Paludiculture Newsletter

With this newsletter the Greifswald Mire Centre (GMC) aims to keep a growing community informed on peatlands and paludiculture. You will find news from research, practice, politics, as well as announcements of conferences and other events and recommended publications. Sign up per e-mail to communication@greifswald-moor.de for upcoming issues! The newsletter is currently provided by the BOnaMoor project coordinated by the Greifswald Mire Centre and financed by the German Federal Ministry of Food and Agriculture through the Agency for Renewable Resources (FNR).

Content

1. General information and news on peatlands and paludiculture

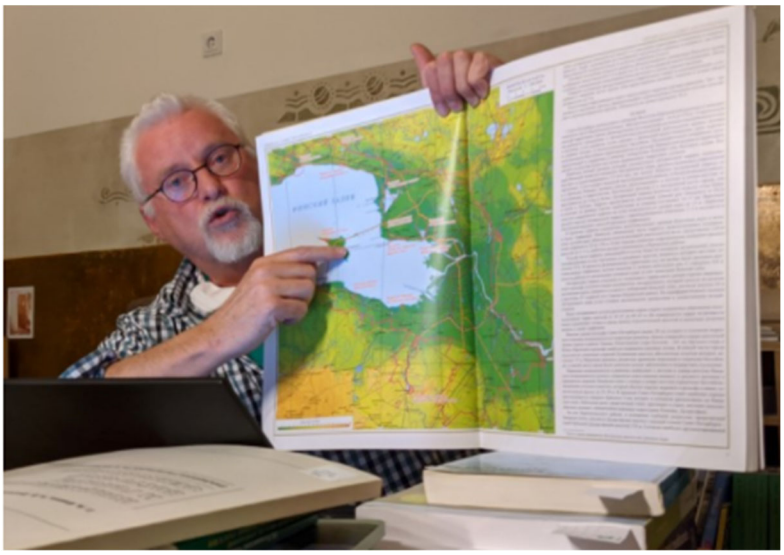
1.1. RRR2021 conference now documented online

1 RRR2021 postcard (Source: lensescape.org)

From 9th -11th March 2021 the partners in the Greifswald Mire Centre organised the 3rd conference online on Renewable Resources from Wet and Rewetted Peatlands - RRR2021. More than 300 scientists and practitioners from 25 countries around the world shared their knowledge about paludiculture. Now, the key messages of the conference, more than 100 presentations and posters, are documented and available online.

You can find videos from two passionate keynotes and the special session on "Finance options for livelihoods from wet peatlands" co-organised with FAO, UNEP, IUCN and WWF on the YouTube channel of the Greifswald Mire Centre. Also some other highlights are to be revisited: The RRR2021 virtual excursions take you to bogs and fens, to rewetted peatlands, pilot sites for Sphagnum or Typha cultivation, a heating plant and a Paludiculture Tiny house. You also may enjoy some breathtaking peatland pictures presented by Tina Claffey in her photography workshop. Concise information on the entire conference is given in the RRR2021 proceedings.

1.2. If there were peatlands on Mars … Prof. Hans Joosten would have gone there



2 Prof. Hans Joosten lecturing on peatlands (Photo: lensescape.org)

On 31st March 2021 peatland scientist Hans Joosten ended his work at the Institute of Botany and Landscape Ecology at the University of Greifswald. For 25 years, the graduate biologist from the Netherlands not only researched and taught about peatlands at there, but also gave the peatland expertise in Greifswald a world-wide reputation. With PeNCIL he created the largest special collection on peatland related publications, and with the Global Peatland Database the most comprehensive database on peatlands worldwide. As one of the founders of the Greifswald Mire Centre, he developed his integrative research approach of paleo- and landscape ecology, ecology and wise use into an interface between

science, politics and practice in all peatland issues - locally and globally. With character, passion and a morsel or two of peat, Joosten has been a high-profile contributor to raising awareness of peatlands in the climate crisis and the concept of paludiculture, from international panels to community institutions. The multiple award winner describes "everything to do with peatlands" as his hobby. If there were peatlands on Mars, it is said, he would have been there too.

2. Opinion

Conversion of peatland management to paludiculture requires compliance with the minimum standards (high water table, adapted vegetation, low emissions, productive use). This compliance is necessary to ensure that the ecosystem services associated with wet peatlands (in particular the reduction of greenhouse gas and nutrient emissions) are achieved. If in a temperate fen peatland mean water tables are half-heartedly raised to only -30 to -50 cm, the improved water supply to the aerated topsoil may even promote peat mineralization and cause higher greenhouse gas and nutrient emissions than under drier conditions.

In land use, people almost always try to improve their economic situation by increasing productivity of the site (“amelioration”). Many wetland plants often have a higher yield when cultivated at lower water tables. Lower water tables also allow the use of conventional harvesting machinery so that investments in new, adapted machinery can be avoided. These circumstances make it attractive to abstain from raising the water table sufficiently to stop peat mineralization and minimize greenhouse gas emissions. Examples of such practices are subsurface irrigation or too low weir level targets. In paludiculture (e.g. with common reed), average water tables should not drop below -10 cm below ground level during summer, and in winter they should always be higher.

Another line of reasoning to weaken the water level targets is that this would allow farmers and landowners to gradually get accustomed to peatland rewetting. After getting used to these somewhat elevated water levels, additional rewetting would be necessary to reach the target levels for emissions reduction. Such stepwise approach, however, would be arduous and probably only works in certain cases. Farms have to orient their business operations towards longer time periods (e.g. 25 years) and cannot blow with every wind. Achieving the eventual emission reduction would come with much higher costs. Paludiculture does not allow half measures to be taken. There is no reason to weaken the concept!

When we later come to certify products from paludiculture, the question may arise if farm's total peatland area has to be managed under wet conditions. Products from one farm may be certified only, if all peatland-based products the farm produces origin from paludiculture. Organic farming shows the way, here funding is only available if 100% of the farm’s area is managed organically! As a basis for certification, a regular monitoring of compliance with the basic site conditions demanded for paludiculture must be in place.

Author: Wendelin Wichtmann, Greifswald Mire Centre, Germany

3. A paludiculture project presented: Cultivating cranberries on peatland in the Netherlands

It takes persistence, patience and lots of water to establish a cranberry cultivation in the Dutch peatlands. The result, however, is a rich vegetation, a sustainably managed soil, no more soil subsidence and of course: an annual yield of very healthy cranberries.

I, Bart Crouwers, started my cranberry cultivation in the fall of 2016, considering that cranberries thrive best in peatlands. The idea was to show that ecology and economy demands can be served at the same time and in the same enterprise. It turned out to be quite a challenge, though.

The peatlands in the Netherlands have been peat meadows for centuries. Up until today almost all peatland is being used as grassland for dairy cows. Because of that it is annually fertilized with manure and mineral fertilizer, it is drained and the acidity is kept on a pH of approximately 6. That makes the ryegrass grow better and contain more protein. It also makes the soil subsidence continue as well as high greenhouse gas emissions, and the biodiversity decrease.

How to turn these well fed ryegrass meadows into cranberry fields? You have to reduce the nutrients, in particular the phosphate and the nitrogen, and you have to find ways to further the natural acidification. You have to bring down the pH from 6 to 4.5. Starting with cranberries on the Dutch peatlands means starting a transformation of the soil, bringing it back to a more natural state. That takes at least couple of years. And in particular during the first three years, the cranberry plants have to cope with competing grasses and weeds. As I am cultivating cranberries organically, that means doing a lot of weeding by hand.

3 Cultivated cranberry plants in summer (Photo: B. Crouwers)

Flooding the fields during winter months has proven to be an effective measure to suppress the grasses and weeds. It will not kill the competing grasses and herbs but it delays their growth. It also helps to rinse out nutrients that delay (buffer) the acidification. Flooding is most effective when only rain water is being used, because that is poor and acidic, more than surface water. As cranberry plants are genetically made to survive in bogs, flooding does not bring any damage to the plants.

4 Harvested cranberries in September (Photo: B. Crouwers)

I chose to cultivate cranberries organically. It is not my objective to realize a cranberry monoculture. I only want to control the competition with grasses and weeds and prevent these from overgrowing or suffocating the cranberry plants. So, I don't need herbicides. Growing cranberries organically also means going for a healthy soil, with all kinds of minerals, bacteria, fungi and other microscopic organisms. Such a healthy, well-balanced soil will keep out or disarm all kinds of diseases. But it takes three to five years to get that far.

The acidification and impoverishment of the soil helps to rule out or suppress certain weeds. Not all plants thrive in an acidic soil like cranberries do. More than many other plants, cranberry plants need fungi, in particular Mycorrhiza, to take the nutrients up. Thanks to fungi, cranberries will grow also in poor soil, as long as there is enough organic matter, as there is in a peat soil. This is also a mechanism to control the competition between cranberry plants and grasses and herbs that do need inorganic nitrogen. When the acidity of the soil has gone down as low as pH°4.5, bacteria will be much less active and fungi will dominate. Cranberries will profit from that, the other grasses and herbs will slow down or even disappear.

Once the pH is 4,5 or lower and the overload of nitrogen and phosphates has been removed, a new ecosystem is established, in which not only cranberries thrive but also herbs and other vegetation that do not dominate or threaten the cranberries. After four or five years, the yield of healthy cranberries may be modest. But it constantly grows and will probably reach its optimum after ten years.

Growing cranberries on peatland will halt the soil subsidence, and more than that. Because of the flooding in winter (water level -2.30 m with soil surface between -2.20 and 2.16 m) and high water levels in summer (water level -2.36 m, same soil surface), the peat will swell (4 inches in my situation) and work as a water reservoir that will secure the humidity of the peatland even when it is hot and there is no rain in weeks. The soil no longer subsides and emits much less carbon dioxide. Cranberry plants last forever, so this is no-till agriculture and makes for a sustainable soil, where micro-organisms keep it alive and healthy.

Author: Bart Crouwers, crouwers@bestberry.nl, The Cranberry Company, Netherlands

4. News from other paludiculture projects

4.1. Projects international

4.1.1. SaltyCo – turning paludiculture biomass into textiles

SaltyCo is a company looking to produce natural textiles from novel sustainable plant sources. We aim to tackle the industry's overconsumption of freshwater and arable land, by growing our crops in blue carbon ecosystems. In this way, we can harness the powerful environmental benefits of these spaces, whilst providing additional revenue streams to farmers.

Currently, we are working with conservation groups to protect wetland environments in Scotland (for example in coastal North Berwick) by extracting plants that we then use to make our 'planet-positive' textiles. With increased interest in our materials, we are now looking to sustainably cultivate our plants and paludiculture on restored peatlands offers a fantastic way to do this. We're currently looking for agricultural partners in the UK to link us with peatland spaces for a pilot project.
At SaltyCo we endeavour to have environment-first methods throughout our supply chain, the combination of encouraging biodiverse environments and storing of carbon creates a perfect opportunity for us to match production with responsibility. We have been greatly inspired by paludiculture projects in the UK and abroad and look forward to joining this community.

If you would like to talk or find out more about our projects, please feel free to get in touch through our website: www.saltyco.uk

5 Examples of natural textiles from novel sustainable plant sources (Photos: SaltyCo)

Author: Finlay Duncan, finlay@saltyco.uk, SaltyCo, United Kingdom

4.1.2. Production and use of common reed (*Phragmites australis)*

Historically reed (*Phragmites australis)* is used for thatching through the whole of Europe, and also in Japan and South Africa. In the last 30 years, half of the yearly quantity of reed thatch in the Netherlands, is used on new architecture. From other countries the same trend is reported. This results in an overall increase in the demand of reed. At the same time there is a decline in locations where reeds can grow and be harvested.

The diminishing of sites results in an increasing import of reed. Since the 1980s, a lot of reed is imported from central, eastern and southern Europe (see Wichmann & Köbbing (2015)). Not all reed proved to be useful or of good enough quality, so new markets were found: Since about 15 years, a lot of reed is imported from China, where areas are vast, labour is cheap and the climate favourable for reed growth. The numbers below show the approximate utilisation of reed for thatching of member countries of the International Thatching Society (ITS). At a sales price of 2.50 Euro per bundle, the total amount per year is 35.6 Mio Euro for all 5 countries.

6 Total number of reed bundles from own production and import used for thatch per year in selected European countries (organised in the International Thatching Society ITS) (Table: (Tabelle: R. Conijn)

ITS-Organised Country	Total bundles	Own production %	Import China %	Import other countries %
Netherlands	8 000 000	10	72	18
Denmark	3 500 000	10	>50	<35
Germany	2 000 000	10	no data	no data
United Kingdom	400 000	10	no data	no data
Sweden	350 000	35	8	56
Sum	14 250 000			

The use of thatch has many benefits, in particular:

- for climate protection: reed 'harvests' CO_2 from the atmosphere, this carbon is conserved in the thatch, carbon in the wet peat soil is protected, and more carbon can be even sequestered and stored in newly formed peat
- for insulation of buildings: two studies have been made over the last few years. Both show that thatch has an accountable insulation value hich is comparable to conventional insulation materials.

7 Genetically different ecotypes of common reed cultivated at Aarhus University (Photo: H. Brix)

Expanding thatch use has several negative aspects, as long as there are not enough growth areas (including on re-wetted peatlands) for reed close to the places of use. Import is associated with major negative environmental impacts and on transport costs (see also the contribution by Tom Hiss in Paludiculture-Newsletter 2020_03). Not the least, import of reed in quality and specifications needed for thatching is also challenging due to difficult communication between producers and users.

In UK-nature reserves, reed harvest is allowed only from November 1st – March 1st, in particular for the protection of breeding birds. For various reasons, reed is traditionally harvested in the wet season. Reed is preferably harvested dry, and must be stored dry. Climate change leads to warmer winters and less frost, which makes harvest more difficult. Further effects are apparently late maturation, and therefore late redeposition of nutrients to rhizomes, and leaching of nutrients.

The selection of genetically different ecotypes of reed which are suitable for cultivation in rewetted peatlands could support reed production in countries with a high demand for reed. Aarhus University has been doing research, and holds a cultivation of selected genetic types, which has over 250 genetic variants (see figure 8). There are large genetic differences among populations, with high phenotypic plasticity within the genotypes. This has influence on morphology, photosynthesis, need for nutrients, enzyme activity, length of growing season, time of flowering, pigments etc. For thatch, there could be selected on variants with a high amount of lignin, specific length, early maturation and salt tolerance according to the respective requirements. The cultivation of reed on rewetted peatlands, instead of harvesting in natural reserves, would make it possible to harvest when the conditions are right, when nutrients are reallocated into the rootsystem and rhizomes, and under optimal weather conditions.

Author: Ruud Conijn, International Thatching Society (ITS) Member of the Board, Denmark

4.1.3. The potential for energy plants using biomass from paludicultures in the Baltics

In the Baltics, i.e. Lithuania, Latvia and Estonia together, there are c. 97,600 ha of suitable areas for paludiculture. Among the areas are agriculturally used drained peatlands, forest on slightly drained peatlands, exhausted peat extraction sites and sites listed for future peat extraction. Paludiculture helps to revitalize peatlands while simultaneously diversifying the energy sector and creating jobs with an economically benefiting activity. There is a selected number of species that are assumed to thrive well on peatland under the climatic and edaphic conditions in the Baltics, while being a good biofuel. These species include common reed, cattail, reed canary grass and sedges.

In the Baltics wood is employed as a main biomass energy source and the aforementioned paludiculture biomass species are comparable to wood in energy characteristics. Lower calorific values of pellets from reed, sedges and reed canary grass range between 4.8 and 5 kWh/kg (dry mass). In comparison wood pellets have ≥ 4.6 kWh/kg (dry mass). A disadvantage is the higher ash content of paludiculture pellets (3-7 %), compared to wood pellets (<1 %, occasionally rising to 2 %).

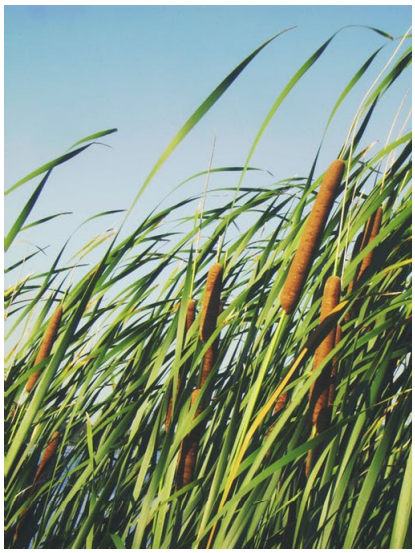
Paludiculture grass species yields in all Baltic states are similar due to climate and soil properties. Reed yield in Estonia is in average 6.3 t/ha (dry mass). Reed canary grass yield in Lithuania is between 7.5 and 8.4 t/ha (dry mass). Sedge yield in Lithuania is between 3.2 and 7.1 t/ha (dry mass). Cattail yield, based on various literature sources, is in range 4.3-22.1 t/ha (dry mass).

Combustion of biomass from paludiculture is advantageous if made close to harvesting areas where a heat distribution grid is already installed and biomass combustion facilities are present. Paludiculture biomass can be used for co-combustion in wood-, straw-, peat- and coal- fired boilers. The technology available on site permits the addition of paludiculture biomass in variable amounts without effecting the performance. There are 633 boiler houses in Latvia and 810 in Estonia (no data for Lithuania) that work with wood. Among them are moving and vibrating grate boilers that can burn pure paludiculture biomass without the need to mix it with wood or other fuel.

8 Wood pellets (Photo: Mrdig / Pixabay)

Moving grate boilers are commonplace in wood-rich regions, particularly in the Baltics. Their construction allows for combustion of fuel with higher amounts of ash and of wide range of moisture (10%-60%) without negative effects for the boiler itself. Ash content is an especially important issue that determines the necessity of using moving or vibrating grates, as opposed to stationary grates. Installed capacity of moving grate boilers ranges from 500 kW to 12.5 MW in a single unit. Another

type of conventional burning technology are pellet boilers with moving grate. This equipment requires biomass to be pelletized and the capacity can be in range between 4 kw and 500 kw. While being versatile with the ability to switch between paludiculture biomass and wood, both of the boiler types require grass biomass to be leached beforehand in order to avoid ash slagging and sintering, as well as corrosion. Ash slagging and sintering is a result of low ash melting temperature of paludiculture biomass caused by the abundance of micro and macro elements, especially potassium. Higher corrosion levels are a result of a high chlorine amount, among other elements. Fortunately, almost all these elements are greatly water-soluble and can be leached if biomass is harvested from late autumn to spring. For example, due to the leaching of mineral substances the ashes of reed canary grass harvested in March–May melt at 1,404 ℃ the melting of ashes from biomass harvested in July–October melt already at 1,074 ℃.



9 Productive stand of cattail (Photo: E. Hopper/Pexels)

Other types of boilers that need biomass which must not be leached beforehand are in place. These include bale burners and boilers specially designed for combusting straw and other grasses. Bale burners allow biomass combustion without shredding or treatment beforehand, but they can only work with bales so they are entirely dependent on that type of fuel supply. Additionally, if a bale burner is not automated, it needs to be stopped and cleaned manually as soon as the loaded bale has finished burning. Furnaces designed for straw combustion have the advantage of continuous operation and the option for fuel co-combustion with wood. Linka Energy boilers are a good example of such technology. The drawbacks are their filters sensitivity to fuel moisture content, as it cannot rise above 21%.

The complete publication is available online here: „The Baltic potential for Heat or Energy plants using graminoid biomass from paludicultures".

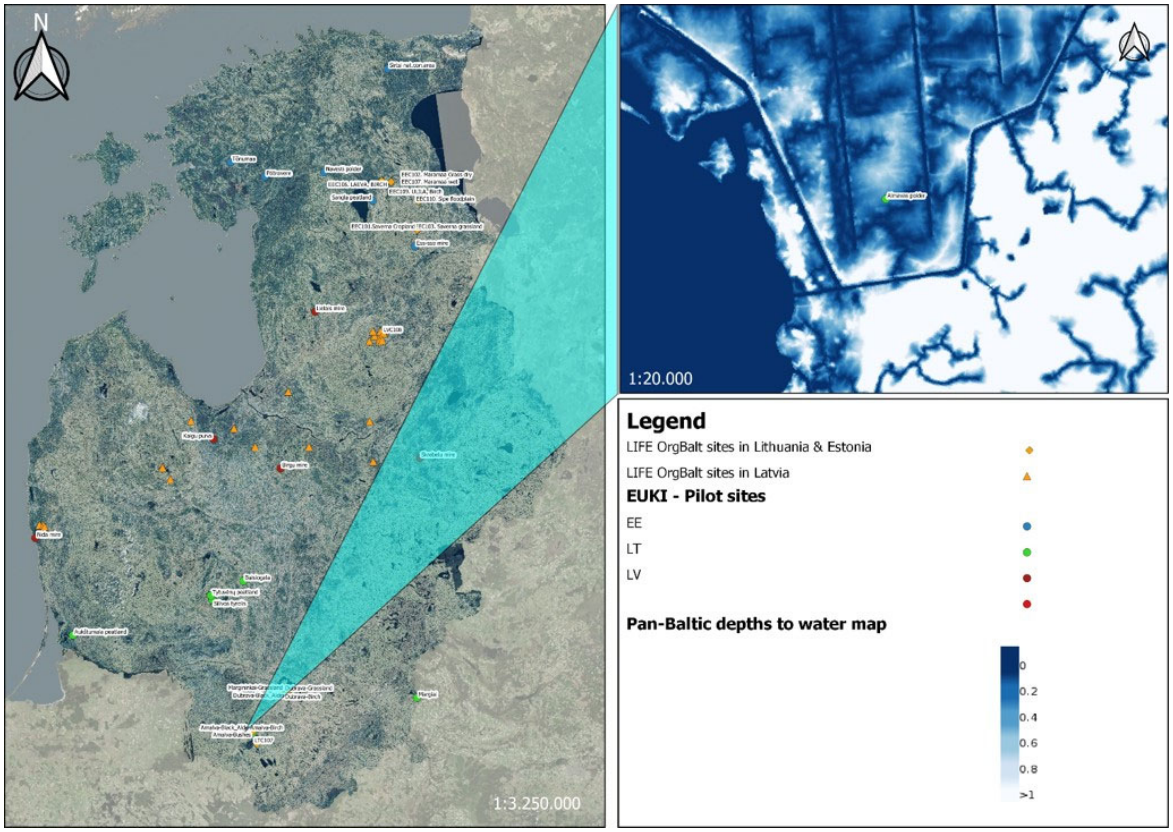
Author: Aleksanders Kalamashnikovs, Dönhoff Fellow at Succow Foundation, partner in the Greifswald Mire Centre.

4.1.4. Pan-Baltic depth to water map

The LIFE OrgBalt Project aims at updating inventory data of peatlands and other organic soils in the Baltics to improve national GHG inventories and to give guidance for the implementation of effective climate change mitigation measures.

As a first interim result a "Pan-Baltic depth to water map" was modelled, following a Canadian approach based on GIS data sets for water bodies and topography for modelling spatial groundwater depth distribution. Analyses were carried out at project lead partner Latvian State Forest Research Institute "Silava". The Panbaltic depth to water map layer is available online as an open WMS data set: https://silava.forestradar.com/geoserver/silava/wms. The map author is Janis Ivanovs (Silava).

In further analysis the existing inventory datasets for organic soils will be updated and emission hotspots can be identified by integration of emission factors from nutrient rich organic soils based on Baltic and Finnish measurement campaigning within the project.



10 Panbaltic Depth to water map with close up to Amalvas Polder Zuvintas biosphere reserve in Lithunia a model site for monitoring of ccm measures in the LIFE OrgBalt project (Andreas Haberl Succow Foundation, QGIS-Version 3.18.0).

Author: Andreas Haberl, Greifswald Mire Centre, Germany

4.1.5. Webinar on climate protection and peatland rewetting for Irish Farmers

The Freshwater Pearl Mussel Project (PMP) in collaboration with the Irish Carbon Connects Partners in Limerick Institute of Technology (LIT) conducted a webinar on “Climate Change, Carbon Sequestration via Peatland Rewetting and Business Models Providing Financial Incentives“ for Irish farmers (15.03.2021), which is now available on https://www.youtube.com/watch?v=yzPhy7p06u8.

In the webinar Dr. Patrick Crushell presented the PMP’s work in collaboration with farmers and landowners in the West of Ireland with regards to rewetting of drained blanket peatlands (c. 16,600 ha), promoting vegetation cover, leading to lesser peat erosion into adjoining water bodies, improving carbon sequestration, water quality and promoting pearl mussel habitat. Henry O’ Donnell of Inishowen Uplands EIP project involving 25 Irish farmers gave an overview on activities e.g. upland grazing of cattle, agroforestry, small farm ponds and its implications for water storage and reduced flooding downstream. Niall O’ Brolchain of INTERREG Care-Peat provided information on EU and global peatland policies having financial support mechanisms, an update on Ireland’s peatland activity and key policy gaps regarding peatland rewetting in Ireland. Dr. Amey S. Tilak from LIT Carbon Connects demonstrated quantifying the carbon sequestration potential of drained but later rewetted

blanket peatlands located near Galway and the "Site Emissions Tool (SET)" developed by VHL, Netherlands. The webinar also included a feedback of the 45 participating Irish farmers.

Authors: Amey S. Tilak and Seamus Hoyne, Limerick Institute of Technology (LIT) - Irish Partners of EU Carbon Connects, Patrick Crushell and Mary McAndrew, Freshwater Pearl Mussel Project (PMP)

4.2. Projects in Germany

4.2.1. Save the date: Field day on Paludiculture on 3rd Sept. 2021

The 3rd of September 2021 the Greifswald Mire Centre invites you to a field day on paludiculture at the Paludi-PRIMA project pilot site near Neukalen in Mecklenburg-Vorpommern. The cultivation of cattail (Typha) on a rewetted fen has been tested here since 2019. During the field day, a tour around the 10 ha trial area will take place. Scientists will report on the cultivation trial, hydrology, the climate impact of peatlands and their biodiversity. A rolling exhibition in the paludiculture tiny house will provide information on the potential uses of paludiculture biomass.

The field day is a joint event of the projects Paludi-PRIMA, MoKli and PRINCESS of the Greifswald Mire Centre. The event may be cancelled at short notice depending on the Corona regulations. More information on the schedule and programme will follow in the coming months. Registration is not required.

11 Invitation for the paludiculture field day (Source: S. Wichmann)

4.2.2. New results about the combustion of paludiculture biomass

In the 20/21 heating period, the BonaMoor project conducted further measurement campaigns at the Malchin heating plant to optimise the combustion of paludibiomass. Sedges (harvested in early summer) as well as sedges and reed canary grass from a late harvest in autumn were used as fuels. When using biomass from a late harvest with humid conditions at the harvest date, bales may be wet. A selection of drier bales (water content of max. 20%) had to be made, as only largely dry biomass (water content < 21%) can be used in the existing combustion plant in Malchin.

12 Combustion of sedges from late harvest (Photo: G. Kabengele)

The flue gas emission values were recorded at two different sampling points (in the flue gas pipe immediately downstream of the furnace and upstream of the flue gas filter and in the outdoor area immediately upstream of the flue gas stack). During the measurement campaigns, the air supply, the ratio between primary and secondary air (see table 13) and the pressure conditions in the furnace were varied.

13 Table: Setting parameters for biomass used (G. Kabengele)

Measurements	Primary air	Secondary air	Oxygen
Sedges (early harvest)	65%	25%	7,5%
Sedges (late harvest)	65%	25%	7,5%
Reed canary grass (late harvest)	50%	45%	9%

The limit values specified in the Air Quality Control (CO: 250 mg/m3 and NOx: 500 mg/m3) were complied with when all the biomass assortments examined were used, and proper operation of the combustion plant was ensured (see table 14).

14 Table: CO and NO_x measured values for biomass used (G. Kabengele)

Component	Sedges (early harvest)	Sedges (late harvest)	Reed canary grass (late harvest)
CO	193,89 mg/m^3	135,32 mg/m^3	127 mg/m^3
NO_x	144,85 mg/m^3	198,82 mg/m^3	192 mg/m^3

Further optimisation will deal with changes in the combustion chamber (including to the positioning of the air supply). Their effects on combustion behaviour will be investigated.

Author: Guy-Rod Kabengele, Hochschule für Technik und Wirtschaft (HTW) Berlin, Germany

5. Events on peatlands and paludiculture

21.06. - 24.06.21 online
SER2021 - 9th World Conference on Ecological Restoration

27.06. - 08.07.21 Chanty-Mansiysk, Russia
VI International Field Symposium WEST SIBERIAN PEATLANDS AND CARBON CYCLE: PAST AND PRESENT

22.08. - 27.08.21 Ghent, Belgium
II. ISHS International Symposium on Growing Media, Soilless Cultivation, and Compost Utilization in Horticulture

23.08. - 27.08.21 online
Eurosoil 2021

31.08. - 04.09.21 Alicante, Spain
SER Conference A New Green Deal For Europe's Nature. Science and political action towards socio-ecological restoration

06.09. - 07.09.21 Vilm, Germany
Biodiversität und Klima - Vernetzung der Akteure in Deutschland

18.09.-12.09.21 Tulcea / Romania
5th International Conference Water resources and wetlands

20.09. - 22.09.21 online
Landscape 2021 - Diversity for Sustainable and Resilient Agriculture

01.10. - 08.10.21 online & Tomsk, Russia
Peatlands of Siberia: functioning, resources, restoration

10.10. - 15.10.21 Christchurch, New Zealand
11. INTECOL International Wetlands Conference

13.10. - 15.10.21 online & Leeuwarden, Netherlands
Sustainable Peatlands: A win for all – Peatland restoration and management for a sustainable future

14.06. - 16.06.22 Arles, France
17th Society of Wetland Scientists Europe Chapter

6. Literature

Eller, F., Guo, X., Ye, S., Mozdzer, Th. J., Brix, H. (2020) Suitability of Wild Phragmites australis as Bio-Resource: Tissue Quality and Morphology of Populations from Three Continents. Resources 9, Vol. 143. https://doi.org/10.3390/resources9120143

Hinzke, T., Li, G., Tanneberger, F., Seeber, E., Aggenbach, C., Lange. J., Kozub, Ł., Knorr, K-H., Kreyling, J., Kotowski, W. (2021) Potentially peat-forming biomass of fen sedges increases with increasing nutrient levels. Functional Ecology. https://doi.org/10.1111/1365-2435.13803

Kandel, T.P., Karki, S., Elsgaard, L., Labouriau, R. & Lærke, P.L. (2020) Methane fluxes from a rewetted agricultural fen during two initial years of paludiculture, Science of The Total Environment, Volume 713, 136670, ISSN 0048-9697, https://doi.org/10.1016/j.scitotenv.2020.136670.

Larsen, S.U., Lærke, P.E. & Jørgensen, U. (2020) Harvest of green willow biomass for feed – effects of harvest time and frequency on yield, nutrient concentration, silage quality and regrowth, Acta Agriculturae Scandinavica, Section B — Soil & Plant Science, 70:6, 532-540, https://doi.org/10.1080/09064710.2020.1785542

Nielsen, C. K., Stødkilde, L., Jørgensen, U., Lærke, P.E. (2021) Effects of Harvest and Fertilization Frequency on Protein Yield and Extractability from Flood-Tolerant Perennial Grasses Cultivated on a fen Peatland. Frontiers in Environmental Science, Vol.9 (April 2021). https://doi.org/10.3389/fenvs.2021.619258

Tshapa, L., Naidoo, K. & Naidoo, G. (2021): Morphological and physiological responses of Arundo donax and Phragmites australis to waterlogging stress, Flora, Vol. 279, 151816, ISSN 0367-2530, https://doi.org/10.1016/j.flora.2021.151816

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Responsible in terms of press law: Nina Körner, Dr. Wendelin Wichtmann

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PALUDI CULTURE

BOnaMoor

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