RRR 2025

Book of Abstracts

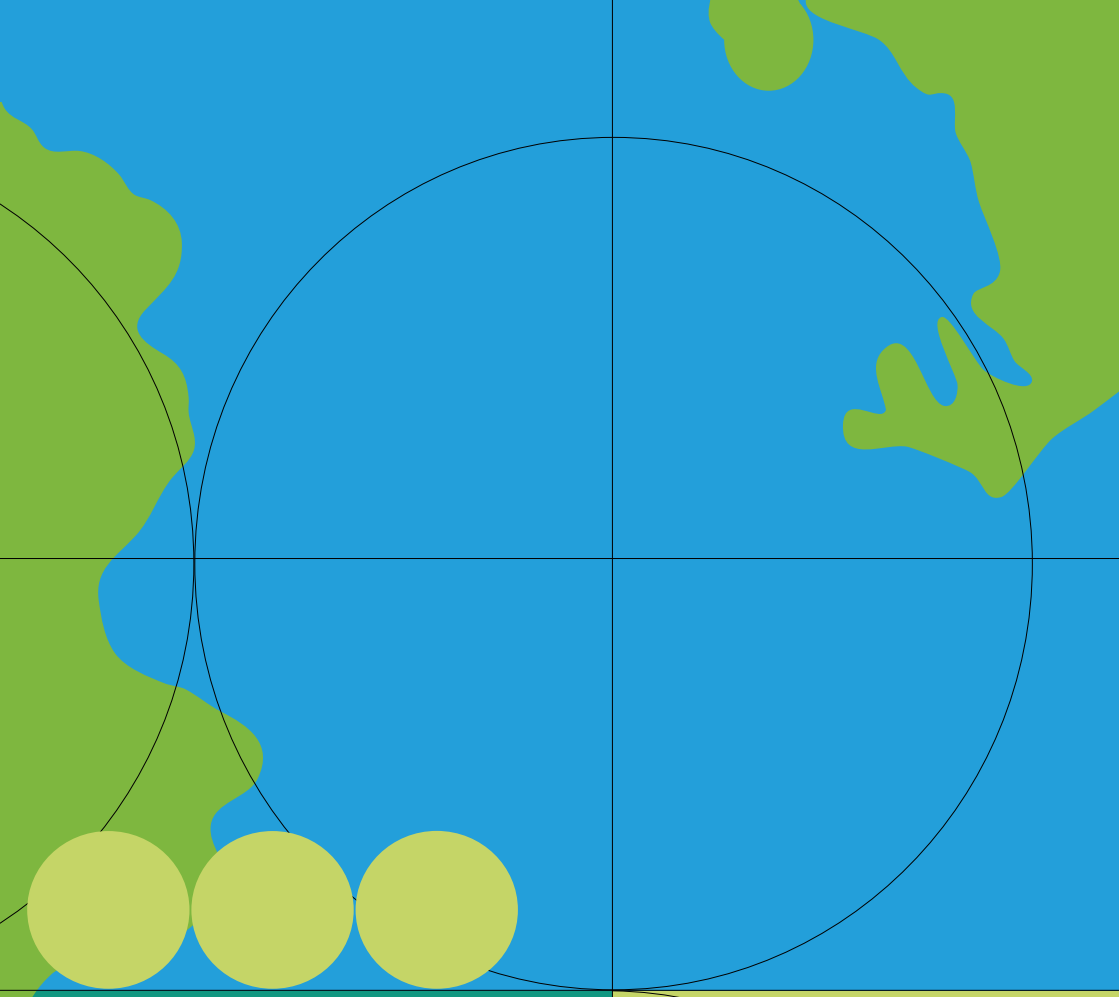
Greifswald, Germany

September 23rd – 26th

4th International Conference on the Utilisation of Wetland Plants

Renewable Resources from Wet and Rewetted Peatlands

GREIFSWALD MIRE CENTRE



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RRR2025 Organising Team

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Greifswald, September 2025

Dear participant,

a little more than a quarter of a century after ‘paludiculture’ was developed as a concept and created as a new term, and in the 10th year of the Greifswald Mire Centre’s existance, we warmly welcome you to the 4th international conference on “Renewable Resources from Wet and Rewetted Peatlands – RRR2025” in Greifswald.

As research and implementation projects on paludiculture are evolving rapidly, we offer a platform for intensive exchange and to foster dialogue between science and practice. By bringing together diverse stakeholders, the event aims to encourage knowledge exchange, build networks, and develop and strengthen practical, forward-oriented solutions.

You can expect passionate keynote speakers in plenary sessions at the beginning of conference day 1 and 2 and more than 150 scientific oral and poster presentations divided over 17 parallel sessions. Additionally, there are 14 workshops and a concluding fishbowl discussion, where you can (and please do) get active. Following the virtual excursions during RRR2021, this year you will have the opportunity to see and experience peatland and paludiculture sites in northern Germany in real life on six excursions. A colorful and exciting evening programme complements the conference. We begin on Tuesday evening with a Conference Dinner, on Wednesday evening, paludiculture products will be presented in a cosy atmosphere, followed by the exciting “Great Paludi-Show”. The excursion day will end with a cultural evening including a zombie fire documentary and immersive peatland soundscapes.

We wish you an inspiring RRR2025 conference where you can share and widen your knowledge about paludiculture worldwide and actively contribute to shaping a sustainable future for our peatlands.

The RRR2025 Organising Team

PALUDI
CULTURE

RRR 2025

Greifswald Mire Centre

The Greifswald Mire Centre is the interface between science, policy and practice in all peatland related questions – locally and globally. It unites around 150 peatland experts in one place. Partners in the Greifswald Mire Centre are the University of Greifswald, the Michael Succow Foundation and DUENE e.V. The Greifswald Mire Centre offers science-based solutions for social challenges related to peatlands such as climate protection, biodiversity conservation and sustainable use.

www.greifswaldmoor.de

UNIVERSITÄT GREIFSWALD
Wissen lockt. Seit 1456

Succow Stiftung

DUENE

ORGANISING TEAM AND PARTNER

This year, the RRR2025 is being organised by scientists from the Greifswald Mire Centre and the Thünen Institute. The team includes the following people:

Greifswald Mire Centre

Susanne Abel, Dr. Greta Gaudig, Amelie Hünnebeck-Wells, Prof. Dr. Gerald Jurasinski, Nina Körner, Johanna Henkel, Josephine Neubert, Anke Nordt, PD. Dr. Franziska Tanneberger, Dr. Sabine Wichmann, Dr. Wendelin Wichtmann

Thünen Institute

Dr. Merten Minke, Dr. Bärbel Tiemeyer, Jannes Säurich

GREIFSWALD MIRE CENTRE

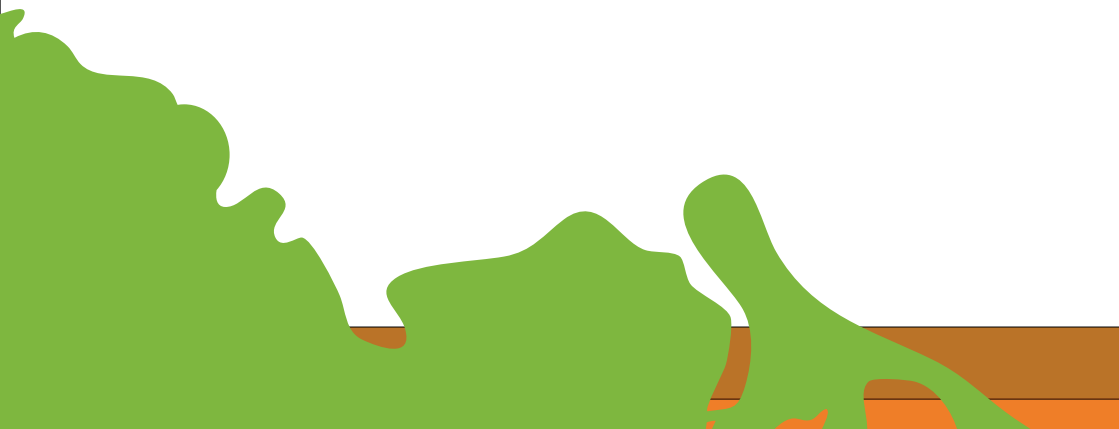
THÜNEN

DAY 1

Tuesday – 23rd September 2025

8:30/ 9:00– 10:30	WORKSHOPS | Abstracts see p. 108ff			
	1 Wetland transitions: Opportunities and trade-offs for paludiculture in reaching nature restoration targets • SR 3.21	**2** Exploring future visions of peatlands applying the Three Horizons Approach • SR 3.22	**3** Digitalised peatland vegetation mapping to derive greenhouse gas emissions – the GEST-APP • SR 3.25	**4** Mycelial bioconversion potential of paludicultural feedstocks (*Typha sp.* and *Salix sp.*) • SR 2.26
10:30–11:00	COFFEE BREAK • Foyer			
11:00– 12:30	WORKSHOPS | Abstracts see p. 112ff			
	5 Unlocking the Potential of Alternative Fibre Sources: Challenges, Solutions, and the Path Forward • SR 3.21	**6** Exploring Stakeholder Perspectives and Incentive Mechanisms in Peatland Rewetting • SR 3.22	**7** Country specific definitions of organic soils • SR 3.25	**8** Smart Paludiculture Workshop • SR 2.26
12:30–13:30	LUNCH BREAK • Mensa			
13:30– 14:30	WELCOME & INTRODUCTION TO THE CONFERENCE Dr. Franziska Tanneberger (Director Greifswald Mire Centre) Tsjerk Terpstra (European Commision) • Peat moss hall			
14:30– 15:15	KEYNOTE Dr. Christian Fritz "Train.To.Paludiculture" • Peat moss hall			
15:15–16:00	COFFEE BREAK • Foyer			

	SESSION 1 Inclusive poster pitches, see p. 14 | Abstracts presentations p. 33ff; abstracts poster p. 121ff		
16:00–17:30	Ecosystem Services 1: Bärbel Tiemeyer • Peat moss hall	Lessons Learned: Rebekka Artz • Reed room	Governance: Sabine Wichmann • Buffalo arena
	Jeroen Geurts: Quantification of ecosystem services in paludicultures with *Typha* and *Phragmites*	Ilze Ozola: A decade of paludiculture in Latvia: progress, challenges and new directions	Anke Nordt: Obstacles, major fields of actions and financial requirements to promote implementation of paludiculture in Germany
	Moritz Adam: Estimating Carbon Accumulation in Helophyte Paludicultures from Dutch Pilot Sites	Matthias Krebs: Variations in water demand for irrigating a *Sphagnum* paludiculture – results of a 11 years study in NW Germany	Bernhard Osterburg: How supportive is the EU Common Agricultural Policy for peatland rewetting and paludiculture?
	Poster pitches	Poster pitches	Poster pitches
	Meline Brendel: Peat formation potential of *Phragmites australis* on commercially cut reed sites in northeast Germany	Leonard Akwany: African Peatlands Conservation and Utilization (Papyrus and Reeds Economies) with case studies from East Africa and Zambia	Nahleen Lemke: Policy options for incentivizing rewetting and using agricultural peatlands in a climate-neutral EU
	Gert-Jan van Duinen: Paludiculture brings biodiversity to the rewetted peat meadow landscape	Clemens Kleinspehn & Birthe Godt: Value chains for toMOORow: Half-time report on PaludiAlliance	Olivier Hirschler: Conditions and options for replacing peat in horticultural growing media in Germany
	Poster pitches	Poster pitches	
19:00 • StraZe	CONFERENCE DINNER		



DAY 2

Wednesday – 24th September 2025

9:00–9:40	KEYNOTE: Dr. Kate Flood “Embedding social-ecological justice for sustainable and equitable peatland transitions” • Peat moss hall		
	SESSION 2 Inclusive poster pitches, see p. 16 | Abstracts presentation p. 44ff; abstracts poster p. 148ff		
9:50–10:45	Peatlands & People 1: Amelie Hünnebeck-Wells • Peat moss hall	Biomass 1: Kristiina Lång • Reed room	Economics & Agronomy: Pia Sommer • Buffalo arena
	Poster pitches	Michael Hafner: Peatland plant fibers for the paper and packaging industry	Poster pitches
	Greta Schmidt: Peat4People: Paludiculture experiences from East Africa	Poster pitches	Regina Neudert: Current knowledge and research gaps in agricultural science and socio-economics of paludiculture: a scoping review
	Nisa Novita: Peatland Restoration in West Kalimantan: A Climate Solution and Pathway to Community Empowerment	Karina Michalska: Valorization of paludibiomass into biogas via regional value chains and cascading-use	Poster pitches
	Bettina Tacke: Well known but insurmountable? Socioeconomic Aspects of the Acceptance of Peatland Rewetting in Brandenburg	Poster pitches	Zhengqiu Ding: Economic trade-offs in peatland rewetting: Assessing opportunity costs and policy levers for paludiculture adoption
	Poster pitches	Poster pitches	Poster pitches
10:45–11:30	COFFEE BREAK & POSTER PRESENTATION • Foyer		
	WORKSHOPS | Abstracts p. 114ff		
11:30–13:00	**9** Paludiculture in the CAP: current experiences and recommendations for post 2027 • SR 3.21	**10** WETBEINGS: transdisciplinary and mutuality based approaches to peatland living • SR 3.22	

SESSION 3 | Abstracts p. 50ff

	Governance: Jan Peters • Peat moss hall	Biomass 2: Ralf Pecenka • Reed room	PV: Volker Beckmann • Buffalo arena
11:30–13:00	Agata Klimkowska: A Landscape Approach to Paludiculture Upscaling: Integrating Ecological and Social Dimensions	Josephine Neubert: Biomass quality for thatching of *Phragmites australis* on commercially cut reed sites in northeast Germany	Oona Allonen: Solar power production on rewetted cutaways – known benefits, unknown practical experience
	Andy Dodson: An Analysis of Stakeholder Conflict and its Impact on the Management and Use of Reedbeds within Great Britain	Mirjam Schibler: Testing effects of cattail in peat-free substrates on crop productivity and soil characteristics shows potential for upscaling	Hanna Rae Martens: Vegetation Response to Solar Panels on Rewetted Peatland
	Karin Ullrich: Solutions for minimising conflicting objectives and creating synergies in the rewetting of peatlands	Thomaz da Silva Lopes Vieira: Sustainable Building Materials from Paludiculture: Life Cycle Assessment and BIM-based Evaluation	Florian Heinrich: Assessing the Levelized Cost of Electricity for Peatland-PV in Germany based on Spatial Indicators
	Katharina Laage: Rewetting “quick and easy” – is it possible?	Martin Krus: Environmental protection and simple, cost-effective construction with building materials made of the paludiculture *Typha angustifolia*	Carl Pump: Analysis of Peatland-Photovoltaic: A system transition and photovoltaic project planner perspective
	Wiktor Kotowski: Landscape-ecological approach to avoid conflicts and maximize synergies between paludiculture, biodiversity and conventional agriculture. A few case-studies from Poland	Niklas Fanelsa: Application of Paludi Biomass in Regenerative Building Materials for Multi-Story Housing	
		Oliver Maaß: From rewetted peatlands to houses: Value chain analysis of building materials made of paludiculture	

13:00–14:00 LUNCH BREAK • Mensa

	WORKSHOP | Abstract p.119		
	11 Paludiculture under National Restoration Plans and Carbon Removals and Carbon Farming Certification Regulation: Country experiences and opportunities • SR 3.22		
	SESSION 4 | Abstracts p. 65ff		
14:00–15:30	Peatlands & People 2: Laura Herzog • Peat moss hall	Biomass 3: Anke Nordt • Reed room	Biodiversity: Franziska Tanneberger • Buffalo arena
	Mehri Khosravi: From Drainage to Paludiculture: Stakeholder Perspectives on Paludiculture Adoption in the UK	Annette Prochnow: Concentrations and yields of strategic elements in paludibiomass from fen peatlands	Susanne Arbeiter: Does faunal biodiversity benefit from rewetting and paludiculture in European peatlands? – a meta-analysis
	Susanne Brorson: Baltic Bioregional – research through studio and 1:1 experimentation with renewable resources from rewetted peatlands	Maximilian Wenzel: Biomass from peatlands as filler material or fibre enforcement for (bio-)plastics – Paludi-Produkt	Jana Packmoor: Is a *Sphagnum* farming site attractive for peatland dragonflies?
	Andreas Stauss: Transition processes with private land owners and farmers	Jonas-Rumi Baumann: Utilisation of Paludiculture Biomass for Injection Moulding – Combining Performance, Sustainability, and Market Competitiveness?	Christine Weisenberger: Genetic characterization of *Typha* species in Germany
	Charlotte Schröder: The Regionality of Meaning Structures Concerning Peatland Rewetting in Germany – A Structural Topic Modeling (STM) Approach to Understanding the Discourse on a Large-Scale Climate Protection Measure	Armin Winter: Innovative Valorization of Aquatic Plants from the Danube Region in a Decentralized Biorefinery	Jürgen Müller: Utilisation pattern of a heterogeneous wet grassland site by water buffalo
	Laura Kearney: Aligning Agri-Environmental Policy with Farmer Values: A Social-Landscape Approach to Peatland Restoration in Northwest Ireland	Hildegard Kieninger: From peatlands to pharmacies by understanding the phytochemical variability of Drosera rotundifolia	Sabine Behr: Maintenance of fen peatlands through year-round extensive grazing in the NSG Pfrunger-Burgweiler Ried
	Nerijus Zableckis: PaluWise Paludiculture demonstrations providing multi-actor approaches and recommendations towards large-scale deployment in the EU. Challenges for the development of paludiculture in Lithuania: Baisogala case	Malte Zoerner: Plant selection for paludiculture: Seeking the most productive genotypes with a high content of bioactive secondary metabolites and good suitability for cultivation _The SoMoMed project – Sundew and cloudberry as medicinal plants in paludiculture	Patrick Gutjahr: Mosquito community structure and dynamic in drained and rewetted peatlands: Initial steps towards vector-resilient management

15:30–16:15 COFFEE BREAK & POSTER PRESENTATION • Foyer

16:15–17:30	WORKSHOP | Abstract p.118		
	12 Promoting Grassroots Uptake of Paludiculture by Farmers through On-farm Trials and Cultural Alignment • SR 3.21		
	SESSION 5 | Abstract p. 82ff		
	Economics: Bernhard Osterburg • Peat moss hall	Ecosystem Services 2: Poul Erik Laerke • Reed room	Monitoring & Methods: Gerald Jurasinski • Buffalo arena
	Christoph Buschmann: Towards a roadmap of rewetting agriculturally used drained peatlands in Germany: Site-specific abatement and opportunity costs for the peatland-rich federal states	John Couwenberg: Vegetation as proxy for GHG emissions from organic soils – 2025 update of the GEST list	Bärbel Tiemeyer: Establishment of a German peatland monitoring programme for climate protection – Open land (MoMoK)
	Julia Casperd: The economics of rewetting patchy lowland peat – farm case studies from the UK	Marco Cosme: Microbiome legacy influences the global warming potential of peatland soil	Azim Baibagyssov: Mapping and Quantifying Biomass Resources in Reed Beds of the Syr Darya Delta, Kazakhstan by Means of Remote Sensing and Random Forest
	Janne Rämö: Water and crop management on peatlands at farm level: the role of carbon incentives	Sannimari Käärmelahti: Temporal changes in biogeochemical drivers and nutrient removal of *Typha latifolia* paludiculture	Gerardo Lopez Saldana: Integrating hydrology, ground motion and vegetation biophysical parameters to assess peatland condition
	Jennifer Merten: Economical and institutional challenges in implementing paludiculture – comparing insights from Flanders (Belgium) and Brandenburg (Germany)	Lara Massa: Balancing productivity and ecology: Insights into nutrient dynamics and management applications at the *Typha latifolia* paludiculture site "Teichweide" polder, Mecklenburg-Vorpommern	Henriette Rossa: Automatic Vegetation Mapping in Peatlands – Compilation of a Ground Truth Dataset for Ecologically Informed Machine Learning
	Konrad Misztal: Capital investments in the paludiculture sector	Dominik Zak: Fast-Mow-Slow – three ways to drop phosphorus release in rewetted peatlands	Julia Casperd: Landscape Scale Nature Recovery on Patchy Rewetted Lowland Peat – a Case Study from the UK

17:30– ca. 21:00 PALUDI EXHIBITION "All you can peat" • Foyer
"The Great Paludi-Show" • Peat moss hall
with street food in the courtyard

DAY 3

Thursday – 25th September 2025

EXCURSIONS		
19:30 CULTURAL EVENING • Lecture hall		
“radio.earth – listening to change” • Buffalo arena	“In Zombie Fire” • Reed room	

DAY 4

Friday – 26th September 2025

09:00–11:00	WORKSHOPS | Abstract p. 118ff	
	13 Co-creation processes – a way to successful peatland restoration und paludiculture implementation • SR 3.21	**14** Workshop on Peatland-PV: Integrating Diverse Perspectives for Holistic Research • SR 3.22
	SESSION 6 | Abstracts p. 95ff	
	Ecosystem Services 3: Matthias Drösler • Peat moss hall	Agronomy: Jürgen Kreyling • Buffalo arena
	Tim Eickenscheidt: Effects of different fertilization strategies and groundwater management scenarios on greenhouse gas dynamics and mitigation potentials in various paludiculture systems	Frank Pannemann: Establishment of *Carex acutiformis* in Paludiculture
	Renske Vroom: Unravelling GHG emission drivers in *Typha* paludiculture: a mesocosm study	Nora Köhn: Assessing cattail (*Typha spp.*) productivity and biomass quality over four years at a 10-ha paludiculture pilot site
	Philipp-Fernando Köwitsch: Effects of topsoil removal on greenhouse gas exchange and carbon allocation of fen paludicultures	Waas Thissen: Cattail species and water management to optimize cattail yields
	Caroline Daun: How to minimise greenhouse gas emissions in *Sphagnum* re-vegetation areas – the role of topsoil removal	Maria Glaubitz: Scale-Up of *Sphagnum* founder material production in a photobioreactor
	Poul Erik Lærke: Biomass yield and greenhouse gas emissions of reed canary grass in a rewetting fen peatland	Jack Clough: Lessons learned from *Sphagnum* Farming with the MIFA approach
	Boodoo Kyle: Drivers- and spatio-temporal variability of greenhouse gas emissions from temperate fen peatlands under paludiculture	Greta Gaudig: Don’t wait too long! – when to harvest a *Sphagnum* paludiculture
	Gerald Jurasinski: Cultivation of *Typha* as a new permanent agricultural crop – initial results regarding the carbon and climate balance	

11:00–11:30 COFFEE BREAK • Foyer

11:30–12:40	Paludiculture – a win-win-win solution, an exciting field of research, a naive utopia, a threat or a force? Which images and strategies promote or hinder the success of paludiculture, and what does this mean for our communication? Dynamic discussion in fishbowl format. Active participation welcome. Facilitation: Ulrike Tröger and Augustin Berghöfer • Peat moss hall
12:30–13:00	Closing with Dr. Franziska Tanneberger • Peat moss hall

13:00–14:00 LUNCH • Mensa

DAY 1

Tuesday – 23rd September 2025

For the exact schedule, please check the Converia app.

	POSTER PITCHES AT THE BEGINNING, IN BETWEEN AND END OF THE SESSIONS		
	Ecosystem Services 1	Lessons Learned 1 + Biodiversity	Governance
Session 1 16:00–17:30	Philipp-Fernando Köwitsch: How much water is required for *Typha* paludiculture?	Roos Galjaard: Lessons learned from BUFFER+: Buffer carbon + water in peatlands: landscape based solutions for climate adaption	Alba A. Alonso: Policy opportunities for peatland restoration in the Common Agricultural Policy and the Carbon Removal and Carbon Farming Regulation
	Matthias Lampe: The water balance of a 10 ha cattail cultivation test site in NE Germany.	Janice Neumann: PALUS DEMOS: Paludiculture large-scale demonstrations – Advancing solutions for degraded peatlands	Päivi Merilä: PaluWise develops advanced solutions for productive use of rewetted degraded peatland ecosystems
	Sebastian F. A. Jordan: Klimafarm: Paludiculture in Northern Germany – Planning, rewetting and collecting first data	Adam. H.W. Koks: Can peat moss (*Sphagnum*) be cultivated on formerly drained Dutch agricultural peatlands – lessons learned from pilot projects	Lars Kretschmer: Germany-wide Potential for Conversion to Paludiculture on Agricultural Land to Reduce Greenhouse Gas Emissions by integrating new Yield Models
	Antonia Fels: Hydrological studies on wet meadow paludicultures in the LivingLab Teufelsmoor	Merten Minke: Networking and overarching coordination of large-scale projects for joint recommendations for sustainable paludicultures	Andrea Lange, An IACS data-based analysis of agricultural land-use on organic soils in Germany
	Sebastian Heller: Phosphor pools in peat and other organic soils: baseline data and sampling protocols for paludiculture	Annette Prochnow, Venja Röber-Terstegen, WetNetBB: Network of model and demonstration projects in Brandenburg's peatland regions	Sarah-Maria Schäffer: Spatial Planning and Peatland Protection: Identifying Opportunities for Rewetting Peatlands
	Gabrielle Rabelo Quadra: Potential of *Sphagnum* paludiculture for water purification and element sequestration: insights from a field-scale topsoil removal experiment	Sören Tech: The project LivingLab Teufelsmoor	Hubert Piórkowski: Paludiculture – a chance for disappearing peatland ecosystems in Poland?

	Hannah M. Silvennoinen: Boreal *Sphagnum* farming for increased biodiversity and decreased greenhouse gas emissions	Roman Adam: -MOOReturn-Combining peatland climate protection and added valuevia peatland revitalization and paludiculture	
	Elena Aitova: The effect of restoration techniques on the carbon savings potential of a raised bog	Jasmin Hanser, Carola Blessing: Testing wild plant mixtures for rewetted peatland	
	Elena Aitova: A review of greenhouse gas emissions and removals from Irish peatlands	Leon Hanke: Genomic analyses & DNA-Barcoding for efficient *Sphagnum* moss differentiation and characterization	
Session 1 16:00–17:30	Marie-Luise Dexl: Methane and nitrous oxide measurements on a water buffalo meadow with a dynamic chamber system.	Wiebke Vogel: Paludiculture with *Typha*: climate protection, economy AND biodiversity?	
	Adam Bogacz: Soil Condition and Paludiculture Potential on a Post-Fire Fen in South-Western Poland	Oswin van der Scheer: Nature based services provided by paludiculture in a peatland wetscape	
	Nisa Novita: Enhancing Climate and Community Resilience Through Tropical Peatland Restoration in West Kalimantan, Indonesia	Susanne Arbeiter: Restoration of the Pomeranian population of the Aquatic Warbler – an endangered fen mire specialist	
	Cordula Gutekunst: Effect of solar panels on greenhouse gas emissions in a rewetted peatland		

DAY 2

Wednesday – 24th September 2025

For the exact schedule, please check the Converia app.

	POSTER PITCHES AT THE BEGINNING, IN BETWEEN AND END OF THE SESSIONS		
Session 2 09:50–10:45	Peatlands & People 1	Biomass utilisation & PV	Economics & Agronomy
	Suza Husse: Venice Agreement for Peatlands	Kristiina Lång: FIBSUN project: Novel fibre value chains and ecosystem services from sustainable feedstocks	Michael Rühs: Analysis of costs and carbon footprint of Paludiculture-biomass harvesting techniques by means of Monte Carlo Simulations
	Carola Kiene: Identifying factors for social acceptance of photovoltaic systems in rewetted peatlands	Marc Küperkoch: Cotton grass: An underestimated fibre plant as an opportunity for the establishment of paludiculture	Malte Schneider & Jenny Hammerich: Scaling Peatland Rewetting through Carbon Markets: A Private Sector Perspective from Central and Eastern Europe
	Karoline Hemminger: Transforming Peatland Management: Stakeholder Roles and Governance in Brandenburg	Jeferson Vicente: Valorisation of Paludiculture Biomass through Furfural Synthesis in a Two-Step Process	Wendelin Wichtmann: Certification of biomass from Paludiculture
	Claudia Oehmke: MoorAgentur MV – networking, advice and support of peatland rewetting at a regional level	Thomas Süß, Andreas Stauss, Elena Zydek, Marie Bajohr: Utilisation of Peatland Biomass Through Pyrolysis – Results and Practical Experiences from the Two German BMUV Projects Klimafarm (SH) and MoorWERT (BY)	Sabine Wichmann: Update on the market of Common Reed for thatching (1990–2023)
	Matthias Schuppler: “Unser Land kann Moor” – Building an Online Networking Platform and Marketplace for Paludiculture Raw Materials	Ekaterina Gualoto-Kirochka, Michael Rühs: Life Cycle Analysis of Paludiculture-biomass use in paper production	Marcus Schlingmann: Dairy farming on wet peatland soils – Options, Grassland Management and Valuation
	Hauke Schmülling: The first student congress on peatland science: “Moore-Motion” in Greifswald	Basri Oktay Koc: Development of processes for the extraction and processing of fiber raw materials from paludi biomass for use in pulp & paper	Emily Pope: Supporting the value chain development for paludiculture production in the UK: *Sphagnum* moss as growing media

		Lyanne Ausema: Paludi & Bau: Turning Wetland material into Sustainable Building Materials	Bettina Tacke: A functioning value chain? Results of the BLuMo project on keeping water buffalo on rewetted peatland areas in Brandenburg
		Steffen Sydow: Development of innovative building materials based on paludiculture bulrush and establishment of a demonstration production facility	Thiade Thorben Langenhan, Jan Gutjahr: Paludi Value Chains as Bioregional Clusters for Regenerative
		Ulrike Wegener: Development of a RAL quality assurance for *Sphagnum* biomass as a growing media constituent	Telse Vogel: Analysing methods for recording machine and work processes for paludiculture procedures – a field test during *Typha* harvest
		Andrea Krüger: MoorPower – Sustainable and innovative photovoltaic solutions for rewetted peatlands	Annelie Säurich: Shearing vanes, penetrometers, and seven operators: Digging into the user effect on trafficability measurements
		Monika Hohlbein: Moor-PV – Climate and peatland protection through a combination of photovoltaics and peatland rewetting	Teresa Koller: Grassland management on rewetted fens: results of field experiments in Bavaria
Session 2 09:50–10:45		Wiltrut Koppensteiner: A systematic review regarding the effects of ground-mounted solar farms on faunistic biodiversity in Europe	Christina Hartung: Factors Influencing Flower Formation in *Carex acutiformis*
		Bas Spanjers: PaludiScout.de – An information platform for harvesting machinery in paludiculture	Constantin Möbius: What influences the germination of *Typha latifolia* seeds? A literature review, supplemented by experimental results and a practical approach.
			Jeroen Pijlman: Sowing cattail: pay attention to soil properties and water levels
			Lars Kretschmer: Influence of nutrient supply on biomass yield and biomass quality of paludiculture plants

Greifswald – a Hanseatic and University Town

The city of Greifswald, situated in northeastern Germany on the Baltic Sea coast, is a founding member of the Hanseatic League of Towns. Alongside the Hanseatic League, the founding of the university in 1456 was decisive for the city's development. Today, Greifswald is a nationally and internationally renowned location for science, technology and research. It is situated amidst extensive forests, peatlands, and lakes, including seven national parks and biosphere reserves and many large restoration projects. The market square with its medieval churches offers visitors one of the most beautiful northern German market place ensembles.

Conference Venue

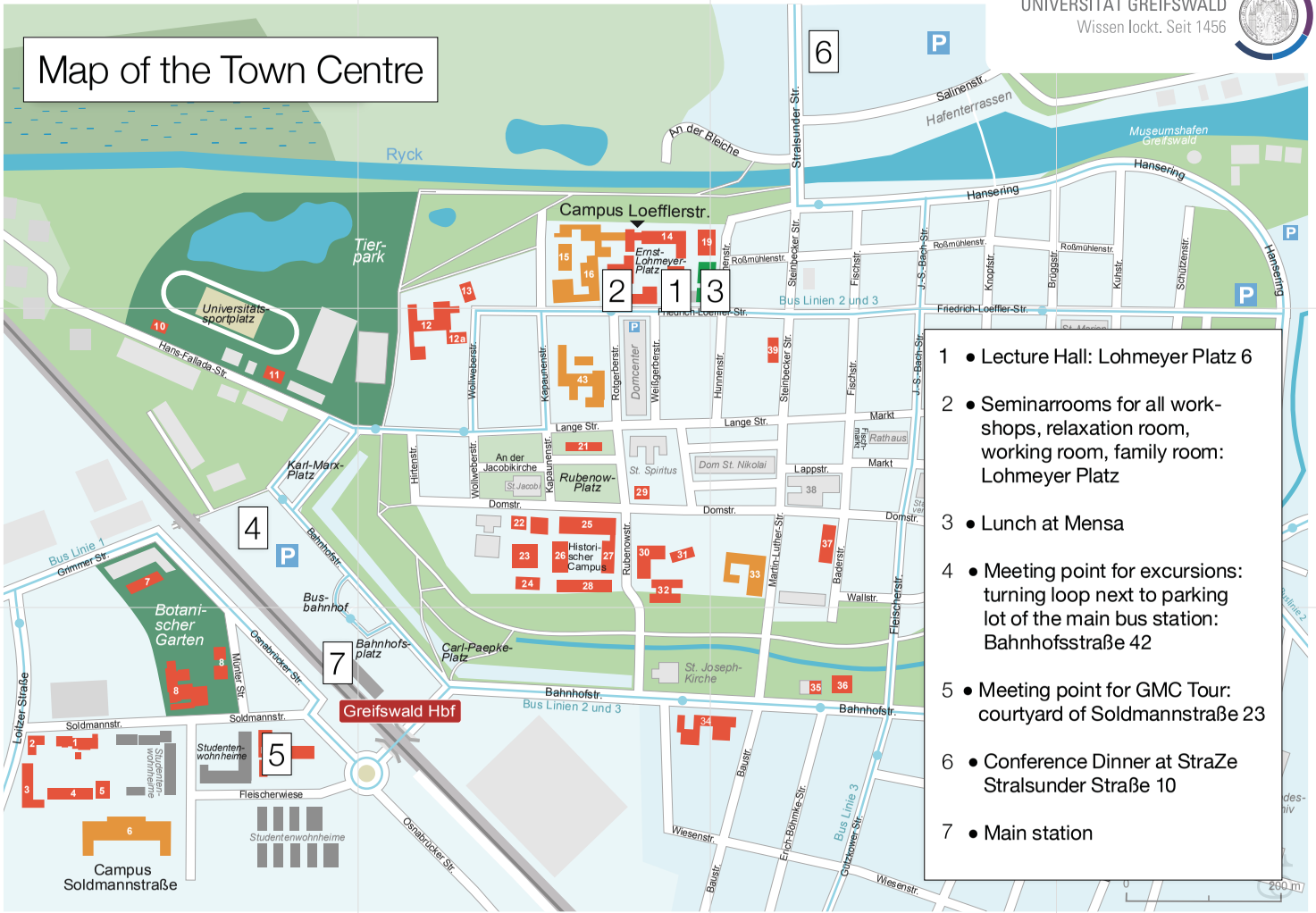
- **Location: Campus Loefflerstraße**

The sessions will take place in the main conference building (lecture hall building) with the "Peat moss hall" also for plenary sessions, the "Reed room" and the "Buffalo arena".

The Workshops will take place in the Seminar rooms 2.26, 3.21, 3.22 and 3.25. These are located on the 2nd and 3rd floors of the building opposite the lecture hall building – behind the fruit trees in the Faculty of Law and Economics building. Here you will also find a relaxation room (SR 3.20, 3rd floor), two work rooms (SR 2.26 and SR 2.28, 2nd floor) and a family room for free use. The rooms are additionally signposted in the building.

UNIVERSITÄT GREIFSWALD
Wissen lockt. Seit 1456

Map of the Town Centre



1 • Lecture Hall: Lohmeyer Platz 6

2 • Seminarrooms for all work-shops, relaxation room, working room, family room: Lohmeyer Platz

3 • Lunch at Mensa

4 • Meeting point for excursions: turning loop next to parking lot of the main bus station: Bahnhofsstraße 42

5 • Meeting point for GMC Tour: courtyard of Soldmannstraße 23

6 • Conference Dinner at StraZe Stralsunder Straße 10

7 • Main station

Instructions for oral presentations

The timing of your presentation is of utmost importance. With so many speakers and other sessions running concurrently, we need to adhere strictly to the time schedule. Please, practice your talk and make sure that it will not overrun your time slot. The length of your talk is limited to 12 minutes with an additional 2 minutes reserved for questions. All speakers are requested to be in the room of their session at least 10 minutes before the session starts, to bring your presentation to the technical staff and to contact the session's chairperson. Please note that it will not be possible to connect your own laptop to the projector. We need your presentation on a memory stick readable by a Windows PC (pdf, ppt or pptx). Please be responsive to the indications on the timing near the end of your talk. Your chairperson will ring a bell after 12 minutes, when you have used all of your time and need to end your talk immediately.

Instructions for poster presentations

Posters must be in A0 Format – upright. Posters can be mounted on boards for display in the foyer and on the 1st floor. Boards are marked with title and your name. Drawing pins and adhesive tape will be provided. Please submit your poster for the presentation in the session as a PDF/PPT file when registering. Please mount your poster as soon as possible after your registration at the desk. There will be two poster session on Wednesday, 24.09.2025 at 10:45–11:30 am and 3:30–4:15 pm. Please stand next to your poster during the poster session to answer questions.

Thank you.

HISTORY OF THE RRR CONFERENCE

The upcoming conference is the fourth in a series of international conferences in Greifswald dealing with paludiculture. The first international conference on the use of wetland plants, RRR2013 (Reed as a Renewable Resource), took place in February 2013 and was attended by around 120 participants from 25 countries. The focus was on practical issues of paludiculture, results from current applied research and experiences from paludiculture projects worldwide. Important harvesting technology issues were discussed at the harvesting machinery exhibition (fair) on the Greifswald market square. The results of the first conference were summarised in a memorandum.

The second international conference (RRR2017 – Renewable resources from wet and rewetted peatlands) with about 200 international participants followed in September 2017 to continue the dialogue on paludiculture and share the latest scientific developments. The conference week was introduced by a national event on climate protection and peatland utilisation, followed by an excursion day, continued by the two day international conference with presentations in 7 sessions and ended with a workshop on *Sphagnum* farming. At the end of the conference, a final declaration was agreed in plenary. Other highlights of the conference were again an exhibition of machinery and paludiculture products as well as the art exhibition "Rumooren".

The third international conference, which took place in March 2021, built on the themes of the previous RRR conferences. The focus was on the potential uses of paludi-biomass and the climate impact of peatlands. A particular challenge for the organising committee was that the Covid pandemic did not allow a face-to-face meeting. It therefore took place online only. Nevertheless more than 300 people participated. Preparing the virtual excursions was an unusual task. In 8 inspiring virtual excursions (films of ca. 7 min each) demonstration sites for paludiculture and peatland restoration as well as paludiculture products in Germany and UK were presented. Other highlights were a literature evening with Hans Joosten, a photography workshop with Tina Claffey and the slow session: Paludiculture & Art.

Find more information, book of abstracts and pictures of the last RRR conferences at www.moorwissen.de/events


Peatlands must be wet:
for the climate, for the land,
for the people, for ever...


SOFTRAK
Cut & Collect
loglogic.co.uk
loglogic
SOFTRAK

Christian Fritz “Train. To.Paludiculture”

Tuesday – 23rd September 2025, 2.30 pm

Christian Fritz is a trained peatland scientist with extensive experience in paludiculture and wetland restoration, which he has focused on since 2005. His research spans carbon, nutrient, and water cycles in European peatlands, complemented by research stays in New Zealand, South America, and Siberia. Since 2023, Christian has chaired the Eco-Hydrology and Peatland Science Group at Radboud University Nijmegen, Netherlands. The group collaborates across disciplines to advance socially inclusive research and quantify processes essential for climate neutrality and ecosystem services in rewetted peatlands and paludiculture systems.

In his keynote speech, Christian Fritz will guide you on a journey across European peatlands managed for the production and use of paludiculture biomass. He will highlight success stories where paludiculture has improved ecosystem services and contributed to climate mitigation, supported by quantitative insights. Christian Fritz will also discuss how best-practice management can overcome barriers and build broader acceptance. As you navigate the challenges and innovations of piloting paludiculture, this journey will explore its limitations, opportunities, and the necessity to scale up paludiculture to achieve a climate-neutral Europe.

Kate Flood “Embedding social-ecological justice for sustainable and equitable peatland transitions”

Wednesday – 24th September 2025, 9.00 am

Kate Flood is a peatland researcher working at the intersection of social science, ecology, and arts and humanities disciplines to explore the relationships between people and peatlands. Her research interests include the cultural and social dimensions of peatland conservation and the role of communities (geographical and communities of interest) in contributing to the restoration and resilience of peatlands. Recent research encompasses diverse peatland-related themes, including work on Peat Hub Ireland, WaterLANDS, and the Tóchar Community Stories project.

This presentation explores the theory and practice of Just Transition in Ireland, focusing on recent research, restoration, and lived experience of communities in the Irish midlands. These communities are transitioning from extractive industries that once provided employment and socio-economic benefits to regenerative models that foreground restoration, conservation, recreation and socio-cultural transition. Such transitions are crucial for driving the societal transformation needed to address the ongoing climate and biodiversity crises and to achieve sustainable development goals. However, significant knowledge gaps, barriers, and challenges remain, particularly regarding the socio-economic, political, and equity dimensions of implementing peatland conservation and restoration initiatives. Drawing on insights from research, practice, and grassroots efforts, this presentation highlights the dual ecological and social nature of peatland restoration and the need for integrated, interdisciplinary research and practice to deliver interconnected ecological, economic and social benefits.

SPECIAL EVENTS DURING THE CONFERENCE

24th September 5.30–9 pm • Lecture hall building

Paludiculture Exhibition & The Great Paludi-Show

Paludiculture exhibition “All you can peat”

We can build houses with it, grow vegetables on it, eat food from it, heat with it and much more. Paludiculture biomass can be used for a large variety of applications. We present them at a creative product fair.

Get ready for the “Great Paludi-Show”!

A fun and interactive evening where you don’t just watch – you think, laugh, and learn. Discover how paludiculture is already becoming reality with surprising products and fresh ideas for you, for industry, and for the planet.

Catering will be provided outside. Food is included in the conference ticket, drinks are not covered and must be paid.

25th September 7.30–9 pm • Lecture hall building | Reed room

In Zombie Fire

● Screening and talk

with filmmaker and researcher Jeanna Kolesova and Suza Husse, coordinator of the transdisciplinary arts and research platform Sensing Peat

A haunting journey through Europe's forgotten peatlands, *In Zombie Fire* reclaims suppressed histories of environmental degradation, labour, and imperial domination, imagining non-extractivist futures through experimental documentary storytelling.

Jeanna Kolesova's experimental documentary film *In Zombie Fire* investigates how imperial narratives endure in energy extraction, centering on the overlooked history and ecological scars of peatlands across Russia, the Baltic states, Finland, and Germany. Once celebrated as engines of Soviet industrialisation, these landscapes bear the hidden costs of labor exploitation, environmental devastation, and geopolitical power struggles that persist today.

Blending archival research, environmental sensing, oral histories, and speculative storytelling, the film approaches peatlands as living witnesses to ongoing violence. Through the narration of the imaginative creature *Swamp Spirit*, it explores how the conquest of wetlands and energy imperialism has reshaped ecologies, bodies, and memories.

Working collaboratively with affected communities, activists, scientists, and historians, *In Zombie Fire* co-creates counter-narratives that challenge dominant histories and envision regenerative futures beyond extractivism.

Video stills from *In Zombie Fire* (Jeanna Kolesova)

Jeanna Kolesova and Suza Husse will screen excerpts and research materials from the documentary and be in conversation about peatlands as ideological figures and narratives as well as unruly muddy presences that shape past, future and present of peatland ecologies and cultures.

Jeanna Kolesova is artistic researcher in residence at the transdisciplinary arts and research platform Sensing Peat at the Michael Succow Foundation, partner in the Greifswald Mire Centre.

www.sensingpeat.net/

25th September 7:30–9 pm • Lecture hall building | Buffalo arena

radio.earth – listening to change

radio.earth is a participatory art and radio project centered on the ecological crisis and its perception. The project emphasises the acoustic, using listening as its core practice. By listening to areas with diverse land-use intensities - ranging from natural spaces to agrarian, urban, and industrial zones - the project aims to expand knowledge and sensitivity about changing natural conditions. radio.earth utilises live acoustic microphones to transmit the audible environment with pristine quality to the internet via cell networks. Listeners can comprehensively experience the soundscape of various places, including their natural and environmental sounds throughout changing seasons. While on air, live broadcasts are announced, exchanged and discussed within an international chat group of artists, researchers and individuals.

https://radio.earth

KoosMic:

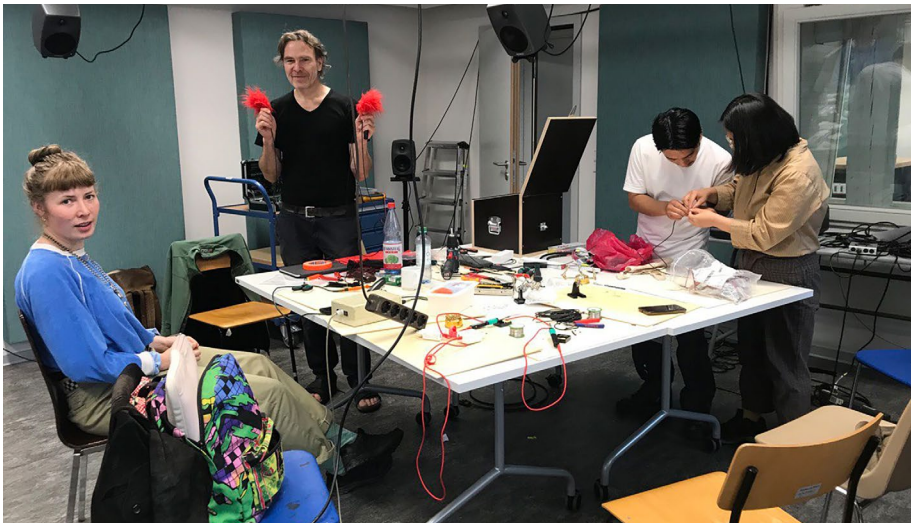
- Live: radio.aporee.org:8443/koosmic

In autumn and winter 2024/25, the KoosMic permanent listening station was established on the island of Koos near Greifswald, in a coastal peatland area managed by the Michael Succow Foundation and scientifically monitored by the Greifswald Mire Centre. The station was initiated by Udo Noll and set up together with students from the Department of Acoustic Ecology, Bauhaus University Weimar under the professorship of Kerstin Ergenzinger.

During the conference, we will listen live to the island's soundscape and selected recordings from recent months, and elaborate on concepts and practises around Acoustic Ecology and the radio.earth project.

Udo Noll is a media artist and graduated as a qualified engineer for photography and media technology at the Cologne University of Applied Sciences. He lives and works in Berlin and Cologne and is the founder and developer of radio aporee, a platform for projects and practice in the areas of field recording, sound art and experimental radio.

https://aporee.org/maps
https://radio.earth/



Photos:: Udo Noll

Kerstin Ergenzinger is a sonic and visual artist and Junior Professor of Acoustic Ecologies and Sound Studies at Bauhaus University Weimar. She works across the fields of sound, sculpture, kinetics, light and drawing and explores the diversity of sensory ecologies and the possibilities of tuning into the differences of the world.

www.nodegree.de
www.sonochoreographic.net
Acoustic Ecologies and Sound Studies

26th September

10 ha *Typha* paludiculture in June 2024 (Photo: T.Dahms)

Excursion 1

Peatland research on *Typha* paludiculture, fen meadows near Neukalen, and a local stakeholder dialogue in a peatland restaurant

- Start: 8 am | End: ca. 5:30 pm
- Highlights: Managed *Typha* paludiculture on 10 ha site with up to 5 m of peat layer, surrounded by grassland dominated by reed canary grass, partly grazed by suckler cows and mown for winter fodder. The fen meadows "Neukalener Seewiesen" (ca. 400 ha) have been drained for agricultural use, nowadays a re-wetted peatland with sedge-meadows dominating. The "Moorbauer" is a riverside excursion restaurant situated in the middle of the peatland and accessible only by swan pedal boat, used to engage in conversations with regional and local stakeholders: moorbauer.com

Water Buffalos (Photo: W. Wichtmann)

Excursion 2

Peatland research on mown and grazed rewetted peatland on the Darß peninsula (Baltic Sea), river valleys of Recknitz and Trebel

- Start: 8 am | End: ca. 6:30 pm
- Highlights: grazing sites with water buffalos on the Darß peninsula. Influence of buffalo grazing on coastal peatlands. First harbingers of migrating cranes. Management of near natural sites for conservation with site-adapted, biodiversity promoting mowing in the lower Recknitz river valley. Study sites of research projects on matter dynamics in rewetted peatlands in the Trebel river valley (WETSCAPES). The sites were rewetted >20 years ago in an EU LIFE project with a generally positive development regarding vegetation development as well as ecosystem functioning. We will also discuss results that showed that paludiculture use might be beneficial for the GHG balance of rewetted peatlands.

Polder Bargischow Süd (Photo: T. Dahms 2022)

Excursion 3

Peatland research and nature conservation near Anklam (near Island of Usedom), establishing a new reed stand, rewetting for breeding birds

- Start: 8:30 am | End: ca. 5 pm
- Highlights: Lower Peene river valley near Anklam with large rewetted sites; long-term project "peatland pilot" with 480 ha former grassland currently in rewetting process; establishment of new reed stand on 40 ha, broad monitoring activities, such as for mosquitos, biodiversity and GHG emissions; project sites of LIFE "LIMICODRA" with high water levels for the protection of meadow birds.

Coastal flood peatland (Photo: AESA aerial)

Excursion 4

Karrendorfer Wiesen – restoration of a coastal flood peatland near Greifswald

- Start: 8 am | End: ca. 1 pm
- Highlights: Created by grazing and seasonal flooding – a coastal flood peatland with anthropozoogenic salt meadows; rare variation of the fen type in their natural form, where natural flooding dynamics still occur, exists in only a few locations along the Bodden coast in NE Germany.

Please come at start time to the meeting point: Bahnhofsstraße 42 (see No. 4 in the map on page 19). Please bring rubber boots and weatherproof clothing. Food and drink will be provided.

Aerial view of the 20 ha *Sphagnum* paludiculture site in the peatland Hankhauser Moor near Oldenburg/ Lower Saxony (Photo: S. Busse)

Excursion 5

Cultivation methods and diverse research on *Sphagnum* paludiculture on rewetted bogs in Lower Saxony / NW Germany

- Start: 6 am, End: ca. 11 pm
- Highlights: Two *Sphagnum* paludiculture sites on former bog grassland (~20 and 10 ha) with subareas at different stages of development (installed in 2024/25, 2020 or 2016) and experiments on best practice, top soil removal depth, water management (different ditch distances, subsurface irrigation), regeneration after harvest, a small scale field trial on the selection of productive provenances of 12 potential *Sphagnum* paludiculture species and field test of axenic in vitro-cultivated *Sphagnum* clones; sundew cultivation. Investigations on GHG, water quality and demand, biodiversity etc.

Photo: M. Hohlbein

Excursion 6

Photovoltaic power plant on a rewetted peatland in Lottorf/ Schleswig-Holstein

- Start: 6 am | End: 8.30 pm
- Highlights: ca. 30 ha pholtovoltaics with an installed capacity of 17 MWp on a rewetted peatland previously used as grassland, continued agricultural use by regularly mowing, research on the impacts of PV systems on rewetted peatlands, focusing on biodiversity, greenhouse gas emissions, and economic viability.

Excursion 7

Tour around the Greifswald Mire Centre with the Director Dr. Franziska Tanneberger

- Start: 3 pm | End: ca. 5 pm
- Meeting point: see No. 5 in the map on page 19
- The tour explains how the GMC came into being and what the main subjects are.

ABSTRACTS OF ORAL PRESENTATIONS

SESSION 1: Ecosystem Services 1

Quantification of ecosystem services in paludicultures with *Typha* and *Phragmites*

Dr. Jeroen Geurts, Sannimari Käärmelahti, Dr. Christian Fritz, Marelle van der Snoek, Dr. Peter van der Maas

To counteract soil subsidence and greenhouse gas emissions, groundwater levels in agriculturally used peatlands are increased in summer (e.g. by subsurface irrigation). This rewetting could lead to increased nutrient mobilisation under anaerobic conditions in nutrient-rich soils, which will lead to eutrophication in ditches and lakes. However, rewetted peatlands can also be used to purify surface water and utilise the available nutrients by cultivating wet crops like *Typha* and *Phragmites*, i.e. paludiculture. These wet crops can provide raw materials for fibre based products (e.g. insulation and building materials, clothing, food trays, paper).

This multifunctional land use can create a win-win situation that combines biomass production of wet crops with the provision of ecosystem services (peat preservation and water purification). Payments for these provided ecosystem services should become part of the business model of a farmer in the form of Carbon Credits, 'Blue Credits', Eco-schemes, reduced water taxes, or subsidies.

To underpin what the water purification potential of paludiculture is, measurements have been done in several mesocosm experiments and field-scale paludiculture pilots within national and European projects (e.g. VIP-NL, TKI, KLIMAP, Carbon Connects and CINDERELLA). These pilots and experiments were used to learn how to cultivate paludiculture crops under different hydrological circumstances (water level and fluctuations), nutrient loads, water quality, soil types and field configurations.

We quantified the water flows and nutrient uptake by *Typha* and *Phragmites* by making water and nutrient balances for multiple field sites and experiments with different soil quality, harvest management and hydrological conditions. The results are also used to investigate which combination of factors will give the most efficient combination of water purification, nutrient uptake and biomass production. In the end, this contributes to developing new ways of sustainable and economical feasible farming on wet peat soils and in brook valleys.

Estimating carbon accumulation in helophyte paludicultures from Dutch pilot sites

Adam Moritz, Herman Fomenko

Rewetting drained peatlands for paludiculture can promote carbon sequestration, potentially making these systems eligible for additional benefits under carbon farming schemes. However, short-term carbon sequestration in paludiculture remains uncertain. To contribute towards filling this gap, this study quantifies carbon accumulation in Dutch paludiculture pilot sites cultivated with *Typha angustifolia* and *Phragmites australis* since rewetting (<10 years).

Peat cores (6 cm diameter) were collected to a depth of 15 cm and sliced fresh into 1 cm increments. Organic matter content and bulk density were analysed using gravimetric methods. In addition, total C and N concentrations as well as stable isotopes ($\delta^{13}C$, $\delta^{15}N$) were assessed. These measurements provide insights into carbon accumulation rates and the potential of paludiculture to function as a long-term carbon sink.

Peat formation potential of *Phragmites australis* on commercially cut reed sites in north-east Germany

Meline Brendel, Nora Köhn, Josephine Neubert, Dr. Sabine Wichmann, Prof. Dr. Jürgen Kreyling

Harvesting *Phragmites australis* for thatching is a traditional paludiculture. Along the shore of the Baltic Sea, several hundred hectares of natu-

rally established reed stands are commercially cut. We examined the peat formation potential of *Phragmites australis* on annually cut reed sites.

We assessed the above- and belowground biomass accumulation and decomposition as well as the effects of water level and temperatures on it. We set up 4 plots of 4 m × 1 m each, aligned along a water level gradient, at five different reed stands, respectively on the island of Rügen (2 sites), the island of Usedom (2 sites) and close to the city of Anklam (1 site) in Mecklenburg-Vorpommern (20 plots in total). In March 2023, after all sites were harvested, ingrowth cores and litter bags were installed to analyse the above- and belowground biomass decomposition and accumulation. Litter bags were filled with autochthonous reed plant material (roots, rhizomes and leaves), and Lipton rooibos tea bags were used as standard material. The installations remained in the plots for approximately 9 months, until December 2023. Aboveground biomass accumulation was examined by harvest in December 2023. The data was recently analysed and the results will be presented at this conference.

The overall results of the project provide valuable information on the peat formation potential of long-time established reed stands which are cut annually for harvesting thatching material.

Paludiculture brings biodiversity to the rewetted peat meadow landscape

Dr. Gert-Jan van Duinen

Switching from drained use of peat soils to paludiculture implies strong changes in site conditions. The intensity of land use also decreases sharply compared to common agricultural practices. To gain more insight into the impact of paludiculture on biodiversity, comparative research was carried out on the biodiversity of flora, invertebrates and birds in 15 paludiculture pilots (mainly cattail cultivation, but also some other wet crops) in the Netherlands, near drained and commonly used grasslands and natural swamp vegetation with cattail.

The species richness of a plot (alpha diversity) sometimes increases, but in other cases is more or less the same as in productive grasslands. Similarly, the average numbers and biomass of insects per square meter are sometimes higher, but sometimes equal to, or lower than those in pro-

ductive grassland or more natural swamp vegetation. However, it is clear that species composition differs markedly between different crops and also between different plots; the gamma diversity of paludiculture plots is much higher than that of relatively uniform productive grasslands. This diversity is driven by diversity in the water regime (e.g. dry soil in summer, or permanent water), vegetation structure, nutrient availability and also time since establishment and dynamics in the plot and its position in the wider landscape.

The changes in invertebrate diversity and productivity have implications for the food chain, birds and other insectivorous animals. Also for birds, we see that the wet conditions provide a suitable biotope for other species than what is common in the peatland area. Plots with paludiculture have a clear added value for biodiversity in the peat meadow landscape.

SESSION 1: Lessons Learned

A decade of paludiculture in Latvia: progress, challenges and new directions

Ilze Ozola, N. Stivrins

Latvia has been exploring paludiculture as a sustainable form of land use for rewetted and degraded peatlands for over a decade. In this presentation, we provide an overview of Latvia's paludiculture development, highlighting key lessons from pilot sites and emerging initiatives. Our assessment covers a range of activities–from the cultivation of *Sphagnum*, *Typha*, and *Alnus* on extracted peatlands to reed management and agrovoltaic trials on rewetted organic soils.

While positive examples exist–such as successful carbon certification pilot projects and promising biomass trials – national implementation remains limited. Barriers include the lack of targeted policy support, gaps in financial mechanisms, and uncertainty in long-term economic viability. Nevertheless, recent studies indicate that rewetting and paludiculture can be feasible for landowners, offering potential climate mitigation and biodiversity benefits.

Paludiculture is gradually gaining recognition in Latvian policy and planning documents. It is referenced in the National Energy and Climate Plan 2021–2030 as a potential tool for reducing greenhouse gas emissions. The 'Latvian Bioeconomy Strategy 2030' also identifies the need for innovative biomass sources, including from rewetted peatlands. Additionally, the Ministry of Agriculture has acknowledged paludiculture in its national strategic plan for the Common Agricultural Policy (CAP) 2023–2027, proposing pilot activities and knowledge exchange initiatives. Paludiculture is also discussed in the ongoing process of updating national peatland and wetland management guidelines, where it is seen as a nature-based solution compatible with both climate and biodiversity goals.

Strengthening the full value chain–from site restoration to product development and market uptake–is crucial for scaling up these efforts. We discuss opportunities for expanding paludiculture in Latvia and the need for a coherent framework to build trust, promote innovation, and integrate nature-based solutions into land use planning.

Variations in water demand for irrigating a *Sphagnum* paludiculture – results of an 11 years study in northwest Germany

Matthias Krebs, Dr. Kristina Brust, Dr. Greta Gaudig

AIM: *Sphagnum* (peat moss) is very susceptible to desiccation and flooding. When cultivating *Sphagnum* biomass in paludiculture, precise and effective water management is therefore essential to achieve high yields. In our study, we investigated the feasibility of continuous water supply and the magnitude of fluctuations in annual water demand over the long-term.

METHODS: We measured and modelled all components of water balance (precipitation, inflow, runoff, evapotranspiration, seepage) in combination with the *Sphagnum* growth for a Sphagnum paludiculture site in the peatland Hankhauser Moor (17 ha size, NW Germany) for a period of 11 years. Furthermore, we studied the effectiveness of different distances between irrigation ditches (10 and 35 m, slightly decomposed *Sphagnum* peat at the surface, H3–4) for *Sphagnum* lawn establishment during a 3year experiment on the same site.

RESULTS: During the 11-year study period, the average water table was 5 cm below the *Sphagnum* surface, when ditch distance was 10 m. In comparison, with a 35 m distance between the ditches, water table fluctuations were higher, and the *Sphagnum* growth was lower 3 years after installation. The observed range of additional water volumes required per hectare and year varied from 450 to 4,060 m^3. Most water was lost due to evapotranspiration and seepage, in particular into the drained surroundings.

CONCLUSION: Water management with a 10 m distance between the irrigation ditches has proven to be suitable for maintaining water tables close below the *Sphagnum* surface fostering rapid *Sphagnum* lawn establishment and substantial *Sphagnum* biomass accumulation, while a greater distance might reduce the success of Sphagnum paludiculture, even if the surficial peat layer has a high hydraulic conductivity. Large variations in annual irrigation demands must be considered for optimal water supply, depending on the specific hydrometeorological conditions experienced during the summer months with frequent precipitation events to prolonged periods of drought.

African peatlands conservation and utilization (papyrus and reeds economies) with case studies from East Africa and Zambia

Leonard Akwany

Africa is endowed with peatlands ecosystem, approximately covering 40 million hectares, which constitutes about 10% of global peatlands area. The narrative of the tropics having insignificant peatland extent and poor data availability on peatlands in Africa has precipitated their degradation resulting into increased greenhouse emissions, biodiversity loss and reduction or loss of overall ecosystem services and goods associated with peatlands. This presentation shares the findings of coarse study undertaken in East Africa (Kagera Peatlands) and Zambia (Lukanga Swamp, Barotse Floodplain and Liuwa Floodplain) Peatlands in terms of peatland presence, soil and vegetation characteristics, threats, people voices and exploring their values and governance for sustainable peatland utilisation and conservation.

Value chains for toMOORow: Half-time report on PaludiAlliance

Dr. Clemens Kleinspehn, Birthe Godt, Claudia Bühler, Jan Peters, Dr. Franziska Tanneberger

The practical implementation of paludiculture in Germany is at a stalemate. Both the farmers considering paludiculture biomass production and the companies interested in processing paludiculture biomass are hesitant to proceed without secured supply of and demand for plaudiculture biomass.

To resolve this stalemate, the toMOORow initiative launched the FNR funded project PaludiAlliance in April 2024. Within this framework, fourteen dedicated business partners committed to develop pilot products with paludiculture biomass, even without a secured supply chain.

In the first half of the project duration, PaludiAlliance partner OTTO successfully sent 100000 cardboard packaging boxes in a customer trial. Other partners from the paper and packaging sector started two pilot projects on natural fibre production and one pilot project providing a transportation solution for plants in customer sale.

Partners from the construction sector started a joint development on two pilots for insulation boards with paludiculture biomassand one pilot for door panels.

Furthermore, the cooperation partners of PaludiAlliance created supportive networks to the facilitate scaled up production of paludiculture products:

The Michael Succow Foundation founded the Biomass Supply Working Group to facilitate communication between farmers and processors, and consists of practising farmers, representatives of the German Farmers' Association, the German Agricultural Society and project managers of pilot projects. Additionally, an online biomass exchange platform for paludiculture is being developed to facilitate trading transactions between farmers and processors.

The University of Greifswald founded a working group on environmental impact of paludiculture farming and its reporting in product LCAs and EPDs. Additionally, a working group on natural fibre production was founded for exchanging technical expertise between PaludiAlliance partners and experts outside of the Alliance.

Here, we report on achievements, progress and challenges of 1.5 years of PaludiAlliance. Additionally, we preview next plans of PaludiAlliance for the next 1.5 years and highlight spin-off developments of the project.

SESSION 1: Governance 1

Obstacles, major fields of actions and financial requirements to promote implementation of paludiculture in Germany

Anke Nordt, Dr. Sabine Wichmann

Paludiculture might pave the way for voluntary large-scale peatland rewetting. However, implementation remains scarce. The long history and large extent of peatland drainage has shaped the political and legal framework as well as perceptions and attitudes, thus impeding rewetting and climate-friendly peatland use.

We illustrate the political, legal, economic and social aspects that hinder the implementation in Germany and give an overview of approaches to overcome multiple constraints. We identify three major fields of action: (1) A consistent peatland mainstreaming approach is needed that overcomes structural barriers and adapts the policy and legal framework, e.g. the Common Agricultural Policy, planning law, water law and nature conservation law. (2) Immediate, comprehensive and attractive positive incentives accompanied with long-term gradual introduction of negative incentives, to support pioneers, to reduce early mover risks and to provide planning certainty for farmers and landowners. (3) Empowering local communities to develop and pursue perspectives for a just transition tailored to their peatland region.

For a theoretical area with potential for wet peatland management in Germany (1 million hectares) we calculated the fiscal financial requirements for rewetting and conversion to paludiculture in a ‘Paludiculture incentives’ scenario. Based on the current costs of rewetting and establishing paludiculture, this scenario could serve as a basis for political discussion. In addition to subsidies for investments and accompanying measures, a climate protection premium is calculated as an incentive for

rewetting. The total volume for the 'Paludiculture incentives' scenario is €21.2 billion (2022–2049), of which almost two-thirds is accounted for by a climate protection premium. At €67.5 billion, the economic benefits of rewetting clearly exceed the financial requirements.

How supportive is the EU Common Agricultural Policy for peatland rewetting and paludiculture?

Bernhard Osterburg, Torsten Uhl

In this contribution the support of the Common Agricultural Policy (CAP) to peatland rewetting is explored with Germany as example. 40% of the funds of the EU Common Agricultural Policy are expected to support objectives of climate policy. According to the German Climate Action Programme 2030 from 2019, adaptations of legal and support policies should enable an effective peatland soil protection. In the German CAP strategy plan, specific agri-environment and climate measures for peatland rewetting through ditch blocking are planned on about 30.000 hectares. On the other hand, significantly more area is receiving CAP area payments without the need to change the current state of drainage. In the CAP strategic plans regulation, the production of paludiculture is defined as an agricultural activity. However, many wetland plants such as reed, cattail or sedges are not recognised as agricultural crops. Only crops listed in Annex I of the Treaty on the Functioning of the European Union are eligible for CAP support, with cotton and energy trees (short rotation coppice) as exemptions. Paludiculture may be eligible for CAP area payments if their establishment is supported through measures of CAP Pillar 2 or national measures for environmental or climate reasons. However, such areas are not recognised as agricultural land, which can pose obstacles to conversion. Other barriers may result from the conditionalities for the maintenance of permanent grassland and restrictions to establish paludicultures on grassland. Although conditionalities have been changed in the German implementing regulations, the state of paludiculture and rewetted peatland in the CAP still is complex and lacking sufficient incentives. For a more supportive role of the CAP for peatland rewetting, clear and easy rules for eligibility of paludiculture and rewetted land should be a first step.

Policy options for incentivising rewetting and using agricultural peatlands in a climate-neutral EU

Nahleen Lemke, Emma André, Cora Petrick, Christine Chemnitz, Prof. Dr. Harald Grethe

Agricultural peatlands in the EU account for around 2% of the total agricultural land area. These 2% emit more than 23% of the total GHG emissions from agriculture and agricultural peatlands.

The study 'Agriculture, Forestry, and Food in a Climate Neutral EU' examines the potential of rewetting agricultural peatlands to significantly contribute to the EU's climate neutrality goal by mid-century. We propose a scenario where 80% of agricultural peatlands are rewetted for paludiculture, wet wilderness, and solar PV, while 20% remains as shallow-drained grassland, potentially reducing annual GHG emissions by about 70 Mt CO_2eq.

A climate policy for the land use sectors which includes emissions from peatland allows for defining a combined emissions mitigation target for agricultural peatlands and agriculture. This policy should create economically viable conditions for farmers to rewet their peatlands, supported through two key mechanisms: rewetting payments and investments in paludiculture value chains. Rewetting payments should be able to be relied upon in the long-term reliable for farmers and oriented on the opportunity cost of the dry land use. In our study we estimate a budgetary requirement of about 12 billion Euro over the next two decades to cover the cost for rewetting payments for 2.8 million hectares of agricultural peatland. Scaling voluntary carbon market schemes can help lessen the financial burden on public funds.

Rewetting payments should decrease over time, transitioning to emissions payments once new value chains for paludiculture products are established. To generate demand from other sectors, e.g. the construction sector to replace fossil-based insulation products, new value chains need public financial and institutional support and policy incentives. EU policies such as the Ecodesign for Sustainable Products Regulation and the Corporate Sustainability Reporting Directive can provide the necessary framework to foster these developments.

Conditions and options for replacing peat in horticultural growing media in Germany

Olivier Hirschler, Bernhard Osterburg

Peat extraction is by far the most climate impacting use of peatlands per area unit. Germany, like other European countries, aims to reduce the extraction and use of peat for horticulture. Commissioned by the Ministry of Food and Agriculture, the Thünen-Institute investigated the possibilities and consequences of substituting peat in horticultural growing media. In this contribution, we present our research regarding (1) global peat flows, (2) potential amounts of peat substitutes, (3) factors driving and hindering the replacement of peat and (4) prices of growing media constituents and potting soils. Further, policy options were analysed in order to derive recommendations. Our findings show that the challenge of the availability of substitutes is not due to a lack of raw materials and could be solved by the development of the supply chain and the infrastructure. This is undermined by the economic advantage of peat, the competition with other sectors and administrative burdens which should be addressed in the policy regarding peat reduction. In the hobby sector, the additional price for peat-free products is not explained by differences in the price of constituents. The inclusion of peat in current carbon pricing systems would only have limited effects and would be of high administrative complexity. A peat ban in the hobby sector would be an effective and efficient way to strongly reduce peat use, but imply changes of the European legal framework. Overall, our findings highlight the importance of developing a European policy addressing peat extraction and use for a fair and effective transformation of the industry. The work focuses on the main peat substitutes today – green compost, wood fibres, composted bark and coir products. However, the results also shed light on the conditions for the establishment of new substitutes, typically, fresh *Sphagnum* moss from paludiculture.

SESSION 2: Peatlands & People 1

Peat4People: Paludiculture experiences from East Africa

Greta Schmidt, Nina Flohr

The 'Peat4People' project, initiated in January 2025 and funded by BMZ, is implemented by GIZ, the Michael Succow Foundation, and FAO. This project aims to revolutionise sustainable peatland management in East Africa, focusing on Uganda and Rwanda. Peatlands in these countries are characterised by their rich biodiversity, significant carbon storage capacity, and essential role in water regulation, yet they face threats from unsustainable land use, peat extraction and climate change. Over three years, Peat4People seeks to implement innovative paludiculture approaches that not only safeguard these vital ecosystems but also enhance the livelihoods of local communities. By developing products that align with both environmental sustainability and economic viability, the project strives to create attractive opportunities for local businesses without compromising the integrity of peatland ecosystems.

Additionally, the project explores sustainable financing solutions tailored to peatland conservation and community development that complement the paludiculture approaches. By identifying funding mechanisms that support both ecological and economic goals, we aim to establish a framework encouraging investment in peatland resources while fostering resilience in local communities.

This presentation will provide an overview of initial experiences and insights from ongoing activities in East Africa, amplifying the voices of local actors engaged in paludiculture. We will discuss the unique challenges and opportunities presented by paludiculture in tropical contexts, including the adaptation of these practices to local environmental conditions and cultural dynamics. Participants will engage in an international exchange of knowledge, contributing to a broader understanding of peatland management and the significance of biodiversity conservation.

The presentation will include actors from Uganda and Rwanda that work on the topic of paludiculture in the government, academia or within the value chain. Potential presenters will be determined in the next steps.

Peatland restoration in West Kalimantan: A climate solution and pathway to community empowerment

Dr. Nisa Novita

With half of Indonesia's peatlands degraded or drained, their restoration offers a cost-effective natural climate solution that can help the country meet its climate commitments while providing significant benefits to local communities. In Mempawah and Kubu Raya regencies in West Kalimantan, Indonesia, we have undertaken peatland restoration projects, including installing canal blocks for peat rewetting and supporting communities in adopting sustainable livelihoods to reduce forest pressure. To evaluate the climate benefits of peat rewetting, we have monitored long-term greenhouse gas (GHG) emissions across different peatland land cover types. Using a LiCOR portable gas analyser with the closed-chamber method, we regularly measure CO_2, CH_4, and N_2O emissions, along with groundwater levels, soil properties, radiocarbon dating, and other climate parameters. For community interventions, we've established field schools to promote reduced chemical fertiliser use, developed agroforestry demonstration plots, and integrated peat conservation into medium-term village planning. In oil palm plantations, our findings show that rewetting drained peatlands reduced heterotrophic respiration by 34% and total respiration by 20%. However, rewetting in these plantations does not reduce CO_2 emissions to the same extent as in secondary forests, likely due to differences in vegetation and land management. This highlights the need for community empowerment to complement hydrological restoration as part of a comprehensive peatland restoration strategy.

Well known but insurmountable? Socio-economic aspects of the acceptance of peatland rewetting in Brandenburg

Bettina Tacke

Sociological and socio-economic factors regarding the rewetting of agricultural peatlands have often been overlooked in scientific research. However, acceptance of this complex and transformative process – par-

ticularly among agricultural stakeholders and regional actors – is essential for successful implementation. Agriculture in Brandenburg has undergone significant structural changes in recent decades, including farms operating on peatland areas, which are primarily used for grassland. At the same time, farms are already experiencing the noticeable impacts of climate change. This study aims to explore the relationship between these factors and the acceptance of rewetting measures. Data was collected between December 2023 and April 2025 using a grounded theory approach, focusing on the challenges and opportunities involved. The core of the research includes about 30 guided interviews, half conducted with land users and the other half with regional stakeholders and experts, such as representatives from associations, NGOs, local politicians, and residents. Despite numerous potential benefits – including adaptation to climate change, improvement of the landscape's water balance, and the long-term economic sustainability of agricultural businesses – land users see many hurdles as insurmountable under the current economic, legal, and political conditions. This presentation summarises the findings of the study.

SESSION 2: Biomass 1

Peatland plant fibres for the paper and packaging industry

Raphael Burkhardtsmayer

The presentation aims to illustrate the results of the 'ProMofa' R&D project on the use of peatland plant fibres in the paper and packaging industry.

Paludicultures can be processed into plant fibres with pulp quality using various methods. This opens up a regional source of raw material for the energy-intensive paper industry. As a negative emissions technology, the usage of peatland plant fibres could make a fundamental contribution to its decarbonisation. The R&D project ProMofa, led by the Donaumoos-Zweckverband in the Bavarian Donaumoos focused on which pulping processes can be applied and which areas of application are possible for the pulp in the paper and packaging industry. The overarching aim was to create a reliable sales market for peatland biomass. If this would be

available, many peatland areas can be rewetted and cultivated with paludiculture.

Paludicultures and their influence on the quality of the peatland plant fibers were investigated. In cooperation with various industrial companies, test productions were carried out for different areas of application. At the same time, the project looked at important levers along the entire value chain. Important experiences and the influence of harvesting technology and post-drying were analysed. In addition to other topics, such as the availability of raw materials, processing and logistics, a particular focus was placed on the profitability of the entire company. Where is there a need for investment and how can this have a positive long-term effect on the operating result of each individual player? Further questions dealt with the marketing of the pulp and the products made from it. The project closed by outlining concrete next steps, that the individual stakeholders must now take in order to sustainably establish the usage of paludicultures in the paper and packaging industry. Further research needs are defined and necessary infrastructural investments are described.

Valorisation of paludi-biomass into biogas via regional value chains and cascading-use

Dr. Karina Michalska, Vincent Plogsties, Dr. Carsten Lühr, Dr. Ralf Pecenka, Dr. Monika Heiermann

Demonstration of the year-round use of paludiculture's raw materials and residues from the material recycling pathways as a biogas feedstock is a way to build acceptance and interest for sustainable peatland use. Integration of material and energetic utilisation into a cascade, i.e. the sequential and consecutive use of resources, can be an option for developing new regional value chains and creating added value in circular bioeconomy practices. Here we evaluate and compare the potential of energy recovery from paludi-biomass at each stage of the value chain, i.e. for raw and pretreated material, a market product (bedding) and a spent bedding.

Paludi-biomass (mixed peatland vegetation harvested in summer) originating from Rhinluch region in Brandenburg, Germany has been used as a source material for bedding production. Valorisation of paludi-bio-

mass into biogas took place at different stages of value chain. Raw biomass has been processed via extrusion or milling into a particularly absorbent fibre, then dried and pelletised into bedding. After utilisation on poultry farm spent product was forwarded for energy recovery stage.

Chemical composition of biomass changed noticeably over the course of the value chain. This in turn influenced the bioenergy yields. In general, paludi-biomass has a lower biogas and methane potential than typical energy crops such as maize or cereals. Both biogas and methane production increased when pretreatment step (i.e. extrusion or milling) was applied. Further processing (pelletising) to final market product affected negatively the efficiency of biomethanation. The spent bedding could provide substantially less biogas, however with the highest methane content (>58%). The changes in methane productivity most likely resulted from the presence of poultry manure in substrate mixture and improvement in C/N ratio.

Presented work outlines the potential of an exemplary local value chain that fulfils the principles of circular bioeconomy and emphasises the idea of cascading-use of peatland's resources.

SESSION 2: Economics & Agronomy

Current knowledge and research gaps in agricultural science and socio-economics of paludiculture: a scoping review

Dr. Regina Neudert, Anke Nordt, Dr. Sabine Wichmann, Dr. Sandra Kleine, Bas Spanjers, Dr. Telse Vogel, Prof. Dr. Volker Beckmann

Knowledge on agricultural and social science aspects of paludiculture, the productive use of wet and rewetted peatlands, has accumulated since the term paludiculture was coined in 1998, more than 25 years ago. A systematic overview of research on agricultural and socio-economic aspects, which comprise knowledge on planning and authorisation, establishment, agricultural practices, biomass utilisation avenues, farm economics and socio-economics of paludiculture, is so far missing from the literature. We synthesise existing literature on agricultural and socio-economic aspects of paludiculture using a systematic literature search using the search

string ‘paludicult’ in Web of Science and Scopus, yielding 244 scientific papers and book chapters. Papers with agricultural and socio-economic content were classified according to more than 20 criteria including the main thematic categories crop production/agriculture, planning/authorisation, utilisation/marketing, farm economics/socio-economics and comprehensive studies/conceptual frameworks. Additionally, we examined for all papers the definitions of paludiculture, location of study sites, and water table descriptions.

The results show that diverse definitions of paludiculture are used, whereas water tables are not always reported. Geographical research clusters emerge in Europe, especially Germany and the Netherlands, as well as south east Asia, in particular Indonesia. A research focus on aspects of establishment and plant cultivation was most widespread, while topics in planning were least covered. We find that a large share of studies relies on literature data, qualitative information or case studies, while larger N studies or comparative investigations were underrepresented.

In our presentation we emphasise the importance of clearly defining paludiculture with regard to actual and target water levels. In particular, scientific literature on paludiculture needs to implement a standard of good practice to report site characteristics and water levels when field investigations are used as data source. In addition, we identify research gaps especially on the planning and authorisation steps of paludiculture as well as socio-economic aspects.

Economic trade-offs in peatland rewetting: Assessing opportunity costs and policy levers for paludiculture adoption

Dr. Zhengqiu Ding, Dr. Andreas Meyer-Aurich

Peatland rewetting faces persistent adoption barriers due to competing economic returns from conventional agriculture versus paludiculture. This study evaluates the financial trade-offs between two peatland uses in Brandenburg: (1) traditional livestock system (suckler cow husbandry) and (2) paludiculture for biomass production. Using a cost-benefit framework, we quantify opportunity costs, integrate environmental externalities, and simulate farmer decision-making under varying policy and market condi-

tions. Results indicate that conventional agriculture generates higher short-term private profits compared to paludiculture, primarily due to established markets for livestock. However, accounting for environmental costs – particularly long-term carbon emissions from drained peatlands – shifts the economic advantage decisively toward paludiculture. Scenario analyses reveal that paludiculture becomes financially competitive when carbon pricing reaches moderate thresholds or biomass markets offer price premiums.

Decision simulations underscore divergent adoption pathways: livestock-focused operations require stronger compensation for lost income from fodder, while diversified farms transition more readily under policies that combine carbon payments with market guarantees. Voluntary adoption hinges on aligning financial incentives with farmers' risk tolerance, particularly where drainage-dependent livelihoods dominate. We propose integrated policy mechanisms, including carbon credits and biomass market development, to bridge private profitability and climate goals. This analysis demonstrates that peatland restoration can be economically viable if financial instruments address both opportunity costs and transitional risks, offering a pathway to reconcile agricultural productivity with ecosystem restoration in carbon-sensitive landscapes.

SESSION 3: Governance 2

A landscape approach to paludiculture upscaling: Integrating ecological and social dimensions

Dr. Agata Klimkowska, Niek Schasfort

Upscaling of paludiculture, particularly spatial planning and water management for the optimal climate and biodiversity benefits and production efficiency, presents an upcoming challenge in European landscapes. Upscaling paludiculture requires a landscape approach that moves beyond site-based peatland restoration or agricultural planning; integrating ecological, social, and economic dimensions into a cohesive framework. Managing peatlands as social-ecological systems acknowledges their role within broader landscapes shaped by hydrological processes, human activities, and abiotic conditions.

Peatland management can deliver multiple benefits, including carbon sequestration, water regulation, nutrient retention, biodiversity conservation, and raw material production. This aligns with the Four Returns framework, emphasizing natural, social, and financial returns. Rewetting drained peatlands safeguards carbon stocks (natural return) while enabling paludiculture (financial return) and fostering community engagement (social return). However, transitioning from drainage-based agriculture to paludiculture also requires addressing land tenure power dynamics and value chain disparities, ensuring equitable decision-making and knowledge integration of local communities.

We apply landscape analysis and stakeholder engagement based on Four Returns principles to assess paludiculture upscaling strategies. Case studies from across Europe illustrate this approach, drawing on insights from the Horizon projects 'WaterLANDS' and 'PaluWise'.

An analysis of stakeholder conflicts and its impact on the management and use of reed beds within Great Britain

Andy Dodson

It is estimated that the United Kingdom lost up to 50% of its remaining reed beds in the latter half of the 20th century. This had a hugely detrimental effect on the species who rely on this habitat, with some being pushed to the point of extinction. The 1996 UK Biodiversity Action Plan (UK BAP) introduced interventions to promote the recovery of numbers of the birds who utilise reed beds. The UK BAP placed significant focus on improving the bittern population. As with any prioritisation, there is an opportunity cost. Whilst some species have been secondary beneficiaries of the work carried out to support the bittern, there have been also unintended consequences, including significant limitations imposed on commercial reed cutting.

A systematic literature review was carried out to investigate post 1996 UK reed bed management. Data used to inform policy creation was found to be limited, and despite the signification limitations, is still being used today, despite evidence that indicates it could be considered overly cautious and inconsistent in approach. The literature highlighted con-

flicts surrounding the management of wetlands because of the competing demands of conservation, food security and the retention of a unique occupation.

Although commercial management of reed beds is not incompatible with conservation, providing a source of income for the conservation organisations that own most of the reed beds, there is reticence amongst those responsible for management to allow this to happen or to enforce strict limitations on cutting. A combined consequence of loss of reed beds and restrictions on commercial cutting have reduced the quantity of UK grown reed used for thatching to approximately 10% of demand, with the remainder being imported.

Solutions for minimising conflicting objectives and creating synergies in the rewetting of peatlands

Dr. Karin Ullrich, Stefanie Heinze, Aaron Scheid, Dr. Ulf Stein, Felix Dengler, Amelie Hünnebeck-Wells, Karoline Krabbe, Dr. Dietmar Mehl, Conny Mehl

The protection and rewetting of degraded peatland sites can contribute to nature, climate and water protection. However, conflicting objectives between the three protected goods can considerably complicate and delay the realisation of rewetting projects. At a status colloquium for the research and development project 'MoorNet – Expert support for the implementation of the National Peatland Protection Strategy and networking of stakeholders' , which involved over 50 participants from science, administration and practical peatland protection. Conflicting objectives between these protected goods that can arise in the practical implementation of rewetting projects, were also collected. In a next step, existing solutions for creating synergies, and for minimising these conflicting objectives, were identified. In addition, requirements for further practical solutions and additional measures were gathered. These findings were then examined in a further research and development project 'Guidelines for minimising conflicts of objectives between nature conservation and climate protection in peatland protection' to develop further solutions. In a next step, these solutions will be systematically prepared as guidelines for peatland protection. This pre-

sentation will provide an overview of the solutions and guidelines already available at the time of the conference.

Rewetting ‘quick and easy’ – is it possible?

Katharina Laage, Dr. Tim Hoffmann, Lara Massa

The ‘NABU Klima+’ funding programme for the rewetting of agriculturally used peatlands in Germany is designed as a low-threshold entry programme for land users willing to contribute to climate change mitigation. It includes site assessment, determination of the greenhouse gas reduction potential and expert support during the approval process under water law in addition to a financial compensation per reduced tonne of CO_2 equivalents. The main aim is to implement wet peatland utilisation as quickly and simply as possible on a large scale by providing a temporary additional source of income. ‘Klima+’ is financed by NABU corporate sponsorships as part of the NABU Climate Fund.

Since the programme was launched in 2022, interest has been very high. Over 3.400 hectares of peatland have already been assessed and a third has been rewetted as part of the programme. Their main form of utilisation is now wet meadow paludiculture. After three years it is time to take stock of this novel approach: we analyse the challenges and success factors as well as the programmes contribution to achieving our climate targets. In addition, we are looking into the cost-effectiveness compared to traditional peatland restoration projects.

Our experiences show that it is possible to make water level increase an attractive choice for land users, but it also highlights the need for a clear political framework and financial reward strategy facilitating the needed land use revolution.

Landscape-ecological approach to avoid conflicts and maximize synergies between paludiculture, biodiversity and conventional agriculture – a few case studies from Poland

Prof. Dr. Wiktor Kotowski

The natural landscape is a functional system in which individual elements – ecosystems – have functions and places assigned through biological and geological evolution. Water is the most important connector of this system. The distribution of individual ecosystems in catchments both depends on and shapes the flow of water through the landscape controlling water resources and wetland ecosystem development. Humans have modified landscapes, disturbing these functional connections between ecosystems. Wetland functions have been turned up-side down, shifting mires from nutrient- and carbon sinks into sources and changing rivers from water reservoirs into pure drains. Moreover, peat subsidence imposed by drainage has altered the geomorphology that was built over thousands of years of landscape development. Protected mire habitats are mere remnants of former large peatland massives, bordered by extensive agricultural landscapes on reclaimed peatlands. While the concept of paludiculture seeks to reverse this loss of ecosystem functions, we are regularly confronted with potential conflicts. Rewetted landscapes are perceived as too wet for the adjacent conventional agriculture and too nutrient-rich for neighbouring nature reserves. In my presentation, I will argue that, while these fears are sometimes justified, conflicts can often be avoided and synergies achieved by wise planning and zoning based on ecohydrological landscape analysis. Understanding the development and degradation of mire landscapes is a good basis for planning their regeneration. Paludiculture can actually form a buffer between peatland nature reserves and conventional agriculture, and between conventional agriculture and water bodies, helping to stabilise water tables and avoid eutrophication. Moreover, different forms of paludiculture and different paludi-species fit into different parts of the to-be-restored wetland landscapes, forming complementary pieces in the ecohydrological puzzle. This vision will be illustrated with several examples of mire landscapes in Poland, most of which I studied together with students of my mire course at the University of Warsaw.

SESSION 3: Biomass 2

Biomass quality for thatching of *Phragmites australis* on commercially cut reed sites in north east Germany

Josephine Neubert, Nora Köhn, Meline Brendel, Luna Münster, Dennis Quadt, Dr. Sabine Wichmann, Prof. Dr. Jürgen Kreyling

Harvesting *Phragmites australis* for thatching is a traditional form of paludiculture. Along the shore of the Baltic Sea, several hundred hectares of naturally established reed stands are commercially cut. We examined the performance of *Phragmites australis* biomass quality for roof thatching at five annually cut reed stands along the shore of the Baltic Sea over two years.

We assessed the traditional roofing material along a water level gradient using key parameters. We set up four plots of 1 m × 1 m each, aligned along a water level gradient, at five sites in Mecklenburg-Vorpommern (20 plots in total): on the island of Rügen (2 sites), the island of Usedom (2 sites) and close to the city of Anklam (1 site). In Mid-December 2023 & 2024, all plots were harvested. The samples were dried and cleaned mirroring the steps taken in commercial thatching craft. Afterwards, we assessed the number, length, diameter, and wall area of the culms, as well as the percentage of panicles, the specific weight, the water absorption and release properties, the breaking and the bending strength and the biomass yield. Using hierarchical generalised additive models (GAM), response parameters were analysed against the mean annual water level as well as the number of days with an average water level above ground. Data from the harvest of 2023 suggest that the period of water level was above ground had a significant positive effect on both culm number and strength. However, this needs to be confirmed with data of the harvesting season 2024, which is currently being analysed. The comparison will be presented at the conference and will give valuable insights on options how to forecast the harvested biomass quality for thatching under different hydrological factors.

Testing effects of cattail in peat-free substrates on crop productivity and soil characteristics shows potential for upscaling

Mirjam Schibler, Dr. Gert-Jan van Duinen

Peat is commonly used as a substrate in agriculture due to its ideal characteristics as a growing medium. However, it is important to find alternative growing media since the extraction of peat for substrate production is a significant driver for the degradation of peatlands. Cattail (*Typha spp.*) shows promising properties as an alternative raw material for growing media and can be cultivated at high water levels on rewetted peatlands (paludiculture). The Interreg VI project 'Paludi & Markt' focusses on testing peat-free potting soil and soil improvers made from cattail on their effects on crop productivity and soil characteristics, as well as on upscaling the cattail production and market integration.

In a greenhouse experiment, *Lactuca sativa* was cultivated on various peat-free potting soils, including fermented cattail, and on a control substrate containing peat. The germination rate of the seeds and the dry weight of the plants were determined after four weeks of growth. More than 90% of the seeds germinated on the substrate with fermented cattail and there were no significant differences in dry weight to the substrate with peat. One difference was a higher variation in dry weight of the plants growing on fermented cattail.

In an outdoor experiment, several peat-free soil improvers, including fermented cattail, and a control made from peat were added to the soil and a seed mixture with grass and herb species was sowed. The soil improvers are being tested for their effects on soil characteristics and biodiversity, including fungi, bacteria, invertebrates, water-holding capacity, soil organic matter content, as well as above-ground plant biomass over a period of two years. This experiment is still running, but the results already from the first measurements after one year show promising results.

Innovative Construction Products from Cattail: Sustainable Insulation Materials in Real-World Applications

Erik Baumann, Carolin Bruns, Thomaz da Silvia Lopes Vieira, Prof. Dipl.-Ing. Jens-Uwe Schulz, Prof. Dr.-Ing. Heinrich Wigger

The protection of peatlands is gaining increasing attention in the Netherlands and Germany. When peatlands dry out, peat oxidation occurs, leading to land subsidence and high CO_2 emissions. Both countries have set goals to reduce CO_2 emissions, as these subsidence effects pose significant challenges for infrastructure, water management, and safety. Paludiculture, the cultivation of plants in permanently wet areas, prevents peat oxidation while promoting biodiversity and providing new bio-based resources. Experimental studies have demonstrated the potential of wetland plants for building material production.

The 'Paludi & Bau' project contributes to the objectives of the 'INTERREG DE-NL VIa' program by advancing existing knowledge on bio-based building materials derived from paludiculture. The goal is to develop innovative and economically viable product chains to integrate sustainable materials into the construction industry.

The project focuses on material testing and determining product characteristics to assess the suitability of fiber-based materials for different construction applications. Using Life Cycle Assessment (LCA) and variant analysis with BIM models, the environmental impact of these materials is evaluated in the building context. Environmental Product Declarations (EPDs) from databases such as Ökobaudat and the ECO Platform are integrated into digital design processes to enhance sustainability assessments.

By combining BIM-supported LCA methods with experimental material testing, this research aims to establish a scientifically validated assessment framework for sustainable construction materials. This approach enables data-driven decision-making in the early design phase and supports the transition to a resource-efficient and circular construction industry.

Environmental protection and simple, cost-effective construction with building materials made of the paludiculture *typha angustifolia*

Prof. Dr.-Ing. Martin Krus

According to the measures catalogue of the Federal Republic of Germany for peat sites, the release of CO_2 should be stopped or significantly reduced through rewetting. This will only be realistically achievable if owners of these areas are given the opportunity for further economically viable use. This requires the cultivation of a raw material from which high-quality products can be produced, allowing farmers to receive profitable returns.

With the development and use of Typha Boards as building materials, significant amounts of carbon will be sequestered long-term, in addition to the emission reductions associated with cultivation. The combination of load-bearing capacity, insulation and fire-protection properties especially distinguishes these building materials. Despite the outstanding properties, Typha Boards are not yet on the market. The reason for this is the ´chicken-and-egg problem´: that a building material producer will only commit to production once the raw material is secured. However, the farmer needs a long-term purchase guarantee before transitioning to the new cultivation method of paludiculture. To resolve this dilemma, larger *Typha* cultivation areas are to be established within a project funded by the FNR (RoNNi), which was launched at the end of 2023. In combination with the development of a continuously operating Typha board production plant, this will demonstrate the complete cycle from cultivation to material production and its economic viability. The production plant that is currently under construction, will be designed for a small annual output, as it is much more ecologically sensible to place several small facilities close to the cultivation areas than to transport the very lightweight raw material over long distances. Furthermore, such a facility is already profitable with a cultivation area of 15 to 20 hectares. With an investment of 400,000 to 500,000 euros, it is also conceivable that several farmers with an own production of Typha boards make significant progress in value creation.

Application of paludi-biomass in regenerative building materials for Multi-Story Housing

Nele Ziegler, Prof. Niklas Fanelsa

In view of the global challenges of climate change and resource scarcity, the development of bioregional and renewable building materials is becoming increasingly significant. The construction sector remains one of the most emission-intensive industries worldwide, while drained peatlands in Germany contribute significantly to the national greenhouse gas emissions with a share of approximately 7%. Building elements made from paludicultures, which are obtained from renewable raw materials, offer a promising approach to combine ecological and economic advantages.

This study examines the potential of paludi-biomass as a regenerative resource for building materials in multi-story housing. The first part of research analyses around 30 potential paludi-based building materials based on their technical properties, usability and availability. The second part evaluates the technical feasibility of five selected building elements through a prototypical multi-story building in Germany.

Paludi-based building materials not only contribute to carbon sequestration and the restoration of sensitive ecosystems, but also replace resource-intensive conventional materials, thereby supporting the regenerative transformation of the construction industry.

Although research on paludi-based building materials has expanded, several barriers hinder their large-scale implementation. These challenges are primarily related to the complexity of rewetting farmlands, limited market demand, legal and technical obstacles, and a lack of knowledge among construction companies.

A key step towards unlocking the potential of paludi-based building materials is the development of prototypical architecture applications. Pilot projects within the framework of ‘Gebäudetyp E’ can demonstrate both the technical and aesthetic properties of the materials and test their practical implementation in real applications. This study employs a demonstrative case study to investigate how much conventional building material in multi-story buildings can be replaced with available paludi-based materials. The insights gained will serve as a foundation for future research and help to establish new approaches in large-scale construction projects, supporting the structural transformation of the construction and agricultural sector.

From rewetted peatlands to houses: Value chain analysis of building materials made of paludiculture

Dr. Oliver Maaß, Dr. Jovanka Saltzmann

Using paludiculture plants from rewetted peatlands as input for producing building materials is frequently proposed as a strategy that can contribute to climate protection and to fostering regional value creation. However, little is known about the characteristics of the value chains of paludiculture building materials. In particular, there is a dearth of knowledge about the requirements and the actors' motivations to engage in the value chain. In addition, only few studies have scrutinized the costs and benefits, the potential risks, and the drivers and barriers for using paludiculture plants along the value chain.

The present research seeks to contribute filling the gap by exploring the characteristics at each step of the value chain (i.e., cultivation, production, trade, use, reuse, disposal) using qualitative research methods. A total of 21 face-to-face interviews, three online interviews and one telephone interview were conducted with 24 different actors in Germany between 2023 and 2025. The interviewees were experts, who were selected according to their expertise in rewetting peatlands, cultivating paludiculture plants, and producing and marketing paludiculture building materials. Some of the interviewees had experience in using and disposing of paludiculture building materials. The interviews were guided by semi-structured guidelines and lasted between 30 and 158 minutes. The information obtained from the interviews was analysed by using qualitative content analysis with the MAXQDA software. The results of the ongoing analysis provide insights into (1) the requirements and actors' motivations for producing and marketing paludiculture building materials, (2) the expected costs and benefits, (3) the potential risks, and (4) the drivers and barriers for using paludiculture plants at each step of the value chain. The findings could be of use for practitioners involved in the value chain and for stakeholders concerned with the rewetting of drained peatlands, the cultivation of paludiculture plants, and the commercialization of paludiculture-based building materials.

SESSION 3: PV

Solar power production on rewetted cutaways – known benefits, unknown practical experience

Allonen Oona, Lauri Ikkala, Liisa Maanavilja

Due to an abrupt decline in peat extraction driven by EU and national policies, peat cutaways with thick residual peat layers are currently being repurposed. Rewetting these cutaways to preserve the carbon in peat soil would support greenhouse gas neutrality goals. Meanwhile, these open areas, with their even terrain and existing road networks, are attracting interest from photovoltaic planners. Could renewable electricity production be combined with peatland rewetting to reduce its land use emissions? We conducted a semi-structured interview with companies constructing solar projects on peatlands to identify the limitations and bottlenecks for high-water-level solar power production. There were no prior experiences in combining solar power production and rewetting in Finland, but we found no compelling obstacles to it. Electrical safety in wet conditions and accessibility for the fire department should be considered in planning. The weak bearing capacity of peat soil poses a challenge for constructing foundations and for operating machinery.

To better understand the prerequisites for combining solar power and rewetting peatlands, we are conducting a pilot study that examines peat layer thickness, mineral subsoil and water regime based on a digital terrain model. Our hypothesis is that different parts of each former peat extraction site have different characteristics. To facilitate the successful integration of solar power and rewetting, it is essential to carefully select the most promising areas. These should have thick peat layers to maximize climate benefits and sufficient water supply from the watershed basin to ensure rewetting success, while also meeting the technical requirements of solar projects for dry ground conditions. We also estimate the suitable area for solar power and rewetting using more general data over a larger region and the GHG emissions from this land use.

This research is part of the REPower-CEST ‘Clean Energy System Transition’ project, which received funding by the European Union (number 151, P5C1I2, NextGenerationEU).

Vegetation response to solar panels on rewetted peatland

Hanna Rae Martens, Prof. Dr. Jürgen Kreyling, Dr. Franziska Tanneberger

To meet climate targets, drained peatlands will need to be rewetted, thereby reducing greenhouse gas emissions from agricultural landscapes. However, possibilities for continued productive use of these landscapes are also necessary. A novel concept that has emerged in recent years is peatland photovoltaics (PV) in combination with peatland rewetting. Until now, there has been almost no practical experience with peatland PV on rewetted peat soils; our project explores the biodiversity of a 'wet' peatland PV site.

For a comprehensive understanding of the biological implications of rewetting and solar power generation, the biodiversity of a solar park on rewetted peatland is currently being studied. This presentation will provide results on plant biodiversity at a 30-hectare rewetted peatland PV site in Northern Germany. To understand the impact of this land use compared to the previous land use on vegetation composition, a vegetation survey was conducted including plots on drained peatland without solar panels, rewetted peatland without solar panels, and rewetted peatland with solar panels. Additionally, to understand the effects of the panels specifically, plant diversity was assessed directly under the panels, partially under panels, and within the rows between panels. Initial results indicate that the plant community within the rewetted solar park has more species adapted to wet conditions, while the species within the drained peatland site are largely typical agricultural species.

Given the need to rewet peatlands and the rapid growth of the solar power industry, it is necessary to understand the biological implications of such a land use, as well as any possibilities for synergies between climate protection and renewable energy production.

Assessing the levelized cost of electricity for Peatland-PV in Germany based on spatial indicators

Florian Heinrich, Enna Wetjen, Carl Pump, Jonas Böhm

Peatland-PV has the potential for CO_2 reduction through peatland rewetting and renewable energy expansion. However, there are only few projects and limited information on the economic viability of such systems.

This study first identifies key factors influencing the Levelized Cost of Electricity (LCOE) for Peatland-PV systems, including peat depth, installation costs, solar irradiation, and distance to the grid connection point. The findings suggest that under favourable conditions, Peatland-PV can be economically competitive with other dual use land systems like Agri-PV and Floating-PV. However, under unfavourable conditions, it is expected that Peatland-PV struggles with economic viability, which highlights the importance of site-specific factors for its feasibility assessment.

In a second step, the spatial distribution of the LCOE is analysed based on the regional distribution of peat depth, solar irradiation and distance to grid connection points. To achieve this, data on peatland locations from Wittnebel et al. (2023) is combined with the solar irradiation data from Global Solar Atlas. The resulting LCOE distributions are evaluated for two German Federal States, Bavaria (South) and Mecklenburg–Western Pomerania (North).

The findings indicate that Peatland-PV in Bavaria achieves lower LCOE due to higher solar irradiation. This occurs despite the greater average peat depths in Bavaria, which contribute to increased material and installation costs. In contrast, LCOE in Mecklenburg-Western Pomerania are higher on average.

The results help refine LCOE estimates for Peatland-PV and highlight that economic feasibility is highest in southern Germany, particularly for larger installations. Peat depth influences costs but has a smaller impact compared to solar irradiation in these two case-study regions.

Analysis of Peatland-Photovoltaic: A system transition and photovoltaic project planner perspective

Carl Pump, Monika Hohlbein, Carola Kiene, Prof. Dr. Volker Beckmann

Wet peatlands are essential long-term carbon reservoirs, but in Germany, rewetting progresses at only around 2,000 hectares per year – far below the 50,000 hectares needed for climate neutrality. A lack of value chains and high operating costs provide little economic incentive. Meanwhile, PV expansion is accelerating, with 50% of new capacity being developed in open spaces. Due to high lease prices, PV has become economically attractive for landowners. 'Peatland PV', financially supported by EEG subsidies, could thus incentivise rewetting.

Sustainable Transition Theory helps to analyse the structural changes needed for Peatland PV adoption by examining political conditions, market mechanisms, and technological developments. Socio-technical system analysis offers insights into infrastructures, actor networks, and institutional challenges that influence its implementation. Additionally, governance approaches identify mechanisms to resolve land use conflicts and support the efficient integration of PV in peatland areas.

Based on these approaches and using qualitative and quantitative methods, we examine the economic, political, and social conditions of Peatland PV. Structured interviews and surveys with experienced project developers collect data on land use, investment barriers, costs, revenues, and social acceptance.

The analysis highlights key challenges from the perspective of photovoltaic planners. It advances scientific literature by integrating the latest practical experiences into a sound theoretical framework. Findings on investment willingness, as well as regulatory and social barriers, provide valuable insights for targeted policy development.

At the same time, the study contributes to a better understanding of how financial incentives, governance mechanisms, and market structures shape the viability of Peatland PV. Identifying barriers and enablers can help policymakers and investors develop strategies to align PV expansion with climate goals. By addressing economic and regulatory challenges, Peatland PV could become a key instrument in combining renewable energy production with effective peatland conservation.

SESSION 4: Peatlands & People 2

From drainage to paludiculture: Stakeholder perspectives on paludiculture adoption in the UK

Dr. Mehri Khosravi

Shifting from drainage-based agriculture to paludiculture is one of the biggest carbon farming game-changers to achieve net zero. Paludiculture will reduce GHG emissions of agricultural peat soils substantially compared to the current drainage based land use by reducing peat oxidation. Lowland peat soils were drained for arable cultivation, which began as early as the 17th century. In the course of subsequent centuries this has led to several metres of peat loss and continued high CO_2 emissions. This long historical legacy of peatland drainage has shaped farmers' perceptions and attitudes towards peatlands as well as influencing policy frameworks. In this study, we explored 35 paludiculture stakeholders including farmers, policymakers, NGOs and academics through semi-structured interviews to understand barriers to the adoption of paludiculture in the UK contexts. Findings indicate that achieving large-scale implementation necessitates substantial evidence to shifts across various aspects such as policy framework, subsidies schemes, paludiculture market as well as key actors' perceptions on wet farming through education and peer to peer communication.

Baltic Bioregional – research through studio and 1:1 experimentation with renewable resources from rewetted peatlands

Prof. Susanne Brorson

In adopting a 'research through studio' methodology, two architectural design studios are utilised to explore the concept of 'regenerative architecture' through the use of bio-based building materials harvested from rewetted peatlands. Both design studios are taught as part of the Bachelor programme in architectural design in the summer semester 2025 with 24 students each; one studio being based at the Academy of Fine Arts, Vienna, and the other at Riseba University Riga, Latvia. Both studios are given

the task to design a 'Floating Centre for Regenerative Architecture', using the case of Cenas bog, a former peat extraction site south west of the city of Riga. An initial research phase is focussed on characteristics of the bioregion of the Baltic states; landscapes, natural resources, traditional building, cultural heritage but also climate change scenarios and the potential use of utilising wetland plants in future regenerative architecture. Design experimentation as part of the design studio is seeking to develop architecture as a process, simultaneously supporting the process of the 'healing of landscapes'. A key element of the design studio is 'travelling through Baltic landscapes', establishing knowledge through observations, and the mapping and drawing of local wetland plants, their material characteristics and potential for architectural design. The design studio from Vienna travelled to the Island of Rügen in May 2025, where a 1:1 design build workshop took place around a 'floating pavilion'. Knowing through making – the process of working with their own hands with several bio-based building materials will contribute to the development of design ideas for the studio assignment. 'Baltic travels' will subsequently resume to Latvia, delivering the 'floating pavilion' to the students in Riga, where both studios meet. A second joint workshop will reflect on the topic and studio outcome, which will deliver several design proposals for the 'Floating Centre for Regenerative Architecture'.

Transition processes with private land owners and farmers

Andreas Stauss

The BMUKN funded peatland pilot 'MoorWERT' in the Bavarian Allgäu region pursues the strategy of testing practical measures together with landowners and farmers and gaining insights for the implementation of peatland protection strategies. Three key observations can be made:

First, a change in awareness among stakeholders is evident since 2018–a more differentiated attitude is now emerging. Structured observation forms were drawn up to document these discussions and subsequently evaluated. There are numerous challenges from an agricultural perspective – in particular, the conversion of existing farm structures, for example in dairy farming, was identified in the evaluations as one of the main hurdles.

Second, since 2023, MoorWERT has made it possible for the first time to provide compensation for disadvantages to both landowners and land managers. However, the evaluations of the farm meetings indicate that, despite this new support, significant uncertainties remain. Concerns were particularly raised about the long-term economic viability of the measures and the reliability of future funding programs. In addition to unclear legal conditions and technical challenges, scepticism continues to prevail among most stakeholders–both regarding funding conditions and the long-term profitability of wet peatland management.

Third, fragmented land ownership in certain regions presents a considerable obstacle. In many hydrological complexes, individual landowners oppose rewetting measures. However, the farm meetings showed that farmers are significantly more open to participation when they are offered fitting exchange land to keep up their structure. This confirms the hypothesis that land exchange programmes could be a key instrument.

These insights provide recommendations for large-scale rewetting concepts, fitting to hydrological units. The experiences from MoorWERT indicate that successful implementation requires expert planning and support that engages a wide range of stakeholders. Additionally, flexible funding instruments, the rapid development of value chains, and the strategic acquisition of exchange land with subsequent land swaps are essential.

The regionality of meaning structures concerning peatland rewetting in Germany – A Structural Topic Modelling (STM) approach to understanding the discourse on a large-scale climate protection measure

Charlotte Schröder, Jens Jetzkowitz

This study analyses the recent German discourse on peatland rewetting, drawing on a corpus of 1,957 newspaper articles published between 2019 and July 2023, primarily in peatland-rich regions of Germany. Our investigation focuses on the influence of regionality on public sensemaking regarding peatland rewetting. Due to the large scope of the analysis, we employed Structural Topic Modelling (STM) as a technique to identify dis-

cursive features and meaning structures. Leveraging STM's capability to compare document variables, we divided the corpus into four discourse strands: national, north east, north west, and south. The results reveal a hegemonic discourse pattern framing peatland rewetting as a climate protection strategy. Furthermore, we highlight key findings on the distribution of topics across the discourse strands. Finally, we offer an interpretation of how the unfolded meaning-structures shape peatland-related activities and provide insights into why large-scale rewetting efforts remain absent.

Aligning agri-environmental policy with farmer values: A social-landscape approach to peatland restoration in north west Ireland

Laura Kearney, Craig Bullock, Shane McGuinness, Guaduneth Chico, Gary Goggins

'WaterLANDS' is a Horizon 2020 EU funded project with six restoration 'Action Sites' across Europe. The Irish Action Site, led by LIFE IP Wild Atlantic Nature, is located at the Cuilcagh-Anierin Uplands SAC in the north west of Ireland, where peatland restoration actions began summer 2024. Over 150 farmers have joined the WaterLANDS programme and 83 are included within the restoration plans for 600 hectares of blanket bog.

Peatland restoration is playing a growing role in EU environmental policy, yet its success relies heavily on the participation and support of farmers who manage these landscapes, which often feature low-intensity High Nature Value (HNV) farming systems. In Ireland, this is often held in commonage. As part of our engagement strategy, we conducted 13 in-depth interviews with local farmers with both 'walking' and 'kitchen' interviews focused on attitudes to results-based payment schemes (RBAPS), place attachment and farming with peatlands. 14 further interviews with expert stakeholders focused on agricultural and environmental policy. The study uncovered key themes shaping land-use and the underlying values, perceptions, behaviours, and opinions that drive decisions alongside the challenges faced by rural communities. The research revealed that low-input, extensive farming practices are facing increasing pressure from a range of issues, including policy shifts, economic and market forces, climate change, and depopulation. Conversely, sustainable 'new' forms of

farming may present opportunities for conservation-focused farming approaches that align with ecological restoration while maintaining farming livelihoods. Farmers need long-term economic planning for their farming business and successors, without losing the traditional productive landscape and connection to place. Restoration also requires time, with long time lags between restoration actions and ecological changes on the land. EIP schemes often fail to align with farmer´s needs for long-term planning or the ongoing management and monitoring requirements of ecological restoration.

Mostly all the farmers in the case study are also participating in a 5-year results-based payment scheme (RBAPS) through the CAP Agri-Climate Rural Environment Scheme (ACRES) with ACRES CP, a locally adapted scheme. Our findings show that restoration efforts gain traction when they integrate ecological goals with rural development and farming values. The research emphasises participatory actions, aligning values, knowledge transfer, supporting rural development and improving the communication of the co-benefits of ecosystem services. We recommend participatory, landscape-scale approaches that view farmers not only as land users but as central partners in shaping and sustaining socio-ecological resilience in upland Ireland.

PaluWise Paludiculture demonstrations providing multi-actor approaches and recommendations towards large-scale deployment in the EU. Challenges for the development of paludiculture in Lithuania: Baisogala case

Nerijus Zableckis, Dr. Jurate Sendzikaite, Dr. Leonas Jarasius

Challenges for the development of paludiculture in Lithuania: Baisogala case. The Foundation of Peatland Conservation and Restoration implemented rewetting of intensively used perennial grassland on drained shallow fen peat soils (5 ha) near Baisogala town, Central Lithuania, as part of the Carbon Offsetting Project.

The area, drained through a dense drainage system (open and closed), was used for decades as arable field or cultural grasslands for fodder pro-

duction. In 2021, the peatland's drainage system was reconstructed, removing or bringing to the surface drainage collectors and installing a sluice regulator with a monk-type sluice to regulate water levels. In 2022, *Phalaris arundinacea* was sown in the peatland to create wet meadow habitats, used for cattle fodder and bedding.

Rewetting required the reconstruction of melioration infrastructure. The permission for rewetting was obtained from the local municipality of Radviliskis, however, after the reconstruction the municipality could not accept the works since the project was implemented by another body than the municipality. The area remains as agricultural land with regulated water level and continues to be used as grassland supported by direct payments. Implementing paludiculture in Baisogala peatland is projected to reduce annual GHG emissions by 85 t CO_2eq in the 5-ha rewetted area.

The project faced many challenges, among them: a) rather complicated and expensive planning and permission obtainment procedures; b) lack of specialised machinery, able to drive on wet conditions. As a result, water levels must be lowered in June for biomass harvesting, later on the basin hardly refills due to lack of precipitation; c) need to search for much more valued products than biomass. Although it sustains the maintenance, but alone it is not competitive to the biomass harvested in neighbouring meadows.

SESSION 4: Biomass 3

Concentrations and yields of strategic elements in paludi-biomass from fen peatlands

Prof. Dr. Annette Prochnow, Dr. Monika Heiermann, Dr. Carsten Lühr, Dr. Björn Meermann, Dr. Ralf Pecenka, Andreas Schulz, Nicole Langhammer, Dr. Susanne Theuerl, Dr. Karina Michalska

Strategic elements are essential raw materials for high-technology applications in the fields of transport, information, communication, energy, chemistry and medicine. They include, among others, germanium (Ge), silicon (Si) and some of the rare earth elements (REEs). The global demand for strategic elements increases rapidly. Due to market disruptions and

detrimental environmental impacts of mining the search for alternative resources of strategic elements has become a critical issue.

Rewetting of peatlands requires the establishment of new biomass utilisation pathways. Plants take up strategic elements from the soil. Like other plants, paludi-biomass may be considered as a potential source for strategic elements. To provide a first insight into concentrations of strategic elements in paludi-biomass, biomass samples were collected from typical fenland vegetation in north east Germany and analysed for Ge, Si and REEs. Remarkable differences were found between vegetation types and elements. While Si contents were high or medium, Ge concentrations appeared to be generally low, and REEs contents were negligible or below quanitifiaction levels. Multiplying element concentrations with biomass yields of the respective vegetation types and element market prices showed, that in some cases relevant element yields and revenues per hectare might be achieved.

To assess the technical and economic feasibility of using paludi-biomass for strategic element supply, further research is needed. This includes more detailed analyses of element concentrations in typical peatland vegetation, the development of processes for element extraction from the plant matrix and cost estimation.

Biomass from peatlands as filler material or fibre enforcement for (bio-)plastics – Paludi-Produkt

Maximilian Wenzel

Drawing pictures of future peatland utilisation strategies is complex and has to be puzzled together from many areas of applied research. What role can natural fibres from paludiculture play within the area of plastics? Is it beneficial for the climate to substitute plastics with peatland-biomass? Using peatland biomass for all sorts of products we need to identify which ones cause the least harm to the environment. The combined research and implementation project ‘Paludi-Produkt’ is a collaboration of research institutes and business partners who investigated into practical applications for the use of natural fibre enforced bioplastics from peatland biomass. Four common peatland species were investigated upon their suitability to be formed into a plastic compound. Several tests were run to

evaluate the suitability of fibre from the different species in combination with different polymers.

Here we present our findings about the interactions of the fibre with the polymers. We show the development of a biodegradable plastic film with paludiculture filler material capable of replacing agricultural foil for combatting weeds. Pieces of the products from the project can be investigated in the exhibition. A basic version of an LCA on the plastic film will be presented alongside with some underlying economics.

Utilisation of paludiculture biomass for injection moulding – Combining performance, sustainability, and market competitiveness?

Jonas-Rumi Baumann, Andreas Hellmann, Stina Behne, Dr. Jan Köbbing, Dr. Doreen Koltermann, Prof. Dr. Jörg Müssig

Fibre-reinforced composites can play a vital role in promoting a more sustainable future. Following Czapla et al. (2021), especially biobased composites are of importance to meet the goal of climate neutrality in 2050 defined by the European Green Deal Implementation. Biobased composites consist, e.g., of natural fibres and, optimally, a bio-based polymer. Established fibre crops such as hemp and flax have been extensively studied and processed with bio-based polymers to produce natural fibre-reinforced composites. A possible challenge in utilising plant biomass for technical applications is the competition for land resources. With limited suitable soil availability, conflicts may emerge with other land uses, such as food crop production. Therefore, it is essential to study the cultivation of plant raw materials on soils unsuitable for food production, such as marginal lands and rewetted peatlands – a practice known as paludiculture. While the environmental benefits of paludiculture are well-documented, viable utilisation pathways and value-added chains for the harvested biomass remain limited.

In the present study, biomass from different paludiculture plants was utilised to produce short fibre-reinforced composites for injection moulding. Injection moulding is a key manufacturing technique for these materials, allowing for high-volume production with short processing times. Among the tested materials, *Typha angustifolia* and *latifolia* and *Phrag-*

mites australis demonstrated promising mechanical properties. The biochemical composition of the biomass was investigated; a strong correlation between tensile strength and cellulose content could be shown. The cost-saving potential of the materials, in combination with their respective mechanical properties, was compared by applying a material index following the Ashby materials selection methodology (Ashby, 2016).

Innovative valorisation of aquatic plants from the Danube region in a decentralised biorefinery

Dr. Armin Winter, Nora Fasching, Dr. Marco Beaumont, Thomas Rosenau, Mihaela Chiorean, Sven Zangeri

Launched in 2025, InnoWAP is an applied research initiative developed in close cooperation with industrial partners from the pulp & paper, packaging, and textile sectors. Its focus lies on the material valorisation of aquatic and wetland plants from the Danube region as renewable resources, aiming to support a regional circular bioeconomy.

A central focus of InnoWAP lies on aquatic and wetland plant species, particularly submerged macrophytes such as *Myriophyllum spicatum* and emergent reed species like *Phragmites australis*. In Vienna's Old Danube, 3,000–4,000 tons are harvested annually to maintain water quality and enable recreational use. In parallel, Lake Neusiedl contains approximately 7,500 hectares (75 km^2) of harvestable reed beds. However, only about 8% of this potential is currently harvested.

These two contrasting plant types represent the extremes of aquatic biomass systemsand serve as reference points for defining the application space: they differ markedly in chemical composition and fibre morphology, which significantly impacts their processability and material performance. In preliminary trials, the pulping behaviour of submerged species was systematically analysed using advanced characterisation techniques, including methanolysis, elemental analysis, FTIR, Py-GC/MS, and fibre morphology assessments.

Paper-like materials derived from these pulps have demonstrated promising mechanical properties, with tensile strengths reaching up to 95 MPa when highly fibrillated. In the context of regenerated cellulose fibres, pulped and bleached aquatic biomass has undergone dissolution trials using ionic liquids. A notable outcome includes a dissolution rate of up to

89% for bleached *Myriophyllum spicatum* pulp in 1-ethyl-3-methylimidazolium acetate (EMIm-Oac).

Building on these findings, the project explores four primary application pathways for aquatic biomass: (1) regenerated cellulosic fibres, (2) paper-based materials, (3) moulded fibre products, and (4) novel forming technologies, each selected to align with the distinct material properties and processing characteristics of the investigated plant types.

From peatlands to pharmacies by understanding the phytochemical variability of *Drosera rotundifolia*

Hildegard Kieninger, Sandy Gerschler, Malte Zoerner, Dr. Kristina Kuprina, Dr. Manuela Bog, Prof. Dr. Martin Schnittler, Prof. Dr. Volker Beckmann, Prof. Dr. Sebastian Guenther, Dr. Christian Schulze

Round-leaved Sundew (*D. rotundifolia L., Droseraceae*), a small, perennial carnivorous plant, has the potential to address two important challenges: providing an economic use for rewetted peatlands in paludiculture and offering a potential solution against multidrug-resistant bacteria through its biofilm inhibiting properties. The responsible bioactive compounds, flavonoids and naphthoquinones, have already been identified. The next step is to ensure a consistently high quality of plant raw material, e.g. by identifying plants with an optimal chemotype for cultivation.

First, the optimal concentration of active compounds necessary for the biofilm inhibition must be determined. Once established, the key factors influencing the composition of the active compounds, whether genetic or environmental, need to be investigated. To identify the critical parameters important for *D. rotundifolia* cultivation as a medicinal plant, sundew samples were collected from 67 populations across 12 countries. Extracts from selected plants were tested for their ability to inhibit biofilm formation in multidrug-resistant *Escherichia coli* (MRGN) using a macrocolony assay. High-performance liquid chromatography with diode-array detection (HPLC-DAD) was employed to quantify the levels of active compounds.

Preliminary results indicate that active compound concentrations vary both within and between populations. However, the greater variability observed between populations than within suggests a geographic influence on phytochemical composition. This variability may be attributed to shared

genetic traits within populations or to site-specific environmental conditions favouring the production of particular compounds. To better understand these influences, genetic analyses are planned, ultimately guiding to the identification of optimal plant genotypes or cultivation conditions for the medicinal use of sundew.

Plant selection for paludiculture: Seeking the most productive genotypes with a high content of bioactive secondary metabolites and good suitability for cultivation – The 'SoMoMed' project – Sundew and cloudberry as medicinal plants in paludiculture

Malte Zoerner, Hildegard Kieninger, Dr. Kristina Kuprina, Dr. Manuela Bog, Dr. Christian Schulze, Prof. Dr. Sebatian Guenther, Prof. Dr. Volker Beckmann, Prof. Dr. Martin Schnittler

Our project aims to identify economically productive plants and promotes the adoption of paludiculture. We focus on two medicinal plant species adapted to the acidic, nutrient-poor conditions of raised bogs: Round-leaved sundew (*Drosera rotundifolia*) and cloudberry (*Rubus chamaemorus*). By characterising the genetic composition and content of bioactive compounds, we evaluate their suitability for cultivation and establish an economic foundation to grow these plants in a sustainable paludiculture.

Sundew and cloudberry plants were sampled as dry material and fresh plants for a common garden in 87 populations from ten European countries. The samples were genetically characterised using microsatellite markers and GBS analysis. High-pressure liquid chromatography with diode array detection and mass spectrometry were used to determine the compound content. A Biofilm inhibition assays with multidrug-resistant *Escherichia coli* was used to assess biological activity. We will also estimate the heritability of the active compound production by repeated measurements in the same individuals over two years. For the economic evaluation, site factors, crop characteristics and laboratory studies were compared between natural and paludiculture sites.

Cultivation provided a large gene pool of all accessions and sufficient material for sundew analysis, while cloudberry cultivation methods could

be optimised. The phenological development and morphology of *Drosera* were described. Extraction methods were optimised and adjusted for genetic and pharmacognostic analyses. Most of the samples were extracted and analysed in multiple ways. The genetic analyses showed little variation in *Drosera*, even in widely separated origins. In *Rubus*, the number of genotypes within populations varied considerably. The composition of active compounds in *Drosera* shows high variability both between and within populations. The next steps include linking and correlating the results and comparisons between samples of subsequent seasons.

SESSION 4: Biodiversity

Does faunal biodiversity benefit from rewetting and paludiculture in European peatlands? – a meta-analysis

Dr. Susanne Arbeiter, Wiltrut Koppensteiner, Alexander Drexler, Prof. Dr. Peter Michalik, Prof. Dr. Jürgen Kreyling, Dr. Franziska Tanneberger

Drained peatlands used for agriculture are hotspots for CO_2 emissions. In addition to substantial greenhouse gas emissions, degradations resulting from drainage and land use intensification have led to extensive habitat loss for peatland-specialised fauna. Today, numerous mire-specific species are among the most endangered species in Europe. Consequently, the rewetting of peatlands is a crucial component in both achieving climate protection objectives and mitigating ongoing biodiversity decline.

Current research suggests that rewetting and agricultural management in wet peatlands (paludiculture) can increase mire-specific biodiversity. To expand the existing knowledge base, we compiled data from projects and literature reporting studies on various faunal organisms in peatlands, comparing drained, rewetted and near-natural conditions, including several projects examining sites where paludiculture had been established. We present first results from a meta-analysis on the effects of rewetting on species composition and abundance of mire-specific spe-

cies of breeding birds, ground beetles, dragonflies, butterflies, spiders and amphibians in bogs and fens throughout northern Europe between Ireland and Belarus.

Is a *Sphagnum* farming site attractive for peatland dragonflies?

Dr. Jana Packmor, Daniel Brötzmann, Prof. Dr. Rainer Buchwald, Prof. Dr. Dirk Albach

The dragonfly and damselfly fauna of a *Sphagnum* farm in Northwestern Germany (Lower Saxony, Rastede; 14 ha) has been studied since 2017 to evaluate the dragonfly diversity in this secondary habitat and changes in species composition depending on the duration of cultivation. In particular, the success of peatland species is taken into account and the species composition of the cultivated areas is compared with that of near-natural, renaturalised and degraded raised bogs.

In the period from 2017 to 2022, a high level of species diversity was recorded in the study area with a total of 27 dragonfly species (33% and 39% of the species that reproduce in Germany and Lower Saxony/Bremen, respectively), some of which presented large populations. Ten of the dragonfly species are classified as typical peatland species of which eight certainly reproduce on the *Sphagnum* farm. Six of the peatland species are listed as endangered, critically endangered or threatened with extinction in the Red List of Lower Saxony/Bremen and/or Germany. Overall, the proportion of reproductive success of peatland species increased over time during the temporal development of the *Sphagnum* farm.

A comparison with selected raised bogs in north-west Lower Saxony revealed a comparable total number of peatland species to our *Sphagnum* farming site. However, some rare peatland species were not recorded at our site, while others were only found as single individuals. We conclude that the habitat structure of the *Sphagnum* farm is not suitable for these species due to lack of larger water bodies with peat moss and shallow areas. We also propose management recommendations to maintain a high dragonfly diversity and support endangered peatland species. Our investigations are continued as part of the research project ‘MOOSland’: Peat moss paludiculture as a sustainable agricultural use of raised bog soils.

Genetic characterisation of *Typha* species in Germany

Christine Weisenberger, Dr. Manuela Bog, Dr. Kristina Kuprina

Typha, commonly known as cattail, is a widespread genus of aquatic plants that plays a significant role in wetland ecosystems. In Germany, the most common species of cattail are *Typha latifolia* and *Typha angustifolia*. However, distinguishing these species based on morphology alone is often unreliable. Moreover, these two species are also shown to hybridise into *Typha* × *glauca*. In North America, for example, this hybrid dominates over parent species and threatens local wetland ecosystems. In Europe, in contrast, reports of *Typha* hybridization remain sparse and contradictory.

In our study, we analysed 48 *Typha* samples from seven populations in Germany using microsatellites and a DNA restriction-based method (PCR-RFLP) for species identification.

Our preliminary data revealed discrepancies between morphological classification and genetic analysis but found no evidence of hybrids among these samples. Only *T. latifolia* and *T. angustifolia* were detected, even when both species co-occurred at the same location. Despite the limited sample size, the absence of *T.* × *glauca* points towards a potential barrier of hybridisation in Germany.

To advance *Typha* genetic research, we are developing a cheap and easy method for the genetic characterisation of this genus. We have been implementing long-read sequencing to screen *Typha* species for genetic variation of their populations and hybridisation events. By integrating morphology, microsatellites, PCR-RFLP, and next-generation sequencing, we hope to shed light on the composition of *Typha* species and hybridisation in Germany.

Utilisation pattern of a heterogeneous wet grassland site by water buffalo

Dr. Jürgen Müller, Almut Scheler, Görres Grenzdörffer, Sebastian Forth

Water buffalo (*Bubalus bubalis*) are increasingly being discovered for landscape management in wetlands in Western and Central Europe. Their

landscape conservation performance depends heavily on their behaviour, which is still insufficiently researched. Here, we observed the behaviour of water buffalo over a complete year in a rotational grazing system on a heterogenous wet grassland site by a herd member equipped with a GPS-tracking collar. Behavioural categories were formed based on the change of position according to cattle standards. We compared frequencies of the key behaviour parameters resting and foraging in relation to soil wetness degree, season, and paddock residence time with means of frequency tabling and the Chi-squared test. The residence densities were visualised on maps of the grazing area. The results show that the wet areas of the pastures are neither avoided, as is known from more choosy cattle, nor favoured, as is often anecdotally reported. The wet areas were visited more frequently in midsummer and early autumn than in spring but were largely avoided in winter. Despite low forage values, wet areas contribute notably to water buffalo diets in certain grazing periods. We conclude that a generalisation of the behaviour of water buffalo on wet pastures cannot be made independent of site characteristics, season and management contexts.

Maintenance of fen peatlands through year round extensive grazing in the NSG Pfrunger-Burgweiler Ried

Sabine Behr

With 2.600 ha, Pfrunger-Burgweiler Ried is the second largest contiguous peatland landscape in south west Germany. Of these, about 1.500 ha have been under nature protection since 2017. As part of a large-scale nature conservation project from 2002 to 2015, large-scale year-round grazing in the peripheral area with robust cattle breeds, such as Scottish Highland cattle, was set up in the project area to care for the partially rewetted meadows. The coordination of grazing and the area management are organised by the foundation Naturschutz Pfrunger-Burgweiler Ried. The extensive year-round grazing of nearly 400 ha in Pfrunger-Burweiler Ried can be described as a successful project in terms of biodiversity. Grazing can create diverse structures in the landscape and provide new habitat for many animals. For example, there has been an increase in typical ‘grazing

birds', which are not only dependent on a rich food supply of insects. In order to keep livestock populations stable and to market the meat, various products can be sourced through the marketing initiative 'Enjoyment of the Pfrunger-Burgweiler Ried.'

Mosquito community structure and dynamic in drained and rewetted peatlands: Initial steps towards vector-resilient management

Patrick Gutjahr, Dr. Franziska Tanneberger, Dr. Mandy Schäfer

With 700 million infections and one million fatalities annually, mosquito-borne pathogens are a major global health issue. Climate change-induced alterations in spatiotemporal distribution of mosquitoes and associated pathogens are projected to intensify these issues. While peatland rewetting is an integral part of rapid, cost-effective climate change mitigation, drainage has historically been linked to the eradication of mosquito-borne pathogens in Europe. Thus, rewetting may amplify the risk of infection locally. However, our knowledge of community structure and dynamics of mosquitoes in peatlands remains limited.

To unravel potential public health risks associated with peatland rewetting, we studied the mosquito population of the Lower Peene Valley, a coastal fen complex in northeastern Germany. The area offers a mosaic of different rewetting stages ranging from drained grassland to reed paludiculture and near-natural sites with diverse helophytic vegetation. Mosquito samples were taken via CO_2-baited traps run biweekly for 24h between April and October since 2023. Specimens were identified morphologically and genetically. Landscape characteristics like vegetation or land use were assessed in a radius of 400m around each trap and compared with mosquito samples.

After analysing over 45.000 specimens from eleven species in five genera, it is evident that mosquito communities differ significantly between drained and rewetted peatlands. Species composition can mostly be explained by the availability of suitable breeding waters. Additionally, the relative abundance of dominant vector species, e.g. *Culex pipiens* s.l. or *Aedes cinereus s.l*. is linked to land use including paludiculture practices in the vicinity. Furthermore, rare species like *Culex modestus* or *Anopheles algeriensis* occur more frequently or exclusively in rewetted sites. Our

data provides a comprehensive geospatial inventory of mosquitoes in peatlands, a crucial step towards connecting the unique habitat structure of peatlands to potential vector species. The results will aid in developing vector-resilient management strategies and further acceptance of rewetting practices.

SESSION 5: Economics

Towards a roadmap of rewetting agriculturally used drained peatlands in Germany: Site-specific abatement and opportunity costs for the peatland-rich federal states

Dr. Christoph Buschmann, Dr. Johannes Wegmann, Dr. Arndt Piayda

In Germany, drained peatlands (organic soils) cause about 45% of agricultural GHG-emissions (including agriculturally used soils) and 7% of total GHG-emissions. Moderate reduction targets have been set at national and EU level (e. g. Nature Restoration Law). In the long-term, however, large-scale emission reductions from organic soils are necessary to comply with the Paris Agreement. Scaling-up of rewetting projects and drafting a roadmap how rewetting of organic soils contributes to climate mitigation goals are therefore the next steps.

Against this background, it is our aim to calculate rewetting costs based on farmers' income changes in the most peatland-rich federal states. Based on Integrated Administration and Control System data, we cluster cattle farms by farm type, their ability to adapt to rewetting and their share of organic soils on forage area. Then we mimic typical farms of the clusters with the linear programming farm-level model Farm Boss by using additional data from statistics and literature, e. g. on grassland yield and quality. Further, we simulate two versions of alternative peatland use. First, moist land use by water retention, which often comes along with extensification, but allows conventional agriculture. Second, full rewetting with high water levels. Corresponding areas are not suitable for conven-

tional agriculture, but for nature conservation or paludiculture cultivation. Results show the opportunity costs, i. e. income losses, per ha of the two versions. They indicate the financial compensations that farmers and/or land owners expect for the rewetting of their land. Further, mapping site-specific opportunity costs to site-specific organic soil emissions, results in high resolution estimates of abatement costs (€/t CO_2eq). Our contribution thus provides estimates of federal-state wide opportunity and abatement costs for peatland rewetting implemented on all affected areas. It constitutes a key component of the roadmap for the rewetting of organic soils in Germany.

The economics of rewetting patchy lowland peat – farm case studies from the UK

Prof. Karl Behrendt, Dr. Iona Huang, Dr. Julia Casperd, Dr. Anthony Millington, Dr. Jackie Symmons, Prof. Fred Worrall, Prof. Simon Jeffery, Scott Kirby

Peatland provides significant value to English food production and economy, with their drainage leading to extensive degradation and GHG emissions. Although some agri-environmental policies support wetter farming, there remains significant uncertainty as to the private and public benefit of adopting wetter farming by landholders, especially in landscapes where peatlands are patchy. Using a case study approach across six farms located within the West Midlands of England, we define the private and social benefits of landholders adopting paludiculture or rewetting for biodiversity in an attempt to minimise or reverse further peatland degradation. A stochastic bioeconomic modelling approach is applied which integrates land use alternatives, carbon modelling, biodiversity net gains and the value of externalities.

Substantial capital costs of rewetting a catchment, land use opportunity costs and their variability, and regulatory and compliance costs all affect the feasibility of rewetting. These potentially present significant barriers to the adoption of wetter farming and the rewetting lowland peatlands. Additionally, current agri-environmental policies and payments are unlikely to be conducive to the adoption of wetter farming or rewetting peatland for environmental objectives in small scale non-contiguous peatlands. This

puts at risk extensive areas of fragmented peatland and may result in continued peatland degradation, agriculture's contribution to GHG emissions and catchments not benefiting from the potential flood mitigation and biodiversity gain opportunities rewetting peatland provides.

Water and crop management on peatlands at farm level: the role of carbon incentives

Dr. Janne Rämö, Domna Tzerni, Prof. Dr. Heikki Lehtonen

We examine the potential of drainage optimisation and rewetting as strategies to reduce emissions from peatlands while maintaining agricultural productivity. By using economic modelling and dynamic optimisation, we quantitatively analyse the implications for production, land use, and farm-level economics. This study analyses a broad set of water management options on peatlands, e.g. open ditches, dams, subsurface drainage, adjustable drainage with and without irrigation, and expands the set of crops compared to earlier studies conducted in Finland.

The farm-level dynamic optimisation model applied in this study includes conventional agriculture and paludiculture options. Paludiculture value chains remain rare in Finland, but utilising various pilot-studies we obtain necessary information on costs and benefits to carry out the analyses. Since paludiculture crops are viable in conditions where the water table is high, and thus GHG soil emissions are low, they are an attractive alternative especially under carbon subsidy schemes.

Our analysis evaluates the impact of carbon subsidies on water management, crop diversity, and farmer income. The results show that while carbon subsidy prices have minimal influence on crop rotation diversity, they significantly affect farmers' income. With a subsidy of 30€/t CO_2eq, or 80€/tCO_2eq in the case of high-value crops, farmers transition into 'carbon farmers', obtaining higher share of total net present value from carbon subsidies rather than traditional agricultural income. Furthermore, the majority of climate benefits are realised already at the 30€/tCO_2eq subsidy threshold.

The findings suggest that carbon subsidies could offer a viable financial incentive for farmers to adopt peatland rewetting practices, which could reduce GHG emissions substantially. However, subsidy schemes

must be carefully designed to avoid unintended distortions in agricultural practices or reductions in crop diversity, while still delivering significant climate benefits.

Economical and institutional challenges in implementing paludiculture – comparing insights from Flanders (Belgium) and Brandenburg (Germany)

Jonathan Etzold, Cyr Mestdagh, Anton Heinrich, Dr. Jennifer Merten

The 'LIFE Multi Peat' project is a cross-country project to protect and restore peatlands across Belgium, Germany, Ireland, the Netherlands, and Poland. In Belgium and Germany, the restoration of peatland sites goes hand in hand with the development of paludiculture pilot projects. To assess the acceptance of paludiculture by local farmers, feasibility studies were conducted for both projects. The presentation will be used to present their results, highlighting the diverse challenges in developing a business case from paludiculture. We include insights into cost-benefit analyses, institutional challenges and the need for regional collaborations and additional funding programs.

In Belgium very little is yet known about paludiculture and our project presents the first real-life example of paludiculture. In the valley of the Grote Beek willows are being grown in buffer strips with a first harvest expected in April 2025. Willows are very important for many pollinators, have water-purifying and nitrogen fixating properties and help absorb CO_2 from the atmosphere. On top of that, the willows are selected for their very good fibre quality and very strong growth capacity of four meters per year. The annual harvest can then be used, for example, to make sustainable insulation material.

In Germany paludiculture will be tested on a degraded fen in Northern Brandenburg. While parts of the project area constitute abandoned land, others are used as pasture or for hay cutting. With raising water tables, vegetation on both sites is likely to change and new value chains need to be developed for the paludiculture biomass. In close collaboration with local farmers, different scenarios are currently being assessed in consideration of their economic viability.

Capital investments in the paludiculture sector

Konrad Misztal

The lecture will address the issue of investments in innovative technologies and services supporting the sustainable development of paludiculture using the example of Wetland Fund – Climate VC activities. The fund focuses on projects with high economic and social potential, generating tangible financial benefits for investors and contributing to the reduction of greenhouse gas emissions. Key financial challenges in the paludiculture sector will be discussed, such as limited access to capital, high risk associated with investments in innovative technologies, and lack of awareness of the economic potential of paludiculture. The Paludiculture sector offers attractive investment opportunities due to high growth potential of the market for ecological and sustainable products, increasing consumer interest in products with a strong impact on environmental protection and a low carbon footprint, the possibility of generating additional income from market mechanisms related to carbon reduction and sequestration. The lecture will also discuss new investment areas in the field of technology acceleration within the emerging paludi-tech sector. The key role of these investments is their significant impact on climate protection, contributing to improving the environmental balance, while creating an opportunity to achieve high returns on investment.

SESSION 5: Ecosystem Services 2

Vegetation as proxy for GHG emissions from organic soils – 2025 update of the GEST list

Dr. John Couwenberg, Prof. Dr. Gerald Jurasinski, Felix Reichelt, Hauke Schmülling

Greenhouse Gas Emission Site Types (GESTs) were developed as a proxy to assess greenhouse gas (GHG) emissions and emission reductions from peatland rewetting projects in temperate continental Europe. GESTs use vegetation as an integrative proxy for GHG fluxes. Vegetation

is well suited for that purpose as it reflects long-term water tables, affects GHG emissions via assimilate supply and aerenchyma, and allows for fine-scaled mapping. Many new flux measurements have become available since we first introduced the GEST approach. Whereas the original GESTs were based on 60, 140 and 128 annual flux measurements for CO_2, CH_4 and N_2O respectively we now have >400, >600 and >400 measurements for evaluation.

We grouped flux data with data on vegetation, mean annual water table and other parameters, including land use, to arrive at classes that best describe GHG fluxes in association with a coherent set of site conditions. The resulting matrix allows us to inter- and extrapolate flux values where direct measurements are not available.

We redefined GEST categories, representing non-treed sites ranging from deeply drained to shallow flooded and nutrient poor to nutrient rich. Special GESTs represent aberrant sites for which GHG fluxes diverge from the general relationship with water table and vegetation or where the relationship between water table and vegetation is atypical. The special GESTs also include sites with peaty soils (<30 cm thick peat layer or < 35% organic material). We present an overview of GESTs and the underlying meta-analysis of flux data. Furthermore, we share our experience in deriving emission factors to strengthen GHG accounting tools and improve MRV of large-scale rewetting.

Microbiome legacy influences the global warming potential of peatland soil

Marco Cosme, Erik Verbruggen, Willern-Jan Emsens, Inge van de Putte, Steven Jacobs, Dr. Hannah M. Silvennoinen, Ivan A. Janssens, Ruurd Van Diggelen

Peatlands can play a crucial role in climate change mitigation by sequestering substantial amounts of carbon dioxide (CO_2). However, they can also serve as sources of methane (CH_4), a potent greenhouse gas (GHG) with aggravated global warming potential. Despite the acknowledged influence of soil nutrients, microbial communities, and vegetation cover on GHG emissions in peatlands, our understanding of the relative contribution of these factors remains limited. In this study, we conducted a

comprehensive year-round mesocosm experiment, manipulating vegetation type, nitrogen (N) loading, and microbial community in peatland soil. Monthly measurements of CO_2 and CH_4 emissions were complemented by analyses of vegetation biomass, peat chemistry, and composition and function of the microbiome at the experiment's conclusion. Our findings reveal that vegetation cover strongly influenced net CO_2 and CH_4 emissions, while the later were also strongly influenced by the microbiome inoculum. The microbial community composition 12 months after inoculation (MAI) was primarily shaped by the initial inoculation, with a secondary impact from vegetation. Surprisingly, year-round N loading exhibited no discernible effects on GHG emissions or microbial community composition. We then assigned metabolic and ecological functions to microbial amplicon sequence variants (ASVs). Using Spearman correlation, we found top ASVs positively and negatively correlated with net CH_4 emission to be involved in methanogenesis and methanotrophy, respectively. Their enrichment at 12 MAI was primarily driven by the initial inoculation, suggesting a microbiome legacy effect in regulating the production and consumption of CH_4. This effect was more influential than that of nitrogen deposition and equally as important as vegetation, underscoring the significance of peat microbiome (and its legacy) in shaping the biogeochemical processes underlying the global warming potential of peatland soil.

Temporal changes in biogeochemical drivers and nutrient removal of *Typha latifolia* paludiculture

Sannimari Käärmelahti, Dr. Jeroen Geurts, Prof. Ralph J. M. Temmink, Prof. Alfons Smolders, Dr. Christian Fritz

Paludiculture has great potential for climate change mitigation by lowering emissions from drained peatlands while allowing agricultural peat use. *Typha latifolia* can be cultivated on rewetted peatlands and used in several commercial applications. *Typha* cultivation contributes to carbon sequestration and nutrient removal, enhancing ecosystem health and improving water quality. However, there is limited research on multi-year biogeochemical monitoring from one *Typha latifolia* site.

This study assesses the seasonal variation in biogeochemical drivers and nutrient removal potential of *Typha* paludiculture. We analysed pore

water, soil and biomass data collected from different seasons between 2020 and 2025 from a one ha paludiculture site in the Netherlands. The development of nutrient (nitrogen, phosphorus and potassium) availability in soil and pore water, biomass productivity, and nutrient accumulation in plants were analysed to evaluate seasonal and longer-term trends.

Our preliminary results indicate higher NPK removal when biomass is harvested in summer or autumn with peak biomass production and nutrient uptake occurring in warmer months. However, biomass yield in colder seasons remained high and nutrient removal still took place. We found indications of a decrease in porewater potassium concentrations over time. On the long-term this might lower biomass yields, because potassium is often a limiting nutrient in paludiculture systems.

These findings highlight the importance of optimising harvest timing to maximise nutrient removal while maintaining long-term soil fertility. Understanding seasonal and long-term nutrient dynamics in *Typha* paludiculture can inform sustainable management practices for rewetted peatlands, balancing biomass production with ecosystem health benefits.

Balancing productivity and ecology: Insights into nutrient dynamics and management applications at the *Typha latifolia* paludiculture site 'Teichweide' polder, Mecklenburg-Vorpommern

Lara Massa, Dr. Franziska Bitschofsky

Peatlands drained for agriculture are major contributors to greenhouse gas emissions, making their restoration crucial for climate protection. Paludiculture – wet farming on rewetted peat soils – offers an innovative solution that can simultaneously reduce emissions and maintain agricultural productivity. As one of the partners in the 'Paludi-PROGRESS' project, we investigate the nutrient budget on the 10-hectare *Typha* (cattail) paludiculture site near Neukalen, one of Germany's largest of its kind.

Central to this research is the large-scale measurement of nutrient flows – a key factor in understanding how paludiculture can deliver both environmental and economic benefits. By tracking nitrogen, phosphorus, iron, and carbon levels in water, sediments, and biomass, we gain insights into nutrient retention, export, and overall water quality. These data reveal

how *Typha* cultivation might enhance ecosystem services, contribute to nutrient retention or improve the overall hydrology, while also supporting harvestable biomass.

Our findings aim to offer practical guidance for land managers and policymakers on balancing productivity with environmental objectives. Detailed nutrient measurements help pinpoint the conditions under which paludiculture most effectively fosters a healthier peatland ecosystem. By comparing results with other restored wetlands, we assess whether *Typha* paludiculture can serve as a scalable model for sustainable agriculture on peat soils.

Ultimately, our work highlights paludiculture as a forward-looking solution that reconciles agriculture, climate protection, and ecosystem health– paving the way for a more sustainable future on peatland soils.

Fast-Mow-Slow – three ways to drop phosphorus release in rewetted peatlands

Prof. Dominik Zak, Karolina Andrioti, Carl Christian Hoffmann, Dr. Renske Vroom, Rasmus Jes Petersen

Rewetting peatlands is widely recognized as a key strategy for addressing global challenges such as eutrophication, biodiversity loss, and rising greenhouse gas emissions. However, long-term drainage and agricultural use have significantly altered the soil characteristics of these ecosystems, potentially hindering the restoration of their lost functions for decades. Given the substantial financial investments required and the urgency of societal needs, it is crucial to make well-informed decisions regarding the restoration techniques employed in degraded peatlands, particularly those in agricultural landscapes.

Three distinct strategies are currently under consideration. First, removing degraded peat before rewetting appears to be an effective short-term restoration measure for returning the peatland to a more natural state. While this approach shows promise, it is not without uncertainties, and a critical question remains: What should be done with the degraded peat? A more feasible option, at present, may be mowing helophyte stands. This method offers high biomass yields over several years, potentially even decades, providing an alternative income depending on the availability of phosphorus (P) in decomposed peat soils and the P load from agricultural

runoff or river flooding. Another possibility is a slow-rewetting strategy, where phosphorus is gradually released rather than being washed out with undesired ecological consequences. However, the success of this approach will depend on specific site conditions, including the availability of technical options for controlled water table management.

Each strategy has its own advantages and limitations. Ultimately, the direction of restorative action will be a matter of societal choice. It is crucial that society understands the potential benefits and drawbacks of these restoration measures to ensure informed and thoughtful decision-making.

SESSION 5: Monitoring & Methods

Establishment of a German peatland monitoring programme for climate protection – Open land (MoMoK)

Dr. Bärbel Tiemeyer, Elaheh Amiri, Dr. Ullrich Dettmann, Arne Heidkamp, Sebastian Heller, Sylvia Holzträger, Malina Kuwert, Silvana Lakeberg, Sharon Laqua, Dr. Merten Minke, Stefan Nagel, Willie Oehmke, Dr. Arndt Piayda, Manuela Rutsch, Bernd Schemschat, Ronny Seidel, Carolin Simon, Thomas Viohl, Holger Wywias, Dr. Stefan Frank

Peat and other organic soils store large amounts of soil organic matter, which is highly vulnerable to drainage. Thus, drained organic soils contribute around 7% to the total German greenhouse gas (GHG) emissions and around 44% to the emissions from agriculture and agriculturally used soils, despite covering less than 7% of agricultural area in Germany. Carbon dioxide (CO_2) is the most important GHG with regards to drained organic soils. To evaluate possible GHG mitigation measures, an improved data set on GHG emissions, in particular CO_2, and their drivers is needed. Furthermore, spatial data and upscaling methods need to be improved.

To meet these needs, a long-term monitoring programme for organic soils is currently (2020–2025) being set up for open land at the Thünen Institute of Climate-Smart Agriculture. A consistent long-term monitoring of

soil surface motions, representatively covering a broad range of organic soil and land use types is combined with the repeated measurement of soil organic carbon (SOC) stocks to assess CO_2 emissions using standardised and peat-specific methods. Land use types comprise grassland, arable land, paludiculture as well as unutilised re-wetted, degraded and semi-natural peatlands. At each of the envisaged approx. 130 monitoring sites important parameters such as groundwater table, vegetation and soil properties are monitored. Synergies with long-term GHG flux measurement programmes are established by investigating common sites. Together with the updated map of organic soils and a revised machine learning model for water levels, all collected data form the basis for improving regionalisation approaches for drivers – particularly water levels and SOC stocks – and CO_2 emissions from organic soils in Germany. Here, we will present the current status of site establishment with a focus on exemplary sites with raised water levels for e.g., paludiculture.

Mapping and quantifying biomass resources in reed beds of the Syr Darya Delta, Kazakhstan by means of remote sensing and random forest

Azim Baibagyssov, Dr. Anja Magiera, Dr. Niels Thevs, Prof. Dr. Rainer Waldhardt

Reed beds, often referred to as dense, nearly monodominant stands of *Phragmites australis*, represent the most productive vegetation in the inland wetlands of Central Asia and offer significant potential for biomass production in this arid region. Kazakhstan, with its vast delta regions, is home to the largest reed stands in the world and provides a valuable case for exploring the potential of reed beds for bioeconomy. However, accurate estimates of available reed biomass are scarce due to insufficient national statistics and challenges in measuring and monitoring across large and remote areas. This study aimed to fill this knowledge gap by estimating the biomass characteristics of common reed utilizing ground-truth field data as the dependent variable and high-resolution Sentinel-2 spectral bands, along with computed spectral indices, as independent variables within multiple Random Forest regression models to quantify biomass in the Syr Darya Delta, a prominent reed bed area in Kazakhstan. Our spatial analysis revealed 58,935 hectares of dense non-submerged

and submerged reed beds (standing biomass of > 10.5 t ha^{-1}) and an estimated 1,240,789 tons of reed biomass resources. Submerged dense reed exhibited the highest biomass at 28.21 t ha^{-1}, followed by dense non-submerged reed at 15.24 t ha^{-1} and open reed at 4.36 t ha^{-1}. The Random Forest models incorporating NDVI and NDWI as key predictors demonstrated robust performance, achieving high predictive accuracy (R^2 = 0.93, RMSE = 2.74 t ha^{-1} for calibration; R^2 = 0.83, RMSE = 3.71 t ha^{-1} for validation). This research underscores the substantial biomass potential of *Phragmites*-dominated wetlands and illustrates the effectiveness of Random Forest regression modelling combined with high-resolution Sentinel-2 data for mapping and quantifying biomass across extensive areas. These findings offer insights for managing and conserving wetland ecosystems, promoting the sustainable use of *Phragmites australis* resources for the bioeconomy in Kazakhstan and beyond.

Integrating hydrology, ground motion and vegetation biophysical parameters to assess peatland condition

Gerardo Lopez Saldana, Yara Al Sarrouh, Sam Doolin, Michel Bechthold, Stefano Salvi, Christian Bignami, Christiano Tolomei, Lisa Beccaro, Prof. Fred Worrall, Susan Page, Kevin Tansey, Harika Ankathi, Ian Jory

The 'ESA WorldPeatland' project enhances peatland mapping and monitoring by developing Earth observation (EO) tools tailored to address stakeholder needs. The project focuses on integrated indicators derived from multitemporal trends in hydrology, surface motion, and vegetation biophysical parameters to assess peatland condition and inform management decisions.

Hydrological indicators, such as water level, support rewetting assessments, fire risk evaluation, and early degradation warnings. WorldPeatland utilizes Sentinel-1 SAR, Sentinel-2 optical imagery, and the SMAP Level-4 soil moisture product to monitor peatland hydrology. Surface motion monitoring, crucial for estimating carbon fluxes and supporting IPCC-aligned GHG emission reporting, employs multi-temporal InSAR techniques, including Enhanced Persistent Scatterers (E-PS) and Intermittent Small

Baseline Subset (ISBAS) algorithms. Vegetation biophysical parameters, such as land surface temperature (LST), albedo, and Leaf Area Index (LAI), help assess peatland function and restoration progress. WorldPeatland integrates long-term MODIS and VIIRS data with high-resolution Sentinel-1 and Sentinel-2 imagery to track vegetation dynamics. The open-source Carbon Durham Model will further analyse peatland carbon budgets.

To assess peatland condition, WorldPeatland developed indicators based on multi-variable temporal trends and standardized anomalies. Time series of water level, surface motion and different vegetation biophysical variables are detrended to remove seasonal effects. Then climatologies are generated and for each variable, standardise anomalies are computed to provide a quantitative metric of the divergence from the climatology at a particular time-step. Statistical trend metrics identify long-term changes across variables, which are then combined to provide a holistic understanding of peatland dynamics.

These indicators will be accessible via user-focused online tools, serving scientists, policymakers, and restoration practitioners. By integrating hydrology, surface motion, and vegetation data, WorldPeatland delivers robust EO-based indicators to support peatland conservation, restoration, and sustainable management.

Automatic vegetation Mapping in peatlands – compilation of a ground truth dataset for ecologically informed machine learning

Henriette Rossa, Dr. Mario Trouillier, Timothy James Husting, Milan Bergheim, Prof. Dr. Gerald Jurasinski, Dr. Daniel Lars Pönisch

Payments for ecosystem services are one approach to counteract the ongoing degradation of peatlands by creating incentives for the conversion of agricultural practices on peatlands. For this, large-scale and cost-effective monitoring methods for peatland ecosystem services are needed. The vegetation composition can be used as an indicator for site conditions and consequently to quantify ecosystem services. This study is part of a project in which we develop a scalable monitoring system for peatland vegetation based on drone images and machine learning models for plant species detection.

Current methods to automatically detect vegetation in drone-based (ortho-)photos face a trade-off between a higher spatial resolution and flight time per hectare. To tackle this challenge different approaches to get imagery and ground truth data and annotated segmentation masks for the machine learning were tested: (1) The M3 approach for vegetation stands, using a DJI Mavic 3 Multispectral drone (RGB and MS imagery, GSD of 10mm) in combination with vegetation data mapped with DGNSS; annotation was done in a set up preprocessing software, (2) The M350 approach for single plants, using a DJI Mavic 350 Multispectral drone (RGB and MS imagery, GSD of 2 mm) with a direct annotation of plants in image tiles with the software CVAT, (3) The (vegetation) type approach, using annotated maps e.g., of biotope types or Greenhouse Gas Emission Site Types (GEST).

Preliminary results show that the tested specific approaches have the potential to be used for large-scale mapping of vegetation in peatlands. The M3 approach works for dominant stands and individuals > 30 cm. The M350 approach is suitable for differentiation of (small) individuals/ species, which often have indicator value. Combining the different approaches could be the key to address even complex use cases. In further tests the relevance of parameters for the automatic image analysis will be determined.

Landscape scale nature recovery on patchy rewetted lowland peat – a case study from the UK

Dr. Julia Casperd, Dr. Anthony Millington, Prof. Simon Jeffery, Dr. Rob Low, Dr. Fraser Baker, Dr. Chris Lakey, Prof. Karl Behrendt, Dr. Iona Huang, Prof. Fred Worrall, Dr. Jackie Symmons, Scott Kirby

The England Peat Map (2024) indicates that lowland peat in Shropshire is typically patchy in its distribution. Approximately 74% of these peaty soils (total area: 325,000 hectares) in England are farmed and highly productive. They contribute 8.52Mt carbon dioxide equivalents (CO_2eq) emissions each year which represents around 3% of England's overall greenhouse gas emissions (Defra, 2023). Paludiculture has been put forward as a means of reducing these emissions. This case study explores the relationship between natural capital opportunities, the environmental services they provide, and farming at higher water tables (paludiculture) on lowland

peat across 6 Shropshire/Staffordshire farms. It evaluates a variety of established and innovative methods used to baseline and monitor biodiversity and landscape resilience including desktop and aerial/satellite assessments, ecological surveys and analysis of biodiversity indicator species assemblages and habitat networks. This case study seeks to understand how this mosaic of land use may be sustainably managed at scale.

SESSION 6: Ecosystem Services 3

Effects of different fertilization strategies and groundwater management scenarios on greenhouse gas dynamics and mitigation potentials in various paludiculture systems

Dr. Tim Eickenscheidt, Carla Bockermann, Prof. Dr. Matthias Drösler

Paludiculture, the productive use of wet and rewetted peatlands, offers a promising alternative to drainage-based agriculture on organic soils, with the potential to reduce greenhouse gas (GHG) emissions while maintaining agricultural productivity. However, the long-term sustainability of paludiculture systems remains uncertain, particularly regarding potential nutrient deficiencies and subsequent yield declines under continuous use. This study investigates the effects of different fertilization strategies and groundwater management scenarios on GHG dynamics and mitigation potentials in various paludiculture systems.

Starting in January 2023, field experiments were conducted using common paludiculture crops, including reed canary grass (*Phalaris arundinacea*), broadleaf cattail (*Typha latifolia*), and sedge (*Carex acutiformis*). Treatments included organic (liquid vs. solid biogas digestate) and mineral fertilizer applications, as well as two groundwater management scenarios (constant rewetting vs. periodic drainage), in compliance with the German fertilization ordinance. Alongside assessments of biomass production and soil parameters, GHG fluxes (CO_2, CH_4, and N_2O) were measured in 2024 using a fully automatic chamber system. We will present results of chang-

es in annual GHG flux dynamics influenced by varying fertilization and groundwater management events. Furthermore, the impacts of these management strategies on GHG mitigation potential and the long-term sustainability of paludiculture systems will be discussed.

Unravelling GHG emission drivers in *Typha* paludiculture: a mesocosm study

Dr. Renske Vroom, Meline Brendel, Caroline Daun, Markku Koskinen, Carolin Vallinga, Prof. Dr. Gerald Jurasinski, Prof. Dr. Jürgen Kreyling

Typha paludiculture is a promising land use option on rewetted peatlands that combines ecosystem service rehabilitation with biomass production for various economic uses. Understanding the effects of *Typha* paludiculture on greenhouse gas (GHG) dynamics is essential, as GHG emission reduction is generally a main incentive of peatland rewetting. *Typha spp.* are so-called 'shunt species' that simultaneously transport oxygen to their rhizosphere and methane (CH_4) to the atmosphere through their aerenchyma. Additionally, *Typha* sequesters carbon dioxide (CO_2) in its aboveground and belowground biomass. The net effect of *Typha* paludiculture on GHG emissions could depend on *Typha* species, water table height and dynamics, and harvesting regime, but the main drivers and their interactions remain unclear.

We studied CO_2 and CH_4 emissions in an outdoor mesocosm gradient experiment with two *Typha* species (*T. latifolia and T. angustifolia*) and unvegetated controls, at three different water table depths (–14,0 or +10 cm), and with three harvesting regimes (winter, winter and summer, or none), in all possible combinations. A summer drought period of 0,3 or 10 weeks was applied to the mesocosms with a 0 cm water table (n=24 mesocosms in total).

During one growing season, aboveground and belowground biomass were monitored daily using a PlantEye and mini rhizotron scanners, respectively. Decomposition was quantified using the teabag method, and soil redox potential was measured continuously. CO_2 and CH_4 fluxes were measured biweekly. We unravel the main drivers of GHG emissions and biomass production and discuss them in the context of GHG emission reduction through *Typha* paludiculture management.

Effects of topsoil removal on greenhouse gas exchange and carbon allocation of fen paludicultures

Philipp-Fernando Köwitsch, Dr. Bärbel Tiemeyer, Claas Voigt, Linus Peterson, Sonia Antonazzo, Dr. Ullrich Dettmann

Drainage-based agriculture on peatlands leads to substantial emissions of the greenhouse gases (GHGs) carbon dioxide (CO_2) and nitrous oxide (N_2O). Paludiculture is an option to mitigate these adverse environmental impacts while maintaining productive land use. Considering that typical fen paludiculture species are aerenchymatous plants, the release of methane (CH_4) is a crucial aspect when optimising the GHG balance of such systems. Topsoil removal is being discussed to reduce CH_4 emissions, but retaining a nutrient-rich topsoil might foster biomass growth.

Typha angustifolia, *Typha latifolia*, and *Phragmites australis* are grown at former grassland on fen peat. In parts of the newly created polder surrounded by a peat dam, approximately 10 cm of topsoil had been removed. To separate the effects of topsoil removal and water level, four smaller sub-polders were installed. GHGs were measured for all three species with and without topsoil removal, at a nearby reference grassland and on the dam. Using manual transparent and non-transparent chambers and a portable analyser for both CH_4 and CO_2, GHG measurements are carried out every two to four weeks on a campaign basis. N_2O is measured using non-transparent chambers and gas chromatographic analysis. After four years, stubble and root biomass were sampled at all plots. Here, we present the GHG balances of four years after planting.

Challenges in water management during the initial year after planting caused an infestation with *Juncus effusus*. Afterwards, water levels were maintained at the surface or slightly above it. However, despite initial suboptimal conditions, all paludiculture treatments were net CO_2 sinks, while fluctuating water levels resulted in low CH_4 emissions. Even in subsequent years, CH_4 emissions remained low, resulting in a GHG sink for almost all paludiculture treatments, even when harvests were included. Topsoil removal had only minor effects on yield and CH_4 emissions but might have affected carbon allocation.

How to minimise greenhouse gas emissions in *Sphagnum* re-vegetation areas – the role of topsoil removal

Caroline Daun, Dr. Vytas Huth, Dr. Greta Gaudig, Matthias Krebs, Prof. Dr. Gerald Jurasinski

Drained peatlands lead to a loss of ecosystem functions and are major sources of GHG. To counteract this effect, these peatlands must be rewetted. Rewetted peatlands can be left to their own devices (wilderness development/ restoration) or continue to be used for agriculture (= paludiculture). *Sphagnum* is a key genus for bog restoration and paludiculture on bogs. For successful *Sphagnum* establishment on rewetted bogs formerly used as grassland, it is recommended to remove the top layer of degraded peat. However, topsoil removal will cause additional GHG emissions and therefore should be minimised. In this study, we assess the climate effects of topsoil removal to a depth of 30 cm or less on a bog grassland in northwest Germany. For this, we measured GHG emissions with closed chambers where *Sphagnum* has been directly applied either on the rewetted mulched grassland ('Without topsoil removal' = TSR0) or on areas with topsoil removal of 5 to 10 cm (TSR5) and 30 cm (TSR30) depth. One year after installation Sphagnum covered 30% of the surface on TSR0, 82% on TSR5 and 90% on TSR30, respectively. The water level was kept high by irrigation and averaged –5.4 ± 5.8 cm relative to the peat surface across all variants. Over the entire study year, TSR5 and TSR30 were GHG sinks of –5.7 ± 1.2 t ha-1 a-1 and –4.5 ± 0.6 t ha-1 a-1 (in CO_2eq), respectively. In contrast TSR0 was a strong source of CH_4, resulting in an annual net GHG budget of 42.3 ± 6.8 t ha-1 a-1. With a share of 80% *Sphagnum* production fields, 5% ditches and 15% causeway in the whole system only TSR5 would lead to a minor sink of –0.3 ± 1.2 t ha-1 a-1, thus would be the most climate-friendly and cost-effective alternative for bog restoration and the installation of a new Sphagnum paludiculture site.

Biomass yield and greenhouse gas emissions of reed canary grass in a rewetting fen peatland

Dr. Poul Erik Lærke, Johannes W.M. Pullens, Andreas F. Rodriguez

Reed canary grass (RCG) grown on undrained peatland might be a climate friendly alternative to traditional agriculture on drained peatland. This study assessed the impact of different harvest and fertilization treatments of RCG (*Phalaris arundinacea*, cv. Lipaula; RCG) on greenhouse gas (GHG) exchange dynamics and global warming potential (GWP) in two measurement periods (5th May in 2020 to 4th May in 2021, and 18th May in 2021 to 17th May in 2022) at a fen with shallow water tables depths (annual mean WTD of –10 cm and –8 cm, respectively). RCG was established in 2018 and in the following years, fertilised management strategies with 2 or 5 cuts per year were compared with a non-harvested scenario (0-cut).

Yields of RCG decreased over the years with 15.6, 11.5 and 8.9 t DM ha-1 yr-1 for the 2-cut system and 14.5, 9.4 and 8.6 for the 5-cut system in 2019, 2020 and 2021, respectively. Mean annual WTD of –13 cm in 2019 was slightly lower than the following years. In general, photosynthetic CO_2 uptake was higher in treatments with active biomass management, but no significant effect of treatments on net ecosystem carbon balance (NECB) was observed, as carbon export in the harvested biomass offset the increased CO_2 uptake. The mean NECB of 22.5 t CO_2 ha-1 yr-1 in 2021-22 across treatments was significantly lower than the mean of 38.7 t CO_2 ha-1 yr-1 in 2020-21. This might be explained by the slightly increasing WTD and more precipitation in the last year, but also by a delayed effect of increasing WTD on decreased peat oxidation. Emissions of CH_4 remained low (1.1–1.9 t CO_2eq ha-1 yr-1) while N_2O emissions were relatively high (4.0-5.7 t CO_2eq ha-1 yr-1) without any treatment effects. The variation found within treatments across the experimental field indicated that vegetation management improved the GHG emissions in the more productive area, while leaving the vegetation unmanaged in the less productive area of the field was beneficial.

Drivers- and spatio-temporal variability of greenhouse gas emissions from temperate fen peatlands under paludiculture

Boodoo Kyle, Stephan Glatzel

A growing number of studies highlight the benefits of rewetting peat soils that were drained to facilitate the practice of traditional forms of agriculture and forestry. Paludiculture offers a possible socio-economically viable option for the conversion of formerly drained peatlands, but the trade-off in emissions reduction compared to rewetting alone only is still largely uncertain. We investigated the effect of paludiculture intensity (high-, low-intensity paludiculture, and wet wilderness) and dominant vegetation type (as an indicator of nitrogen and water table levels) on GHG emissions from 14 different fens, located in the Netherlands, Germany, and Poland, over a two-year period. Further, we investigated the drivers of and spatio-temporal variability in the GHG fluxes. All GHG flux measurements were conducted using closed, non-flow-through, dark, non-steady-state chambers. Diurnal sampling was conducted over five consecutive days per season (spring, summer, autumn, winter) in the first year of the experiment, while regular monthly sampling was conducted at all sites for the entire two-year period. GHG emissions varied on a temporal (seasonal/diurnal) and spatial (country specific site conditions) scale. We found that there was largely no significant difference in GHG emissions (as CO_2 equivalents, CO_2eq) under different paludiculture intensities and wet-wilderness, across all three countries studied. Overall, reduced CO_2 emissions at paludiculture sites compensated for higher CH_4 emissions, with little impact of N_2Oemissions across all treatments. *Typha sp.* dominated sites showed a substantially higher reduction in CO_2 (and overall GHG emissions – as CO_2eq) compared to *Carex sp.* dominated sites. Water table, soil temperature, bulk density, C:N ratio and phosphorous concentration were the most important predictors of GHG fluxes. Our results highlight paludiculture as a low GHG-emission-alternative to traditional agriculture on drained peat soils and non-productive use of rewetted peatlands (wet wilderness) as well as the need to paludiculture site-specific conditions and consideration of spatial and temporal variability in GHG fluxes.

Cultivation of *Typha* as a new permanent agricultural crop – initial results regarding the carbon and climate balance

Caroline Daun, Prof. Dr. Gerald Jurasinski, Dr. Franziska Köbsch

The productive use of rewetted peatlands (paludiculture) represents an alternative land use option for farmers where water levels remain permanently at the peat surface. This allows for the maintenance of the production function and is expected to effectively minimise both peat mineralisation and the emission of greenhouse gases (GHG). However, data on GHG emissions from paludiculture on fens, especially for *Typha* paludiculture, and the results so far are strongly divergent. Many fen species suitable for paludiculture such as common reed, sedges and cattail possess large aerenchymatous tissue. CH_4 emissions, therefore, play a major role in the carbon footprint of such systems.

In a fen peatland in north east Germany, a 10-ha large paludiculture pilot site was established in 2019, including irrigation ditches and causeways. Two cattail species *Typha angustifolia* and *T. latifolia* were planted and sown. Prior to this conversion, the site was drained and used as grassland.

GHG measurements (CO_2, CH_4 for all site elements and N_2O for the causeway) have been carried out every two to four weeks since November 2023 on all elements of the *Typha* site (drier and wetter stands, ditches, causeways) with closed manual chambers. Additionally, CO_2 and CH_4 fluxes were measured at the total site level using the Eddy covariance method. We assume, based on findings from other studies, that the causeway contributes by far the most to global warming of the site due to the high CO_2 emissions. The ditches may act as hotspots for CH_4 and CO_2, whereas the *Typha* area may represent a GHG sink. Here, we present results from the first 16 months of the GHG measurements and place them in the context of other available studies.

SESSION 6: Agronomy

Establishment of *Carex acutiformis* in paludiculture

Frank Pannemann, Prof. Dr. Matthias Drösler

Paludiculture is the best land use-option in fens from a greenhouse-gas perspective. Lesser pond-sedges (*Carex acutiformis*) even showed the strongest carbon sink function among the plants examined in the 'MOORuse' project (2016-2022, Eickenscheidt et al. 2023)

In the project 'MoorBewi' (2021-2024) extensive cultivation trials with lesser pond sedges (*Carex acutiformis*) have been conducted. In three-year planting trials, weed-management techniques were studied (mechanical, suppression, cover plants, cutting). It turned out that weed suppression using straw worked best and resulted in a faster population establishment. Additionally, for the first time, a caterpillar-based direct planting method was tested, that makes it possible to plant after rewetting. While the establishment by planting became faster and respectively simpler, sowing remained difficult.

In this survey, data from four field experiments with different focal topics and two greenhouse-trials were consolidated. They have been conducted between 2022 and 2025 at the research farm Karolinenfeld of the Bayerische Staatsgüter and at the Paludiculture Science Center (PSC) of the Hochschule Weihenstephan-Triesdorf (HSWT). The focus areas were pre-treatment methods, sowing-time, foster-plants, weed-management, sowing depth and germination temperature.

In the lab, germination rates of 50 to 70% were achieved, whereas in field trials, emergence rates of only 1% to 20% were reached. This presentation highlights the factors required for a successful establishment by sowing.

The preliminary result is that keeping the precise and steady environmental conditions during the long (four-week) germination phase is of paramount importance.

Assessing cattail *(Typha spp.)* productivity and biomass quality over four years at a 10-ha paludiculture pilot site

Nora Köhn, Meline Brendel, Josephine Neubert, Dr. Sabine Wichmann, Prof. Dr. Jürgen Kreyling

The 'Paludi-PROGRESS' project ('Paludiculture in practice: Optimisation of cattail and reed cultures', project period 2022 to 2025) aims to test and further develop the cultivation of cattail (*Typha spp.)* as a new permanent crop on wet peatlands. One of the main tasks is to evaluate the productivity and biomass quality of cattail on a 10-hectare paludiculture pilot site, established in September 2019 in north east Germany.

From 2021 to 2024, biomass samples were collected twice a year, in summer (July) and winter (November/December). Prior to the first sampling in 2021, four different density categories were identified based on the visual impression of the cattail vegetation (ranging from dense to sparse cattail plant occurrence). Sampling plots were randomly distributed within these sub-areas of the pilot site. To monitor the cattail vegetation, several parameters were recorded for each plot e.g. the number of cattail plants and spadices, plant height and diameter, dry weight, water content and chemical composition (carbon, nitrogen, phosphorous, potassium, lignin, cellulose and hemicellulose).

From winter 2021 to winter 2024, cattail biomass productivity more than tripled from 1.8 to 6.8 t dm/ha across the total pilot site. In the areas with dense cattail vegetation, the biomass increased from 4.1 to 8.2 t dm/ha. Different stand densities showed an influence on morphological parameters but had only a minor effect on the chemical composition of the biomass.

The collected data show unique results about the development of cattails on a large-scale pilot site and therefore provide important information for future use of cattail from commercial-scale cultivation. Additionally, it is important to evaluate whether the given growing conditions lead to appropriate biomass quality for various utilization options.

Cattail species and water management to optimise cattail yields

Waas Thissen, Jacco de Stigter, Dr. Abco de Buck, Jeroen Pjlman, Youri Egas, Dr. Jereon Geurts

To make cattail cultivation economically viable in the Netherlands, relatively high dry matter yields per hectare are necessary. Previous field trials indicated that broadleaf cattail (T. latifolia) yields are higher at a water level of approximately 20 cm above the soil surface compared to levels between 20 cm below and 10 cm above it. However, methane emissions tend to increase when the water level rises above the soil surface. Water level fluctuations with alternating higher and lower levels may balance yields and methane emissions. Additionally, such fluctuation results in a nutrient supply via surface water, which may increase yields.

A field trial was conducted in Zuiderveen (the Netherlands) during 2022 and 2023 with broadleaf and narrowleaf cattail (*T. angustifolia*). Fields with a constant water level of 20-30 cm above soil were compared with fields where water levels fluctuated weekly (in 2022) or monthly (in 2023) between about 0 and 30 cm above the soil surface. Measurements included plant height, number of shoots, percentage of flowering shoots, and dry matter yield. Initial shoot density variation was taken into account in the statistical analyses.

Broadleaf cattail had 44% higher dry matter yields (6.4 vs. 3.6 t ha-1) and 10% taller plants at constant water levels compared to fluctuating levels. Narrowleaf cattail had 32% higher yields (10.6 vs. 7.2 t ha-1) and taller plants 16% at constant water levels under the brackish conditions of Zuiderveen.

Water level fluctuation did not inhibit narrowleaf cattail growth more than broadleaf cattail, however it led to an increase in inflorescences in narrowleaf cattail. Nitrogen and phosphate supplied via ditch water did not increase yields, likely because nutrient concentrations in the water were relatively low. Therefore, if higher yields of cattail are desired, there must be sufficient nutrients in the soil from previous management, and the most appropriate species for local conditions should be chosen.

Scale-up of *Sphagnum* founder material production in a photobioreactor

Maria Glaubitz, Dr. Greta Gaudig, Linni Dahlhausen, Prof. Dr. Clemens Posten, Prof. Dr. Claudia Grewe

AIM: To install Sphagnum paludiculture sites, approximately 40 m^3 of Sphagnum founder material produced in photobioreactors per hectare is required. In comparison to Sphagnum cultivation on bogs or in glasshouses, the growth rate in a photobioreactor can be up to 180 times higher. In order to address the high demand of Sphagnum founder material, the photobioreactor process was scaled up with a low-cost design.

MATERIALS & METHODS: The influence of light was examined and the cultivation medium was optimised by conducting experiments in laboratory-scale photobioreactors (2 to 10 L). Process technological behaviour was characterised, including specific power input and the CO_2 volumetric mass transfer coefficient. Cultivation experiments in technical- scale bubble column reactors (40 L) took place both indoors and outdoors to assess Sphagnum productivity and morphology as well as energy efficiency. RESULTS: The tested photobioreactors showed a (dry biomass) productivity for *Sphagnum palustre* of 0.14 ± 0.03 g L-1 d-1 in 10 L scale and 0.10 ± 0.02 g L-1 d-1 in 40 L scale. Specific power input was below 55 W m-3 in all the pneumatically driven photobioreactors, while CO_2 volumetric mass transfer coefficient ranged from 7 h-1 to 9 h-1. Outdoor photobioreactor cultivation did not significantly reduce productivity to indoor cultivation.

CONCLUSION: The Sphagnum cultivation process can be successfully scaled up from 10 L to 40 L using a low-cost photobioreactor system with indoor biomass productivity reduced by only 30%. Increasing power input and light supply can increase biomass productivity in the tested photobioreactors. Furthermore, outdoor bioreactor cultivation seems to be suitable for reducing light energy costs. The process shows strong potential for further scalability to achieve the goal of enlarged provision of Sphagnum founder material more quickly. Sphagnum biomass produced in photobioreactors established successfully on rewetted bogs.

Lessons learned from *Sphagnum* Farming with the MIFA approach

Dr. Jack Clough

Sphagnum farming (SF) for growing media replacement can enhance Ecosystem Services (ES) and maintain land productivity. In the UK, the broader paludiculture policy area is growing. However, the uptake of SF is slower than that of other crops. This may be hindered by lack of knowledge, technical challenges, and reluctance to raise water tables.

The conventional SF approach uses the Moss Layer Transfer Technique (MLTT) to provide founder material from a donor site with surface irrigation via raised water tables. This method is challenging in the UK´s lowland agricultural context, where donor Sphagnum sites are scarce and there is reluctance to increasing water levels within a conventional agricultural landscape.

This talk presents a novel alternative SF option – the Micropropagated-Irrigation-From-Above 'MIFA' approach. Micropropagated *Sphagnum* requires reduced amounts of donor material, and overhead irrigation removes the need for active water table management, thereby addressing some current challenges associated with SF in the UK.

The effectiveness of the MIFA approach on *Sphagnum* hydrology and growth was monitored through three pilot studies and two experimental field sites in the UK, using hydrological and growth measurements.

Sphagnum water availability was assessed via pore water pressure (PWP) measurements. Across the field sites, the MIFA approach resulted in PWP measurements broadly equivalent to literature values for natural peatland systems, and better than those recorded for a drained peatlands capable of supporting Sphagnum growth.

Sphagnum growth was assessed up to 24 months post-establishment using Terrestrial Laser scanning (TLS), with increases in the carpet height of Sphagnum of up to 16 cm recorded. Suggesting that growth under the MIFA approach was comparable to, or even better than that of Sphagnum growth achieved under the conventional SF approach.

The results demonstrate that the MIFA approach produces a good Sphagnum crop across two contrasting sites, offering a viable alternative to the MLTT approach for *Sphagnum* farming in areas where the conventional SF approach is problematic.

Don't wait too long! – when to harvest a *Sphagnum* paludiculture

Dr. Greta Gaudig, Matthias Krebs

AIM: Sphagnum biomass can be produced in paludiculture and utilised for horticultural substrates. In a large-scale field trial, we observed the establishment of a Sphagnum lawn within one and a half years after installation. In our study, we investigated the development of net biomass accumulation over a 11 year period to define the optimum harvest time.

METHODS: In 2011, a Sphagnum paludiculture site was established in the bog Hankhauser Moor (Lower Saxony). Vegetation development was monitored for 11 years and the accumulated dry mass for single plant groups was determined. To estimate the proportion of growth and decomposition, Sphagnum biomass was removed from lawns up to 25 cm thick and for single Sphagnum species in five cm layers. These samples were dried, placed into litter bags, and returned to the bog in the same layer for one year at different water tables and nutrient supplies.

RESULTS: During the first ten years after installation, the accumulated biomass increased evenly each year, reaching 45 tons of dry Sphagnum mass per hectare. In the following year, accumulated biomass was slightly lower. In the decomposition experiment, an average biomass loss of 20% was recorded in this year, with higher losses observed under elevated nutrient supply. The biomass loss decreased with increasing depth and was highest in the uppermost layer at an average of 30%. At the species level, *S. fallax* showed the highest biomass loss in the uppermost layer, averaging 41%.

CONCLUSION: Effective water management will enable continuous and reliable biomass growth over a period of ten years. However, even under optimal conditions, decomposition exceeds the growth of new biomass over time, ultimately reaching a point of equilibrium where the net biomass accumulation ceases. For maximum yields, this point in time should not be exceeded and the complete harvest should take place by then at the latest.

ABSTRACTS OF WORKSHOPS

Wetland transitions: Opportunities and trade-offs for paludiculture in reaching nature restoration targets

Dr. Christian Fritz, Quint van Giersbergen, Tom Heuts, Dr. Gabrielle Rabelo Quadra, Dr. Agata Klimkowska

With growing attention on nature restoration laws and the need for sustainable land use alternatives, paludiculture offers a promising solution. But where can paludiculture be most effectively implemented? In this interactive co-creation workshop, we aim to optimise paludiculture implementation in Europe, by bringing together researchers, policymakers, land managers, and industry stakeholders. Using wetland and greenhouse gas hotspot maps, we will explore where nature restoration goals align with paludiculture opportunities, considering soil conditions, hydrology, and socio-economic feasibility, and where trade-offs may occur. Our main goal is the co-creation of a roadmap for paludiculture implementation by identifying key hotspots in Europe, evaluating trade-offs, and aligning opportunities with nature restoration goals.

Workshop Structure:

- Introduction and Presentations (20 min) – Overview of the workshop's goals and the co-creation of a roadmap for paludiculture implementation. Key insights from mapping tools, modelling scenarios, and expert stakeholders.
- Breakout Discussions (60 min) – Participants will join topic-focused groups (e.g., GHG emissions, biodiversity, socio-economic benefits, water management in specific regions) to evaluate trade-offs, identify challenges and solutions, and define potential paludiculture hubs, supported by expert facilitators.
- Final Discussion (40 min) – Bringing together key takeaways to co-develop action points for advancing paludiculture in Europe.

This session fosters collaboration and knowledge exchange, bringing together participants to explore challenges, identify synergies, and develop practical pathways for scaling up paludiculture while balancing ecological, economic, and social factors. Join us in shaping the future of sustainable wetland use and integrating paludiculture into nature restoration!

Exploring future visions of peatlands applying the Three Horizons Approach

Dr. Laura Herzog, Dr. Larissa Koch, Pia Müller, Fiona Hasenbach, Claudia Heindorf

In this workshop, we aim to collaboratively explore various future scenarios for peatlands and identify the transformation knowledge necessary to achieve them. To facilitate this, we will employ the Three Horizons Approach. This method makes implicit knowledge and assumptions about the future explicit, examines emerging changes, and ultimately develops actions that bridge the gap from today to tomorrow.

We invite participants to envision the futures of peatlands they wish to see thrive–this is referred to as Horizon 3. Additionally, we encourage participants to reflect on the current business-as-usual practices in peatland management and the potential scenarios that may arise from this–termed Horizon 1.

The workshop's goal is to identify the space between these two horizons, namely, the transformation from the status quo to a desired positive future state for peatlands. Consequently, we aim to outline the transformation pathway, which we call Horizon 2.

The guiding questions for our workshop are: a) What visions of peatlands and what underlying assumptions exist among the participants? b) What is the current status quo of peatlands and their agricultural use? c) How can these visions inform transformation pathways?

Through this exercise, we will refine our understanding of target knowledge–knowing where we want to go–and reflect on how we can facilitate meaningful transformation.

Outline

- Welcoming and short ice breaker
- Short input: The science behind visioning exercises and the Three Horizon Approach
- Working on future visions and the business-as-usual scenarios
- Identifying the transformation pathways in the plenary
- Reflection on the Three Horizons Approach
- Wrap Up & take-home messages

Digitalized peatland vegetation mapping to derive greenhouse gas emissions – the GEST-APP

Milan Bergheim, Dr. Daniel Lars Pönisch, Timothy James Husting, Henriette Rossa, Linda Heutlin, Nadia Schrott

Peatlands represent vital ecosystems that play a significant role in carbon storage and biodiversity. Vegetation and paludiculture mapping are an essential component of monitoring peatlands and verifying credits based on ecosystem services such as carbon credits. The commodification of peatland ecosystem services has the potential to support the financing of rewetting and renaturation measures.

The VALPEATS Group has developed an application for the purpose of facilitating standardised and digital peatland vegetation mapping. It enables users to pre-analyse peatland sites using satellite images, define regions of interest, and subsequently gather peatland-specific plant species in the field. The identification of plants is based on a comprehensive botanical inventory that supports various spellings and the use of auto-fill to ensure a rapid, seamless, and efficient workflow. Participants will engage in hands-on activities using the GEST-App to record plant data in a simulated peatland environment. The workshop will cover the app's functionalities, including RTK GNSSS integration, data input, visualization, and export. Attendees will learn how to interpret the results at different rewetting scenarios.

By the end of the workshop, participants will be introduced to the use of the GEST-App, and the interpretation of collected data in the context of the assessment of greenhouse gas emissions. The workshop will also feature a discussion part to explore potential future developments of the

GEST-App. We cordially invite you to participate in this interactive workshop and discover how digitalisation can support peatland studies.

Mycelial bioconversion potential of paludicultural feedstocks (*Typha sp.* and *Salix sp.*)

Peter Petros, Dr. Pauliina Lankinen, Dr. Sylwia Adamczyk, Kalle Kaipanen, Dr. Petri Kilpeläinen, Dr. Janne Kaseva, Prof. Kirsi S. Mikkonen, Dr. Tuula M. Jyske

Paludicultural biomass production offers significant annual yields and regenerative growth without the need for soil turnover or re-planting. However, paludiculture as an economic land-management practice remains highly under-adopted compared to conventional agriculture and forestry, particularly in Nordic peat-dominated regions, due largely to a lack of industrial applications and market awareness. Mycelial bioconversion is a growing bio-based industrial process for transforming a wide array of bio residues and feedstocks into new value chains. Little research has been conducted on mycelial bioconversion efficacy of paludicultural feedstocks. Our study investigated the bioconversion ability of wood-decay basidiomycete species (*G. lucidum, F. fomentarius, P. floridanus, T. hirsuta, T. versicolor*) on pre-extracted biomass (PEB) and unextracted biomass. Pre-extraction types were pressurised hot water extraction (PHWE) and hydrodynamic cavitation extraction (HCE), with PHWE utilised on short-rotation coppice (SRC) willow (*Salix schwerinii x Salix viminalis*.) and HCE on perennial cattail grass (*Typha latifolia*) and SRC willow, both of which are major cold and water-tolerant paludicultural crops. Mycelial bioconversion was primarily assessed with hyphal extension and ergosterol content, with each basidiomycete species exhibiting different growth traits on PEB and unextracted biomasses. Mycelial bioconversion with *Fomes fomentarius* yielded statistically significant ergosterol content in both willow and cattail PEB and unextracted biomasses compared to other fungal species. Extraction type had a significant impact on mycelial bioconversion efficacy, with hydrodynamic cavitation pre-extracted willow and cattail biomasses performing comparably to unextracted biomasses across all species. These results highlight the potential of hydrocavitation-extraction as a value-added process prior to mycelial bioconversion of paludicultural willow and cattail biomasses, shedding light on the added valorisation potential of mycelial bioconversion for cascaded, extracted bioresidues.

Workshop participants will get a chance to see and handle fungal cultures utilised, intermediate and final form mycelium materials and learn more about the entire process chain.

Unlocking the potential of alternative fibre sources: Challenges, solutions, and the path forward

Prof. Kristiina Lång, Dr. Alba Alonso Adame, Dr. Pedro Varão, Dr. Gabrielle Rabelo Quadra

Adopting alternative fibrous feedstocks in industrial production presents numerous opportunities but significant bottlenecks. This roundtable discussion will bring together industry representatives, primary producers, and policymakers to exchange insights on overcoming key challenges and identifying viable solutions. Key discussion topics are: (1) addressing the biggest obstacles in integrating fibrous feedstocks and exploring practical innovations; (2) defining critical quality parameters and identifying gaps in certification, including the potential for CE certification; (3) examining the role of carbon credits, sustainability requirements, and market dynamics in decision-making; and (4) discussing legal uncertainties and policy gaps that impact the scalability of alternative fibre sources. The 'FIBSUN' and 'PALUWISE' projects are among the organisers. They support the development of resilient and competitive production systems while enhancing the provision of ecosystem services from degraded soils. This discussion will contribute to the ongoing dialogue on sustainable industrial transitions. While the session is closed to ensure focused exchange, we may publish a public summary or paper with the consent of participants to share key insights with the broader conference community.

Exploring stakeholder perspectives and incentive mechanisms in peatland rewetting: an experimental game on decision-making and cooperation

Tim Kleineberg, Bettina Tacke, Karoline Hemminger

Peatland rewetting is a key strategy for climate change mitigation, water balance restoration, and long-term agricultural sustainability. However, land users often perceive insurmountable barriers due to economic, legal, and political uncertainties. In this workshop we will conduct an experimen-

tal game to explore stakeholder perspectives and the role of financial incentives in the process of rewetting.

We used results from two studies conducted in Brandenburg to formulate typologies of stakeholders in the process of rewetting: (1) a qualitative analysis based on 30 guided interviews with land users, regional stakeholders, and experts, applying a grounded theory approach, and (2) a stakeholder network analysis. Based on these typologies, the participants will take on the roles of landowners, farmers, and other stakeholders in an experimental game.

The game includes multiple scenarios, such as market-driven mechanisms, local actor interventions, and environmental constraints. By discussing opportunities and obstacles to rewetting under different economic and governance conditions, the game will simulate decision-making under diverse financial incentives and cooperation dynamics.

The game concludes with a reflection session involving the participants, allowing for a deeper evaluation of strategies and experiences. The outcomes will be assessed based on rewetting success, economic viability, and socio-economic behaviour.

This workshop aims to foster a deeper understanding of incentive-based decision-making in peatland rewetting, examining socio-behavioural aspects that influence these processes and providing valuable insights for policy design and stakeholder engagement strategies. The workshop is organized in cooperation with the two Brandenburg peatland pilot and demonstration projects ‘WetNetBB’ and ‘BLuMo’.

Country specific definitions of organic soils

Sebastian Heller, Dr. Stefan Frank, Dr. Bärbel Tiemeyer, Malina Kuwert

Paludiculture is commonly defined as peat-preserving land use. However, organic soils can be form from various mire substrates with a high carbon content (e.g. Gyttja). Cultivated peatlands can be significantly altered by peat extraction (e.g. Fehnkultur), mineral cover, deep ploughing (e.g. Moorkultisole) or severe degradation (e.g. Wasted peat). These uniquely carbon-dense soils can be categorised using a variety of interna-

tional and national classification systems. The objective of this workshop is to compile various definitions of organic soils, considering their genesis, as well as their physical and chemical properties. Participants are encouraged to contribute additional definitions relating to peatlands. A focal point of the workshop will be the revised German Soil Survey Guidelines (KA6). This field-tested manual enables the precise characterisation of severely degraded organic soils, as well as the identification of new peat formation after rewetting. The aim is to provide an overview ranging from simplified concepts to detailed classification systems for organic soils, with the intention of improving both scientific work and everyday communication on peatlands.

The main points of the workshop are given below. The schedule can be modified according to the available time.

- Presenting and complementing an overview of carbon-rich mire substrates (criteria: substrate genesis and distinct carbon content).
- Presenting and complementing the definitions of peat and other organic soils (criteria: diagnostic horizons, substrates, carbon content, depth and cultivation practices).
- German Soil Survey Guidelines (KA6) emphasising e.g., Gyttja soils, new peat accumulation, Moorkultisole.
- Discussion of other classification schemata for a detailed organic soil classification

Smart Paludiculture Workshop

Dr. Saeed Hamood Alsamhi, Dr. Niall O'Brolchain, Dr. Al Margaret Waskow

The feasibility of peatland rewetting projects depends on economic and governance structures that allow and fund the work to be done, while the management of successful rewetting projects depends on appropriate monitoring, data quality, and decision-making. This workshop explores how smart humans, both technically adept and non-technically adept, can work with smart technology-enhanced policy analysis and computational tools including Artificial Intelligence (AI) to support sustainable paludiculture, either by aiding the creation of frameworks and infrastructure that enable paludiculture project success, or by analysing the data of precision agriculture tools in paludiculture project management. The focus of the

workshop will be on the intersections between evidence-based policies and financial frameworks, crop-monitoring data analytics, and AI predictions of emissions, peatland health, and nutrient concentration under different scenarios. With AI-driven models additionally capable of evaluating biodiversity, identifying patterns in species distribution, predicting the ecological impacts of rewetting efforts, or even providing in-depth analyses of large policy collections, this workshop aims to bridge the gap between AI, agricultural data collection, and policy frameworks to support peatland paludiculture management to be more efficient, ecologically conscious, and economically viable. We invite academics, policymakers, and business leaders to work together and explore the potential of AI-powered smart paludiculture.

Paludiculture in the CAP: current experiences and recommendations for post 2027

Dr. Sabine Wichmann

With the current EU funding period (from 2023), the European Commission has paved the way for reducing the discrimination of paludiculture compared to drainage-based peatland use, providing incentives for raising water levels and introducing a new minimum standard for peatland protection. However, implementation at national level varies widely between EU Member States. In this workshop, we want to exchange the current experiences from different countries on the following questions:

- How can paludiculture be eligible for direct payments (CAP, 1st pillar: wet grassland, agricultural product, new derogation rule)?
- Which payment schemes are introduced for voluntary measures (CAP, 2nd pillar: eco-schemes, agri-environment-climate measures) and investment measures? Can incentives be combined (e.g. public and private instruments)?
- How is the minimum standard for the protection of peatlands and wetlands (GAEC 2) defined?

At the beginning, 2–3 short impulse presentations will introduce the pros and cons of CAP implementation in selected countries such as Germany, the Netherlands and Finland. This introduction will open the floor for lessons learnt from other peatland rich Member States. Ideally, the contributions will

also go beyond the texts of the national CAP strategic plans by addressing experiences with specific paludiculture sites and farmer acceptance.

Finally, the joint discussion will be used to develop policy recommendations for the next EU funding period post 2027. The results will be taken up by the EU Horizon project 'Paludi4All' (socio-economic and climate and environmental aspects of paludiculture) for policy advice at EU level.

WETBEINGS: transdisciplinary and mutuality based approaches to peatland living

Suza Husse, Andreas Haberl, Dr. Jūratė Sendžikaitė

The workshop creates a space for joined thinking about liveable futures widening paludiculture and wet peatland horizons. It is based on the transdisciplinary project 'WETBEINGS' developed in and with the Aukštumala peatland in spring and summer 2025 with the aim to gather diverse approaches to living in and with peatlands based on mutuality and sustainable survival for the whole of the ecosystems, including humans. WETBEINGS brings together artists, researchers, peatland custodians and conservationists, peatland people living, working and making culture in peatlands.

During the workshop we will share findings from engaging with Aukštumala as a living peatland archive and biodiverse organism, with a focus on dialogues between local peatland people, cultures and economies and trans-local, scientific, artistic, eco-political and agro-economic expertise from different fields of peatland conservation and rewetting. Participants will learn about and experiment with artistic, transdisciplinary and community-based practices and catalyst formats designed to raise awareness on peatland ecosystem services, to retrain our senses to be attuned to our ecological interdependencies and WETBEING, to foster acceptance for needed transformations towards wet peatlands and to overcoming colonial narratives of drained=progress.

WETBEINGS is a project of the arts and research platform Sensing Peat at the Michael Succow Foundation with the Foundation for Peatland Conservation and Restoration, Lithuania, WETBEINGS is organised with 'The Venice Agreement' for Peatlands and 'RePeat'.

Paludiculture under National Restoration Plans and Carbon Removals and Carbon Farming Certification Regulation: Country experiences and opportunities

Elisabet Rams, Sophie Hirschelmann, Jan Peters, Marie Lorenz

The EU Nature Restoration Regulation (NRR) mandates Member States to assess and put restoration measures on degraded peatland habitats, and drained peatlands in agricultural use, as part of their National Restoration Plans (NRPs). Perceived by many as a potential 'game changer', particularly for peatlands in agricultural use, the NRR could be a tool to trigger large-scale transformation (and restoration) and to help slow and halt the catastrophic decline of biodiversity, while stimulating sustainable and resilient economies. That potential, however, depends entirely on effective implementation and sufficient funding. At the same time, the EU Carbon Removal Carbon Farming (CRCF) Regulation presents an opportunity to finance restoration efforts by certifying emission reductions of peatland rewetting.

This workshop will explore how NRPs can integrate paludiculture as part of the restoration measures and how CRCF can help bridge economic viability gaps. While paludiculture value chains and markets are still in development, the voluntary carbon market under CRCF could provide critical financial incentives to scale up sustainable wet peatland use.

Through a combination of 1–2 technical inputs and a world café discussion, participants will exchange experiences on integrating paludiculture into NRPs, financing mechanisms for NRP, and governance challenges, fostering peer learning and cross-country collaboration.

Guiding questions:

- How can paludiculture be effectively integrated into National Restoration Plans to meet both ecological and economic objectives?
- What role can the CRCF play to meet the peatland targets under NRPs?
- What challenges and opportunities have emerged during the first year of developing NRPs in relation to peatland restoration and paludiculture?

Promoting grassroots uptake of paludiculture by farmers through on-farm trials and cultural alignment

Dr. Doug McMillan, Dr. Filipa Ferraz, Dr. Bastiaan Molleman

500,000 hectares of drained peatland in Europe require restoration annually between now and 2050, without sacrificing food security and a supply of sustainable raw materials. This can only be achieved with the large-scale uptake of diverse paludiculture crops requiring widespread cooperation from farmers and landowners. Green Restoration Ireland (GRI) implemented the Farm Carbon EIP which focused on finding solutions to reduce greenhouse gas emissions from peat grasslands. It took a whole-farm approach providing different 'entry points' for various farm actions and established Ireland's first on-farm paludiculture trials to provide answers to farmer concerns around rewetting and loss of productive land. Cultural alignment with a 'farmer perspective' was sought through trials of appropriate paludiculture crops (grasslands) and for higher income streams using drained marginal lands. This approach registered a 70% success rate for farmers adopting some level of grassland rewetting – a higher success rate would have been achieved with greater project longevity.

The session will open with a brief five to ten minutes presentation on the Irish 'experience' with paludiculture followed by a collaborative brainstorming session with participants to identify the key factors that would motivate farmers to make the transition. This comprehensive understanding of the barriers and enablers to grassroots adoption of paludiculture will inform strategies for change.

Co-creation processes – a way to successful peatland restoration und paludiculture implementation?

Marie Lorenz, Sophie Hirschelmann, Inga Lutosch

Reducing greenhouse gas emissions from peatlands is an urgent necessity. However, rewetting peatlands is progressing too slowly in terms of achieving climate targets. Still, processes to achieve peatland restoration

are complex, take time and pose many challenges, especially for farmers from a business and agronomic perspective. Various questions arise in this context, such as: How can farmers overcome economic challenges associated with the conversion to wet peatland use? How to design successful customised solutions enabling value creation in wet peatlands on a long-term basis?

Finding answers to these questions requires the cooperation of many different actors and joint solution development. If the implementation of peatland protection isn't to be designed from above, it requires equal participation, collaborative approaches and, in the best case, ownership of the entire process by all involved. We think that co-creation, which can be understood as processes bringing together diverse groups that iteratively create new knowledge and practices, can be a promising approach here.

In this workshop, we want to address the challenge that lies between the time pressure on the one hand and the need for successful participation to find well-accepted solutions that work for many on the other.

After briefly introducing the main criteria and instruments of co-creation, we will invite participants to 'take positions' based on opposing hypotheses and to formulate and discuss their own priorities in implementing participatory approaches for peatland restoration. We will look at different project phases in which participation or co-creation can take place, at different target groups and at societal effects. Building on this, we will invite participants to share experiences on approaches and instruments contributing to achieve peatland restoration and paludiculture.

After the workshop, the participants should have gained a clearer attitude towards designing co-creation processes and learnt about possible tools to apply.

Workshop on Peatland-PV: Integrating diverse perspectives for holistic research

Carola Kiene, Carl Pump, Monika Hohlbein, Andrea Krüger, Prof. Dr. Jürgen Kreyling, Agnes Katharina Wilke, Dr. Franziska Tanneberger

In the projects 'Moor-PV' and 'MoorPower', we are analysing the effects of combining rewetting with the construction of photovoltaics on peatlands

that were previously used for agriculture. We are investigating technical, environmental, ecological, socio-economic and legal aspects over the next three years. While these pioneering projects take a multi-perspective approach, some viewpoints remain under-represented in existing research.

We invite conference participants from all disciplines and nations to join us in a workshop, to identify knowledge gaps, integrate diverse viewpoints and develop a more comprehensive understanding of peatland-PV. During this workshop, we will use the world café method, a structured discussion format that encourages dynamic knowledge exchange. Participants will be divided into small groups, with each group tackling key questions on Peatland-PV that have been pre-defined by our research team. The groups will then rotate to ensure that all participants engage with all topics, while designated observers document insights for a concluding synthesis.

This workshop offers a unique opportunity to not only present research findings but also actively generate new qualitative data on social, economic and environmental perceptions of Peatland-PV. By engaging participants in direct dialogue, we aim to collectively shape future research directions on Peatland-PV.

ABSTRACTS OF POSTER PRESENTATION: Ecosystem Services 1

How much water is required for *Typha* paludiculture?

Philipp-Fernando Köwitsch, Dr. Bärbel Tiemeyer, Dr. Christian Brümmer

The drainage-based agriculture on peatlands leads to high greenhouse gas emissions and significant nutrient runoff into adjacent water bodies. Paludiculture, the peat-preserving, wet cultivation of peatlands, can mitigate these negative environmental impacts while maintaining productive land use.

For the successful cultivation of fen paludiculture crops such as cattail (*Typha latifolia* and *Typha angustifolia*), high water levels and sufficient nutrient supply are essential. However, ensuring adequate water availability for large-scale paludiculture is a widely debated issue, especially in the context of increasing water scarcity. Although evapotranspiration represents a major water loss pathway in a *Typha* paludiculture system, reliable data on the water requirements of cattail cultivation in temperate regions are still lacking. Nevertheless, large-scale paludiculture could also help mitigate flood peaks, as these systems are capable of temporarily storing large amounts of water.

One of the key objectives of the joint project 'Sustainable Production and Utilisation of Cattail on Fen Sites in Lower Saxony' (RoNNi) is to quantify the water balance of *Typha* paludiculture. For this purpose, polders of approximately 8 hectares will be established in two model regions in Lower Saxony (Emsland and Cuxhaven) to cultivate *Typha angustifolia* and *Typha latifolia*. All surface inflows and outflows will be recorded, and evapotranspiration will be measured using the eddy covariance technique. Additionally, groundwater inflow and percolation losses will be calculated using geohydrological modelling.'

Beyond gaining insights into the water requirements of cattail paludiculture, the project results will also serve as a basis for calculating nutrient inputs and outputs. Running until 2032, the RoNNi project aims to provide crucial findings on water and nutrient dynamics in large-scale *Typha* paludiculture systems.

The water balance of a 10 ha cattail cultivation test site in NE Germany

Dr. Matthias Lampe

In the planning for the cattail trial field of the 'Paludi-PRIMA' project, the water demand of the crop to be established was rather uncertain. The irrigation requirement was estimated to lie between 20000 and 40000 m3 a-1 on average and to probably not exceed 80000 m3 a-1 in years with unfavourable atmospheric conditions. Since the first growing season after construction in 2019however, the pumping volumes have tended to be closer to the upper limit of these figures, with a mean of around 60000 m3 a-1 biased by a single low value near the other extreme. The unexpected losses are largely caused by seepage into the large aquifer formed by glacio-fluvial sediments beneath the thick peat layer. The losses could initially only be estimated from water level changes during winter and consistency checks of the yearly water balances. Several drilling profiles, measurements of permeability and the installation of piezometer tubes in the field and its neighbourhood now provide the basis for proper groundwater modelling. With the new data, the water balances are reviewed and used to obtain estimates of the evapotranspiration as the unknown residual.

Klimafarm: Paludiculture in Northern Germany – Planning, rewetting and collecting first data

Dr. Sebastian F. A. Jordan, Christof Kluß, Frank Lemke, Rita Kopp, Katrin Helmich, Prof. Dr. Friedhelm Taube

In response of the urgent need to mitigate global warming, most nations are striving to reduce anthropogenic greenhouse gas emissions. Germany for instance, committed itself to carbon neutrality by 2045. However, even the complete cessation of emissions from the industrial sector and fossil fuel combustion will not be sufficient, as the Agricultural and Land Use, Land Use Change and Forestry (LULUCF) sector ranks as the 4th largest anthropogenic source of greenhouse gases. Drained and converted peatlands are one of the largest contributors in this sector, despite their relatively small total area. Thus, protecting and conserving these large carbon stocks by rewetting is urgently needed. One way to stop the

degradation of such soils while enabling further usage is: paludiculture.

Here, we will introduce the project 'Klimafarm', one of four German pilot initiatives focused on rewetting peatlands while exploring various paludiculture methods that aim to be economically viable for farmers. Our part of the project involves the monitoring of greenhouse gas emissions (CO_2, CH_4, N_2O) through eddy covariance and chamber measurements before and after rewetting of three extensive used areas and two intensive used reference sites. Furthermore, we will present our approach and discuss first data.

Hydrological studies on wet meadow paludicultures in the LivingLab Teufelsmoor

Antonia Fels, Dr. Bärbel Tiemeyer

The use and simultaneous rewetting of peatland sites is becoming an increasingly important issue in today's society. The hydrology and soil characteristics of an area are important factors that determine whether a site is suitable for certain paludicultures or other types of use and their effects on greenhouse gas exchange and nutrient dynamics.

Osterholz-Scharmbeck (Northwestern Germany) is one of the districts in Germany with the highest share of peatlands and other organic soils. Here, in the Teufelsmoor, retention areas have been managed for over 10 years, inundating them from January to April/May. This is intended to preserve species-rich wet meadows and to protect meadow birds. These species require low intensity management, but there are currently no options for utilising the harvested biomass. The project 'LivingLab Teufelsmoor – climate and nature protection-oriented wet management of wet peat soils with innovative biomass utilisation in the district of Osterholz' aims to establish an innovative value chain, achieve nature conservation goals and reduce greenhouse gas (GHG) emissions.

Water levels need to be known to understand GHG emissions and properties of the biomass. Thus, peat and ditch water levels in a retention area are monitored with dataloggers at 31 sites in order to calculate water levels of the whole area and to inform on possible necessities to optimise the hydrological situation. In addition, at a moist meadow and a reference area, not only water levels but also the water balance will be measured. To

do so, discharge measurements will be carried out and data from eddy covariance measurement systems will be used to determine evapotranspiration. Here, we will present the first year of hydrological data. In future, results will enable upscaling of the measurement results of GHG emissions and provide information on the water requirements of wet meadow paludicultures.

Phosphor pools in peat and other organic soils: baseline data and sampling protocols for paludiculture

Sebastian Heller, Dr. Bärbel Tiemeyer, Dr. Ullrich Dettmann, Philipp-Fernando Köwitsch, Arne Heidkamp, Malina Kuwert, Sharon Laqua, Dr. Arndt Piayda, Bernd Schemschat, Dr. Stefan Frank

Labile or plant-available phosphorus (P) plays a key role in biomass production, affects the soil organic matter mineralisation and is susceptible to leaching losses. This critical P pool is commonly assessed using agronomic soil tests (calcium-lactate extraction, PCAL), while the redox-sensitive P is extracted using a bicarbonate-buffered dithionite solution (PDT). However, the few studies available on peat and other organic soils often characterise P stocks over broad depth increments or focus primarily on leaching risks. Consequently, there is an urgent need for a comprehensive investigation of P stocks to assess both beneficial and potentially detrimental effects of labile P in paludiculture systems, namely its role in plant nutrition and eutrophication risk. Here we analyse the labile P pool (PCAL and PDT) from about 100 sites, covering more than 500 soil horizons from the German Peatland Monitoring Programme. The dataset spans a wide range of organic soil types, land use practices, and water management regimes. Additionally, data from a fen paludiculture project are included to investigate the spatial and temporal variability of PCAL. The results will provide a baseline dataset for labile P pools in various organic soils, considering land use factors such as management intensity and water management. Moreover, an appropriate soil sampling protocol will be derived specifically for paludiculture sites.

Potential of *Sphagnum* paludiculture for water purification and element sequestration: insights from a field-scale topsoil removal experiment

Dr. Gabrielle Rabelo Quadra, Prof. Ralph J.M. Temmink, Sannimari Käärmelathi, Matthias Krebs, Dr. Gijs van Dijk, Prof. Alfons J. P. Smolders, Adam H.W. Koks, Dr. Greta Gaudig, Dr. Christian Fritz

Sphagnum paludiculture as an alternative to drainage-based peatland agriculture may effectively contribute to mitigating environmental challenges, such as local and regional downstream pollution, particularly concerning nitrogen (N), potassium (K), and phosphorus (P). However, its broader water purification potential remains under explored, as most research has focused on helophytes. This study examines the ability of *Sphagnum* to retain nutrients and trace elements and its impact on water quality under different topsoil removal (TSR) strategies. Over two years (the third and fourth years after site installation), we monitored *Sphagnum* biomass and water quality under three treatments: no topsoil removal (TSR0), 5–10 cm removal (TSR5), and 30 cm removal (TSR30, the common practice). We quantified carbon (C), N, P, K, sulphur (S), iron (Fe), manganese (Mn), arsenic (As), cadmium (Cd), chromium (Cr), and lead (Pb) in *Sphagnum* biomass, pore water within the fields, and surface water in surrounding ditches. C and N sequestration were similar in TSR5 and TSR30 but lowest in TSR0. P sequestration was highest in TSR30. Sequestration of Fe, Mn, Cr, and Pb was also higher in TSR30, though TSR5 showed comparable results, while TSR0 had the lowest values. As and Cd sequestration were similar in TSR30 and TSR5. Porewater N, P, Fe, and Mn concentrations were lowest in TSR30, whereas S concentrations peaked in this treatment. Similarly, surface water S concentrations were highest in TSR30, along with elevated ammonium (NH_4^+) levels. In contrast, P, Fe, and Mn concentrations in surface water were highest in TSR0. Mn concentrations were lowest in TSR5. In conclusion, to enhance the water purification potential of Sphagnum paludiculture, moderate topsoil removal (5–10 cm) appears to be the optimal strategy. It effectively reduces nutrient and trace element concentrations while maintaining *Sphagnum* growth.

Boreal *Sphagnum* farming for increased biodiversity and decreased greenhouse gas emissions

Dr. Hannah M. Silvennoinen, Dr. Carl-Frederik Johannesson, M. Grygoruk, M.O. Kyrkjeeide, K. Rydgren, J.K. Töpper, K. Broch Hauge

Interest in establishing *Sphagnum* paludiculture is on the rise. To date, trials have shown that *Sphagnum* paludiculture can reduce both greenhouse gas emissions and pressure on fossil peat extraction. However, little is known about the potential of farming *Sphagnum* in the boreal zone where a substantial proportion of drained peatlands are used for forestry, in addition to industrial peat extraction. In the 'PEATWAY' project we will establish *Sphagnum* farming field trials at two recently rewetted sites close to Oslo, Norway: (1) a site where peat extraction ceased in the 1950s and (2) a site that was used for Norway spruce rotation forestry until 2024. We will study the carbon balance (net ecosystem exchange and CH_4 fluxes) at the Sphagnum farming trials and adjacent sites in which (1) current vegetation is removed and left as bare peat, and (2) where vegetation is removed, and *Sphagnum* is actively re-established using the moss layer transfer technique. *Sphagnum* biomass production and plant biodiversity will also be monitored at all fields. Here we will present the project set-up in closer detail and show initial results from the first year of the field experiment.

The effect of restoration techniques on the carbon savings potential of a raised bog

Elena Aitova, Dr. Terry R. Morley, Dr. Florence Renou-Wilson, Dr. David Wilson, Dr. Shane Regan

Peatlands are critical ecosystems that serve as one of the largest natural terrestrial carbon stores. According to the latest research, Irish peatlands emit 1.9 Mt C y^{-1} annually, indicating the need for a national climate policy to prioritise peatland restoration.

This study aimed to evaluate the effect of rewetting on greenhouse gas (GHG) emissions in a degraded raised bog by measuring carbon dioxide (CO_2) and methane (CH_4) fluxes over a three-year period before and following restoration. We measured GHG fluxes from four distinct ecotypes

in drained and rewetted areas at Cloncrow bog, Co. Westmeath, as part of the INTERREG NWE 'Care-Peat' project.

Restoration works included installing 991 m of peat dams and 865 m of trench cell bunding over 32 ha. Our results indicate that the annual water level depth was within 10cm below for all rewetted areas, however, the rewetting effect varied in the high bog and cutover areas due to site-specific conditions. After three years of rewetting, we found a ca. 30% increase in the extent of active raised bog and bog-associated vegetation and a reduction of carbon emissions between 59 to 218 g C m-2 y-1. Our findings improve our understanding of the restoration of drained domestic peat extraction sites, one of Ireland's largest land use categories and the second largest C emission contributor.

A review of greenhouse gas emissions and removals from Irish peatlands

Elena Aitova, Dr. Terry R. Morley, Dr. David Wilson, Dr. Florence Renou-Wilson

Healthy, fully functioning peatlands are the most effective natural carbon store. When disturbed, peatlands release greenhouse gases into the atmosphere and lose carbon via surface runoff. Since peatlands cover around 20% of the land area in the Republic of Ireland, their management is of particular significance in reducing national greenhouse gases (GHG) emissions.

Ireland is obligated to report anthropogenic emissions from peatlands. Ireland's annual National Inventory Report complies with the methodology described in the Intergovernmental Panel on Climate Change (IPCC) Guidelines and the Wetlands Supplement 2013. They provided globally applicable 'default' emission factors (EFs) for calculating emissions and removals from drained and rewetted peatlands. However, the default EFs were based on field data often collected from geographical areas climatically and ecologically dissimilar to Ireland. Moreover, these EFs were limited by data availability and the level to which they could be disaggregated. In our work, we developed further stratification of peatland land use categories based on peatland characteristics and management in Ireland.

We reviewed peatland carbon (C) flux studies within Ireland, extracting data for carbon dioxide, methane, and nitrous oxide fluxes, as well as fluvial losses and here proposed preliminary country-specific EFs for various peatland land uses and management practices. Using our derived EFs and latest areal estimates, national emissions from peatlands (excluding horticulture and combustion) amount to 1.9 Mt C y^{-1}. Our analyses suggest that peatland management through rewetting and restoration has the potential to substantially reduce emissions from drained peatlands, and this paper attempts to quantify this reduction. This is critically important given the large areas of degraded peatlands that have been earmarked for rewetting in the next decade.

Methane and nitrous oxide measurements on a water buffalo meadow with a dynamic chamber system

Marie-Luise Dexl, Mridul Trehan, Florian Braumann, Carla Bockermann, Martina Schlaipfer, Fabiola Decker, Dr. Janina Klatt, Heta Meyer, Prof. Dr. Matthias Drösler

Nature conservation associations promote grazing on rewetted peatlands as a sustainable land use alternative due to its potential to enhance biodiversity compared to conventional agricultural practices. However, the greenhouse gas (GHG) emissions from such ecosystems remain largely uncertain.

To address this knowledge gap, an Eddy covariance flux tower was installed in a rewetted fen peatland in the Swabian Donaumoos near Leipheim, southern Germany. The site, previously used for drained croplands, has been converted into a water buffalo pasture. A preliminary analysis of data collected in 2023 indicated substantial methane (CH_4) emissions, while nitrous oxide (N_2O) fluxes were not measured.

In response, dynamic chamber measurements were introduced in 2024 to quantify N_2O and CH_4 fluxes within the footprint of the Eddy tower. Four distinct vegetation cover types were selected for analysis: bare peat, short grass, rushes, and sedges. Results confirm seasonal variations, with higher GHG fluxes observed during the summer and lower fluxes in winter, likely driven by soil temperature fluctuations. Furthermore, it is hypothe-

sised that areas with lower vegetation cover will exhibit elevated N_2O emissions, while those with higher vegetation density will be associated with increased CH_4 fluxes.

Soil condition and paludiculture potential on a post-fire fen in Southwestern Poland

Prof. Dr. Adam Bogacz, Agnieszka Dradrach, Magda Debicka

Paludiculture is beneficial for the preservation of peatlands after fire events, as it maintains high water levels, prevents peat decomposition, and reduces carbon emissions. This study evaluates the viability of paludiculture management on a fen peatland affected by fire in the temperate climatic zone of south-western Poland. The investigated area had been impacted by historical agricultural drainage and a fire in 2008. Field surveys and soil sampling were conducted in June 2013, when the fen was flooded. Subsequent analyses included soil morphology and physico-chemical properties to classify the soil and assess its hydrophobicity. MED values ranged from 0 to 24%, indicating a spectrum from hydrophilic to strongly hydrophobic conditions. The highest degree of secondary transformation (W1 index of 0.42–0.56) was observed in soil profiles no. 2 and 3. However, profiles no. 1 and 4 showed greater potential for paludiculture due to their peat composition. The implementation of paludiculture is expected to support sustainable agriculture. In contrast, conservation tillage or aqua-agro management is recommended for areas with advanced secondary transformation to prevent further organic matter depletion.

Enhancing climate and community resilience through tropical peatland restoration in west Kalimantan, Indonesia

Dr. Nisa Novita, Dr. Rasis Ritonga, Adi Gangga, Egydia Saputri

With half of Indonesia's peatlands degraded or drained, their restoration offers a cost-effective natural climate solution that can help the country meet its climate commitments while providing significant benefits to local communities. In Mempawah and Kubu Raya regencies in West

Kalimantan, Indonesia, we have undertaken peatland restoration projects, including installing canal blocks for peat rewetting and supporting communities in adopting sustainable livelihoods to reduce forest pressure. To evaluate the climate benefits of peat rewetting, we have monitored long-term greenhouse gas (GHG) emissions across different peatland land cover types. Using a LiCOR portable gas analyser with the closed-chamber method, we regularly measure CO_2, CH_4, and N_2O emissions, along with groundwater levels, soil properties, radiocarbon dating, and other climate parameters. For community interventions, we've established field schools to promote reduced chemical fertiliser use, developed agroforestry demonstration plots, and integrated peat conservation into medium-term village planning. In oil palm plantations, our findings show that rewetting drained peatlands reduced heterotrophic respiration by 34 % and total respiration by 20%. However, rewetting in these plantations does not reduce CO_2 emissions to the same extent as in secondary forests, likely due to differences in vegetation and land management. This highlights the need for community empowerment to complement hydrological restoration as part of a comprehensive peatland restoration strategy.

Effect of solar panels on greenhouse gas emissions in a rewetted peatland

Dr. Cordula Gutekunst, Monika Hohlbein, Hanna Rae Martens, Carl Pump, Prof. Dr. Gerald Jurasinski

Drained peatlands are a strong source of greenhouse gas emissions. Peatland rewetting projects that aim to return sites to their near-natural state may collide with the need for land use in an agricultural or alternative way. The installation of ground-mounted photovoltaic systems might be an economically attractive use option for rewetted peatlands, beside the utilisation with paludiculture – i.e. agriculture and forestry on wet peatlands. In the project 'Moor-PV' we investigate the impact of photovoltaic systems (solar panels) in rewetted peatlands on biodiversity, peat conservation as well as the water and greenhouse gas balances. For the latter we measure fluxes of the three most important greenhouse gases (carbon dioxide, methane and nitrous oxide) under and outside the rows of bifacial solar panels to estimate annual balances at two different solar parks east

and west of a railway line. Preliminary data indicate that solar panels might have a reduction effect on CO_2 emissions in recently rewetted peatlands. Once gas fluxes are completely analysed, the impact of solar panels on the microclimate and their shading effect as a driver for potentially altered vegetation growth will also be investigated. Our results will help to foster our understanding of the greenhouse gas exchange in this specific environment and, thus, inform solar park operators and farmers about climate friendly use options on rewetted peatlands.

Lessons Learned 1 + Biodiversity

PALUS DEMOS: Paludiculture large-scale demonstrations – Advancing solutions for degraded peatlands

Janice Neumann

Degraded peatlands are a significant source of greenhouse gas emissions and environmental degradation, yet they offer untapped potential for sustainable land use. The EU Horizon project 'PALUS DEMOS' addresses this challenge by establishing three large-scale (>50 ha) paludiculture demonstration sites in Ireland, the Netherlands, and the United Kingdom. These sites serve as living labs to test and showcase sustainable agricultural practices on rewetted peatlands, preserving peat soils, mitigating emissions, and optimising water management.

Using advanced technologies like remote sensing, drones, and AI, the project develops robust monitoring, reporting, and verification methods to quantify carbon storage and ecosystem services. These tools support scalable, low-cost solutions for carbon markets and policy frameworks. PALUS DEMOS also identifies best practices for transitioning degraded peatlands to productive wet agriculture, focusing on crop performance, soil and water management, and biomass production.

To ensure long-term viability, the project stimulates paludiculture markets by developing business models and supply chains for paludiculture products, such as biomass for horticulture, construction, and bioenergy. By engaging farmers, businesses, investors, and policymakers, PALUS

DEMOS fosters Europe's transition to a biobased circular economy.

Through open data and stakeholder collaboration, the project ensures knowledge transfer and scalability, providing evidence-based recommendations for large-scale adoption. By aligning policies at EU, national, and local levels, PALUS DEMOS addresses governance gaps and supports Europe's climate and sustainability goals.

Can peat moss (*Sphagnum*) be cultivated on formerly drained Dutch agricultural peatlands – lessons learned from pilot projects

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Peatlands are indispensable carbon storages in a world facing climate change, and their restoration is important to reduce carbon emissions and store carbon. Peat mosses (*Sphagnum*) are capable of capturing carbon from the atmosphere and storing it in newly formed peat. Part of the VIP-NL project (VIP-NL: Peat innovation programme Netherlands) tests various methods to cultivate *Sphagnum* in previously drained agricultural peatlands in the Netherlands, both as an potential alternative source of income for farmers (Sphagnum paludiculture) and as a method for fen restoration. Here we present the combined results of different field trials and lab experiments. This will provide insight into growth requirements for *Sphagnum* and methods to meet these requirements in the field.

From previous laboratory experiments, we know that *Sphagnum* does not tolerate high bicarbonate concentrations when inundated. Surface water in Dutch former agricultural peatlands is, however, often characterised by high bicarbonate concentrations. At the largest field site, Ilperveld, a new *Sphagnum* cultivation trial combines water level management with acidified surface water to remove bicarbonate and improve conditions for *Sphagnum* growth. In other pilot studies at Ankeveen and Bûtefjild, the effects of phased mowing, hydrological gradients

and harvesting on *Sphagnum* (re)growth are investigated. Harvested *Sphagnum* biomass will be tested by the horticultural industry to assess its suitability as a growing medium. Additionally, at all sites, carbon removal and storage will be estimated.

Here, we present some lessons learned from our pilot studies. This includes challenges, such as factors hampering *Sphagnum* growth like competition by vascular plants, water level management and peat rot, inhibiting *Sphagnum* growth. The deliverables will include a practical guideline for setting up *Sphagnum* cultivation in former agricultural Dutch peatlands, a rough map of promising areas for *Sphagnum* cultivation and an assessment of the economic and practical feasibility of large-scaled *Sphagnum* cultivation in the Netherlands.

Networking and overarching coordination of large-scale projects for joint recommendations for sustainable paludicultures

Dr. Merten Minke, Dr. Bärbel Tiemeyer, Dr. Franziska Tanneberger, Jannes Säurich

Drained peatlands used for agriculture in Germany are responsible for greenhouse gas (GHG) emissions of about 43 million tonnes of CO_2 equivalents per year. Switching from drainage-based to wet peatland utilisation would strongly reduce GHG emissions and has a large potential to halt peat degradation, reduce nutrient fluxes to receiving water courses, and to improve water retention and biodiversity. However, large-scale conversion to paludiculture is not yet happening due to challenges like complex approval processes, high installation and maintenance costs, limited expertise, unfavourable framework conditions, and a lack of established value chains for the biomass produced.

To facilitate the transition to paludiculture, the German government is funding ten long-term projects. These include nine projects in peatland regions across the country that implement paludicultures on a practical scale to demonstrate all procedures, including planning and approval, rewetting and establishment, management, processing and marketing of the products. Project sites vary with respect to peatland type and site conditions, land ownership and area sizes, former land use and type of paludi-

culture. Within the projects, scientific studies are carried out on the effects of paludiculture on GHG emissions and other ecological parameters, as well as on economic and socio-economic issues.

In order to be able to derive nationwide representative results it is essential that scientific studies are carried out using comparable methods and that the data will be comprehensively analysed. The PaludiZentrale-project is therefore responsible for the overarching coordination, networking and consultation of the nine large-scale projects. This includes harmonisation of the methods, coordinated data management, data synthesis and the development of recommendations for action for economically viable paludicultures. To reach these goals PaludiZentrale established together with the large-scale projects the common network 'PaludiNetz'.

In our contribution we will present PaludiZentrale and PaludiNetz and give insights into the joined work of the PaludiNetz projects.

WetNetBB: Network of model and demonstration projects in Brandenburg's peatland regions

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Brandenburg has extensive fen peatlands with diverse habitats, but they are almost entirely drained and undergoing progressive degradation.

'WetNetBB' aims to demonstrate the unique synergy potential of sustainable peatland uses for climate, water, soil, and biodiversity protection as well as for regional value chains, thus creating acceptance and interest in sustainable peatland use in selected regions of Brandenburg and beyond. The project is funded by the Federal Ministry of Agriculture, Food and Regional Affairs (BMLEH) by the Sondervermögen des Klima- und

Transformationsfonds and Fachagentur Nachwachsende Rohstoffe e.V. (FNR) and organised in four modules:

1. In the land management module, demonstration areas for rewetting are prepared, set up and managed with agricultural innovativeness. In addition, measures to increase biodiversity are tested and specialised technology is tested on a large scale.
2. IIn the biomass utilisation module, processes for the cascading material and energy utilisation of paludi-biomass are developed, demonstrated on a practical scale and introduced to the market in cooperation with processing companies.
3. IIn the transfer and public relations module, an innovation forum for wet peatland use will be created that networks all interested stakeholders with each other, creates opportunities for mutual knowledge transfer and is designed for long-term cooperation.
4. IIn the scientific monitoring module, short-, medium- and long-term interactive effects of wet peatland use, in particular greenhouse gas emissions, hydrology and biodiversity, as well as economic incentives, policy measures and social cooperation are considered and evaluated.

As a result, WetNetBB is intended to act as a catalyst for the transformation to sustainable peatland use by taking up and bringing together these developments.

The project LivingLab Teufelsmoor

Sören Tech, Antonia Fels, Heike Schoof, Tanja Blömken, Dr. Bärbel Tiemeyer, Frank Havemeyer, Theresa Otten, Jan Peters, Jessica Meissner, Katrin Pengelly, Sonja Medwedski, Dr. Sarah Witte, Sebastian Küwen, Dirk Brockmann

In these times of rising temperatures, more frequent extreme weather events and high greenhouse gas emissions, research on climate adaptation and protection strategies is becoming increasingly important. In order to fulfil this goal, the German ministry for agriculture and food (BMLEH) has funded together with the FNR a project that aims to address precisely this issue.

The project is called ‘LivingLab Teufelsmoor – climate and nature conservation-orientated wetland management of peat soils with innovative utilisation

of growth in the district of Osterholz'. The aim of this project in the Teufelsmoor region in northwestern Germany is to raise the water levels on predominantly agriculturally utilised peatland to a peat-preserving level and to establish an innovative value chain for the produced biomass. The aim is to fulfil nature conservation goals and reduce greenhouse gas emissions.

The transdisciplinary joint project supports farmers in developing solutions for economically viable value chains for products from paludicultures. The spectrum of uses ranges from construction and insulation materials to packaging and pulp moulding parts.

The project is being implemented by the Lower Saxony Chamber of Agriculture, the Thünen Institute of Climate-Smart Agriculture, the district of Osterholz, the Lower Saxony Landvolk (Osterholz district association), the Michael Succow Foundation, a partner in the Greifswald Mire Centre, and the TU Dresden.

MOOReturn – Combining peatland climate protection and added value via peatland revitalisation and paludiculture

Roman Adam, Ludwig Bork, Hans Werner, Sophie Hirschelmann, Dr. Uta Berghoefer

Climate protection needs wet peatlands! Peatlands are important carbon reservoirs and when wet, the carbon remains stored in the peat and can even form new peat. They are also extremely important for groundwater and flood protection and the preservation of typical peatland animal and plant species. 95% of Germany's peatlands, which cover around 5% of the country's land area, are drained and mostly used for agriculture. The livelihoods of many landowners and land users are closely linked to the drained peatlands. Drainage-based land use is therefore contrary to climate protection. Peatland revitalisation is the decisive measure to prevent the ongoing anthropogenic emission of greenhouse gases from peatlands and at the same time enable natural carbon sequestration with long-term storage for the future. The concept of paludiculture opens up prospects for adapted use and new opportunities of adding economic value.

The 'MOOReturn' project combines peatland revitalisation with economic value creation in the Malchin project region. Through the gradual

rewetting of several hundred hectares of peatland along the Upper Peene, an annual greenhouse gas reduction of approximately 5,000 tons will be achieved. This interdisciplinary research project, supported by nine partners from science, industry, and local government, explores innovative processing techniques for paludiculture biomass and its diverse utilisation pathways. The focus is particularly on product streams for paper and packaging materials, fibre boards & building materials, as well as chemical raw materials. The deployed florafuel processing plant enables flexible processing of various biomasses, thereby ensuring a resilient upgrade of the value chain. This processing method aims to be residue-free, which also enables research into the production of fertilisers from by-products of the processing chain. In addition to ecological benefits through reduced greenhouse gas emissions and increased biodiversity, economic incentives are created for farmers.

Testing wild plant mixtures for rewetted peatland

Jasmin Hanser, Dr. Carola Blessing, Dr. Julia Walter

Rewetting of drained peatland used for agricultural purposes is an efficient measure for climate protection. Multiple ways of utilisation of rewetted peatlands are necessary in order to enable farmers to continue achieving economic value on these areas. At the same time, more measures to increase biodiversity are needed on agricultural land. Therefore, we aim to develop a wild plant mixture suitable for rewetted peatland and waterlogged conditions that is eligible for biodiversity funding with the potential to be used for biogas production. Funding for flower mixtures suitable for biogas production already exists in Baden-Württemberg (FAKT II E 14/ E15) and other federal states, but currently, there is no mixture suitable for rewetted peatland.

In this pot experiment, 26 different species were tested and individually sown or planted in pots filled with substrate typical for rewetted peatland (high turf content, acidic conditions) in 2024 (n=6). Seven of these pots were randomly placed in a larger container in which the desired water level of -5 cm to 0 cm could be adjusted. Plant height was recorded every three to four weeks, in total seven times until harvest. 14 out of 17 planted spe-

cies and 4 out of 9 sown species had enough biomass to be harvested on 5 September 2024 at 5 cm above ground. The following species showed high aboveground biomass at permanent high water levels: *Lythrum salicaria*, *Mentha aquatica*, *Lycopus europaeus* and *Epilobium hirsutum*.

The experiment will be continued in 2025. All potential species will be sown and overwintered. Additionally, their competitive strength in species mixtures will be assessed.

Genomic analyses & DNA-Barcoding for efficient *Sphagnum* moss differentiation and characterisation

Leon Hanke, Walja Wanney, Nica van Gessel, Dr. Juliana Parsons, Dr. Eva Decker, Ralf Reski

The prevention of further peatland drainage marks an important goal in the fight against climate change with dried areas releasing large amounts of stored CO_2. Reasons for peatland drainage include agricultural exploitation and the extraction of peat. This peat is commonly utilised as a horticultural substrate, especially due to its water retention capability. A promising alternative in similar environments, suitable for cultivation in paludiculture (i.e. wet peatlands) are peat mosses (genus *Sphagnum*). As a key component of the natural peat building process, they exhibit comparable characteristics as white peat. However, to be considered by farmers as a commercial option, large amounts of *Sphagnum* need to be harvested. This in turn requires large amounts of founder or starter material which can be acquired by mass cultivation in controlled photobioreactors.

For such purposes, precise and fast species identification is important to properly characterise samples and facilitate a potential workflow for Sphagnum paludiculture. However, distinguishing these mosses remains a challenging task. Especially laboratory-grown strains can deviate from their wild-type morphology which complicates the correct identification. In this project we aim at establishing a DNA-barcoding workflow to quickly and efficiently differentiate *Sphagnum* mosses on a molecular level. This enables the easy identification of new material and could prevent the accidental release of unwanted moss species or ecotypes.

In connection with this, additional objectives included in-depth ge-

nomic comparisons and analyses to gain more insight into inter- and intra-species relations and similarities. We focus on the degree of differentiation of *Sphagnum* mosses from various geographical origins with the help of two new reference genomes. This could help resolve future questions about the ecological impact of the release of moss material into delicate environments such as peatlands.

Paludiculture with *Typha*: climate protection, economy AND biodiversity?

Wiebke Vogel, Prof. Dr. Dirk Albach

Cattails (*Typha*) are an important crop in paludiculture. Our aim is to learn more about the effects of cattail-paludiculture on biodiversity. Within the framework of the joint project 'Sustainable production and utilisation of cattail on fen sites in Lower Saxony' (RoNNi), we will investigate vegetation, birds, amphibians, grasshoppers and dragonflies on several field sites in the administrative districts Cuxhaven and Emsland in Germany. We study the long-term effects from before establishment in 2024 to 2031 on (prospective) paludiculture-sites with cattail and two kinds of reference areas: with natural reeds and with the cultivation form before the establishment of the paludiculture.

The following research question will guide our methods: How does the occurrence of vegetation, amphibians, birds, grasshoppers and dragonflies develop over the years on new paludiculture-sites compared to the areas of reference?

What is the effect of the soil seed bank: a treasury of biodiversity or threats to cattail?

A comparison of natural *Typha* stands with the cultivation form was planned. But due to the lack of natural *Typha* stands in the regions we choose reed stands. The surprising lack of *Typha* stands led us to a wider framework of cattail research: Is there a loss of natural cattail-sites? What could cause a loss? What is the genetic diversity between natural cattail-occurrences and paludicultures? Could cattail-paludiculture replace lost natural, large-scale cattail-sites and their specific biodiversity?

The swamp provides: Exploring key nature-based services from paludiculture in a wetscape system

Oswin van der Scheer

In a peatland wetscape where nature, paludiculture, and high water table farming coexist, various nature based services can be provided by different land use practices (Temmink et al., 2023). In this promotion project, situated within the EU PalusDemos project, important nature based services provided by paludiculture in such a wetscape are assessed. The research will explore three themes: Water quality, biodiversity, and organic matter.

Firstly, the role of *Typha* paludiculture in improving water quality will be investigated by measuring influx and efflux water in a test site in the Netherlands. Water quality will be assessed by measuring dissolved nutrients, as well as dissolved and particulate organic matter quantity and quality. Further change in water quality will be investigated by effect directed ecotoxicity analysis. The effect of paludiculture on different modes of action will be assessed through passive sampling of surface water and sediment, combined with comprehensive bioassay testing.

Secondly, a multi taxon study on fauna biodiversity will be conducted on multiple *Typha* paludiculture sites throughout the Netherlands. Species diversity and red list status in the paludiculture fields will be compared to drained meadows and natural *Typha* stands. By integrating data across different species groups, including birds, bats, invertebrates, and amphibians, this study aims to clarify the complex role of paludiculture in supporting landscape-level biodiversity.

Thirdly, the persistence of organic matter in paludiculture soils will be assessed using decomposition experiments for different organic matter fractions. This research will include method development for density fractionation, advancing our toolkit for organic matter research in peat soils.

By integrating state of the art methods with large scale case studies, this thesis will provide new insight into the multitude of ecological and societal services provided by paludiculture. It will contribute to a deeper understanding of these novel ecosystems and their role in sustainable peatland management.

Restoration of the Pomeranian population of the Aquatic Warbler – an endangered fen mire specialist

Dr. Susanne Arbeiter, Dr. Martin Flade, Dr. Franziska Tanneberger

The Aquatic Warbler (*Acrocephalus paludicola*) is a small passerine that breeds in mesotrophic fen mires in Central Europe and winters in sub-Saharan Africa. Global populations strongly declined due to habitat loss caused by large-scale peatland drainage and agricultural intensification. Although conservation measures have stopped the decline in the core breeding area, peripheral populations continue to decline. The westernmost population in northwestern Poland and northeastern Germany (Pomeranian population) is currently threatened with extinction. The Aquatic Warbler is a habitat specialist, restricted to shallow inundated sedge fen mires with low vegetation height. Because of mainly eutrophic site conditions at the Pomeranian breeding sites, habitat maintenance highly depends on human management. Therefore, paludiculture, e.g. harvesting reed for thatching, grazing or other biomass use of late cut grass helps to provide favourable habitat conditions for Aquatic Warblers. We present the aims of the EU funded project 'LIFE4AquaticWarbler' (´Conservation of Europe's rarest continental passerine: a transboundary initiative for Aquatic Warbler recovery´, LIFE23-NAT-LTLIFE4AquaticWarbler-101148281) implemented between 2024 and 2033. The project includes measures to restore and improve Aquatic Warbler habitats in Lithuania, Poland, Germany, Hungary, and Ukraine, and the reinforcement of decimated populations, such as the Pomeranian population, through translocation of juveniles from the core breeding area. In Germany, hydrological and management measures to improve habitat conditions and subsequently the reintroduction of the species by translocation are planned for the Moellensee mire (Brandenburg) and the Lower Peene Valley (Mecklenburg-Vorpommern). The project is accompanied by a comprehensive monitoring of vegetation structure and food availability to assess the impact of the implemented measures on habitat quality.

Governance

Policy opportunities for peatland restoration in the Common Agricultural Policy and the Carbon Removal and Carbon Farming Regulation

Dr. Alba Alonso Adame, Matilde Fachini, Odette González

The European Union aims to reduce GHG by at least 55% by 2030. Peatlands have an essential role in climate change mitigation acting as carbon sinks. However, more than 50% of the peatlands in Europe are drained for agricultural use. Despite policy initiatives, European legislation such as the Common Agricultural Policy (CAP) payments are still favouring drainage-based practices, which need to be phased out to reach climate and environmental commitments. Although the current CAP includes peatland protection through GAEC 2 and other measures, weak implementation continues to threaten peatlands, limiting their potential for climate mitigation and sustainable use. Preventing peat lose through rewetting could help reducing CO_2 emissions and partially restore the hydrology of peatlands. An adequate support from the CAP, together with a clear understanding of paludiculture as a more sustainable agricultural use, and available information on peatlands could be helpful to restore drained peatlands. There is still a need to incentivise peatland restoration both politically and economically.

Furthermore, restoring degraded peatlands is included in the Carbon Removal and Carbon Farming (CRCF) Regulation as a relevant activity for carbon farming. The development of a framework for paludiculture aligning with CRCF requirements will help to standardise it. However, any carbon captured by means of peatland rewetting should exceed the emissions from this activity.

2025 will be a key year as the methodologies on peatlands under the CRCF will be released, and the post 2027 CAP proposal will be published. Wetlands International Europe, together with its members and other relevant stakeholders, is working to influence these files to ensure they support peatland restoration and paludiculture. We aim to use this occasion at the conference to share our knowledge and recommendations around the files with a broader audience.

PaluWise develops advanced solutions for productive use of rewetted degraded peatland ecosystems

Dr. Päivi Merilä, Dr. Rebekka Artz, Dr. Christian Fritz, Dr. Jenny Rhymes, Prof. Dr. Wiktor Kotowski, Dr. Alba Alonso Adame, Josipa Arapović

Paludiculture has a large potential to support the EU's climate targets and biodiversity strategy while providing farmers and landowners with income, but only if the practice is scaled up. Currently, there are too few large-scale sites involving local actors that demonstrate industrial scale paludiculture farming models. The goal of Horizon Europe funded 'PaluWise' project (2025-2029) is to develop advanced solutions for productive use of rewetted degraded peatland ecosystems that support EU climate objectives and nature restoration actions. The project encourages multiple actors in 4 large-scale paludiculture demonstrations to co-innovate and improve cost-effective, climate smart value chains and provide recommendations for its large-scale deployment in the EU. The demo sites develop field-scale operations and their associated five value chains (crops: Downy Birch, Reed, Sedges, *Typha*, Reed Canary Grass). By having two established (Netherlands, United Kingdom) and two new sites (Finland, Poland), PaluWise can demonstrate different stages of paludiculture and associated value chains, emphasising replicability and scalability. Network sites (e.g., PaludiZentrale, Germany) will provide lessons learnt guidance and engage actors in innovating improvements (e.g. maintaining high water levels, adapting machinery, choosing suitable crop species). Activities cover the full sequence from deciding where paludiculture might be a suitable option (WP1 decision support tool for rewettability), what works well for primary producers and paludiculture manufactures and industries (WP2 demos), what are the benefits/impacts in emission reduction, carbon sequestration potential, biodiversity and other ecosystem services at landscape scale (WP3, WP4), and how to upscale and get support (WP5). We will identify barriers and provide recommendations to boost improved policy and legislation for large-scale deployment of paludiculture in Europe.

Germany – wide potential for conversion to paludiculture on agricultural land to reduce greenhouse gas emissions by integrating new yield models of cattail and reed

Lars Kretschmer, Dr. Doreen Koltermann, Saskia Bacher, Burkhard Golla, Dr. Maren Langhof, Dr. Jovanka Saltzmann

Drained organic soils account for 83% of climate-relevant emissions from agricultural land. This represents an enormous potential for greenhouse gas reduction, which can only be realised through adapted wetland agriculture (paludiculture). Currently, potential studies on rewetting are only available for a few federal states and not considering the yield potential of paludiculture crops using models. This research aims to fill the gap by evaluating cultivation areas across Germany with regard to their rewetting potential and yield potential of paludiculture crops, with a focus on reed and cattail. It seeks to identify and evaluate potential cultivation areas, for estimating greenhouse gas reduction and the yield models developed. In addition, it estimates the potential for reducing greenhouse gases based on current literature data.

Analysis of potential cultivation areas: Relevant site criteria (e.g., peat thickness, mean groundwater level, climatic water balance, etc.) were thoroughly evaluated to assess rewetting potential. The assessment built upon existing evaluation frameworks with partial modifications.

Greenhouse gas reduction: We analysed current greenhouse gas emissions based on existing models and assigned existing carbon stocks to individual field blocks. A WebGisViewer tool will visualise the rewetting potential and greenhouse gas reduction for each field block.

Paludiculture yield potentials: We collected data on yields of paludiculture crops and yield-influencing factors (e.g., water level, harvest date, cutting height, etc.) from cultivation trials, natural plant populations, and wastewater treatment trials. Based on these data, we modelled biomass yields for reed and cattail under three different assumptions: Influence of 1) harvest date and 2) harvest date and mean water level on yields from established populations, and influence of 3) the cultivation year on winter harvest yields.

An IACS data-based analysis of agricultural land use on organic soils in Germany

Sarah- Maria Schäffer, Andrea Lange, Dr. Johannes Wegmann

The majority of organic soils in Germany have been drained for agricultural use. The ongoing mineralisation of these drained agricultural used organic soils leads to emissions of 43 Mio. t CO_2eq. per year. This is about 44% of all agricultural GHG emissions (including agricultural soils). Reducing GHG emissions from agricultural used organic soils is of great importance to achieve national reduction targets by 2045.

The aim of our study is to analyse the current agricultural use and the spatial distribution of organic soils within the farms' agricultural land. With the analysis we aim to identify farms with the highest dependency on organic soils. For this purpose, we also determine the economic typology of farms, focusing on dairy farms operating on organic soils. In addition, we want to know the current economic value creation on organic soils.

To achieve our aims, specific land use data to agricultural holding information is needed. Data from official agricultural statistics or Farm Accountancy Data Network (FADN) do not include site-specific information. However, this information is given in the data from the Integrated Administration and Control System (IACS) and can be linked to individual farm information. The geo-referenced IACS data allows us to merge it with the updated map of organic soils in Germany (2023). In addition, we use data of the Kuratorium für Technik und Bauwesen in der Landwirtschaft (KTBL) to calculate standard contribution margins.

Due to data availability, we focus on the year 2020. As data depth provided by the federal states differ, we put an emphasis on Lower Saxony which has also a high share of organic soils.

Our analysis provides important information how rewetting of organic soils would affect the current land use. This serves as a basis to help decision makers to make informed decisions.

Spatial planning and peatland protection: Identifying opportunities for rewetting

Sarah-Maria Schäffer, Wiltrut Koppensteiner

In the debate on accelerating peatland protection in Germany, spatial planning is frequently mentioned. It establishes legal frameworks for spatial development. Given the limited availability of space, planning processes define land functions through objectives and principles, involving stakeholders and feasibility assessments. These processes result in priority and reserved areas that can either support or hinder peatland protection. However, existing spatial planning regulations do not always align with peatland protection goals, creating both opportunities and obstacles for rewetting.

This study aims to identify organic soils across Germany where spatial planning either facilitates or restricts peatland protection measures. Spatial planning documents at both the state and regional levels were collected and the different spatial planning categories were standardised. We overlaid this dataset with the updated map of organic soils to determine intersections with priority and reserved areas. Based on previous studies, the spatial planning categories were expanded as favourable, ambivalent or restrictive for peatland protection such as full rewetting, cultivation of paludiculture or extensification. Favourable areas offer good to very good implementation potential, while restrictive areas indicate moderate to poor feasibility.

In Germany, 78% of organic soils are subject to spatial planning regulations. Spatial planning categories such as infrastructure or wind energy present challenges, whereas nature and landscape or flood protection support peatland protection. Categories such as agriculture or recreation favour in most protection options, but some require further assessment. The fact that such a high proportion of organic soils is regulated highlights the need to integrate peatland protection into future spatial planning efforts.

Although spatial planning documents are only updated approximately every ten years, their long-term influence makes them a key instrument for peatland protection. Identifying areas where rewetting can be prioritised within the existing framework provides a foundation for policymakers to integrate peatland protection into future spatial planning decisions.

Paludiculture – a chance for disappearing peatland ecosystems in Poland?

Dr. Hubert Piórkowski, Marek Rycharski, Zuzanna Oświecimska-Piasko

According to data from the last century, there are over 50.000 natural and drained peatlands in Poland covering approximately 1.4 million hectares. Fens dominate among peatlands, with a share exceeding 90%. Non-forest peatlands also clearly predominate with a share of approximately 80%. The spatial differentiation of the peat index reflects to the morphogenetic zones distinguished in Poland.

Estimates indicate that over 85% of the peatland area has been drained, mainly due to agricultural purposes as these lands are traditionally used as meadows and pastures (over 90% of the area). Since the introduction of the Common Agricultural Policy (CAP) in Poland, semi-natural habitats on organic soils have been included in the agri-environmental payments covering peatlands, rushes, wet meadows, as well as waders' habitats (e.g. great snipe). The agricultural measures on these parcels are varied and adjusted to the habitats and soil moisture conditions (e.g. wet meadows include extensive mowing, biomass harvest, and thorough ban on drainage). Since 2011, environmental monitoring of selected CAP measures has been conducted. The results indicate that the state of all wetland habitats is mostly unsatisfactory or bad, which means that the implemented requirements do not enhance sufficiently the improvement of the habitats' conditions.

It is essential to develop and implement effective measures to prevent further degradation of peatlands. The first one is to revise the assumptions and requirements of current agri-environmental schemes. The second one is to expand measures supporting water retention in rural landscape, and the third one to introduce paludiculture.

Currently, there are no system solutions based on paludiculture developed and widely implemented in Poland, which would be an economically justified alternative to conventional agriculture. The upcoming perspective of CAP programming, as well as the needs resulting from the implementation of the Nature Restoration Law, presents an opportunity to initiate changes in this area.

Peatlands & People 1

Venice Agreement for peatlands

Suza Husse

The ‘Venice Agreement’ is a unique effort to build trans-local and decolonial tools in peatland protection, assert the rights of peatlands through transdisciplinary collaborations and a bottom-up approach that recognises local initiatives as key collaborators in the global process of peatland conservation. Conceived as a living document and a tool for conservation, it addresses climate crisis and biodiversity loss through direct conservation actions.

From our meeting on World Peatland Day on June 2, 2024, in Torres Vedras, and the connected series of underground workshops in different peatlands around the world, a new Venice Agreement document emerged: It stresses the wellbeing of peatlands for planetary health; bottom-up organisation and circularity between the local and global; sharing knowledge; fostering diversity, equity, accessibility, and inclusion; decolonisation and queering; as well as transformative social and environmental land justice.

The poster presents outcomes and processes of the project ‘Peatland Languages’ by the arts and research platform ‘Sensing Peat’ at Michael Succow Foundation / Greifswald Mire Centre and The Venice Agreement. This project has translated the Venice Agreement document into different local languages in direct dialogue with specific peatlands and peatland cultures. Collective translation processes in ecosystems in Patagonia and Puerto Rico, East Africa and Northern Europe are co-organised by local community organisations with Indigenous authorities and practitioners, artists, scientists, researchers and peatland inhabitants of various backgrounds.

The translations of the Venice Agreement into Spanish, Selk‘nam, Kishwahili, Spanish, Norwegian, Lithuanian, German, and French are published as posters and an online documentation of the translation process. While the workshops on site support ongoing bottom up nature conservation cultures and the amplification of ancestral and scientific peatland knowledge, the online documents create peatland literacy in different local as well as widely spoken languages

Identifying factors for social acceptance of photovoltaic systems in rewetted peatlands

Carola Kiene, Carl Pump, Prof. Dr. Volker Beckmann

Photovoltaics (PV) contribute to greenhouse gas neutrality, while peatland rewetting can reduce emissions and serve as carbon storage. Both measures rely on suitable land, which creates even more competition for land resources. Combining multiple uses, such as energy generation through PV and peatland rewetting (peatland PV) or additional agricultural use of rewetted land (paludi PV), can reduce land use conflicts while contributing to climate change mitigation.

Acceptance by affected and involved stakeholders and within the general population, has frequently been identified as a critical factor for the expansion of renewable energies and the rewetting of peatlands. Broad public acceptance often contrasts with significantly lower acceptance at the local level (commonly referred to as the 'Not in My Backyard – NIMBY' phenomenon). A lack of local acceptance can jeopardise long-term expansion goals. Therefore, it is crucial to identify factors that either hinder or foster acceptance, enabling targeted measures to improve local acceptance. These factors, however, can vary substantially depending on the specific context.

Key factors influencing local acceptance of renewable energy projects include economic impacts, trust in stakeholders, social norms, and effects on nature and communities. For ground-mounted photovoltaic systems, additional factors such as project-specific attributes (e.g., size, location and design) and impacts during the construction phase have been identified. There is increasing evidence that combining agriculture and solar energy production (agrivoltaics) can increase social acceptance.

However, research on the acceptance of PV installations on rewetted peatlands is currently lacking. To address this gap, we conducted a systematic literature review to identify factors influencing social acceptance of ground-mounted PV systems and rewetting measures in peatlands among different stakeholder groups. From this analysis, we synthesise and propose potential acceptance factors that are likely relevant for peatland PV projects.

Transforming peatland management: Stakeholder roles and governance in Brandenburg

Karoline Hemminger, Dr. Cheng Chen, Prof. Dr. Bettina Matzdorf

'WetNetBB' is a collaborative project led by the State Office for the Environment Brandenburg in partnership with four research institutes. The project aims to drive the transition towards rewetting and sustainable peatland use by implementing innovative land management practices in demonstration areas and fostering collaboration among local stakeholders and industry representatives. In Brandenburg, peatland rewetting presents unique challenges due to complex hydrological conditions and the fragmented system of land ownership and tenure, necessitating cooperation among diverse stakeholders at the landscape scale. A distinguishing feature of this transformation is the paradigm shift required in land management, as rewetting and the establishment of new value chains represent long-term, largely irreversible commitments. Additionally, the processing and marketing of novel paludiculture crops demand the engagement of a wide range of actors across innovative value chains.

Our research focused on identifying key stakeholders at two critical levels: the rewetting process (e.g., landowners and land managers) and the value chain level. To achieve this, we applied a participatory network analysis tool, NetMap, to examine the roles and linkages of stakeholders. Preliminary findings of one of our project regions, Rhinluch/Havelland highlight the central stakeholders and the governance changes needed to enable the large-scale implementation of rewetting initiatives in Brandenburg.

MoorAgentur MV – networking, advice and support of peatland rewetting at a regional level

Claudia Oehmke, Nadine Reinwardt, Lena Isenberg, Dr. Almut Mrotzek

The MoorAgentur MV is a service centre, to support people interested in rewetting and wet use of peatland in Mecklenburg-West Pomerania. The MoorAgentur MV is currently unique in Germany. The model project started in 2023 and is funded by the federal government as part of the'Paludi MV' pilot project.

Mecklenburg-West Pomerania is one of the federal states with the largest amount of peatlands relative to its land area in Germany (13%). Around 90% of these peatlands are drained, they account for more than one-third of the state's total greenhouse gas emissions. The state government has recognised its responsibility and has been supporting peatland rewetting and paludiculture for several years. However, large rewetting projects still face major challenges, such as complex and time-consuming approval procedures, long processes to resolve ownership structures, and also the establishment of future management after rewetting.

We would like to share our experiences in increasing the acceptance of rewetting, which can be achieved through various approaches. On the one hand, this includes providing information on the basics of peatlands and climate protection. On the other hand, it involves also listening to all those affected and involved in rewetting projects in order to jointly develop area-specific rewetting strategies, taking all interests into account. Networking with the various authorities involved in the planning procedure also offers opportunities to accelerate planning procedures for rewetting, especially when legal framework conditions hinder peatland protection and individual solutions are required within the authorities. Our experiences of networking and problem-solving in the daily work deal with lots of questions on how to approach rewetting projects, identifying gaps and needs, and how to move forward together with the various stakeholders involved.

'Unser Land kann Moor' – Building an online networking platform and marketplace for paludiculture raw materials

Dr. Matthias Schuppler

Paludiculture, the sustainable use of wetland biomass, offers a promising solution for climate mitigation, biodiversity conservation, and regional economic development. However, the commercialisation of paludiculture raw materials remains a challenge due to fragmented supply chains, limited market access, and a lack of structured networking opportunities among stakeholders.

This poster presents the development of an online networking platform and marketplace designed to connect actors along the paludiculture value chain, including farmers, processors, landscape managers, and industries.

The platform aims to facilitate knowledge exchange, improve logistics, and establish reliable market structures for wetland-derived biomass such as reed, cattail, and peat moss.

Key features of the platform include:

- A digital marketplace to enable efficient trade of paludiculture products, ensuring transparency and fair pricing.
- A networking hub fostering collaboration between producers, buyers, land owners, civil services and investors to drive innovation.

The platform's design follows a participatory approach, integrating feedback from stakeholders to ensure usability and relevance. Initial testing phases have demonstrated increased engagement and interest from the paludiculture community. Future developments will focus on scaling the platform, integrating certification mechanisms, enhancing supply chain traceability and best practices.

By addressing current market barriers, this initiative contributes to the broader adoption of paludiculture, promoting climate-resilient land use and fostering a circular bioeconomy.

The first student congress on peatland science: 'MooreMotion' in Greifswald

Hauke Schmülling, Antonia Klaußner

The first student congress on peatland science 'MooreMotion' takes place in Greifswald between the 4th and 7th of September 2025 under the slogan 'Ideas flow, Communities grow'. The organisation of the congress is initiated and funded by the Joachim Herz Stiftung and implemented by engaged students from diverse study programs of the University of Greifswald. Our idea is to create a space for about 150 participants from all over Germany to exchange and learn a lot about peatlands and present their own research. The conference program consists of various lectures, poster presentations, peatland excursions around Greifswald, productive workshops, and a wide range of informal activities to create a positive atmosphere. Our aim is to inspire and promote students' ambitions and exchange in all disciplines around peatland science, independent of their current state of knowledge. Further, we aim to build up a creative and young peatland science network across students and institutions all

across Germany. The highlights and results of the MooreMotion congress we will present here!

Biomass utilisation & PV

FIBSUN project: Novel fibre value chains and ecosystem services from sustainable feedstocks

Prof. Kristiina Lång

'FIBSUN' project studies five value chains, of which one is related to paludiculture: cattail and common reed fibres as raw materials for flexible insulation boards. Cattail was produced in The Netherlands (Ankeveen), and it was harvested four times during the year to monitor changes in its quality. The fibre width did not differ between harvests. The cellulose structure of cattail differed from the reference wood but not between harvest times. The cattail biomass was treated in an extrusion process and insulation board prototypes were produced in an industrial scale plant. To improve the performance of the value chain, a mobile biorefinery is trialled and a suitable fibre mix is under development.

The studied site in Finland is an abandoned and rewetted peat extraction site. The natural expansion and productivity of a reed stand is studied at the site but the raw material for the insulation boards originated from a lakeside, the most common growing site of reed. The cellulose structure of reed was closer to the reference wood that that of cattail. The optimisation of reed treatment for insulation boards includes reducing its hydrophilic content through hot water extraction and developing a mechanical process to produce reed particles resembling those originating from wood. Insulation board prototypes were produced using different configurations. Reed is considered a valuable biomass for many applications but as roof thatching is not common, its markets are underdeveloped in Finland.

The best performing flexible insulation board configurations will be validated to optimise the industrial production parameters, and the feasibility of the related value chains estimated. For both biomass types, technical adjustments are needed for their integration in the existing industrial lines.

Cotton grass: An underestimated fibre plant as an opportunity for the establishment of paludiculture

Marc Küperkoch

Abundant cotton grass growth in rewetted peatlands as an opportunity for the establishment of paludiculture. Cotton grass has been used for numerous textile applications throughout history but has been repeatedly rejected due to the low cost of imported fibres, the primary use of peatlands as a source of peat and the difficulty of processing it as a fibre crop. In initial preliminary tests, the potential of cotton grass as a fibre plant was evaluated and its structure and composition investigated. The next step deals with fibre extraction and processing as well as the subsequent use in textile applications. Particular attention will be paid to the synergetic use of hemp in the form of hemp bast or as a dissolved fibre and cotton grass in a blend.

Both fibres have important properties and can be obtained from regional cultivation. Hemp is already being used again in clothing and technical textiles and is responsible for numerous technical innovations that would have been unimaginable a decade ago. This development gives cause for optimism that cotton grass can experience a similar development. The cotton grass project aims to take a holistic approach, taking into account the technical possibilities, economic benefits and environmental impact. To this end, there is close contact with the University of Greifswald and the Thünen Institute. In addition, relevant stakeholders from industry and agriculture are involved.

Valorisation of paludiculture biomass through furfural synthesis in a two-step process

Jeferson Vicente

The bioeconomy promotes the sustainable use of biological resources to generate economic, social, and environmental benefits. In this context, wetland management supports biodiversity conservation, carbon emission reduction, and biomass production. This biomass can be processed into value-added products, replacing fossil-based materials. Lignocellu-

losic biomass from wetlands (Paludiculture) can be decomposed into lignin, cellulose, and hemicellulose. Cellulose and hemicellulose, in turn, can be used to produce monomers with 5 or 6 carbons by hydrolysis. This hydrolysis process generates intermediates like furfural, Hydroxymethylfurfural (HMF), and ethanol. Furfural is widely used in the production of solvents, resins, and biodegradable polymers. However, when produced from wetlands, it is necessary to study the production process and optimise it to make it economically viable. Thus, to evaluate and optimise the furfural synthesis from wetland biomass, an acid hydrolysis process (pH 2, H_2SO_4 0.01M) was conducted, followed by a furfural synthesis stage. To define the optimum parameters for the process, the first stage was performed at temperatures of 160, 170, and 190°C for 1 hour, while the second stage was evaluated at temperatures of 190 and 200°C for 40 minutes. The first stage enabled the cleavage of cellulose and hemicellulose biopolymers present in the biomass, leading to the release of monomers for furfural production. In the second stage, furfural synthesis was observed from the monomers generated in the first stage. Optimal conditions (170°C for 50 min, followed by 200°C for 30 min) yielded approximately 5.3% of furfural relative to the biomass mass, corresponding to 36.6% of the total sugar content in the hydrolysate. These results demonstrate successful furfural synthesis using the two stages process, moreover, opened up possibilities for the production of HMF or other by-products by modifying the conditions of the second hydrolysis stage.

Utilisation of peatland biomass through pyrolysis – Results and practical experiences from the two german BMUV projects Klimafarm (SH) and MoorWERT (BY)

Thomas Süss, Andreas Stauss

The utilisation of peatland biomass can be crucial for fostering acceptance and making land available for peatland rewetting. Harvested biomass varies from cultivated paludicultures to diverse wet grassland vegetation. The latter can become unsuitable for high-value applications – such as construction materials – due to the presence of problematic plants (e.g.,

Jacobea aquatica) or poor harvest conditions (e.g., excessive moisture). Comparable biomass streams also occur in landscape management, where disposal often incurs high costs.
Efficient pyrolysis processes based on peatland biomass can offer a solution here by replacing wood-based resources while generating biochar for long-term carbon sequestration and energy (heat, pyrolysis gas, etc.)

The two BMUV projects, 'Klimafarm' (Eider-Treene-Sorge- lowland) and 'MoorWERT' (East Allgäu), have investigated the production of biochar in initial test trials, presenting results and practical experiences that highlight the similarities and differences between the two approaches.

The poster provides insights into various aspects, including material acquisition and harvesting, financial considerations, laboratory analysis of biomass and biochar, storage and logistics, details about the two different pyrolysis processes, and the performance of peatland biomass in these processes. Additionally, it shares practical experiences and explores the potential for future developments.

Life cycle analysis of paludiculture-biomass use in paper production

Ekaterina Gualoto-Kirochka

Within the 'EDELNASS' project, we are analysing two main pathways for the future use of wetland biomass and its bioeconomy. This spontaneously growing type of biomass might be frequently available from rewetted peatlands in future.

For comparison with competing products – either from fossil basis or from other renewable resources – Life Cycle Analysis (LCA) delivers helpful insights into the environmental performance of paludiculture biomass production and further processing to industrial pre-products.

Here, we present the LCA framework proposed to assess environmental impact, focusing on Greenhouse Gas (GHG) emissions and biodiversity. Generally, we are following a cradle to gate approach, defining the borders of our system for assessment rather narrow. Thus, in a first step the focus is set on the land management, assessing the GHG emissions during production and harvest of the biomass on rewetted sites and the further transport and processing of the biomass towards the ready-to-use raw

material for the use in the production of the paper pulp.

As paludiculture and the site rewetting play a crucial role in the context of this production system, the LCA will be expanded in a second step towards including land use change and the resulting benefits in terms of GHG emissions and other ecosystem services. Beyond the LCA framework, some first results for the pathway of paper pulp production from wet meadow biomass are presented.

Development of processes for the extraction and processing of fibre raw materials from paludi-biomass for use in pulp paper

Basri Oktay Koc

The 'EDELNASS' project focuses on the material use of paludi-biomass grown on five peatland areas in Germany. Therein, the project objective of ATB is to explore the use of peatland biomass as an alternative to wood cellulose fibres for paper and moulded fibre applications. The aim is to optimise fibre extraction and processing methods, considering the parameters of material quality. For the optimisation, it is important to characterise the properties of biomass according to location, harvest time, storage, pre- and post-processing. At this point, ATB's main objectives are

- Developing fibre materials through raw material-specific pre-treatment and thermo-mechanical refining.
- Optimising energy-efficient pulping with targeted fractionation to meet fibre quality requirements.
- Conducting pilot and industrial trials for paper and moulded fibre production.

Biomasses are stored and preserved with different methods such as fresh, silage and field drying. After removal, biomass is first cut with a guillotine and prepared for fibre production. Thermo-mechanical fibrillation is conducted with an extrusion and refining system. The fibrillation process is completed by drying the intermediate. Furthermore, the fibres are subjected to mechanical beating. By increasing bonding surface it is aimed to improve the physical properties of the paper and moulded paper samples to be produced as the final product.

The extracted fibres are characterised by their size, chemical analysis

results, and the suitability of processing trials for paper and moulded fibre components. This is supplemented by the investigation of paper quality relevant properties.

Peatland biomass presents a viable raw material for sustainable fibr production, supporting circular economy principles and reducing dependency on wood fibres. The results contribute to eco-friendly innovations in the paper and packaging industries.

Paludi & Bau: Turning wetland material into sustainable building materials

Lyanne Ausema

Peatlands store carbon, support biodiversity, and help prevent land subsidence. But when drained, they release greenhouse gas emissions and degrade. Interreg VIA project 'Paludi & Bau' tackles this issue by transforming wetland crops into bio-based building materials.

We develop eco-friendly insulation and board materials using cattail (*Typha*) and mycelium, offering a sustainable alternative to traditional construction materials, which

- reduces greenhouse gas emissions by keeping peatlands wet
- creates a new market for farmers and producers
- supports circular and biobased construction.

Paludi & Bau does this by Prototype development – testing materials for strength, insulation, and fire safety; Scaling production – setting up supply chains in the Netherlands & Germany; Collaboration – bringing together farmers, manufacturers, and builders; Knowledge sharing – ensuring adoption through workshops and demonstrations TRL 6-7; Moving from lab-scale to real-world application!

By connecting nature and construction, Paludi & Bau aims to make peatland conservation profitable while promoting sustainable building practices.

Development of innovative building materials based on paludiculture (*Typha*) and establishment of a demonstration production facility

Steffen Sydow

The production of high-quality products from paludiculture is a fundamental requirement for profitable returns in order to encourage farmers to convert their existing farming practices to paludiculture. As part of the 'RoNNi' project, further innovative building materials are being developed in addition to the already completely developed Typhaboard, whereby four different approaches are being pursued. Firstly, an improved bulk insulation is being developed from *Typha*. Secondly, the technology developed at the WKI for the production of wood foam is being applied, with a *Typha* wood foam sandwich representing a central development goal. In addition, the *Typha* itself is foamed to generate an insulating material, whereby higher strength is not the main focus. Another application involves the production of a *Typha* board that uses *Typha* foam as a binder instead of magnesite, creating an insulating and at the same time load-bearing building material made exclusively from the raw material *Typha*.

Besides the production of larger *Typha* cultivation areas, a demo production plant is being developed for the economical and continuous production of the *Typha* board. This is intended to counteract the chicken-and-egg problem, whereby a building material producer is only ready to produce once the raw material has been secured, while farmers need a long-term guarantee of purchase before they switch to the new cultivation method of paludiculture. The production plant is deliberately designed for low annual production, as it makes more ecological sense to set up several smaller plants close to the cultivation areas than to transport the very light raw material over long distances. In addition, such a plant is already profitable with a cultivation area of 15 to 20 hectares. With an investment of 400,000 to 500,000 euros, it is conceivable that several farmers can achieve significant progress in value creation with their own production of *Typha* boards.

Development of a RAL quality assurance for *Sphagnum* biomass as a growing media constituent

Ulrike Wegener

The German government's Climate Action Plan 2050 aims to reduce the use of peat in growing media for the hobby and professional market in Germany. By 2026, the objective is for growing media intended for the hobby sector to be peat-free, and by 2030 the professional sector should be almost peat-free.

In order to achieve this objective, it is necessary to utilise alternative growing media constituents in substantial quantities and of sufficient quality. As the amount of established peat substitutes such as wood fibre, coconut products, composted bark and substrate compost is limited, new constituents need to be found. Cultivated and processed *Sphagnum* biomass is very similar to low decomposed peat moss peat ('white peat', H2-H4) and a proven high-quality peat substitute. *Sphagnum* biomass is an agricultural product and can be cultivated in paludiculture.

In order to ensure the quality of processed *Sphagnum* biomass, a group of experts is recently developing appropriate quality and testing regulations for a RAL (German Institute for Quality Assurance and Certification) quality mark for *Sphagnum* biomass as a growing media constituent, initiated and financed by the 'MOOSland' project. Products bearing the RAL quality mark are widely recognised within the substrate industry and among professional growers as an impartial and neutral attestation of quality.

The expert group collects and evaluates data in order to derive practice-orientated limits values for various relevant test parameters. After they finish work on the quality and test specifications, the RAL will start the approval procedure for the new quality assurance. As soon as this step has been completed, *Sphagnum* biomass production areas and the processed *Sphagnum* biomass can be certified under the supervision of Gütegemeinschaft Substrate für Pflanzen e.V..

MoorPower – Sustainable and innovative photovoltaic solutions for rewetted peatlands

Andrea Krüger

The combination of photovoltaic (PV) systems and rewetting could be an economically attractive form of utilisation for currently drained peatland areas while simultaneously reducing greenhouse gas emissions and providing other ecosystem services. The University of Greifswald, Institute of Botany and Landscape Ecology, coordinates an innovative project combining peatland PV, rewetting and paludiculture (Paludi PV) in cooperation with the Fraunhofer Institute for Solar Energy Systems ISE, the University of Hohenheim and the Thünen Institute of Climate-Smart Agriculture. The project is called 'MoorPower' and funded by the German Federal Ministry of Research, Technology and Space (BMFTR). It runs from December 2024 to June 2028.

This project plans the rewetting of drained peatlands and their utilisation by ground-mounted PV systems together from the outset. The experimental setup allows the comparison of different PV installation methods and the estimation of their effects on water quality, soil physics and the microbiome. Social acceptance, legal issues and economic aspects are analysed together with climate protection and biodiversity assessments at different scales of investigation. Recommendations for the implementation of peatland/Paludi PV in Germany will be derived. We herewith invite all interested scientists to join us with their research on our experimental platform. The results of this research are urgently needed to evaluate PV systems on peatland soils, to identify possible negative effects of the systems and to avoid these, e.g., through technical guidelines and authorisation requirements, or to adapt existing systems accordingly.

Moor-PV – Climate and peatland protection through a combination of photovoltaics and peatland rewetting

Monika Hohlbein

The rewetting of peatlands is the most effective measure to reduce greenhouse gas emissions from drained peatlands. However, the previous forms of agricultural utilisation will no longer be possible after rewetting. In addition to the site-adapted utilisation of wet or rewetted peatlands (paludiculture), the construction of ground-mounted photovoltaic systems could also represent a new economically attractive use option. Since the Renewable Energy Sources Act was implemented in 2023, peatland PV systems have been eligible for funding as 'special solar systems' in Germany. The Federal Network Agency of Germany has drawn up more specific requirements for this, which also includes compliance with minimum water levels. However, there is still a considerable need to test and research the impact of the installation of photovoltaic systems on peatland soils, particularly regarding peat conservation, greenhouse gas emissions, water balance, and biodiversity. In addition, research needs to focus on understanding the economic incentives of peatland PV systems to promote rewetting of previously drained, agriculturally used peatlands.

The project 'Moor-PV' is the first project in Europe where greenhouse gases, biodiversity, and economic aspects of photovoltaics in a rewetted peatland are measured. The 30-hectare field site is located in Schleswig-Holstein on a fen that was formerly intensively used grassland. The first part of the photovoltaic system was built in 2021, the second in 2023. The three-year project started in January 2024 and is funded by the Joachim Herz Stiftung.

A systematic review regarding the effects of ground-mounted solar farms on faunistic biodiversity in Europe

Wiltrut Koppensteiner

The reduction of greenhouse gas emissions by peatland rewetting is one of the most pressing challenges in climate change mitigation in Ger-

many today. One new land use option for agriculturally used peatlands in combination with rewetting is 'peatland PV', based on the recent amendment of the Renewable Energy Sources Act. However, 'peatland PV' evokes questions on the response of taxa to this new land use option. These cannot sufficiently be answered based on few existing studies. As peatlands are important habitats for endangered and highly specialised species, the future transformation of peatland use will have considerable impacts on biodiversity conservation.

This systematic review describes the existing evidence of the effect for wildlife species of ground-mounted photovoltaic panels in small to medium sized solar farms on grassland. Our methods follow the systematic review guidelines by using a PECO framework and a systematic search and screening strategy. Based on a systematic search string the data corpus consists of 4,672 publications found in seven databases including services for grey literature. Additional 429 publications identified through other sources were included. After removing duplicates, title and abstract screening using a double-screener approach, 383 records were screened for full-text resulting in 108 records for the analysis. Based on these existing evidence we aim to derive possible effects on species of conservation concern, which need to be considered when installing 'peatland PV'. Additionally, existing gaps in knowledge and the mitigation methods for potential negative effects of solar farms regarding biodiversity conservation are summarised. Here, we present first preliminary results.

PaludiScout.de – An information platform for harvesting machinery in paludiculture

Bas Spanjers

Raising water levels on agriculturally used peatlands requires adapting farming systems, posing significant challenges for land users. Adapted grassland technology or specialised machinery is required to reduce soil pressure in order to minimise negative impacts on wet soils. However, most available solutions are prototypes rather than serially produced machines, leading to high investment costs. Finding suitable equipment or contractors remains a major hurdle for land users. Despite extensive scientific and grey literature on adapted harvesting machinery, this informa-

tion is rarely accessed by key stakeholders. Moreover, there is no centralised up-to-date platform to facilitate information to specialised machinery for paludiculture.

The project 'PaludiZentrale' addresses this gap with PaludiScout.de, an online information platform for specialised harvesting machinery. This platform enables users to find appropriate machinery, dealers, developers and contractors, compare products, and access relevant technical information. The German and English website serves as a bridge between suppliers (dealers, technology developers, contractors) and users (land users, project participants).

At RRR2025, we will present the first version of the website and invite participants to activate their networks, engage with the platform, and contribute factsheets of available technology. Together, we aim to improve access to suitable machinery and take a crucial step toward the sustainable management of wet and rewetted peatlands.

Economics and Agronomy

Analysis of costs and carbon footprint of Paludiculture-biomass harvesting techniques by means of Monte Carlo Simulations

Michael Rühs

Within the 'EDELNASS project', two working groups from Greifswald University are analysing two main pathways for the future use of wetland biomass and its bioeconomy together with other working groups – the use of hay fibres for paper (ATB Potsdam) production and the synthesis of platform chemicals (University of Hohenheim and Applied University of Albstadt-Sigmaringen). This spontaneously growing type of biomass might frequently be available from rewetted peatlands in future.

The profitability and competitiveness of the production of such raw materials are crucially important for future implementation and mainstreaming of wet meadows utilisation for production of basic fibres for bioeconomic pathways.

The poster points out the economic perspective of harvesting biomass

under rewetted conditions, making use of some special technique (e.g. crawlers) or at least an adapted standard technique necessary. Beyond that, the harvesting processes on wet sites are more demanding in terms of time slots for the usually necessary late harvest in autumn/ winter and due to the site conditions.

In a Monte Carlo Simulation three types of main technical solutions are compared: an adapted standard technique, a special small-sized and a special large-sized technique, raising the risk of harvest losses.

The results reflect the costs per ton of biomass and the resulting. GHG-emissions per ton of biomass. The costs are important for farmers considering adopting this production system on their farms. But they are even more important in comparison to other competing biomass proveniences in the question of competitiveness. Beyond that, the GHG footprint of the biomass harvest is one building block in the LCA of the production pathways – presented in another poster here.

Scaling peatland rewetting through carbon markets: A private sector perspective from Central and Eastern Europe

Malte Schneider, Jenny Hammerich

As Europe scales up peatland restoration under national climate and biodiversity goals, the success of rewetting efforts increasingly depends on private actors and viable economic models. Drawing from project pipelines in Germany, Poland, Lithuania and Latvia, this contribution offers a practical perspective from aeco GmbH – Europe's leading private project developer and financier for peatland carbon projects.

We share hands-on experience on how carbon markets can be used to incentivize landowners and farmers to support rewetting, including a comparative overview of voluntary carbon standards and emerging certification frameworks such as SOCIALCARBON or the EU CRCF. In parallel, aeco is actively contributing to the development and testing of biodiversity certification approaches.

We also explore how companies across sectors – from retail to construction – seek to integrate rewetted peatlands into their value chains to diversify their raw material base and account for Scope 3 emissions via

the use of paludiculture biomass. Our contribution highlights the challenges and opportunities of combining carbon and biodiversity certification, paludiculture development and corporate insetting strategies.

In sum, aeco provides insight into how restoration projects can transition from public funding dependence to scalable, market-driven climate and nature solutions – while ensuring local actors are rewarded fairly and remain in control.

Certification of biomass from paludiculture

Dr. Wendelin Wichtmann

Product certification is an effective means of attesting the quality of products that distinguishes them from comparable conventional products. Information asymmetries can thus be avoided. This applies also for products from paludiculture on the basis of the ecosystem services provided on the harvested area. A corresponding certification system is currently being developed. This system will be suitable for application for a wide range of products made from biomass produced in paludiculture (medicine, construction material, paper, energy). Extensive literature studies and the results of three workshops were used to develop the basis for such certification. A paludiculture standard was developed and underpinned with corresponding criteria that can be checked using verifiable indicators. The next step will be to determine the concrete implementation of a corresponding certificate. A list of six principles has been formulated already mainly orientating at environmental effects which should be met and ecosystem services which shall be provided. The principles for the standard for products from paludiculture are underpinned by criteria, each of which can be confirmed/verified using indicators.

The indicators are measurable and confirm whether a criterion is met or not. An important indicator is, for example for principles 1 and 2, the medium water table, which must be at least -10 cm on most of the area. Compliance with these and other indicators must be checked regularly (at the beginning and then e.g. every 5 years) as part of monitoring or a visual assessment and field surveys. It is expected that the certification system will be further developed by follow up projects and an organisation will be

found to manage the certificate. The first audits can then be carried out by independent organisations and, if the defined principles are met, first certificates with product labels can be awarded.

Update on the market of Common Reed for thatching (1990–2023)

Dr. Sabine Wichmann

Common Reed (*Phragmites australis*) has a long history as a locally sourced building material, particularly for roofing. Reed-thatched houses are a traditional feature of coastal European architecture. At the same time, the area of natural reed beds has declined and local supply is limited in many countries. Consequently, national demand for thatch must now be met through imports, and reed became a globally traded commodity.

The Netherlands, Germany, Denmark and the United Kingdom are known as countries relying heavily on imported reed. Our study also identified Belgium, Italy, Spain, France and Ireland as additional reed-importing countries. We analysed European trade statistics to determine a) the annual volumes imported by these nine countries in the years 1990 to 2023 and b) the origin of the imported reed. Our study revealed large variations in import volumes and trading partners, both across countries and over time.

The cultivation of reed as a paludiculture crop can improve the quantity and quality of local reed. Furthermore, conflicts between commercial harvesting and the conservation of natural reed beds may be reduced. Our findings offer valuable insights into the market prospects for Common Reed across Europe.

Dairy farming on wet peatland soils – Options, grassland management and valuation

Marcus Schlingmann

Raising water levels in peatlands is crucial for reducing greenhouse gas emissions and achieving climate protection targets. However, high water levels on agricultural land require adapted management, which often means changing existing work and operating procedures.

In Baden-Wuerttemberg, peat soils are mainly in the south east, where numerous small dairy farms rely on drained fens for intensive grassland management. Many management options for wet peatland use, such as paludiculture for fibre production, are difficult to integrate into dairy farms, which depend on these lands for fodder production. Thus, practical concepts specially adapted to dairy farms are essential for successful rewetting.

The 'Moormilch' project aims to develop climate-friendly and economically viable solutions for agricultural use of fens, with a special focus on the Allgaeu and Upper Swabian region in Baden-Wuerttemberg. In particular, utilisation options for cattle feeding will be developed and demonstrated for practitioners. Prior experiments suggest tall fescue (*Festuca aundinacea*) as a viable option on wet fens with an acceptable fodder value. Therefore, tall fescue will be cultivated on already wet and undrained experimental and demonstration sites to gain experience in the cultivation and for knowledge transfer to practitioners. Targeted average water table will be higher than 30 cm below ground level. A feeding trial with tall fescue as part of the feed ration of high yielding dairy cows will be conducted to identify potential productivity losses. Additionally, marketing strategies and product valuation to compensate for higher costs and reduced productivity of such management will be investigated, with local dairy plants being a crucial stakeholder in this process. Finally, yet importantly, the climate relevance of these measures will be investigated and evaluated by means of greenhouse gas measurements on grazed and mowed sites with each drained as well as rewetted conditions.

Supporting the value chain development for paludiculture production in the UK: *Sphagnum* moss as growing media

Emily Pope, Vera Eory

The UK is prioritising peatland restoration as a strategy in its commitment to achieving net-zero emissions by 2050, given that degraded peatlands account for approximately 4% of the nation's greenhouse gas emissions with over 80% of these ecosystems currently degraded.

Paludiculture, the practice of cultivating crops on wet or rewetted peatlands, offers a possible solution by enabling productive land use while

restoring the high water tables necessary to prevent carbon release. *Sphagnum* moss is a paludicultural crop in its early trial stages in the UK that has potential as a growing media constituent as the UK horticultural sector transitions away from peat-based media. However, upscaling a value chain can be challenging as it requires supply and demand to grow simultaneously. This case study is based on qualitative, semi-structured interviews conducted with a diverse range of stakeholders. An analysis of the interview results using the Agricultural Innovation Systems (AIS) framework will identify barriers and generate interventions that could encourage the growth of the novel *Sphagnum* value chain in the UK.

A functioning value chain? Results of the 'BLuMo' project on keeping water buffalo on re-wetted peatland areas in Brandenburg

Bettina Tacke

The keeping of water buffalo is one established value chain of paludiculture in Germany, yet it faces substantial challenges, particularly in terms of marketing and slaughter. Water buffalo are well suited to grazing wetlands and supporting the restoration of carbon-rich peatland ecosystems and are therefore often used for landscape management. However, the economic viability of their farming depends largely on the marketing strategy of buffalo products and efficient processing systems.

One of the biggest challenges is the limited demand for water buffalo meat. This niche market requires special marketing strategies to raise consumer awareness and promote the nutritional and culinary benefits of buffalo meat. In addition, the relatively small buffalo farming sector in Brandenburg with around 1.500 animals makes it difficult to establish a consistent supply chain for meat production. Farmers often have difficulty organising stable prices and reliable sales of meat.

Slaughtering is another major obstacle. Water buffalo are more difficult to handle than conventional cattle, and slaughterhouses in Brandenburg are limited, which leads to logistical challenges for farmers. Slaughtering is therefore often shot in the pasture, which has a benefit for animal welfare and meat quality. The subsequent slaughter and butchering chain is usually a complex and time-consuming process.

The Brandenburg peatland pilot project ‘BLuMo’ is intensively researching and examining market and slaughter issues as well as other challenges. It is the only pilot and demonstration project in Germany dedicated to this topic. It is working to increase the potential of keeping water buffalo for economically profitable peatland management, integrating sustainable agricultural practices and at the same time contributing to the protection of wetlands.

Paludi value chains as bioregional clusters for regenerative construction

Thiade Thorben Langenhan

In Bavaria, 110,000 acres of drained peatlands are used for agriculture. Though this area only represents 3.5% of the agricultural land, it is responsible for 25% of all agricultural CO_2 emissions of the state. Rewetting peatlands not only stops current greenhouse gas emissions but also enables the sequestering of CO_2. This positive impact was recognised by policymakers and led to legal measures such as the Bavarian ‘Moorbauernprogramm’. Due to the lack of a market, the complexity of the transformation and therefore little planning predictability, current efforts remain stuck in pilot phases. Solving current issues could offer the opportunity for Germany to take a leading role in peatland transformation.

The study investigates, how the principle of commoning in regional clusters can support the development of a value chain for paludi materials in the construction sector.

Interviews with existing clusters explore their spatial qualities, fields of action and organisational structure. The research is extended by comparison with more developed clusters outside the peatland topic. Building upon the findings, a strategy which connects stakeholders through a collective approach is designed, creating a paludi value chain for the building industry in the Bavarian Prealps. The region is dominated by grassland which is easier to transform than arable land. Due to their fragmented state, intensive collaboration between farmers, authorities, experts, industry and other stakeholders is required.

The approach of a regional bottom-up cooperative lowers implementational challenges, individual economic risks and is a well-known con-

cept in the agricultural sector. Applied to peatlands the cooperative could extend into multiple fields of impact ranging from knowledge collection and networking to the hands-on implementation of Paludi culture and establishment of necessary infrastructure. The study collects best practice strategies from existing clusters and demonstrates their extended usage. Furthermore, the results can be applied as strategies beyond the Bavarian Prealps region.

Analysing methods for recording machine and work processes for paludiculture procedures – a field test during *Typha* harvest

Dr. Telse Vogel

The recording of machine and work processes for paludiculture procedures is crucial for generating precise planning data. It could further be useful for optimising processes and the development of improved specialised machinery. However, detailed information on working times and processes for the diversity of paludiculture procedures is currently lacking. This study examines two methods for recording machine and work processes: a video camera with a GPS tracker and telemetry modules. These tools were tested for their suitability during a *Typha* harvest in December 2024. The *Typha* biomass was harvested in two stages using caterpillar-based technology for both mowing and collecting.

The video camera records videos and associated telemetry data, such as GPS data, speed, and time. This allows for the precise determination of work time requirements and optimisation opportunities for individual working steps. However, data evaluation is time-consuming, and quality can only be checked after collection. In contrast, telemetry modules automatically record data, reducing the time required for evaluation. Additionally, the data can be checked in real time during data collection and adjusted if necessary. The level of detail in the recorded data next to GPS data, speed and time depends on the harvesting machinery and access to engine data like engine speed and fuel consumption. If engine data is available, the time requirements for machine work can be presented in detail. On the other hand, machine downtime (e.g., breaks, discussions, repairs, waiting times due to task completion) cannot be differentiated.

A combination of both methods could enable a more comprehensive and accurate recording of machine and work processes. Finally, the choice of method depends on the specific requirements of data collection.

Shearing vanes, penetrometers, and seven operators: Digging into the user effect on trafficability measurements

Annelie Säurich

Peat soils in agricultural use have a rather firm but variable vegetation cover over less load-bearing peat layers. In order to ensure the safe use of machinery, site specific load-bearing capacity must be taken into account when assessing trafficability. This is particularly important in rewetted peatlands where changing vegetation and soil conditions increase the risk of surface damage or getting stuck. Load-bearing capacity is a combination of the sheer force of the vegetation cover and the penetration resistance of the soil and depends on factors such as root density, bulk density, water content, pore size distribution and organic matter structure.

In order to compare data measured in the PaludiNetz projects using identical equipment, but with different users and working on different sites, it is essential to test for a user effect and, if present, to quantify it. Therefore, a field trial with 7 participants was carried out in the Teufelsmoor near Bremen. Following a sampling design that minimised the influence of site characteristics, each participant took 42 samples with the shearing vane and penetrometer, respectively.

The results for the shearing vane (0–14 cm depth) ranged between 22 and 42 kPa with a mean of 31.5 ± 3.9 kPa. One participant's values were shown to be significantly different from three of the others. The maximum penetration resistance values of the penetrometer ranged from 0.43 to 1.33 MPa, recorded in the top 20 cm of the soil profile. In deeper peat layers (20–80 cm) values from 0.16 to 0.63 MPa were measured. Linear mixed effect models showed that depth was by far the most important explanatory variable, while user contributed only marginally. However, significant differences between users were also found for the penetrometer.

Grassland management on rewetted fens: results of field experiments in Bavaria

Teresa Koller

Grassland is the predominant land use on drained peatlands in Bavaria, providing an opportunity to raise water tables and reduce CO_2 emissions. However, wet grasslands often yield low-quality forage and are prone to encroachment by non-palatable or toxic species. To address these challenges, we conducted field experiments to establish and manage grasslands on rewetted fens with moderate mowing intensity (three to four cuts per year) to produce forage for dairy farms. The study tested six grass species mixtures, including a newly developed blend for long-term grass swards in southern Germany ('LfL mix'). The experiments were conducted near Rosenheim and along the Danube in Bavaria. Our research focused on several key aspects: establishing wet-tolerant grasses on cropland and dry grasslands, identifying quality forage grasses suited to high water tables and evaluating yield and forage quality. We found that when converting cropland to grassland, sowing is best done in autumn before raising the water table. Reed canary grass (*Phalaris arundinacea*) and tall fescue (*Festuca arundinacea*) performed best in weed competition, trafficability, biomass, and forage quality. Reed canary grass became dominant in continuously wet conditions. Ryegrass (*Lolium perenne*), creeping bent (*Agrostis stolonifera*), and clover perished, leaving bare patches with poor trafficability, which were quickly colonised by soft rush (*Juncus effusus*). The annual biomass yield of tested seed mixes ranged from 8 to 10 tons of dry matter and was preserved as hay, haylage, or silage. Protein and potassium contents were relatively low. The forage can be used in dairy farms as a structural component, making it particularly suitable for late-lactating cows due to its low potassium content and for feeding heifers.

Factors influencing flower formation in *Carex acutiformis*

Dr. Christina Hartung

Carex acutiformis, along with *Phragmites australis*, *Typha* spp., and *Phalaris arundinacea*, is considered one of the most promising plant spe-

cies for cultivation in fen paludiculture. To establish new stands of *Carex acutiformis*, it is crucial to have an adequate amount of seeds accessible. However, only a limited amount of *Carex acutiformis* seeds is currently available on the market. Additionally, the conditions under which *Carex acutiformis* forms flowers and seeds are still largely unknown.

The objective of this study is to investigate whether the groundwater level affects the flower formation of *Carex acutiformis*. Additionally, the study aims to explore potential differences in flowering patterns across various sites, different genotypes and stands of different ages.

To investigate this, a greenhouse experiment was conducted in March 2025, in which soil cores containing *Carex* plants were collected from four sites in southern Germany, representing different stand ages and genotypes. Soil samples were also collected from each location to assess nutrient availability. Immediately following extraction, the sods were placed in troughs and transferred to a greenhouse. Within the troughs, two distinct water levels were applied (WL1 = 0 cm, WL2 = –14 cm). The experiment was replicated three times. At the time of flowering, the number of flower stalks, seed weight, and seed fertility per soil core were recorded. Additionally, *Carex* flowering was monitored directly at the different field sites and compared with flowering patterns observed in the greenhouse.

What influences the germination of *Typha latifolia* seeds? A literature review, supplemented by experimental results and a practical approach

Constantin Möbius

The germination of *Typha latifolia* seeds is influenced by several environmental factors, which have been investigated both through literature research and laboratory experiments in a germination cabinet and in a greenhouse as part of the ‘Paludi-PROGRESS’ project.

1) Water availability plays the most important role. Seeds germinate only on moist soil, while submersion of more than a few centimeters inhibits germination. 2) Fluctuating temperatures are another important factor. The seeds need summer daytime temperatures alternating with cool nighttime temperatures to initiate germination. 3) The germination of *Typha latifolia* is light induced, which means that the seeds must be exposed to

sufficient light. 4) Laboratory tests with seeds on wet filter paper or paper towels showed germination rates of about 30%, with very large variations. After placing the seeds between two layers of filter paper or paper towel, the germination rate increased to a reliable 75 to 90%. This is most likely due to an even supply of water without submerging the seeds. 5.) Another observation in these experiments was that the proportion of germinated seeds was much higher on moist soil and also under water when several seeds were very close together. This suggests some kind of recognition mechanism, perhaps via release of small amounts of phytohormones.

These findings can be used in practice when sowing seeds. Specifically, the aim is to develop seed pills that contain several seeds and have the ability to absorb water without dissolving immediately. This would ensure optimal hydration. If light can reach the seeds directly and the pills are sown onto soil with a suitable moisture content, this method could be particularly useful for the controlled cultivation of *Typha latifolia* in wetlands.

Sowing cattail: pay attention to soil properties and water levels

Dr. Jeroen Pijlman

The cultivation of cattail (*Typha*) offers promising opportunities for reducing greenhouse gas emissions and soil subsidence, improving water quality and providing a new revenue model for farmers on peat soil. Sowing cattail is a more cost-effective start of cultivation than planting, however its effectiveness in establishing a homogenous and dense stand varies greatly. Previous studies have shown that cattail is sensitive to soil and water properties. Therefore, two experiments were conducted on the germination and early growth of cattail after sowing.

The two experiments were conducted in a greenhouse using buckets (22.2 × 22.2 cm, filled with 15 cm soil). Experiment 1 comprised four different peat soils of which either 10 cm topsoil was removed or not, and three water levels (–10,0 or +10 cm). Experiment 2 comprised three sowing densities (4,25 or 100 seeds per bucket) and seeds from three origins in the Netherlands, one soil and a fixed water level (0 cm).

Broadleaf cattail (*T. latifolia*) had 2.5–4.0 times higher seed germination rate than narrowleaf cattail (*T. angustifolia*). A water level of –10 cm

was disastrous for germination, while 0 cm and +10 cm respectively were beneficial for germination and growth. Soil pH, phosphorus-iron ratio and salinity were important factors for growth, with higher early plant growth rates on more fertile soils. Plant growth was generally higher on soils where the top layer was not removed. A higher sowing density led to a more dense stand. Seed origin did not affect the measured parameters.

Further studies are needed to determine optimal seeding rates and to further develop seeding strategies such as pre-germination or repeatedly sowing at multiple moments. Insights of these experiments are also important when evaluating the suitability of a site for cattail cultivation.

Influence of nutrient supply on biomass yield and biomass quality of paludiculture plants cattail and reed

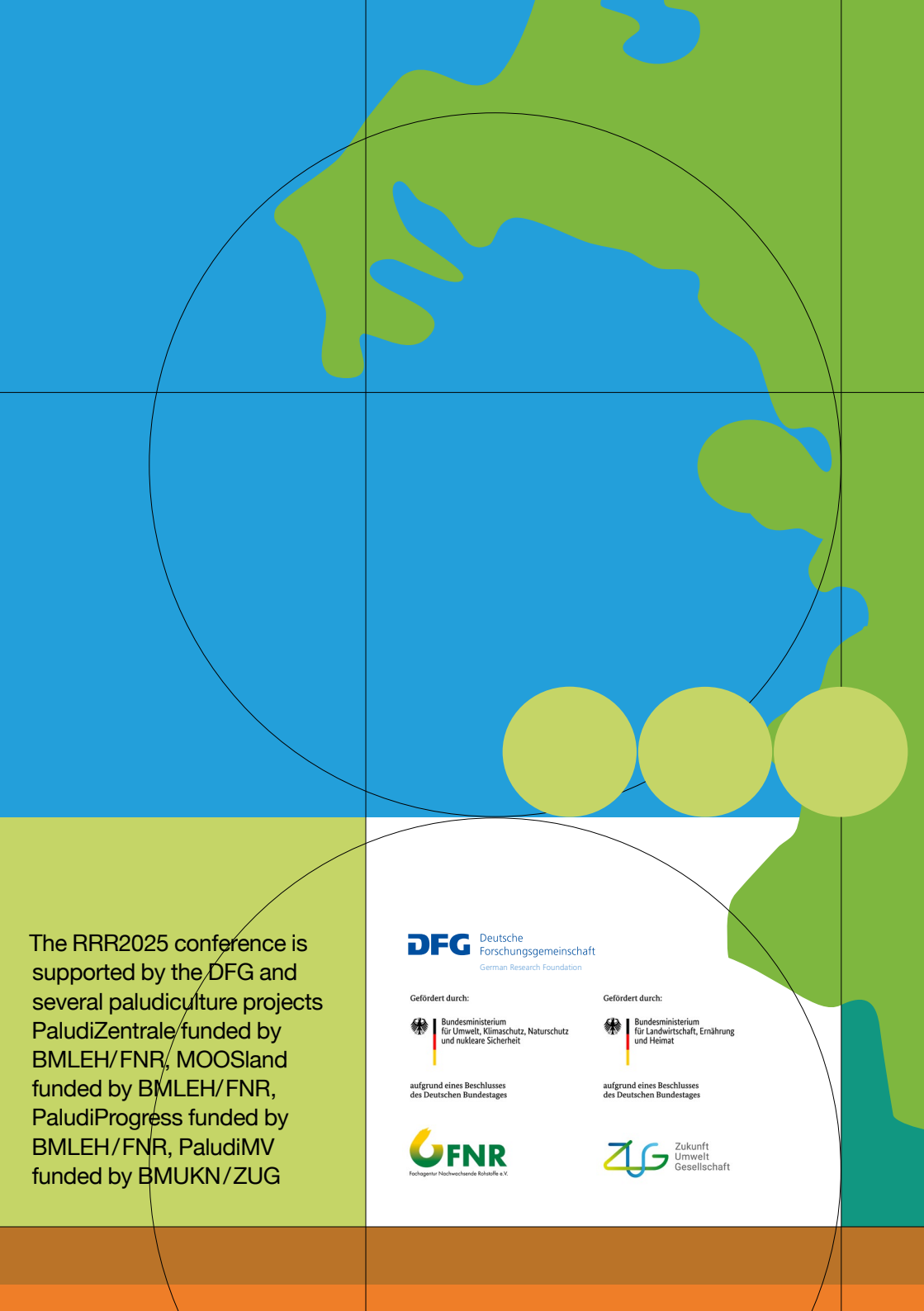
Lars Kretschmer

Initial research with paludiculture plants has shown that nutrient depletion is possible if nutrients are not returned to the field. In long-term, this could lead to biomass yield losses and quality changes in the permanent cultivation of paludiculture plants.

In the present study, we carried out trials with established cattail (*Typha latifolia, Typha angustifolia*) as well as reed (*Phragmites australis*) in 1000 litre containers, which showed first signs of nutrient depletion at the third year (2022). In 2023, we tested the influence of different nutrient supply levels of nitrogen (N), phosphorus (P) and potassium (K) (D0 variant: water only, D1: 78 kg ha^{-1} N, 30 kg ha^{-1} P, 60 kg ha^{-1} K, D2: 238 kg ha^{-1} N, 60 kg ha^{-1} P, 180 kg ha^{-1} K) on the development of biomass yield and quality. Each variant was divided into 7 parts. During the flooding period from April to June 2023 each part was applied weekly to the containers simulating polluted water. The initial water level was kept constant at 10 cm below the soil surface as subsurface irrigation and was changed to 10 cm above soil surface one week after the last nutrient application.

The highest nutrient applications (D2) kept the biomass yields of *T. angustifolia* and *P. australis* at the same level as in the previous year 2022 (without additional nutrient supply) while the continuous decline in the biomass yield of *T. latifolia* could only be partially compensated. In terms of

biomass quality, *T. latifolia* and *P. australis* showed an increased cellulose content in the D2 variant. The morphological quality of reed was positively influenced in the D2 variant (the sum of the medium and long shoots was twice as high compared to the D0 and D1 variants).



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FNR Fachagentur Nachwachsende Rohstoffe e.V.

ZUG Zukunft Umwelt Gesellschaft