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. CAP 'gamechanger' webinar

At 3rd of June the Greifswald Mire Centre hosted a webinar on "Peatlands in the new CAP: potential and synergies for sustainable regional economies with climate and biodiversity benefits" organised jointly with Wetlands International – Europe and the National University of Ireland. It raised awareness on the potential to mainstream EU climate, biodiversity, water quality and rural income objectives by effectively addressing peatland conservation, restoration and sustainable use (paludiculture) in the new CAP and other EU policies. A position paper with policy recommendations was presented. Dedicated to MEPs, EC's officials, farmer organisations, practitioners, NGOs and academics the 60 min webinar was fully booked. See the GMC's youtube channel for the full webinar contributions in one playlist.

1 The beginning of the CAP 'gamechanger' webinar (Photo: GMC)

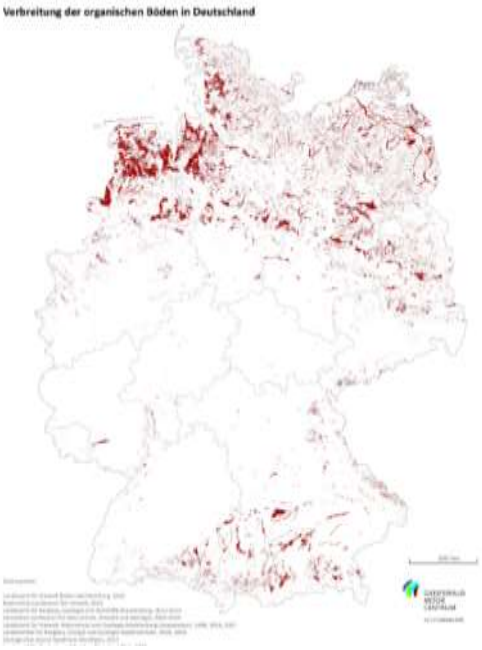
1.2. Come with us where paludiculture is – GMC shows work in 5 videos + one arty short movie

2 One of the #Moormussnass videos (Photo: GMC)

At 31st of May peatland lovers worldwide – artists, activists, scientists and others - contributed to a 24 hour online peatland festival, the PeatFest of the activist's group re-peat.earth. At 12:45 (CET) the peatland scientists and conservationists of the GMC showed their engagement for #Peatlandsmustbewet or #Moormussnass in five videos. Now, all films are available on our youtube channel. They take you to five different places – drained and/or restored peatlands or paludiculture pilot sites. See why we cultivate Typha and peat mosses… Hear about drainage damages and greenhouse gas measurements... Come with us to the beautiful Baltic coastal peatlands! And – follow Swantje Furtak on her way discovering peatlands and paludiculture. With tangy ideas and lovingly crafted animations the young filmmaker created a lively film – and path for others to understand why peatlands must be wet. Watch now!

1.3. New map of peatlands in Germany – now for download in the Proceedings of the GMC

The Greifswald Mire Centre compiled an up-to-date map on the current distribution of peatlands in Germany. The Aggregated Map of Organic Soils in Germany is also freely available as a GIS data download. It's area-specific data can now be used, for example, to plan climate and nature conservation measures in peatlands covering several federal states. The Greifswald Mire Centre developed the map with help of responsible administrative institutions of the individual federal states within the MoorDialog project. It was published as the first volume of the Proceedings of the Greifswald Mire Centre in 2020 (in German).



3 Map of current distribution of peatlands in Germany (Source: GMC)

2. A paludiculture project presented: MoKli

MoKli - Peatland and climate protection - realising practical solutions with land users

The majority of the fens and bogs in Germany are drained and have been converted into agricultural areas - altogether covering 7% of the total agricultural area. However, these drained peatlands cause 36% of the total agricultural emissions (including methane emissions from animal husbandry and nitrous oxide emissions from fertilization). Through rewetting, emissions of around 10 - 30 t CO_2 eq. reduce per hectare per year and continue to use the land through paludiculture. All of this is known.

4 Field day on paludiculture for landowners and landuseres (Photo: Ph. Schroeder)

But the implementation of rewetting measures and/or paludiculture is problematic because there is no general recipe for this. Here MoKli (abbreviated from the German 'Moor- und Klimaschutz') comes in: Sustainable strategies for climate-friendly use of peatlands have to be designed nationwide, but regionally differentiated and practically implemented. To this end, the project first provides knowledge about the climate-damaging effects of drained peatlands, possibilities to avoid GHG emissions from drained peatlands and about paludiculture. Especially land owners and users, representatives of water management, agriculture, nature conservation, as well as from municipalities, authorities, associations and companies are addressed.

In the five peatland-rich federal states in Germany MoKli is working in model regions. Here cooperations are established and solutions for rewetting and paludiculture are developed and implemented. MoKli is also working to establish the term "Moor-Klimawirt (Peatland carbon farmer)" - a farmer who provides climate protection on peatlands and is recognized for it. The project is also active in the design

of framework conditions for climate protection through peatland protection with political decision-makers at local, state, federal and EU level.

MoKli is carried out jointly by the Michael Succow Foundation, the University of Greifswald, both partners in the Greifswald Mire Centre, and the German Association for Landscape Management (DVL). The project is funded as part of the National Climate Protection Initiative (NKI) of the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety based on a decision by the German Bundestag.

5 Demonstration of typha harvest at field day (Photo: Ph. Schroeder)

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3. News from other paludiculture projects

This section compiles news from current projects and initiatives on paludiculture from various regions and countries.

3.1. Projects international

3.1.1. Reversing the San Joaquin-Sacramento River Delta's decline through paludiculture: current progress

The Sacramento-San Joaquin Delta peatlands in California are an important example of soil oxidation and subsidence. The delta is about 1 m above sea level but the surface of many islands is now up to 9 m below sea level due to subsidence. Surface soil organic matter levels are as high as 60% and GHG emissions can be as large as 64 t CO_2-Äq. per ha and year. Up to 100,000 ha may be suitable for re-flooding and paludiculture management. About 5 billion cubic meters of peat accumulated during the last 7,000 years of wetland development. Drainage of the peatlands, which began in the 19th century, has resulted in the loss of about one-half of this volume and is on-going. Subsidence, which threatens levee stability, continues at rates ranging from about 0.5 cm to over 3 cm per year on about 100K ha in the western and central Delta and generates approximately 25 Mt ha^{-1} of CO_2eq emissions per

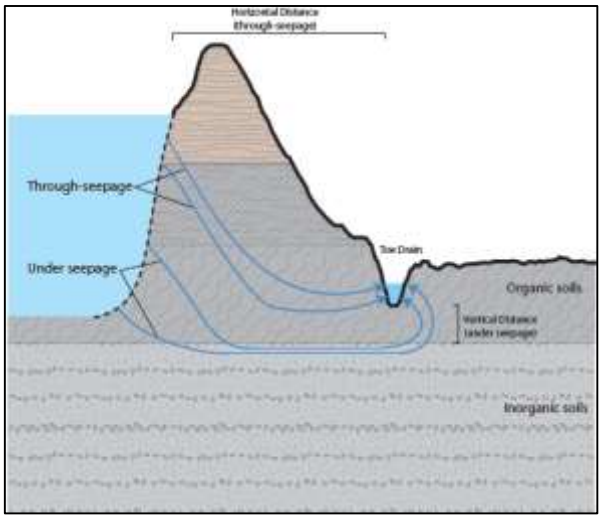
6 San Joaquin-Sacramento Delta (Source: Stephen Kaffka)

year. Agriculture is the predominant land use and crops such as maize, alfalfa and wheat dominate on peat soils.

A protocol for the restoration of the Delta has been published by the American Carbon Registry, which allows for the calculation of carbon budgets and the estimation of carbon emissions from current agricultural practices and the consequences of re-flooding farmed lands. The recreation of natural and seasonal wetlands and rice cultivation are included in the protocol (Deverel et al., 2017)[1]. The protocol for restoration of California Deltaic wetlands has facilitated the verification of carbon-offset credits for restored permanently flooded wetlands on State-owned Delta islands. During April 2020, over 56,000 tons of CO_2eq were verified by a third-party verifier (SCS Global) for approximately 690 ha of wetlands. These are the first verified wetland carbon offsets in the U.S. and are available for trading in the voluntary carbon market. These offsets can yield income generally commensurate with current agricultural lease values on State-owned islands. However, greater income is required to convince private landowners to enroll in the carbon market. Building on success in the voluntary carbon market, a transition from the voluntary to the California carbon offset compliance market is expected to result in higher prices per ton of CO_2eq (approximately USD 15) and prices are projected to rise to over USD 30 per ton of CO_2eq within 10 years which will likely increase land-owner participation.

Yet higher income levels for farmers may be possible, however, from the production of biofuel feedstocks using paludiculture methods through California's Low Carbon Fuel Standard and the federal Renewable Fuel Standard[2]. Instead of retiring the majority of current farmland in the Delta region, feedstocks from paludiculture would result in alternative fuels for transportation, including renewable natural gas, H_2, aviation fuels and other uses, further reducing industrial carbon emissions above the effects of retiring farmland. The final outcome will likely be a combination of simple wetland restoration and paludiculture.

Economic alternatives to current Delta management are needed. The current trajectory of Delta management is unsustainable. The Delta's steady decline, due to current farming methods, is characterized by constant soil subsidence resulting in large yearly CO_2 emissions from oxidizing peat soils. Subsidence leads to increasing levee and water supply vulnerability. Delta Islands are becoming less farmable, with declining economic prospects. This highly altered ecosystem fails many native species. Farming perennial wetland grasses for bioenergy or other bio-products can reverse that trajectory.



7 Seepage of river water to the polder system (Figure: Stephen Kaffka)

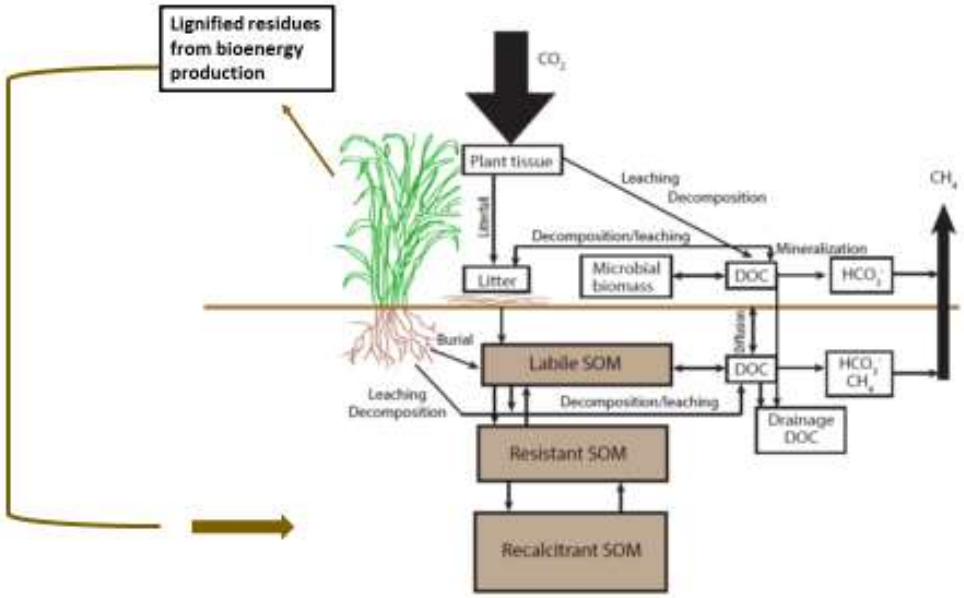
Funding for initial stages of a paludiculture project in the Delta region has been provided recently by a grant from the California Department of Fish and Wildlife, in cooperation with the Metropolitan Water District of southern California, a major land-owner in the Delta. Initial steps focus on

[1] https://americancarbonregistry.org/carbon-accounting/standards-methodologies/restoration-of-california-deltaic-and-coastal-wetlands

[2] https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard ; https://www.epa.gov/renewable-fuel-standard-program

site evaluations, planning, site selection and permitting for future agricultural operations. Paludiculture focused on re-flooding for the production of *Typha* spp., and *Schoenoplectus acutus* for biomass is one of the activities being evaluated and planned. The overall project's longer-term objectives are to assess the use of paludiculture as a way to sustain the physical structure of Delta Islands and levees, the capacity of the Delta to transmit water for beneficial uses, and create extensive areas of new wildlife habitat, while sustaining economic activity. A second objective is to measure all critical GHG fluxes (CO_2, CH_4, N_2O) associated with paludiculture in the Delta.

Biomass produced is foreseen primarily as a feedstock for transportation fuels. California's aggressive climate policies, especially the Low Carbon Fuel Standard, combined with the federal Renewable Fuel Standard, should support paludiculture as an economic alternative to drained agriculture. Widespread implementation of paludiculture can help California meet its ambitious climate and greenhouse gas reduction goals through Bioenergy production with Carbon Capture and Storage (BECCS). Significantly, 'carbon-negative' biofuels currently have carbon credits worth more than an additional $ 2/L under the low carbon fuel standard. Federal credits increase this value further. The value of carbon removal from the atmosphere and storage in peat soils is not yet adequately accounted and is a focus of this project. This project will provide guidance for future implementation and expansion across the Delta.



8 Conceptual model for the quantification, monitoring, reporting and verification of greenhouse gas emissions reduction and removals from the restoration of California deltaic and coastal wetlands version 11. Nov 2017; modified

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3.1.2. Future crops to meet climate and nature requirements - a demonstration of paludiculture in Store Vildmose, Denmark

For centuries peat has been an important resource, as people have drained the fens and bogs for land to produce food, and used the dried peat as a fuel. This leads to releases of CO_2 from the dried peat, and a reduction in capacity of the land to store water, resulting in reduced protection from floods and other unwanted consequences.

The project Creating a New Approach to Peatland Ecosystems (CANAPE) responds to these issues by restoring wetland areas to reduce their CO_2 emissions and improve their capacity to store water, and by aiming to develop the markets for products produced from wetland ecosystems - a type of farming known as paludiculture.

9 Figure of test area divided into plots (Aerial shot: Peter Hahn)

10 Place of project site in Denmark (Source: Peter Hahn)

In the Northern part of Denmark Store Vildmose ('Great Wild Bog') was 150 years ago a raised bog covering more than 5,000 ha – one of the largest peatland areas in Denmark. Due to peat mining and drainage for agricultural purposes, today only 1,200 ha exist as raised bog under protection. The rest is used either for potato farming or as grass fens for dairy cattle. Despite the intensive drainage and use of the peatland, Store Vildmose still contains enormous amounts of peat.In order to reduce greenhouse gas emission, there has been an increasing focus on rewetting peatlands. Since many peatlands are used for agricultural purposes, it is necessary to help farmers to find a way to earn an income from their rewetted peatlands.

In the Danish part of the project, paludiculture is tested on a former potato field in Store Vildmose. The test site covers four hectares and is situated next to existing raised bog. The purpose of the project is to demonstrate how a traditional cultivated area can be converted to paludiculture. The aim of the project is to test and get more knowledge on how to prepare traditional cultivated land for paludiculture, how to plant and sow crops adapted to wet conditions and experiences on harvest methods.

The private nature fund, Aage V. Jensen Nature Fund, have put the test field at our disposal. As part of an adjacent bog restoration project, the top soil on the test field has been removed and used for building up a large dam along the edge of the neighboring raised bog. The test field was therefore prepared for the demonstration site.

The Danish CANAPE team that counts two municipalities (Jammerbugt and Brønderslev), the Danish Nature Agency and the peat excavation company Pindstrup Mosebrug implements the demonstration project. University of Aarhus and SEGES assists with professional knowledge and the consultant company COWI coordinates the whole demonstration project.

11 Manual planting of pre-cultivated Typha plants using a 'Pottiputki' tool (Photo: Peter Hahn)

The test site is divided into 7 plots each covering 0,35 ha. The plots are placed as shown in the figure and are treated according to the table. In plot 1 Typha seeds were sown using a long hose mounted on a rebuilt sprayer machine. The Typha plants were planted manually using a 'Pottiputki' – a planting tool used for planting containerized seedlings in forestry. Plot 3 is reference plot to follow the spontaneous development of vegetation. In plots 4-7 reed canary grass and fescue, respectively, were sown by traditional sowing machinery, since these plots are and will stay drier than the plots treated with Typha.

Since the catchment area to the test site is small and the soil surface is quite flat, it has been necessary to install a solarpowered pump to control the water level in plot 1 - 3. The water level, the nutrient content of the of the drainage water pumped into the plots as well as the growth and conditions of the crops are monitored regularly over the next years. The first harvest will take place next summer.

It is the goal of this demonstration project to get more knowledge on the practical conversion of traditionally cultivated peatland fields to rewetted paludiculture fields and to raise the awareness of paludiculture among landowners, the agricultural advisory segment and the public in general.

Plot no.	**Crop**	**Treatment**
1	Typha	Sowing
2	Typha	Planting of pre-cultivated Typha plants. The plants are planted with a density of 1 plant per 1, 2 and 3 m², respectively. The plots are irrigated with water from a drainage ditch
3	Reference plot	No treatment
4	Reed canary grass	The area is fertilized
5	Fescue arundinacea	The area is fertilized
6	Reed canary grass	Without fertilizer
7	Fescue arundinacea	Without fertilizer

Table: treatment of plots

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3.2.3. Water Works – paludiculture in the Great Fen, England

We are delighted to introduce you to our project: Water Works. This is an ambitious undertaking that could change the mind-set of a generation as well as achieving positive action against climate change. Water Works is a two-year project that has sustainability and societal resilience at its heart. Funded by the People's Postcode Lottery the project duration is officially 1st April 2019 to 31st March 2021, though there are ambitions to continue work on the site beyond this.

The Water Works project is located within the Great Fen Project, Cambridgeshire, England. This is a visionary landscape where a carefully controlled raising of water levels and the gradual re-wetting of peat soils is creating a 3,700 ha mosaic of wet habitats, a watery haven for rare fenland species and a new green lung for the ever burgeoning populations of Cambridgeshire. Some 20 years into a 100-year vision, the Great Fen now has some 1,700 hectares managed for nature conservation including 1,200 hectares of restored land.

Water Works will demonstrate a combined integrated paludiculture system with 4.5 ha of field scale trials (a first in the UK). This is achieved through raising water levels which protects peat soils, locks in carbon, supports wildlife and offers new economic opportunities for farmers, growers and producers. The project aims to develop and demonstrate paludiculture techniques in the UK. Ultimately, increased awareness and uptake of paludiculture are necessary to reverse the enormous carbon losses from our agriculturalised peat soils.

12 Ground preparation on site (Photo: Henry Stanier)

The Great Fen Project has built its success on partnerships; The Water Works project is no different and is made up of several partners. Researchers at the University of East London have proposed wetland species and new crops that will grow and thrive at the higher water tables which are being tested. These crops have potential applications in industry and medicine or can be used for food and flavourings.

The four main crops to be tested are common reed (*Phragmites australis*), reedmace (*Typha* spec.), *Sphagnum* bog moss and sweet 'manna' grass (*Glyceria fluitans*). This last is a western equivalent of wild rice and was gathered from the wild until the beginning of the 20th Century but its potential as a cultivated crop has never been explored.

In addition to these main crops we are going to be testing up to 20 other wetland species, including wild celery and cranberry (both of which already support major industries in their cultivated form, albeit the American species in the case of cranberry). As well as advising on the range of crops to grow and their cultivation needs, the University of East London will be measuring the growth of crops and assessing the effect of paludiculture management on soil moisture. This in turn provides a close correlation with the anticipated halting of carbon emissions from these wetland soils.

13 Aerial shot of planting beds, partly finished, partly still in construction (Photo: Henry Stanier)

All have the potential for new, sustainable income streams for the region's farmers and growers. Spreading the word and showing what can be done in real life conditions to working farmers and landowners is a huge part of the project. In showing what can be achieved the Great Fen is hoping to create a ripple effect, changing perceptions and practices across a generation of fenland farmers. If wet farming catches on in the fens, wildlife will benefit too, as projects such as the Great Fen which need a high-water table to sustain its wetlands will be less isolated, giving nature a wider network in which to recover.

Climate-change experts at the Centre for Ecology and Hydrology are monitoring the site-specific greenhouse gas flux for Water Works. We aim to demonstrate carbon sequestration at higher water levels in a practical setting where paludiculture and nature conservation are the driving forces behind re-wetting. Such data will be key in creating an evidence base for lowland peat carbon trading in the future.

Societal resilience is as important as natural resilience, and this is where the final strand of this complex project fits in. Water Works, working with delivery partner Cambridgeshire ACRE, is spearheading the movement to create a UNESCO Fens Biosphere www.fensbiosphere.org.uk which is a global accolade that recognizes the unique character of the Fens and its people, shares learning and supports development through harnessing all sectors of society to work together to achieve sustainable outcomes.

The Great Fen and its Water Works project is an exemplar of how integrated and well-considered land and water management can benefit both conservation and agricultural production, encourage communities to work together to manage landscapes and valuable natural resources for mutual benefit, provide stewardship for public goods and create opportunities to bring people closer to nature.

As we write this introduction, like many projects, we have been impacted by the current Covid-19 outbreak. The preparatory groundwork aimed to remove the surface vegetation and oxidised peat whilst also installing water controls. This groundwork occurred during the winter of 2019 but faced delays due to Covid-19 in spring 2020. The finishing touches are taking place now that construction work is permitted again. Our spring planting has also been delayed. Our plants and plant propagules are currently being held by nurseries in various parts of the UK until we are ready for them. We are rising to the challenge, and are working on safe operating procedures for groups to start the planting (Covid-19 restrictions dependent) and hope to be planting later this summer.

We look forward to sharing our progress, learning from others and raising awareness of paludiculture here in the UK and further afield.

More information: https://www.greatfen.org.uk/big-ideas/wet-farming

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3.2.4. The environmentally harmful substitution of the European reed industry

Reed from China displaces European production

14 House with thatched roof on the island of Fehmarn (Photo: Tom Hiss)

With large natural reed deposits on Lake Neusiedl and in the eastern puszta, Hungary is one of Europe's traditional suppliers of reed bundles used for thatching[3]. Since about twelve years the Hungarian reed has been displaced by reed from China, so that many Hungarian reed beds are no longer harvested. In the Netherlands today 80% of thatched roofs are covered with reed from China, in Europe more than 50%. The formerly dominant supplier from Hungary has largely disappeared from the market.

How does the absurd transport of "straw" around half the world come about? A simple agricultural material is transported within China up to 2,000 km by truck, loaded onto a container ship, shipped 21,000 km to Northern Europe and then driven by truck to its destination. The Hungarian lorry has just 1,200 - 1,400 km to cover from the reed depot to the construction site in Northern Germany or in the Netherlands - and yet it is not competitive.

Environmental dumping by maritime shipping

The distortion of competition is caused in particular by the tax-free burning of mineral oil products on the world's oceans, combined with high taxation and regulation of truck transports in Europe. Overall, this leads to significantly higher pollutant emissions than it would be the case under fair competitive conditions. European transports are burdened by the energy tax on diesel (€ 0,47 per litre in Germany) and must comply with the EURO 6 pollutant standard. In contrast, untaxed ship diesel with a significantly higher sulphur content and without pollutant filters is used for sea transport. Thus, long distance transport routes are indirectly promoted.

[3] see Wichmann & Köbbing (2015) http://dx.doi.org/10.1016/j.indcrop.2015.09.027 for a comprehensive overview on reed export and import in Europe

Approx. 1,065 litres of marine diesel are burned for transporting a 40-foot container of reed from China to Northern Europe.[4] For the truck pre-carriage in China and on-carriage in Europe another 400 litres of diesel are needed. The same amount of reed from Hungary causes a consumption of approx. 300 litres of fuel. In total the fuel consumption for reed from China is five times higher than from Hungary. The CO_2 and SOx emissions of the ship transport exceed this factor many times due to the lack of filter technology.

15 Stored thatch bundles in a barn of Hiss company, Bad Oldeslohe, Germany (Photo: Achim Schäfer)

Unfair competitive conditions

The fuel consumption for the China import of a 40-foot container would be subject to € 500 energy tax in Germany (1,065L x 0.4704 €/L). The lack of taxation favours the import from China to Europe; this could be mitigated by an EU CO_2 external tax. The case of reed import shows that a regulatory policy that stops at the external borders of the EU can destroys trading structures in Europe in exchange for significantly higher pollutant emissions worldwide.

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See also the position paper "Reed cutting is an endangered UNESCO cultural heritage - potentials for regional value creation and environmental protection hardly used" of the Greifswald Mire Centre with the Mecklenburg-Vorpommern Thatchers Association (2019) – in German. https://www.greifswald-moor.de/files/dokumente/Infopapiere_Briefings/Faktenpapier%20Rohrwerbung.pdf

3.2. Projects in Germany

3.2.1. Ongoing research on *Sphagnum* cultivation sites in northwest Germany

A recent project has tested the cultivation of *Sphagnum* mosses from 2015 to 2019 on two cut-over bog sites with shallow residual layers of highly humified black peat in northwest Germany. A project consortium has gathered for implementation and scientific monitoring of the experimental sites consisting of the Institute of Environmental Planning at the Leibniz University Hannover, the Thünen Insti-

[4] See A.R. Moeller - Maersk, Annual Report 2019, p. 42: The fuel efficiency of the leading container shipping company in 2019 was 41,2 g/TEU*NM (gram per twenty-foot equivalent and nautical mile). At 11,500 nautical miles from China to Europe and a specific weight of 0,89 kg/L, this results in 1,065 litres of marine diesel consumption for a 40-foot container (twice the size of a 20-foot container).

tute of Climate-Smart Agriculture in Braunschweig and the growing media producer Klasmann-Deilmann GmbH. The study was financed by the Lower Saxony Ministry for Nutrition, Agriculture and Consumer Protection and the German Federal Environmental Foundation (DBU).

16 *Aerial view of the Sphagnum cultivation site 'Provinzialmoor' (photo: Klasmann-Deilmann GmbH)*

The project has demonstrated that the cultivation of *Sphagnum* mosses is possible even under the difficult hydrological conditions of highly humified black peat. While sufficient water quantity and quality are known to be prerequisites for successful *Sphagnum* cultivation, a sufficient peat layer thickness has proven to be an essential factor for successful establishment and growth. Maintaining an optimal water table proved to be a challenge on thin layers of highly humified black peat. The irrigation effort must be increased to compensate for additional water loss and low hydraulic conductivity. Especially on sites with difficult hydrological and soil conditions, a favourable microclimate provided by vascular plants and rewetted surroundings can promote successful establishment of *Sphagnum*.

The horticultural trials have indicated that the cultivated *Sphagnum* biomass can be used as a high-quality growing media constituent and that the preparation and hygienisation of *Sphagnum* fibres is possible with existing substrate-production technology. Compared to conventional agricultural use, the wet management of the sites reduces greenhouse gas emissions, and the greenhouse gas emissions of an irrigation polder did not exceed those of a semi-natural reference site. The greenhouse gas exchange of the *Sphagnum* cultivation areas was strongly influenced by water availability and the composition and development of the vegetation. *Sphagnum* cultivation creates habitat for endangered animal and plant species of raised bogs. The species composition of a cultivation site depends strongly on the donor material, the age of the site, its maintenance and the landscape context. With regard to bog restoration, the introduction of *Sphagnum* fragments has proven to be an interesting option to speed up the regeneration of rewetted peat extraction sites.

17 Sphagnum cultivation site 'Provinzialmoor' with GHG plots (photo: Klasmann-Deilmann GmbH)

What is next?

The cultivation sites are now being used for the harvest of donor material which is introduced to further rewetted cut-over bog sites for restoration. Klasmann-Deilmann is continuing to develop suitable harvesting technology in cooperation with Dutch and German partners within the INTERREG project 'Bioeconomy – Green chemistry'. Suitable machines for regular mowing, harvest cutting and crop

collection on the cultivation sites are being tested. If necessary, existing technology is adapted or further developed. Particularly challenging is the soft ground, combined with the high weight of the harvested peat moss and the separation of vascular plants and peat moss fibres. The Thünen Institute is continuing to evaluate the greenhouse gas balance at one of the cultivation sites, also considering the impact of the *Sphagnum* harvest and of high temperatures experimentally induced by Open-Top-Chambers. Additionally, a greenhouse experiment is set up to elucidate the effects of the interaction between water level, peat properties, temperature and nitrogen deposition on *Sphagnum* growth and completion with vascular plants (https://www.thuenen.de/en/ak/projects/optimization-of-*Sphagnum*-paludicultures/). The Institute of Environmental Planning is using the gained knowledge for the restoration of bogs in the region of Hannover.

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3.2.2. Video on climate friendly management of the Brandenburg peatlands

121.000 ha of the 165.000 ha peatland in the federal state of Brandenburg are in agricultural use. To prevent further peat degradation, Brandenburg wants to show that the management of peatlands can be profitable without draining the meadows. Last autumn technical equipment and utilization possibilities of wet peatlands were demonstrated at the symposium "Climate friendly management of the Brandenburg peatlands". One of its results is a 6 min video on typha, peatlands and climate protection (German with English subtitles).

18 Climate friendly peatland management in Brandenburg (Photo: brandenburg.imwandel.net)

The state of Brandenburg provides two subsidy programmes and plans demonstration areas for the establishment of paludicultures. More information on www.moore.brandenburg.de (German only).

Author: Bas Spanjers, Fachberater im Landesamt für Umwelt Brandenburg/Fachbereich Moorschutz

3.2.3. Video documenting development of Sphagnum farm at Barver

19 Impressive aerial shots of the paludiculture site are part of the Barver Sphagnum farm video (Footage: Nicolas Kuper)

Half a year ago it nearly was only an idea, now it is reality: the Sphagnum farm in Barver (see Paludiculture Newsletter 2020_3). It was set up in winter and spring months as a trial and demonstration facility for the sustainable cultivation of wet peatland areas (paludiculture) as part of the INTERREG project CANAPE. A documentary video now offers a look behind the scenes of this in the Diepholz region unique facility. The 6.5 min film gives insight into the development of the paludiculture site - from the initial planning and extensive earthworks to the seed of the peat mosses at beginning of April.

For the documentary (in German and English) filmmaker Nicolas Kuper from Bakum has been on site in all weathers from the very beginning. The intention was to document the metamorphosis from a drained, only slightly productive raised bog grassland area to a wet cultivated paludiculture area. And since the video is also intended to advertise the paludiculture and the village of Barver, the result should also be aesthetically pleasing to the eye. The CANAPE-Team and filmmakers now hope for a lot of clicks at https://youtu.be/RtAjAnDVgUI. Feedback is welcome!

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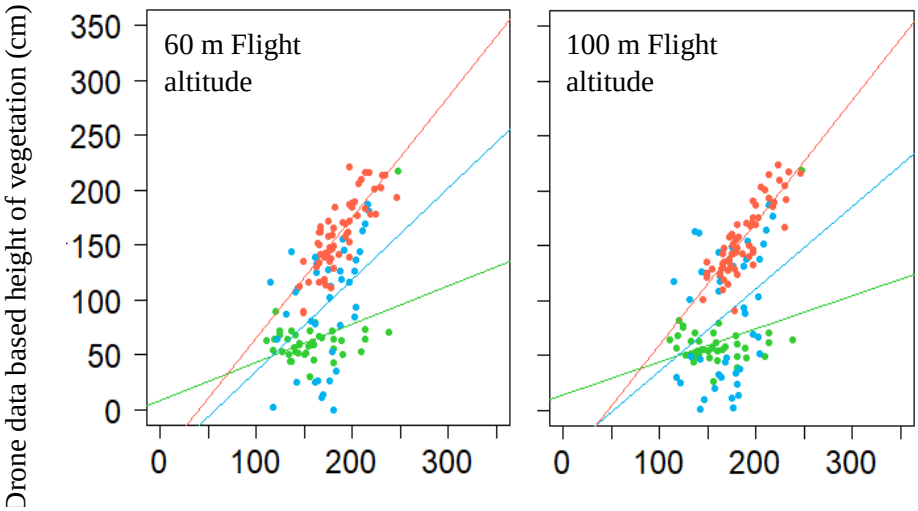
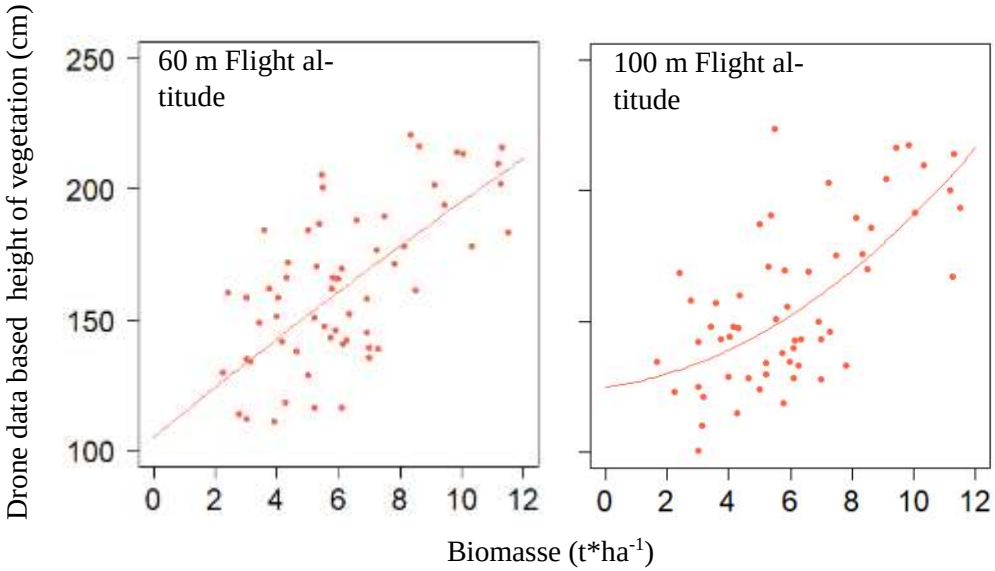
3.2.4. BOnaMoor - Attempt to determine biomass using photogrammetry

The determination of standing biomass in rewetted peatlands is important not only for research but also for producers. Conventional methods have so far been imprecise or time and cost intensive. An alternative is drone-based photogrammetry. In the winter of 2019, the BOnaMoor project examined whether the method is suitable for reed stands used in paludiculture. The drone flew the areas used for production of thatching at the Lieschower Wiek, the Groß Lobber See and near the Peene estuary (all NE-Germany) at heights of 60m and 100m. To validate the drone data, measurements of the plant height, plant density and biomass in the field were also carried out. Here the result of comparing field data and point cloud data from photogrammetry:



20 Regression between field data and drone data based vegetation height for Groß Lobber See (red), Lieschower Wiek (green) and Peene estuary (blue) at 60 m (left) and 100 m (right) flight altitude (Figure: Dahms & Herberger)

The closest relationship between plant height measured on the ground and plant height determined by drone was found on the test area at Großer Lobber See (R^2 = 0.71 (60 m), R^2 = 0.48 (100 m)).



21 Regression between biomass and drone data based vegetation height for Groß Lobber See (red), at 60 m (left) and 100 m (right) flight altitude (Figure: Dahms & Herberger)

There was less correlation at the other locations. It was not possible to clearly determine causes such as lower blade density, snow cover, poor quality crop or wind. However, the use of drone-based biomass determination showed to be potentially suitable for reed stands. Further refinement of the method is required.

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3.2.5. BOGOS – Optimised grassland utilisation of single farms on organic sites in Brandenburg

The aim of the EAFRD project BOGOS (2018-2021) is to develop examples of sustainable grassland use on organic sites while analysing grassland use concepts adapted to individual farms. To this end, the project is working with four cooperative farms in Uckermark, Havelland and Spreewald to explore and implement possibilities for optimisation. The farms generate a substantial part of their added value from grassland farming. In total, about 1,400 ha of grassland are cultivated on organic soils on the cooperative farms.

22 Extremely dried-out topsoil, patchy plant stock and hardly usable biomass in the Uckermark, north of the federal state of Brandenburg,in summer 2019 (Photo: Franz Wenzl)

Procedure and first results

Grassland use on organic sites is generally of great importance in Brandenburg. Grassland accounts for almost 23 % of the agricultural area, of which about 75 % is located on the fen and floodplain sites typical of the north-eastern German lowlands. The drainage-based management of these sites is associated with increasing problems such as soil degradation, soil subsidence and the associated micro-relief as well as massive greenhouse gas emissions. These typical problems are also clearly evident at the cooperative farms.

In the project, site analyses were carried out on a selected area of each farm. Criteria for the selection of the areas include classification of the areas in the Brandenburg peatland soil map, a minimum size of 10 ha, (development) possibilities for regulating and raising water levels, no/minimum impact on adjacent users and infrastructure as well as operational interest. The site analyses include soil condition, plant cover, feed yields and qualities as well as hydraulic engineering conditions. The species composition of water levels was mapped using a simplified recording method based on Succow & Joosten (2001).

The range of water level classes[5] determined extends from 2- (moderately dry, summer water deficit) to 4+ (very moist). The water levels are different on the selected study areas of the farms. Thus, sites in Spreewald predominantly show water levels of the water level 3+ (moist) and 4+. Here the peat consumption is reduced by the relatively high water levels. The biomass is well usable for basic feeding of suckler cows. At the same time there are problems with liver and rumen flukes, which multiply on the (very) moist areas. Areas in Havelland and Uckermark show water level classes in the range of 2-, 3+ and 4+ in similar proportions. The farms in Havelland and Uckermark regions have to cope with severe drought and yield losses. The topsoil is severely degraded due to many years of drainage and is predominantly presumed to be drained. As a result, the nutrient supply of the vegetation is partially unbalanced. This is expressed by the dominance of plants with poor feed value such as lawn-grass melilot ((Deschampsia cespitosa) or flutter-grass (Juncus effusus) (indication of potassium deficiency).

[5] Couwenberg 2016: Soil moisture classes. In: Paludiculture – productive use of wet peatlands. Schweizerbart Science Publishers, p. 92

After two dry summers, the sand-foamcress (*Arabidopsis arenosa*) is dominating in considerable proportions, especially on areas with water level 3+ (moist).

Based on farm structure analyses, the effects of grassland management changes on farm value added will be assessed. The intensity of the areas' use corresponds from low-intensity to high-intensity grassland with two up to four cuts at maximum. The farms are very diverse in their structure and use the grassland in different ways, both as pasture for suckler cows, water buffaloes and geese and as a forage basis for dairy cows. The situation in the cooperating farms reflects very well the complexity of the task being worked on in the project. On the one hand, there is the necessity to produce fodder for the respective livestock farming, on the other hand, there is a decreasing effectiveness of the receiving waters and thus partly wet conditions, but also very dry topsoil and grassland in summer. Adjacent infrastructure, such as railway lines, which limit the decisions on water regulation, as well as nature conservation requirements, which must be included in the planning, must also be taken into account.

A commissioned analysis of the existing amelioration systems determines the hydraulic engineering options on the operational areas and, in addition to the aforementioned analyses of the sites, flows directly into the participatory scenario development.

Outlook

On the basis of the analyses carried out, utilisation optimisations will be developed in the second project phase from summer 2020 together with the companies (co-design approach). Both solutions for grassland fodder production with wet and dry fodder are to be developed.

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4. Events on peatlands and paludiculture

16./17.06.2020 cancelled	Bioenergy Forum Rostock https://www.3-n.info/news-und-termine/veranstaltungen/veranstaltungen-dritter/14-rostocker-bioenergieforum.html proceedings will be made available online
14.-17.09.2020	6th IAHR Europe Congress, Warsaw, Poland; https://iahr2020.pl/
14.-18.09.2020	Symposium "Mires of Northern Eurasia: biospheric function, diversity, management", Petrozavodsk, Russia, mire2020@krc.karelia.ru; abstract submission deadline: 01.06.2020
18.-23.10.2020	11th INTECOL International Wetlands Conference, Christchurch, New Zealand; http://www.intecolwetlands2020.co.nz/intecol20
25.-28.10.2020	Conference of the Geological Society of America (GSA), Montreal, Canada - session T153 „Soils and Long-Term Environmental Change" https://community.geosociety.org/gsa2020/home
25.-27.11.2020	Conference "Sustainable & Resilient Urban-Rural Partnerships – URP2020", Leipzig, Germany https://www.urp2020.eu/; abstract submission deadline: 31.05.2020

09.-11.03.2021	RRR2021 – Conference on "Renewable resources from wet and rewetted peatlands", Greifswald, Germany, www.rrr2021.com
2.-7.05.2021	International Peatland Congress 2020, Tallinn, Estonia www.ipc2020.com
17.-21.05.2021	TISOLS 10th International Symposium on Land Subsidence, The Netherlands, www.tisols2020.org
19.-24.06.2021	RE3 Conference "From Reclaiming to Restoring and Rewilding", Quebec, Canada, http://www.re3-quebec2020.org/
23.-27.08.2021	Eurosoil2020, Geneva, https://eurosoil2020.com/wp-content/uploads/2020/01/Eurosoil-2020-Geneva-Sessions-Descriptions-V4.pdf
31.08.-04.09.2021	SER Conference "A NEW GREEN DEAL FOR EUROPE'S NATURE. Science and political action towards socio-ecological restoration", Alicante, Spain, www.sere2020.org

5. Literature

5.1. Scientific papers

Budiman, I., Januar, R., Daeli, W., Hapsari, R. D., Sari, E (2020) Designing the special pilot economic zone on peatlands. Journal of Geography of Tropical Environments, Vol 4, No 1 (2020). http://www.jglitrop.ui.ac.id/index.php/jglitrop/article/view/73/0

Budiman, I., Bastoni, Sari, E., Hadi, E. E., Asmaliyah , Siahaan, H., Januar, R., Hapsari, R. D. (2020) Progress of paludiculture projects in supporting peatland ecosystem restoration in Indonesia. Global Ecology and Conservation, Vol. 23. https://doi.org/10.1016/j.gecco.2020.e01084

Feldmann, T. (2020) Moore in der Bildung für nachhaltige Entwicklung in Mecklenburg-Vorpommern. Proceedings of the Greifswald Mire Centre 02/2020 (self-published, ISSN 2627-910X), 318 p. + Peatland case (pdf, 4,5 MB)

Geurts, J., Oehmke, C., Lambertini, C., Eller, F., Sorrell, B., Mandiola, S.R., Grootjans, A., Brix, H., Wichtmann, W., Lamers, L. & C. Fritz (2020): Nutrient uptake and biomass production by Phragmites australis and Typha latifolia in a European wetland and peatland gradient. Science of the Total Environment, Special Issue Natural and Treatment Wetland Services in a Changing World.

Heck, M. A., Lüth, V. M., , Krebs, M., Kohl, M., , Prager, A., Joosten, H., Decker, E. L., Reski, R. (2020) Axenic in-vitro cultivation of nineteen peat-moss (Sphagnum L.) species as a resource for basic biology, biotechnology and paludiculture. bioRxiv 004770. https://www.biorxiv.org/content/10.1101/2020.03.25.004770v1

Jabłońska, E., Winkowska, M., Wiśniewska, M., Geurts, J., Zak, D. Kotowski, W (2020) Impact of vegetation harvesting on nutrient removal and plant biomass quality in wetland buffer zones. Hydrobiologia. https://doi.org/10.1007/s10750-020-04256-4

Juutinen, A. et al. (2020) Cost-effective land-use options of drained peatlands– integrated biophysical-economic modeling approach. Ecological Economics, Vol. 175. https://doi.org/10.1016/j.ecolecon.2020.106704

Kabiri, St., Allen, M., , Okuonzia, J. T., Akello, B., Ssabaganzi, R, Mubiru, D. (2020) Detecting level of wetland encroachment for urban agriculture in Uganda using hyper-temporal remote sensing. AAS Open Research. https://aasopenresearch.org/articles/3-18

Ludwig, G. (2019) Opportunities and Challenges of Sphagnum Farming & Harvesting. https://www.theseus.fi/bitstream/handle/10024/267196/Thesis%20YAMK%20Gilbert%20Ludwig%20Final.pdf

Tegetmeyer, C., Barthelmes, K.-D., Busse, S. & Barthelmes, A. (2020) Aggregierte Karte der organischen Böden Deutschlands (pdf). Proceedings of the Greifswald Mire Centre 01/2020 (self-published, ISSN 2627-910X), 10 p. (in German). download map 'Organic soils in Germany' (jpg in high resolution) + download data ESRI-Shapefile (zip, 366 MB)

Triadi, L.B. (2020) Water management for agriculture development in peatlands. IOP Conference Series: Earth and Environmental Science, Volume 437, Number 1. https://iopscience.iop.org/article/10.1088/1755-1315/437/1/012041

Walton, C.R., Zak, D., Audet, J., Petersen, R.J., Lange, J., Oehmke, C., Wichtmann, W., Kreyling, J., Grygoruk, M., Jabłońska, E., Kotowski, W., Wiśniewska, M.M., Ziegler, R. & Hoffmann, C.C. (2020) Wetland buffer zones for nitrogen and phosphorus retention: Impacts of soil type, hydrology and vegetation. Science of the Total Environment. DOI: 10.1016/j.scitotenv.2020.138709

Ziegler, R. (2020): Paludiculture as a critical sustainability innovation mission. Research Policy, Vol. 49, Issue 5. https://doi.org/10.1016/j.respol.2020.103979

Further new publications on peatlands and mires, restoration and rewetting of peatlands as well as nature conservation can be found in the IMCG bulletins, which are regularly published on the IMCG homepage: http://www.imcg.net/pages/home.php

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