



ILTER Scientific Conference 2022

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ORAL PRESENTATIONS

Data Management practices in ILTER network: principles, tools and best practices

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ILTER is a network of national and regional Long-Term Ecological Research Networks. The Information Management Committee (IMC) of ILTER is working towards more coordination between the data and information management networks for better access to data and related artefacts. To understand more about the data and information management practices and capabilities across ILTER, IMC ran a survey across the ILTER network. The survey responses will provide a better understanding of individual network capabilities and capacity in data management.

The proposed workshop session will provide an overview of the data and information management practices at several ILTER networks and discuss an initial analysis of the ILTER data management capabilities survey. Following is the workshop program:

- FAIR and open data for OZCAR French Research Infrastructure
- Developing open data management for LTER Netherlands
- SAEON Open Data Platform: An infrastructure developed to enable access to environmental observation data in South Africa
- Australia's terrestrial ecosystem data management practices
- Advances in eLTER data management

Inside ILTER - survey on network-level data management capabilities

Keywords: information management, data, repository

DEIMS-SDR - more about long-term ecosystem observation sites

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Providing information on the context of long-term observation, i.e. the observation and research facilities where measurements were done, is key for re-using data generated for a defined area. This information is also needed to manage site networks of research infrastructures or research networks or to enable a link from in-situ observations to earth observation. To cover these requirements, the Dynamic Ecological Information Management System – Site and Dataset Registry (DEIMS-SDR, <https://www.deims.org/>) allows the description of in-situ environmental observation or experimental sites implementing a multipurpose data model and generating persistent, unique and resolvable identifiers for each site. The aim of DEIMS-SDR is to collect site information in a catalogue describing a wide range of sites across the globe, providing information including each site's location, ecosystems, facilities, measured parameters and research themes and enabling that standardised information to be openly available. DEIMS-SDR currently stores over 1200 site records along a wide geographic, altitudinal and ecosystem gradient. To address research needs as well as to enhance interoperability and machine readability, the used site model has been revised and compared to existing de-facto standards resulting in a more modular structure. The presentation summarises current developments in improving accessibility and interoperability of site information. We illustrate the capabilities of the data model focussing on the description of multi-layered geographic information that is needed to accurately document sites and the various observation locations they might cover.

Keywords: DEIMS-SDR; metadata; discovery; long-term observation; site catalogue; API

Digital experiment towards linking forest management to ecosystem services

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Forest management plays important role in developing solutions for sustainable delivery of ecosystem services, yet there are many challenges, as for example establishing the causal link between the flow of services and management. Experiments on the manipulation of forest structure and composition for these purposes are rare. Remote sensing technology offers opportunity to fill this gap through development of alternative approaches. This study takes such approach to examine changes in forest functional properties in relation to management intensity gradient, as a step towards understanding the effects this has on ecosystem services. The study was conducted in Serbian LTER site Fruška gora. Landsat satellite images were used to both screen the intensity of management and forest cover changes over twenty-year time interval. Forest functional properties were mapped by integrating field-data on tree species functional traits, and their change examined in relation to management using linear mixed effect models. On one hand, results exemplify how management manipulation of species composition and abiotic conditions affects functional properties, and so ultimately ecosystem services. On the other hand, they showcase the important role of novel technologies in supporting forest management decisions, and in the face of increasing pressures on forests.

Keywords: forest, Fruška gora, linear mixed effect models

Bulgarian LTER: from projects to a coherent Research Infrastructure

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Between its establishment in 2007 and December 2020, EU level research projects were the main funding of the Bulgarian Long Term Ecosystem Research Network. Since 2021, with its official acceptance to the Roadmap for Research Infrastructure of the Republic of Bulgaria 2020-2027, the network entered a period of transition towards a sustainable, coherent national research infrastructure.

This development is late in comparison to the policy relevant work on mapping and assessment of ecosystem services (MAES) which became a focus of active Bulgarian participation in 2012 and led to an assessment of 66% of the country's territory (outside NATURA 2000) by 2017.

Having in mind the rich biodiversity and small GDP of Bulgaria, the optimization of environmental spending requires maximal synergy between science and policy initiatives. A prerequisite for such synergy in ecosystem assessments and monitoring was a Methodological Framework that combines the Whole System approach with integrated assessment, in situ validation and monitoring guidelines for ecosystems and their services. This framework is supportive to fusing different and very variable data sources across all nine ecosystem types at the semantic, ontological, methodological and information compatibility levels.

Even so, the transition from a project driven effort of a group of sites to a sustainable, cohesive national network poses a number of challenges, which we present and discuss.

Keywords: Whole System approach, Data fusion, Natural Capital Accounting, Ecosystem Services, Assessment scales, Data Diversity

The importance of nitrogen research at eLTER and ILTER infrastructures

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The discovery of the Haber Bosch process almost 100 years ago, has been ground breaking in manufacturing synthetic nitrogen fertiliser, and has secured food production for the growing global population. The side effects of this success story are serious nitrogen pollution problems. Global average nitrogen fertiliser uptake rates by crops are well below 40%. The remaining ~60% nitrogen leaks to the atmosphere, soils, waters, with consequences impacting human and ecosystem health, biodiversity, air quality and increases global warming. Globally the agricultural sector is the largest source of N pollution, with fossil fuel combustion at 2nd place. Nitrogen pollution is present in all ecosystems, even the high Arctic. Long-term monitoring sites, such as ILTER/LTER/eLTER experience changes/losses of species composition, eutrophication and changes in weather patterns. Adding nitrogen monitoring to the networks can significantly improve scientific understanding and develop mitigation options. The aim of this talk is to describe the sources and sinks of nitrogen, not only from nitrogen rich systems, such as agricultural, but also from low nitrogen ecosystems, receiving N pollution with damaging effects. Examples are provided from long-term monitoring sites: (i) Carbon and Nitrogen budgets in low N systems, such as Boreal forests (ILTER Hyytiälä) and high N deposition rates to the Högwald forests in Germany will be compared. (ii) Changes in peatland vegetation due to enhanced N deposition rates (Burnsmuir Whim Bog ILTER). (iii) Comparing nitrous oxide, ammonia and NO_x fluxes from arable, grasslands, forests and wetlands (NitroEurope IP) and measures to reduce agricultural N pollution. (iv) Increased precipitation due to climate change can reduce nutrient availability in tropical forests, including nitrogen (Taiwan ILTER EAP); (v) Excess nitrate in aquatic systems in Northern Adriatic Sea (ILTER). Nitrate could not be used by phytoplankton due to PO₄ limitation.

Keywords: Nitrogen, climate change, eutrophication, ecosystem health

Towards forest landscape integrity: A novel ecological restoration approach using earth observation data

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Many global environmental agendas, including biodiversity loss, land degradation depend upon retaining forests with high ecological integrity, yet the scale and degree of forest modification remain poorly quantified and mapped. The fragmentation of forest is one of the threats to forest landscape integrity and connectivity. Therefore, an estimation of where forest fragmentation is likely to occur is critically important for improving the integrity of the forest landscape. We prepare a forest fragmentation susceptibility map for the first time by developing an integrated model and identify its causative factors in the forest landscape. Our proposed model is based upon the synergistic use of the earth observation data, forest fragmentation approach, patch forests, causative factors, and the weight-of-evidence (WOE) method in a Geographical Information System (GIS) platform. We evaluate the applicability of the proposed model in the Indian Himalayan region, a region of rich biodiversity and environmental significance in the Indian subcontinent. This study identifies Himalayan moist temperate and pine forests as being likely to be most affected by forest fragmentation in the future. The results suggest that the study area would experience more forest fragmentation in the future, meaning loss of forest landscape integrity and rich biodiversity in the Indian Himalayan region.

Keywords: forest landscape integrity; forest fragmentation susceptibility; ecology restoration, patch forests; land-use/land-cover change; forest conversion and loss; weight-of-evidence; Indian Himalayan region; remote sensing and geographical information system (GIS)

Don't ask what NBS can do to you, ask what you can do
for NBS!

In short: LTSER and NBS interface

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In the study carried a decade ago across a number of ILTER sites, we distinguished at least 4 types of environment management schemes, differing mostly with the extent of substitution of natural capital with organizational one, (de)coupling of ecosystem functions, and the level of ecosystem vs organizational integrity. However, when looking closer at urban-rural continuum, we can recognize similar pattern with analog consequences. Those consequences refer, amongst others, to the scale, context, and the role of Nature-Based Solutions. For many reasons the concept is sold in the form of big scale, blue-green infrastructures, while in fact, we talk about solutions starting from micro scale (i.e., mycorrhiza inoculation, nutrient sorbents in geochemical barriers) and ending in the landscape scale (i.e., shelter belts, small retention), and harvesting from decades of observations and experimentations (what marks LTER role 1). Depending on the context and location, NBS perform different functions: enabling nature, rehabilitating habitats, or restoring nature, or protecting it. In consequence, the role of LTSER platforms regarding NBS should be viewed broader than just socio-ecological monitoring for proving or denying the concept (role 2). In fact, each NBS implementation is a great manifestation of the whole system approach adopted by LTER, and not necessarily, by its function, must be long-term per se. However numerous NBS implementations indicate the critical importance of LT multi-stakeholder platforms working as entry points for business, science, education, and social animation (role 3). The presentation will use NBS implementation examples to illustrate the roles performed by LTSER in their development, research, implementation, monitoring and upscaling.

Keywords: NBS, LTSER, ecosystem services

New LTER-BG “Parangalitsa” site for long-term monitoring and research studies in mountain forests – current results and challenges

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The long-term ecological studies in mountainous forests of “Parangalitsa” Biosphere Reserve has started in 1979 with the establishment of six permanent experimental plots along altitude gradient covering a wide range of indicators for monitoring. The site is a part of the network of bioecological stations of Forest Research Institute – BAS and research is focused on highly productive coniferous forests with a unique biomass. In the main experimental plots, long-term complex studies were conducted during the period 1979 - 1998, a large-scale database was created and a number of significant scientific results were obtained. In the period 2000 - 2018, separate targeted studies were carried out - focused on some ecosystem processes, which allows the analysis and evaluation of the functioning of ecosystems to be done. The site is part of the UNECE ICP Forests Level 1 network and regular monitoring surveys have been carried out in the period 1987 to the present. The long-term environmental research programs have expanded rapidly since the establishment of the global LTER network in 1993, reflecting the increased appreciation of the importance of long-term research in assessing and solving complex environmental problems. Moreover, the LTER-Europe highlights the need of better integration of traditional natural science and holistic ecosystem research approaches that include studies of human-environment interactions. In this regard, in 2020 “Parangalitsa” site was proposed for a new site in the national LTER-BG network and it is promising for the assessment of forest ecosystems in the conditions of global changes and for the application of an integrated ecosystem approach. In this presentation some of the most significant results obtained in the last decades are summarized and presented, outlining the role of long-term monitoring for obtaining information about the climate, soil and forests, impact of natural events such as windthrows and insect outbreaks on soil C stocks and discussed in the perspective of current challenges.

Keywords: NBS, LTSER, ecosystem services

What does nature feel like? Using embodied walking interviews to discover cultural ecosystem services

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The definitions of cultural ecosystem services (CES) and the methodologies for assessing them are constantly evolving. One major trend has been moving away from utilitarian and functional definitions regarding the immaterial benefits humans derive from nature towards an emphasis on how nature contributes and interacts with human values, perceptions, and identity. As such, it is necessary to develop methodologies that can better express the depth of meaning of CES to strengthen the conceptual foundation of the concept, and its application. This presentation demonstrates the use of embodied interviews, conducted with informants while walking in nature, to capture real-time, intuitive and grounded perceptions of, and reactions to, nature and its associated services in diverse ecosystem types. In our primary research, conducted in four eLTER LTSER platforms, results provide a deep, nuanced understanding of diverse human-nature relationships and expose two distinct groups of CES values or themes: general (common across research sites) and local (site specific). 'General' CES include cognitive and psychological services, among them calmness and newness, heightened imagination and curiosity, increased energy and motivation, and gaining new perspectives. Local themes differed from one ecosystem to another and included more biodiversity- and geodiversity-related values pertaining to local species and geology, as well as more sensory-based experiences. In a second research project, we explored the use of this methodology across urban-nature gradients to explore how CES and nature experiences shifted with increasing levels of urban intensity.

Keywords: Cultural ecosystem services, embodied thinking, relational values, focusing, LTSER

Drought as a climate change agent and its effects on the structure function and state of semiarid terrestrial ecosystems

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During the last thirty years of continuous study at the Shaked Park LTER site in semiarid northern Negev, Israel, knowledge about the structure-function and state changes in the terrestrial dryland ecosystem was gained. After 15 years of study, a repeated drought caused state transition from shrubland to grassland. The processes of climatic induced transition initiated by extensive shrub mortality cascading to the expansion of biological soil crusts (biocrusts) cover. This transition increased nutrient, resource leakage and overland water runoff from the watershed slopes into the dry riverbed. In the next transition, the ecosystem shifted to a grassland state leading to slopes ecosystems recovery that increases productivity and diversity and reduces resource leakage.

The long-term research in Park Shaked made it possible to study ecosystem responses to higher frequency and magnitude of droughts as consequences of climate change. The long-term studies before and after the drought-induced system collapsing and recovery made it possible to quantify the effects of the dead shrub's legacy and the role of biological soil (biocrusts) as environmental engineers that regulate state transition from shrubland to grassland. Both ecosystem engineers regulate water and organic matter redistribution that initiates patches of annual grasses that later developed into grassland.

The information regarding the role of organic matter legacy from shrub mortality, its redistribution in the system by runoff, and its relationship with biocrusts, herbaceous plants, shrubs, and soil properties shed new light on the effect of climate change on ecological processes.

Keywords: biocrusts, shrub mortality, herbaceous plants, soil properties, ecosystem engineers, runoff, organic matter redistribution

Proposal for integration of pollinator monitoring schemes and LTER network

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Pollination is a vitally important process for global crop production and insect pollinators, providing this ecosystem service, represent a key component of global biodiversity. Thus, multiple reports on global insect declines and so-called pollination crisis have raised concern of both scientific community and the public. However, despite widespread concern about declines in pollination services, little is known about the patterns of change in most pollinator assemblages. In order to halt the loss of pollinators, European Commission has started several ambitious actions and projects. To overcome the impediment of the lack of knowledge on pollinators (namely wild bees, hoverflies and butterflies), a group of top pollinator experts developed a proposal for EU Pollinator Monitoring Scheme (EU-PoMS), a field-based monitoring scheme that aims to provide robust information on the status and trends of pollinator populations in EU countries. Additionally, projects aiming at strengthening taxonomic capacities and providing adequate taxonomic resources were launched. Serbia, although still not a part of an EU, is heavily involved in these initiatives and projects, thanks to the fact that several leading experts on hoverflies come from here. As a preparatory phase for EU-PoMS, national project named Serbian Pollinator Advice Strategy (SPAS), financed by the Science Fund of the Republic of Serbia, was established, aiming to perform the monitoring of hoverflies, bees and butterflies on 30 sites throughout Serbia, three times annually, for three years (2022-2024). Considering the significance of the question of pollinator loss, and the size of both EU-PoMS and LTER networks, finding a way to combine them, both in the sense of efforts and results, could yield significant benefits for all involved parties.

Keywords: bees, butterflies, hoverflies, insect decline, network, pollination

The integrated management model of indigenous ecological agricultural landscape and human-wildlife conflict

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The native tribes of Hualien are located in the transition zone between the original ecological land and the urban settlement, providing habitats composed of diverse landscapes to conserve various biological communities and maintain the balance between the ecological environment. The plains and shallow mountains between the Central Mountains and the Coastal Mountains, according to the location of the tribes, it is divided into the four main Corridor Tribes. However, with the aging of the agricultural population, the migration of the young population under the influence of social industrialization, and the inability to pass on the traditional farming knowledge of the aborigines and elders, most of the farmland has been idle and turned into a wasteland, forming a discontinuity of biological habitats. Our project aims to connect the tribes to form the corresponding harmony between the original village corridor and the national land green network in the sustainable management of the corridor landscape; at the same time, evaluate the quantitative and effective ecosystem service indicators, provide the corresponding and reference basis for the payment of ecological service benefits, to improve the efficiency of promoting ecological agriculture policies and maintain the integrity of the ecosystem and create a hometown environment for sustainable co-prosperity.

Keywords: agricultural landscape, landscape metrics, human-wildlife conflict

Combining local and network studies to enhance impactful science

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Publishing results from a single ILTER site is often problematic as reviewers question the wider utility of the results obtained from a single site. In this presentation we provide an example where the publication of the network paper was important for the acceptance of the paper reporting the local single site study. Our example focuses on management-relevant knowledge of recreational cultural ecosystem services to aid management decisions. The network study (Teff-Seker et al 2022) demonstrated how embodied interviews, conducted with informants while walking in nature, captured real-time intuitive and grounded perceptions of, and reactions to, four different ecosystem types and their associated services (ILTER sites in Israel, Netherlands, Finland, and Scotland). The results provided a deeper and more nuanced understanding of diverse human-nature relationships and reflect two distinct groups of cultural ecosystem service values or themes: general (common across research sites) and local (site specific). The publication of the general themes facilitated the acceptance of the local site-specific paper (Dick et al 2022) which combined the walking interviews and a spatial recreational model of the whole Cairngorms National Park, Scotland (ESTIMAP-Recreation). The network study showing that the findings of the local study were also found elsewhere was critical in the acceptance of the local study into the peer reviewed literature.

Keywords: Stakeholder perceptions, Place-based, Social-ecology, Cultural ecosystem services

Ecological restoration within eLTER community: the results of a questionnaire

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The knowledge on the structure and functions of ecosystems gather within LTER could be useful in scaling up ecosystem restoration to meet the challenges of the UN Decade on Ecosystem Restoration, the EU Green Deal, and Biodiversity Strategy 2030. We tried to collect information on the range of ecological restoration projects that have been implemented in eLTER sites within Europe. We have developed an online questionnaire to gather information about possible contributing experts and the related eLTER sites and

the details of restoration projects including the use of LTER services. We have analysed 45 restoration projects in 19 countries in Europe and northern Africa. Most of the projects aimed to restore grasslands (25%), forest & woodlands (23%) and freshwater ecosystems (19%). Active restoration (86%) was preferred over passive restoration methods (14%). 76% of the projects were long-term monitored (> 5 years monitoring) and plant cover, species number and diversity were the most monitored variables. Restoration success was ranked to higher on the long term. More than 80% of projects used eLTER infrastructure, expert knowledge or data collected within eLTER sites. This overview revealed that ecological restoration is important within eLTER sites and that the eLTER network provides additional value to restoration through its infrastructure, gathered long-term data sets and knowledge on ecosystem structure and function that could be used to help upscaling restoration in Europe.

Keywords: Long-term monitoring, ecological restoration, active restoration, passive restoration

Mesta River LTER site (South West Bulgaria): macrophyte-based assessment

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Thirty-two aquatic macrophyte taxa from four taxonomic groups (algae, pteridophytes, bryophytes, spermatophytes) were registered at eight sites along Mesta River LTER site in 2021. The diversity was highest at helo- and hygrophyte groups. Bryophytes dominated mountain river sites, while semi-mountain supported macrophyte assemblages dominated by vascular plants. Macrophyte-based assessment indicated downstream deterioration with lowest score observed at Mesta River after sewage discharge of Gotse Delchev town.

Keywords: aquatic macrophytes, ecological status

How much time? Modelling oak natural regeneration in dryland Mediterranean systems

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In Mediterranean drylands, oak regeneration is crucial to maintain a traditional High Nature Value Farmland system called montado – a species-rich open woodland dominated by cork oak or holm oak, occurring in dryland areas where silvicultural, extensive grazing and other uses are combined. In this system, grazing and climate may hamper tree regeneration, promoting desertification processes and threatening its sustainability.

Here, we will show two works conducted in the Montado LTsER Platform, in Portugal, where we researched the time needed for oak regeneration after grazing exclusion and under different microclimatic conditions. To evaluate the temporary effects of grazing exclusion on cork oak, a chronosequence of sites that are grazed and excluded from grazing for 5, 9 and 13 years was assessed. The results suggest that although seedlings germinate in grazed and excluded sites, grazing prevents their growth into saplings and young trees, while an exclusion of 9 years was optimal for successful tree regeneration. In the second experiment, we modelled the 60-years holm oak regeneration in an old-fields area, as a function of long-term macroclimate and microclimate. We found that microclimate, using Potential Solar Radiation as a proxy, was key for tree regeneration. The less sun-exposed areas had 90% tree cover after 60 years, while the more sun exposed had recovered only ~20 % of tree cover. Moreover, the model successfully predicted reforestation failure to an area where holm oak reforestation actions were conducted.

Taken together, our research suggests important factors and the timeframe operating on oak regeneration in this slow-growing, water-limited system, with the aim of improving management and efficiency of restoration efforts.

Keywords: tree regeneration; dryland; succession; passive restoration; grazing; Potential Solar Radiation

Long-term ecosystem and biogeochemical research at the LTER site "Istituto Scientifico Angelo Mosso" (NW Italian Alps)

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The LTER macrosite "Northwestern Italian Alps" includes the research site "Istituto Scientifico Angelo Mosso" (Mosso Institute), located in the alpine tundra close to the Monte Rosa Massif (NW Italy). Studies at the Mosso Institute, the core of this research area, began in 1907 and, over the last century, have covered several disciplines, such as human physiology (in particular how the human body reacts at high elevations), and especially Alpine meteorology and glaciology, thanks also to the presence of the Meteorological Observatory that supported the Institute, and now hosting an Automatic Weather Station managed by the Comando Truppe Alpine – Servizio Meteomont.

In addition to the precious historical climate data series, numerous research activities on specific snow/soil/vegetation interactions has been ongoing since 2005, with particular reference to the dynamics of carbon and nitrogen in the soil. These studies are conducted in two typical alpine tundra habitats. The first one is characterised by having a long snow cover duration (SCD) and is mainly composed of *Salix herbacea*, while the second one has a lower SCD and is mainly composed of *Carex curvula*. Moreover, investigations are ongoing on the chemical characteristics of high-altitude lakes fed by different elements of the cryosphere such as rock glaciers, glaciers and permafrost, and on the characteristics of atmospheric deposition. In particular, it is intended to estimate the atmospheric nitrogen and carbon load by analysing snow and summer precipitation.

In recent years, particularly since winter 2020, microplastics in the snowpack have also been studied. The results have shown that high-altitude environments are not exempt from anthropogenic pollution, so even these small plastic particles can reach remote sites in the Alps. Over the next few years, research activities for microplastics will be further investigated in order to better understand their origin and, above all, to study the fate of these pollutants in high-altitude environments.

Keywords: Alpine tundra, soil, snowpack, nutrients, pollutants

Fusing socio-ecological and cultural ecosystem services indicators: challenges of going from national to local scale. A case study from the high mountain ecosystems of Rila, Bulgaria

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Cultural ecosystems services are among the most difficult to quantify, and research in this area is rapidly evolving. The Bulgarian Methodological Framework for Mapping and Assessment of Ecosystem Services was initially developed between 2015 and 2017, before the current standardization effort within the European Long-Term Ecosystem Research Network eLTER. Later, the EU level KIP-INCA project and its related research developed clear supply and demand modelling for some cultural services. Consequently, the Methodological Framework's parameters are not well suited to measure socio-ecological parameters in LTSE platforms; also, they are not clearly divided to measure supply and demand in the context of the SEEA EA environmental accounting. On the other hand, by following the Whole System approach, it aims at a complete coverage of ecosystem services provided by each ecosystem type in the country and as such, has many more parameters to be measured and evaluated during ecosystem assessments. It furthermore accounts for all ecosystem services in a given area, thus removing the overlap between proposed LTSE methods related to crop and animal rearing and the overall measurement "ecosystem services profile".

In a case study based on our study area in Rila mountain, we extend prior work on landscape scale ecosystem assessment. We specify the parameters of Physical use of land-/seascapes in different environmental settings, Cultural heritage and Bequest for measuring cultural ecosystem services with available data on the local scale. This part of our work to integrate diverse and not always consistent data. In the process, we look at the fusion of existing parameters, new small-scale data sources and the concept of cultural ecosystem services supply and demand across the grassland, forest and sparsely vegetated ecosystems that form the High Mountain Ecosystems (HME) landscape.

Keywords: Cultural Ecosystem Services, Natural Capital Accounting, Whole System Research, Assessment scales, Data Diversity

The role of soil microbial diversity in ecosystem multifunctionality

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Soils are responsible for the provision of countless ecosystem functions and services, vital for the well-being of diverse communities of organisms. Soil microorganisms especially have a key role in nutrient cycling and ecosystem multifunctionality. Microbial diversity and community composition are shaped by their local biogeochemical context, which affects how these functions are being carried. With expected global changes in climate and land-cover, it is crucial to refine our understanding of how the effect of microbial diversity on ecosystem multifunctionality varies depending on the soil system. To tackle such large-scale challenge related to soil biodiversity and functioning, we created iSBio: The International Soil Biogeography Consortium, a global collaboration network of experimental platforms, with over 100 collaborating institutes, already connected through the TeaComposition network. Following a global soil sampling campaign, we linked long-term standardized decomposition measurements with soil functions (including microbial respiration and aggregate stability) and diversity measurements to unravel the context-dependency of these relationships. We used measured and extracted climatic and soil properties to define the direct and indirect roles of these components on the diversity-functionality relationship.

Keywords: Soil biodiversity, ecosystem multifunctionality, decomposition

POSTER PRESENTATIONS

The effect of 12 years lowland and lowland-upland system on soil organic matter in Taiwan

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The purpose of project was concern how cropping system(low land/low land up land), fertilizer dosage(CA and SA), and different sites(Chiko and Dounan) influence the soil organic matter content. The treatments included cropping system, fertilizer in two sites. Temperature-dependent differentiation of total carbon was detected by Soli cube. Site, farming system, and depth were significant ($p < 0.01$) in soil organic matter. Soil organic matter in Chiko was higher than Dounan due to the soil texture was silty clay loam in Chiko and sandy loam in Dounan . Lowland cropping system showed higher SOM than low/up land system which means more water logging period may protect SOM. TOC400 was higher than ROC no matter in Chiko or Dounan, which mean most crop residue may turn into biological labile carbon.

Keywords: Soil organic matter, Cropping system, Temperature-dependent differentiation of total carbon

A 50-year permanent plot network in Australian tropical rainforest: recent research and future opportunities

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I present an overview of a 50-year permanent plot network in the Australian tropics and the associated dataset. This dataset comprises continuous high-quality records of tree recruitment, growth, mortality, and species identities. In addition, I will summarise recent high-impact research that has used these data, including a summary of my own research on 1) carbon sink dynamics of Australian tropical forest and 2) uncertainties in these carbon sink estimates. To date, these data have been used to ask: What is the impact of cyclones on forest dynamics? How makes the Australian tropics distinct from or similar to tropical forests elsewhere? How do Australian tropical forests respond to climate? There is tremendous potential for further research using the existing long-term dataset, or for novel research using the existing plot infrastructure.

Keywords: Australian tropics, carbon sink dynamics, forest dynamics, long-term analysis

Study of the biodiversity of Srebarna Lake - LTER- Bulgaria Site

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Srebarna Lake is a typical floodplain wetland ecosystem, situated on the riverine terrace of the Lower Danube, encompassing great diversity of protected and rare plant and animal species, as well as protected natural habitats. It was designated as a Monument of World Cultural and Natural Heritage (1983), UNESCO Biosphere Reserve (1977), Ramsar site (1975), Important Bird Area (1990) and a site of the Natura 2000 Ecological Network, because of its extremely rich biodiversity. The Reserve is a host of diverse algal flora, over 100 zooplankton species, more than 150 aquatic macroinvertebrates, about 270 vascular plant species, 103 macrophyte species, 29 fish species, 21 reptile and amphibian species and 41 mammal species. The avifauna numbered a total of 230 species, the nesting colony of Dalmatian Pelican, being the pearl of the Reserve. After the embankment of the Danube in 1948, a progressive degradation of the lake ecosystem occurred. Since 1999 Srebarna Lake has been declared a Managed Reserve, which allows the implementation of various measures for recovery and conservation of the wetland ecosystem. This has led to a restoration process of the ecosystem over the last 20 years. Despite the serious changes, as a result of human intervention during the years, Srebarna Lake remains the most significant model site for studying biodiversity and development processes in the wetland ecosystems on the Danube River flooding terrace along the Bulgarian Danube section. The lake is also of a great value as a model site for the implementation of programs, and projects related to the application of good management practices in the conservation of protected natural sites.

Keywords: Biodiversity, Srebarna Lake, LTER site, Bulgaria

Mesta River – a LTER Site (South-West Bulgaria) - A 40 Year Long-term Research of Hydrology and Hydrochemistry

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Mesta River is a representative Bulgarian water site within the European Long-Term Ecological Research Network (eLTER). The river's watershed comes from the protected, according to NATURA 2000 and Biodiversity law, territory which falls within two national parks - Rila and Pirin. Its upper and middle stretches are located in South-West part of Bulgaria. Afterwards the river enters the territory of Greece. The aim of the study was to trace long-term trends of the physico-chemical and hydrological parameters during the period 1978-2021. The selected parameters: water flow, water temperature, oxygen concentration and saturation, and nutrients (ammonium, nitrite- and nitrate nitrogen concentrations) were measured at 8 sites situated on the main river and its tributaries during high and low water periods. The sampling sites are situated between 1915 m a.s.l. and 392 m a.s.l. They represent longitudinal changes in the river hydrology and hydrochemistry and are characterized by various ecological situations such as different types of human impact (in the influenced river stretches) and/or local effects of climate change (which are better defined in unaffected river sections). The analysis showed a clear tendency in a 40-year period of a decrease of the water flow during both high and low water periods. Gradual increase of the water temperature values and a decrease of oxygen concentration and saturation in the upper, high mountain stretch of the river was observed. Nevertheless, with the lowering of the altitude towards the border with Greece, the oxygen concentration and saturation increased during the study period. Concentrations of the nitrite and nitrate nitrogen increased and those of the ammonium nitrogen decreased along the river continuum.

Keywords: Mesta River, environmental parameters, hydrochemistry, hydrology, long-term research

Modeling and prediction of inflorescence emergence in 'Yu Her Pau' litchi based on long-term phenological monitoring

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Litchi (*Litchi chinensis*) is one of the most popular fruit crops in East Asia. Currently, major commercial litchi production is located in the subtropical regions, where the cool temperatures in the winter suffice the need for successful floral induction. However, the trend of rising temperatures in recent years due to global climate change could lead to insufficient cool temperature accumulation in the existing litchi-producing area and thereby threatens fruit production. This further implies the production area may be shifted in the coming decades. In particular, floral induction in early-maturing 'Yu Her Pau' is more sensitive to cool temperatures than other mid- or late-maturing varieties, making it more prone to yield fluctuation associated with increasing winter temperatures. To develop strategies against this urgent challenge, the relationship between the environments (i.e., cool temperatures) and flowering behavior in early-maturing litchi varieties needs to be assessed in a quantitative manner. The objective of this study was to characterize the cool-temperature requirement for litchi inflorescence emergence by documenting the phenological changes from flush maturation to macroscopic appearance of inflorescences in 12 'Yu Her Pau' trees of two field plots during 2012 to 2018 (i.e. six flowering seasons). The cool-temperature effectiveness function of 'Yu Her Pau' inflorescence emergence was optimized by coefficient of variance using beta-distribution model. Our results suggest the minimum, optimum, and maximum temperature is around 0 °C, 19.8 °C, and 21.9 °C, respectively, for effectiveness integration on inflorescence emergence, and ca. 60.37 cumulative degree days (CDDs) in 'Yu Her Pau'. Simulations of temporal-spatial distribution of inflorescence emergence in YHP based on the cool-temperature accumulation model created herein were also performed using 24 models under four representative concentration pathways (RCPs). We detected an increased incidence of unsuccessful inflorescence emergence in existing litchi-growing regions on Taiwan, including some areas of Kaohsiung, Pingtung, and Taitung in 2050, indicating an imminent threat to the litchi industry that requires immediate solutions.

Keywords: flowering, subtropical fruit, phenology, modeling

