Proceedings

GREIFSWALD
MIRE
CENTRE

RRR2021 *virtual conference*

Renewable Resources from Wet and Rewetted Peatlands

March 09th - 11th 2021

The RRR2021 is organised by the partners in the Greifswald Mire Centre

The RRR2021 conference is funded by

Imprint
Authors collective

Partners in the Greifswald Mire Centre

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Institute of Sustainable Development of landscapes of the Earth (DUENE e.V), c/o Soldmannstraße 15, 17487 Greifswald, Germany

Cover photo: Cattail seedlings ready for planting on a paludiculture site before rewetting, NE Germany, Photo: Tobias Dahms (lensescape.org)

Greifswald, March 2021

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PALUDI CULTURE
RRR 2021

Welcome to virtual RRR2021

3rd RRR conference on "Renewable Resources from Wet and Rewetted Peatlands

In the light of the Paris Agreement and the necessity to reduce all anthropogenic CO_2 emissions globally to net zero around the year 2050, peatland rewetting and innovative land use concepts for wet peatlands are an important contribution to achieve this goal. The first two RRR conferences on the utilisation of wetland plants (paludiculture) were held in 2013 and 2017 in Greifswald.
The Covid19 pandemic has been prohibiting in-person conferences for about a year now, but research and implementation of paludiculture are rapidly evolving. We acknowledge the need for international exchange by organising a virtual conference to continue the dialogue on paludiculture. The 3rd RRR conference on "Renewable Resources from Wet and Rewetted Peatlands - RRR2021" takes place from 9th - 11th of March 2021 and is organised by the partners in the Greifswald Mire Centre.
You can expect passionate keynote speakers in plenary sessions at the beginning of conference day 1 and 2. Altogether more than 100 scientific oral and poster presentations are divided over 21 parallel sessions. The session on "Finance options for livelihoods from wet peatlands" is co-organised with FAO, UNEP, IUCN and WWF. Excursions usually represent one of the most enjoyable and inspiring part of the programme when traveling to conferences. Therefore, we cordially invite you to join two plenary sessions with eight inspiring virtual paludiculture excursions. The literature evening, workshops, and an art session are further highlights of the programme. Several booths in the virtual exhibition hall expose wetland-related products, techniques, and services. The virtual platform provides the best networking opportunities with discussion forums, open spaces, and face to face conversations to get in contact with scientists, practitioners, pioneers, and other experts from all over the world.
We wish you an inspiring RRR2021 conference where you can share and widen your knowledge about paludiculture worldwide.

The RRR2021 conference team

Welcome speech by Christian Holzleitner

Christian Holzleitner is currently Head of Unit responsible for *Finance for Innovation and Land Use* in the Directorate-General for Climate Action in the European Commission. Previously, he worked as assistant to the Director-General for Climate Action, covering all issues related to EU and international climate policy, and at the Directorate-General for Competition in the area of State aid for services of general economic interest in the postal, transport, and health sectors.

Before joining the European Commission, Christian Holzleitner worked as senior manager with KPMG Germany on international transfer pricing. He is an economist and holds a PhD from the University of Linz (Austria).

Significance of the conference

The production and utilisation of wetland biomass offers manifold opportunities to address the increasing and diversifying demand for biomass and can reduce the competition between biofuel and food production. Wetland biomass can substitute fossil resources as a raw material for manufacturing and industry and for energy production, and it can also provide food: e.g. directly with berries or products from the water buffalo, or indirectly with cattail and Azolla as fodder for livestock as well as with peat moss, cattail and alder wood fiber as components of growing media.

The cultivation and utilisation of paludiculture crops can provide sustainable land use options for peatlands. The rewetting of degraded peatlands for paludiculture with water tables raised to the soil surface reduces greenhouse gas emissions and restores many other ecosystem services like nutrient removal, water retention and habitat provision.

Members of the RRR2021 conference team:

Greifswald Mire Centre, Greifswald, Germany: Susanne Abel, Tobias Dahms, Greta Gaudig, Monika Hohlbein, Nina Körner, Mira Kohl, Constantin Möbius, Felix Närmann, Anke Nordt, Claudia Oehmke, Jan Pottgießer, Anja Prager, Bas Spanjers, Franziska Tanneberger, Sabine Wichmann, Wendelin Wichtmann

Key topics

- Biomass to product
- Greenhouse gas emissions and other climate effects
- Yield, water and nutrient dynamics
- Biodiversity at ecosystem level and within species
- Sphagnum farming, vegetation restoration and propagules
- Harvesting techniques
- Worldwide developments of paludiculture
- Regional and national transition of peatland use & socio-economics
- Framework conditions and policy support
- Case studies (SE-Asia)

Host institutions

The University of Greifswald, the Succow Foundation and DUENE e.V. are partners in the Greifswald Mire Centre which unites some 70 peatland experts in one place. The Greifswald Mire Centre is the interface between science, policy and practice in all peatland related questions – locally and globally, and offers science-based solutions for social challenges related to peatlands such as climate protection, biodiversity conservation and sustainable use.

UNIVERSITÄT GREIFSWALD
Wissen lockt. Seit 1456

Succow Stiftung

DUENE

GREIFSWALD MIRE CENTRE

Technical instructions

Instructions to all participants

Here you can find instructions for using the conference platform. Questions to the presenters you can ask mainly via the chat. The moderator will select the questions and pass them on to the presenters.

General instruction to presenters

Please find in the table the time you will have for your presentation and the discussion afterwards, depending on what you will present (keynote, talk, poster, virtual excursion). For a smooth running of the conference we kindly ask you to send us the files of your presentation as back-up, your poster as pdf or your video as soon as possible, at the latest until **28th of February** for posters, videos and virtual booths, and at the latest until **7th of March** for talks.

	presentation time	time for discussion	Please send your file(s) to info@rrr2021.com	Deadline for file delivery
Keynote Speaker	20 min.	5 min	Back-up presentation	07.03.2021
Parallel session	60 min.			
Talk	10 min.	5 min.	Back-up presentation	07.03.2021
Poster pitch	2 min.	1-4 min.*	(see Poster exhibition)	
Poster exhibition	Continually		Poster PDF	28.02.2021
Virtual excursion	6-8 min.	4 min.*	Video or YouTube link	28.02.2021
Workshop	divers		Back-up presentation	07.03.2021
Virtual booth	Continually		Booth information	28.02.2021

* joint discussion

Briefing & Test events

On the **2nd of March** 2021 two virtual test events with an instruction briefing is planned, one in the morning and one in the afternoon. You can get familiar with our virtual platform and able to rehearse your presentation/session. An invitation will follow soon. Please note, that you must be registered to attend the test event.

Speaker instructions

We are looking forward to your oral presentation at the RRR2021 conference. The following guidelines will provide you with important information and instructions to prepare your presentation.

General Information

- The conference will start with two keynotes each on day 1 and day 2 in plenary sessions. Your keynote presentation may not exceed 20 minutes. After your talk, there are 5 minutes left for discussion.
- Parallel sessions last 60 minutes and usually contain 4 speakers. **Your presentation may not exceed 10 minutes**. After your talk, there are 5 minutes left for discussion. In some sessions we have planned poster presentations of 2 minutes each (see also poster presentation instructions). If there is still time left at the end of the session, the moderator can invite you for a panel discussion.
- Each session will be accompanied by a moderator responsible for introducing the speakers and poster presenters, controlling the timing of the session, and facilitating questions.

Preparation

- Please register as soon as possible, but at latest before **1st of March**. Without a registration you are unfortunately not able to present.
- All speakers are expected to produce a PowerPoint presentation.
- We strongly recommend you prepare a live presentation. However, in case of uncertainties like unreliable internet connection you are invited to send us a pre-recorded talk. Instructions to produce it can be found here. In case of a pre-recorded presentation, we ask you to be available for discussions during the whole session.
- If your PowerPoint presentation contains audio, video, or unusual files, you must inform the conference committee (info@rrr2021.com) in advance to ensure the necessary technical arrangements can be made.
- We would like to have your back-up presentation in case of technical issues. Please send your presentation (PowerPoint or PDF) as soon as possible, but the latest by **7th of March** to info@rrr2021.com.
- Name your PowerPoint-file, using the code of your session in the detailed programme followed by your name. For example: session2.1_NoraKöhn.pdf
- After the conference, we want to upload all the PowerPoint presentation on our website www.moorwissen.de. Please indicate when registering if you agree. Please note, that it is your responsibility to determine if and how you can use the images in your presentation without violating copyright. In case of modifications, please send us your modified Powerpoint PDF that is suitable for our website and name it like this (Session 2.1 Nora Köhn_Website).
- The Speakers Tutorials can be found here. Please read them carefully.

Presentation day

- Please, check the preliminary programme for the day and time of the session in which you are pitching. The online programme is regularly updated and contains details of all sessions and speakers.
- Please read the Speakers Tutorials.
- 15 minutes before your session starts, you will be expected in your session room (not the exhibition booth). Your moderator will give you the latest instructions.
- Please make sure your audio and video settings work properly.
- There is no need to upload your presentation slides, please simply share your screen with the other participants.

- To keep the sessions running to schedule and allow questions from the audience it is important to keep the presentations within the allotted time. The moderator can cut your presentation if it over-runs the allotted time of 10 minutes.
- Each session is also accompanied by a technical host who can assist you. Please, contact the technical host in the chat in case of technical questions.
- Please respect the netiquette – if you are not speaking, please mute yourself to avoid any background noise.
- If you still wish to continue the discussion after the session, the moderator can schedule in consultation with the technical host an extra session at 16:45 (day 1 & day 2) in the networking (open space) or at day 3 during the whole day. This session will be scheduled at the reception site of the virtual platform.

Instructions for poster presenters

We are looking forward to your poster presentation at the RRR2021 conference. In order to get the most attention for your poster, you will be able to:

- provide a one-page poster in pdf, that will be displayed in your virtual exhibition booth,
- promote your poster in a 2-minute pitch during the session,
- participate live in discussion during your session,
- and discuss your poster with the attendees in your exhibition booth. The following guidelines will provide you with important information and instructions to prepare your poster presentation.

General Information

- We have planned poster pitches of two minutes each after the last talk in the session (see detailed programme).
- The purpose of your poster pitch is to promote your poster and to invite the audience to discuss your poster in your virtual exhibition booth. Do not go to much in detail.
- All poster pitches will be live, no pre-recorded pitches.
- Each session will be accompanied by a moderator responsible for introducing the speakers & poster presenters, controlling the timing of the session, and facilitating questions.
- During your poster pitch, the moderator will display your poster on the screen for the audience. You do not have to care about the technical stuff.
- The moderator will cut your pitch after two minutes.
- After your pitch you must be available for a (panel) discussion.

Poster requirements & Preparation

- For your poster you are free to select shape and size, but we recommend for the online presentation to use the 16:9 format (widescreen) and a resolution of at least 300 dpi.
- Please register as soon as possible, but at latest before **1st of March**. Without a registration you are unfortunately not able to present.
- All poster presenters should submit a one-page poster PDF. Please, send this to (info@rrr2021.com) as soon as possible, but the latest by **28th of February**.
- Name your poster file, using the code of your poster pitch in the programme followed by your name. For example: Poster_2.1.A_TobiasDahms.pdf
- After the conference, we want to upload all posters on our website www.moorwissen.com. **Please indicate when registering if you agree**. Please note, that it is your responsibility to determine if and how you can use the images in your poster without violating copyright.

The poster in your virtual exhibition booth

- Your poster will be displayed in your exhibition booth titled with the code of your poster pitch in the programme followed by your name. For example: Poster_2.1.A_TobiasDahms.pdf
- Your virtual booth is the place where your poster will be discussed. Attendees can contact you face to face or in the chat for questions. You are also able to give a poster presentation for one or more interested persons.
- Please read the tutorial for the virtual exhibition and inform yourself at the test event on the **2nd of March** about the possibilities.

Day of the poster pitch

- Please, check the preliminary programme for the day and time of the session in which you are pitching. The online programme is regularly updated and contains details of all sessions and speakers.
- Please read the Speakers Tutorials.
- 15 minutes before your session starts, you will be expected in your session room (not the exhibition booth). Your moderator will give you the latest instructions.
- Please make sure your audio and video settings work properly.
- There is no need to share your screen with the other attendees. The host will display your poster during your pitch.
- To keep the sessions running to schedule and allow questions from the audience it is important to keep the pitch within the allotted time. The moderator will cut off your pitch after two minutes.
- Each session is also accompanied by a technical host who can assist you. Please, contact the technical host in the chat in the case of technical questions.
- Please respect the netiquette – if you are not speaking, please mute yourself to avoid any background noise.

Instructions for exhibitors

The utilization of peatland products and the development of adapted techniques are fundamental elements in the sustainable management of wet and rewetted peatlands. We are looking forward to the booth of your peatland related product, technique, or service in our exhibition hall. The following guidelines will provide you with important information and instructions to prepare your booth.

General Information

- The expo vendor booth can be designed with pre-recorded videos, live video stream session, company logo and links to your website. In this link (youtube.com) you will find an example of the possibilities of your expo booth.
- Your expo booth will be continually available for all the participants during the whole conference.
- Your virtual booth is the place where your product, technique or service will be discussed. Participants can contact you face to face or in the chat for questions. You are also able to give a poster presentation for one or more interested persons.
- Exhibitors will pay the usual registration fee.

Requirements & Preparation

- All exhibitors should submit this template with the information to design your booth. Please, send this to (info@rrr2021.com) as soon as possible, but the latest by **25th of February**.
- Please register as soon as possible, but at latest before **1st of March**. Without a registration you are unfortunately not able to present.
- Please read the tutorial for the virtual exhibition and inform yourself at the test event on the **2nd of March**.

The RRR2021 programme

The programme which is described on the following pages represents that version which was the newest one at the date when these proceedings have been uploaded. Please be aware that after this date there might be some slightly changes in the programme. On the conference homepage you will always find the most up to date version.

Day 1 and 2 will each start with two passionate keynote speakers. Altogether more than 100 scientific oral and poster presentations are divided over 21 Sessions. The session on "Finance options for livelihoods from wet peatlands" at the second day is co-organised with FAO, UNEP, IUCN and WWF. Excursions usually represent one of the most enjoyable and inspiring part of the programme when traveling to conferences. Since this part cannot take place, eight inspiring virtual paludiculture excursions will be presented. The literature evening, workshops, and an art session are some other highlights in the programme. Several booths in the virtual exhibition hall expose wetland-related products, techniques, and services. The virtual platform provides the best networking opportunities with discussion forums, open spaces, and face to face conversations to get in contact with scientist, practitioners, pioneers, and other experts from all over the world.

RRR2021 Conference programme from day 0 (8th of March) till day 3 (11th of March)

Day 0 **8th of March 2021** **Start: 18:00 (CET)**	**Day 1** **9th of March 2021** **Start: 08:30 (CET)**	**Day 2** **10th of March 2021** **Start: 08:30 (CET)**	**Day 3** **11th of March 2021** **End: 18:00 (CET)**
The RRR2021 virtual conference is online, feel free to have a look and get familiar with our virtual platform. Take a first glimpse at the posters or visit our virtual exhibition hall with booths that offer you wetland-related products, techniques, and services.	See: RRR2021 Conference Programme	See: RRR2021 Conference Programme	The RRR2021 virtual conference is still online. Continue your networking activities in open spaces, watch the recorded videos from the keynotes or the virtual excursions, visit the virtual exhibition room or just take the time to complete your poster tour.

RRR2021 Conference Programme Overview – Day 1 (9th of March)

Time (CET)	STAGE A		
08:30-08:45	**Login & Warm Up**		
08:45-09:05	**Welcome & Opening**		
09:05-10:00	**Keynote Hans Joosten (University of Greifswald, Germany)** **Keynote Bärbel Tiemeyer (Thünen-Institute, Germany)**		
	STAGE A	**STAGE B**	**STAGE C**
10:15-11:15	Session 1.1 Biomass to product (Material use)	Session 1.2 Greenhouse gas emissions and other climate effects	Session 1.3a Sphagnum farming Session 1.3b *Sphagnum* vegetation restoration
11:15-11:30	Break		
11:30-12:30	Session 2.1 Biomass to product (Energy)	Session 2.2 Greenhouse gas emissions and other climate effects	Session 2.3a *Sphagnum* vegetation restoration Session 2.3b Sphagnum & Drosera farming
12:30-13:30	Break		
13:30-14:15	VIRTUAL EXCURSIONS (Plenary Session, Stage A)		
14:15-14:30	Break		
14:30-15:30	Session 3.1 Biomass to product	Session 3.2 Greenhouse gas emissions and other climate effects	Session 3.3 Biodiversity at ecosystem level
15:30-15:45	Break		
15:45-16:45	Session 4.1 Harvesting techniques	Session 4.2a Biodiversity within species (Genetics of Reed) Session 4.2b Peatland properties	Session 4.3 *Sphagnum* propagules
16:45-17:00	Break		
17:00-18:00	Networking (Open space A)	Networking (Open space B)	Networking (Open space C)
20:00-22:00	SLOW Session: Paludiculture & Art (via ZOOM)		

RRR2021 Conference Programme Overview – Day 2 (10th of March)

Time (CET)	STAGE A
08:30-09:00	**Login & Warm Up**
09:00-09:10	**Welcome & Organisation (Greifswald Mire Centre)**
09:10-10:00	**Keynote Zélie Peppiette (European Commission, Belgium)**
	Keynote Kristiina Regina (Natural Resources Institute Finland (Luke), Finland)

	STAGE A	STAGE B	STAGE C
10:15-11:15	Session 5.1 Worldwide developments of paludiculture	Session 5.2 Yield, water and nutrient dynamics	Session 5.3 Regional and national transition of peatland use & socio-economics
11:15-11:30	Break		
11:30-12:30	Session 6.1 Finance options for livelihoods from wet peatlands (co-organised with FAO, UNEP, IUCN and WWF)	Session 6.2 Yield, water and nutrient dynamics	Session 6.3 Regional and national transition of peatland use & socio-economics
12:30-13:30	Break		
13:30-14:15	VIRTUAL EXCURSIONS (Plenary Session, Stage A)		
14:15-14:30	Break		
14:30-15:30	Session 7.1 Case studies (South-east Asia)	Session 7.2 Framework conditions and policy support	Session 7.3 Regional and national transition of peatland use & socio-economics
15:30-15:45	Break		
15:45-16:15	Closing ceremony (Plenary Session, Stage A)		
16:15-16:30	Break		
16:30-18:00	Workshop A: Global network for paludiculture	Workshop B: Photography	Networking (Open space D)
20:00-22:00	Literature Evening with H. Joosten (via ZOOM)		

RRR2021 Detailed Conference Programme Day 1 (9th of March)

Time (CET)	STAGE A		
08:30-08:45	Login & Warm Up		
08:45-08:55	Opening & Organisation (Greifswald Mire Centre)		
08:55-09:05	Welcome by Christian Holzleitner (European Commission, DG Clima)		
09:05-10:00	Keynote Hans Joosten (University of Greifswald, Germany) Keynote Bärbel Tiemeyer (Thünen-Institute, Germany)		
10:00-10:15	Break		
	STAGE A	**STAGE B**	**STAGE C**
10:15-11:15	**Session 1.1 Biomass to product (Material use)** *Anke Nordt*	**Session 1.2 Greenhouse gas emissions and other climate effects** *John Couwenberg*	**Session 1.3a Sphagnum farming** *Matthias Krebs*
	Biomass quality of paludiculture plants (Cattail and Common reed) for various utilisation options **Nora Köhn**	Promising pathways to reduce GHG emissions by methane oxidation in rewetted peatlands including paludi-culture lands **Christian Fritz**	Paludiculture on former bog gras-sland: sustainable biomass produc-tion and benefits of a Sphagnum farming site in NW Germany **Greta Gaudig**
	Common reed for thatching in Northern Germany **Sabine Wichmann**	Chimneys and blankets: species-dependent methane emission pathways in a rewetted dutch peatland **Renske Vroom**	Establishing a landscape-scale carbon farm on former drained, agricultural pasture. **Mike Longden**
			Session 1.3b *Sphagnum* vegetation restoration
	Production of thatching materials **Ruud Conijn**	Persistently high CH_4 emissions 10 years after rewetting: The necessity for long-term observations when measuring GHG emissions of transi-tional systems **Danica Antonijevic**	Restoring ecosystem functions and reversing land subsidence by grow-ing *Sphagnum* on highly degraded eutrophic peat soils - a success story from the Netherlands **Bas van de Riet**
		Effects of saltwater intrusion into freshwater rewetted coastal fen on methane cycling microbial commu-nity **Cordula Gutekunst**	OptiMOOR – optimizing manage-ment strategies for peat bog resto-ration after intensive agricultural use **Gerald Jurasinski**
11:15-11:30	Break		

	STAGE A	STAGE B	STAGE C
11:30-12:30	**Session 2.1 Biomass to product (Energy)** *Paul Goriup*	**Session 2.2 Greenhouse gas emissions and other climate effects** *Christian Fritz*	**Session 2.3a *Sphagnum* vegetation restoration** *Greta Gaudig*
	The optimal harvest date of *Typha latifolia* and *Phalaris arundinacea* as biogas substrates **Christina Hartung**	Mitigation potential of paludiculture for five different Danish peatland sites under controlled water tables – a mesocosm study **Claudia Nielsen**	Bog Growth- restoration of *Sphagnum* vegetation after peat extraction **Jan Köbbing**
	Fuel quality and combustion behaviour of pure and kaolin additivated pellets from fen paludicultures in a small-scale biomass boiler **Daniel Kuptz**	A national research programme on greenhouse gas emissions and land subsidence from lowland peat in the Netherlands **Gilles Erkens**	Early stages of revegetation of a terminated extracted peatland after two years of rewetting **Eva Weber**
	Energetic utilization of biomass from rewetted peatlands at a 800 kW heating plant for community heating in Malchin **Mirko Barz**	Carbon sequestration potential of a former cutaway Irish blanket Peatland located on Ireland's Western Coast **Amey Tilak**	Rewetting of a transition mire by sprinkling with demineralised water **Bernhard Hasch**
			Session 2.3b Sphagnum farming & Drosera farming
	Poster*: Poster 2.1.A **Tobias Dahms**	**Poster***: Poster 2.2.A **Philipp Köwitsch**	**Posters*:** Poster 2.3b.A **Matthias Krebs** Poster 2.3b.B **Jens-Uwe Holthuis** Poster 2.3b.C **Laura Panitz** Poster 2.3b.D **Balázs Baranyai**
12:30-13:30	**Break**		
13:30-14:15	**STAGE A: Virtual excursions (plenary session)** ***Sabine Wichmann***		
1	Sphagnum farming on 17 ha in the peatland Hankhauser Moor, NW Germany **Greta Gaudig**		
2	*Sphagnum* farm Barver **Jens-Uwe Holthuis**		
3	Sphagnum farming re-thought **Neal Wright**		
4	Peat bog rewetting research sites in Northwestern Germany **Gerald Jurasinski**		
14:15-14:30	**Break**		

	STAGE A	STAGE B	STAGE C
14:30-15:30	**Session 3.1 Biomass to product** *Tobias Dahms*	**Session 3.2 Greenhouse gas emissions and other climate effects** *Bärbel Tiemeyer*	**Session 3.3 Biodiversity at ecosystem level** *Nerjius Zableckis*
	Cranberries on peatland in the Netherlands **Bart Crouwers**	Long-term observation of greenhouse gases of a Sphagnum farming area on former bog grassland in North-western Germany **Caroline Daun**	Sphagnum farming in north-west Germany: is it offering a secondary habitat for bog-typical dragonfly species? **Daniel Brötzmann**
	Reed canary grass as a potential agent for phytoremediation and phytomining of strategic elements **Oliver Wiche**	Greenhouse gas exchange of a Sphagnum paludiculture on a former peat extraction site in the late stages of the rotation cycle **Laura Panitz**	Can paludiculture promote fen biodiversity? A literature-based review with focus on Europe **Felix Närmann**
	Making use of peatland biomass - from theory to charcoal **Marcel Welle**	Greenhouse gas benefits of Sphagnum farming using micro-propagated material in the UK **Anna Keightley**	What does paludiculture contribute to arthropod diversity? **Gert-Jan van Duinen**
	Posters*: Poster 3.1.A **Christina Hartung** Poster 3.1.B **Carsten Lühr** Poster 3.1.C **Anke Nordt**	**Posters*:** Poster 3.2.A **Christian Fritz** Poster 3.2.B **Hanna Kekkonen**	**Posters*:** Poster 3.3.A **Jürgen Müller** Poster 3.3.B **Monique Nerger** Poster 3.3.C **Teresa Rojas Lara**
15:30-15:45	**Break**		
15:45-16:45	**Session 4.1 Harvesting techniques** *Wendelin Wichtmann*	**Session 4.2a Biodiversity within species (Genetics of Reed)** *Gerald Jurasinski*	**Session 4.3 *Sphagnum* propagules** *Matthias Krebs*
	Introduction of types of and challenges for machinery for paludiculture biomass harvest on wet peatlands **Jan Pottgießer**	Population genetic structure of common reed (*Phragmites australis*) **Kristina Kuprina**	Selection of highly productive *Sphagnum* species and provenances in Europe to maximize the yield in Sphagnum farming **Mira Kohl**
	Special machines for working in wet areas with low ground pressure, development of new machine types for working on mires and wetlands **Holger Wolter**	How can the population genetic diversity of common reed, *Phragmites australis*, change over 24 years? **Anna Rudyk**	Axenic in-vitro cultivation of 19 peat-moss (*Sphagnum* l.) species as a resource for basic biology, biotechnology and paludiculture **Melanie Heck**
	Cattail (*Typha*) harvesting technic development for Substrate and more **Robert Wellink**	**Poster*:** Poster 4.3.A **Paul Muto**	Sphagnum farming using micro-propagated *Sphagnum* and simulated rain irrigation to significantly improve production of a growing medium **Neal Wright**
	High-capacity machines for working in areas with fragile soil structure **Anne Wieb Dijkstra**	**Session 4.2b Peatland properties** **Posters*:** Poster 4.2b.A **Anna Kühnel** Poster 4.2b.B **Kerstin Fuhrmann** Poster 4.2b.C **Kilian Walz**	**Poster*:** Poster 4.3.A **Mira Kohl**
16:45-17:00	**Break**		
17:00-18:00	**Networking (Open space A)**	**Networking (Open space B)**	**Networking (Open space C)**
20:00-22:00	**Evening Programme**		
	SLOW Session: Paludiculture & Art (via ZOOM)		

*Posters day 1 (9th of March)

Poster 2.1.A Biomass to product (Energy)	A case for solid fuels. Comparing costs, energy consumption and greenhouse gas emissions of different fuels for the local heating plant in Malchin. **Tobias Dahms**
Poster 2.2.A GHG emissions and other climate effects	Effects of topsoil removal on greenhouse gas exchange and water quality of fen paludicultures in North-Western Germany **Philipp Köwitsch**
Poster 2.3b.A Sphagnum farming & Drosera farming	Optimising Sphagnum farming in water management, climate impact, biodiversity & product development – the new joint project OptiMOOS **Matthias Krebs**
Poster 2.3b.B Sphagnum farming & Drosera farming	*Sphagnum* farm Barver – creating a new perspective for peatland ecosystems **Jens-Uwe Holthuis**
Poster 2.3b.C Sphagnum farming & Drosera farming	Optimizing the management of Sphagnum paludicultures under difficult conditions – interaction of climate change, nutrient depositions, peat properties and vascular plant invasion **Laura Panitz**
Poster 2.3b.D Sphagnum farming & Drosera farming	Sundew cultivation (D*rosera rotundifolia*) on *Sphagnum* in paludiculture - the great potential of a tiny medicinal plant **Balázs Baranyai**
Poster 3.1.A Biomass to product	Suitability of fen plants as growing media constituent in terms of chloride content **Christina Hartung**
Poster 3.1.B Biomass to product	Fenland biomass for a climate-friendly future - Development of value chains **Carsten Lühr**
Poster 3.1.C Biomass to product	The Paludi-tiny house **Anke Nordt**
Poster 3.2.A GHG emissions and other climate effects	The potential of automated transparant-chambers to detect 'cold spots' and 'hot moments' of carbon fluxes in periodically wet and rewetted peatlands **Christian Fritz**
Poster 3.2.B GHG emissions and other climate effects	Greenhouse gas emissions from energy willow, nature conservation field and grass on a cultivated peat soil **Hanna Kekkonen**
Poster 3.3.A Biodiversity at ecosystem level	Implementation of a water buffalo grazing system on a coastal wet grassland site interspersed with reed beds **Jürgen Müller**
Poster 3.3.B Biodiversity at ecosystem level	PaluDivers: Development and accompaniment of the testing of nature conservation minimum standards for the conservation and promotion of biodiversity in future paludicultures on agricultural land **Monique Nerger**
Poster 3.3.C Biodiversity at ecosystem level	Linking up Peatland Restoration with Community Empowerment and Orangutan Conservation Activities in Central Kalimantan, Indonesia **Teresa Rojas Lara**
Poster 4.2a.A Biodiversity within species (Genetics of Reed)	Commercialising vegetative propagation systems for perennial grasses for paludiculture production using CEEDS™ technology. **Paul Muto**
Poster 4.2b.A Peatland properties	Peat soil in Bavaria - implications for agricultural and climate-change strategies from a century of archived peat soil data **Anna Kühnel**
Poster 4.2b.B Peatland properties	Mo(o)re balance – About losses of high elevation and water table dynamics in a water pumped catchment area **Kerstin Fuhrmann**

Poster 4.2b.C Peatland properties	Comparative studies on peatland properties along a land use gradient in Ireland **Kilian Walz**
Poster 4.3.A *Sphagnum* propagules	Selecting highly productive *Sphagnum* (peatmoss) provenances and their mass-propagation – results of the joint Sphagnum farming research project ‚mooszucht' **Anja Prager & Mira Kohl**

RRR2021 Detailed Conference Programme Day 2 (10th of March)

Time (CET)	STAGE A		
08:30-09:00	**Login & Warm Up**		
09:00-09:10	**Welcome & Organisation (Greifswald Mire Centre)**		
09:10-10:00	**Keynote Zélie Peppiette (European Commission, Belgium)**		
	Keynote Kristiina Regina (Natural Resources Institute Finland (Luke), Finland)		
10:00-10:15	**Break**		
	STAGE A	**STAGE B**	**STAGE C**
10:15-11:15	**Session 5.1 Worldwide developments of paludiculture** *Hans Joosten*	**Session 5.2 Yield, water and nutrient dynamics** *Jürgen Kreyling*	**Session 5.3 Regional and national transition of peatland use & socio-economics** *Jan Peters*
	Paludiculture worldwide: is there a need to differentiate the concept? **Wendelin Wichtmann**	High water tables promote fast biomass production and long-term nutrient removal in Sphagnum farming **Renske Vroom**	Towards net zero CO_2 in 2050: An emission reduction pathway for organic soils in Germany **Franziska Tanneberger**
	Paludiculture – first results from a global survey of practical paludiculture initiatives **Rafael Ziegler**	Regulating alkalinity of water is a matter of life and death for Sphagnum farming **Adam Koks**	Will Dutch water management strategies result in a transition of peatland use? **Henk van Hardeveld**
	Paludiculture in Indonesia **Haruni Krisnawati**	How much can *Carex* sp. contribute to peat formation and to counteract eutrophication in fen peatlands under different nutrient levels? **Tjorven Hinzke**	The WaterWorks project **Jack Clough**
	Posters:** Poster 5.1.A **Faizal Parish** Poster 5.1.B **Sri Lestari** Poster 5.1.C **Mulyadi**	Effects of harvest and fertilization frequency on protein yield and extractability from flood-tolerant perennial grasses cultivated on a fen peatland **Claudia Nielsen**	GrasGoed (GrassGood) – Wetlands as part of a circular economy **Katrien Wijns**
11:15-11:30	**Break**		

	STAGE A	STAGE B	STAGE C
11:30-12:30	**Session 6.1 Finance options for livelihoods from wet peatlands** (co-organised with FAO, UNEP, IUCN, WWF) *Maria Nuutinen*	**Session 6.2 Yield, water and nutrient dynamics** *Jürgen Kreyling*	**Session 6.3 Regional and national transition of peatland use & socio-economics** *Volker Beckmann*
	Results of the peatland management sessions, case and global consultations **Maria Nuutinen & Laura Villegas**	Plant selection for paludiculture: water and nutrient level optima differ among *Typha* species **Kerstin Haldan**	Abatement costs of climate friendly peatland management options for agriculture: case study results for two German peatland regions **Christoph Buschmann**
	Sustainable Land Use Finance – inspiring investment in Peatlands **Dianna Kopansky**	Biomass utilization avenues and nutrient removal potential of Paludiculture crops *Phragmites* and *Typha* depend on harvesting season **Christian Fritz**	Cost-effectiveness of measures to mitigate greenhouse gas emissions from drained peatlands **Ralph Temmink**
	Landscape finance: emerging models for financing peatland restoration at scale **Paul Chatterton**	The impact of wetland restoration on water retention in the catchment scale in the Neman basin – costs and benefits **Marta Stachowicz**	Economic viability of Sphagnum farming on former bog grassland **Sabine Wichmann**
	Investing in peatlands – from bankers to bogs **Clifton Bain, Emma Goodyer & Renée Kerkvliet Hermans**	**Posters**:** Poster 6.2.A **Marina Abramchuk** Poster 6.2.B **Doreen Koltermann**	**Posters**:** Poster 6.3.A **Telse Vogel** Poster 6.3.B **Franz Wenzl** Poster 6.3.C **Bas Spanjers**
12:30-13:30	**Break**		
13:30-14:15	**STAGE A: Virtual excursions (plenary session)** *Anke Nordt*		

1 Field-scale *Typha* paludicultre in NE Germany - Set-up and 1st year's experiences
Sabine Wichmann

2 Paludi-Tinyhouse
Anke Nordt

3 Paludiculture-biomass heating-plant at the Kummerower See – a virtual field trip
Max Wenzel

4 Cattail (*Typha*), a multitalent for a rewetted landscape
Aldert van Weeren

14:15-14:30	**Break**		

	STAGE A	STAGE B	STAGE C
14:30-15:30	**Session 7.1 Case studies (South-east Asia)** *Faizal Parish*	**Session 7.2 Framework conditions and policy support** *Stefan Ewert*	**Session 7.3 Regional and national transition of peatland use & socio-economics** *Silvia Lotman*
	Addressing fragile peat ecosystems for the livelihoods of rural communities: lessons from Indonesia **Niken Sakuntaladewi**	Instruments for climate-friendly peatland use: Peatland protection in the EU-Common Agricultural Policy **Sophie Hirschelmann**	Potentials and capacities of climate change mitigation by peatland rewetting and wet agriculture on peatlands (paludiculture) in the Baltic countries **Andreas Haberl**
	Calophyllum spp.: An endemic species for restoring tropical peatlands in Indonesia **Mamat Rahmat**	Incentive based policy instruments guiding towards sustainable use of peatlands in EU **Cheng Chen**	Challenges for paludiculture development in Estonia **Jüri-Ott Salm**
	Stakeholder's role at field level towards tropical peatland restoration in South Sumatra, Indonesia **Bondan Winarno**	Incentives for paludicultures to achieve the climate target 2030 and 2050 **Achim Schäfer**	Potentials for paludicultures on rewetted peatlands in Latvia **Ilze Ozola**
	Nature-based solution: A case study on community-based active-ties to safeguard peatlands in Pahang, Malaysia **Lew Sien Yan**	**Posters**:** Poster 7.2.A **Monika Hohlbein** Poster 7.2.B **Wendelin Wichtmann**	First steps of paludiculture as sustainable use of rewetted peatlands in Lithuania **Nerijus Zableckis**
15:30-15:45	**Break**		
15:45-16:15	**STAGE A: Closing ceremony (plenary session)**		
16:15-16:30	**Break**		
16:30-18:00	**Workshop A**	**Workshop B**	**Networking (Open space D)**
	Global network for paludiculture – needs & options for exchange **Rafael Ziegler & Susanne Abel**	Photography Workshop: gifts from nature's peatlands **Tina Claffey**	
20:00-22:00	**Evening Programm**		
	Literature Evening Hans Joosten (via ZOOM)		

**Posters day 2 (10th of March)

Poster 5.1.A Worldwide developments of paludiculture	Peatland rehabilitation through multi-stakeholder partnership: Creating better livelihood for community in Malaysia **Faizal Parish**
Poster 5.1.B Worldwide developments of paludiculture	Paludiculture practices by smallholder farmers in southern Sumatra of Indonesia: opportunities and challenges **Sri Lestari**
Poster 5.1.C Worldwide developments of paludiculture	Peatland management based on local wisdom in Giam Siak Kecil Landscape in Riau Province, Indonesia **Mulyadi**
Poster 6.2.A Yield, water and nutrient dynamics	DESIRE: Development of Sustainable peatland management by restoration and paludiculture for nutrient retention and other ecosystem services in the Neman river catchment. **Marina Abramchuk**
Poster 6.2.B Yield, water and nutrient dynamics	Growth development of selected paludicultures in mesocosms **Doreen Koltermann**
Poster 6.3.A Regional and national transition of peatland use & socio-economics	Efficiency of cattail establishment on an eight-hectare fen sites in terms of working time and manpower requirements **Telse Vogel**
Poster 6.3.B Regional and national transition of peatland use & socio-economics	Implementation of single-farm optimized wet grassland management on organic soils **Franz Wenzl**
Poster 6.3.C Regional and national transition of peatland use & socio-economics	The climate friendly management of the agricultural peatlands in Brandenburg **Bas Spanjers**
Poster 7.2.A Framework conditions and policy support	Vorpommern - Ready to rewet? **Monika Hohlbein**
Poster 7.2.B Framework conditions and policy support	Certification of products from paludiculture: project design, potential, open questions, challenges **Wendelin Wichtmann**

Keynote speakers

Hans Joosten

Prof. Dr. Dr. hc Hans Joosten studied biology and worked as academic researcher and policy officer in the Netherlands. Since 1996 he leads the Working group of Peatland Studies and Palaeoecology of Greifswald University (Germany), since 2008 as an Extraordinary Professor. A key research topic of his group is the development of paludiculture (a term he coined in 1998). In 2016 he edited, together with Wendelin Wichtmann and Christian Schröder, the first textbook on paludiculture. Hans Joosten is Secretary- General of the International Mire Conservation Group and since 2009 intensively involved in UNFCCC and IPCC, especially with respect to emissions from organic soils, and in FAO in advancing climate-responsible peatland management.
In his keynote speech, Hans Joosten will elaborate how the concept of paludiculture has developed from a niche management option into an inevitable and comprehensive policy strategy to comply with the Paris Agreement and the Sustainable Development Goals. Both political and technical progress has been impressive but is still far from sufficient. Hans will discuss the constraints, challenges, options and perspectives to scale up paludiculture worldwide to reach the ultimate goal: having all peatlands wet again by 2050.

Zélie Peppiette

Zélie Peppiette is based in Brussels and works in the Directorate-General for Agriculture and Rural Development of the European Commission. She is advisor to the Deputy Director-General in charge of sustainability, income support and rural development. Among many other tasks, she has been instrumental in setting up Round tables on the Green Architecture of the Common Agricultural Policy (CAP) of the European Union in 2018-2019, facilitating exchange between agricultural and environmental stakeholders.
She will consider the implications of the future EU policy framework on peatland use in the EU, in particular how the Common Agricultural Policy may affect peatlands and paludiculture.

Bärbel Tiemeyer

Dr. Bärbel Tiemeyer studied Land Management and Environmental Protection at Rostock University and Sustainable Management of the Water Environment at the University of Newcastle upon Tyne. After returning to Rostock for her PhD, she has been working at the Thünen-Institute since 2010. The Institute of Climate-Smart Agriculture is responsible for the sectors agriculture and LULUCF of the German GHG inventory. She heads this institute's Peatland Group. Besides conducting research projects on GHG fluxes, hydrology and water quality, the group is responsible for deriving emission factors and regionalisation methods for organic soils in the greenhouse gas inventory.

Bärbel Tiemeyer will give a keynote on GHG emissions from organic soils in Germany – status quo and mitigation options – presenting the current methodology for organic soils in the GHG inventory and its underlying data. Spatial data comprise high resolution maps of land-use, type of organic soil and a map of mean annual water table. Emissions of CO_2, N_2O and CH_4 were synthesized from a large data set. Further, results of recent projects on different management options including water management by ditch blocking and submerged drains in grasslands and paludiculture will be presented and discussed.

Kristiina Regina

Prof. Dr. Kristiina Regina is an environmental scientist employed by the Natural Resources Institute Finland (Luke). She has investigated GHG fluxes and their mitigation on drained peat soils since 1992 but has studied widely soil management options also on mineral soils. Her work has been a combination of experimental work, development of the greenhouse gas inventory and studying the incentives for climate smart land use. She started the first field experiments on paludiculture in Finland. She is a member of the Finnish Climate Change Panel since 2016 but has even before that served as a link between researchers and policy makers. Kristiina Regina will discuss current and future peatland use in Europe reflecting on socioeconomic implications, and with a particular focus on the Nordic perspective.

Content: Abstracts of oral and poster presentations

Session 1.1 Biomass to Product (Material use)

Session 1.1		Biomass to product (material use)
Stage		A
Time		09.03.2021 10:15-11:15
Moderator		Anke Nordt
Talk:	**1**	Biomass quality of paludiculture plants (Cattail and Common reed) for various utilisation options **Nora Köhn**
	2	Common reed for thatching in Northern Germany **Sabine Wichmann**
	3	Production of thatching materials **Ruud Conijn**

1.1.1 **Biomass quality of paludiculture plants (Cattail and Common reed) for various utilisation options**

Köhn*, Nora A. K.; Haldan*, Kerstin L.; Neubert*, Josephine; Wichmann*, Sabine; Joosten, Hans*
**University of Greifswald, Institute of Botany and Landscape Ecology, Partner in the Greifswald Mire Centre, Germany*

AIM: The project Paludi-PRIMA (Putting paludiculture into practice – integration, management and cultivation) aims at identifying biomass requirements of paludiculture plants for various utilisation options. For quality assessment of common reed as a thatching material several parameters are already established, including breaking strength, diameter and length of single culms as well as element content. In contrast, only few parameters are so far available to assess the biomass quality of cattail. While cellulose, hemicellulose and lignin content are relevant for use as fodder, the culm length plays an important role for use in insulation and construction panels.
MATERIALS AND METHODS: Aboveground biomass of *Phragmites australis*, *Typha latifolia* and *Typha angustifolia*, grown in a mesocosm experiment, was tested. In the mesocosm experiment five *P. australis* clones from thatching reed stands, as well as the two native *Typha* species were grown in different water and nutrient levels from May 2019 until February 2020. Morphological (i.a. plant number, culm length, fresh weight) and chemical (i.a. carbon, nitrogen and phosphorous content) parameters as well parameters related to reed as thatching material (i.a. biodegradability and water absorptive capacity) were assessed.
RESULTS: First results show different responses of aboveground productivity of *Typha* species to nutrient and water levels. For example, *T. angustifolia* shows more biomass growth than *T. latifolia* at lower nutrient availability and higher water levels. The five clones of *P. australis* show different morphological characteristics, for example in terms of culm diameter and culm length.
Because of the young plant age, it is not yet possible to compare the plants from the experiment with those of natural thatching reed stands, but we expect that comparison of the clones will provide information on the biomass quality required for use as thatching reed.
CONCLUSIONS: Supported by a survey about biomass requirements for several products, it is planned to draw conclusions about the suitability of cattail and common reed for various utilisation options. Additionally, it is important to evaluate which growing conditions lead to appropriate biomass quality. Together, this will provide important information for biomass producers and the processing industry.

Key words: paludiculture, biomass quality, cattail, common reed

1.1.2 Common reed for thatching in Northern Germany

Wichmann, Sabine*; Becker, Lea*; Beckmann, Volker*
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Common reed is considered as a promising paludicultural plant. The utilization as roofing material, i.e. for thatching, is one of the best known and most common applications in Europe. Despite of its long tradition as locally available roofing material, reed for thatching is nowadays an internationally traded commodity. Countries as Germany, the Netherlands, the United Kingdom and Denmark rely on imports of up to 85% of the national consumption. We conducted a written survey among all thatchers in Northern Germany in 2019 for the first in-depth analysis of the market for thatching reed. Thatching companies are the key actors in the reed value chain by linking the final demand with the market for raw materials. We determined the market volume of thatching reed in Northern Germany, the market shares of reed from different origins and assessed the market potential for reed of regional origin. Quantity, quality attributes and promotion by thatchers were investigated as key factors. Considering the large areas of drained peatlands, rewetting already a very small share of it for reed cultivation would allow to improve the regional availability of reed as traditional ecological roofing material.

Key Words: *Phragmites australis*, thatching companies, market analysis

1.1.3 Production of thatching materials

Conijn, Ruud*; Kaarup, Joergen*
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Phragmites australis (Waterreed), and Miscanthus sinensis (Elephant grass). The thatched roof has prooven by Cradle to Grave analysis, to be the most sustainable roof existing, and versitile at the same time. Especially *Phragmites australis* has a large variety in characteristics. Growing in nature, they can only be harvested within a restricted period, whereas produced as crops, they can be harvested when the conditions are best. At the moment, most of the *Phragmites australis* used in Europe, is imported from China. The *Phragmites australis*, harvested in Europe, are of a wide variation of genotypes, of which some are unsuitable for roofs, but thatchers can not sort or recognise them. We wish to select the genotypes with the best caracteristics for the thatched roofs, and create cultures that produce materials with a long life span. 20 years of experience says that it is good buisness for danish farmers to cultivate thatch Miscanthus sinensis, elephant grass for thatched roofs. The economy is at least as good as growing winter wheat, and at the same time the crop is environmentally and nature-friendly.

Key words: reed, elephant grass
link: http://thatchers.eu/content/outer-page, https://straatagetskontor.dk/

Session 1.2 Greenhouse gas emissions and other climate effects

Session 1.2		Greenhouse gas emissions and other climate effects
Stage		B
Time		09.03.2021 10:15-11:15
Moderator		John Couwenberg
Talk:	1	Promising pathways to reduce GHG emissions by methane oxidation in rewetted peatlands including paludi-culture lands **Christian Fritz**
	2	Chimneys and blankets: species-dependent methane emission pathways in a rewetted dutch peatland **Renske Vroom**
	3	Persistently high CH_4 emissions 10 years after rewetting: The necessity for long-term observations when measuring GHG emissions of transitional systems **Danica Antonijevic**
	4	Effects of saltwater intrusion into freshwater rewetted coastal fen on methane cycling microbial community **Cordula Gutekunst**

1.2.1 Promising pathways to reduce GHG emissions by methane oxidation in rewetted peatlands including paludiculture lands

Fritz, C. *; Smolders, A.J.P. **,*; Günther, A. ***; Vroom, R.J.E.*; Temmink, R.J.M. *; van Dijk, G. **,*; Aben, R. *; Geurts, J. *; Harpenslager, S. *; Kosten, S. *; Couwenberg, J. ****; Jurasinski, G. ***; Lui, W. ***; van den Elzen, E. *; van den Berg, M. *; Wichern, F. ******; Weideveld S. *; Gremmen T. **,*; van de Riet B. **,*; Huth, V. ***; Grootjans, Ab ***; Lamers, L.P.M. *,**

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INTRODUCTION: Rehabilitation of peatland and wetland ecosystem functioning requires rewetting. Climate benefits of rewetting increase when not only stored carbon is secured, but methane emissions remain on low to intermediate levels as well. We introduce a number of management options to avoid high methane emissions after rewetting and quantify the effects.

METHODS: In the period of 2009-2019, experiments investigating different management options, such as biomass harvesting and (top)soil removal or changes in plant cover, water table, (irrigation) water quality and nutrient status were conducted on rewetted peatlands and wetlands in the Netherlands and Germany. Methane emissions were measured using closed chambers and bubble traps.

RESULTS and DISCUSSION: Methane emissions varied widely between sites and years (2-3 orders of magnitude, range 0.001 to 0.5 g m-2 d-1). We also observed a pronounced seasonality of fluxes modulated by temperature and oxygen availability. Some of the rehabilitated sites showed lower methane emissions than their drained control counterparts.

We identified major drivers of ‘methane hotspots’ and ‘methane coldspots’. Flooding of vegetation on formerly intensively used land without biomass removal substantially increased methane emissions. In contrast, some peat forming vegetation and Paludiculture crops (e.g. *Sphagnum* mosses) were associated with ‘methane coldspots’. Likewise, preventing extended summer floods resulted in substantially reduced methane emissions. In addition, high chloride concentrations and brackish water hold a significant potential to lower methane production.

Over the years, methane efflux often decreases because easily degradable carbon stocks (e.g. crop residues) have already been broken down, vegetation colonizes shallow lakes (post-drought), new deposits are formed creating low methane microtopes and algae blooms are prevented by lowered nutrient imports.
CONCLUSION: Our results suggest that several management options exist that can be used to effectively reduce methane emissions in rewetted peatlands. These include prevention of summer flooding, manipulation of water quality, and reduction of methane production feedstocks. Making methane reduction management available on the landscape scale can pave the road towards low methane rewetted peatlands.
The long-term warming effects of methane after rewetting are much lower than of the CO_2 that would be emitted without rewetting. Lowering methane emissions would make taking the wet road even more attractive, also on the short-term.

Key words: peatland rewetting, ecosystem services, methane oxidation, GHG emission, water table management, climate mitigation, top-soil recycling, water quality, paludiculture crops, Sphagnum farming, methane transport, CO_2 emission, carbon sequestration, peat formation, microtope

1.2.2 **Chimneys and blankets: species-dependent methane emission pathways in a rewetted dutch peatland**

Vroom, R.*; Gremmen, T.**; van den Berg, M. *; van de Riet, B.**; Kosten, S.*
** Radboud University, Nijmegen; **B-WARE Research Centre, Nijmegen, The Netherlands*

Paludiculture has been identified as an effective means to reduce carbon and nutrient emissions from formerly drained peatlands. Yet, paludiculture may also be a substantial source of the greenhouse gas methane (CH_4). Many wetland plant species have been classified as potential 'paludicrops'. CH_4 emissions and associated pathways are prone to differ substantially depending on paludicrop species and its characteristics, such as the ability to transport gases through aerenchymous tissue, or a growth form that covers the water surface. However, quantitative insight of total CH_4 emissions is largely lacking. Whereas many studies investigated diffusive CH_4 emissions from paludicrops, including water-atmosphere diffusive fluxes and plant-mediated fluxes, large uncertainties exist concerning the importance of CH_4 ebullition and seasonal dynamics.
In this study, we aimed to quantify CH_4 emissions from three well-known paludicrops: *Typha latifolia*, *Typha angustifolia* and Azolla filiculoides. Diffusive as well as ebullitive CH_4 fluxes were studied year-round in a field trial on a rewetted former agricultural peatland near Assendelft, the Netherlands.
We found that total emissions were considerably lower in A. filiculoides than in both *Typha* species, but the importance of the different pathways differed between species. A. filiculoides caused the lowest diffusive CH_4 emissions, followed by unvegetated areas. Substantially higher diffusive emissions were measured in plots vegetated with *Typha* species, with *T. latifolia* causing the highest emissions. Ebullitive fluxes were generally low, but showed a contrasting pattern, with the highest ebullitive fluxes occurring in A. filiculoides – contributing to over 50% of the species' total CH_4 emission. Preliminary data suggest that biggest share of both diffusive and ebullitive emissions occurred during the summer months.
Our results underline that choice of species has a substantial effect on carbon dynamics in paludiculture. In order to adequately assess total paludiculture CH_4 emissions, both diffusive and ebullitive fluxes need to be quantified.

Key words: paludiculture, greenhouse gases, *Typha*, *Azolla*, ebullition

1.2.3 Persistently high CH_4 emissions 10 years after rewetting: The necessity for long-term observations when measuring GHG emissions of transitional systems

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*Leibniz-Centre for Agricultural Landscape Research (ZALF), Germany

GHG measurements of terrestrial ecosystems are often limited to a couple of years. Due to anthropogenic disturbances and impacts of the global climate change, most terrestrial ecosystems are, however, in a transitional stage, which affect GHG emissions in one way or another. This emphasizes the necessity of longer-term observations to avoid misinterpretations and premature conclusions. Exemplary for this, we present 14 consecutive years of CH_4 flux measurements at a formerly long-term drained fen grassland within the Peene catchment (near Zarnekow), following rewetting. When drained, natural peatlands turn from a net C sink to a C source. It is suggested that rewetting of peatlands (and e.g., subsequent use for paludiculture), despite of increasing CH_4 emissions, holds the potential to mitigate climate change by reducing their overall GWP. Time span for this transition, however, is fairly unknown. Throughout a 14 years' study period distinct stages of an ecosystems transition, differing in their impact on CH_4 emissions, were observed. During the first two years of the measurement period directly following rewetting in autumn 2004, an eutrophic shallow lake was formed. This development was accompanied by a fast vegetation shift from dying off cultivated grasses to submerged hydrophytes and helophytes and evidenced substantially increased CH_4 emissions. Since 2008, helophytes have gradually spread from the shore line into the lake. This process was only periodically delayed by exceptional inundation and finally resulted in coverage of the measurement site (2016, 2017). Measurements on open shallow water, between 2009 and 2015, showed exceptionally high CH_4 emissions. However, these decreased significantly after macrophytes succeed from marginal areas into the lake, reaching the measurement site. Hence, on the one hand, CH_4 emissions only decreased after ten years transition following rewetting. On the other hand, established cattail, which is also used for paludiculture, finally resulted in significantly reduced CH_4 emissions.

Key words: greenhouse gas emissions, rewetting, peatlands, methane, ecosystem transition

1.2.4 Effects of saltwater intrusion into freshwater rewetted coastal fen on methane cycling microbial community

Gutekunst, C.*; Jenner, A.**; Jurasinski, G.*; Böttcher, M. E. **; Koebsch, F.*; Kallmeyer, J.***; Knorr, K.-H.****; Unger, V.*; Liebner, S. ***, *****
**University of Rostock, Landscape Ecology, Rostock, Germany; **Leibniz Institute for Baltic Sea Research Warnemünde, Rostock, Germany; ***GFZ German Research Centre for Geosciences, Helmholtz Centre Potsdam, Potsdam, Germany; ****University of Münster, Institute of Landscape Ecology, Münster, Germany; *****University of Potsdam, Institute of Biochemistry and Biology, Potsdam, Germany*

AIM: We aim to evaluate the usefulness of coastal peatland rewetting with saltwater in order to prevent methane emissions after rewetting and investigate possibilities for paludiculture.
MATERIALS AND METHODS: We studied the effect of saltwater intrusion originating from a storm surge in January 2019 on microbial abundance and community data together with CO_2 and CH_4 fluxes into a long-term freshwater rewetted coastal fen. We took soil cores to analyze the microbial methane-cycling community relative to all bacteria and archaea from four locations along a salinity gradient from highly to little saltwater-influenced. We used high-throughput sequencing and quantitative polymerase chain reaction (qPCR) on pools of DNA and cDNA targeting total and putatively active bacteria and archaea (16S rRNA), methanogens (mcrA) and methanotrophs (pmoA). In parallel, we measured GHG fluxes with the closed-chamber method on three randomly chosen spots at each location and put these fluxes in context with continuously measured Eddy covariance fluxes on the ecosystem level.

RESULTS: Local chamber measurements along the transect imply lower CH_4 emissions at plots with higher salinity post-intrusion. We expect that this will coincide with a drop in ecosystem methane fluxes and with shifts from methanogenic – dominated towards more sulfate-driven microorganisms. We also expect that organisms involved in anaerobic methane oxidation with sulfate as terminal electron acceptor will be more prominent after the saltwater intrusion.
CONCLUSIONS: With this, the effect of rewetting with saltwater on GHG fluxes and microbial communities in degraded fens will be discussed relative to the effects of freshwater inundation and seasonal droughts which were assessed in the same location before.

Key words: Greenhouse gases, coastal peatland, fen restoration, methanogens, methanotrophs

Session 1.3a Sphagnum farming & Session 1.3b *Sphagnum* vegetation restoration

Session 1.3a		**Sphagnum farming**
Stage		**C**
Time		**09.03.2021 10:15-11:15**
Moderator		**Matthias Krebs**
Talk:	**1**	Paludiculture on former bog grassland: sustainable biomass production and benefits of a Sphagnum farming site in NW Germany **Greta Gaudig**
	2	Establishing a landscape-scale carbon farm on former drained, agricultural pasture. **Mike Longden**
Session 1.3b		***Sphagnum* vegetation restoration**
Talk:	**1**	Restoring ecosystem functions and reversing land subsidence by growing *Sphagnum* on highly degraded eutrophic peat soils - a success story from the Netherlands **Bas van de Riet**
	2	OptiMOOR – optimizing management strategies for peat bog restoration after intensive agricultural use **Gerald Jurasinski**

1.3.1 **Paludiculture on former bog grassland: sustainable biomass production and benefits of a Sphagnum farming site in NW Germany**

Gaudig, Greta*; Prager, Anja*; Krebs, Matthias*, Wichmann, Sabine*
**University of Greifswald, Institute of Botany and Landscape Ecology, Partner in the Greifswald Mire Centre, Germany*

Sphagnum farming is paludiculture on bogs and aims at cultivating *Sphagnum* biomass for later harvest as a crop, e.g. as a raw material for horticultural growing media. Field trails on rewetted former bog grassland and cut-over bogs in North West Germany showed the feasibility of Sphagnum farming, both on peat and on floating mats. Here we present the results we achieved on our 14-ha rewetted study site in the peatland Hankhauser Moor (Lower Saxony, Germany) on former bog grassland.

- *Sphagnum* growth: A mainly closed *Sphagnum* lawn was established within 18 months and had accumulated 39 t dry mass per hectare eight years after installation. *Sphagnum* biomass was partly mechanically harvested after five years. The regeneration after harvest was slow.
- Water demand: In a drained landscape irrigation with 160 mm of water during summer is needed to compensate the water deficit.
- Water quality: *Sphagnum* mosses grow well due to low bicarbonate concentrations and pH values in the peat pore water. The *Sphagnum* production fields act as an active nutrient sink as the *Sphagnum* mosses achieved high nutrient sequestration rates.
- Greenhouse gas emissions: Our Sphagnum farming site represented a slight GHG source of
- 2.5 t CO_{2e} ha^{-1} yr^{-1} during the establishment phase, representing a significant reduction compared to previous use.
- Biodiversity: Our Sphagnum farming site provides a substitute habitat for bog species, but also for other partly rare flora and fauna species (spiders, dragonflies).
- Economics: Sphagnum farming is economically feasible when harvested biomass is traded as founder material or as raw material for higher prised cultures. The profitability as an alternative to peat in growing media would be achieved with a surcharge of e.g. 10% or with the reduction of currently high production costs.

For the large-scale implementation of Sphagnum farming more research is needed to reach technological maturity and to reduce costs.

Key words: Sphagnum farming, benefits, bog grassland
link: www.sphagnumfarming.com, www.moorwissen.de

1.3.2 **Establishing a landscape-scale carbon farm on former drained, agricultural pasture**

Longden, Mike *; Keightley, Anna**; Johnson, Sarah*; Field, Chris**; Wright, Neal***
**Lancashire Wildlife Trust; **Manchester Metropolitan University; ***Micropropagation Services (EM) Ltd., Great Britain*

Key words: *Sphagnum*, Carbon farming, Peatland, Drained, Agriculture
link: https://www.nweurope.eu/projects/project-search/care-peat-carbon-loss-reduction-from-peatlands-an-integrated-approach/

1.3.3 **Restoring ecosystem functions and reversing land subsidence by growing *Sphagnum* on highly degraded eutrophic peat soils- a success story from the Netherlands**

van de Riet, Bas*,**; van den Elzen, Eva**; van den Berg, Merit**; Hogeweg, Niels***; Smolders, Fons*,**; Lamers, Leon**
**B-WARE Research Centre; **Radboud University; ***PWN, The Netherlands*

AIM: In the Ilperveld Nature Reserve (NL), we applied rewetting in combination with *Sphagnum* application to halt land subsidence and restore ecosystem functions, including carbon sequestration and biodiversity, on a drained peat meadow grassland formerly used for cattle farming.
MATERIALS AND METHODS: During site construction the vegetation and top 10 cm of the peat soil were removed, leaving a degraded and relatively nutrient-rich peat surface on which *Sphagnum* fragments were applied before rewetting with surface water.
RESULTS: During 4 growing seasons (2014-2017) the vegetation development was monitored. Over time we saw a fast establishment of *Sphagnum* (cover of 90%) within the first two years. Already after 3.5 years the *Sphagnum* vegetation created a thick (8-12 cm) new layer of recently formed 'white peat', consisting of largely undecomposed dead peat mosses. It covered the nutrient-enriched decomposed peat soil, restored the hydrological properties and thereby supported the establishment of typical fen species. In 2015 and 2016, methane and CO_2 fluxes were measured every two months. At the peatmoss site, greenhouse gas emissions were reduced by circa 35 t CO_2-eq. ha^{-1} yr^{-1} compared to drained peat grassland nearby representing the original, agricultural situation. The change in land use reduced CO_2 emissions drastically, while methane emissions remained very low.
CONCLUSIONS: During the severe drought events in 2018/19 water quality proved to be of key importance. The surface water is relatively rich in bicarbonate, which is toxic to *Sphagnum*, and therefore it could not be used to inundate the *Sphagnum* fields. We recently developed a technique based on the removal of bicarbonate by adding hydrochloric acid, making the quality of the surface water more suitable for *Sphagnum* establishment and growth. We expect this measure can help to successfully implement Sphagnum farming in areas with surface waters high in bicarbonate, such as lowland polders.

Key words: Sphagnum farming, polder landscape, biodiversity, greenhouse gas balance, water quality

1.3.4 OptiMOOR – optimizing management strategies for peat bog restoration after intensive agricultural use

Jurasinskl, Gerald*; Gutekunst, Cordula*; Rosinski, Eva**; Koebsch, Franziska*; Günther, Anke*; Huth, Vytas*
*University of Rostock, Landscape Ecology; **Hofer & Pautz GbR, Altenberge, Germany*

AIM: Peat bogs are among the most threatened ecosystems in Germany. The restoration of peat bogs was strongly focussed on former peat extraction sites so far although most peat bogs are under intensive grassland use (54% in Lower Saxony). In the project OptiMOOR (2016 to 2021) we are currently investigating strategies of peat bog restoration after intensive grassland use to develop guidelines for optimal peat bog restoration.
MATERIALS AND METHODS: We set up a 1-ha field trial in the „Hankhauser Moor" in Lower Saxony, Germany comprising 7 different restoration approaches, including, for instance, „rewetting only", „rewetting with prior removal of the upper 30 cm", and the latter with „additional spreading of *Sphagnum* propagules", among others. We regularly measured greenhouse gas exchange, recorded vegetation and biogeochemical and other ancillary parameters and will present three years of data.
RESULTS: First surveys prior to field-trial installation showed that the biogeochemical conditions for successful peat bog restoration and composition of the seed bank were very unfavourable due to high nutrient contents, altered soil properties, and absence of propagules typical for peat bogs. Although GHG balances varied across studied years, the variants with top soil removal and *Sphagnum* propagule spreading typically showed the lowest GHG emissions or even net uptake and had the fastest development of typical bog vegetation and fauna.
CONCLUSIONS: Proper preparation of rewetting sites can help achieving restoration goals faster and the gathered knowledge can also be informative for paludiculture projects on peat-bogs. The fate of the carbon in the removed, degraded, upper soil layers has to be addressed and further research into potential strategies to use the dump onsite or off site is needed.

Key words: rewetting, greenhouse gas exchange, biodiversity, methane, carbon dioxide, restoration
links: Baltic TRANSCOAST: www.baltic-transcoast.de, WETSCAPES: www.wetscapes.de, OptiMOOR: www.optimoor.de, FOMOSY-KK: https://www.auf.uni-rostock.de/professuren/h-w/le0/forschung/fomosy-kk/ , OptiMOOS: https://www.auf.uni-rostock.de/professuren/h-w/le0/forschung/optimoos/

Session 2.1 Biomass to product (Energy)

Session 2.1		Biomass to product (Energy)
Stage		A
Time		09.03.2021 11:30-12:30
Moderator		Paul Goriup
Talk:	**1**	The optimal harvest date of *Typha latifolia* and *Phalaris arundinacea* as biogas substrates **Christina Hartung**
	2	Fuel quality and combustion behaviour of pure and kaolin additivated pellets from fen paludicultures in a small-scale biomass boiler **Daniel Kuptz**
	3	Energetic utilization of biomass from rewetted peatlands at a 800 kW heating plant for community heating in Malchin **Mirko Barz**
Poster:	**A**	A case for solid fuels. Comparing costs, energy consumption and greenhouse gas emissions of different fuels for the local heating plant in Malchin. **Tobias Dahms**

2.1.1 The optimal harvest date of *Typha latifolia* and *Phalaris arundinacea* as biogas substrates

Hartung, Christina*; Heuwinkel, Hauke*; Dandikas, Vasilis**; Eickenscheidt, Tim*; Zollfrank, Cordt***
** University of Applied Sciences Weihenstephan-Triesdorf; ** Bavarian State Research Center for Agriculture; *** Technical University of Munich*

AIM: The aim of this study was to identify the optimal harvest date of *Typha latifolia* (broadleaf cattail) and *Phalaris arundinacea* (reed canary grass) for the use as biogas substrate in terms of specific biogas yield, biogas yield per hectare and composition of these plants.
MATERIALS AND METHODS: *Typha latifolia* and *Phalaris arundinacea*, which were cultivated on a rewetted fenland in Germany, were harvested at five different harvest dates depending on their developmental stage in 2018 and/or 2020. At each harvest, the biomass of three to four plots (plot size: 1.25 m^2) per plant species was cut 10 cm above the ground. Dry matter yield was assessed for each plot by drying the biomass at 60 °C and determining the residual moisture content of subsamples at 105 °C. After chopping and milling the dried biomass to <10 mm, the specific biogas yield of the samples was determined via a batch-test according to VDI 4630. The biogas yield per hectare was calculated by multiplying the specific biogas yield by the biomass yield. Furthermore, the composition of <1 mm milled samples was analyzed using the Weender – Van Soest fodder analysis.
RESULTS: The specific biogas yield decreased with increasing plant maturity. It was significantly positively correlated to the N content and negatively to the lignin content. Both plant species achieved the highest biogas yield per hectare at the 4th and 5th harvest date, equivalent to the time of highest biomass yield.
CONCLUSION: As older plant material was found to be less degradable, harvest dates at flowering were considered to be optimal regarding the biogas yield per hectare combined with the anaerobic degradability. Multiple harvests per year might enhance the biogas yield per hectare. However, long-term effects of multiple harvests on the plant stock need to be taken into account.

Key words: biogas, *Typha*, Phalaris, harvest date, composition
link: https://forschung.hswt.de/forschungsprojekt/958-mooruse

2.1.2 Fuel quality and combustion behaviour of pure and kaolin additivated pellets from fen paludicultures in a small-scale biomass boiler

Kuptz, Daniel *; Kuchler, Carina*; Rist, Elisabeth*; Schön, Claudia*; Hartmann, Hans*
**Technology and Support Centre in the Centre of Excellence for Renewable Re-sources (TFZ), Solid Biofuels, Germany*

Fuel quality and combustion behaviour of *Typha spp.*, *Phragmites australis*, *Phalaris arundinacea* and *Carex spp.* were tested in a small-scale biomass boiler (Guntamatic Powerchip 20/30, 30 kW nominal heat output). All fuels were pelletized at TFZ to a diameter of 6 mm (pure and additivated with kaolin). Pellets were analysed for their physical and chemical fuel properties according to interna-tional standards for solid biofuels. During combustion, gaseous and total particulate matter (TPM) emissions were measured and slag formation was evaluated.
Ash content of pure pellets ranged from 4.3 w-% (d. b. = dry basis) for *Phalaris* to 6.8 w-% (d. b.) for *Typha*. Combustion relevant chemical elements such as N, S and Cl increased in paludiculture pellets while K only doubled compared to wood pellets. Mean CO emissions for pure pellets ranged from 14 mg/m3 for *Phragmites* to 292 mg/m3 for *Typha* and remained below the German emission threshold limit for straw fired boilers (400 mg/m3 at 13 % O2, 1. BImSchV). NOX emissions were 3 to 6 times higher compared to the combustion of wood pellets and correlated well with N content in fuels (R2 = 0.69). SO2 and HCl emissions were significantly in-creased during the combustion of fen cultures. TPM emissions of pure pellets were below the emission threshold of 1. BImSchV (20 mg/m3) for *Phragmites* (14 mg/m3) and *Phalaris* (14 mg/m3), while both *Carex* and *Typha* were above the threshold with 31 mg/m3 and 115 mg/m3, respectively. In some cases, additivation of pellets with kaolin led to a small decrease of CO and TPM emissions. For *Phragmites*, *Phalaris* and *Carex*, extreme slag formation was detected that would lead to a boiler breakdown at long term operation.
In conclusion, the utilization of fen cultures for combustion might be possible in small-scale boilers but suitable technical measures to decrease TPM emissions (*Typha*) or slagging (*Phragmites*, *Phalaris*, *Carex*) should be applied. The latter re-quires a specially adapted boiler technique which can actively destroy the agglomeration build-up in the fire bed or prevent slagging by active cooling.

Key words**:** pellets, combustion, emissions, slagging, fuel quality

2.1.3 Energetic utilization of biomass from rewetted eatlands at a 800 kW heating plant for community heating in Malchin

Barz, Mirko *; Kabengele, Guyrod *; Wichtmann, Wendelin **; Wenzel, Maximilian **; Oehmke, Claudia **; Dahms, Tobias **; Bork, Ludwig ***

**Hochschule für Technik und Wirtschaft (HTW) – University of Applied Sciences Berlin, Gemany; **University of Greifswald, Institute of Botany and Landscape Ecology, Partner in the Greifswald Mire Centre; ***Agrotherm GmbH Malchin, Germany*

Since November 2018, HTW in collaboration with GU started an innovative research project, studying the production of biomass on wet peatland sites and the optimization of the thermal utilization of such biomass sources in small and medium scale applications, e.g. household systems and centralized heating plants for communities. The project is therefore focused on an alternative opportunity of using peatlands for bioenergy production, avoiding soil degradation and reducing fossil fuel based GHG emissions by their replacement.
Several wetland plant species such as *Phragmites australis*, *Phalaris arundinacea* or *Carex* species were considered. *Phragmites* e.g. grows rapidly and the annual yields reach under Central European conditions up to 23.8 t dry matter per ha and year. The heating value of reed (17.7 MJ/kg) e.g. is remarkable and comparable with Miscanthus. One downside of reed-combustion is the high ash content of the biomass,

which ultimately leads to problems regarding the combustion process. Other species all have their specific combustion related pros and cons. The optimization of the combustion process via harvest time management and biomass mixture is one of the goals of the project.
Modified conventional agricultural technologies are suitable to harvest, compact, transport and store the reed and well established conversion technologies as e.g. boiler technologies for straw can be used for the utilization of the reed biomass. First results of this research project will be introduced, including the results of measuring campaigns, carried out at an 800 kW heating plant for community heating in Malchin (Mecklenburg Western Pomerania) during 2019 until 2020. For example variations in settings variations at boiler operation show that *Carex* bales could burn under the concentrations limits allowed by the technical Instructions on Air Quality (TA-Luft). Carbon monoxide (CO) and nitrogen oxide (NOx) was recorded respectively with 207 and 297 mg m-3.
Using wetland biomass as solid fuel leads to about 5 t additional GHG and about 15 MWh primary energy consumption savings per ha compared to fossil fuel. However, the heat generation and fuel costs are significantly higher (between 50 and 90 € per MWhth) compared to fossil fuels.
See the BonaMoor project website and the GMC twitter account @greifswaldmoor and the Paluculture-Newsletter, established by BonaMoor.

Key words: bioenergy, common reed (*Phragmites australis*) reed canary grass (*Phalaris arundinacea*) sedges (*Carex* species), combustion, peatlands, climate change mitigation

2.1.4 A case for solid fuels. Comparing costs, energy consumption and greenhouse gas emissions of different fuels for the local heating plant in Malchin.

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At present, peatlands in Germany are mostly drained for agricultural use, which is associated with high greenhouse gas emissions. In order to achieve the climate protection goals, the rewetting of peatlands is therefore a requirement in Germany. One way of making productive use of rewetted peatlands is to use the above-ground biomass as fuel in heating plants. An example for such a use is the local heating plant in Malchin, Mecklenburg-Vorpommern. The 800 kW plant uses biomass from wet fen meadows as fuel.
While often seen as outdated interim technology, thermal utilization of biomass is still important as mitigation technology for climate change (e.g. for BECCS).
For the share of non-woody biomass from rewetted peatlands that is not suitable for the use as raw material, the use as solid fuel is a utilization with a GHG emission advantage compared to other (biomass) fuels.
We conducted detailed time studies during regular nature conservation mowing to assess the manpower and working time requirements for harvest. Further costs and time requirements where retrieved by semi-structured interviews, literature and databases. Based on this data we compare provisioning costs, energy consumption and greenhouse gas emissions of different fuels for the local heating plant in Malchin. gqualitative comparison of the different fuels from a technological, environmental and climate change mitigation view.

Key words: biomass, harvesting, costs, energy consumption, greenhouse gas emissions

Session 2.2 Greenhouse gas emissions and other climate effects

Session 2.2		Greenhouse gas emissions and other climate effects
Stage		B
Time		09.03.2021 11:30-12:30
Moderator		Christian Fritz
Talk:	1	Mitigation potential of paludiculture for five different Danish peatland sites under controlled water tables – a mesocosm study **Claudia Nielsen**
	2	A national research programme on greenhouse gas emissions and land subsidence from lowland peat in the Netherlands **Gilles Erkens**
	3	Carbon sequestration potential of a former cutaway Irish blanket Peatland located on Ireland's Western Coast **Amey Tilak**
Poster:	A	Effects of topsoil removal on greenhouse gas exchange and water quality of fen paludicultures in North-Western Germany **Bärbel Tiemeyer**

2.2.1 **Mitigation potential of paludiculture for five different Danish peatland sites under controlled water tables – a mesocosm study**

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** Aarhus University, Department of Agroecology – Climate and Water; **CBIO – Centre for Circular Bioeconomy, Foulum; ***Aarhus University, Department of Agroecology – Soil Fertility; ****iCLIMATE, Aarhus University Interdisciplinary Centre for Climate Change, Foulum, Denmark*

Mitigation potential of paludiculture for five different Danish peatland sites under controlled water tables – a mesocosm study
Drainage of peatlands led not only to a substantial loss of global peatlands and the associated ecosystem functions but also to emission hotspots. In Denmark, carbon dioxide (CO_2) and nitrous oxide (N_2O) emissions from agricultural peatlands have been reported as ranging between 3.5 to 13.6 Mg C ha^{-1} yr^{-1} and up to 61 kg N_2O-N ha^{-1} yr^{-1} respectively. Recent studies highlighted to potential of paludiculture for mitigating these emissions. However, an assessment for this mitigation potential based on a determination for variation in greenhouse gas dynamics (GHG) across spatially and geobiochemically distinct Danish peatlands has been lacking. Therefore, a mesocosm experiment was established, allowing the assessment of annual GHG flux dynamics under controlled ground water tables (GWT) for soils from five Danish peatlands. Seventy-five mesocosms were grouped into three treatments: GWT – 40 cm, uncultivated; GWT – 5 cm, uncultivated; and GWT – 5 cm, cultivated with reed canary grass (RCG).
Emissions of CO_2, CH_4, and N_2O were measured using opaque chambers in biweekly intervals over the course of a full year. There was a clear difference in GHG dynamics across the different peatland sites in dependence of soil chemical and physical properties. CO_2 fluxes across all sites were significantly decreased in the wet as compared to the dry scenario while fluxes of CH_4 were higher at elevated GWT as compared to a GWT of – 40 cm, showing spikes of up to 37.5 mg m^2 h^{-1}. Cultivation with RCG showed significant reductions of CH_4 to maximum peaks of 2.05 mg m^2 h^{-1}, despite having an elevated GWT.
Soil chemistry, biomass growth and environmental variables were highlighted as critical drivers of GHG fluxes to the atmosphere. The results indicated that paludiculture is a promising mitigation method to not only decrease CO_2 emissions, but also mitigate potential high peaks of methane.

Key words: GHG, paludiculture, mesocosm, methane

2.2.2 A national research programme on greenhouse gas emissions and land subsidence from lowland peat in the Netherlands

Erkens, G.[1,2], Aben, R.[3], van den Akker, J.[4], van Asselen, S.[1], van den Berg, M.[3], Boonman, J.[5], van de Craats, D.[4], van Dijk, G.[6,3], Franssen, W.[7], Fritz, C.[3], Hefting, M.[2], Hessel, R.[4], Hommes, S.[1], Hutjes, R.[7], van Huissteden, K.[5,8], Keuskamp, J.[2], Kruijt, B.[7], Lootens, R.[5,9], van de Riet, B.[6,3], van de Velde, Y.[5], Velthof, G.[4]
[1]Deltares Research Institute, Utrecht, [2]Utrecht University, Utrecht, [3]Radboud Universiteit Nijmegen, Nijmegen, [4]Wageningen Environmental Research, Wageningen, [5]Vrije Universiteit Amsterdam, Amsterdam, [6]B-WARE Research Centre, Nijmegen, [7]Wageningen University, Wageningen, [8]Kytalyk Geoscience, Epse, [9]Flevo Instruments, Lelystad, The Netherlands

Following the Paris Agreement (2015), the Dutch government aims to reduce the net CO_2 (eq) emission from the Dutch peat meadow areas with 1 Mton per year by 2030. The peat meadows of the Netherlands have been drained for already a 1000 years to create arable land. Presently, the main land use is dairy farming on grassland. Drainage of peatlands causes land subsidence, and as a result of peat degradation, greenhouse gas emissions (CO_2, CH_4, N_2O). Critical factors that determine the level of greenhouse gas emissions from the peat meadows are amongst others the groundwater level, the amount of clay admixture, the level of fertiliser addition. To meet the 2030 emission reduction aim, the main focus is on raising groundwater levels in the peat meadow area. This can be either passively achieved by raising the ditch water levels, or actively by using submerged drainage systems that drain in winter, but infiltrate water in summer.
However, before implementing measures, it is imperative that the exact effects of the proposed measurements on greenhouse gas emissions and subsidence are known, under different environmental conditions. In existing and previously executed studies, results so far show mixed outcomes. Therefore, a Dutch national research programme commenced autumn 2019, in which greenhouse gas emissions, subsidence and a broad spectrum of influential factors are measured in five field sites.
Each of the five field sites consists of one measurement plot in an area where the groundwater level is raised and one reference plot where the groundwater level dynamics remained the same. A measurement plot consists of continuously operating gas analyser chambers that rotate within the plot every two weeks. In additions, subsidence is measured with extensometers and spirit levelling. Sensors, both in situ and above ground, provide information on relevant parameters such as soil moisture, soil temperature, oxygen availability, and meteorological parameters. Samples are being extracted from the field sites and tested on microbiological assemblages, geological and soil mechanical parameters, soil and (ground-)water biogeochemical parameters. The whole programme is designed to run for at least five years, but first results that support policy development, are supposed to be reported in a few years.

Key words: greenhouse gas emissions, mitigation, monitoring network, national scale, peatlands, subsidence
link: https://www.nobveenweiden.nl/

2.2.3 Carbon sequestration potential of a former cutaway Irish blanket Peatland located on Ireland's Western Coast

Tilak, A.*; Hoyne, S.*; Crushell, P.**, McLoughlin, D.**; Overy, P.***

**Research and Development Unit (RDI) of Limerick Institute of Technology (LIT), Ireland; **Freshwater Pearl Mussel Project, Ireland; ***Institute of Technology, Sligo, Ireland*

The goal of EU INTERREG Carbon Connects Project is reducing the "High Carbon Footprint of Drained Peatlands in North-West Europe using Sustainable Bio-based Business Models providing Income Sources for Farmers and Landowners on their Rewetted Peatlands". The Irish partners in Limerick Institute of Technology (LIT) have collaborated with the Pearl Mussel Project (PMP) European Innovation Partnership (EIP) and the Institute of Technology, Sligo (ITS) to quantify the carbon sequestration potential of a cutaway blanket peatland" on a PMP participant's farmland. The PMP is a results-based agri-environment scheme, financially rewarding farmers and landowners for the ecological quality of their farmlands. The cutaway blanket peatland of 9 ha is located within the Owenriff river catchment, Co. Galway, one of the top eight most important catchments for Freshwater Pearl Mussel in Ireland. This cutaway peatland will be rewetted as a part of the Carbon Connects project to investigate its "Carbon Sequestration Potential". Rewetting will also improve the farmer's PMP score, thus increasing the ecological quality payment. The peatland will be monitored in two phases:
Pre-rewetting (May-September 2020) and post-rewetting (October 2020-December 2021). The pre-rewetting monitoring of vegetation (Sedges with *Sphagnum* moss species), rainfall, groundwater levels, water chemistry and carbon in peat and groundwater began in mid-May 2020. The GHG emissions in pre- and post-rewetting quantified using a "Site Emissions Tool (SET)" based on vegetation, groundwater levels and farmland management factors. The pre-rewetting SET results, expressed in tons (t) CO_2-eq ha^{-1} yr^{-1}, were CH_4: +4.72 t CO_2-eq; CO_2: -1.98 t CO_2-eq and N_2O: +2.33 t CO_2-eq. From the SET results, the site is a CH_4 and N_2O source, but a CO_2 sink with Global Warming Potential (GMP) of +5.11 t CO_2-eq ha^{-1} yr^{-1}. We look forward to quantifying the GMP of this cutaway peatland in the post-rewetting phase.

Key words: Irish Blanket Peatlands, EU Carbon Connects Project, Pearl Mussel Project, carbon sequestration and bio-based business models

links: 1) EU INTERREG Carbon Connects Project:
https://www.nweurope.eu/projects/projectsearch/cconnects-carbon-connects/
2) LIT EU INTERREG Carbon Connects Project: https://lit.ie/rdi/development/energy/carbon-connects
3) Freshwater Pearl Mussel Project: https://www.pearlmusselproject.ie/

2.2.4 Effects of topsoil removal on greenhouse gas exchange and water quality of fen paludicultures in North-Western Germany

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**Thünen Institute of Climate-Smart Agriculture, Braunschweig, Germany; **Soil Science, University of Trier, Trier, Germany*

Drainage is necessary for conventional agriculture on peatlands, but this practice causes high emissions of the greenhouse gases (GHG) carbon dioxide and nitrous oxide as well as the release of nutrients. Paludiculture is an option to mitigate these adverse environmental effects while maintaining productive land use. Whereas the GHG exchange of paludiculture on rewetted bog peat, i.e. Sphagnum farming, is relatively well examined, data on GHG emissions from fen paludicultures is still very scarce. As typical fen paludiculture species are all aerenchymous plants, the release of methane is of particular interest when optimising the GHG balance of such systems. Topsoil removal is, on the one hand, an option to reduce both methane emissions and phosphorus release upon rewetting, but on the other hand, nutrient rich topsoils might foster biomass growth. In this project, *Typha angustifolia*, *Typha latifolia*, and *Phragmites* *australis* are grown at a fen peatland formerly used as grassland. Water levels will be kept at the surface or slightly above it. In parts of the newly created polder, the topsoil will be removed. To be able to separate the effects of topsoil removal and water level, four smaller sub-polders will be installed. Here, the water balance and the retention (or release) of different solutes can be determined individually. Besides nitrogen, phosphorus and dissolved organic carbon we will also investigate the fate of antibiotics. Greenhouse gas exchange will be measured with closed manual chambers for all three species with and without topsoil removal as well as at a reference grassland site close by.

Key words: *Typha angustifolia*, *Typha latifolia*, *Phragmites australis*, nutrient retention, GHG reduction

Session 2.3a *Sphagnum* vegetation restoration & Session 2.3b Sphagnum farming

Session 2.3a		***Sphagnum* vegetation restoration**
Stage		**C**
Time		**09.03.2021 11:30-12:30**
Moderator		**Greta Gaudig**
Talk:	**1**	Bog Growth- restoration of *Sphagnum* vegetation after peat extraction **Jan Köbbing**
	2	Early stages of revegetation of a terminated extracted peatland after two years of rewetting **Eva Weber**
	3	Rewetting of a transition mire by sprinkling with demineralised water **Bernhard Hasch**
Session 2.3b		**Sphagnum & Drosera farming**
Poster:	**A**	Optimising Sphagnum farming in water management, climate impact, biodiversity & product development – the new joint project OptiMOOS **Matthias Krebs**
	B	*Sphagnum* farm Barver – creating a new perspective for peatland ecosystems **Jens-Uwe Holthuis**
	C	Optimizing the management of *Sphagnum* paludicultures under difficult conditions – interaction of climate change, nutrient depositions, peat properties and vascular plant invasion **Laura Panitz**
	D	Sundew cultivation (*drosera rotundifolia*) on *Sphagnum* in paludiculture - the great potential of a tiny medicinal plant **Balázs Baranyai**

2.3.1 Bog Growth- restoration of *Sphagnum* vegetation after peat extraction

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Lower Saxony has the most peatlands in Germany, with a bog area alone of 208,000 ha. Of this, approx. 27,000 ha were or are used for peat extraction. Until 2040, approx. 15,000 ha will be rewetted and used for nature conservation. The given goal of rewetting is the creation of a growing bog again.
However, investigations in recent decades have shown that typical raised bog vegetation often does not resettle on its own. Approx. 2/3 of the rewetted peat extraction areas are either too wet and thus permanently overflooded or too dry and gradually become overgrown with bushes.
Our research work in recent years has shown that through targeted water management combined with introduction of hummock peat mosses (*Sphagnum* spec.), raised bog vegetation can reappear in a few years. The bog areas can thus develop from sources to sinks of greenhouse gas emissions. Flora and fauna typical of raised bogs will settle again.
The rare peat mosses required for such restoration technique are propagated by us in outdoor fields or in greenhouses. Depending the planting seasons and sites conditions like vegetation, water availability and irrigation possibilities *Sphagnum* fragments or small bundles are used.
Especially in view of climate change, this restoration approach offers the advantage of significantly accelerating the classic raised bog restoration.

Key words: bog, restoration, peatmoss, *Sphagnum*
link: https://www.bwb.de/de/24581.php

2.3.2 Early stages of revegetation of a terminated extracted peatland after two years of rewetting

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Swedish University of Agricultural Sciences, Department for Soil and Environment, Uppsala, Sweden

The recolonization by peat-forming plant species after rewetting is crucial for the restoration of terminated extracted peatlands. The aim of this study was to investigate the early stages of revegetation in Ekeby Mossen, a former extracted peatland (originally a bog) in south-central Sweden, to receive an insight in the dynamics of this process.
Before rewetting the site in autumn 2018, *Sphagnum* fragments were spread as propagules on reference surfaces. From that time on, a general vegetation mapping was carried out continuously and data was additionally collected from drone flights. Vegetation surveys were carried out along a transect throughout the vegetation period in 2020 (May to October).
Along the shoreline of the newly established shallow lake, plants re-colonized the area very fast, with leaving only smaller patches of bare peat. At the central lake area, where former ditches were situated, *Typha latifolia* and *Phragmites australis* already established in vast populations in May 2019. Along the transect, the coverage of higher plants generally increased throughout 2020, although it was less dense during the very dry and warm month of August. The plant species richness was rather low, even for bog or fen vegetation. The two species that covered most of the area and had the highest biomass increase were *Juncus effusus* and *Carex canescens. Rumex acetosella* had a high abundance as well, but decreased drastically towards the end of the vegetation period. In the contrary, *Sphagnum* species increased in abundance in general, with being present in seven out of nine plots along the transect.
The fast re-colonization by peat-forming species (*Phragmites*, *Carex* and *Sphagnum*) observed in this study indicates that rewetting is a good measure for restoring extracted peatlands.

Key words: peat-forming species, restoration, *Sphagnum*, landscape development, shallow lake

2.3.3 Rewetting of a transition mire by sprinkling with demineralised water

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AIM: As a result of decades of river bank filtration for drinking water abstraction on the Berlin river Unter-havel, the groundwater levels in the neighbouring forest Grunewald have dropped by several meters.
The transition mires Barssee and Pechsee in the Grunewald are significantly affected by the lowering of the groundwater table. The water level and the surface of the bogs, each of which is only about 1 ha in size, also dropped by several meters. As a result, the hole bog dried out except the central part. Against the background of the European Habitat Directive it is necessary to ensure, that the status of the habitat is not deteriorated. Since the extraction of river bank filtrates from river Havel is indispensable for drinking water supply, irrigation of the oligotrophic mire is being tested as a measure to limit damage.
MATERIALS AND METHODS: For this purpose, drinking water is demineralised by means of reverse osmosis to such an extent that it corresponds to natural rainwater. The treated water is then rained daily with a quantity of approx. 20 m^3 over the Barssee bog with circle sprinklers. Despite the higher costs, irrigation was chosen as the application method, as this corresponds most closely to the natural conditions.
The pilot project will be accompanied by extensive monitoring. This includes the permanent recording of bog and groundwater levels, bog surface oscillation, vegetation development, bog chemistry and faunistic studies (dragonflies, amphibians). The investigations are carried out in comparison with the neighbouring Pechsee bog as a reference.

RESULTS: Within the first months (May – September 2020), the bog water level has already been significantly raised and the vitality of the *Sphagnum* species has been improved. P-remobilisation lasted only for a short period of time, so that no internal eutrophication processes have been detected to date.

Key words: transition mire, quaking bog, reverse osmosis, rewetting, Barssee

2.3.4 **Optimising Sphagnum farming in water management, climate impact, biodiversity & product development – the new joint project OptiMOOS**

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** University of Greifswald, Institute of Botany and Landscape Ecology, Partner in the Greifswald Mire Centre, Greifswald, Germany*

Sphagnum farming is feasible as the 14-hectare site in the peatland Hankhauser Moor (North West Germany, installed in 2011 and 2016) what high biomass yields show. At the same time, the improvement of ecosystem services has been demonstrated: significant reduction of greenhouse gas emissions compared to the drainage-based previous use, water and nutrient retention and local cooling have been achieved, and the Sphagnum farming sites represent a valuable habitat for rare, bog-typical species.
Although the biomass growth of the peat mosses is very high, other than the target peat moss species were promoted due to nutrient-rich conditions. Therefore, strategies for nutrient reduction in the water used for irrigation of Sphagnum farming sites are being developed in the joint project and tested in glasshouse and field trials. For this, we planted cattail, reed in water basins. Additional potentials for reducing the climatic impact of Sphagnum farming sites are the reduction of topsoil removal during site preparation and the proportion of ditches, as most greenhouse gases (GHG) are emitted from the ditches. We investigate *Sphagnum* growth and GHG emissions after topsoil removal in different depths and different irrigation systems (temporary ditches at 10 m intervals, ditch interval 35 m, subsoil irrigation). As a result of the joint project, both nutrient discharges to surface waters (by increasing nutrient retention and removal) and greenhouse gas emissions are further reduced by a Sphagnum farming site. At the same time, the long-term effects of establishment, growth and regeneration of a peat moss lawn on the existing Sphagnum farming sites will be further investigated, also with regard to biodiversity (flora, fauna) and economy. In addition to the implementation of Sphagnum farming, it is planned to develop a substrate consisting exclusively of biomass from paludiculture plants.
Partners in the project are the Universities Greifswald, Oldenburg and Rostock, and the Research Institute for Horticulture Hanover-Ahlem.

Key words: peat moss, water purification, topsoil removal, GHG reduction, growing media
link: https://www.moorwissen.de/en/paludikultur/projekte/torfmooskultivierung/optimoos.php

2.3.5 ***Sphagnum* farm Barver – creating a new perspective for peatland ecosystems**

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**Stiftung Naturschutz im Landkreis Diepholz, Germany*

The “Sphagnumfarm Barver” is investigating agricultural production of peatmosses on former bog grassland under regional conditions in Diepholz district (Lower Saxony, NW-Germany) (runtime of project: 2018-2021).
A paludiculture pilot (size: 1 ha; geometry: quadratic) was created in spring 2020. A fundamental prerequisite of planning of the paludiculture was an in-depth basic evaluation of its inhomogenous peat body consisting of proportions of black and white peat. Site preparation included removal of earthified, eutrophic topsoil and leveling, destruction of drainages, construction of a foil-sealed water reservoir,

traverse of pipes and cables and building of irrigation ditches, inflow and outlet. The irrigation system is automated. Finally, the polder was inoculated manually with fragmented peat mosses of different origins. Within 2 months after inoculation and intensive hydromanagement, a growing Sphagnum lawn is emerging. This indicates, that the regional cultivation of *Sphagnum* on degraded and drained bog grassland with proportions of black peat and white peat is feasible. Most challenging is the artificial watering being a trade-off between flood irrigation of a black peat area and sub irrigation of the adjacent white peat zone.
The now starting phase is aiming on an optimal developed *Sphagnum* stock. Field experiences show technical challenges to be overcome (e.g. wet-adapted machinery or procedures for managing and harvesting). The proof that *Sphagnum* cultivation on black peat is possible is interesting for several thousand hectares of peat-depleted production sites, which could be made available for farming peat moss in a short time instead of being "recultivated". This deviation of progress by cultivating on "unsuitable" black peat might speed up technological developments and economic breakthrough of Sphagnum farming, thus empowering general agricultural acceptance.

Key words: Sphagnum farming, bog grassland, black peat, field experiences
link: https://northsearegion.eu/canape/news/canape-so-how-do-you-build-a-moss-farm/

2.3.6 **Optimizing the management of *Sphagnum* paludicultures under difficult conditions – interaction of climate change, nutrient depositions, peat properties and vascular plant invasion**

Panitz, Laura*; Piayda, Arndt*; Tiemeyer, Bärbel*
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Global change is expected to have adverse effects on productivity and greenhouse- gas mitigation potential of *Sphagnum* paludicultures. However, the interactions between different aspects of global change have not been assessed systematically yet. The aim of this study is to examine how peat properties, climate change, nitrogen eutrophication and indirect effects via the promotion of vascular plant encroachment affect biomass yield and carbon © exchange of *Sphagnum* paludicultures.
A greenhouse experiment with packed bog peat soil columns will be carried out in the vegetation period of 2021. Four different temperature and ground water level treatments each, simulating different climate change scenarios, three different amounts of nitrogen input, two different peat substrates (slightly and highly decomposed) and three different vegetation compositions (*Sphagnum papillosum*, *S. papillosum* and *Molinia caerulea* and *S. papillosum* and *Betula pendula*) are combined in a full factorial design.
A series of measurement campaigns with manual chambers will be conducted over the course of one vegetation period to quantify CO_2 and CH_4 fluxes for each treatment combination. Germination and survival rates of *M. caerulea* and *B. pendula* and growth of *S. papillosum* will be monitored throughout the experiment. Biomass production of each plant species will be measured at the end of the experiment. Models describing the relationships between greenhouse gas fluxes and environmental variables will be fitted to calculate C balances per treatment combination for the vegetation period. A process-based model will be used to analyse how the abiotic environment determines germination success and growth of vascular plant species on *Sphagnum* paludicultures.
The results of the study will provide valuable information for the adaptation of the management of *Sphagnum* paludicultures to future environmental conditions. The findings can also be used to optimize the management of natural or rewetted *Sphagnum* peatlands with regard to the reduction of greenhouse gas emissions.

Key words: *Sphagnum* paludiculture, global change

2.3.7 Sundew cultivation (*Drosera rotundifolia*) on *Sphagnum* in paludiculture - the great potential of a tiny medicinal plant

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The round-leaved sundew (*Drosera rotundifolia* L.) is typical for nutrient-poor raised bogs and plays a special role in the ecosystem. In many European countries, this plant species is considered endangered or highly endangered. Until now no method for the large-scale cultivation of sundew has yet been realized to produce the quantities of the *Drosera* raw material required by the pharmaceutical industry. Therefore, large quantities of European and non-European *Drosera* species are still being collected in natural peatlands. Sphagnum farming areas in Germany are in many respects comparable to intact raised bogs, and the nutrient-poor environment of the cultivated *Sphagnum* serves as a habitat for native *Drosera* species, such as *Drosera rotundifolia* L. and *Drosera intermedia* Hayne. Therefore, these cultivated areas offer a new alternative for the cultivation of *Drosera*. The suitability of *Sphagnum* lawn for *Drosera* cultivation was investigated in four studies, with a focus on the cultivation of *D. rotundifolia* in Sphagnum farming areas. The self-developed „peat pot method" turned out to be the most suitable *Drosera* cultivation method because of the special microclimate of the *Sphagnum* lawn, the low-competitive environment and the permanently wet *Sphagnum* peat in the plant pots. *D. rotundifolia* plants growing in the Sphagnum farming area showed a 7 to 8 times higher concentration of 7-methyljuglon than *D. madagascariensis*, which is mainly used for ‚Droserae herba'. The highest concentrations of bioactive ingredients of *D. rotundifolia* were found in 13 to 24 month old flowering plants. Biomass productivity of *D. rotundifolia* on Sphagnum farming areas was 320 kg ha^{-1} yr^{-1} FW (total biomass). Harvestable yield (only flowering plants) were 6 times higher (230 ha^{-1} yr^{-1} kg FW) than in natural bogs of Central and Northern Europe. Cultivation of *D. rotundifolia* on *Sphagnum* lawns meets the cultivation requirements of the pharmaceutical industry and has many ecological benefits compared to the collection in the wild.

Key words: Drosera cultivation, Droserae herba, biomass potential, bioactive ingredients, harvest time, cultivation methods

Session 3.1 Biomass to product

Session 3.1		Biomass to product
Stage		A
Time		09.03.2021 14:30-15:30
Moderator		Tobias Dahms
Talk:	1	Cranberries on peatland in the Netherlands **Bart Crouwers**
	2	Reed canary grass as a potential agent for phytoremediation and phytomining of strategic elements **Oliver Wiche**
	3	Making use of peatland biomass - from theory to charcoal **Marcel Welle**
Poster:	A	Suitability of fen plants as growing media constituent in terms of chloride content **Christina Hartung**
	B	Fenland biomass for a climate-friendly future - Development of value chains **Ralf Pecenka**
	C	The Paludi-tiny house **Anke Nordt**

3.1.1 Cranberries on peatland in the Netherlands

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**The Cranberry Company, The Netherlands*

Cranberries thrive best on peatland, because peatland contains a lot of organic matter, is not nutrient rich, is acidic by nature and holds water. Growing cranberries on the peatlands in the Netherlands, is an interesting option as it makes use of available water, keeps the peatland humid, halts the subsidence and establishes a new, sustainable ecosystem. It is also a challenge, though, because most of the peatlands have for centuries been used as grassland for dairy cows and therefore frequently been fertilized with manure and artificial fertilizer, drained and kept on a pH of approximately 6.
To turn these well fed ryegrass meadows into cranberry fields, we have to reduce the nutrients, in particular the phosphate and the nitrogen, and to further natural acidification. Flooding the fields during winter has proven to be very effective to suppress competing grasses and weeds. Flooding does not affect the cranberries as these plants are genetically made to survive in bogs.
Because of the availability of fresh water in the peatlands, it is attractive and feasible to grow cranberries organically. As long as your objective is to control the competition instead of realizing a cranberry monoculture, you do not need herbicides. The other instrument to control the competition is frequently mowing the weeds and grasses just above the top of the cranberry plants. Removal of the mowed vegetation will impoverish the soil and further the acidification.
Once the pH is 4,5 and the overload of nitrogen and phosphates removed, a new ecosystem is established. The monoculture of ryegrass (*Lolium perenne*) is then turned into a biodiversity with many cranberry plants. It takes patience and lots of water to establish a cranberry farm in the Dutch peatlands. The result is a rich vegetation, a sustainable soil and an annual yield of tons of very healthy cranberries.

Key words: cranberries, water management, nutrient management
link: https://www.thecranberrycompany.nl/

3.1.2 **Reed canary grass as a potential agent for phytoremediation and phytomining of strategic elements**

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Reed canary grass (*Phalaris arundinacea* L.) is a perennial wetland grass (Poaceae) with desirable plant traits for soil remediation and bioenergy purposes. Concomitantly, it has been demonstrated that *P. arundinacea* accumulates germanium (Ge) and rare earth elements (REEs) making this species especially interesting in phytoremediation and phytomining research. The process chain of phytomining involves the accumulation of the elements in plant biomass, the use of the biomass for bioenergy production and subsequently the extraction of the raw materials from ashes or digestates. As a result of large-scale field, lab and greenhouse experiments we could demonstrate that *P. arundinacea* outperforms other bioenergy plants on marginal soils with respect to the accumulation of Ge and REEs, while soil–plant transfer of heavy-metals is comparably low. The highest phytoextraction efficiency for Ge and REEs was demonstrated on acidic soils with high organic matter contents. Additionally, we found significant differences in Ge and REE accumulation among different genotypes and populations of *P. arundinacea*. More specifically, we found that Ge accumulation is related to genotypic variation in silicon (Si) accumulation, while relationships between iron (Fe) and REE concentrations indicated interactions during nutrient acquisition. Inoculation of plant populations with plant growth promoting rhizobacteria increased plant yields and soil–plant transfer of all elements by one order of magnitude compared to the untreated references. Finally, the elements contained in the biomass were enriched by a factor of 40 in ashes leading to a "bio-ore" which is subject of further chemical extraction processes. Overall these findings indicate that (i) *P. arundinacea* is a promising plant species for phytomining of Ge and REEs on marginal soils, (ii) soil management techniques can enhance phytoextraction efficiency and (iii) future breeding activities of *P. arundinacea* cultivars towards enriched contents of desired elements are a promising approach to obtain cultivars for sustainable phytoextraction.

Key words: reed canary grass, bioenergy, phytomining

3.1.3 Making use of peatland biomass – from theory to charcoal

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Re-wetting peatland is an essential part of every climate change strategy. Peatland biomass is a great resource and its usage offers the potential to combine climate protection and local value creation chain. The use of charcoal for barbeque causes severe damage to climate and ecosystems. For instance, tropical wood was found in 42 % of all barbeque charcoal sold 2018 in Germany. Additionally, for many coals, a high risk for illegal depletion was reported. The combination of re-wetted peatland biomass and local production provides an alternative for your barbeque pleasure. We are happy to guide the rocky road from idea to realization with a focus on prototype development and marketing.

Key words: peatland biomass, biochar, prototype realization

3.1.4 Suitability of fen plants as growing media constituent in terms of chloride content

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AIM: The aim of this study was (1) to investigate how the chloride content of different fen plant species is influenced by harvest date, water level and cutting frequency and (2) to evaluate under which conditions the chloride content is low enough to use these plants as horticultural growing media constituent.
MATERIALS AND METHODS: *Typha latifolia*, *Phragmites australis*, *Phalaris arundinacea* and *Carex acutiformis* were cultivated on a rewetted fen peatland in Germany under three water level regimes. With exception of *Phragmites*, plants were harvested in June 2017, October 2017 and January 2018. The first harvest of *Phragmites* was in October as not sufficient biomass was available in June. In addition, regrown *Typha*, *Phalaris* and *Carex* from plots harvested in June 2017 were cut a second time in October 2017 or January 2018. In order to investigate the influence of harvest date on the chloride content more intensively, additional samples were collected during the period 2016-2019 from nine sites. For analysis of chloride, the plant materials were dried and milled <4 mm. Chloride was extracted with water and measured by potentiometric titration.
RESULTS: The chloride content of all fen plants decreased with increasing plant maturity and decreasing water level. Biomass, which was harvested before winter, mostly contained more than 1 g chloride per L substrate (= upper threshold for RAL-certified substrate compost used in mixing proportions not exceeding 20 vol.-%). Plants, which were cut a second time in October, showed equal or higher chloride contents compared to those harvested for the first time. However, there was no difference between the chloride contents of plants, which were cut the first or second time in January.
CONCLUSIONS: Only fen plants harvested in winter are suitable as raw material for growing media.

Key words: peat substitute, growing media constituent, fen plant, chloride
link: https://forschung.hswt.de/forschungsprojekt/958-mooruse

3.1.5 Fenland biomass for a climate-friendly future - Development of value chains

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The federal state of Brandenburg in northeast Germany is covered by approx. 263,000 ha of organic soils (fenland and bogs). Nearly all of these areas have been drained for intensive cropland or grassland use, resulting in degradation of organic matter and a release of large amounts of greenhouse gases (GHG). Rewetting of fenlands by changing water management practices is discussed as a GHG mitigation option. However, rewetting severely restricts land use and requires the development of site-adapted management systems and innovative value chains for fenland biomass.
Within the framework of a long term joint project, process chains based on biomass from extensive grassland and paludiculture are to be developed for the design of regional value-added chains. Considering cascading use of the biomass prioritizes material use of biomass before energy use. The aim is to create process chains for highly lignocellulosic fen biomass from cultivated or naturally grown reeds, reed-grass, cattails, and sedges. The project seizes existing approaches and practical solutions for similar raw materials, takes up concepts from ongoing new development work and will integrate them into its own research and process development. Available solutions will be adapted for the use of fen biomass for energy, taking the different raw material properties of e.g. reed (*Phragmites* ssp.), sedges (*Carex* ssp.), cattail (*Typha* ssp.) or reed canary grass (*Phalaris arundinacea* L.) into account. New solutions such as the production of fibres in a twin-screw extruder will be added. The produced fibre materials could be used for peat replacement in growing substrates in organic farming, for the production of pellets for animal bedding or as raw materials for the production of packaging and isolation materials.
In the first step concepts and first results of eight different process chains will be presented and discussed.

Key words: fenland biomass, agriculture, paludiculture, biomaterial, bioenergy

3.1.6 The Paludi-tiny house

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Tiny houses gain increasing popularity as living space, weekend retreats, (private and commercial) holiday cottages. Container based constructions are developed as (covid-19 infection proof) working spaces or could serve as show rooms in nature reserves.
The paludi tiny house was built in 2020 “as a demonstrator” with insulation-, building-, and furniture material made from reed, cattail, alder, and wet meadow grasses to show existing paludi-products and potential paludi-products “in practice”.
Paludi-materials are within different components of the tiny house:

- Parts of the roofing thatched with reed,
- Wall insulation from cattail (boards, chaff, seed wool), reed (bound stems), gras fibre (soft boards),
- Interior wall panels made from alder,
- Kitchen work surface from alder solid wood,
- Integrated wardrobe made from mixed grasses and reed fibre boards (100% fibres, without adhesive).

The building materials lead to decreased carbon concentration in the atmosphere through

- reduced carbon emissions from rewetted organic soils used for raw material production (compared to drained peatland use)
- carbon storage within the building materials, and
- replacement of fossil oil based insulation materials.

We exemplary quantify the carbon footprint of insulation material used in the tiny house and compare it to common non-renewable insulation products. We use emission factors for rewetting organic soils and estimate direct emissions from harvesting, transport and processing. We also quantify the carbon stored in paludi insulation material.
I.e. for reed insulation boards (bound stems), the emission reduction from rewetting (~15 t CO_2 ha^{-1} a^{-1}) and carbon sequestration in the product (~6,6 t CO_2 ha^{-1} a^{-1}) amount to 0,65 t CO_2 emission reduction per m^3 insulation product (under a scenario of regional produced reed to minimise transport). Compared to this benefit the emission reduction through replacing fossil based insulation materials is negligible.

Key words: Products, carbon footprints
Link: www.paludi-tinyhouse.de

Session 3.2 Greenhouse gas emissions and other climate effects

Session 3.2		**Greenhouse gas emissions and other climate effects**
Stage		**B**
Time		**09.03.2021 14:30-15:30**
Moderator		**Bärbel Tiemeyer**
Talk:	**1**	Long-term observation of greenhouse gases of a *Sphagnum* farming area on former bog grassland in North-western Germany **Caroline Daun**
	2	Greenhouse gas exchange of a *Sphagnum* paludiculture on a former peat extraction site in the late stages of the rotation cycle **Laura Panitz**
	3	Greenhouse gas benefits of Sphagnum farming using micropropagated material in the UK **Anna Keightley**
Poster:	**A**	The potential of automated transparant-chambers to detect 'cold spots' and 'hot moments' of carbon fluxes in periodically wet and rewetted peatlands **Christian Fritz**
	B	Greenhouse gas emissions from energy willow, nature conservation field and grass on a cultivated peat soil **Hanna Kekkonen**
	C	Effects of raised water level on greenhouse gas fluxes in boreal peat fields **Sanna Saarnio**

3.2.1 Long-term observation of greenhouse gases of a Sphagnum farming area on former bog grassland in North-western Germany

Daun, Caroline*; Günther, Anke*; Jacobs, Oona*; Jurasinski, Gerald*
**University of Rostock Faculty of Agriculture and Environmental Sciences, Rostock, Germany*

AIM: We want to obtain a long-term view of the total greenhouse gas balances on a *Sphagnum* production site in North-West Germany, for which few insights about greenhouse gas exchange exists so far.
MATERIALS AND METHODS: A field-scale experiment with closed opaque and transparent chambers was carried out over 4 years. The production system consists of productions strips, ditches, and dams.
In the first two years the production strips *Sphagnum palus*tre L. and *Sphagnum papillosum* Lindb. as well as the ditches were investigated. In the following two years, GHG exchange on a dam was additionally measured.
RESULTS: In both *Sphagnum* mosses production areas, there was a significant decrease in methane fluxes, which could not be observed for CO_2. Despite this, both *Sphagnum* moss production areas were greenhouse gas sinks during the establishment phase and beyond (5-9 t CO_2-eq ha^{-1} yr^{-1}), but with larger fluctuations after harvesting. In comparison, the ditches represent source of both carbon dioxide and methane that emitted a larger amount of methane during the first two years, resulting in a net greenhouse gas release of ~11 CO_2-eq ha^{-1} yr^{-1}. Thus, 80% of CH_4 emissions are caused by open water areas. In addition to the ditches, the dam has relatively high CO_2 emissions (over 2g CO_2 m^{-2} h^{-1}).
CONCLUSIONS: An optimization of the entire production area towards a minimum of dams and ditches is desirable.

Key words: Sphagnum farming, paludiculture, methane, carbon dioxide, ditches

3.2.2 Greenhouse gas exchange of a *Sphagnum* paludiculture on a former peat extraction site in the late stages of the rotation cycle

Panitz, L.*; Krebs, M.*; Gaudig, G.*
**University of Greifswald, Institute of Botany and Landscape Ecology, Partner in the Greifswald Mire Centre*

Despite of a growing interest in *Sphagnum* paludicultures, it is still unclear how big their greenhouse gas (GHG) mitigation potential is during an entire rotation period.
The aim of this study is to provide information on the GHG exchange of a *Sphagnum* paludiculture over the first three years of the rotation cycle and on the impact of harvest and subsequent regeneration on the overall GHG balance.
To monitor the annual development of the exchange of CO_2 and emissions of CH_4 and N_2O, monthly measurement campaigns using the static chamber approach are conducted on a *Sphagnum*- paludiculture on a former peat extraction site in North- West Germany. GHG exchange is being investigated on this site since 2017 (for results for the initial phase see Oestmann et al. 2020, submitted). Models describing the relationships between GHG fluxes and environmental variables (photosynthetic active radiation and soil temperature) are fitted to calculate annual carbon balances.
In October 2020, *Sphagnum* mosses will be harvested and the GHG exchange during the regeneration of the moss layer will be measured for another 18 months.
Preliminary results for 2019 suggest, that, after considerable net emissions of CO_2 during the extreme summer of 2018 and despite the still unfavourable hydrological conditions, in the third year, carbon uptake balanced or even outweighed carbon emissions. However, it is likely that the enhanced uptake of CO_2 is to a larger extent the consequence of the invasion of vascular plants occurring during the third year, rather than of moss growth. Moreover, water table depth is an important driver of GHG emissions and still not optimal for *Sphagnum* growth.
The GHG exchange of *Sphagnum* paludicultures can vary greatly from year to year, depending on vegetation development and abiotic environmental conditions of the specific year. Thus, long-term measurements are needed to evaluate their mitigation potential.

Key words: greenhouse-gas exchange, *Sphagnum* paludiculture

3.2.3 Greenhouse gas benefits of Sphagnum farming using micropropagated material in the UK

Keightley, Anna*; Caporn, Simon*; Field, Chris*; Wright, Neal**
** Manchester Metropolitan University; ** Micropropagation Services Ltd (BeadaMoss®), Great Britain*

Peatlands drained for peat harvesting or conversion to agriculture are known to lose carbon storage capacity and become sources of carbon greenhouse gas (CGHG) emissions. The use of paludiculture to mitigate carbon loss while retaining farming livelihoods is receiving increasing attention and *Sphagnum* moss is a suitable potential crop. The Sphagnum Farming UK project trialled BeadaMoss® *Sphagnum palustre* growth under a range of cover treatments (perforated plastic, nylon mesh, straw, no cover), surface irrigation with solar-powered drip and spray regimes, and unregulated water-table (Patents pending). Trials were conducted at two contrasting sites: Little Woolden Moss (LWM), an ex-milled Lancashire peatland, and Sharpley, an organo-mineral Leicestershire agricultural field (surface stripped). Long-term annual rainfall and mean temperatures are 867 mm, 9.4 °C and 620 mm, 10.0 °C respectively. CGHG fluxes were measured monthly for one year, and seasonally thereafter, using a closed chamber system and Los Gatos UGGA. There was a greater uptake of CGHG in plots with *Sphagnum* than bare plots, in *Sphagnum* under cover than with no cover, and uptake increased with increasing *Sphagnum* ground cover. CGHG modelling is in progress. All covers kept the soil temperature warmer in winter. Water-table depth (measured at LWM only) was higher in spray- than drip-irrigated areas (-11.2 ± 7.9 and -15.3 ± 9.2 cm respectively). No treatment changed methane fluxes at either site, which were minimal across the monitoring period (mean of <0.0004 g CH_4 m^{-2} h^{-1} across treatments) with random emission or uptake of methane, so negligible values are assumed, showing the benefits of controlled surface irrigation. This crop system also generated high rates of biomass and volume production (reported in another paper). Our research demonstrates methods of successful BeadaMoss® *Sphagnum* cultivation suitable to expand to field-scale trials, with potential benefits for CGHG balance on ex-milled peatlands and even agricultural land.

Key words: *Sphagnum*, micropropagation, GHG, irrigation, *Sphagnum* propagules

3.2.4 The potential of automated transparent-chambers to detect 'cold spots' and 'hot moments' of carbon fluxes in periodically wet and rewetted peatlands

Fritz, C. *,*******; van Huissteden, J. **; Nouta; R. *,***; Aben, R. *; Kruijt, B. ****; van den Berg, M. *; van der Velde, Y. **; Boonman, J. **; van de Riet, B. ********,*; Pelsma, T. *****; Bosma, N. ***; Erkens, G. ******; Lui, W. *******; van Dijk, G. ********,*; Smolders, A.J.P. ********,*, L.P.M. Lamers* & S. Weideveld*

Aquatic Ecology and Environmental Biology, Radboud University, Nijmegen, The Netherlands; ** Vrije Universiteit, Amsterdam The Netherlands; * Wetterskip Friesland, Leeuwarden, The Netherlands; **** Wageningen University, Wageningen, The Netherlands; ***** Waternet, Amsterdam, The Netherlands; ****** Deltares, Delft, The Netherlands; ******* Integrated Research on Energy, Environment and Society, University of Groningen, Groningen, The Netherlands; ********B-Ware Research Centre, Nijmegen, The Netherlands*

INTRODUCTION: Raising water levels to nearby surface levels is a promising management tool for climate mitigation action in peatlands. Rewetting provides a waterlock. High water levels also favour carbon sequestration by Paludiculture crops and peat forming vegetation. However, carbon fluxes can remain high after rewetting. This presentation discusses the potential of automated transparent gas-flux chambers to unravel drivers of the spatio-temporal variability.
MATERIALS AND METHODS: In 2019, we deployed portable custom-made automated flux-chambers (diameter 40 cm, height 50 cm) in 5 peatland sites. Three-minute flux measurements were conducted on 3 PVC soil collars every 10 Each month chambers were installed in the field for a period of 3-5 days per site. Soil and air temperature were continuously logged as well as water levels using automated gauges.
RESULTS AND DISCUSSION: One individual researcher transported, set-up and maintained automated the light-weight chambers in one day per site using portable energy. Periods of heavy winds and power failure were detected and filtered-out resulting in 60 % remaining flux data. Fluxes from automated chambers overlapped largely with eddy co-variance fluxes suggesting reliability of the flux measurements. Sites with ditch drainage and summer irrigation revealed considerably lower night fluxes (150-200 kg CO_2 ha^{-1} d^{-1}) in periods when water levels remained within 20 cm below the surface. In contrast, during the warm summer 2019 we detected fluxes exceeding 500 kg CO_2 ha^{-1} d^{-1} with highest fluxes related to high biomass.
Planting Paludiculture crops such as *Sphagnum*, *Typha* and *Phragmites* combined with water levels at or above the surface resulted in lower CO_2 night fluxes (ecosystem respiration) compared to their drained counterparts with fodder grasses. Carbon fluxes in the wet 'cold spots' were also related to standing biomass with *Sphagnum* fields revealing the lowest CO_2 night fluxes. At rewetted sites methane fluxes revealed a high spatial variability related to subsite/block rather than to vegetation.
Conclusion: Portable automated transparent flux-chambers for near-continuous measurements of net ecosystem CO_2 give insights in the spatio-temporal variability of carbon fluxes after rewetting.

Key words: carbon fluxes, static chambers, GHG emissions, peatland rewetting, water table management, water-logging, paludiculture, Sphagnum farming, carbon sequestration, spatial variability, continous flux measurements, eddy co-variance, peat formation

3.2.5 Greenhouse gas emissions from energy willow, nature conservation field and grass on a cultivated peat soil

Kekkonen, Hanna*; Honkanen, Henri **; Myllys, Merja **; Regina, Kristiina **
**Natural Resources Institute Finland, Oulu; ** Natural Resources Institute Finland, Jokioinen*

In Finland, organic soils cover about 12% of the cultivated area. This corresponds to an area of about 263,000 ha. These fields produce a significant amount of greenhouse gas emissions nationally in the agriculture and land use sectors. More than 50% of the agricultural emissions (including carbon dioxide (CO_2) in the land use sector) are from cultivated organic soils. According to internationally and nationally agreed emission reduction goals, emissions from agriculture must be reduced. Due to their high emission load, peatlands appear to be the most potential target for greenhouse gas mitigation measures. Raising the ground water level and selecting crops suitable for wet conditions could be a partial solution to mitigate the emissions. We started an experiment with the aims of 1) monitoring the success of three potential species in wet cultivation and 2) estimating the impact of a moderate water level rise on greenhouse gas emissions.
In 2018, a research field was established to study the success of energy willow (*Salix*), bog whortleberry (*Vaccinium uliginosum*) and grass mix for silage on a peat soil that has been cultivated for more than 100 years. To raise the ground water higher than the conventional level, submerged drainage was established. As bog whortleberry did not succeed in this experiment, these test plots were changed to a treatment corresponding to nature conservation fields.
We measured the growth and annual yield of the different plant species, as well as ground water level and CO_2 balance, nitrous oxide (N_2O) and methane (CH_4) gas fluxes on average every second week. Results of a two-year period from this experiment will be presented.

Key words: greenhouse gases, biomass, peat soils, ground water level
link: https://www.luke.fi/sompa

3.2.6 Effects of raised water level on greenhouse gas fluxes in boreal peat fields

Saarnio, Sanna*; Mäkipää, Raisa*; Kekkonen, Hanna*; Regina, Kristiina*
**Natural Resources Institute Finland*

Croplands in peat soil compose only 10 % of Finnish field area but their greenhouse gas (GHG) emissions comprise over 50% of the agricultural GHG emissions in Finland. In CANEMURE project, first study site was established in June 2019 and second in October 2019 at Ruukki, Siikajoki, Finland. Study sites consist of control area with normal drainage and paludiculture area with raised water level. Soil respiration, ecosystem respiration and net carbon dioxide (CO_2) exchange, methane (CH_4) and nitrous oxide (N_2O) fluxes are measured regularly 1-2 times per month. Environmental factors (water table, peat temperature at different depths, photosynthetically active radiation) are measured continuously by data loggers. Yield is estimated in connection of normal harvest by weighting biomass samples from known areas. In the first study site, the crop species is reed canary grass (*Phalaris arundinacea*) during the whole study. In the second study site, the vegetation (*Avena sativa*, *Brassica rapa* subsp. *oleifera*) was grown for wild animal and bird species 2019-2020 whereas in 2021 the hay (*Phleum pratense*, *Festuca pratensis*, *Trifolium pratense*) will be harvested for domestic animals. The experimental setup was first unsuccessful but after the frost melt in spring 2020, the experimental setup was renewed and after that the difference in the water level between the control area and paludiculture area has been evident on both study sites. The wetter conditions in paludiculture area seemed to decrease ecosystem respiration systematically on study site I, but not in study site II. CH_4 was released only from study site II and paludiculture seemed to increase the release. Lower N_2O efflux was observed from paludiculture area than control area during first peak emissions. Conclusions cannot yet be drawn from these few measurements, but updated data will be shown in the conference.

Key words: paludiculture, peat, boreal, CO_2, CH_4, N_2O
link: https://www.hiilineutraalisuomi.fi/en-US/Canemure/Subprojects/Natural_Resources_Institute_Finland

Session 3.3 Biodiversity at ecosystem level

Session 3.3		Biodiversity at ecosystem level
Stage		C
Time		09.03.2021 14:30-15:30
Moderator		Nerjius Zableckis
Talk:	1	Sphagnum farming in north-west Germany: is it offering a secondary habitat for bog-typical dragonfly species? **Daniel Brötzmann**
	2	Can paludiculture promote fen biodiversity? A literature-based review with focus on Europe **Felix Närmann**
	3	What does paludiculture contrimit bute to arthropod diversity? **Gert-Jan van Duinen**
Poster:	A	Implementation of a water buffalo grazing system on a coastal wet grassland site interspersed with reed beds **Jürgen Müller**
	B	PaluDivers: Development and accompaniment of the testing of nature conservation minimum standards for the conservation and promotion of biodiversity in future paludicultures on agricultural land **Monique Nerger**
	C	Linking up Peatland Restoration with Community Empowerment and Orangutan Conservation Activities in Central Kalimantan, Indonesia **Teresa Rojas Lara**

3.3.1 Sphagnum farming in north-west Germany: is it offering a secondary habitat for bog-typical dragonfly species?

Brötzmann, Daniel*; Packmor, Jana*; Buchwald, Rainer*
**Carl von Ossietzky Universität Oldenburg, Institut für Biologie und Umweltwissenschaften, Germany*

AIM: Dragonflies (Odonata) act as a reliable indicator for ecological quality of (semi-)aquatic ecosystems. With the decline of peat covered areas worldwide, bog-typical dragonfly species experience significant habitat loss. Within the joint research project OptiMOOS, this study aims to evaluate the importance of a 14 hectare Sphagnum farming site in north-west Germany as a secondary habitat for dragonflies. Key concerns are species establishment and differences in dragonfly species assemblages.

MATERIALS AND METHODS: Between April and September (2017-2020) the survey was carried out in Hankhausen (Lower Saxony, Germany). The Sphagnum farming site has been established in 2011 and was expanded in 2016. Irrigation ditches ensure water availability on each site. Along these irrigation ditches, 20 plots (50 m length each) were studied, representing different stages of development (A1: established 2011, not/partly harvested, n=4 (inner ditches); A2: established 2011, not/partly harvested, n=4 (outer ditches); B: established 2011, harvested 2016, n=4; C: established 2016, not harvested, n=8). Both dragonfly adults and exuviae have been sampled in a two-week interval.

RESULTS: A total of 24 species (20 autochthonous) has been observed in the study area. The percentage of bog-typical species ranges from 36 to 46 %. While 8 species prefer peat mosses, 2 species are highly specialized for conditions observed in raised-bogs: Northern White-faced Darter (*Leucorrhinia rubicunda*) (vulnerable) and Subarctic Hawker (*Aeshna subarctica*) (critically endangered). Subarea A1 contains the highest percentage of bog-typical species. A significant increase in bog-typical species over time has been observed in subarea C.

CONCLUSIONS: This study illustrates that a Sphagnum farming site is able to offer secondary habitats for bog-typical (endangered) dragonfly species, and thus plays an important role in the conservation of biodiversity. The variability of subareas (different ages/stages) is one key factor for species richness in this

study. Focused maintenance measures are necessary to avoid the deterioration of crucial habitat parameters over time.

Key words: Sphagnum farming, biodiversity, indicator species, dragonflies, conservation
link: https://www.moorwissen.de/en/paludikultur/projekte/torfmooskultivierung/optimoos.php

3.3.2 **Can paludiculture promote fen biodiversity? A literature-based review with focus on Europe**

Närmann, Felix*; Tanneberger, Franziska*
**University of Greifswald, Institute of Botany and Landscape Ecology, Partner in the Greifswald Mire Centre, Germany*

Agriculture and forestry on drained peatlands do not only cause disproportionally high CO_2 emissions, but also lead to drastic losses of characteristic peatland biodiversity. Site-adapted, wet land use following rewetting (paludiculture) can effectively lower CO_2 emissions and may also restore habitats for characteristic peatland species. This has been demonstrated for Sphagnum farming on bogs. The various types of paludiculture on fens cannot yet be sufficiently evaluated by monitoring data since there are only few paludiculture pilot sites and biodiversity monitoring here is scarce.
Thus, we conducted a literature review (177 references) on effects of rewetting and management (mowing and grazing, mainly for conservation purposes) on biodiversity in European fens and identified its potential benefits, losses and trade-offs. Whenever possible we referred to literature from organic soils, but also included basic knowledge from mineral soils.
Management effects on higher taxonomic levels are strongly taxa specific and may differ within orders or even families and between management types. Generally, management promotes thermo- and heliophilic as well as open area species and phytophagous invertebrates. In some habitats regular disturbance is even necessary to promote and maintain high-valued species (e.g. fen meadows). In others it poses high risk to species sensitive to mowing/grazing by directly killing or harming, or by modifying microhabitats.
To tackle these different responses, we developed biodiversity conservation measures to mitigate negative and promote positive aspects of management on wet fen peatlands. Conservation measures include the establishment of rotational fallows, the adapted management of ditches, the adaptation of mowing/grazing times as well as the use of specific mowing machineries.
We conclude that paludiculture has the potential to make an important contribution in conserving fen biodiversity. Furthermore, there is an urgent need for accompanying field research focussing on biodiversity on paludiculture pilot sites. Field research should have a long-term perspective and should also comprise the stage before rewetting.

Key words: rewetting, mowing, grazing, biodiversity, fen

3.3.3 **Acomparative study of invertebrate diversity and biomass between 4 paludiculture pilot sites and nearby common grassland on drained peat (but rather extensive use) What does paludiculture contribute to arthropod diversity?**

van Duinen, Gert-Jan*; Dam, Steften*
**Stichting Bargerveen, Radboud Universiteit Nijmegen, The Netherlands*

To get an insight in the value of paludiculture for arthropod diversity, as well as the fauna food web, numbers of arthropods, size, biomass and taxonomic order or family composition were compared between four paludiculture pilot sites (3 with *Typha* and 1 with *Sphagnum*) in The Netherlands and four nearby non-intensively used drained grassland sites. Arthropods were sampled using emergence traps in

June and July 2018. Diptera were the most numerous taxonomic group and these were identified to family.
Overall, in this study paludiculture pilot sites and neighbouring drained agricultural grasslands on peat did not differ significantly in either number of arthropods nor biomass produced. However, in two sites the arthropod biomass production was much higher in the paludiculture than in the grassland. Only in one site both the arthropod number and biomass were considerably lower in the paludiculture than in the grassland. A possible explanation for this might be that here the *Typha* is much more productive (high and dense) than in in the other sites, likely due to the higher nutrient availability. Further investigations are needed to assess the figures for conventional, intensively used and drained grassland.
The change of drained grasslands into paludiculture may not in any case change total biomass production of arthropods, but will change community composition. This will also have consequences for predators, like insectivorous birds; their species composition will change, as well. Since paludiculture produces a different arthropod community than grasslands, the establishment of paludiculture is likely positive for overall biodiversity on the landscape scale.

Key words: arthropod, *Typha, Sphagnum*

3.3.4 **Implementation of a water buffalo grazing system on a coastal wet grassland site interspersed with reed beds**

Bende, Jonathan*; Grenzdörffer, Görres**; Müller, Jürgen*
**University of Rostock, Grassland and Forage Science; **University of Rostock, Geodesy and Geoinformatic, Rostock, Germany*

Coastal wet grassland fulfils a number of ecosystem services (ESS). The effectiveness of ESS depends on the condition of this resource. Both, over-intensive use and abandonment of use, impair the provisioning and regulating ecosystem functions. Extensive grazing with water buffaloes (*Bubalis bubalus*) has proven its suitability to control reed invasion into open coastal habitats as a refugium for breeding waders and to maintain species-rich grassland associations under coastal wetland conditions recently. Hence, the aim of the present study was to develop a concept for the implementation of water buffalo pastures in a grassland area on the coastal fringe of the island of Usedom. For this purpose, we developed planning schemes for the feed demand and determined the biomass volume by means of UAV-supported photogrammetry. On the basis of aerial photographs and hyperspectral images, a digital elevation model was derived and the reedbed areas as well as large sedge and rush areas were spatially recorded. In a next step, the pasture area was divided into grazing units which a) provide an adequate nutritional basis, b) take into account the landscape conservation aspects of the displacement of reeds, and c) allocate mowing areas for winter forage harvests. The results of this planning are presented in the form of maps and grazing plans and are used for immediate implementation in practice.

Key words: landscape planning, ecosystem services, landscape conservation, UAV-based site investigation, extensive husbandry

3.3.5 PaluDivers: Development and accompaniment of the testing of nature conservation minimum standards for the conservation and promotion of biodiversity in future paludicultures on agricultural land

Luthardt, Vera*; Birr; Friedrich*; Hennenberg, Klaus**; Nerger, Monique*; Reise, Judith**; Winger, Christian**
*Eberswalde University for Sustainable Development; **Oeko-Institut e.V., Freiburg, Germany*

Paludicultures can act as substitute habitats for peatland-typical species when used in an adapted manner. Therefore, minimum standards of nature conservation should be formulated and applied for these forms of management. The aim of the PaluDivers project is to develop those minimum nature conservation standards for the production-oriented management of rewetted organic soils while (largely) preserving the peat body on agricultural land (paludiculture). Paludiculture projects in Germany and the EU that have already been put into practice are to be analyzed for their effects on nature conservation. The data will be collected in a publicly accessible database. On this basis, recommendations are to be developed as to which data should be collected to evaluate the development of biodiversity in paludiculture projects. New paludiculture pilot projects in Germany should be advised and supported in the implementation of biodiversity-oriented monitoring activities.

Key words: Monitoring, Biodiversity, Paludiculture
link: https://www.hnee.de/de/Fachbereiche/Landschaftsnutzung-und-Naturschutz/Forschung/Forschungsprojekte/Aktuelle-Projekte/PaluDivers/PaluDivers-E10934.htm

3.3.6 Linking up Peatland Restoration with Community Empowerment and Orangutan Conservation Activities in Central Kalimantan, Indonesia

Rojas Lara, Teresa*; Gaiser, Nina-Maria*
Borneo Orangutan Survival (BOS), Germany

Indonesia has 36% of the world's tropical peatlands. In its natural state, tropical peat is an effective way of carbon offsets. However, Indonesia is currently the world´s fifth biggest emitter of greenhouse gases, which come principally from peatland and forest fires. In 2019, 1.6 million hectares of land in Indonesia were burned, 42% of it on peatlands. The provinces of Central and West Kalimantan were the most affected.

At the same time, Borneo Orangutan Survival (BOS), the worldwide biggest primate conservation NGO, is working to conserve the critically endangered Bornean orangutan (*Pongo pygmaeus*) and its habitat through the involvement of the local communities living nearby orangutan habitat. One of BOS' intervention areas is the Mawas protected forest, located within the ex-Mega Rice Project in Central Kalimantan. Mawas encompasses 309,000 hectares, most of them peatlands, and is the home to one of the last tracts of forest supporting wild orangutans. An estimated 2,550 wild orangutans are found in this area.

This paper presents practical experiences and recommendations from the work of BOS Foundation Indonesia in cooperation with BOS Germany and local communities in Borneo in restoration of degraded peatlands, including paludiculture activities. Rewetting of degraded peatlands is achieved through canal blocking strategies. The strategy consists of dam building, which are overplanted with vegetation, and reforestation. Up to now BOS Germany has provided support to block more than 12 canals, rewetting around 2.500 hectares of peatland. Reforestation activities to recover degraded areas are carried out with native species. By 2020, more than 160 hectares of degraded land have been reforested. All activities are carried out in close cooperation with local and indigenous communities. Mawas has 53 villages with 29,000 families, of which a large percentage live below the poverty line. The principle of paludiculture, to restore the peat ecosystem while still paying attention to economic interests, is a sustainable option for these families. Agroforestry schemes with Sapat trees, a medicinal tree, are being implemented in the border side of peatlands. New agroforestry scheme proposals which include sago (*Metroxylon* spp), Jelutung (*Dyera costulata*) and fruit trees in rewetted peatlands are in preparation. Finally, beje aquaculture, a traditional and sustainable technique for breeding fish in artificial ponds in peatlands, is going to be used as a source of proteins and income generation for the local population.

Key words: Peatland restoration, Paludiculture, Biodiversity, Orangutan, Borneo
link: https://www.orangutan.de/

Session 4.1 Harvesting techniques

Session 4.1		Harvesting techniques
Stage		A
Time		09.03.2021 15:45-16:45
Moderator		Wendelin Wichtmann
Talk:	1	Introduction of types of and challenges for machinery for paludiculture biomass harvest on wet peatlands **Jan Pottgießer**
	2	Special machines for working in wet areas with low ground pressure, development of new machine types for working on mires and wetlands **Holger Wolter**
	3	Cattail (*Typha*) harvesting technic development for Substrate and more **Robert Wellink**
	4	High-capacity machines for working in areas with fragile soil structure **Gerrit Jan De Vries**

4.1.1 **Introduction of types of and challenges for machinery for paludiculture biomass harvest on wet peatlands**

Pottgießer, Jan*
**University of Greifswald, Institute of Botany and Landscape Ecology, Partner in the Greifswald Mire Centre, Germany*

The biomass harvest is a huge challenge in paludiculture. The challenging conditions require harvesting machinery to be able to meet the requirements of low ground pressure and the ability to preserve the peat surface structure, while being economically viable at the same time. The need for a high acerage performance, the ability to remove the biomass in desired quality, avoidance of multiple crossings, high area efficiency, and cost efficiency are some of the central requirements which harvesting machinery must fulfill. The presentation gives an introduction to different approaches to meet some, or all of the above-mentioned conditions and experiences which have been made in different paludiculture projects.

Key words: harvest, machinery

4.1.2 **Special machines for working in wet areas with low ground pressure, development of new machine types for working on mires and wetlands**

Wolter, Holger*
**Biber GmbH & Co.KG, Pattensen, Germany*

The company Biber sells and developes machines for working in wet areas with minimal ground pressure. The machines are based on the system “Brielmaier” from south Germany. The rewetting of areas makes it necessary to build new machines with reduced CO_2 emission and minimal ground pressure with insect-friendly cutting system.

Key words: Rewetting, ground pressure, reduced CO_2 emission, no rotation cutting, insect-friendly
link: www.biber-werksvertretungen.de

4.1.3 Cattail (*Typha*) harvesting technic development for Substrate and more

Wellink, Robert*
*****_Wellink Equipment BV, The Netherlands_

In the multiple-party project "*Typha*Substrat" three German Partners are working in the coming 3 years on the development of growing mediums with at least 50% less peat in them on the basis of biomass from cattail (*Typha*).

Growing this biomass on formerly drained and agricultural used peatlands brings not only profit for the climate (no carbondioxid emissions from drained peat) but also ensures solid, good end healthy harvest in dry years. But the rewetted state of those fields makes harvesting tricky. *Typha* is grown in pretty wet conditions which askes for harvesting technic with a very low soil pressure.
The used Harvesting technics and the combined field-logistics have to fit the later use of the harvested biomass. This looks simple but needs constant discussion between constructor and end-user of the biomass.
Wellink Equipment will work test some existing mowing/harvesting machinery to find out what best can be used to start with. After this initial fact-finding, with the help of European-harvesters of wet biomass with yearlong experience we will commence on remaking old machinery or create complete ne mowing heads to be able to harvest chopped (particles in different size) or bundles cattail.
The machinery will be made fitting on Log logic Softrack machines which have a proven track record of wetland experience.

4.1.4 High-capacity machines for working in areas with fragile soil structure

Jorritsma, Jeroen*
**De Vries Cornjum BV, The Netherlands*

De Vries Cornjum is the specialist in the field of maintenance in difficult natural areas. The company has more than 40 years of experience in maintaining all kinds of natural areas, blue grasslands and wetland meadows. We have a wide range of self-developed machines such as tracked mowers, tracked self-loading wagons, tracked wood chippers, flail/chopping machines etc. Due to this wide range of machines, we are able to take the right approach to every job.
During the presentation, various machines and methods will be shown.

Key words: Wetlands, ground pressure, tracked vehicles
link: www.devriescornjum.nl, https://www.youtube.com/channel/UCMzKdsZHXRehfPC81D4XIPg

Session 4.2a Biodiversity within species (Genetics of Reed) & Session 4.2b Sphagnum farming

Session 4.2a		Biodiversity within species (Genetics of Reed)
Stage		B
Time		09.03.2021 15:45-16:45
Moderator		Gerald Jurasinski
Talk:	1	Population genetic structure of common reed (*Phragmites australis*) **Kristina Kuprina**
	2	How can the population genetic diversity of common reed, *Phragmites australis*, change over 24 years? **Anna Rudyk**
Poster:	A	Commercialising vegetative propagation systems for perennial grasses for paludiculture production using CEEDS™ technology. **Paul Muto**
Session 4.2b		Peatland properties
Poster:	A	Peat soil in Bavaria - implications for agricultural and climate-change strategies from a century of archived peat soil data **Anna Kühnel**
	B	Mo(o)re balance – About losses of high elevation and water table dynamics in a water pumped catchment area **Kerstin Fuhrmann**
	C	Comparative studies on peatland properties along a land use gradient in Ireland Kilian Walz

4.2.1 Population genetic structure of common reed (*Phragmites australis*) in Mecklenburg-Western Pomerania (Germany)

Kuprina, Kristina*; Landeau, Robin*; Seeber, Elke*; Schnittler, Martin*; Bog, Manuela*
**University of Greifswald, Institute of Botany and Landscape Ecology, Partner in the Greifswald Mire Centre, Germany*

Common reed, *Phragmites australis*, is one of the most widespread wetland species and it is of great interest for industrial, energy, agricultural and water treatment uses. Many researchers suggest that the stability of reed stands is related to their genetic diversity; the higher the genetic variability, the better the stand's ability to cope with unfavorable conditions. Different factors could decrease the population genetic diversity. Here we examine how disturbance caused by location on the sea coast or mowing affects the genetic variability of reed populations. Therefore, 30 samples from each 24 reed stands (among them, 8 brackish-/freshwater regional pairs, 7 regularly mown populations) were collected (n=720 in total). Samples were haplotyped using 2 chloroplast DNA regions and genotyped with 8 microsatellite loci (SSR). Additionally, the stem width and length were measured. The analyses revealed intensive clonal growth inside the populations, which comprised 6 haplotypes and 162 genotypes but no genetic differentiation between fresh/brackish/mowed populations could be detected. This is evidence that reeds can freely spread across the studied region (max. distance 164 km) both via seeds and pollen. Interestingly, studied brackish water populations had significantly higher allelic (but not genotypic) diversity than freshwater ones, which could hint to a heterozygote advantage in these environments. The mown stands generally did not differ in their genetic diversity from the other stand types; moreover, one mown population was the most genetically diverse. Finally, ANOVA revealed that brackish water stand reeds had significantly shorter and thinner stems than freshwater ones, pointing towards an ecological differentiation.

Key words: reed, genetic diversity, dispersion, population genetics

4.2.2 How can the population genetic diversity of common reed, *Phragmites australis*, change over 24 years?

Rudyk, Anna*; Seeber, Elke**; Kuprina, Kristina**; Schnittler, Martin**; Bog, Manuela**
**Saint Petersburg State University, Russia; **University of Greifswald, Institute of Botany and Landscape Ecology, Partner in the Greifswald Mire Centre, Germany*

Common reed (*Phragmites australis*) is the most widespread swamp plant used in paludiculture. The establishment and maintenance of the vitality of any population depends to a large extent on its genetic diversity. In this study, we investigate the genetic composition of the 10-hectare reed population planted more than 20 years ago in the reed project in Biesenbrow (1996-1998) in northeastern Germany, where reeds with different genotypes and ecotypes were planted in different densities with three establishment methods (planting potted plants, planting stem cutting, sowing panicles) under changing water regimes. Despite the fact that the original samples of genotypes have not been preserved, we are trying to re-identify them using 8 microsatellite loci and describe the genetic diversity in the plots where reeds were planted in different densities (1, 4 and 10 plants m^{-2}). We also want to answer the question, which clones are better adapted and, therefore, can be found more often in unplanted areas and in the border regions between the plots. The results of our investigation may shed light on how population variability changes over time and whether it depends on planting density. This information could be used perspectively to maintain high or, if necessary, low genetic diversity in newly established reed populations.

Key words: reed, genetic diversity, population establishment

4.2.3 Commercialising vegetative propagation systems for perennial grasses for paludiculture production using CEEDS™ technology

Paul Muto*, Michael Carver**, Paul Carver**
**Natural England, **New Energy Farms EU Ltd, Great Britain*

This project addresses the potential for two grass species to be considered as important paludiculture crops:

- *Phragmites australis* (common reed or Norfolk Reed)
- *Molinia caerulea* subsp. *arundinacea* (purple moor grass)

Phragmites australis can be established from vegetative plantlets or rhizome pieces, but both methods are time consuming and expensive. *Molinia caerulea* subsp. *arundinacea* can be established from seed, but seedling vigour is very low, making it difficult to establish due to competition from weeds. This project will assess the potential for an innovative vegetative propagation technology to facilitate the commercial establishment of these species.

This initiative will work with a UK plant technology business, New Energy Farms, which has developed a patented method of vegetative propagation, Crop Expansion Encapsulation and Drilling System (CEEDS™), originally intended to improve the establishment of *Miscanthus* crops. The proposal will explore the suitability of CEEDS™ technology for both *Phragmites* and *Molinia*. It is an innovative technology that will not only facilitate the establishment of paludiculture grasses, but may also have application for other species that are difficult to establish under habitat restoration initiatives. The project will investigate the physiological responses of plant tissues to a range of treatments to determine the potential to develop

vegetative production techniques. Materials will be tested in controlled environments and larger scale pot trials and field plantings will be carried out. After 9 months to one year, it will be clear the plants are demonstrating responses which will encourage further exploration towards novel methods of commercial vegetative propagation.

Key words: paludiculture, vegetative propagation, *Phragmites*, *Molinia*

4.2.4 Peat soil in Bavaria - implications for agricultural and climate-change strategies from a century of archived peat soil data

Conze, Nadine*; Kühnel, Anna*; Machl, Thomas*; Kotzi, Jutta*; Kuhn, Gisbert*; Freibauer, Annette*
**Bavarian State Research Center for Agriculture, Germany*

In Bavaria, as in many other areas of the world, cutting of peat for economic exploitation as well as drainage for agricultural cultivation during the last centuries has led to major degradation of peatland soil, turning them from carbon sinks to carbon sources. Today, 5% of Bavarian carbon emissions arise from peat soil (5.2 M t CO_2-eq.), which, however, represents only 3 % of Bavaria's total area. Since 90% of Bavarian peat soil is under agricultural or forestry cultivation, it is of crucial socioeconomic interest to establish adaption methods that help to fulfil climate change agreements by simultaneously sustaining agricultural benefit. However, knowledge of the current status on peat soil condition of Bavarian farmlands and grasslands is scarce, yet necessary for the development of cultivation strategies.
Here we outline how a historic dataset in combination with present-day peat soil analysis will contribute to resolve questions on today's peat soil extent and thickness as well as their changes over time. Our compilation of peat-soil datasets will further serve as a basis for evaluating adaption and rewetting potential.
The Bavarian State Research Center for Agriculture (LfL) archives historic maps which cover peat soil information over the course of the last century. Maps display the extent of fens and bogs, their vegetation cover and cultivation, transects with soil profiles as well as hydrological, geomorphological and soil-engineering information. Detailed data sets on soil physical properties at specific sites are additionally dispersed within numerous paper files.
We present how the archived maps and datasets are transferred into a digital form and processed thereupon. A comprehensive database of the historic material will, furthermore, facilitate the evaluation of changes in peat soil depths and degradation over time and will be used to allocate areas with strong rewetting potential in order to preserve peat soil under agricultural use.

Key words**:** peat soil, agriculture, rewetting potential, peat soil archive, database, Bavaria

4.2.5 Mo(o)re balance – About losses of high elevation and water table dynamics in a water pumped catchment area

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Losses of high elevation based on artificial drainage systems provide particularly big challenges for coastal lowlands. In the agricultural lowland area Sorgekoog in Schleswig-Holstein, more than 13,000 leveling points from the years 1966 and 2006 and digital elevation models from the years 2006 and 2020 were evaluated in order to determine the changes in elevation in previous years. Long term observations of ditch water tables and soil water tables show no correlation nowadays. Ditch blocking did not raise the soil water table in summer periods, furthermore high losses of elevation were detected. Based on these results pedogenetic aspects and their effects on the height changes and ditch and soil water table interactions were analyzed in more detail. Significant differences with regard to the subsidence and shrinkage sensitivity of different soil types and soil textures as well as different Holocene thicknesses could be determined. The majority of determined changes in altitude lie in a range from -0.3 m to -0.82 m in 40 years (1966-2006). The height losses of clay covered soils amount to 0.34 m in 40 years (1966-2006) were significantly larger than those of uncovered peat soils with 0.31 m in 40 years (1966-2006). The results indicate that in lowland areas which have been drained for many years, soil properties can engage a significant importance with regard to changes in altitude and missing interactions between ditch and soil water tables. In addition, the high evapotranspiration rates in the windy peatland area will be one main of other factors. Appropriate water management is essential, even in soils covered with clay. In view of an outdated water management infrastructure and prospective high investment requirement, there is an urgent need to take action to harmonize water table fluctuations and to reduce further height losses.

Key words: land subsidence, artificial drainage, soil type, wetland management, sustainable agriculture
link: www.eider-treene-verband.de

4.2.6 **Comparative studies on peatland properties along a land use gradient in Ireland**

Walz, Kilian*
**University of Limerick, Republic of Ireland*

It is estimated that ombrotrophic peatlands cover approximately 20% of the land area of the Republic of Ireland. Yet, the country is only starting to examine the potential for paludiculture as a suitable alternative to traditional land uses. Alongside research on the warming potential of these land use systems, important knowledge on properties of peat, such as carbon stocks, bulk densities and peat chemistry were limited until now, and with this a solid foundation for the planning of paludiculture activities was missing. In this contribution results of the country’s first nationwide peatland survey conducted between 2017 and 2019 are presented, with the aim to fill a gap in regard to the yet scarce knowledge on the influence of peatland type, land use and rewetting on soil and vegetation properties of Irish bogs. Several modeling studies form part of the assessment of the effect of land use on degradation of peat properties. In this presentation, the influence of land use and rewetting is examined and a new estimate of peat-soil carbon stock for each land use and peatland type is proposed, using a mixed effects modeling approach. It forms the basis for the subsequent estimation of carbon stocks on a national level.

Key words: land use, carbon stocks, bogs, Ireland

Session 4.3 *Sphagnum* propagules

Session 4.3		*Sphagnum* **propagules**
Stage		**A**
Time		**09.03.2021 15:45-16:45**
Moderator		**Matthias Krebs**
Talk:	**1**	Selection of highly productive *Sphagnum* species and provenances in Europe to maximize the yield in Sphagnum farming **Mira Kohl**
	2	Axenic in-vitro cultivation of 19 peat-moss (*Sphagnum* l.) species as a resource for basic biology, biotechnology and paludiculture **Melanie Heck**
	3	Sphagnum farming using micropropagated *Sphagnum* and simulated rain irrigation to significantly improve production of a growing medium **Neal Wright**
Poster:	**A**	Selecting highly productive *Sphagnum* (peatmoss) provenances and their mass-propagation – results of the joint Sphagnum farming research project ‚mooszucht' **Anja Prager**

4.3.1 Selection of highly productive *Sphagnum* species and proveniences in Europe to maximize the yield in Sphagnum farming

Kohl, Mira*; Prager, Anja*; Krebs, Matthias*
**University of Greifswald, Institute of Botany and Landscape Ecology, Partner in the Greifswald Mire Centre*

Since Sphagnum farming is a new kind of agriculture on rewetted peatlands and *Sphagnum* is not an established crop, no variety of cultivars do exist yet. For the first large scale field experiments single available wild provenances of *Sphagnum* species have been, with yields up to ~7 t dry mass ha^{-1} yr^{-1} in NW Germany. However, to get Sphagnum farming more profitable the yield has to be enhanced. Hence, the aim of this study is the selection of highly productive *Sphagnum* by comparing productivity of different microprovenances (= a species from one microhabitat (hummock, lawn, hollow) in one mire). For this, we collected twelve *Sphagnum* species (*S. austinii, S. centrale, S. denticulatum, S. fallax, S. fimbriatum, S. fuscum, S. magellanicum, S. palustre, S. papillosum, S. riparium, S. rubellum, S. squarrosum*) in 31 mires in 10 countries all over Europe. The selection was conducted in three steps. 1.) In total 474 microprovenances were cultivated in a common garden experiment in Greifswald (NE-Germany) over one vegetation period to determine the 15 most productive microprovenances per species (180 in total). 2.) To validate the results of step 1 and to dertermine the two most productive microprovenances per species three single individuals of each selected microprovenance were used to investigate its dry weight after 46 days growth in a climatic chamber experiment. 3.) To test the productivity of the in step 2 selected microprovenances they were cultivated under different water and nutrient regimes on a rewetted bog grassland in NW-Germany – the region with the highest area potential for Sphagnum farming in Germany. First results under controlled conditions in a climatic chamber indicate an increase in yield of up to 40% for *S. papillosum*, but yet need to be validated under field conditions.

Key words: productivity, common garden, climate chamber, rewetted bog grassland, micro habitat

4.3.2 Axenic in-vitro cultivation of nineteen peat-moss (*Sphagnum l.*) species as a resource for basic biology, biotechnology and paludiculture

Heck, Melanie A.*; Lüth, Volker M.*; van Gessel, Nico*; Krebs, Matthias**, ***; Kohl, Mira**, ***; Prager, Anja**, ***; Joosten, Hans **, ***; Decker, Eva L.*; Reski, Ralf *, ****, *****
**Plant Biotechnology, Faculty of Biology, University of Freiburg, Germany; **University of Greifswald, Institute of Botany and Landscape Ecology, Partner in the Greifswald Mire Centre; ***Greifswald Mire Centre, Germany; ****CIBSS – Centre for Integrative Biological Signalling Studies, University of Freiburg, Germany; *****Cluster of Excellence livMatS @ FIT – Freiburg Center for Interactive Materials and Bioinspired Technologies (FIT), Freiburg, Germany*

AIM: The cultivation of *Sphagnum* can substitute peat with a renewable and eco-friendly biomass with similar physical and chemical properties as low humidified peat, which is used extensively in horticulture. This will help to mitigate climate change as CO_2 emissions are reduced by rewetting drained peatlands. Sphagnum farming requires large volumes of *Sphagnum* founder material of controlled quality, which can only be supplied rapidly and sustainably by axenic cultivation in bioreactors.
MATERIALS AND METHODS: We established axenic in-vitro cultures from spore capsules of 19 *Sphagnum* species collected in Austria, Germany, Latvia, Netherlands, Russia and Sweden, namely *S. angustifolium, S. balticum, S. capillifolium, S. centrale, S. compactum, S. cuspidatum, S. fallax, S. fimbriatum, S. fuscum, S. lindbergii, S. medium/divinum, S. palustre, S. papillosum, S. rubellum, S. russowii, S. squarrosum, S. subnitens, S. subfulvum, and S. warnstorfii*. These species cover five of the six European *Sphagnum* subgenera, namely *Acutifolia, Cuspidata, Rigida, Sphagnum* and *Squarrosa*.
RESULTS: The growth of all 19 *Sphagnum* species was measured in suspension cultures with a selection of up to six best growing clones per species. The productivity of the best growing clones was compared and their ploidy was determined by flow cytometry. We identified haploid and diploid *Sphagnum* species and found that their cells are predominantly arrested in the G1 phase of the cell cycle. So far, we did not find a correlation between plant productivity and ploidy. To reliably discriminate our *Sphagnum* species, DNA barcoding was achieved by sequencing introns of the nuclear genes BRK1.
CONCLUSION: With this collection, high-quality founder material for diverse large-scale applications but also for basic *Sphagnum* research is available from the International Moss Stock Center (IMSC). Scaling up this cultivation method will facilitate a low-cost production process for fast-growing *Sphagnum* biomass.

Key words: cell cycle arrest, DNA barcoding, genome size, Sphagnum farming

4.3.3 Sphagnum farming using micropropagated *Sphagnum* and simulated rain irrigation to significantly improve production of a growing medium

Wright, Neal*; Keightley, Anna**; Field, Chris**; Clough, Jack***; Caporn, Simon**
**Micropropagation Services Ltd; **Manchester Metropolitan University; ***University of East London, Great Britain*

To conserve the large carbon stores in intact peatlands we must reduce the extraction of peat for horticulture. A renewable high-quality replacement for peat in growing media is cultivated *Sphagnum* moss, but more trials are required to demonstrate its commercial viability. The aim of this trial was to test management methods on two different sites in England: a cut-over peatland and an organic-mineral farm soil. *Sphagnum palustre* was planted in late Summer-Autumn of 2018 in two micropropagated propagule forms: BeadaHumok™ and BeadaGel™. Three different cover materials provided crop protection: straw, perforated plastic, nylon mesh or no cover, with four replicates for each treatment. Water availability to *Sphagnum* is usually achieved by controlling a high water-table, however, here we provided water from above (drip or spray irrigation) to simulate rain, while the water table below was unregulated. *Sphagnum* establishment and growth was good, after teething problems caused some damage, on both peatland and farmland sites. The spray irrigation produced faster growth than drip and

all three cover types were better than no cover. Typical farm weeds were a significant problem on both sites. *Sphagnum* volume and biomass production rates were impressive. After nearly two years, biomass production by volume was up to 1600 m^3 ha^{-1} (standard industry bulk density), and by dry matter to 14,800 kg ha^{-1}. A full harvest is planned after 3 years and large-scale trials are in progress. The successful production (patents pending) of BeadaMoss® *Sphagnum* biomass using surface irrigation techniques on different soils demonstrates the potential for volume cultivation in a variety of landscapes, not restricted to wetlands, and could simplify the expansion to commercial scale by avoiding problems of raising water tables in adjoining agricultural crops. The high productivity should make *Sphagnum* Farming viable at a larger scale, even with the high relatively set-up costs.

Key words: Sphagnum farming, BeadaMoss®, irrigation, growing media
link: http://www.beadamoss.co.uk/page8.html

4.3.4 Selecting highly productive *Sphagnum* (peatmoss) provenances and their mass-propagation – results of the joint Sphagnum farming research project ‚mooszucht'

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**University of Greifswald, Institute of Botany and Landscape Ecology, Partner in the Greifswald Mire Centre; **Albert-Ludwigs-University of Freiburg, Faculty of Biology, Department Plant Biotechnology, Germany; ***Karlsruhe Institute of Technology – KIT, Department Bioprocess Engineering, Germany; ****Enterprise Niedersächsische Rasenkulturen NIRA GmbH & Co. KG – NIRA, Germany*

To reach the zero CO_2 emission goal 2050 of the 'Paris Agreement' both, the drainage-based use of peatlands and the use of peat in growing media is no longer appropriate. *Sphagnum* offers a climate-friendly alternative for both, when it is cultivated as a renewable crop on degraded rewetted peatlands (Sphagnum farming) and the produced biomass is used in growing media substituting peat. Field trails on rewetted former bog grassland and cut-over bogs showed the feasibility of Sphagnum farming, but so far only wild parent material was used as donor material. The 'Mooszucht' project addresses the potential of increasing *Sphagnum* productivity by selecting highly productive wild provenances and the large-scale mass propagation of selected provenances as founder material for implementing Sphagnum farming or for restoration purpose (www.paludiculture.com).
So far, 474 moss samples of 12 *Sphagnum* species have been collected from 31 mires (10 European countries). The most productive mosses were selected in a common-garden and a climate chamber experiment (comparing increment of lawn height, cover of capitula, and dry weight increase). First results showed 40 % higher biomass productivity for *Sphagnum papillosum* (Georgian provenance) and 12 % for *S. palustre* (Czech provenance) compared to mosses formerly cultivated in our pilot field. To validate productivity in laboratory we spread most productive provenances in a field experiment and characterized them genetically by SSR marker assays.
A protocol for both axenic in-vitro cultures, generated from spore and vegetative moss material was developed. The optimization of culture conditions in a stirred tank-reactor allowed e.g. a 40-fold biomass increase within 23 days for a *S. palustre* clone. To further scale up the photo-bioreactor approach, a trickle bed-reactor was developed. In this reactor a productivity of 300 g m^{-2} d^{-1} was reached for a *Sphagnum palustre* clone. Additionally, non-axenic *Sphagnum* mass propagation was successful tested on irrigated fleeces.

Key words: Sphagnum farming, provenances, selection, mass-propagation
link: www.mooszucht.paludikultur.de, www.sphagnumfarming .com

Session 5.1 Worldwide developments of paludiculture

This session aims to provide an update for the worldwide paludiculture network, to foster the ‘practioners’ community, and to discuss conditions and developments for paludiculture worldwide.

Over the last decades, there has been increasing practical and scholarly interest in paludiculture, the productive use of wet and rewetted peatlands and other wet livelihoods on peatland landscapes. This session will look at practical experience with paludiculture to explore the following questions: What can we learn from practice for the definition of paludiculture and its relation to productive use, people and nature? Which ecosystem services can be maintained or restored by wet management and what´s as the implication for classifications and typologies of paludiculture? What do we know about enablers and opportunities, obstacles and barriers faced by implementers of paludiculture and their diffusion across the world? What kind of a practical action could support paludiculture practitioners to foster a network for sharing knowledge and experience around paludiculture and other wet livelihoods?

Session 5.1		**Worldwide developments of paludiculture**
Stage		**A**
Time		**10.03.2021 10:15-11:15**
Moderator		**Hans Joosten**
Talk:	**1**	Paludiculture worldwise: is there a need to differentiate the concept? **Wendelin Wichtmann**
	2	Paludiculture – first results from a global survey of practical paludiculture initiatives **Rafael Ziegler**
	3	Paludiculture in Indonesia **Haruni Krisnawati**
Poster:	**A**	Peatland rehabilitation through multi-stakeholder partnership: Creating better livelihood for community in Malaysia **Faizal Parish**
	B	Paludiculture practices by smallholder farmers in southern Sumatra of Indonesia: opportunities and challenges **Sri Lestari**
	C	Peatland management based on local wisdom in Giam Siak Kecil Landscape in Riau Province, Indonesia **Mulyadi**
	D	Economic benefit on drained peatlands: a challenge for rewetting **Dian Charity Hidayat**

5.1.1 Paludiculture worldwise: is there a need to differentiate the concept?

Wichtmann, Wendelin*; Joosten, Hans*
**University of Greifswald, Institute of Botany and Landscape Ecology, Partner in the Greifswald Mire Centre, Greifswald, Germany*

Paludiculture is defined as the productive use of wet peatlands under conditions that stop subsidence and minimise the emissions of greenhouse gases (Concluding statement of the RRR2017 conference). Paludiculture comprises the use of any biomass, from spontaneous plant growth on near-natural sites to artificially established crops on rewetted sites. Paludiculture should maintain the peat body, and may facilitate peat accumulation and the provision of various ecosystem services associated with natural, undrained peatlands.

In practice the term ‘paludiculture’ is also being used for land use that does not comply with the criteria of the definition, for example, for cultures where the water levels remain too low to stop peat oxidation. How can leakage be avoided on the farm-level? How do wet livelihoods and paludiculture fit together?

Key words: wet peatland utilisation, definition of paludiculture, concept

5.1.2 Paludiculture – first results from a global survey of practical paludiculture initiatives

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**HEC Montréal; Canada; **University of Greifswald, Institute of Botany and Landscape Ecology, Partner in the Greifswald Mire Centre, Germany; ***Maastricht University, The Netherlands*

Paludiculture uses spontaneously grown or cultivated biomass from wet peatlands under conditions in which the peat is conserved or even newly formed. While the practice is old, the term was only coined in the 1990s and a theory knowledge base around paludiculture is only currently emerging. This presentation contributes to this emerging knowledge base via the first global survey on practical paludicultures.
The online survey, conducted in fall 2020, collects information on the goals and context of these paludicultures, their economic benefits and innovation, the management and monitoring of paludicultures, collaboration and networking as well as the opportunities and barriers that such initiatives face along with their outlook on the future of paludiculture.
Based on the survey, we discuss implications for the contested definition of paludiculture, and the tensions between nature conservation and productive use of peatland. We discuss the relation between “old” paludicultures drawing on traditional uses, and “new” paludicultures based on scientific-technological innovation. We also discuss patterns of barriers and opportunities for paludiculture across the world, and their implication for a regenerative use of the land toward more circular economies.

5.1.3 Peatland rehabilitation through multi-stakeholder partnership: Creating better livelihood for community in Malaysia

Nor Asikin*, Siew Yan (Serena) Lew*, Faizal Parish*; Nagarajan Rengasamy*

**Global Environment Centre (GEC), Malaysia*

Rehabilitation of degraded peatland area by Global Environment Centre (GEC) started more than a decade in Selangor State then extended to Pahang in Peninsular Malaysia, through multi-stakeholder partnerships. Integrated management approach and multi-stakeholder engagement have been emphasized and prioritized to maximize impact of effort in conservation and rehabilitation. Up to date 2020, more than 2,000 hectares of degraded peatland areas have been rehabilitated in both Selangor and Pahang states. Multi-stakeholder include local government, private sector and local community have been recognizing the importance and value of peatland ecosystem hence have been involved in the conservation and rehabilitation effort together with GEC and State Forestry Departments. Apart from the rehabilitation, the local communities have been gaining income from the alternative livelihood options such as patrolling, community nurseries, and other farming activities. Community based patrolling and monitoring teams have been formed to monitor and maintain the rehabilitated areas to check ground water level, fire prevention alert system, and construction of canal blocks. The community backyard nurseries have produced thousands of indigenous or pioneer species saplings for selective planting at rehabilitation sites. Starting from collecting wildings to propagating seedlings of tree species, and other ornamental plants, fruit trees and vegetables. Besides, there have been alternative livelihood activities e.g. fish farming, handicrafts and stingless bee keeping to improve community’s income. Private sector in particular oil plantation companies have been engaged through corporate society responsibility projects or recovery projects to rehabilitate the degraded and fire-prone peatland areas that adjacent to their managed land and forest reserves. The local government e.g. Forestry Department Peninsular Malaysia, State Forestry Departments, District Offices, Department of Orang Asli Development (JAKOA) and technical departments who have been supportive and acknowledge the importance and value of peatland ecosystem, and have been recognizing the need of integrated management through multi-stakeholder partnership to sustainably manage and protect the peatland ecosystem.

Key words: peatland rehabilitation, livelihood, integrated management, community, stakeholder engagement

link: Kindly refer to official website Global Environment Centre (GEC),

https://www.gec.org.my/index.cfm?&menuid=334

Facebook: Global Environment Centre https://www.facebook.com/globalenvironmentcentre

Peatlands in Southeast Asia https://www.facebook.com/ASEANpeat/

#peatmatters; #peatforlife; #peatland; #aseanpeat

5.1.4 Paludiculture practices by smallholder farmers in southern Sumatra of Indonesia: opportunities and challenges

Lestari, Sri*; Winarno, Bondan*; Premono, Bambang Tejo*; Kunarso, Adi**

**Environment and Forestry Research Development Institute of Palembang, Ministry of Environment and Forestry of Indonesia; **RMIT University, Australia*

Peatland management practices have long been carried out by communities in Indonesia, including those who participated in the transmigration programme from Java island to Sumatra. Several transmigration areas in Sumatra are peatlands which are still overgrown with trees and shrubs. This study aims to observe paludiculture practices by smallholder farmers as a source of their livelihoods. Based on discussions and interviews with people living in the transmigration area of Sumatra, they experienced difficulties in managing this marginal land for planting agricultural crops when they first arrived at this location. However, they kept trying because they had no choice to survive. They have to choose shallow peat to be planted. Additionally, water management must be applied so that the agricultural crops are not submerged in water during the rainy season. The types of agricultural plants developed by the community vary widely, including pineapple, coconut, areca nut, corn, vegetables and fruits. Paludiculture practices for food production is a profitable opportunity to fulfill the community's daily needs. Initially, peatland management by the community was not carried out by draining the peatlands. However, along with the development of technology, knowledge and information, the community began to expand their land, not only on shallow peat, but also on deeper peat. Challenges arose when communities started to build canals to reduce standing water so that it could be planted. As a result, the peatlands in this area are increasingly subsiding and drying out during the dry season. The lack of tree vegetation has also reduced the ability of peatlands to store water which causes flooding during the rainy season. In conclusion, the management of peatlands wisely is needed so that the community's paludiculture practices can support food production. On the other hand, the sustainability of peatlands is also maintained.

Key words: challenges, community, opportunities, paludiculture, peatland

5.1.5 Peatland Management based on local wisdom in Giam Siak Kecil Landscape in Riau Province, Indonesia

Mulyadi*

**Yayasan Gambut, Indonesia*

Key words: rewetting, community fire patrol, Agroforestry, alternative livelihood options, Paludiculture

links: Kindly refer to official website Yayasan Gambut, https://www.yayasangambut.org/
Facebook: Yayasan Gambut https://web.facebook.com/YayasanGambut #peatmatters; #peatforlife; #peatland; #aseanpeat

5.1.6 Economic benefit on drained peatlands: a challenge for rewetting

Hidayat, Dian Charity*; Mendham, Daniel**; Sakuntaladewi, Niken*; Rahmanadi, Donny*; Rochmayanto, Yanto*; Ardhana, Adnan*

**National Research and Innovation Agency Indonesia; **CSIRO Australia*

The peatlands may definitely provide added economic value through nurseries, agriculture and plantations. It has become an obstacle to the rewetting programme, especially for deep peatlands on private land. In order to be accepted by the community, the rewetting programme should be able to replace the opportunity cost of the community that will potentially be lost. The paper intends to describe how much the economic benefits of deep peatland management by the community that will be lost by rewetting. The research was conducted in Tumbang Nusa Village, Jabiren Raya District, Pulang Pisau Regency from April 2019 to January 2020. The data were processed using descriptive qualitative and quantitative methods, as well as farming analysis. The results showed that the businesses affected by rewetting were nurseries using peat land as media, intercropping agriculture and small-scale oil palm plantations. The economic benefits that will be lost from the business are IDR 26,052,000, IDR 78,477,000 and IDR 12,017,000, respectively. From the three business activities, the most profitable business is intercropping farming which requires very intensive drainage.

Key words: drained - deep peatlands, rewetting, economic benefit

Session 5.2 Yield, water and nutrient dynamics

Session 5.2		Yield, water and nutrient dynamics
Stage		B
Time		10.03.2021 10:15-11:15
Moderator		Jürgen Kreyling
Talk:	1	High water tables promote fast biomass production and long-term nutrient removal in Sphagnum farming **Christian Fritz**
	2	Regulating alkalinity of water is a matter of life and death for Sphagnum farming **Adam Koks**
	3	How much can *Carex* sp. contribute to peat formation and to counteract eutrophication in fen peatlands under different nutrient levels? **Tjorven Hinzke**
	4	Effects of harvest and fertilization frequency on protein yield and extractability from flood-tolerant perennial grasses cultivated on a fen peatland **Claudia Nielsen**

5.2.1 High water tables promote fast biomass production and long-term nutrient removal in Sphagnum farming

Vroom, R.J.E.*; Fritz, C.*,****; Temmink, R.J.M.*; Krebs, M.**; van Dijk, G.***,*; Prager, A.**; Gaudig, G.**; Lamers, L.P.M.*; Joosten, H.**

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Peat moss cultivation (Sphagnum farming) is paludiculture on rewetted degraded bogs. Harvested *Sphagnum* biomass can be used as a renewable raw material for horticultural substrates, substituting fossil peat. Sphagnum farming allows the sustainable use of abandoned cut-over bogs and degraded bog grasslands, with benefits for climate change mitigation and biodiversity.

In this study, we investigate water quantity/quality, farm-scale nutrient dynamics and *Sphagnum* performance in the peatland Hankhauser Moor (NW-Germany). The site was developed on a former bog grassland in 2011 (4 ha) and expanded in 2016 (additional 10 ha). It comprises 10 m wide *Sphagnum* production fields surrounded by narrow ditches. After ca. 30 cm topsoil removal the site has been rewetted. The water table are synchronized with *Sphagnum* growth by automatic irrigation via ditches.

The ditches successfully irrigate the *Sphagnum* lawn over the entire production field of 10 m width, and thus directly promote high biomass production. Until harvest, biomass sequestered 1.6-2.0 t C ha-1 a-1. Experimental drought in 2020 (lowering ditch water levels) decreased productivity sharply, which was species dependent.

The infiltrating irrigation water is a substantial source of potassium and in particular of phosphorus. While large amounts of nitrogen are supplied by atmospheric deposition (ca. 22 kg N ha-1 a-1), mainly from agricultural surroundings, its concentration is low in pore water in the lawns and in the ditch water. An ammonium legacy persists in deeper peat layers of the 2016 site, but concentrations have lowered substantially within a year. Despite high N deposition we observed a high *Sphagnum* biomass productivity probably as a result of a balanced nutrient stoichiometry. We will discuss the interaction between *Sphagnum* crop species, nutrient availability and moisture supply based on 2020-field data.

Our study over eight years shows that successful Sphagnum farming can be persistently accomplished on former bog grassland using an adaptive surface water-fed irrigation system keeping pace with *Sphagnum* mosses that thrive under nutrient-rich conditions.

Key words: *Sphagnum*, water management, irrigation, nutrient removal, nutrient sequestration, phosphorus, nitrogen, carbon sequestration, Sphagnum farming, bog, drought, growing substrate, methane oxidation

5.2.2 **Regulating alkalinity of water is a matter of life and death for Sphagnum farming**

Koks, Adam*; Van Dijk, Gijs***; Fritz, Christian**; Van de Riet, Bas***; Smolders, Fons***; Lamers, Leon**

** B-WARE Research Centre, Nijmegen, The Netherlands; ** Aquatic Ecology and Environmental Biology, Radboud University, Nijmegen, The Netherlands; *** Both B-ware Research Centre and Aquatic Ecology and Environmental Biology, Radboud University, The Netherlands*

Key words: Sphagnum farming, cations, alkalinity, bicarbonate, water management

5.2.3 **How much can *Carex* sp. contribute to peat formation and to counteract eutrophication in fen peatlands under different nutrient levels?**

Hinzke, Tjorven*; Tanneberger, Franziska*; Aggenbach, Camiel[**,***]; Knorr, Klaus-Holger****; Kotowski, Wiktor[*****]; Kozub, Łukasz******; Lange, Jelena*; Li, Guixiang*****; Pronin, Eugeniusz*****,*******; Seeber, Elke*; Wichtmann, Wendelin*; Kreyling, Juergen*

**University of Greifswald, Institute of Botany and Landscape Ecology, Partner in the Greifswald Mire Centre; **Ecosystem Management Research Group, Department of Biology, University of Antwerp, Belgium; ***KWR Water Research Institute, Nieuwegein, The Netherlands; ****Ecohydrology & Biogeochemistry Group, Institute of Landscape Ecology, University of Münster, Germany; *****Department of Ecology and Environmental Conservation, Institute of Environmental Biology, Faculty of Biology, University of Warsaw, Poland; ******Institut of Environmental Biology, Faculty of Biology, Adam Mickiewicz University, Poznań, Poland*

Carex species are main peat forming plants in ground- and surface-water-fed temperate peatlands (fens). Fens not only comprise natural nutrient gradients, but also face eutrophication from atmospheric sources and their catchment areas, as well as in the course of drainage and rewetting. Such increased nutrient levels potentially impact *Carex* biomass production and decomposition, and thereby peat formation and carbon sequestration. Likewise, fen nutrient levels likely influence nutrient storage in *Carex* above- and below-ground tissues and thus the nutrients removable by harvest and sequestered in peat. To assess and quantify the contribution of *Carex* to the main ecosystem functions of peat formation and nutrient retention in fens, controlled experiments are necessary.

Here, we investigated how different levels of nutrients, i.e., nitrogen and phosphorous, influence production and decomposition of above- and below-ground *Carex* biomass, as well as nutrient storage in *Carex* shoots and roots. For that, we cultured five different *Carex* species with different realized ecological niches concerning nutrient availability under 12 different nitrogen and phosphorous levels, chosen to represent low to high natural nutrient levels in fens.

According to our results, increased production of *Carex* biomass at high nutrient levels is not matched by increases in decomposition. Following from this, the *Carex* peat formation potential, i.e., the root biomass produced and not decomposed within one growing season, actually increases with increasing nutrient levels, as suggested by our study. Additionally, we show that *Carex* sp. have the potential to remove nutrients from fens, with up to one third of all available nitrogen removable by harvest of above-ground biomass even at high nutrient levels. Based on our study, we suggest that *Carex* can form peat even in highly eutrophied rewetted fens, and that harvest of *Carex* above-ground biomass can be an efficient remedy to counteract anthropogenic eutrophication.

Key words: paludiculture, ecosystem restoration, nitrogen, phosphorous, root recalcitrance, decomposition

5.2.4 **Effects of harvest and fertilization frequency on protein yield and extractability from flood-tolerant perennial grasses cultivated on a fen peatland**

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Paludiculture, and in particular the cultivation of perennial grasses as biomass feedstock for green biorefineries, may be an economic and environmentally sustainable option for agricultural peatlands in temperate regions. However, the optimal biomass quality for protein extraction from flood-tolerant grasses is largely unknown. The aim of this study was to define the effect of harvest and fertilisation frequency (once to five-times annually) on protein yield and extractability for the perennial grasses reed canary grass (RCG) and tall fescue (TF), cultivated on an agricultural fen peatland. The content of protein fractions was determined according to the Cornell Net Carbohydrate and Protein System (CNCPS). Protein extractability was assessed by lab-scale biorefinery techniques using a screw-press followed by acid precipitation of true protein. Both analyses were compared to correlate potential extractable protein yields with actual biorefinery protein outputs.
Total annual crude protein (CP) yield was highest in two cut treatments, with CP yields of 3.4 (± 1.6) t dry matter (DM) ha^{-1} yr^{-1} and 2.9 (± 0.9) t DM ha^{-1} yr^{-1} for RCG and TF, respectively. The highest neutral-extractable true protein (fractions B1 and B2) yield, according to the CNCPS method, was found in the two cut treatments with 1.5 (± 0.3) t DM ha^{-1} yr^{-1} (44.5 % of total CP), and 1.1 (± 0.2) t DM ha^{-1} yr^{-1} (38.8 % of total CP) for RCG and TF, respectively. Using biorefining techniques were up to 38 % of CP precipitated, resulting in between 1.0 – 2.2 t DM ha^{-1} yr^{-1} of extracted protein concentrate, with the highest yield obtained from RCG with four cuts annually.
No significant improvement regarding annual biomass and protein yields was observed with more than two annual cuts. The yields have shown to be competitive to the obtainable DM and CP yields from legume species cultivated on mineral soil. Given the high biomass as well as protein concentrate yields, we conclude that paludiculture crops such as reed canary grass and tall fescue are promising candidates to open novel and feasible pathways as feedstock for value-added product chains from wet agricultural peatlands with enhanced valorisation beyond the utilisation for bioenergy.

Key words: biorefinery, crude protein, paludiculture, plant fractionation, reed canary grass, tall fescue

Session 5.3 Regional and national transition of peatland use & socio-economics

Session 5.3		**Regional and national transition of peatland use & socio-economics**
Stage		**C**
Time		**10.03.2021 10:15-11:15**
Moderator		**Jan Peters**
Talk:	**1**	Towards net zero CO_2 in 2050: An emission reduction pathway for organic soils in Germany **Franziska Tanneberger**
	2	Will Dutch water management strategies result in a transition of peatland use? **Henk van Hardeveld**
	3	Great Fen Paludiculture trials **Kate Carver**
	4	GrasGoed (GrassGood) – Wetlands as part of a circular economy **Katrien Wijns**

5.3.1 Towards net zero CO_2 in 2050: An emission reduction pathway for organic soils in Germany

Tanneberger, F.*; Abel, S.*, **; Couwenberg, J.*; Dahms; T.*; Gaudig, G.*, **; Günther, A.***; Kreyling, J.*; Peters, J.**; Pongratz, J.****; Joosten, H.*

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The Paris Agreement reflects the global endeavour to limit the increase of global average temperature to 2°C, better 1.5°C above pre-industrial levels to prevent dangerous climate change. This requires that global anthropogenic net carbon dioxide (CO_2) emissions are reduced to zero around 2050. The German Climate Protection Plan substantiates this goal and explicitly mentions peatlands, which make up 5% of the total area under land use and emit 5.7% of total German annual greenhouse gas emissions. Based on inventory reporting and assumptions of land use change probability, we have developed emission reduction pathways for organic soils in Germany that on a national level comply with the IPCC 1.5°C pathways. The more gradual pathway 1 requires the following interim (2030, 2040) and ultimate (2050) milestones: Cropland use stopped and all Cropland converted to Grassland by 2030; Water tables raised to the soil surface on 15%/60%/100% of all Grassland, on 50%/75%/100% of all Forest land, and ultimately on 2/3 of all Settlements and on 100% of all Wetlands. Also a more direct pathway 2 without interim 'moist' water tables and the climate effect (radiative forcing) of different scenarios is presented and discussed.

Key words: emission reduction pathways, organic soils, GHG emissions

5.3.2 Will Dutch water management strategies result in a transition of peatland use?

van Hardeveld, Henk *; Westenend, Joris*

**Waternet, The Netherlands*

The Dutch peatlands require more sustainable management strategies, to prevent continuing soil subsidence and the accompanying emission of greenhouse gasses. Because top-down strategies of large-scale rewetting have met with fierce resistance in the past, current strategies focus on more gradual changes. Surface water levels are no longer periodically lowered to cope with soil subsidence, resulting in progressively wetter conditions. When these changed conditions result in a Net Value Added for paludiculture that exceeds the Net Value Added of dairy farming, it is believed that farmers will voluntarily change their land use. However, it is unclear if the pace of this gradual strategy is fast enough to achieve a marked reduction of greenhouse gas emissions in the next decades. Therefore, we used the RE:PEAT tool to assess the impacts of water management strategies during 2020–2100 in Polder de Ronde Hoep, a peatland polder of nearly 11.9 km^2 near Amsterdam shaped like a round hoop. We found that progressively higher water levels will have minor impacts until 2050, with a 20% reduction of greenhouse gas emissions. The reduction of the average agricultural Net Value Added was € 150–200 ha^{-1} yr^{-1}, which results in a transition to paludiculture in 3% of the polder. Changes were more prominent during 2050–2100, with 40% reduction of greenhouse gas emissions and a transition to paludiculture in 70–75% of the polder. A large-scale raise of the water levels was shown to result in a 50–65% reduction of greenhouse gas emissions and a transition to paludiculture in 95% of the polder in 2100. Because the polder is shaped like a bathtub, a further reduction of greenhouse gas emissions would require large investments in water management infrastructure, to achieve optimal water levels throughout the entire polder. We believe the results show that paludiculture can be an important component of strategies for a transition of peatland use, especially if the Net Value Added is supplemented by payments for the ecosystem service of carbon sequestration. However, to achieve a transition in the upcoming decades, a gradual raise of water levels will not suffice. Moreover, complementary measures will be needed for sustainable peatland use throughout the entire polder. The next step is to use the RE:PEAT tool to explore options for a collective implementation of adaptive management strategies for the next decades.

Key words: water management, impact assessment, adaptation strategies

5.3.3 **Great Fen Paludiculture trials**

Clough, Jack*; Carver, Kate**; Parker, Lorna**; Morrisson, Ross***
**University of East London; **Wildlife Trust BCN/Great Fen Project; ***UK Centre for Ecology and Hydrology, Great Britain*

Most remaining peat soils within the East Anglian Fens, U.K. are cultivated conventionally. A transition towards long term sustainable land use in the region is needed. The adoption of paludiculture will contribute to this transition. The Water Works project aims to introduce the concept of paludiculture in the East Anglian Fens by showcasing paludiculture crops on a demonstration site and ensuring wide stakeholder engagement. The project is built on partnerships between the Wildlife Trust BCN (project lead and landowner), University of East London, UK Centre for Ecology and Hydrology (Academic partners) and Cambridgeshire Acre (Community development partners) and is funded by the Peoples Postcode Lottery. A 5 ha paludiculture demonstration site has been constructed at the Great Fen project, Peterborough, U.K. The demonstration site consists of 10 bunded compartments, a water control system and a water storage area. The demonstration plots contain 4 main crops: bulrush (*Typha latifolia*), common reed (*Phragmites australis*) sweet manna grass (*Glyceria fluitans*) and *Sphagnum* moss (*Sphagnum* spp.). 11 "novel" fenland species with historical use and future potential will also be trialled. The project has progressed well: construction is complete, planting is underway and wider stakeholder engagement is ongoing. Key challenges for the project involved developing a demonstration site during the Covid-19 pandemic and securing the appropriate permissions or consents for a new land use alien to the region. Scientific data such as greenhouse gas balance and crop yields are at an early stage. However, the key finding of the work so far is that a high level of enthusiasm for the project exists across a wide range of stakeholders. Stakeholders range from Government bodies to farmers in the Fens, their enthusiasm provides confidence that paludiculture may one day be widely accepted within the U.K.

5.3.4 GrasGoed (GrassGood) – Wetlands as part of a circular economy

Wijns, Katrien*
Natuurpunt, The Netherlands

'GrasGoed' is an Interreg crossborder project that ran from August 2016 to March 2020. It allowed nature managers, companies, and knowledge institutes in the border region between Flanders and the Netherlands, to explore the possibility to process grass clippings into sustainable biobased products.
Grass clippings from managed wetlands (such as reedland, wet heathland, peatland, etc.), are often seen as a waste product. That is unfortunate, because thousands of tons of clippings are released every year. It is difficult to remove the clippings from these wet areas. Moreover, dumping them is very expensive. 'GrasGoed' aimed to create a circular economy by using clippings as raw material. Within the project we focused on the entire value chain from mowing a wetland, transporting and refining grass clipping to establishing a sustainable product and introducing it to the market. Where possible we tried to improve the value chain by adjusting mowing machines, transportation and processing machinery. For example one machine was further sophisticated so it was able to break down the cell structures of the grass and separate it into fibres, proteins, and other cell fluids. From these semi-manufactures we developed new, regional products. Some examples are paper and insulation from grass fibres. Prototypes of these products were showcased and introduced to the market, on a small scale. Also, the environmental impacts of these biobased products were compared to the impacts of its conventional alternatives in a Life Cycle Analyses (LCA).
Natuurpunt is a voluntary organisation that protects and manages nature areas in Flanders. With over 100,000 members and thousands of active volunteers, we are the largest wildlife association in the country. Natuurpunt manages approximately 24,000 hectares of nature reserve, studies species and habitats, raises awareness and runs educational programmes. The nature organisation produces large quantities of grass clippings in its nature reserves every year. The clippings often lie on hard-to-reach and wet areas.

Key words: wetlands, grass clippings, circular economy, value chain, biobase

Session 6.1 Finance options for livelihoods from wet peatlands (co-organised with FAO, UNEP, IUCN, WWF)

Session 6.1		**Finance options for livelihoods from wet peatlands (co-organised with FAO, UNEP, IUCN, WWF)**
Stage		**A**
Time		**10.03.2021 11:30-12:30: The lectures listed here are intended as impulse presentations that do not follow a specific time schedule**
Moderator		**Maria Nuutinen**
Talk:	**1**	Results of the peatland management sessions, case and global consultations **Maria Nuutinen & Laura Villegas**
	2	Sustainable Land Use Finance – inspiring investment in Peatlands **Diana Kopansky**
	3	Landscape finance: emerging models for financing peatland restoration at scale **Paul Chatterton**
	4	Investing in peatlands – from bankers to bogs **Clifton Bain, Emma Goodyer & Renée Kerkvliet Hermans**

6.1.1 Joint session "Finance options for livelihoods from wet peatlands"

Co-organised by the partners of the Greifswald Mire Centre, FAO, UNEP, IUCN and WWF

Management of peatlands in wet state and the development of livelihoods in these landscapes present both a challenge and a great opportunity for local economies and for achieving national climate commitments. Improvements to peatland management and development of sustainable livelihoods are lacking financial instruments and incentives. Various stakeholders are searching for funding that could help communities to be more resilient and build back better in peatland landscapes. The session will focus on sharing examples of successful resource mobilization for developing sustainable livelihoods in wet peatland landscapes. The event lists and presents available options to close the financial gap for scaling-up sustainable peatland management.

Expert organizations will elaborate on the question: what are potential and existing finance frameworks and mechanisms available for wet livelihood development on peatland landscapes? The solutions will focus on (i) donor schemes and fiscal incentives, (ii) ecosystem services capitalization, and (iii) private sector investment and business case development. In this joint event, FAO and partners will discuss opportunities to build the business case for restoration, paludiculture and other livelihood options in wet peatland landscapes. The results of this session aim at supporting various stakeholders with the will to develop wet livelihoods on peatland landscapes and lacking resources.

Food and Agriculture Organization of the United Nations | UN environment programme | Global Peatlands Initiative | IUCN | WWF | GREIFSWALD MIRE CENTRE

Session 6.2 Yield, water and nutrient dynamics

Session 6.2		Yield, water and nutrient dynamics
Stage		B
Time		10.03.2021 11:30-12:30
Moderator		Jürgen Kreyling
Talk:	1	Plant selection for paludiculture: water and nutrient level optima differ among *Typha* species **Kerstin Haldan**
	2	Biomass utilization avenues and nutrient removal potential of Paludiculture crops *Phragmites* and *Typha* depend on harvesting season **Christian Fritz**
	3	The impact of wetland restoration on water retention in the catchment scale in the Neman basin – costs and benefits **Marta Stachowicz**
Poster:	A	DESIRE: Development of Sustainable peatland management by restoration and paludiculture for nutrient retention and other ecosystem services in the Neman river catchment. **Marina Abramchuk**
	B	Growth development of selected paludicultures in mesocosms **Doreen Koltermann**

6.2.1 Plant selection for paludiculture: water and nutrient level optima differ among *Typha* specie

Haldan, Kerstin L.*, Köhn, Nora*; Hornig, Anja*; Schade, Lisa*; Kreyling, Jürgen*

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AIM: We aimed to reveal growth, productivity and fitness patterns of *Typha latifolia* and *Typha angustifolia* along gradients of nutrient and water availability, enabling us to give recommendations for species selection regarding field conditions.
MATERIALS AND METHODS: We conducted a mesocosm experiment at Greifswald University. The native species *T. latifolia* and *T. angustifolia* were grown in (A) a gradient of 15 water levels (40 cm aboveground to 45 cm belowground), and (B) a gradient of 15 levels of nutrient availability, (3.6 kg N ha-1 yr-1 to 400 kg N ha-1 yr-1). We recorded growth, above- and belowground biomass and photosynthesis.
RESULTS: Under most tested nutrient and water conditions, *T. latifolia* had a higher above- and belowground productivity than *T. angustifolia*. Only under extreme conditions (high water table, lowest and highest nutrient availability) productivity of both species was similar.
An optimum of productivity can be observed at intermediate nutrient levels (35 kg N ha-1 yr-1) for *T. latifolia* and at a lower nutrient availability (10 – 15 kg N ha-1 yr-1) for *T. angustifolia*. The same trend can be found regarding maximum height of plants and shoot number.
While productivity of *T. angustifolia* did not change significantly over the water level gradient, *T. latifolia* showed an optimal productivity at water levels below the surface, where it also had a greater maximum height than *T. angustifolia*. *T. latifolia* produced more shoots than *T. angustifolia* under all water levels.
Mean photosynthetic performance was higher in *T. latifolia* than in *T. angustifolia* in all levels and no clear trend could be observed along the two gradients.
CONCLUSION: Our findings demonstrate that potential paludiculture species can show different response patterns to two of the most influential environmental conditions, nutrient and water availability,

regarding their productivity. This highlights the importance of selecting paludiculture species not only for the intended biomass use but also for given field conditions.

Key words: *Typha*, Mesocosm experiment, Nutrients, Water level, Gradient experiment

6.2.2 Biomass utilization avenues and nutrient removal potential of Paludiculture crops ***Phragmites*** and ***Typha*** depend on harvesting season

Geurts, J.*; Fritz, C.*; Oehmke, Claudia**; Lambertini, Carla ***,****; Eller, Franziska****; Sorrel, Brian K.****; Mandiola, Samuel R.*****; Grootjans, Albert P.*****; Brix, Hans****; Wichtmann, Wendelin**; Lamers, Leon P.M.*; Smolders, Alfons J.P.*

**Radboud University Nijmegen, The Netherlands; **University of Greifswald, Institute of Botany and Landscape Ecology, Partner in the Greifswald Mire Centre, Germany; ***University of Bologna, Italy; ****Aarhus University, Department of Bioscience, Denmark; *****University of Groningen, The Netherlands*

INTRODUCTION: Paludiculture, sustainable and climate-smart land use of formerly drained, rewetted organic soils, can produce significant biomass in peatlands whilst potentially restoring ecosystem system services. However, the effects harvesting date on biomass quality and nutrient removal potential by Paludiculture have rarely been studied.
MATERIAS AND METHODS: We studied the relationship between harvesting period and plant-available nutrients, biomass yields, biomass utilization potential and nutrient removal potential for two important paludiculture species, *Typha latifolia* and *Phragmites australis*, on rewetted peat and mineral soils in a large-scale European survey.
RESULTS: *T. latifolia* and *P. australis* high biomass production rates 10–30 t dry matter ha−1 y−1 and absorbed significant amounts of carbon, nitrogen, phosphorus, and potassium in stands older than 3 years. Summer biomass produced substantial protein yields and was exploitable for forage and to some degree for human consumption.
Low N:P ratios (5–9) and low N content (< 2%) in *T. latifolia* tissue suggest N limitation, but P uptake was still surprisingly high. *P. australis* had higher N:P ratios (8–25) and was less responsive to nutrients, suggesting a higher nutrient use efficiency. However, both species could still produce significant biomass at lower nutrient loads and in winter, when water content of biomass was lower and nutrient removal still reasonable. Winter biomass was favorable for building material and fiber usages such as growing material replacing fossil peat for potting soil.
CONCLUSION: Paludicrops take up substantial amounts of nutrients, and both summer and winter harvests provide an effective way to sequester carbon in a range of high-valued biomass products and to control nutrient effluxes from rewetted sites at the landscape scale. Food utilization avenues focusing on protein and fiber extraction warrant further investigation.

Key words: paludicrops, carbon sequestration, protein yields, human consumption, fodder, dairy farming, roughage, growing substrate, carbon sequestration, nitrogen, phosphorus removal, water table management, winter harvest

6.2.3 The impact of wetland restoration on water retention in the catchment scale in the Neman basin – costs and benefits

Stachowicz, Marta*; Manton, Michael**; Zableckis, Nerijus***; Kamocki, Andrzej****; Samerkhanova, Amalj*****; Wichtmann, Wendelin******; Grygoruk, Mateusz*

Warsaw University of Life Sciences, Poland; **Vitautas Magnus University, Kaunas, Lithuania;*Lietuvos Gamtos Fondas, Lithuania; ****Bialystok University of Technology, Poland; *****Nature Park "Vishtynetsky", Kaliningrad, Russia; ******University of Greifswald, Institute of Botany and Landscape Ecology, Partner in the Greifswald Mire Centre, Germany*

There is an ongoing debate on the cost-effectiveness of wetland restoration and the impact of these measures on recovering wetland functions. The aim of this study was to quantify water retention that can be gained from restoration of peatlands in the Neman catchment which is a precondition for the provision of ecosystem services like greenhouse gas emissions reduction, for biodiversity and/or for changing to paludiculture. Another goal is to estimate possible economic benefit resulting from these measures. In the study, we analyzed extensive peatland database and applied the scenario of rewetting drained peatlands through blocking the drainage ditches existing within their boundaries with dams. We estimated the costs of restoration in order to obtain net water retention value. It was found that the restoration of drained peatlands in the Neman catchment could increase catchment retention by 253.5 M m^3 of water, which corresponds to 1.5% of the total annual Neman discharge. The calculated possible net water retention value is 123.5 M EUR $year^{-1}$. We revealed that the potential economic benefit from retained water due to rewetting drained peatlands in the research area exceeds 12 times the costs of restoration. The results from cost-benefit analysis indicate that the costs incurred for the restoration of wetlands in the Neman catchment are an investment for the future, especially that the benefits from other ecosystem services of wetlands were not included in the calculations. However, the results are estimates and due to the data quality and adopted assumptions, they may be subject to error. An in-depth analysis and assessment of long-term effectiveness of restoration of wetlands is necessary to obtain more accurate results and develop proper plans for restoration and change of landuse to paludiculture.

Key words: wetlands, peatlands, ecosystem services, water retention, restoration

6.2.4 DESIRE: Development of Sustainable peatland management by restoration and paludiculture for nutrient retention and other ecosystem services in the Neman river catchment.

Abramchuk, Marina*, Wichtmann, Wendelin*, **; Manton, Michael***; Zableckis, Nerijus****; Samerkhanova, Amalj*****; Banaszuk, Piotr ******, Grygoruk, Mateusz*******, Wilk, Tomasz********

Succow Foundation, partner in the Greifswald Mire Centre; **Greifswald University, partner in the Greifswald Mire Centre, Germany; ***Kaunas University, Lithuania; ** Lithuanian Fund for Nature, Vilnius, Lithuania; *****Nature Park Nature park "Vishtynetsky", Kaliningrad, Russia; ******Bialystok University of Technology, Poland; *******Warsaw University of Life Sciences, Poland; ********Polish Society for the Protection of Birds, Poland*

The project „DESIRE“ is supported by the Interreg Baltic Sea Region Programme 2014-2020 for the period 1/2019 – 12/2021. The challenge of the project „DESIRE“ is the improvement of peatland management in the Neman catchment. The Neman river is the forth largest river in the catchment area of the Baltic Sea. The project comprises a mixed approach of drafting policy recommendations, generating new knowledge via modelling, and using pilot sites to demonstrate peatland rewetting and implementation of paludiculture. The project aims at increasing the capacity of decision makers to adopt policies that incentivise peatland management for nutrient retention via enhanced institutionalised knowledge and competence and more efficient use of human and technical resources. Rewetting stops, inter alia, further soil degradation, decreases uncontrolled water run-off, strongly reduces nutrient- and GHG emissions and is good for biodiversity. DESIRE focuses on numerous disturbed peatlands in the Neman catchment and will exemplarily restore some of them to act as wetland buffer zones. The ability of rewetted peatlands to catch nutrients will be enhanced with innovative land use practices (paludiculture). Demonstration sites for paludiculture are implemented in Lithuania and Kalingrad region. Specific policy instruments like river basin management plans and agri-environmental schemes are analysed and adapted or newly developed within the project to provide instruments and incentives for stakeholders to implement measures following the project's pilot examples, joined by economic investigations. Water quality in the Neman basin will benefit by (1) reduction of nutrient loads from diffuse sources in the catchment area (mainly arable lands) and (2) preventing peatlands to act as nutrient sources and internal-external eutrophication hot spots.

Key words: rewetting, modelling, policy instruments, buffer zones, nutrient retention
Link:https://www.greifswaldmoor.de/files/dokumente/Infopapiere_Briefings/2021_factsheet_Wetland%20buffer%20zones_final.pdf

6.2.5 Growth development of selected paludicultures in mesocosms

Koltermann, Doreen*; Schwarz, Kai-Uwe*; Langhof, Maren*; Greef, Jörg-Michael*
Federal Research Centre for Cultivated Plants, Institute of Crop and Soil Science, Germany

As part of a joint project (Product chains made from fen biomass, funded by EFRE), one aspect is the investigation of the growth characteristics of the paludiculture plants *Phalaris arundinacea*, *Phragmites australis*, *Typha angustifolia*, and *Typha latifolia* in mesocosms using 1000 liters Intermediate Bulk Container (IBC) filled with peat substrate from fen. The three-years trials are divided into the establishment phase (part 1) in the first year (2020) and the plant development phase at different water levels (part 2) in the following two years. During the establishment phase, the focus is on the plant density with one, three, and six plants per m². From the second year, we investigate the effects of three different water levels with three replications: 10 cm above the soil surface, at the soil surface, 10 cm below the soil surface. We examine the influence of the plant density (part1) or the water levels (part 2) on plant growth characteristics, e.g. the number of shoots per m^2, plant height, and biomass yield. So far, the first data indicate that the plant density influences the development of the individual plants. Differences between the plant species were observed. The first results will be available by the end of the year 2020. In February/March 2021, biomass yield is determined and evaluated.

Key words: *Thypha*, *Phragmites*, *Phalaris*, mesocosm, fen, growth characteristics, biomass
link: https://www.3-n.info/projekte/laufende-projekte/produktketten-aus-niedermoorbiomasse/

Session 6.3 Regional and national transition of peatland use & socio-economics

Session 6.3		Regional and national transition of peatland use & socio-economics
Stage		C
Time		10.03.2021 11:30-12:30
Moderator		Jan Peters
Talk:	1	Abatement costs of climate friendly peatland management options for agriculture: case study results for two German peatland regions **Christoph Buschmann**
	2	Cost-effectiveness of measures to mitigate greenhouse gas emissions from drained peatlands **Ralph Temmink**
	3	Economic viability of Sphagnum farming on former bog grassland **Sabine Wichmann**
Poster:	A	Efficiency of cattail establishment on an eight-hectare fen sites in terms of working time and manpower requirements **Telse Vogel**
	B	Implementation of single-farm optimized wet grassland management on organic soils **Franz Wenzl**
	C	The climate friendly management of the agricultural peatlands in Brandenburg **Bas Spanjers**

6.3.1 Abatement costs of climate friendly peatland management options for agriculture: case study results for two German peatland regions

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**Thuenen Institute Coordination Unit Climate Protection, Braunschweig, Germany*

Our work investigates the change in farms' income situations when converting part of their drained peatland to more climate friendly extensive use (grassland used as forage area of conventional farms) or set-aside with higher water levels (target level in summer of 10-30 cm below ground).
The analysis of the status quo situation is based on farm data from 15 typical farmers cultivating organic soils in two German peatland regions with very different agricultural structures; firstly, the Rhinluch in Brandenburg with mainly large (Ø 2000 ha) mixed farms; secondly, the Eider Treene Sorge area in Schleswig-Holstein with smaller farms (Ø 200 ha) that are predominantly grassland based. In addition, we carry out grassland monitoring at various sites to estimate forage quality and quantity at different water levels and intensities of grassland use. Forage parameters for target areas (summer water level of 10-30 cm below ground) are derived from data of extensively used areas and assumptions on water level induced changes. Data on CO_2 emissions at different water levels we take from literature and German emission accounting.
For farm business modelling we apply an adapted version of the linear programming model Farm Boss. The model is based on an extensive database allowing a detailed coverage of technologies regarding costs, labor and products. The adapted version provides for a differentiation between mineral and organic soils, for example with regard to fertilizer application and forage quantity and quality.
Results will show farm level effects of increasing extensification of peatland areas for different farm types. This includes especially the associated loss of fodder quantity and quality. We will show possible farm adaptation reactions (different crop rotations or changes in livestock management) and calculate the changes in income. Finally, the results will show greenhouse gas abatement costs of extensification for different farm types in a static view as well as in a dynamic view with interannual harvest fluctuations. We will conclude how high farmers' expectations for financial compensation will at least be, so that they

voluntarily implement peatland protection measures, and we will show which agricultural business models are possible in this context.

Key words: abatement costs, extensive grassland management, linear programming farm model

6.3.2 Cost-effectiveness of measures to mitigate greenhouse gas emissions from drained peatlands

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Drainage and intensive use of peatlands can negatively affect the environment. Continuous drainage leads to high carbon dioxide emissions, soil subsidence, downstream eutrophication and the loss of typical biodiversity. Fortunately, many mitigation measures are available to reduce or halt these detrimental environmental effects. However, it is often unclear what their investment costs and cost-effectiveness related to greenhouse gas (GHG) emissions mitigation are (cost-effectiveness for brevity). In our study, we determined this for several mitigation measures for drained peatlands. These measures are diverse and range from different forms of paludiculture to sand additions to subsurface drainage. To gain insight in the variation of investment costs of each measure, we created three costs scenarios – low, medium and high. For these scenarios, assumptions for land-use change and material costs differ. Next, we performed a literature study to determine for each mitigation measure their GHG-reduction potential (hectare required to reduce 1 ton CO_2-eq yr^{-1}) and then calculated their cost-effectiveness. Our results demonstrate that the costs of most mitigation measures are well below € 10.000 per hectare. However, costs can differ substantially – factor 60 – between types of mitigation measures. Moreover, the costs for different scenarios for a specific measure can vary greatly. High investments in groundwork including sand/clay transport, high planting costs and creating hydrologically isolated fields (dams, irrigation) are usually resulting in increased costs. Consequently, the cost-effectiveness can vary substantially (more so for measures with 1-4 ton CO_2-eq ha^{-1} yr^{-1} reduction potential). Factors that significantly affects cost-effectiveness include size of pilot sites, after use intensity, water management and groundwork needed to create conditions required for the measure. Sites with high investments can target more ecosystem services than climate mitigation only. Benefits of water retention, flood control and biodiversity would need to be included in a large cost-benefit analysis. We argue that it is important to explore large-scale rewetting, use landscape heterogeneity as a factor to select mitigation measures and species to keep cost down.

Key words: rewetting, GHG mitigation, cost-effectiveness

6.3.3 Economic viability of Sphagnum farming on former bog grassland

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Sphagnum biomass has been acknowledged as high-value raw material for professional horticulture. While the qualitative competitiveness with peat has been shown, we examine the current competitiveness in price and discuss market prospects. Our calculations are based on 5-years of field experience on former bog grassland in North West Germany and anticipate costs and revenues for a total cultivation time of 20 years. Sensitivity analysis encompasses costs, yields, prices and the effect of public non-market payments. We found that the cultivated *Sphagnum* biomass cannot compete with current market prices of peat, whereas it is economically viable for orchid cultivation in case of medium to high *Sphagnum* productivity. Selling *Sphagnum* shoots as founder or "seeding" material is profitable even in pessimistic scenarios with high costs and low yields. Cost-covering prices for *Sphagnum* biomass substituting peat seem achievable, if end consumer pay a top up of 10 % for peat free cultivated plants. A commercial-scale implementation, an increasing market demand for renewable and setting climate targets for the agricultural and horticultural sectors will accelerate the development of Sphagnum farming as a profitable alternative to drainage-based peatland agriculture and peat extraction.

Key words: sustainable growing media, break-even price, sensitivity analysis
link: www.sphagnumfarming.com

6.3.4 Efficiency of cattail establishment on an eight-hectare fen site in terms of working time and manpower requirements

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At present there is very little practical experience, especially with the large-scale cultivation of cattail (*Typha* spec.). Therefore, the Federal Ministry of Food and Agriculture (BMEL) is funding the joint project "Putting Paludiculture into Practice": Integration - Management - Cultivation" (Paludi-PRIMA). The focus of the project is on the cultivation of cattail *(Typha angustifolia and Typha latifolia)* in an approx. 8-hectare practical trial.
Here, among other things, working time studies are carried out along the value chain of cattail cultivation. Working time studies are a prerequisite for the collection of data for planning work processes and calculating costs.
We performed time studies during the planting and sowing of cattail in the practical trial. Three establishment procedures have been studied:

(1) a planting with adapted technology (forestry machine) in September 2019
(2) and sowing by hand in June 2020
(3) and sowing by drone in June 2020

Planting required six times more man hours than sowing. However, in comparison to sowing, a higher establishment success can be expected with planting. The use of special technology could significantly reduce the man hours required (sowing by hand vs. sowing by drone), but also leads to higher investment costs.
Currently, there is a need for further research with regard to the applicability of the establishment procedures for cattail under consideration of the site conditions and for development of suitable techniques for the cultivation of cattail. Further working time studies are planned, in particular on harvesting and processing methods of cattail.

Key words: working time study, cattail cultivation, planting, sowing

6.3.5 Implementation of single-farm optimized wet grassland management on organic soils

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The aim of the project "Implementation of single-farm optimized wet grassland management on organic soils (BOGOS)" is the transfer of knowledge and experience towards a climate friendly and soil conserving, nature conservation compatible and climate change resistant agriculture of organic soils. For four farms in in Brandenburg, Germany, with significant areas of meadows and pastures on organic soils individual

solutions for an optimized management of the grassland are developed. For this transfer project it is essential that knowledge and experience from applied science and agricultural practitioners are being combined. It is also planned to gradually establish a network to provide space for acquisition of competencies, exchange of knowledge, experience and ideas on a regional and nationwide level.
First steps include evaluating the current management and the value chain of cooperating farms. The site conditions are analyzed on representative grassland sites by mapping parameters on moisture status, soil quality, plant stock, yield and plant nutrition. Additionally, a report on the melioration status and in some cases studies on parasite infestation of cattle are prepared. The results of these studies provide the basis for the next step: the participatory decision-making process between farmers, scientists and regional stakeholders. Alternative grassland management scenarios which are acceptable for the users are analyzed ecologically and economically in order to facilitate decision-making. This also includes the definition of implementation paths with regard to current funding possibilities. Finally, the implementation of alternative grassland management options is accompanied by consulting and monitoring.

Key words: grassland, agriculture, peatland, transfer
link: https://bogos-gruenlandnutzung.info/

6.3.6 The climate friendly management of the agricultural peatlands in Brandenburg

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In the federal state of Brandenburg in Germany, 121.000 ha of the 165.000 ha peatland are in agricultural use. These soils emit about 9% of the total GHG-emissions in Brandenburg. To prevent further peat degradation, Brandenburg wants to show that the management of agricultural peatlands can be profitable without draining the meadows. Different strategies to achieve this target were rolled out. The first strategy is the implementation of “peat-sustainable-water-regimes” in grassland of 10 cm below surface in winter and 40 cm in summer, or higher. For this strategy, a funding programme was initiated for farmers of € 387/ha/year. The second strategy is to support the investment of new or adapted technical equipment to maintain the wet peatlands without damaging the soil. For this strategy, an additional subsidy programme (ProMoor) was initiated, and workshops and events were organized. The third strategy is the establishment of paludicultures connected with the development of new markets.
The Rhinluch is the biggest remaining peatland area in Brandenburg. In cooperation with seven farmers and other stakeholders, alternatives for the conventional drained meadow management have been explored. In a demonstration area of about 300 ha, the different strategies will be implemented. All the farmers are going to apply for the “peat-sustainable-water-regimes” programme. Three farmers have purchased new lighter harvesting techniques already and the establishment of paludicultures with cattail, wet meadows (sedges), reed and canary grass is planned for the next 10 years. Initial consultation interviews with local utilization companies and organizations were done, to develop value-added chains for the biomass at regional level. Six monitoring wells were placed for hydrological analyses. After facing three dry years in Brandenburg, climate change seems to be the biggest challenge for rewetting the peatlands. Water infrastructural measures like installation of inlets and weirs are planned to rewet the demonstration area orderly.

Key words: rewetting, demonstration area, subsidy programme, stakeholder
link: www.moore.brandenburg.de (German only), https://youtu.be/uXnylnK9ydQ

Session 7.1 Case studies (South-east Asia)

Session 7.1		Case studies (South-east Asia)
Stage		A
Time		10.03.2021 14:30-15:30
Moderator		Faizal Parish
Talk:	1	Addressing fragile peat ecosystems for the livelihoods of rural communities: lessons from Indonesia **Niken Sakuntaladewi**
	2	*Calophyllum* spp.: An endemic species for restoring tropical peatlands in Indonesia **Mamat Rahmat**
	3	Stakeholder's role at field level towards tropical peatland restoration in South Sumatra, Indonesia **Bondan Winarno**
	4	Nature-based solution: A case study on community-based activities to safeguard peatlands in Pahang, Malaysia **Faizal Parish**

7.1.1 Addressing fragile peat ecosystems for the livelihoods of rural communities: lessons from Indonesia

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In the 1990's 1.5 million ha of peat-land was developed for agriculture in Pulang Pisau Regency, Central Kalimantan Province. While the peat was not well suited to agriculture, this development has left a legacy of seasonal disasters, fires in the dry season and floods in the rainy season. This degraded condition presents a serious challenge for people living on peatlands to survive. Fire control prior to 2015 focused on a strategy of suppression, which came at very high cost, and the results were not always very satisfactory. Additionally, there is not much that can be done to deal with flooding. After 2015, fire control was carried out more comprehensively, integrating fire prevention and suppression strategies, with commitments to restore damaged peatlands, as well as the implementation of a no-burning policy. However even with these measures in place, fires still occur, with the area of burned land continuing to increase until 2019. This paper discusses lessons that have been learned from the efforts of the Government of Indonesia to save peatlands from fires, while at the same time providing livelihoods for rural communities, and community reactions to environmental changes and peatland restoration policies. We explored the situation in the village of Tumbang Nusa, Central Kalimantan Province, which is one of the villages where peatlands burn frequently. This village has received assistance from the central and local governments, NGOs, and is often used as a research location. Data was collected from the government, NGO's, key villagers and village communities. Key findings were that: 1. environmental sustainability, food availability and cash income are all important issues to ensure survival of the community, 2. To ensure that peatland restoration is sustainable, it must be carried out in tandem with economic development and the capacity of the community to source food. 3. Successful peat restoration requires not just physical actions (blocking canals, planting trees suitable on peatlands), but needs to cover economic, social, institutional and policy aspects as well. 4. The village administrative unit is a key implementation partner that is needed to realize both environmental sustainability and development through peatland restoration.

Key words: peatland, fire, livelihood, Indonesia

7.1.2 *Calophyllum* spp.: An endemic species for restoring tropical peatlands in Indonesia

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Some species of *Calophyllum* spp. grow naturally on peatlands. Such species can contribute to sustainable use and production of seed oil with maintaining forests in the protected zone where prohibited tree felling, in peatland where limited potential tree resources and crop. Thus commercialization of products of seed oil of *Calophyllum* spp., which can grow in peatland will contribute to enhance livelihood improvement of local people in addition to forest protection and restoration in peatland. In such context, the study has conducted to collect information of existing resources of *Calophyllum* spp. in peatland as well as production and business potential of seed oil of *Calophyllum* spp. in the domestic market in Indonesia. The research was conducted through data collection from various literatures, field observations and interviews with key informants. Based on the results of the studies, we found 22 species of *Calophyllum* that grow on peat in Indonesia. Most of the species are endemic to peat, but there is one introduced from mineral soil, namely *Calophyllum inophyllum*. From a number of peat endemic *Calophyllum*, there are five species that can be selected for development in tropical peat revegetation, namely: *Calopyllum lanigerum, Calophyllum soulatri, Calophyllum sundaicum, Calophyllum tetrapterum*, and *Calophyllum teysmannii*. These types have relatively large fruit sizes, so they have the potential to be developed as a source of seed oil. The market for *Calophyllum* seed oil in Indonesia is very potential. Currently, there is an industry that absorbs *Calophyllum* seed oil and is still short of raw materials. Its main use is as raw material for liniment to treat skin diseases. In conclusion, referring to its ecological and marketing aspects, *Calophyllum* has great potential for revegetating peatlands and revitalizing people's livelihoods. However, a more in-depth study of the seed oil content is still needed

Key words: Bintangor, peat restoration, peat revegetation, Tamanu oil

7.1.3 Stakeholder's role at field level towards tropical peatland restoration in South Sumatra, Indonesia

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Degradation of peatlands in Indonesia, including in South Sumatra, continues to occur even though various ways have been made to reduce its degradation. Latest, the government has launched the peatland restoration programme in 2016 involving various stakeholders. This paper highlights the role of stakeholders at the field level concerning the peatland restoration programme. The Snowball sampling technique and in-depth interview with the stakeholder were applied to collect the data of this study. Peatland restoration is a new approach and a big agenda for all stakeholders in sustainable peatland management. Peatland Restoration Agency (PRA) as a national institution through local staff and local facilitator is the lead stakeholder in peatland restoration at the field level of South Sumatra. The works of PRA which are consisted of rewetting, revegetation and, revitalization of the livelihood, cooperate with the provincial government in implementing the programme. Another important stakeholder at the field level is the head of the village that has roles in the programme implementation by encouraging villagers to actively participate in peatland restoration. Support from other stakeholders such as corporate, local agricultural extension staff, local army, and police staff are needed in accelerating and monitoring the programme. Unfortunately, there is less involvement of stakeholders at the district level during the programme implementation. This is despite the fact that the government at the district level has

administrative authority over the area, including peatlands. Therefore, engaging the district level stakeholders to participate in the restoration programme is a necessity. All the stakeholders realize the importance of collaborative works and long-term programmes for the success of restoration but the conflict of interests among stakeholders remains the big challenge. Moreover, initiating the multi-stakeholder partnership and strengthening the capacity of the villager are requirements in the peatland restoration programme.

Key words: field level, restoration, stakeholder's role, tropical peatland

7.1.4 Nature based solution: A case study on community based activities to safeguard peatlands in Pahang, Malaysia

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**Global Environment Centre (GEC), Malaysia*

Degradation of South East Pahang Peatland Landscape (SEPPL) is due to existing abandoned logging canals and massive canal systems from plantations development. The peatland landscape has been degraded and contributing to greenhouse gas emission from its carbon rich peat ecosystem. The degradation is further worsen with multiple fire incidents due to its low water table, in particular during dry season. Started in 2018, a pilot programme initiated to engage and empower a local indigenous community staying within the landscape to rehabilitate the degraded peatland area. These community based activities are directly contributing to living of the community and thus in return the community assisting in protecting and conserving adjacent peat swamp forest from further degradation. Main approach introduced was to rewet the degraded peatland and provide alternative livelihood options link to nature based solutions. Construction of canal blockings to slow down water flow and raising water level, installation of water level markers in drains and signboards of Fire Danger Rating System (FDRS) to inform the community and trespassers on fire risk. In addition, community based patrolling programme has also been established to assist in monitoring the fire risk within and adjacent to the rehabilitated area. In order to continue the rehabilitation effort, a series of enrichment planting activities have been conducted at slow and limited natural regeneration area, by using wildings prepared from community nursery which generating income for the local, on top of apiculture and fishery to educate the community on importance of the peat ecosystem. Through the effort of this pilot project, it is successfully engaged multi-stakeholder from government, private sector and the local community in protecting and conserving the SEPPL. The programme has rewetted a total of 1,700ha within the landscape and there has been no fire outbreak reported for almost 2 years.

Key words: rewetting, community based patrolling, enrichment planting, early warning systems, alternative livelihood options

link: The official Global Environment Centre (GEC) website:
https://www.gec.org.my/index.cfm?&menuid=334
Facebook: Peatlands in Southeast Asia: https://www.facebook.com/ASEANpeat

Session 7.2 Framework conditions and policy support

Session 7.2		Framework conditions and policy support
Stage		B
Time		10.03.2021 14:30-15:30
Moderator		Stefan Ewert
Talk:	1	Instruments for climate-friendly peatland use: Peatland protection in the EU-Common Agricultural Policy **Moritz Stüber**
	2	Incentive based policy instruments guiding towards sustainable use of peatlands in EU **Cheng Chen**
	3	Incentives for paludicultures to achieve the climate target 2030 and 2050 **Achim Schäfer**
Poster:	A	Vorpommern - Ready to rewet? **Monika Hohlbein**
	B	Certification of products from paludiculture: project design, potential, open questions, challenges **Wendelin Wichtmann**

7.2.1 Instruments for climate-friendly peatland use: Peatland protection in the EU-Common Agricultural Policy

Hirschelmann, Sophie*; Raschke, Isabell**; Stüber, Moritz**; Wichmann, Sabine***; Peters, Jan***
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The ambivalent role of agriculturally used peatlands for climate protection is gaining more and more attention at policy level. A number of funding schemes provide support for the transition from drainage-based agriculture to peat-preserving land use. Among them, the EU Common Agricultural Policy (CAP) plays a key role. We compiled and analysed the experiences and findings of involved experts, i.e. representatives of ministries and administrations of the German federal states, on the implementation of German and European funding schemes relevant for the agricultural use of peatlands, presenting recommendations for their future design for peat soil protection on agricultural land. Raising water levels to soil surface remains the most effective way to reduce greenhouse gas emissions from peatlands. So far, successful examples of rewetting mostly relate to conservation-focused projects, which lead to the abandonment of land use. However, land uses still possible after rewetting like wet meadow management (e.g. grazing) and paludiculture need to be upscaled, to address larger areas under agricultural use. Such pioneering work comes along with the conversion of farms and production, land value loss and high investment costs. Thus, funding is required that covers all three phases of implementation (preparation, area-related measures, biomass processing). Funding for accompanying measures, e.g. advisory services or cooperative approaches, is essential to support farmers during the transition. The use of the climate protection potential by rewetting and farming wet peatlands is impeded primarily by the current lack of eligibility of paludiculture for CAP direct payments, economic viability due to lacking prospects for biomass utilisation, short funding periods and water scarcity. The implementation of comprehensive legal regulations and funding instruments is necessary to take fully advantage of the climate protection potential of peatlands. Long-term funding programmes must be developed specifically aiming at the protection of peatlands, addressing all three phases of implementation with suitable, well-coordinated instruments. Farmers must be supported in every step of conversion, rewarded for provided environmental services, and recognised for their contribution to climate protection by managing peatlands climate-friendly.

Key words: policy instruments, CAP, framework conditions, peatland use, paludiculture, cross-farm cooperation
links: https://www.moorwissen.de/de/paludikultur/projekte/mokli/index.php
https://www.dvl.org/projekte/projektdetails/moor-und-klimaschutz-praxistaugliche-loesungen-mit-landnutzern-realisieren

7.2.2 Incentive based policy instruments guiding towards sustainable use of peatlands in EU

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The European Union (EU) is the second largest greenhouse gases (GHG) emitter from drained peatlands. The EU's climate target will not be achieved without reducing GHG emissions from drained peatlands. This will involve significant changes in agricultural production conditions. Despite increasing concerns about the sustainable use of peatlands, there is a lack of assessments of policies steering mitigation measures in peatlands at different governance levels and sectors. In this paper, we aim to understand the institutional setting of such policies in the EU multilevel governance structure, i.e. how are policies adopted by the EU, its member states and at the local level to incentivize climate smart agriculture? Agri-Environment-Climate Measures (AECM) under the EU Common Agricultural Policy (CAP) are the policy in our focus, as they seem well suited to prescribe the new direction for climate mitigation measures in agricultural policy and complementary governmental schemes. For our analysis we build on the concept of Multi-Level Governance (MLG). Our study follows a case study approach by comparing AECMs in three peatland rich countries in the EU: Germany, Netherland and Finland. We reviewed relevant scientific literature and policy documents on sustainable peatland management and conducted semi-structured expert interviews with policy makers, scientists, civil society representatives. The documents and interviews were analysed through a content analysis, focusing on factors influencing the implementation of incentive-based policy to support sustainable peatland management. We highlight trade-offs and synergies between different governmental and sectoral policies regarding peatland use. We reveal the importance of economic incentives in steering farmer's land use – only if revenues are sufficient, there is a willingness to try new alternatives. This calls for a cross-sector alignment of incentive schemes. At the same time drainage based agriculture should be phased out while introducing alternative incentives for the reduction of GHGs.

Key words: drained peatlands, policy, Common Agricultural Policy, governance
link: https://www.eragas.eu/en/eragas/Research-projects/PEATWISE.htm

7.2.3 Incentives for paludiculture to achieve the climate targets 2030 and 2050

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**DUENE, Partner in the Greifswald Mire Centre; ** Michael Succow Foundation, Partner in the Greifswald Mire Centre, Greifswald, Germany*

According to the German government's Climate Protection Plan 2050, the land use sector (LULUCF) is to remain a net sink for greenhouse gases until 2030. Since the current projection report indicates that the target will not be achieved, more ambitious measures are required in Germany. Forestry will no longer be able to compensate for the GHG emissions from drained peatlands which are the largest source in the sector right now.
Large-scale rewetting of peatlands is required to maintain the LULUCF sector as net carbon sink. Furthermore, products made from paludiculture biomass can make an additional contribution to climate

protection by storing carbon (e.g. insulation materials) and / or replacing non-renewable raw materials or fossil fuels. However, paludiculture is currently not yet implemented on a large scale. The main obstacles are the ongoing promotion of conventional drainage-based peatland use and the absence of economic incentives for converting from conventional drainage-based land use to paludiculture as well as the lack of demand for paludi-products.
On behalf of the German environmental agency, we have determined the potential contribution of peatland rewetting for achieving the climate targets, examined the obstacles and costs for the conversion to paludiculture, and identified measures suitable for promoting peatland rewetting and paludiculture. Finally, we have developed proposals for the design and combination of economic incentives for an effective reduction of greenhouse gas emissions from peatlands and the conversion to paludiculture in Germany.

Key words: economic incentives, greenhouse gas emissions, climate policy, LULUCF

7.2.4 **Vorpommern - Ready to rewet?**

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Agriculturally used peatlands cover 72,000 ha (about 10 %) of the Vorpommern Region (North East Germany). However, the potential for climate protection by rewetting is high. Only 200 ha are under peat-preserving, 3,500 ha under slightly peat-debilitating conditions. Vorpommern Connect aims to improve the urban-rural relationship in order to promote regional development in line with the Sustainable Development Goals. The value-added opportunities from paludiculture, in particular from the proven energetic utilization of permanent grassland paludiculture, and the demands of the population on their agriculturally shaped environment are investigated.
A GIS-based spatial analysis and a postal population survey (~12,500 addressees, response rate 17 %) were carried out, as well as discussions and workshops with stakeholders.
In spite of the low transport worthiness of biomass, sufficient agriculturally used peatlands within a 10 km radius of almost everywhere allow for an abundance of potential sites for heating plants from 2,500 MWh/a.
77 % of the population say that if there is a chance of drastically reducing greenhouse gas emissions, it should be taken. 59 % know the connection between rewetting and the reduction of greenhouse gases. 52 % are in favour of rewetting while maintaining productive land use. However, only 14 % have heard of paludiculture. Only 33 % would pay a surcharge of at least 10 % for sustainably and regionally produced heat.
Through stakeholder participation, fields of action which can be tackled locally and lead to a stronger implementation of paludiculture where identified: networking, financing of ecosystem services, biomass production together with biomass utilisation, upscaling and awareness raising. These were each backed by at least one project approach.
In addition to the large potential of available area and the population's basic willingness to do so, a large-scale change in land use towards paludiculture requires the promotion of various regional measures.

Key words: paludiculture, spatial analysis, population survey
link: www.vorpommern-connect.de

7.2.5 Certification of products from paludiculture: project design, potential, open questions, challenges

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*University of Greifswald, Institute of Botany and Landscape Ecology, Partner in the Greifswald Mire Centre

Drained fens will be largely rewetted as part of climate protection measures. Biomass from wet or wet peatlands cannot be used economically for meat production by robust cattle after rewetting. Only paludiculture with water buffaloes will allow meat production to be maintained on these areas.

The project presented here aims to develop a seal for paludiculture products, using the example of meat production in the context of keeping water buffaloes (parallel to barbecue coal). Therefore a certification model for the use of biomass from wet peatlands is being developed. In view of the increasing environmental awareness of consumers, there is a strong incentive for producers to integrate environmental friendliness as part of the product characteristics and to communicate this by means of labels.

Parameters necessary for a paludiculture certificate will be determined and its organisation will be worked out. This shall ensure that a product actually originates from wet peatland utilisation. Abiotic and biotic effects of buffalo husbandry on wetlands will be studied and ecosystem services will be quantified in cooperation with Rostock University. These will serve as a basis for the creation of a certificate, which is needed for the sustainable marketing of products from paludiculture, e.g. buffalo meat, but also for the certification of other products from wet peatland use (e.g. barbecue charcoal).

The use of this seal (certificate) "from paludiculture" represents an added value, as it implies that ecosystem services are provided during cultivation/production, such as reduction of emissions of greenhouse gases to atmosphere as well as nutrients to ground- and surface waters, water retention and many others. Taking into account the claims that a certificate requires, the different ecosystem services that can be provided by paludiculture are described and, where possible, quantified. The project will lay the foundation for new, adapted business models in agriculture, landscape conservation and tourism.

Key words: paludiculture, certification, seal for paludiculture, water buffaloes

Session 7.3 Regional and national transition of peatland use & socio-economics

Session 7.3		Regional and national transition of peatland use & socio-economics
Stage		C
Time		10.03.2021 14:30-15:30
Moderator		Silvia Lotman
Talk:	1	Potentials and capacities of climate change mitigation by peatland rewetting and wet agriculture on peatlands (paludiculture) in the Baltic countries **Andreas Haberl**
	2	Challenges for paludiculture development in Estonia **Jüri-Ott Salm**
	3	Potentials for paludicultures on rewetted peatlands in Latvia **Ilze Ozola**
	4	First steps of paludiculture as sustainable use of rewetted peatlands in Lithuania **Nerijus Zableckis**

7.3.1 Potentials and capacities of climate change mitigation by peatland rewetting and wet agriculture on peatlands (paludiculture) in the Baltic countries

Haberl, Andreas*; Ivanovs, Janis**; Jarasius, Leonas***; Ozola, Ilze****; Peters, Jan*; Piirimäe, Kristian*****; Salm, Jüri-Ott*****; Stirvins, Normunds****; Zableckis, Nerijus***

**Michael Succow Stiftung, Partner in the Greifswald Mire Centre, Greifswald, Germany; **Latvian State Forest Research Institute "Silava", Salaspils, Latvia; ***Lithuanian Fund for Nature LFN, Vilnius, Lithuania; ****Lake and Peatland Research Center, Purvisi, Latvia; *****Estonian Fund for Nature ELF, Tartu, Estonia*

While peatlands only cover ~10% of land in Europe, they comprise Europe's largest terrestrial carbon stock. Drained peatlands are major sources of greenhouse gases and nutrients (nitrogen, phosphorus). In the Baltic countries (Estonia, Latvia, and Lithuania) >50% of the 21,602-24,646 km^2 total peatland area are drained and degraded for agriculture, forestry, and peat extraction. Hence Baltic countries rank among the EU's Top 10 of greenhouse gas emitters from drained peatlands (LV 5th, EE 8th, LT 9th).
Rewetting of drained peatlands and use with close-to-surface groundwater levels (paludiculture) could reduce or even stop emissions and considerably contribute to reach Baltic Countries' climate mitigation targets. However, adaptation of peatland agriculture to higher water levels is challenging for society and needs to tackle physical, social, legal, and technologic obstacles.
Therefore, we conducted feasibility studies on the use of peatlands in Estonia, Latvia, and Lithuania. Assessed suitability of peatlands for paludiculture and integrated the results in national and Pan-Baltic maps considering physical, social, and economic criteria. GIS analysis shows that in total 450,668 ha (~1/4 of suitable peatlands) are available for paludiculture in the near-term. As agriculture and forestry are the main driving factors for peatland drainage we analysed legal frameworks for, and the impact of the EU's Common Agricultural Policy (CAP) on peatland utilisation in the Baltic states. Whilst the CAP supports drainage-based peatland use with payments from the 1st and 2nd pillar it neglects the special properties of peat soils. Lacking incentives for raising water levels it subsequently frustrates implementation of paludicultures. To incorporate our results into national and regional strategies for steering spatial and rural development planning we: Started a multi-level stakeholder dialogue on CAP and National Energy and Climate Plans; promoted wet peatland management and paludiculture; selected auspicious sites for paludiculture; and preplanned a paludiculture pilot, in each Baltic state.

Key words: Baltic countries, paludiculture potential, paludiculture pilots, feasibility study, stakeholder dialog
link: https://www.succow-stiftung.de/en/peatlands-climate/euki-paludiculture

7.3.2 **Challenges for paludiculture development in Estonia**

Salm, Jüri-Ott*
**Estonian Fund for Nature, Estonia*

Based on Estonian National Greenhouse Gas Inventory Report (2020) drained peatland area covers 340,000 ha and emissions from mineralization of peat and related to peat use for energy and horticulture were in 2018 in total 2.3 mio. t CO_2-eq. Without changing the peatland management, there is no pathway to fulfil reduction obligations of the Paris Climate Change Agreement. In addition, the "Climate Policy until 2050 of Estonia" calls for the preservation of carbon stock in peat soils both in agricultural and forestry lands. Climate impact is one of the reasons why peat soils are gaining more attention in Estonia. It seems contradictory but public funding is used for maintenance, establishment and renovation of drainage network or intensive management of drained areas, which leads to further degradation of peatlands, continuous emissions – thus not considering agreements on climate policies.
On the other hand, there is lack of long-term studies to determine potential outcomes in the course of implementation paludiculture – carbon balance, productivity, economics and conditions for public support. In order to overcome this bias, Estonian Fund for Nature has initiated cooperation with peat mining companies and academic institutions to start up with trials on abandoned peat mining areas. These are also potential areas for paludiculture development in Estonia – there are about 5,600 ha of abandoned areas and it is expected that additional 5,000 ha of mining sites will be exhausted within next 40 years.
Technical plan has been completed for establishment of paludiculture pilot site to Sangla abandoned peat mining area. Design is meant to cover part (app 44 ha) of the site where peat mining stopped about 10 years ago. Depending of the outcomes it could be possible to widen the paludiculture area to the rest of ca 600 ha which is either abandoned or under active mining process

Key words: paludiculture, climate policy

7.3.3 **Potentials for paludicultures on rewetted peatlands in Latvia**

Ozola, Ilze*; Stirvins, Normunds*, **; Ivanovs, Janis***
**Lake and Peatland Research Center, Puikule, Latvia; **University of Latvia, Riga, Latvia;*
****Latvian State Forest Research Institute "Silava", Salaspils, Latvia*

Almost all main land use types in Latvia can be found on organic soils - agriculture, forestry, peat extraction and nature protection. While peatlands cover only 7% of all agricultural lands, their share of emissions from drained peatland in the agricultural and land use sector is almost 30% (BIO4ECO, 2017). Legislation promotes drainage - if land is permanently wet it is not considered as agricultural land. Only the peat mining sector actively promotes rewetting of extracted peat fields. Therefore, in Latvia in terms of the project "Paludiculture in the Baltic states" focused on possibilities to establish paludicultures on extracted peat fields.
"The Guidelines for the sustainable use of peat for the period 2020-2030" were approved on November 2020 and among degraded peatland recultivation types suitable for conditions in Latvia paludicultures are listed. According Guidelines there should be developed recultivation plans for 7 870 ha of degraded peatlands until 2023 and for 26 232 ha until 2030.
Lake and Peatland Research Centre has initiated cooperation with peat mining company SIA Laflora to start up with trials on abandoned peat mining areas (*Sphagnum*, *Typha*, *Calamus acorus,* water lilies). New

fields for *Sphagnum* and *Alnus glutinosa* implementation were planned in 17 ha of Kaigu Mire. Paludicultures will be planted in areas next to the peat extraction to show that it is possible to use peat fields immediately after their extraction on remaining non exploitable peat deposites. On the long run the site can develop in to a carbon sink and can boost circular economy by providing climate neutral biomass resources from implemented paludicultures.

Key words: Baltic countries, Latvia, paludiculture potential, paludiculture pilots, peatland recultivation

7.3.4 First steps of paludiculture as sustainable use of rewetted peatlands in Lithuania

Zableckis, Nerijus*; Jarašius, Leonas*; Sendžikaitė, Jūratė*; Sinkevičius, Žydrūnas*
Foundation for Peatlands Restoration and Conservation, Lithuania

Peatlands cover approx. 10 % (653,933 ha) of Lithuanian territory. Due to high drainage rates (~67 % or 440,000 ha) peatlands become a prominent source of GHG emissions. According to Valatka et al. (2018) 10.8 Mt CO_2-eq. yr^{-1} are emitted from the damaged peatlands of Lithuania. Majority of these emissions (7.2 Mt CO_2-eq. yr^{-1}) comes from drained organic soils used in agriculture. Sustainable use of peatlands would help to fulfil reduction obligations of the Paris Climate Change Agreement. Therefore, paludiculture as a low-emission land use alternative for peatlands could be applied.
Based on the recent studies, peatlands which are fully suitable for implementation of paludiculture in Lithuania cover 262,689 ha. These are mainly drained peatlands used in agriculture and abandoned peat mining sites. Agricultural lands are used for perennial pastures and meadows (149,467 ha) and arable land (71,527 ha).
The implementation of paludiculture approach in Lithuania is focused on the sustainable use and rewetting of abandoned peat mining sites and severely drained agricultural peatlands. In the exploited part of Aukštumala peatland first attempts to establish *Sphagnum* mosses plantation (2 ha) were carried out in 2019. Establishment of peat forming vegetation will be also implemented in 2 ha trials of exploited part of Ežerėlis peatland. For implementation of paludiculture in organic soils used in agriculture, 3 pilot sites (total area ~ 70 ha) located in Žuvintas Biosphere Reserve and characterize by severely drained fen meadow habitats were rewetted in 2020. The biomass gained from these sites will be further used for fodder production, cattle grazing and bedding. Although paludiculture is a promising alternative of peatland use, there is a need for more successful paludiculture implementation examples to showcase the methods on establishment of suitable wetland plants, maintenance of rewetted sites and practical usage of biomass.

Key words: paludiculture, rewetting, farmers, grasslands, *Sphagnum*, peatlands
link: www.pelkiufondas.lt

Virtual excursions

Virtual excursions (plenary session)	
Stage	**A**
Time	**09.03.2021, 13:30-14:15**
Moderator	**Sabine Wichmann**
1	Sphagnum farming on 17 ha in the peatland Hankhauser Moor, NW Germany **Greta Gaudig**
2	*Sphagnum* farm Barver **Jens-Uwe Holthuis**
3	Sphagnum farming re-thought **Neal Wright**
4	Peat bog rewetting research sites in Northwestern Germany **Gerald Jurasinski**

1. Sphagnum farming on 17 ha in the peatland Hankhauser Moor, NW Germany

Gaudig, Greta; Furtak, Swantje
**University of Greifswald, Institute of Botany and Landscape Ecology, Partner in the Greifswald Mire Centre*

After a successful pilot trial on a cut-over bog we started to convert a deeply drained bog grassland in Northwestern Germany into a paludiculture in 2010. In principle, the cultivation of Sphagnum biomass aims to the later harvest as a crop and usage e.g. as a raw material for horticultural growing media. The virtual excursion takes you to the Sphagnum farming site in the peatland Hankhauser Moor (NW Germany), which is meanwhile 17 hectares in size. We show, how to convert the bog grassland into a Sphagnum farming site, how to manage the site and how to harvest the produced *Sphagnum* biomass. Additionally, we explain the economics and the benefits of Sphagnum farming, e.g. the reduction of greenhouse gas emissions, nutrient filter, increase of (bog) biodiversity as results from the MOOSWEIT project (2016-2019) with the universities of Greifswald, Rostock and Oldenburg and the peat company Torfwerk Moorkultur Ramsloh as partners. Of course there are still challenges for large-scale implementation of Sphagnum farming, e.g. sufficient founder material and nutrient rich irrigation water, which we address in other projects and also present in the film.

Key words: peat moss, peat substitute, mechanical harvest, bog grassland, benefits
link: www.sphagnumfarming.com

2. *Sphagnum* Farm Barver

Holthuis, Jens-Uwe
Stiftung Naturschutz im Landkreis Diepholz, Germany

In winter 2019/ spring 2020, the Interreg project CANAPE created (Lower Saxony, Germany) a paludiculture pilot (size: 1 ha) in Diepholz district to trial agricultural production of peatmosses on former bog grassland under regional conditions ("*Sphagnum* Farm Barver").
The clip gives some impressions of administrative forerun of construction works. Following, essential steps of site preparation like removal of eutrophic, earthified topsoil and levelling, building of irrigation ditches and outlet, construction of a water reservoir and drilling of a groundwater well are shown in detail. Finally, manual inoculation of the prepared polder with *Sphagnum* diaspores with help of a self-developed "*Sphagnum*-Express" is shown.

Key words: Sphagnum farming, bog grassland, black peat, field experiences
link: https://northsearegion.eu/canape/news/canape-six-months-of-learning-and-growing-at-sphagnum-farm-barver/

3. Sphagnum Farming re-thought

Wright, Neal*; Wright, Jacqueline*; Caporn, Simon**; Keightley, Anna**
**BeadaMoss®; **Manchester Metropolitan University, Great Britain*

A tour and results of Sphagnum Farming UK – a project where Sphagnum Farming has been Re-Thought as a commercially viable field grown crop on lowland farming soils.
In the tour we show our trials testing management methods on two different sites in England: a cut-over peatland and an organo-mineral farm soil. You will see *Sphagnum palustre* planted in Autumn of 2018 in two micropropagated propagule forms: BeadaHumok™ and BeadaGel™, with three different materials providing crop protection.
The site tour shows the unique method of applying water from above (drip or spray irrigation) to simulate rain, while the water table below was unregulated, allowing easy site access compared to flooded sites. The faster growth of spray irrigation compared to drip and all three cover types compared to no cover can be seen. Successful production

(patents pending) of BeadaMoss® *Sphagnum* biomass using these techniques on different soils demonstrates the potential for volume cultivation in a variety of landscapes, avoiding problems of raising water tables in adjoining agricultural crops.
Carbon GHG monitoring showed greater net CO_2 uptake in *Sphagnum* under covers versus no cover, and as *Sphagnum* ground-cover increased, with minimal methane fluxes across all treatments, demonstrating avoided losses. Typical farm weeds were a significant problem and future trials in our new 3-year project are set to examine ways to overcome these.
3D laser scanning photographs and virtual objects will show impressive *Sphagnum* volume and biomass production rates. Standard industry bulk density measurements show that after nearly two years, biomass production by volume was up to 1600 m^3 ha^{-1}, with dry matter up to 14800 kg ha^{-1}. This high productivity should make Sphagnum Farming viable at a larger scale (our next project – previewed).
Grown *Sphagnum* has proved highly successful as growing medium on commercial nurseries, which will be shown in our brief tour.
A tour and results of Sphagnum Farming UK – a project where Sphagnum Farming has been Re-Thought as a commercially viable field grown crop on lowland farming soils.

Key words: Sphagnum Farming, paludiculture, BeadaMoss®, peatlands

4. Peat bog rewetting research sites in Northwestern Germany

Jurasinski, Gerald*; Daun, Caroline*; Gering, Keno**; Rosinski, Eva***; Huth, Vytas*
**University of Rostock, Landscape Ecology; **University of Oldenburg, Landscape Ecology; ***Hofer & Pautz GbR, Germany*

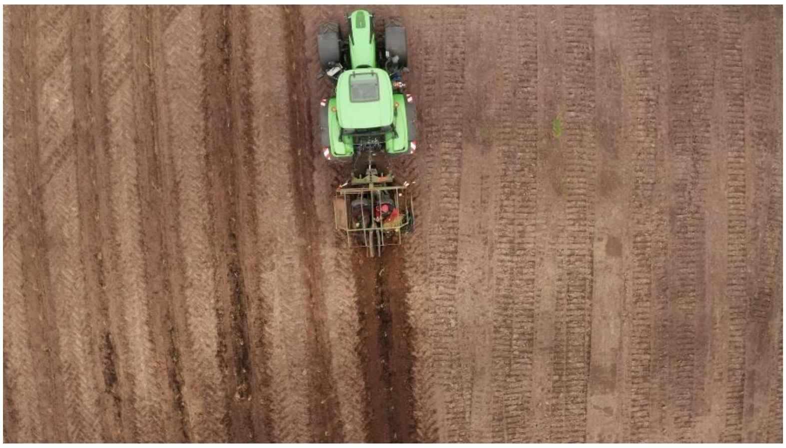
The virtual excursion takes you to two exciting research sites in Northwestern Germany. Here, the landscape ecology group of the University of Rostock runs long- and mid-term research on greenhouse gas exchange after rewetting in cooperation with many colleagues from the University of Greifswald, the University of Oldenburg, the EFMK (Europäisches Fachzentrum für Moor und Klima), and many other partners. The footage will include general introductions to the sites, the research goals and will also feature some of the methodologies we are employing to gather data on GHG exchange, vegetation composition and water parameters in the field.

Key words: rewetting, greenhouse gas exchange, biodiversity, methane, carbon dioxide, restoration
links: Baltic TRANSCOAST: www.baltic-transcoast.de
WETSCAPES: www.wetscapes.de
OptiMOOR: www.optimoor.de
FOMOSY-KK: https://www.auf.uni-rostock.de/professuren/h-w/le0/forschung/fomosy-kk/
OptiMOOS: https://www.auf.uni-rostock.de/professuren/h-w/le0/forschung/optimoos/

Virtual excursions (plenary session)		
Stage	**A**	
Time	**10.03.2021, 13:30-14:15**	
Moderator	**Anke Nordt**	
	1	Field-scale *Typha* paludiculture in NE Germany - Set-up and 1st year's experiences **Sabine Wichmann**
	2	Cattail (*Typha*), a multitalent for a rewetted landscape **Aldert van Weeren**
	3	Paludi-tiny house **Anke Nordt**
	4	Paludiculture-biomass heating-plant at the Kummerower See – a virtual field trip **Max Wenzel**

1. Field-scale *Typha* paludiculture in NE Germany – Set up and 1st year's experiences

Wichmann, Sabine*, Neubert, Josephine*; Köhn, Nora*; Haldan, Kerstin, Vogel, Telse**
**Institute of Botany and Landscape Ecology, University of Greifswald, Partner in the Greifswald Mire Centre, ** Institute of Plant Production and Business Management, State Research Institute for Agriculture and Fisheries Mecklenburg-Vorpommern, Germany*



Putting paludiculture into practice is the objective of the Paludi-PRIMA project (2019-2022). A core task is the establishment and investigation of a *Typha* field on a formerly drained fen grassland. The area is ~10 ha, including infrastructure, with about 8 ha of *Typha*. The virtual excursion takes you to the demonstration site located in the river valley of the Teterower Peene in NE Germany.
In August and September 2019, construction works were carried out to prepare the pilot site for rewetting, thereby creating a wet island in a drained landscape. 50,000 *Typha* seedlings (*Typha latifolia*, *Typha angustifolia*), grown by a commercial nursery specialized in wetland plants, were delivered in mid-September 2019. The *Typha* seedlings were planted in two densities (0.5 and 1 plant m-2) using two tractors and planting machines from forestry. Subsequently, the site was rewetted. Drone seeding was conducted in June 2020. Vegetation development in the first growing season (2020) showed a limited planting success but impressive germination from seeds. Further challenges are related to water management, weeds adapted to high water levels and geese eating leaves and roots. By monitoring stand establishment, water balance, nutrient uptake, biomass quality, biodiversity and cost data, the field trial generates practical information on the technical implementation, plant growth, and economic efficiency of *Typha* paludiculture. Greenhouse gas measurements and the harvest of *Typha* biomass for insulation and construction material of high value are planned as next steps.

The film was designed and produced by Swantje Furtak.

Key words: *Typha latifolia, Typha angustifolia*
link: Project Paludi-PRIMA: www.moorwissen.de/en/prima, *Typha* demonstration site: www.moorwissen.de/en/prima_demo

2. Cattail (*Typha*), a multitalent for a rewetted landscape

van Weeren, Aldert*
**Wetland Products Foundation, Bugewitz-Kamp, Germany*

Over the last 20 years the search for biomass as raw material for bio based circular products did take up speed and intensity and is currently at a momentum.
One biomass stands out of the woods, as it can be used for multiple products in the building sector and as growing medium, to mention some.
Grown on formerly drained rewetted fen-land it gives high yields also in the hot and dry growing seasons which seem to become our new normality. These constructed nature-like new wetland provide not only cattail biomass but also a long list of ecosystem-services.
Apart from that they can deliver lifesaving task as floodplains but also in the vicinity of city conglomerates for helping coping with the negative results of climate change. These are important socio-economic "off-springs" apart from massively reducing GHG-emissions from the formerly drained peatlands which they are grown on.
Multiple negative problems attached to modern industrial (diary) agriculture can be reduced by using cw`s with cattail for reducing the nutrient load and other contamination in the water.
And last but not least, depending on harvesting-time in the year the biomass has multiple uses.
We ourselves are constantly surprised from the growing range of possible uses of this plant. As a fibre or in different chopped fraction with or without additives and with or without only bio based binders.
But still there is a long road to go fully open the market for these fantastic bio based circular world.

3. Paludi-tiny house

Nordt, Anke*; Furtak, Swantje*; Abel, Susanne*
**University of Greifswald, Institute of Botany and Landscape Ecology, Partner in the Greifswald Mire Centre*

The virtual excursion visits the paludi-tiny house, built in 2020 with insulation-, building-, and furniture material made from reed, cattail, alder, and wet meadow grasses. The paludi-tiny house shows the application possibilities of paludi products in practice. The excursion also visits some of the producers who process paludi plants into products.

Paludi-materials are within different components of the tiny house:

- Parts of the roofing thatched with reed
- Insulation from cattail (boards, chaff, seed wool), reed (bound stems), grass fibre (soft boards)
- Interior wall panels from alder
- Kitchen work surface from alder solid wood
- Integrated wardrobe made from grass and reed fibre boards (100% fibres, without adhesive)

Key words: products, biomass processing
link: www.paludi-tinyhouse.de

4. Paludiculture-biomass heating-plant at the Kummerower See – a virtual field trip

Wenzel, Max*; Furtak, Swantje*
Greifswald Mire Centre

This field trip will show you around one of the paludiculture-sites at which the biomass for the heating-plant in the town of Malchin is produced. A detour to the heating-plant itself is also included.

The well preserved "Neukalener Seewiese" is part of a nature conservation area which is dedicated to protect the remnants of the formerly widespread peatlands around the Kummerower See. Due to former drainage activities, its upper most peat layer is comparably slightly degraded. Dominated by mainly three species of sedges, the vegetation cover itself gives the impression of forming a "liquid interface" between earth and sky by seemingly floating in the wind. Other herbaceous species such as *Caltha palustris* or *Mentha aquatica* give a hint at the comparably high water level throughout the year. Next to numerous other recently rewetted areas, the Seewiese is probably the most beautiful part of the 400 ha of paludiculture-sites used to produce the biomass for the heating plant. We will see an interview with the farmer who manages the production of the paludiculture-biomass. Some footage of the ongoing harvest with specially adapted agricultural machines will be shown before we take the turn to the town of Malchin. We will witness the complete process of how the biomass passes through the heating plant and is ultimately burned in the furnace. Almost solely running on biomass from paludiculture-sites, the heating-plant can produce energy of up to 3.8 GWh yr^{-1}. This equals 380.000 litres of heating oil and a lot of avoided emissions. But how many households can this heating plant supply with heat energy in reality? Find it out yourself by joining the field trip!

Key words: field-trip, paludiculture biomass, heating plant, energy production, peatlands
link: www.paludiculture.com

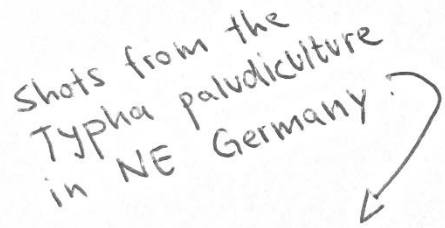
Filmmaker: Swantje Furtak

As a filmmaker and science journalist I produced the 4 virtual excursions for the Greifswald Mire Centre:

- Sphagnum farming on 17 ha in the peatland Hankhauser Moor
- Field-scale Typha paludicultre in NE Germany
- Paludi-tinyhouse
- Paludiculture-biomass heating-plant

I study Biochemistry at the University of Greifswald. After having shot a short documentary on Paludiculture in Spring 2019 I got fascinated by the topic of peatlands. Within the peat research field I can combine my biochemical background with my passion for filmmaking.

Do not hesitate to contact me if you are interested in shooting a film about your research: swfurtak@gmail.com



Workshops

Workshop A: Global network for paludiculture – needs & options for exchange

10.03.2021, 16:30 – 18:00, Stage A

Sharing knowledge is important to advance good practices in paludiculture projects. In this session, we first want to collect the existing network options for paludicultures around the world (based on a first input by the organisers). In a second step, we invite a discussion around needs not yet met as well as opportunities to improve existing communication and learning possibilities about paludiculture. Thus, this session welcomes all interested in networking and sharing knowledge around practical paludiculture projects.

Susanne Abel (Greifswald Mire Centre, Germany) & **Rafael Ziegler** (HEC Montreal, Canada)

Workshop B: Potography: Gifts from Nature's Peatlands

10.03.2021, 16:30 – 18:00, Stage B

Pictures by T. Claffey

When we give back to Mother Nature, she surely rewards us.
The benefits of peatlands are not just environmentally positive for our fight against climate change, the benefits for our biodiversity are massive. Maintaining the water table level above, or close to, the soil surface promotes the development of unique flora and fauna, encouraging the replenishing of a diverse living carpet.
So many ancient marsh loving species are reawakened, replenished, and make themselves visible to us again. *Sphagnum* mosses propagate and radiate, spreading their feathery limbs, while Marsh Marigold raises its beautiful yellow bloom to the sky. Frogspawn glistens in the Spring sunshine as the frogs celebrate their watery world. Ancient orchids reveal their splendour, Bog Asphodels yellow anthers flutter in the breeze. Carnivorous plants entice with their sticky tentacles, as the insect world celebrates the abundance of nectar in these marshy wetlands. Each season brings with it a feast for the senses.
Join me on a visual journey through these marshy peatland wildernesses and celebrate the magical life within them.

For any photography enthusiasts, all images are taken handheld, with natural light, and all camera settings will be revealed for each image shown.

Claffey, Tina

Key words: photography, macro, wilderness, bog, peatland, Ireland, flora, fauna

Tina Claffey

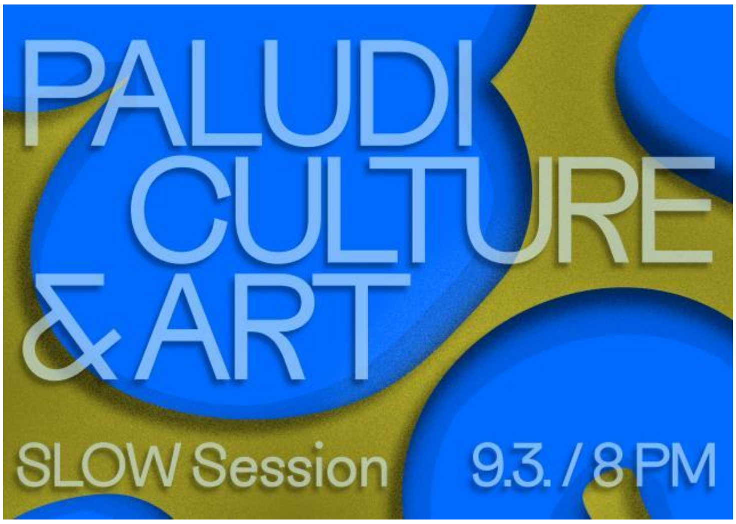
I am an award winning Irish nature photographer & author of 'Tapestry of Light-Ireland's bogs & wetlands as never seen before'. For almost 10 years, I lived and worked in pristine wilderness areas in Botswana, and this experience awakened my appreciation of the natural world of Ireland.
I love to get 'lost' in the bogs, eskers and wetlands of Ireland with my macro lens.
These unique environments are home to extraordinary plant and animal species that have adapted to their acidic environment to survive. The macro lens allows me to capture these species in a way that cannot be seen by the naked eye.
Much of the flora and fauna are at ground level, so capturing my desired shot requires me to lie down, sometimes getting soaked in the process as I look for new perspectives and ways of seeing. I am transported to other worlds as I look through the lens. Capturing these scenes that defy our sense of reality, glimpses of ancient worlds that co-exist with us, are what inspire me to keep exploring and sharing the beauty around us.
For this workshop I created a macro photography visual journey that takes the participants through the seasons in our bogs and wetlands, to share the wonderful and unique species of flora and fauna of Ireland's peatlands.
There is also the possibility of including the camera settings of each image, and equipment used, for participants interested in the practical side of photography.

link: https://tinaclaffey.com/

Evening programme

SLOW Session: Paludiculture & Art

09.03.2021, 20:00 – 22:00, via ZOOM



This Session welcomes the RRR2021 participants to discover paludiculture from another perspective. The two artists Vreni Knödler and Lisa Marie Quester will join us - the winners from the paludiculture residency programme 2020, a collaboration of the Greifswald Mire Centre and the BURG Giebichenstein University of Art & Design. Together we will search for intersections between the presentations of the conference and the works of the two artists. What can we learn and take away from each other? The SLOW session will function as a deliberate counter-design to the strictly timed scientific conference.

Organisation & Moderation: Susanne Abel (Greifswald Mire Centre), Prof. Dr. Sara Burkhardt (Burg Giebichenstein University of Art and Design), Prof. Aart van Bezooijen (Free University of Bozen-Bolzano, Faculty of Design and Art) and Michael Trepel (Kiel University).

Vreni Knödler

Vreni Knödler, Burg graduate in the field of communication design, is working as an independent graphic designer in Berlin:

"Everything changes. The rate of change is growing. If we want to keep pace we have to speed up. Disconnecting from our daily routines gives freedom to look closely to what surrounds us, staying in nature allows us to reconnect with ourselves and our environments. The observations made during the 3 weeks Paludi residence are transferred into a digital exhibition space that gives its visitors the chance to slow down and experience the mire in a new way: appealing to reflection before conviction, promoting an interdisciplinary dialogue instead of monologues."

Lisa Marie Quester

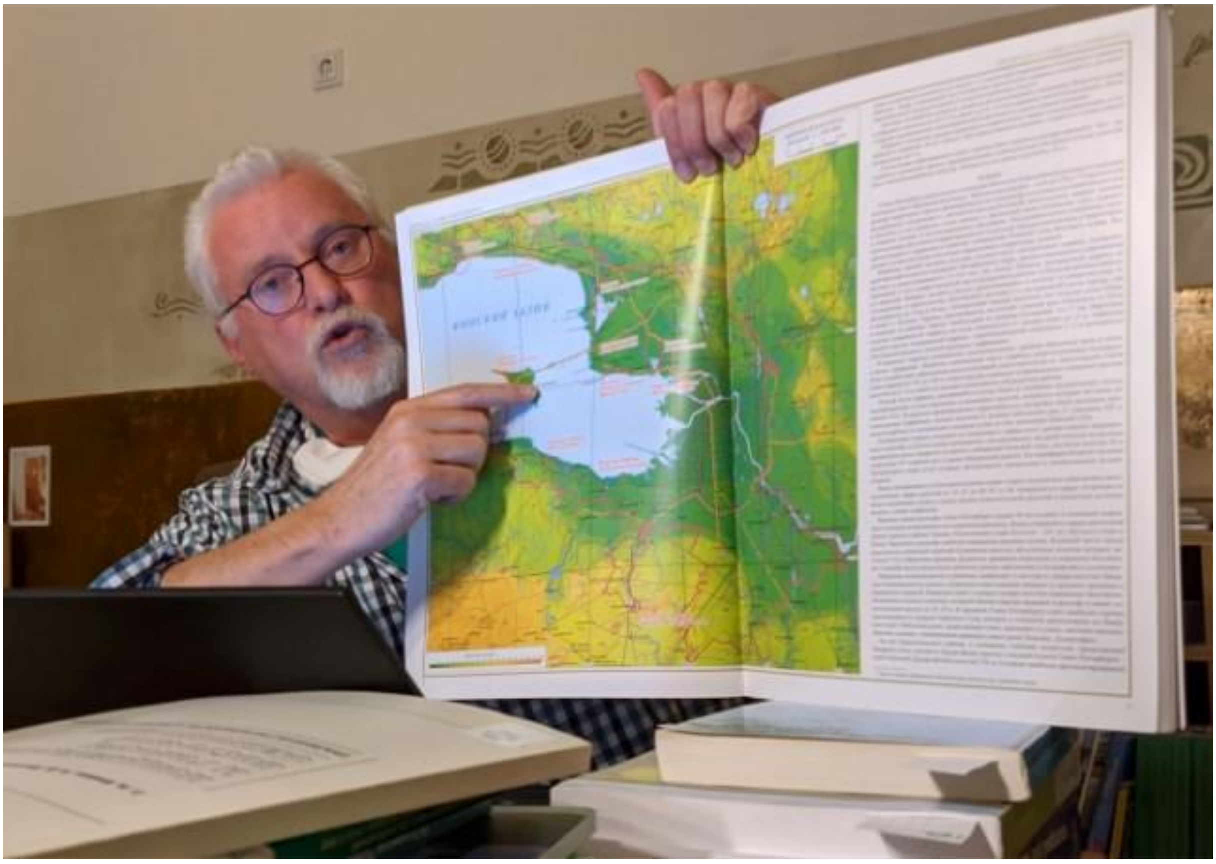
Lisa Marie Quester has studied Textile Arts at Burg Giebichenstein, University of Art and Design Halle, and is fascinated by apparent trivialities, silence and relations:
"Observing a mire contains a bunch of possibilities for an artistic research. The organism with its course of action: absorbing, receiving and conserving embodies fundamental conditions, which are about to disappear. The uptake and sequestration function is brutally degrading in peatlands. In the field of communication and human interaction lending-an-ear and «listening» is slowly disappearing. Transmitting is en vogue."

The artistic work of Lisa Marie Quester visualizes the threatened and rescued peatlands (=rewetted areas) in form of Shibori textiles - a Japanese manual resist dyeing technique. Additionally, inspired by philosophical thoughts of Byung-Chul Han and Andreas Weber.

Literature evening with Hans Joosten

10.03.2021, 20:00 – 22:00, via ZOOM

Peatland expert and bibliophile Prof. Hans Joosten regularly present stories and facts around peatlands at public literature evenings in the Greifswald Peatland and Nature Conservation International Library (PeNCIL). For the conference he opens the doors of the library to the participants and invite you to listen about a strong woman, who laid the foundations of peatland research in the tropics under the most difficult conditions: Betje Polak - Queen of tropic peatlands.



Prof. Hans Joosten

Photo: Sphagnum farming site in the peatland Hankhauser Moor, NW Germany, 2020 Tobias Dahms (lensescape.org)