes in stand composition, while services were enhanced by stand heterogeneity and age. However, canopy cover decreased both biodiversity and services. Forest features were the most important drivers of final ecosystem services, while intermediate services responded more to environmental factors. Forest features were also the main drivers of synergies between services. Our results suggest that it may not always be possible to maximise biodiversity and ecosystem services within a single stand, and that it might be helpful to plan management at larger spatial scales. More generally, we show that it is essential to “unpack” management, biodiversity and ecosystem services by studying multiple forest features, taxa and services. Such approaches can help to fine-tune management interventions to maintain and promote biodiversity and ecosystem services in anthropogenic landscapes.

Keywords: temperate forests, forest management, Biodiversity Exploratories, ecosystem service interactions, multi-taxa

13. Type of submission: **Abstract**

T. Thematic Working Group sessions: T2b Linking land management and biodiversity change to ecosystem services

How do land-use intensification and biodiversity loss affect the resilience of ecosystem functioning? – A meta-analysis of manipulative experiments

First author: Abiel Rindisbacher

Other author(s): Santiago Soliveres, Eric Allan, Markus Fischer

Affiliation, Country: University of Bern, Switzerland

Grasslands provide important ecosystem services to people: for example feed for livestock, pollination of nearby crops or pest regulation, but also recreational value. Stability of functioning is important for a healthy ecosystem and thus for a sustainable supply of these services. Biodiversity is expected to increase ecosystem resilience, while land-use intensification may reduce it either via a direct negative effect on functioning or indirectly via



a negative effect on biodiversity. However, not much is known about the importance of biodiversity for resistance in agricultural systems and whether its effects depend on the nature of the disturbance or the type of ecosystem property responding. To address this question, we synthesized available evidence from manipulative experiments performed across a land-use intensity gradient in 150 temperate agricultural grasslands, within the framework of the Biodiversity Exploratories. The experiments manipulated disturbances, such as soil disturbance, mowing frequency and climatic conditions, or resource addition through fertilization. Comparing results from the various experiments allowed for an analysis across types of function and types of disturbance. We quantified the resistance as the deviation of the treatment level from the control level using log response ratios and fitted a mixed-model to control for temporal and spatial dependencies between variables and account for other covarying environmental factors. Our analysis showed that biodiversity was an important driver of resistance, but its effects depended on the type of treatment and response. The aboveground compartment appeared to be more negatively impacted by the different disturbances while the belowground variables were generally rather overshooting. These effects increased with biodiversity for the various disturbances but showed a decreasing trend for resource addition. Our results show that high diversity systems have potentially more to lose but can also be more resistant to the various disturbances they are likely to face in the course of global change.

Keywords: resistance, biodiversity, land-use, disturbance, ecosystem functioning

14. Type of submission: **Abstract**

T. Thematic Working Group sessions: [T2b Linking land management and biodiversity change to ecosystem services](#)

Effects of multitrophic β -diversity and land-use intensity on grassland multifunctionality

First author: Noëlle Schenk

Other author(s): Caterina Penone, Eric Allan

Affiliation, Country: University of Bern, Switzerland

Land-use intensification is reducing the biodiversity of multiple organism groups and previous studies have shown that this loss of biodiversity at multiple trophic levels reduces local scale ecosystem multifunctionality. At the same time, land-use is also reducing the difference in biodiversity among communities, leading to biotic homogenisation and a loss of β -diversity. Although a few studies have shown that the β -diversity of single groups can



affect landscape multifunctionality, because different species supply functions in different locations, the importance of β -diversity across different trophic levels is unknown. We used generalized dissimilarity modelling to assess the effects of multitrophic β -diversity and differences in land-use intensity on 19 ecosystem functions, working with a dataset of 4737 grassland species belonging to 14 trophic groups and measured on 130 different sites. We show that a homogenisation of biodiversity led to a homogenisation of ecosystem functions at the landscape level. Landscape multifunctionality was influenced by both components of β -diversity, turnover (differences in composition) and nestedness (differences in number of species). Overall, most groups were important, including above- and belowground taxa. Turnover in biotic factors, i.e. β -diversity, had as large effects on landscape scale multifunctionality as turnover in abiotic factors. Our results indicate that β -diversity at many trophic levels is required for landscape scale multifunctionality and biotic homogenisation therefore represents a major threat to the functioning of ecosystems.

Keywords: biodiversity, ecosystem functioning, beta-diversity, land-use, trophic groups