

30 years anniversary of the KisKun LTER site

Workshop on the results of ecological and nature conservation research

PROGRAM AND BOOK OF ABSTRACTS

Természet Háza, Kecskemét, Hungary

10 October 2023

Organizers

Centre for Ecological Research and
Kiskunság National Park Directorate



Kiskunsági
Nemzeti Park

The KISKUN LTER field research network was established almost 30 years ago, and research in the area has been ongoing with varying levels of activity. The conference aims to summarise the results of ecological and conservation research in and around the Kiskunság Sand Ridges, to get to know each other's research, to explore possible synergies and opportunities for cooperation, including the organisation of joint publications, proposals, and events. This will strengthen the KISKUN LTER and the Hungarian LTER as research infrastructures of national importance, and thus take steps towards possible funding of research infrastructures in Hungary.

The workshop was supported by Super-G (Developing SUsustainable PERmanent Grassland systems and policies) project. The presentations are held in Hungarian.

Organized by Miklós Kertész, Katalin Török, Katalin Szitár, and Zoltán Vajda

PROGRAM

10:00-11:30 - 1. szekció / Session 1

Az előadóiülés megnyitása / Opening of the conference

Kertész Miklós - A magyar LTER története / The history of Hungarian Long-Term Ecological Research Network (LTER-Hu)

Szitár Katalin - Az európai LTER aktuális törekvései / Activities of the European eLTER

Török Katalin, Melinda Halassy, Katalin Szitár, Anna Kövendi-Jakó, Bruna Paolinelli Reis - Restaurációs ökológiai kutatások története, összefoglalása a KISKUN LTER területén / History and summary of research on ecological restoration at the KisKun LTER site

Kröel-Dulay György, Orbán Ildikó, Ónodi Gábor - Az aszályok és bolygatások hatása a nyílt évelő homokpusztagyepekre

Ruprecht Ádám, Botta-Dukát Zoltán, Halassy Melinda, Mártonffy András, Szitár Katalin, Csecserits Anikó - Másodlagos szukcesszió eltérő útjai a fülöpházi parlagokon / Different pathways of secondary succession in the Fülöpháza old-fields

Gallé Róbert - Ízeltlábú közösségeket befolyásoló tényezők homoki erőssztyeppeken / Landscape and local factors affecting arthropods in forest-steppes

11:30-12:00 – Kávészünet / Coffee break

12:00-13:30 - 2. szekció / Session 2

Boros Emil - A kiskunsági szikes tavak múltja, jelene és jövője / Past, present, and future of Kiskunság alkaline soda pans

Vörös Lajos, Somogyi Boglárka - Különleges algavilág a Kiskunság szikes tavaiban / Unique algal flora in the soda pans of the Kiskunság

Fodor Eszter, Biró Marianna, Molnár Zsolt - Növényfajokkal és élőhelyekkel kapcsolatos hagyományos és helyi ökológiai tudás a Kiskunságban / Traditional and local ecological knowledge about plant species and habitats in the Kiskunság region

Kalóczkai Ágnes, Tormáné Kovács Eszter, Fabók Veronika - Természetvédelem és mezőgazdálkodás - társadalomtudományos kutatásaink az elmúlt 15 évben a Kiskunságban / Agriculture and land use – 15 years of social science research in Kiskunság

Berki Boglárka, Botta-Dukát Zoltán, Csákvári Edina, Gyalus Adrienn, Halassy Melinda, Mártonffy András, Rédei Tamás, Csecserits Anikó - Egy évelő faj is kimerülhet: a közönséges selyemkóró többéves mechanikus kezelésének hatása / Even a perennial species can be depleted: the impact of five years of mechanical treatment of the common milkweed

Halassy Melinda, Krpán Emese, Bruna Paolinelli Reis, Sáradi Nóra, Török Katalin - Az invazív idegenhonos növényfajok gyakoriságának hosszú távú változásai a restaurációs ökológiai kísérletekben, az idő, a kezelések, a szárazság és a táji tényezők hatása / Long-term changes of invasive alien plant species in restoration ecology experiments, effects of time, treatments, drought and landscape invasion

13:30-14:30 Ebédszünet

14:30-15:45 3. Szekció / Session 3

Nagy Tamás - A Baksi puszta madárállományának változása az elmúlt 20 év során, egyes jellemző fajokat és élőhelyeket kiemelve, különös tekintettel a szikes vízi és szikespusztai élőhelyek állapotának változásai által indukált állományváltozásokra / Changes in the bird population of Baksi Puszta over the last 20 years, with a special focus on population fluctuations induced by changes in the status of sodic wetlands and sodic steppes

Tamás Enikő Anna - Az Ágasegyháza-orgoványi rét és a Kolon-tó talajvízszint és talajvízáramlási viszonyainak aktuális jellemzése és összevetése a KNPI megalakulása időszakában mért jellemzőkkel

Lellei-Kovács Eszter, Vajna Flóra, Somay László, Molnár Csaba, Máté András, Báldi András - Parlag-felülvetéssel a homoki gyepek ökoszisztéma szolgáltatásainak gazdagításáért / Fallow oversowing with native species for increasing soil quality, biodiversity and other ecosystem services in dry permanent grasslands

Bihaly Áron, Máté András, Báldi András - Vadvirágos gyepek telepítésének gyakorlati kérdései / Restoration of flower-rich grasslands to improve biodiversity and ecosystem services in agricultural landscapes

Tölgyesi Csaba - A homokfásítás hidrológiai hatásai / Hydrologic effects of afforestation on sand

15:45-16:30 Diskusszió / Discussion

Poszterszekció

Nagy Anna Fruzsina, Csecserits Anikó, Csonka Anna Cseperke, Halassy Melinda, Kertész Miklós, Kröel-Dulay György, Ónodi Gábor, Sáradi Nóra, Vörös Márton, Rédei Tamás - Melegedés és aszály hatása a nyílt homokpusztagyep növényzetére / Effects of warming and drought on the vegetation of open sand grasslands

ABSTRACTS

Session 1-1

The history of Hungarian Long-Term Ecological Research Network (LTER-Hu)

Miklós Kertész

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Dedicated long-term ecological research started in the early 1970s in Balaton by MTA BKLI, and then in late 1970s in the Bugac area of Kiskunság National Park by teams of József Attila University, Szeged and Eötvös Lorand University, Budapest. Encouraged by the early successes of the US LTER (US Long-term Ecological Research Network), other teams of MTA institutes and universities initiated long-term studies, too. The International Long-term Ecological Research Network (ILTER) was launched in a summit organized by US LTER, on which Hungarian scientists were also present, namely Gábor Fekete and Edit Láng from MTA ÖBKI. Going home, they started propagating the idea of organizing a national network. In the next two years, a delegation of Hungarian scientists visited US LTER sites, and an illustrious group of US LTER scientists visited Hungary, and with their help, the Hungarian Long-Term Ecological Research Network (LTER-Hu) was established.

LTER-Hu adapted the US LTER research criteria. An LTER site

- should be dedicated to scientifically and socially important central topics,
- conducting area-based community level or socio-ecological studies
- in landscape context, with monitored weather and basic ecological processes as primary production, population size of the most important species, etc.,
- supported by safe site and institutional background.

Although all the criteria could not be fulfilled at the beginning, the LTER-Hu started with three sites: KISKUN LTER hosted by MTA ÖBKI, Balaton LTER hosted by MTA BLKI, and Síkfőkút LTER hosted by DATE. Beside advice, the American colleagues helped us with collaborative projects, too. Later, the Balaton and KISKUN LTER developed into platforms, where the social aspect is also emphasized, and further sites are established. The LTER site status helped us to join international projects like DIRT in Síkfőkút and VULCAN/INCREASE in Fülöpháza.

LTER-Hu was active in the European scene as a member of the Central-Eastern European regional group of ILTER. The EU played a pivotal role in developing European and global LTER network due to sponsoring a series of projects from Alternet (2004-2009) to eLTER PLUS and PPP (2020-2025). During that period, the European LTER was formed in 2007 in Balatonfüred. In the mid-2010s, European LTER took efforts to join the ESFRI process which aims to form EU-scale research infrastructures. In 2018, eLTER was accepted as a future RI of the ESFRI roadmap, and in 2020, eLTER PPP and PLUS started to build up the eLTER RI substantially and formally, too. We hope that in the near future LTER-Hu will get the necessary formal political support to join eLTER RI.

Session 1-2

Activities of the European eLTER

Katalin Szitár

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eLTER (Integrated European Long-term Ecosystem, critical zone and socio-ecological Research) has been investigating long-term relationships between people and nature, and facilitating high impact research for addressing the grand societal challenges in European ecosystems and socio-ecological systems. For supporting the implementation and long-term operation of top infrastructures, ESFRI (European Strategy Forum on Research Infrastructures) publishes and regularly updates a Roadmap, which reflects strategic European priorities. In 2018, eLTER was accepted as a future RI (research infrastructure) on the ESFRI roadmap. The inclusion to the roadmap marks a milestone towards the sustainable operation of eLTER sites. eLTER is currently in the preparation phase on the way to become a fully-fledged RI. Between 2020 and 2025, two Horizon 2020 funded projects (eLTER PPP and Plus) help to accomplish the ESFRI process. eLTER PPP coordinates the detailed specification and decision making processes towards the eLTER RI implementation and legal entity, whereas eLTER PLUS connects major scientific user communities with the site networks, and works on detailed site and observation specifications. Major challenges of the loosely organized networks are being systematically addressed, including the establishment of eLTER Standard Observations and a Service Portfolio for a wide range of internal and external users.

eLTER RI will comprise in-situ National Research Infrastructures with eLTER Sites (focal points for long-term ecosystem observation and research) and eLTER Platforms (large areas facilitating socioecological research and exemplary stakeholder engagement), and European level Central Services (data access, training and method harmonization). The in-situ facilities will be open for research and education via a centralised scheme. A range of centrally-provided services will make eLTER RI more than the sum of its national networks. The Central Services will consist of a Head Office, Service Portal, and Topic Centres with six Thematic Service Areas. The Head Office is currently hosted by UFZ, Germany, and is responsible for coordination, strategic development, and outreach. The eLTER Service Portal will be the one-stop gateway to all eLTER RI resources, supporting the collection of and access to data provided both centrally and by eLTER in situ facilities. The Thematic Service Areas cover a range of activities, such as quality assurance for data, modelling and analysis tools, design and synthesis, training, and technological innovation.

eLTER RI is worth joining because it provide access to research infrastructure sites and data across Europe, support research projects, education, and trainings, facilitate international and interdisciplinary collaborations, provide better visibility on scientific and policy landscapes, and help financial sustainability of in-situ facilities.

Session 1-3

History and summary of research on ecological restoration at the KisKun LTER site

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The first research project on ecological restoration was launched in 1995 at three locations on clear-cut *Robinia pseudoacacia* stands to test mowing as a method to help the regeneration of the native sand grassland. This was the year of the foundation of the Hungarian Long-term Ecological Research (LTER) network. Later several other restoration methods were applied to facilitate the recovery of sand grasslands at abandoned arable fields, like soil nitrogen immobilisation; seeding of native target species and their combinations. Treatments were applied for a few years, but monitoring was carried out longer, up to 22 years. This long-term follow up enabled to evaluate short and longer term outcomes of treatments. Main results are as follows:

- Seeding of native species proved to be the best method to support the spread of target species and to control invasive species;
- Mowing created establishment windows that could be occupied by both target and invasive species;
- Nitrogen immobilisation had some minor positive impact on target species and could be used in the first period of restoration after degradation, but was neutral to invasives;
- Short-term results might lead to misinterpretation of success; long-term monitoring is crucial in evaluating restoration outcomes;
- Results are applicable in the Kiskunság region in land use planning and nature conservation projects.

Linking ecological restoration with the eLTER network has benefits: collaboration with other sites; use of background data collected at the sites (meteorology, soil, reference ecosystems); taking advantage of existing multidisciplinary team; data and sampling standardisation; Whole System Approach and others. Nature Restoration Law of the EU requires strengthening of ecological restoration, therefore the site-based restoration at eLTER sites could be leveraged to be included in the European Research Infrastructure, eventually as a Topic Centre.

Session 1-4

The effect of droughts and disturbances on open sand grasslands

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More intense and frequent droughts predicted for the future will heavily affect grasslands worldwide and, along with various other disturbances, possibly trigger major vegetation shifts. Therefore, documenting these changes and understanding the mechanisms behind them is essential. Our study aimed to investigate how dominant species in a semiarid grassland respond to a combination of small-scale experimental disturbances and naturally occurring droughts and uncover the underlying mechanisms.

We conducted a small-scale disturbance experiment in a semiarid temperate grassland in the Fülöpháza sand dunes, and followed recovery for 18 years, including severe drought events. In 1999, we established 16 sites, eight dominated by *Festuca vaginata* and another eight by *Stipa borysthenica*, the two dominant species of sand grasslands in the region. At each site, three permanent plots were marked that received either a cutting or digging treatment or remained as controls. We monitored the cover and density changes of *Festuca* and *Stipa* annually.

In the early years following the disturbance, *Festuca* recovered at a similar rate under both disturbance treatments, while *Stipa* recovered faster in cut than in dug plots. When natural drought events caused major diebacks of both species, *Stipa* recovered very quickly and regained dominance in initially *Stipa*-dominated plots, and it also took over in initially *Festuca*-dominated control and cut plots. However, digging at *Festuca*-dominated sites delayed drought-induced *Stipa* colonisation and thus favoured *Festuca* recovery. We found that the poor performance of *Stipa* in dug plots was related to sharply reduced seedling establishment, which resulted from the low number of seeds captured by the bare soil surface after digging.

Our results demonstrate that recurring drought events may induce dominance shifts in temperate grasslands, but small-scale disturbances can modulate vegetation responses. Our findings emphasise the importance of post-disturbance regeneration patterns in drought-induced vegetation shifts and show that seed dispersal strategy may have a major effect on vegetation dynamics.

Literature: Orbán, I., Ónodi, G., Kröel-Dulay G. 2023. The role of drought, disturbance, and seed dispersal in dominance shifts in a temperate grassland. *Journal of Vegetation Science* 34 : 4 Paper: e13199

Session 1-5

Different pathways of secondary succession in the Fülöpháza old-fields

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The conversion of grassland to agricultural use leads to a loss of biodiversity, but abandoned fields and orchards can give way to semi-natural grasslands by the process of secondary successions. In our study, which spans 23 years, we investigated how the cover of different life-form groups, different disturbance tolerance groups and the most common invasive species, the milkweed (*Asclepias syriaca* L.) have changed.

The research was carried out in fields abandoned in different years in the Kiskunság National Park near Fülöpháza. In the 40, 4m x 4m large permanently marked plots the cover of vascular plants was surveyed in 7 years between 2000 and 2023. There was an invasive plant management in the years 2014-2015. During data processing, different characteristics of plant species such as habitat requirement and life form were collected. The analyses were performed using the statistical software R 4.1.1.

Annual plant species cover decreased until 2020 and then increased in 2023. The cover of woody shrubs showed a sharp increase in 2023 compared to previous years, while the cover of perennial plant species increased until 2010, then decline until 2023. The cover of generalist plant species decreased over the years of the study. The cover of specialist plant species was almost the same in all years except 2010, when it increased. The cover of weeds also follows a similar trend. The cover of milkweed in the study plots increased until 2010 and then started to decline, after the management in 2014-2015.

From our results, initially specialist and perennial plants appeared more and more in the fallows among annuals and generalists. The trends in cover data show a break in 2015 for most of the groups studied, which could be caused by drought or even by changes in grazing conditions, but we do not have data on the latter. The exception is disturbance-tolerant weeds, which are persistently present in the fallows, as is typical of sandy grasslands. It can also be seen that shrub encroachment are only characteristic of certain quadrats, but that in these areas there is a high degree of habitat conversion. Contrary to our expectations, no further spreading of milkweed was detected, its percentage cover following the same trend as other perennial plants.

Session 1-6

Landscape and local factors affecting arthropods in forest-steppes

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Eurasian steppe grasslands and forest-steppes underwent dramatic changes during the last two centuries. Land-use changes, such as agricultural intensification and abandonment of historical land-use practices like extensive grazing and forest plantation, negatively affect biodiversity. It influences species richness, functional diversity, ecosystem functioning and food webs. Land-use change resulted in a dramatic alteration of landscape structure. Only small patches of the original grasslands remained intact or semi-natural. The loss of suitable habitat areas is usually associated with habitat fragmentation; fragmented landscapes hold a few to many habitat patches generally reduced in size. Two main parameters that describe landscape structure are landscape composition and configuration. Composition involves a set of variables giving information on the amount or portion of different land cover types, such as natural grasslands, forests and plantations, and agricultural land between the natural habitats. Configuration describes the spatial arrangement and shape of these land cover types. A higher number of patches with irregular shapes results in a higher configurational heterogeneity. We focused on the effects of a patch-scale parameter, the fragment size and landscape-scale parameters, such as habitat amount, connectivity, and matrix quality on the species richness and abundance of habitat specialist and generalist plants and arthropods of forest-steppes of the Kiskunság. In our first study, we investigated the biota of forest patches on extensive natural forest steppes (1). Secondly, we focused on the landscape scale effects on the grassland component of small forest-steppe fragments using the habitat-matrix binary classification of the landscape (2). In our third study, we involved the impact of matrix quality effects on natural grasslands and forests (3).

(1) We found that increasing forest fragment size, forest habitat amount, and forest edge length generally positively affected forest spider abundance, but negatively affected open-habitat arthropod abundances and plant species richness, varying a little among the studied taxa. The effects of fragment size were often moderated by landscape composition, configuration, and habitat association of species. (2) Fragment size, connectivity, and their interaction affected specialist and generalist species abundances. Large fragments had higher species richness of ground-dwelling spiders, and the effect of connectivity was more strongly positive for specialist arthropods and more strongly negative for generalists in large than small fragments. (3) Species turnover (beta diversity) was higher for steppes than for forests indicating a higher degree of isolation for steppes. Increasing matrix quality decreased plant species richness in small fragments. Matrix quality positively affected spider richness independently of fragment size but did not affect ants. These differences among taxa highlight the complexity of the effects of landscape structure and call for a situation-specific optimization of landscape management in nature conservation.

An effective conservation strategy should consider not only the presence of habitat fragments, but also their size, configuration and connectivity to maximize the diversity benefits of forest patches. For our particular situation, improving matrix quality would help preserve the threatened forest steppe biota. Besides the well-known effect of enhancing habitat quality, increasing connectivity between fragments by restoring natural and semi-natural habitat patches would help to maintain forest-steppe biodiversity.

Session 2-1

Past, present, and future of Kiskunság alkaline soda pans

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The inland alkaline soda waters (IASW) are unique wetlands with a high European protection priority. The Danube–Tisza interfluve (DTI) is the hotspots of natural origin IASW in the Carpathian Basin, therefore their protection and long-term ecological monitoring is a priority task. Before water regulation, there were hundreds of IASW in the naturally arid DTI, however, as a result of water regulation, landscape transformation and climate change, almost 85% habitat loss occurred in the IASW ecosystems here, which restoration is a great challenge. Two types of IASW beds are known, the alluvial in the river valleys and deflationary type on the higher sand dunes plateau (Homokhátság). The deflationary type had almost completely disappeared due to a significant drop in the groundwater level, therefore the FAO classified the Kiskunság region as a semi-desert zone in 2003. The water cycle of IASW is primarily determined by the local (e.g. at sand dunes), transitional regional (e.g. in river valley) groundwater discharge of gravity flow systems driven by precipitation. Since the Kiskunság area is located on the western border of the Eurasian steppe zone, where precipitation cycles can be divided in 5-10 and 30-40 years periods in the lowlands, which can also be recorded in the water level fluctuations of the IASW in DTI. However, these water level cycles are becoming overturned by climate change, coupled with inadequate water management and land use. Therefore, the groundwater level decreasing is significant not only on the higher sandy area, but also in the lower river valleys, which is related with the decrease in the salinity of IASW there. If this trend continues, water retention alone will not be enough to preserve the remaining few dozen IASW, the active water supply will also be necessary. Although, it is still not recommended to directly flood the bed of IASW with a reference ecological condition, but the investigation of the managed aquifer recharge possibilities is necessary, in order to conservation and restoration of IASW. For this task, a long-term case study of water supply and grazing management is provided by 40 years of positive experiences in the Kiskunság National Park and Szomor Ecofarm (Apaj-puszta, Alsó-Szúnyogi-rét), which is a small-scale ecosystem restoration of the ancient hydrography in the Dunavölgy-plain.

Session 2-2

Unique algal flora in the soda pans of the Kiskunság

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The Carpathian Basin is rich in athallassohaline water bodies, considering their water chemistry features they are divided into two distinct types. Soda lakes and pans with sodium carbonate dominance represent the one of the most unique water bodies in Europe occurring in Austria, Hungary and Serbia. We investigated the diversity and ecological role of these small algae in turbid and saline lakes of the Carpathian Basin. APP abundance varied over a wide range, the maximum values were remarkably high ($1-1.6 \cdot 10^8$ cells/ml), probably the highest APP abundance values reported in the world. Our results indicated that the increase in turbidity promote the proliferation of picoalgae over larger phytoplankton as a significant positive relationship was found between TSS concentration and APP abundance.

APP contribution in the studied soda pans varied between 0 and 100%. The lowest contribution (8-11%) was found in humic rich waters, and the highest average APP contribution was found in turbid soda pans, where APP often reached 100% dominance. In soda pans and lakes, the contribution of picoalgae to total phytoplankton biomass increased with increasing TSS concentration. Regarding the composition of the picoplankton, two types of cells can be distinguish by microscopy: phycocyanin-rich picocyanobacteria (CyAPP), which are usually described in eutrophic waters and picoeukaryotic algae (EuAPP), which are characteristic to winter phytoplankton communities in shallow lakes. CyAPP abundance and biomass were lowest in winter, then higher values were observed in most lakes in spring and maximum values were observed in summer. The abundance and biomass of EuAPP showed the opposite trend, and maximum abundance was observed in winter in most lakes. To understand the regulatory role of temperature, the photosynthesis of a picocyanobacterial and a picoeukaryotic algal strain isolated from a soda pan was compared at different temperatures and light intensities. Based on the obtained data, the winter predominance of picoeukaryotes and the summer predominance of picocyanobacteria seem to be caused by different optima of these groups for light and temperature. At low CDOM concentrations (<200 mg/l), the dominance of CyAPP was observed, then above this the dominance shifted towards EuAPP and above 2000 mg/l we observed almost exclusively the dominance of EuAPP. It has been hypothesized that high CDOM content affect APP composition due to changes in underwater light climate: in humic soda pans, red and far red (> 680 nm) light dominance might be adventagous for picoeukariotic algeae. Despite the extreme environmental conditions of these lakes, we observed remarkable diversity among picophytoplankton communities with a novel species (*Chloroparva pannonica*) from turbid soda pans.

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Session 2-3

Traditional and local ecological knowledge about plant species and habitats in the Kiskunság region

Eszter Fodor, Marianna Biró, Zsolt Molnár

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Knowledge co-production and cooperation between the scientific and local traditional knowledge systems are important for a better understanding of socio-ecological processes in a changing landscape. In a fine-scale cultural landscape, such as the Kiskunság region, where small-scale management is essential for the protection of valuable habitats, communication and cooperation with locals is also crucial. We aim to support these interactions by collecting traditional ecological knowledge from locals in order to explore their perceptions of nature.

We conducted semi-structured interviews with elderly local farmers, professional herders selected by snowball sampling. We paid special attention to the diversity of the interviewees' personalities and aspired adapting to the season, weather condition, the interviewees' current work routine and physical limitation of their health issues, thus coming even closer to the reality they live in and perceive. We conducted 2-5 interviews per informant. Of the 42 interviews carried out so far, 19 have been conducted in-door, covering an average of 50 species from coloured plant pictures (both invasive and native species), and 22 were made out-door, where the basic plant list was supplemented with taxa encountered in a given area at a given time (up to nearly 100 species). Besides the local folk names and traditional uses, we also asked for a description of their preferred habitat and local oral history about the changes in their distribution and abundance over time.

Based on our experiences, the answers indirectly included the respondent's personal emotional attachment to the species or habitat, and thus we can draw conclusions why they evaluate a species as useful, useless or harmful. This relational system has led to some interesting observations: in the case of invasive alien plant species we found some surprising results regarding the unconscious patterns behind the perceptions of locals, for example, they automatically regard a species that has been part of the landscape since their birth as native (*Robinia pseudoacacia*, *Elaeagnus angustifolia*) and they find the presence of certain aggressively spreading alien species beautiful and joyful (*Opuntia* sp.).

Session 2-4

Agriculture and land use – 15 years of social science research in Kiskunság

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²*Hungarian University of Agricultural and Life Sciences*

The way stakeholders use the landscape is crucial for preserving natural values. The basis of effective conservation is to explore the attitudes and preferences of land users, especially farmers, and understand their relationship to the land and their emotions toward nature.

The rich natural, social and cultural endowments of Kiskunság provide an excellent setting for our social science research projects focusing on the relationship between nature and humans, which we have conducted since 2004. Primarily, we work in the framework of LIFE projects, but OTKA and doctoral research projects have also been carried out in the area of the Kiskunság LTER.

Our research projects focus on three main topics: (1) exploration of conflicts between conservation and agriculture, (2) assessment of ecosystem services, and (3) participatory planning. In most cases, these research focuses are not separated from each other, in real life they often appear intertwined and interconnected.

Our most frequently used methods include desk research and secondary analysis, semi-structured interviews, questionnaires combined with open and closed questions, and focus groups/workshops.

Among our research areas were: Tiszaalpár and Alpár-Bokrosi backwater, Peszéradacs meadow (Kunpeszér, Kunadacs, Kunszentmiklós area), and the soda pans grasslands of Felső-Kiskunság.

Land user groups are in the centre of our research projects, and our main goal is to reveal a relationship with nature and to understand the dilemmas and effects behind their decisions related to land use. Our research is successful if we come to conclusions and proposals that can bring about good results both for nature conservation and for farmers and other land users. For example, if we can sensitise the parties toward each other in a land use conflict, and thus cooperation is formed in connection with sustainable land use, or if the local people can accept the management plan of a protected area without tension due to the participatory process we lead.

In addition to the tangible practical results, our most important scientific results include:

- clarification, characterisation, and new categorisation of the types of nature conservation conflicts,
- description of ecosystem service preferences of land users,
- analysis of the connection between ecosystem services and land use conflicts,
- identification and analysis of the criteria of effective participation processes.

Session 2-5

Even a perennial species can be depleted: the impact of five years of mechanical treatment of the common milkweed

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One of the most invaded regions in Hungary is the Kiskunság. One of the most abundant invasive plants here is the common milkweed (*Asclepias syriaca* L.), a clonal, perennial herbaceous plant. The most of the study's results shown the impacts of milkweed can be negative or positive. Therefore, it is worth to study the impact of milkweed, especially where it causes risk and most widespread, e.g. in secondary grasslands.

Our study aimed to assess the impact of milkweed on soil condition and vegetation composition, effectiveness of mechanical control and short-term effect of milkweed removal on the vegetation in abandoned croplands.

We selected 10 abandoned croplands (i. e. old-fields) in Fülöpháza. We assigned three (4 m x 4 m large) plots invaded by milkweed and one non-invaded plot in each old-fields. We used three types of treatments: (a) complete removal of milkweed shoots twice a year, (b) half of the shoots removal of milkweed twice a year, (c) no treatment. The non-invaded plot used as a control. The four types of plots were located relatively close to each other in a same plot, so their environmental background and history did not differ significantly.

The study was started in June 2019, when a vegetation survey and soil sampling were conducted before the first treatment. We measured the basic soil properties (pH, total soil organic matter (humus), CaCO₃, K, P, C and NO₃⁻ content.). The treatment and vegetation monitoring were repeated twice a year in 2020, 2021, 2022, and 2023.

Our result showed that there was no significant difference between invaded and non-invaded plots in the measured basic soil properties in either studied soil layers in 2019. We repeated the soil sample in 2021. We find significant differences in CaCO₃ in the 10-20 cm soil layer between invaded and non-invaded plots. Short-term mowing treatment negatively affected the milkweed shoots after the second year of treatment and also reduced cover by 2023. The sand specialist plant cover increased in summer in 2023. After the total removal of milkweed shoots, the cover of other neophyte plant species is increased. Our results show that the composition of the vegetation in the invaded plots is different. We conclude that longer-term mowing or grazing would be needed to reduce milkweed abundance. Additional seeding could help the recovery of native grassland vegetation.

Session 2-6

Long-term changes of invasive alien plant species in restoration ecology experiments, effects of time, treatments, drought and landscape invasion

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Ecological restoration is an essential tool to combat plant invasions. However, restoration activities focus on disturbed areas and may involve disturbance themselves, so invasive alien species may be the first to establish and secondary invasions may occur after control of the focal invasive species in restoration areas. We studied the long-term changes in neophytes in sand grassland restoration after initial mowing, nitrogen immobilization and seeding. The longest observation series (23 years) was used to study the effects of droughts on vegetation composition. To characterize landscape invasion, we estimated the level of neophyte species and the distance from plantations in 500 m landscape buffers. On-site cover of annual neophytes decreased and that of perennials (including woody species) increased over time. Seeding has successfully suppressed annual neophytes. Overall, the perennial neophytes did not respond to the treatments. Initial mowing has controlled the recolonization of *Robinia pseudo-acacia* in the long term, however, the control of the focal invasive species led to secondary invasion in certain cases. Droughts indirectly promoted the neophyte species over target species. Higher neophyte covers in treated plots compared to control plots were associated with higher levels of neophyte species in the landscape and, to a lesser extent, with proximity to plantations. We conclude that initial seeding with native species is the best practice for restoring sand grasslands in abandoned fields and invaded landscapes. Our results highlight the need for further studies to find effective management strategies for perennial neophyte species, especially in changing climatic conditions that may increase the risk of invasion.

Session 3-1

Changes in the bird population of Baksi Puszta over the last 20 years, with a special focus on population fluctuations induced by changes in the status of sodic wetlands and sodic steppes

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In the last 20 years, we have witnessed climatic changes that have significantly affected grassland habitats. Birds, as indicator and umbrella species, are good indicators of these processes. They are strongly linked to water availability and vegetation structure, which are determined not only by soil conditions but also by rainfall and grazing. The Baksi Puszta (or Szeri Puszta), situated on the borders of Pusztaszer, Ópusztaszer, Tömörkény and Baks, with its diverse landscape elements (dry and wet salt and sandy grasslands, saline lakes and marshes on a total area of 2300 ha) provides a diverse habitat for bird species characteristic to open waters, wet and dry grasslands. In my study, I monitored the population changes of nine bird species over a 20-year period in this area.

The three species that showed the highest population fluctuations were associated to salt lakes, i.e. avocet (*Recurvirostra avosetta*), black-winged stilt (*Himantopus himantopus*) and Kentish plover (*Charadrius alexandrinus*). The latter species disappeared during the study period, as it did from most of the country. The fluctuations of the species are partly related to rainfall, but for avocet, the current condition of the surrounding habitats (e.g. nearby Lake Csaj) is important, which are able to attract the entire breeding population of this species by providing safer breeding grounds even in sufficiently wet years. The extinction of the Kentish plover is mainly due to the conversion of annual salt pioneer swards, resulting from changes in vegetation structure due to alterations in water conditions (and partly due to grazing).

The annual population changes of three wet grassland bird species, the lapwing (*Vanellus vanellus*), the black-tailed godwit (*Limosa limosa*) and the redshank (*Tringa totanus*), also fluctuated with precipitation. Overall, all three species showed a decline in abundance, the smallest for the lapwing and the largest for black-tailed godwit, which can be associated with decreasing spring surface water cover of salt wet grasslands.

Two of three dry grassland breeding species, the red-footed falcon (*Falco vespertinus*) and the roller (*Coracias garrulus*), showed a clear increase in population size. For the first third of the study period, this increase can only be explained by the increase in artificial nesting sites. Later on, the population increased despite the steady nest number. The lesser grey shrike (*Lanius minor*), although showing an overall decline over the 20-year period, is unfortunately a national phenomenon, which is due more to changes in migration and wintering conditions rather than to habitat modifications.

Overall, the six species associated with water and wet grasslands have experienced significant population declines over the last 20 years. This is due not only to the extremes of rainfall, but also to a significant increase in nest and chick predation by foxes and hooded crows, and to changes in grazing practices. In two of our three species associated with dry grasslands, population increases associated with warming and drying of the climate are clearly observed. Accordingly, our task is not only to keep the water on the site, but also to create as much surface water as possible for the late winter-early spring period, which could mitigate or even reverse the above-mentioned population declines.

Session 3-3

Fallow oversowing with native species for increasing soil quality, biodiversity and other ecosystem services in dry permanent grasslands

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Grassland systems have a huge role in the human well-being, however, grassland quality is highly variable, and in many cases, when they cannot fulfil their multiple functions, may need to be improved. In the frame of the SUPER-G project, which goals and objectives are to co-develop sustainable permanent grassland systems and policies, we established a grassland overseeding experiment in the Kiskunság. With overseeding more than ten years ago abandoned parcels with a seed mixture of locally characteristic and targeted native plant species, our aim was to study the overseeding effect on fallow succession and development of grassland functions, as soil quality, carbon cycling, feed production, biodiversity, and pollination ecosystem services.

In October of 2019 nine fallow plots, each half hectare, were oversown with 12 regionally native plant species in the Kiskunság, near Kunpeszér. Additionally, all parcels were mown every year, with a timing depending on the actual weather. Until 2023, annually botanical surveys, soil investigations, soil respiration measurements, biomass surveys and various studies on insects were taken. We can state that oversown species germinated tardily, but successfully for now. On the development of the vegetation, and on soil properties and soil activity had an impact not only the overseeding itself, but the weather of different years, the drought, the incidental grazing and damage by deer, as well as the landscape history and the habitat properties. These all caused high variability between parcels.

The annually yield of aboveground biomass showed a substantial increase in the oversown plots. Regarding soil properties, high variability between the years and parcels could be observed. However, during the time, significant increase was detected in soil organic matter and total soil nitrogen content. Generally, soil respiration increased significantly with overseeding, however, with a high variability between parcels. In general, plant biomass, mostly the legumes, plant diversity, as well as flying pollinator diversity and abundance increased with the successful overseeding, as well. In some cases, where the impact of the oversowing delayed, the seed germination or the seedlings could cope more tardily with drought, grazing and trampling, eventual seedling predation by ground squirrel or an unfortunate legacy of previous landuse with pesticide application. All these impacts, either combined or one by one, may hinder the success of the overseeding and the regeneration of the ecosystem. However, if overseeding can be successful in the first and second year, long-term development of the vegetation and a more stable yield for years can be expected. To reach these goals, a fruitful cooperation with the farmers and the Kiskunság National Park was established.

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Session 3-4

Restoration of flower-rich grasslands to improve biodiversity and ecosystem services in agricultural landscapes

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The loss of biodiversity and pollinator insects is a global problem, partly due to habitat loss caused primarily by agricultural intensification. Efforts to promote the diversification of agricultural habitats, aimed at mitigating the negative effects of agricultural management, are becoming more widespread. The establishment of wildflower plantings, (most common form: wildflower strips) is supported by both agri-environmental schemes and ecological intensification practices. This support is due to their positive impact on the species richness and abundance of beneficial arthropods, including pollinators and biocontrol agents.

However, to maximize the effectiveness of wildflower plantings in enhancing agrobiodiversity, we need to understand the drivers of this effectiveness at local and landscape scales. To study the impact of wildflower planting in the under-researched East-Central European region, we set up a large-scale experiment in Hungary in 2020, using a seed mix of 32 native plant species to establish large, diverse wildflower plots in different landscape contexts (homogeneous and heterogeneous agricultural landscapes) with two different spatial configurations (one large field and three smaller strips). After establishment, we conducted systematic monitoring at both the local level (standardized transects, flower source surveys, Malaise traps, botanical sampling) and the landscape level (trap nests, pan traps) to assess their impacts on flower sources, pollinator insects, and other arthropods.

Our results indicated that these wildflower plantings had an overall positive effect on the species richness and abundance of pollinator insects, even in the first two years. However, we found that landscape heterogeneity, the richness and abundance of flower supply, the configuration of wildflower parcels, and seasonal variation strongly influenced the magnitude of these effects. These findings can be used to make recommendations for establishing and maintaining more successful wildflower plantations. Further studies are recommended to investigate the long-term effects.

Session 3-5

Hydrologic effects of afforestation on sand

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The Danube-Tisza Interfluvium of Hungary has been experiencing aridification since the 1970s, threatening the existence water-based habitats and the productivity of the region. Numerous factors have been identified that contribute to the process, but there is no consensus on their relative importance. The most contradictory factor is afforestation, which is often considered as a success story for stabilizing moving sand in the region. However, we show that these forests create a significant negative water balance, accelerating aridification. Other contributing factors are decreasing in importance, while the relative share of afforestation is increasing. We conclude that afforestation should be stopped in the region and the overall forest cover should be decreased by avoiding replantation after clearcutting plantation forests. Afforestation should focus on major river valleys, where it could facilitate the large-scale rehabilitation and restoration of the floodplains.

Poster Session

Effects of warming and drought on the vegetation of open sand grasslands

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In recent decades, climate change has become an unavoidable problem. Increases in mean temperatures and extremes in precipitation patterns are affecting the functioning of habitats and communities. Our studies were carried out in the Fülöpháza sandhills of the Kiskunság National Park, part of the Kiskun LTER network. Our main question was: how did change in long-term and after the drought of 2022 the vegetation of the sandy grassland, including the dominant plant species?

During the research, monitoring activities were carried out in 200 4m x 4m large quadrats in 9 years since 2000. Changes in total cover, life form groups and dominant species over time were investigated.

To summarize our results, total cover of vascular plant species declined significantly due to the drought of 2022. Perennial species were affected by the drought, but annuals showed a jump in cover due to the current year's drought, while biennials showed a jump due to the favourable climate of the previous autumn. The cover of the two dominant grass species, *Festuca vaginata* and *Stipa borysthena*, has declined sharply by 2023. As with the grass species, the cover of *Euphorbia seguieriana* and other common companion species - *Koeleria glauca*, *Fumana procumbens*, and *Dianthus serotinus* - was drastically affected by drought. In turn, the new open spaces in vegetation may provide opportunities for the introduction and spread of new alien species.