



Biodiversity Dynamics and Complexity

iDiv Annual
Conference 2019
Abstract book

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Thursday, 29 August
16.30–18.15
Conference room 1AB

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Comparison of the diversity of the Coleoptera between the understory and the canopy in the floodplain forest of Leipzig

Jessica Hetzer, Poster

The importance of plant geometry for grassland dynamics

Nora Haack, Poster

Diversity patterns of beetle communities in the canopy of the Leipzig floodplain forest

Anja Tehel, Poster

Honey bee-associated viruses across taxonomic families of the bees

Maria-Theresa Jessen, Poster

Who can cope with global change? - The hidden life of grassland seedlings

Aldo Compagnoni, Poster

Quantifying the probability of extinction risk: a case study on an endangered dune plant

Roman Patzak, Poster

Exploring a three-dimensional habitat: drivers of spatial lichen diversity patterns in the tree crown

Topic Session 3: Biodiversity Dynamics and Complexity, 29. Aug, 16:30 - 18:15

Session keynote

Herrmann, Martina

Friedrich Schiller University Jena

Complex food webs in groundwater coincide with high genetic potential for chemolithoautotrophy

Absence of light-driven primary production, limited oxygen and space cause groundwater ecosystems to show lower food web complexity compared to other freshwater habitats. Subsurface chemolithoautotrophy provides additional input of carbon, however, its effects on groundwater food webs are poorly understood. Using a molecular approach, we followed eukaryotic and bacterial communities in oligotrophic groundwater along a hillslope setting of alternating mixed carbonate-/siliciclastic bedrock in central Germany. Across all sites, we found diverse protist communities including Ciliophora, Cercozoa, Centroheliozoa, and amoeba.

Correlation with hydrochemical parameters was less pronounced for eukaryotes compared to bacteria. Notably, presence of metazoan top predators such as Cyclopoida (Arthropoda) and Stenostomidae (Platyhelminthes) was not bound to oxygen availability but was restricted to wells where abundances of functional genes associated with chemolithoautotrophy were 10 to 100 times higher compared to wells without these top predators. In turn, wells closer to recharge areas with presumably increased inputs of soil-derived substances showed low potential for chemolithoautotrophy and harbored up to 85% fungi within the eukaryotic communities. Our results demonstrate the existence of complex food webs with several trophic levels in oligotrophic groundwater.

Chemolithoautotrophy appears to provide strong support to the proposed trophic interactions, feeding in additional biomass produced by light-independent CO₂-fixation.

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Topic Session 3: Biodiversity Dynamics and Complexity, 29. Aug, 16:30 - 18:15

Standard talk

Schnitzler, Jan

Leipzig University

Macroevolutionary and macroecological patterns of plants and their chemical compounds

Throughout their evolutionary history, plants have developed a wide range of chemical compounds associated with their growth as well as their interactions with the abiotic and biotic (intra- and interspecific) environment, which determine their survival and ultimately their evolutionary success. Yet, little is known about the link between the spatial and phylogenetic patterns of biodiversity and chemodiversity (the diversity of chemical compounds). Combining spatial, phylogenetic, ecological, phytochemical and environmental data from ca. 2,600 geographic regions worldwide, I will explore the large scale spatial and evolutionary patterns of plant species, their chemical compounds.

Co-Authors:

Schnitzler, Jan

Topic Session 3: Biodiversity Dynamics and Complexity, 29. Aug, 16:30 - 18:15

Standard talk

Kambach, Stephan

Leipzig University

Beyond the growth-survival trade-off: A global analysis of demographic diversity and trade-offs in species-rich forests

The range of species' viable life-history strategies is restricted by allocation trade-offs between demographic processes. Forest trees can experience trade-offs between growth in light versus survival in shade conditions (fast-slow continuum) and, weaker, trade-offs between high growth and survival versus high recruitment rates (stature-fecundity gradient). In an unprecedented global analysis, we tested the generality of both gradients across different forests and hurricane regimes. Based on repeated censuses in ten tropical forests (ForestGeo) and using linear, hierarchical Bayesian and weighted principal component analyses, we estimated and correlated the annual recruitment, growth and survival rates of all tree species. We found that growth rates in top canopy layers were negatively related to survival rates in bottom layers and to recruitment rates per adult basal area. Homogeneous forests were all structured by the fast-slow and the stature-fecundity gradient. In hurricane-disturbed forests, demographic relationships either resembled those from homogeneous forests or showed decoupled growth and survival, but not recruitment rates. Hurricane events reinforced the fast-slow and the stature-fecundity trade-off only in the short-term. We showed that tropical forest were generally structured by a fast-slow and stature-fecundity trade-off, as long as demographic relationships are not decoupled by heterogeneous habitats or long-term hurricane effects.

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Topic Session 3: Biodiversity Dynamics and Complexity, 29. Aug, 16:30 - 18:15

Standard talk

Häußler, Johanna

Friedrich Schiller University Jena

A Bayesian network approach to trophic metacommunities: habitat loss accelerates top species extinction rates in fragmented landscapes

How does habitat loss affect food webs? Despite its relevance this question is still largely unresolved. Here, we develop a novel approach to trophic metacommunities which is rooted in single-species metapopulation models on fragmented landscapes (Hanski & Ovaskainen 2003, Population Biology). The crux of our approach is that species' extinction rates are calculated from a Bayesian network representation of the food web (Eklöf et al. 2013, Methods in Ecology & Evolution). We then apply different habitat loss scenarios, which vary in the order, in which habitat patches are removed from the landscape. We explore whether these scenarios differ in their effect on food web persistence and how species' extinction rates scale with trophic level. Our results show that progressing habitat loss strongly decreases food web persistence at the landscape scale with top predators being the most vulnerable. The extent of this decrease significantly varies across the habitat loss scenarios we tested, emphasizing that there is strong variation among habitat patches in their contribution to long-term species persistence. Summarising tractability and computational efficiency, our model provides a complementary method to other spatial food web models and can be readily applied to empirical food webs.

Co-Authors:

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Topic Session 3: Biodiversity Dynamics and Complexity, 29. Aug, 16:30 - 18:15

Standard talk

Motivans, Elena

Helmholtz-Centre for Environmental Research - UFZ

Martin Luther University Halle-Wittenberg

Heterogeneous habitats promote diverse plant-pollinator interactions in Estonia

The management of many traditional meadows and pastures has been abandoned in the past decades. In order to preserve species diversity and pollinator communities in these grasslands, there is a strong interest to restore abandoned areas. We surveyed plant-pollinator networks in two types of traditionally managed grassland in Estonia to determine if the management type fosters different species and different structures of plant-pollinator networks. Specifically, we compared mowed wooded meadows, which have more heterogeneous light conditions, to grazed alvar pastures, which have more uniform light conditions. We find a higher abundance of pollinating insects in wooded meadows, which resulted in higher pollinator diversity compared to alvar pastures. Further, alvar pastures contain proportionately more hymenopterans whereas lepidopterans and dipterans are more proportionately present in wooded meadows. Rarefied network comparisons between the habitat types revealed that both habitats had similar nestedness and links per species, but wooded meadows had higher connectance and network level specialization (H2). Our results also demonstrate that the roles of individual plant and pollinator species in the network shifted between the habitat types. Therefore, restoring the wooded meadows supports more individuals and interactions, but restoring both habitat types supports diverse interactions and network structures across the broader landscape.

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Motivans, Elena

Topic Session 3: Biodiversity Dynamics and Complexity, 29. Aug, 16:30 - 18:15

Speed talk

Clark, Adam Thomas

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sDiv

Leveraging scale to build empirically tractable theory and metrics of stability and coexistence

Ecosystem stability and species coexistence are immensely important to basic ecological research, management, and conservation. Decades of theoretical and empirical work has demonstrated that estimations of both stability and coexistence can vary greatly depending on the spatial and temporal scale of measurement. For example, a species that shows stable behaviour at small scales may be wiped out due to dynamics occurring at larger scales. Nevertheless, surprisingly few studies have addressed the interface between scale and these metrics, and it remains unclear what general patterns underlie observed patterns. A major challenge that limits practical applications of stability research is that most theoretical methods are not tractable in empirical systems. However, a number of recent studies suggest that by combining information from across many different scales, it may be possible to broadly characterize dynamical behaviour of species and ecosystems. During this session, I will (i) demonstrate the influence that measurement scale has on perceptions of stability and coexistence; (ii) present results of recent studies that address these challenges; and (iii) discuss important future directions for ongoing research, based on a review that I am conducting in collaboration with Yuval Zelnik, at the Centre for Biodiversity Theory and Modelling in Moulis, France.

Co-Authors:

Clark, Adam Thomas

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Topic Session 3: Biodiversity Dynamics and Complexity, 29. Aug, 16:30 - 18:15

Speed talk

Kühn, Ingolf

Helmholtz Centre for Environmental Research - UFZ

Martin Luther University Halle-Wittenberg

Trait composition in glacier forefield succession

Due to climate warming, glaciers retreated during the past 150 years in many parts of the Alps to allow for studying natural primary succession. I analysed in four glacier forefields of the Northern Limestone Alps (Dachsteingebirge, Berchtesgadener Alpen), covering a chronosequence of areas where the glaciers retreated approx. 10, 40, 70 and >100 years ago, respectively, with 52 relevés in an almost balanced design. I surveyed the vegetation of the initial sampling period, namely species richness, vegetation cover and the composition of several traits, based on the TRY database, across the chronosequence. I used linear mixed effects models and multinomial, vector generalized linear models. While it is obvious that cover as well as species richness increased with successional time, traits revealed more pronounced patterns. There is, e.g., an increase in the proportion of insect pollinated species and a decrease in those able to do selfing. Similarly, there is a decrease in the proportion of facultative mycorrhiza over time and an increase in non-mycorrhiza. Using Grime's Strategy, the proportion of ruderal strategists is low, as expected, and decreases further while the proportions of both competitors and especially stress strategists are higher and even increase during successional stages.

Co-Authors:

Kühn, Ingolf

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Topic Session 3: Biodiversity Dynamics and Complexity, 29. Aug, 16:30 - 18:15

Speed talk

Volf, Martin

Friedrich Schiller University Jena

Predators, parasitoids or chemicals: what promotes species turnover in canopy herbivores?

Tree canopies support a substantial part of global biodiversity, including hyperdiverse communities of herbivorous insects. The diversity and composition of herbivore communities is often driven by the variation in chemical traits of their hosts. Using the Leipzig Canopy Crane Facility, we explored the effect of branch-localized induction of plant defences on insect communities associated with canopy oaks. We took an integrative approach combining manipulative defense induction with predation assays, food-choice trials, chemical analysis, and sampling of herbivore assemblages. The branches induced by methyl jasmonate, a plant hormone, attracted more predators and produced leaves that were less palatable to caterpillars. This indicates a branch-localized induction of direct and indirect defences which is to be confirmed by a detailed chemical analysis. These findings suggest that canopy trees can redirect their defences only where truly needed. In addition, we suggest that such a localized induction has a potential to create a variation in leaf traits and can drive the species turnover in the associated herbivores – a hypothesis we will test using data on ca. 1,000 caterpillars sampled from the experimental branches.

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Topic Session 3: Biodiversity Dynamics and Complexity, 29. Aug, 16:30 - 18:15

Speed talk

Yan, Lijuan

Friedrich Schiller University Jena

Environmental selection: a look into the distribution and adaptation of microbes in a dynamic groundwater ecosystem

Microorganisms are the dominant inhabitants of groundwater ecosystems, essential for all biogeochemical processes and drinking water quality. Surface inputs and the local hydrogeological setting are crucial to influencing groundwater microbiomes. However, the formation of groundwater microbiomes and their responses to subsurface conditions is still largely unknown due to the limited accessibility of the subsurface. Here we took advantage of the Hainich Critical Zone Exploratory (Germany) which allows disentangling spatial and temporal patterns to identify drivers of groundwater microbiome formation and differentiation along a 5.4 km transect. We show that environmental selection drives the spatial assembly of groundwater microbiomes, with dissolved oxygen, nitrate and ammonia as the major determinants. Microbial community structure revealed more refined spatial differentiation than hydrochemical parameters alone. The proximity to the recharge area gave prominence to high groundwater microbial diversity. Identity of core OTUs suggested that nitrite oxidation or complete ammonia oxidation (*Nitrospira*), nitrate or sulfate reduction (*Thermodesulfovibrionia*) and anaerobic ammonia oxidation (*Brocadiae*) were potentially the key biogeochemical functions prevalent at specific sites associated with the local hydrochemistry. Overall, this study demonstrated the importance of environmental selection in shaping microbial communities as well as the potential functions in biogeochemical cycles in freshwater karst aquifers.

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Topic Session 3: Biodiversity Dynamics and Complexity, 29. Aug, 16:30 - 18:15

Poster

Heintz-Buschart, Anna

Helmholtz-Centre for Environmental Research – UFZ

Leipzig University

Deadwood-based fungal and prokaryotic networks are highly modular and specialized

Fungi and prokaryotes are important deadwood-inhabiting groups mediating critical steps in wood decomposition. Community assembly in relation to wood properties and environmental conditions is commonly explored using next generation sequencing techniques. However, studies that consider microbes from different kingdoms and assess how these groups relate to each other are largely missing. Bipartite interaction networks provide the opportunity to examine the deadwood consumer-resource relationship in detail and to compare network topologies and related indices. Here, we developed a computational framework to robustly apply bipartite network construction to fungal and prokaryotic sequencing data, building interaction networks within the deadwood of thirteen temperate tree species. Several diversity- and specialization-related indices were determined and related to intrinsic wood traits such as water content, pH and lignin. The present study revealed highly modular and specialized interaction networks for both wood-inhabiting groups. Wood traits explained the community organization, indicating that many fungal and prokaryotic species are specific decomposers. Nevertheless, as the specialization of fungi significantly surpassed the prokaryotes, our results indicate higher ecosystem performance by fungi. The present study illustrates that the application of bipartite interaction networks is a useful tool to explore the deadwood-colonizers relationship based on sequencing data.

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Topic Session 3: Biodiversity Dynamics and Complexity, 29. Aug, 16:30 - 18:15

Poster

Richter, Ronny

Leipzig University

Combining remote sensing based fine-scale habitat mapping with ecological modelling reveals species-specific habitat preferences in birds of the Russian Far East.

Knowledge on habitat preferences is essential for successful species conservation. However, for many species, especially those living in remote areas, we currently lack this knowledge, and resources (time and money) to quantify habitat preferences based on systematic monitoring programs are limited. Here, we aim to develop a cost-efficient method to describe habitat preferences for birds based on a combination of population surveys and fine-scale habitat maps derived from remote sensing. We apply this method to three bird species living in the Russian Far East.

We created a fine-scale habitat map based on a high spatial resolution, multiband (VIS-NIR-SWIR) remote sensing product, incorporating the information from SPOT 6 (VIS-NIR) and Landsat 8 (SWIR). We used the resulting remote sensing-derived environmental parameters (habitat proportions and Shannon's diversity index) as covariates in a hierarchical distance sampling procedure to analyse habitat preferences of the target bird species. Habitat characteristics were predictable with higher accuracies using the fine-grained remote sensing product including SWIR information compared to using SPOT 6 data alone. We could link the abundance of the three target bird species in our study to the proportion of wetland, willow shrubs, and habitat heterogeneity.

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Topic Session 3: Biodiversity Dynamics and Complexity, 29. Aug, 16:30 - 18:15

Poster

Hahn, Lisa

Leipzig University

Comparison of the diversity of the Coleoptera between the understory and the canopy in the floodplain forest of Leipzig

Our study is part of the Leipzig Canopy Crane (LCC) project and investigates the diversity and ecology of the Coleoptera in the nature reserve "Burgaue". It facilitates the investigation of different forest strata and of conceivable changes in the number of individuals and species composition in the understory and the canopy. During a period of 26 weeks, more than 270,000 arthropods were captured (with 44 window-flight traps), from which 19,906 individuals belonged to the Coleoptera. Among them Scolytidae and Cantharidae were identified as the most abundant families, Sericoderus lateralis and Rhagonycha fulva as the most abundant species in the understory and canopy, respectively. In addition, several faunistic peculiarities were found, which underline the outstanding value of the floodplain forest in Leipzig. Special attention was paid to the comparison of the understory and the canopy, which was investigated in parallel studies. We detected pronounced differences both in the number of individuals and in the family composition. The data evaluated in this study serves as a basis for further long-term investigation of the Coleoptera and their spatial and temporal distribution pattern. Beyond, we are extending our determination towards DNA-barcoding and will establish a reference database, the "Leipzig Barcode of Coleoptera – LBoC".

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Topic Session 3: Biodiversity Dynamics and Complexity, 29. Aug, 16:30 - 18:15

Poster

Hetzer, Jessica

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The importance of plant geometry for grassland dynamics

Grasslands cover about 20% of Europe's land area and can range from species-poor intensively managed to species-rich extensively managed grasslands. To understand how species-richness and management relate to the dynamics of grasslands, also in relation to climate change, individual- and process-based models are valuable tools. Here, we use the individual-based grassland model GRASSMIND and demonstrate that the species-specific geometries of individual plants are traits with a strong impact on grassland dynamics and functioning. However, information on plant geometries of species is scarce due to challenges in their measurement.

We present a methodological framework developed for detecting such geometric traits on example of a grassland experiment in Saxony (Global Change Experimental Facility) in which we captured individual plant-trait over a time period of 5 month. We observed differences in the development of plant height and lateral extent for four common grass species and demonstrate improved simulations of the seasonal biomass as well as species composition for grassland communities.

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Topic Session 3: Biodiversity Dynamics and Complexity, 29. Aug, 16:30 - 18:15

Poster

Haack, Nora

Leipzig University

Diversity patterns of beetle communities in the canopy of the Leipzig floodplain forest

Xylobiont beetles are excellent model organisms to study and understand the emergence of biodiversity, as they are a speciose, functionally diverse and well described group. Specifically, we aim to determine the impact of niche and neutral processes on diversity of communities and the rarity and abundance of single species. As a first crucial step we studied the influence of niche parameters on biodiversity at different scales. We found that niche parameters have a stronger influence on beta than on alpha diversity. Species richness of xylobiont beetles in the Leipzig floodplain forest is not significantly influenced by sampled tree species or vertical canopy stratum. Community composition on the other hand is shaped by both. Our results give an overview over the alpha and beta diversity of xylobiont beetles and provide the first opportunity to assess the influence of tree species and stratum on beetle biodiversity in the Leipzig floodplain forest.

We gratefully acknowledge the support of the German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig funded by the German Research Foundation (FZT 118).

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Topic Session 3: Biodiversity Dynamics and Complexity, 29. Aug, 16:30 - 18:15

Poster

Tehel, Anja

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Honey bee-associated viruses across taxonomic families of the bees

Viruses associated with honeybees are suggested as one out of many possible reasons for wildbee decline. RNA viruses like Deformed wing virus (DWV) or Black queen cell virus (BQCV) are already highly prevalent in a variety of bumblebee species. However, despite their potential role in bee decline, the occurrence of these viruses in wildbees, especially from genera other than *Bombus*, is poorly investigated.

We address viral spill-over from honeybees to wildbees and the role of viruses in wildbee species decline. We collected wildbees in Central Germany and screened them for RNA viruses. We found that BQCV and DWV-B was at high prevalence in bee species belonging to the Apidae but it was at lower prevalence in wildbee species of the families Colletidae, Halictidae and Andrenidae.

To help interpret patterns of viral prevalence across the phylogeny of bees, we experimentally infected *Exoneura robusta*, a Apidae, and *Amphylaeus morosus*, a Colletidae with DWB-B. As expected the virus seemed to struggle to replicate in the Colletidae, but replicated in the Apidae.

Our data suggest that a phylogenetic component exists to viral susceptibility; honeybee viruses may seem to represent a bigger problem for species in the family Apidae than for phylogenetically more distant families.

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Topic Session 3: Biodiversity Dynamics and Complexity, 29. Aug, 16:30 - 18:15

Poster

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Who can cope with global change? - The hidden life of grassland seedlings

Climate change, nutrient enrichment and changes in sheep grazing patterns are current challenges for plant species diversity in grassland ecosystems. By altering light availability and the amount of litter they modulate key factors decisive for species establishment especially from seeds. Monitoring changes in adult plant community composition in response to global change drivers is important, yet it remains unclear how seeds and seedlings, the future plant community, are affected and in turn how the performance of this life stage impacts on the adult community. Surveying and tracking a set of 14 sown common grassland species plus recording natural regeneration along with measuring light availability, soil moisture and litter depth, we investigated how nutrient enrichment, sheep exclosure, additional illumination, litter removal and climate change, influences seed germination and seedling establishment success. This talk highlights first results on seed and seedling performance from a multifactorial experiment in the Global Change Experimental Facility (GCEF) in Bad Lauchstädt. Based on preliminary data litter and sheep exclosure have a negative effect on seedling establishment, which seems to be driven by reduced light availability. In general germination and establishment is species specific with *Plantago media*, *Achillea millefolium* and *Daucus carota* being most successful across treatments.

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Topic Session 3: Biodiversity Dynamics and Complexity, 29. Aug, 16:30 - 18:15

Poster

Compagnoni, Aldo

Martin Luther University Halle-Wittenberg

Quantifying the probability of extinction risk: a case study on an endangered dune plant

Ecologists expect climate change to be a major cause of species extinctions, but these predictions are qualitative. Quantitative, rather than qualitative extinction forecasts would be most valuable to managers and policy makers. However, such quantitative forecasts need associate a mean probability of extinction to its uncertainty. Estimating this uncertainty is challenging, because it requires large amounts of data, combined with proper statistical and mathematical models. Here, we used a 14-year long dataset of an endangered dune plant collected across seven field sites in California (USA) to forecast the extinction probability by year 2050 arising from projected changes in climate. We fit hierarchical Bayesian models to estimate observation, parameter, and process uncertainties. We performed a leave-one-year-out cross validation to select the best annual climatic predictor of demography, which turned out to be air temperature. Finally, we forecasted extinction probability by 2050 using both Integral Projection and Individual Based population models. In three out of seven populations of this plant, changing climate will increase a non-zero mean extinction probability to a mean extinction probability of one. However, the uncertainty in these estimates is large enough that it suggests all populations have a non-zero probability of surviving.

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iDiv Annual Conference 2019

Topic Session 3: Biodiversity Dynamics and Complexity, 29. Aug, 16:30 - 18:15

Poster

Patzak, Roman

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Exploring a three-dimensional habitat: drivers of spatial lichen diversity patterns in the tree crown

In the tree crown, biodiversity is not distributed evenly. There are several mutually non-exclusive mechanisms which can potentially determine the emergence of spatial biodiversity patterns in such a complex, three-dimensional habitat. Size, age and distribution of crown elements shape vertical gradients of habitat optimality and heterogeneity, available surface area and successional stages of resident communities. Gradients, which are expected to showcase distinct mechanistic fingerprints on the scale of both sampling plots and height layers. Using epiphytic lichens on *Fraxinus excelsior* and *Quercus robur* as target objects, we aim to ascertain which of these gradients offers a mechanistic explanation as driver of observable biodiversity patterns. In both tree species lichen species richness exhibited a unimodal vertical pattern, skewed towards the top of the crown. This pattern was observable on both scales, suggesting a prominent gradient of environmental optimality, rather than heterogeneity. Null model evaluation further contested the importance of heterogeneity. Successional patterns, although secondary in explaining the richness gradient, shape a distinct compositional gradient from younger to older crown elements. Available surface area offered no conclusive explanation.

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