Interreg Baltic Sea Region

EUROPEAN REGIONAL DEVELOPMENT FUND

EUROPEAN UNION

DESIRE

# STUDY TOUR GUIDE

# PALUDICULTURE IN NORTHERN GERMANY

**21st – 24th October 2019**

UNIVERSITÄT GREIFSWALD
Wissen lockt. Seit 1456

Succow Stiftung

Partner in the GREIFSWALD MIRE CENTRE

EU STRATEGY FOR THE BALTIC SEA REGION FLAGSHIP

## Imprint

Unless stated differently, material for this study tour guide was compiled from the following resources:

- Haberl, A. (2018): Study tour guide – paludiculture (EUKI project). Michael Succow Foundation, Greifswald/Germany.
- Author's collective (2017): Proceedings of the 2nd International Conference on the Utilisation of Wetland Plants RRR 2017 conference in Greifswald. Michael Succow Foundation and Institute of Sustainable Development of Landscapes of the Earth (DUENE e. V.), Greifswald/Germany.
- Wichtmann, W.; et al. (2016): Paludiculture – productive use of wet peatlands. Schweizerbart Science Publishers.
- Theuerkauf, M.; et al. (2006): New nature in North-Eastern Germany – a field guide of the SER conference 2006. Institute of Botany and Landscape Ecology, University of Greifswald/Germany.

This study tour guide has been elaborated for the EU INTERREG project "DESIRE" and edited by Jelena Lange and Wendelin Wichtmann with contributions from Sabine Wichmann and Josephine Neubert.

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All partners in the Greifswald Mire Centre.

Greifswald, October 2019

Cover photo: Tom Hiss giving explanations on the Hiss Reet company in Bad Oldesloe during the EUKI-Paludi-Baltic excursion in 2018 (W. Wichtmann).

Print: digital print copy, Greifswald

The project "DESIRE" is supported by the Interreg Baltic Sea Programme 2014-2020. The project is a flagship project of the EU Strategy for the Baltic Sea Region in the Policy Area "Nutri". It is financed by the European Regional Development Fund (ERDF), the European Neighbourhood Instrument (ENI), and the Russian national funding.

On behalf of:

Implemented by:

# Content



**Infoboxes:**

# Overview – The DESIRE project

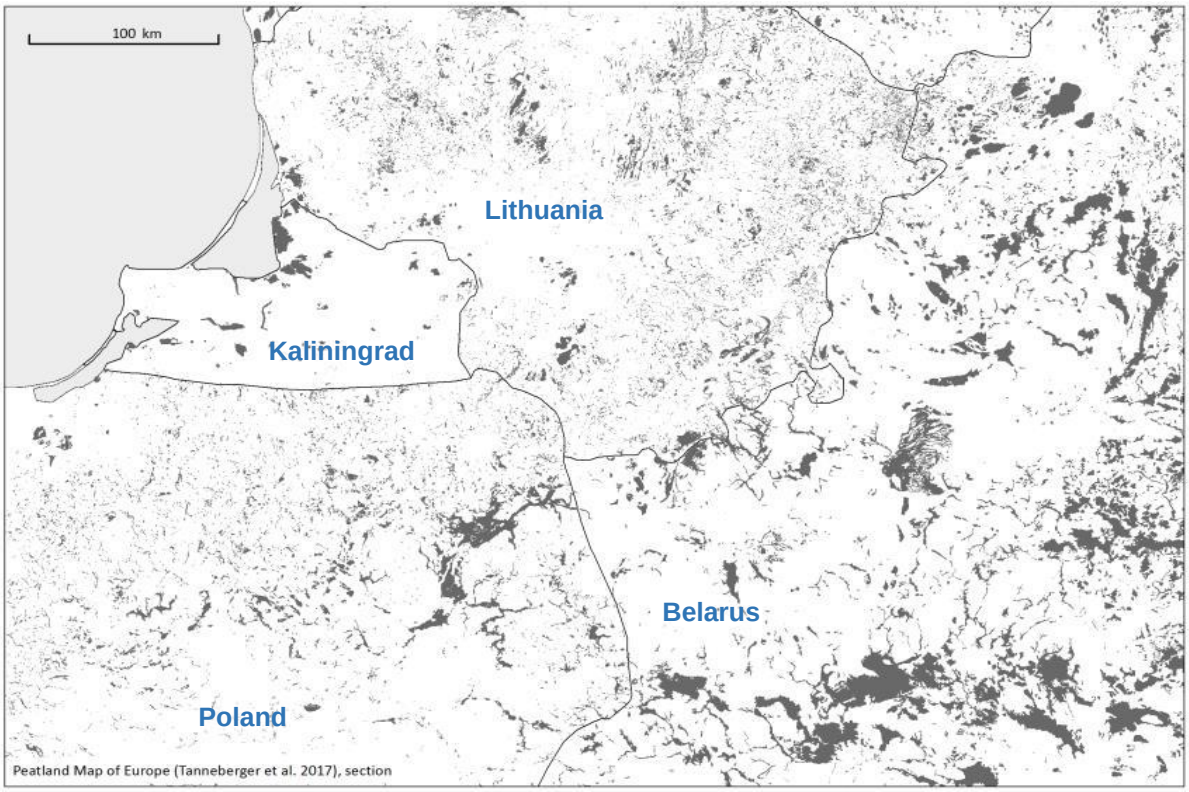
The study tour to paludiculture sites and companies dealing with paludi-biomass in Northern Germany will be carried out in the framework of the project “DESIRE” within the actions “Dialogue of multidisciplinary working group on paludiculture implementation” and “Cross-sectoral dialogue on paludiculture biomass utilisation”. The project DESIRE is supported by the Interreg Baltic Sea Programme 2014 – 2020 for 2.5 years and is a designated flagship project of the EU Strategy for the Baltic Sea Region in the Policy Area “Nutri”.

The project addresses the improvement of peatland management in the Neman river catchment by rewetting and paludiculture. It is led by Greifswald University supported by the Michael Succow Foundation (Greifswald) and cooperates with partners and associates from all countries in the catchment area (see list below).

The project comprises a mixed approach of generating new knowledge via experiments and modelling, using pilot sites to demonstrate peatland rewetting and implementation of paludiculture and drafting evidence based policy recommendations. Capacity of policy makers and other decision makers will be increased to adopt policies that incentivise peatland management for nutrient retention.


The catchment of the Neman river (Čerkasova et al. 2016 [1]).

[1] Čerkasova, N., Ertürk, A., Zemlys, P., Denisov, V., Umgiesser, G. (2016): Curonian Lagoon drainage basin modelling and assessment of climate change impact. Oceanologia 58 (2), pp 90 – 102.




Peatland distribution in the catchment area of the Neman river (modified after Tanneberger et al. (2017): The peatland map of Europe. Mires and Peat 19, pp 1-17.).

The DESIRE project is based on the main assumption, that water quality in the Neman basin and eventually in the Baltic Proper will benefit by

- reduction of nutrient loads from diffuse sources in the catchment area (mainly arable lands) and
- preventing peatlands to act as nutrient sources and internal-external eutrophication hot spots.

**Area of the Neman river catchment**

| Total basin area, km$^2$ | Country | Drainage basin area, km$^2$ | % of total basin area | % of total runoff in medium dryness years |
|---|---|---|---|---|
| **98 200** | Lithuania | 46 795 | 47.7 | 50 |
| | Belarus | 45 600 | 46.4 | 43.5 |
| | Kaliningrad Oblast (Russia) | 3 132 | 3.2 | 6.2 |
| | Poland | 2 554 | 2.6 | 0.3 |
| | Latvia | 98 | 0.1 | 0.3 |

Reference: http://www.helcom.fi/Lists/Publications/Forms/AllItems.aspx

| DESIRE in short | |
|---|---|
| **Full name** | "Development of Sustainable (adaptive) peatland management by Restoration and paludiculture for nutrient retention and other ecosystem services in the Neman river catchment" |
| **Duration** | January 2019 – June 2021 |
| **Financing** | European Regional Development Fund (ERDF), European Neighbourhood Instrument (ENI), Russian national funding |
| **Target groups** | regional and national authorities in the Neman catchment area, NGOs, decision makers in forestry and water management, farmer`s associations, and agricultural administrators and consultants |
| **Partners** | ▪ University of Greifswald (Germany, lead partner)<br>▪ Michael Succow Fundation (Germany)<br>▪ Warsaw University of Life Sciences – SGGW (Poland)<br>▪ Polish Society for the Protection of Birds (Poland)<br>▪ Lithuanian fund for Nature (Lithuania)<br>▪ State budget Institution of the Kaliningrad region "Nature Park 'Vishtynetsky'" (Russia)<br>▪ Bialystok University of Technology (Poland)<br>▪ Vytautas Magnus University (Lithuania) |
| **Associated Organizations** | ▪ Biebrza National Park (Poland)<br>▪ Belarussian State University (Belarus)<br>▪ Institute for Nature Management of the National Academy of Science of Belarus<br>▪ Regional Water Management Authority Polish Waters in Bialystok (RZGW) (Poland)<br>▪ Regional Directorate for Environmental Protection in Bialystok (RDOŚ) (Poland)<br>▪ Mecklenburg-Vorpommern Research Centre for Agriculture and Fisheries (Germany)<br>▪ APB-Birdlife Belarus<br>▪ Environmental Protection Agency of Lithuania<br>▪ Žuvintas Biosphere Reserve (Lithuania) |

**DESIRE-Project websites:**

- Interreg Baltic Sea Region Programme Website (English): https://projects.interreg-baltic.eu/projects/desire-183.html
- University of Greifswald (English): https://botanik.uni-greifswald.de/experimentelle-pflanzenoekologie/projekte/desire/ https://bit.ly/2o5RCoo
- Greifswald Mire Centre (German): https://greifswaldmoor.de/projekte.html
- Michael Succow Fundation (English): http://www.succow-stiftung.de/desire.html
- Polish Society for the Protection of Birds (Polish): www.otop.org.pl/naszeprojekty/chronimy/torfowiska-desire/
- Lithuanian Fund for Nature (Lithuanian): https://www.glis.lt/?pid=1&news_id=635
- Bialystok University of Technology (Polish): https://pb.edu.pl/brpm/desire/

**Box 1: What is paludiculture?**

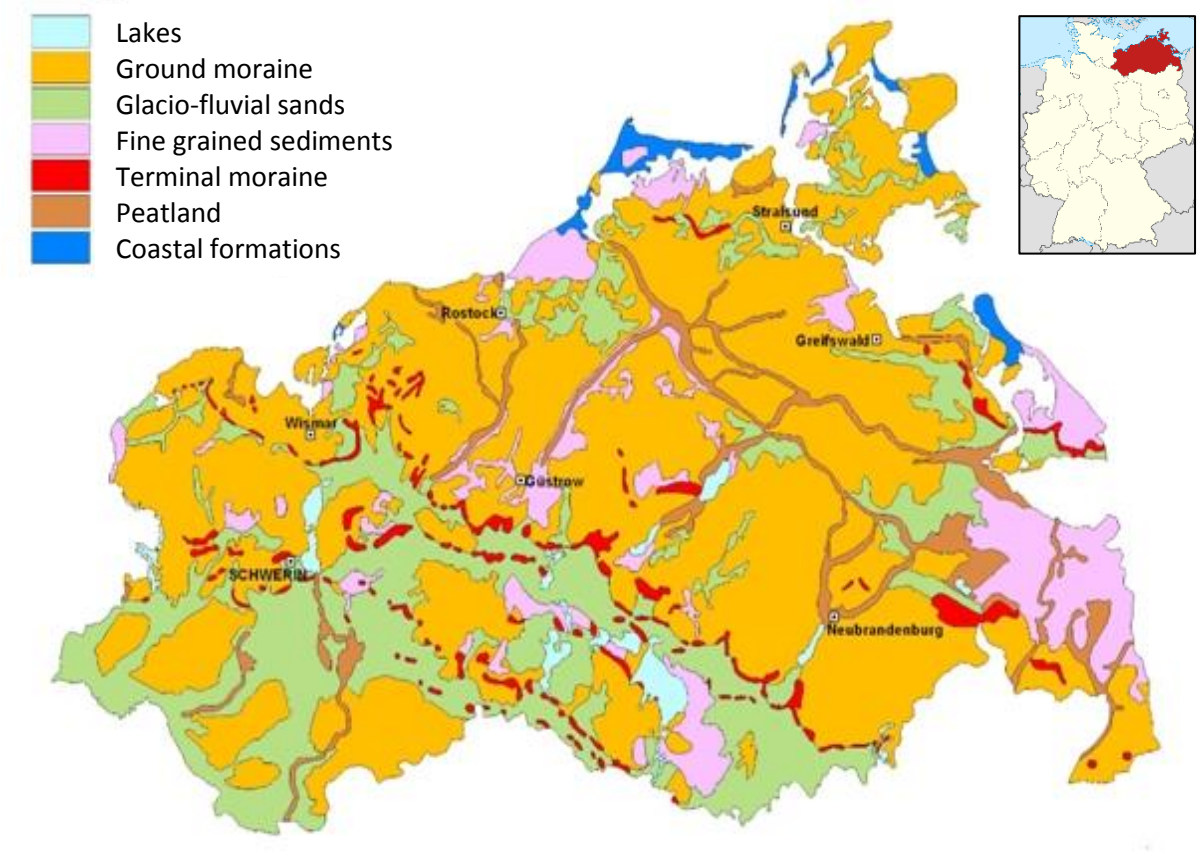
"Paludiculture is the agricultural or silvicultural use of wet and rewetted peatlands. Paludiculture uses spontaneously grown or cultivated biomass from wet peatlands under conditions in which the peat is conserved or even newly formed (Wichtmann & Joosten 2007). Paludiculture differs fundamentally from drainage based conventional peatland use, which leads to huge emissions of greenhouse gases and nutrients and eventually destroys its own production base through peat degradation (Joosten et al. 2012). Paludiculture allows the re-establishment and maintenance of ecosystem services of wet peatlands such as carbon sequestration and storage, water and nutrient retention, as well as local climate cooling and habitat provision for rare species (Chapter 5; Joosten et al. 2012, Wichtmann et al. 2010). Paludiculture implies an agricultural paradigm shift. Instead of draining them, peatlands are used under peat-conserving permanent wet conditions. Deeply drained and highly degraded peatlands have the greatest need for action from an environmental point of view, and provide the largest land potential. The implementation of paludiculture is the best choice for degraded peatlands. Paludiculture is a worldwide applicable land management system to continue land use on rewetted degraded peatlands. Various plants can be cultivated profitable under wet conditions. Paludiculture is also a land use alternative for natural peatlands particular for regions where the increasing demand for productive land drives the drainage. Because of their vulnerable ecosystem services, pristine peatlands should best be protected entirely. If land use on pristine mires is unavoidable, paludiculture should always be given preference over drainage-based land use (Joosten et al. 2012)"

Text copied from Wichtmann, W.; et al. (2016): Paludiculture – productive use of wet peatlands. Schweizerbart Science Publishers.

## Introduction – Mecklenburg-Vorpommern

### Landscape

The federal state of Mecklenburg-Vorpommern is located in northeast Germany and extends along the Baltic Sea coastal plain. The moderate climate is primarily influenced by the Atlantic Ocean and the Baltic Sea. The region's landscape was largely formed by glaciers, which deposited material and shaped the scenic hilly sites and lowlands that filled during the Holocene after the melting of the ice of the late glacial period of the Vistula ice age (since ~ 11.000 years before present) with wide peatlands, lakes, and meandering streams. The central part of Mecklenburg-Vorpommern is characterized by a hilly plateau stretching from west to east, dominated by fertile clay soils and covered by beech forests. The Southwest, located between the plateau and the Elbe river, is characterized by poor sandy soils, pine forests, and marshy valleys. Along the coast, steep cliffs alternate with beaches and dunes. Within Germany, Mecklenburg-Vorpommern is the federal state with the largest peatland area (mainly fens) and the largest river valley mire – the Peene River valley.




Geological units of Mecklenburg-Vorpommern, and its location in Germany (top right corner). Source: Landesamt für Umwelt, Naturschutz und Geologie.

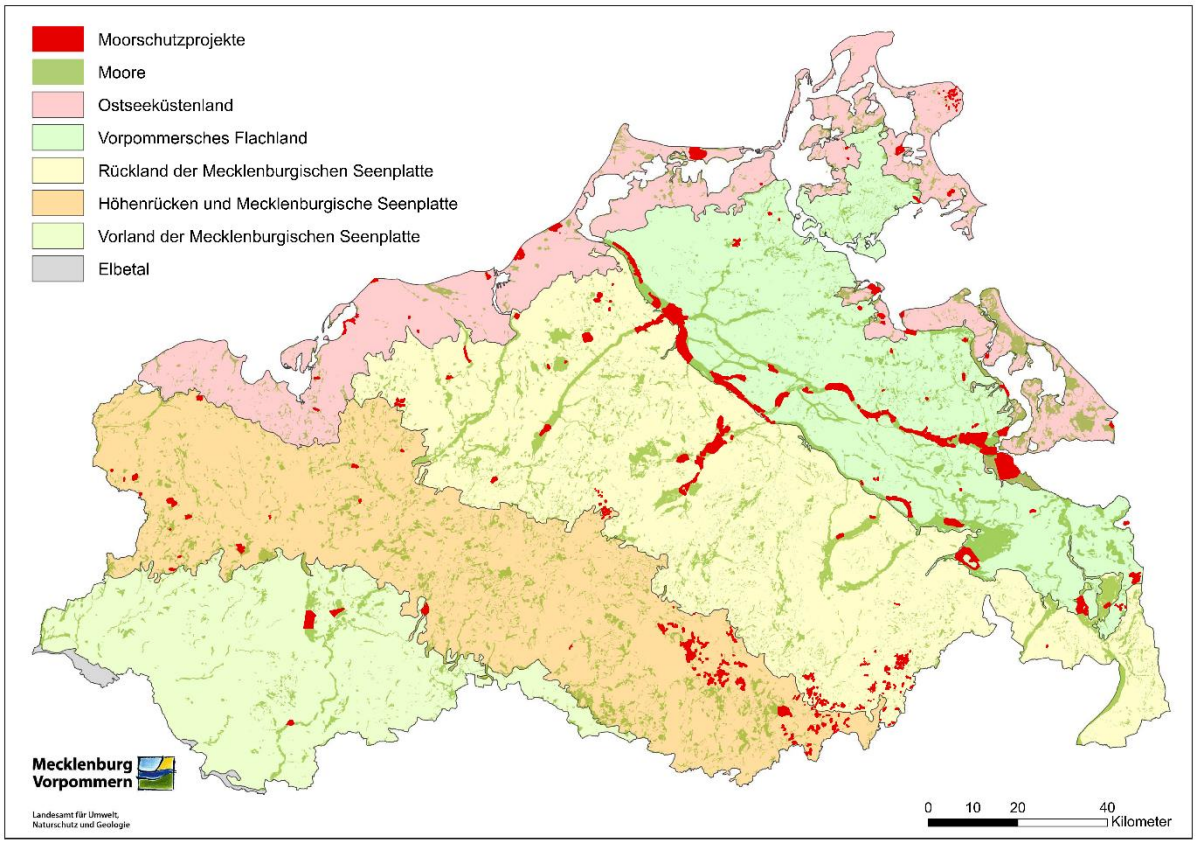
### Land Use History

In the recent past, agriculture was the main driving force shaping the landscape in the region. This was particularly the case during the Soviet era (1945–90), when the forced collectivization program merged small private farms into large state owned collective farms ("Landwirtschaftliche Produktionsgenossenschaften", LPG). After the German reunification

(1990) and privatization of farms, these relatively large-scale structures in agriculture compared to German and Western European standards continued to prevail. On the one hand, this helped to maintain and develop the competitiveness and efficiency of agriculture as an important economic sector in the country. However, on the other hand, this exacerbated environmental problems that were induced in the 1960s with a large-scale program for land reclamation and drainage of peatlands - the “Komplexmelioration”. Peatland drainage measures within this melioration program were implemented until the early 1980s. But fertility and capillary water conductivity dramatically decreased under intensive agricultural use on drained peatlands, so that a peatland conservation movement started in the 1990s.

**Current Land Use**

At present, nearly two-thirds of the state are covered by farmland and about one-fifth by forest. The main cultivated crops of the region are wheat, barley, sugar beets, potatoes, rye and hay. Corn (maize) and peas are also grown, and the state is among Germany’s leading producers of rapeseed. The region’s pastures, mainly on drained peatlands, support herds of cattle, sheep and horses. The majority of the peatland area is drained for agricultural purposes. These soils cause 27% of the total CO2 emissions of the federal state. Less than 3% of the peatland area are under near natural or undrained conditions, another 59% are extremely or strongly degraded by drainage.




Landscapes and peatland restoration projects in Mecklenburg-Vorpommern.

**Nature Conservation**

The conservation of peatlands was integrated in the federal program for peatland conservation of Mecklenburg-Vorpommern (Moorschutzprogramm MV) in 2000. Since then, measures for re-wetting and stabilization of hydraulic conditions have been implemented on 26,032 ha of peatlands (8.9 % of the total peatland area). Further re-wetting and conservation projects are planned. Currently, there are 283 nature reserves, 110 landscape reserves and three national parks, scattered all over the state - large parts of these parks also include peatlands. For example, the "Vorpommern Lagoon Area National Park" in large parts is situated on the Darss Peninsula and its surrounding waters, and the National Park "Jasmund" is located on the northeastern coast of the island of Rügen.

**Box 2: Peatlands in Mecklenburg-Vorpommern**

Peatlands currently cover 12% (about 290,000 ha) of the land area of Mecklenburg-Vorpommern. The most widespread type are river valley peatlands. Pristine river valley peatlands consist of three adjacent and functionally connected hydrogenetic mire types that are fed by ground and surface water. From the edge of the river valley to its center they consist of surface flow mires (spring mires), percolation mires in the valley plain, and flood mires adjacent to the river.

**Spring mires** are fed by ground water and develop when aquifers are truncated and therefore artesian ground water continuously discharges to the surface. Spring mires are sloped, sometimes even forming small cupolas and ridges. Where the artesian ground seeps out with high pressure Calcium is precipitated; the peat is highly decomposed and shows a high Calcium content.

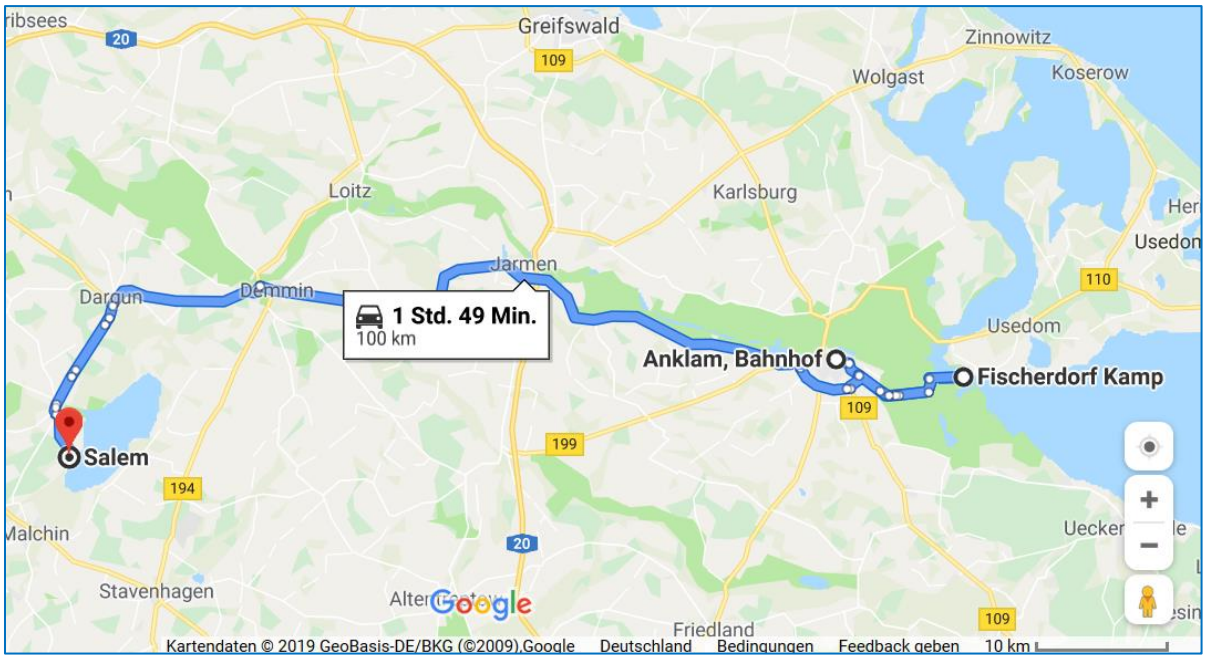
**Percolation mires** stretch across the sloped river plain adjacent to the spring mires. They are fed by the spring mire water discharge and the continuous ground water inflow. For this reason, the peat is only slightly decomposed and mineral and nutrient contents decrease to the center of the valley until the flood water regime of the river overrules the groundwater flow. The hydraulic conductivity of the peat body is high, and surface water levels are stable due to continuous water supply and the oscillation capacities of the slightly decomposed peat body. Percolation mires are the dominant peatland type of the North-Eastern German Plain, for example in the Peene catchment area.

**Flood mires** are under the influence of water from neighbouring water bodies. They are inundated periodically or episodically and can also fall dry. This mire type only occurs where inundations regularly occur. Inundation mires can be found in parts of the "Große Rosin" at the "Kummerow" lake and in the Lower Peene valley, downstream of Anklam. The periodically occurring dry periods provoke the development of highly decomposed peat and eutrophic nutrient conditions.

**Locally bogs** (ombrotrophic mires) can develop in river valley complexes where precipitation water forms rainwater lenses nesting in groundwater fed fen areas. The "Anklamer Stadtbruch" has 500 ha of such bog area nesting in a percolation mire. It is the biggest bog complex in Mecklenburg-Vorpommern, but unfortunately widely destroyed by peat extraction.

# Excursion Day 1 – Monday, 21st October

## Route and schedule




| Time | Location or event | Remarks |
|---|---|---|
| | 13:00 Arrival in Berlin<br>13:46 Train from Central Station (HBF) to Anklam<br>15:44 Arrival at Anklam station | Travel to Anklam (via Berlin) |
| 16:00 – 16:30 | Bus transfer to field sites in Kamp (25 Min.) | |
| 16:30 – 17:45 | *Typha* cultivation test site polder, harvesting techniques, *Typha* products | |
| 17:45 – 19:35 | Bus to Salem near Malchin (110 Min.) | |
| 19:30 | Salem at lake Kummerow | Check in Kolping Hotel |
| 19:45 | Kick-off dinner in Restaurant Kolping, Salem | |

## The Peene River Valley

### Landscape

The Peene River valley is one of the largest fen areas in Germany, comprising 45,000 ha of land. Due to its wild character, it is known as the ‘amazon of the north’. The landscape was formed by melting water during the Ice Age and shows landscape units of extended flat ground moraines of Mecklenburg-Vorpommern. It stretches across 85 km from Lake Kummerow (Kummerower See) in the west to the Oder Lagoon (Oderhaff) in the east. After the Elde River, the Peene River has the second largest catchment area and discharge of all rivers in this federal state. It has an extremely small hydraulic gradient of only 20 cm over 85 km. When water levels in the Baltic Sea are high or when strong easterly winds occur, an unusual phenomenon can be observed: the Peene River flows upstream. The Peene river valley belongs to the system of the large river valleys of northeastern Germany that were formed during the last ice ages as glacial valleys. By autonomic peat growth, extend percolating mires formed fed by Calcium rich groundwater from the mineral ridges and with peat deposits being more than 9 m thick. Close to the Peene River, a narrow area is covered by flood-plain fens, characterized by the special hydrological situation of the river.


Location and aerial photograph of the Peene River Valley.

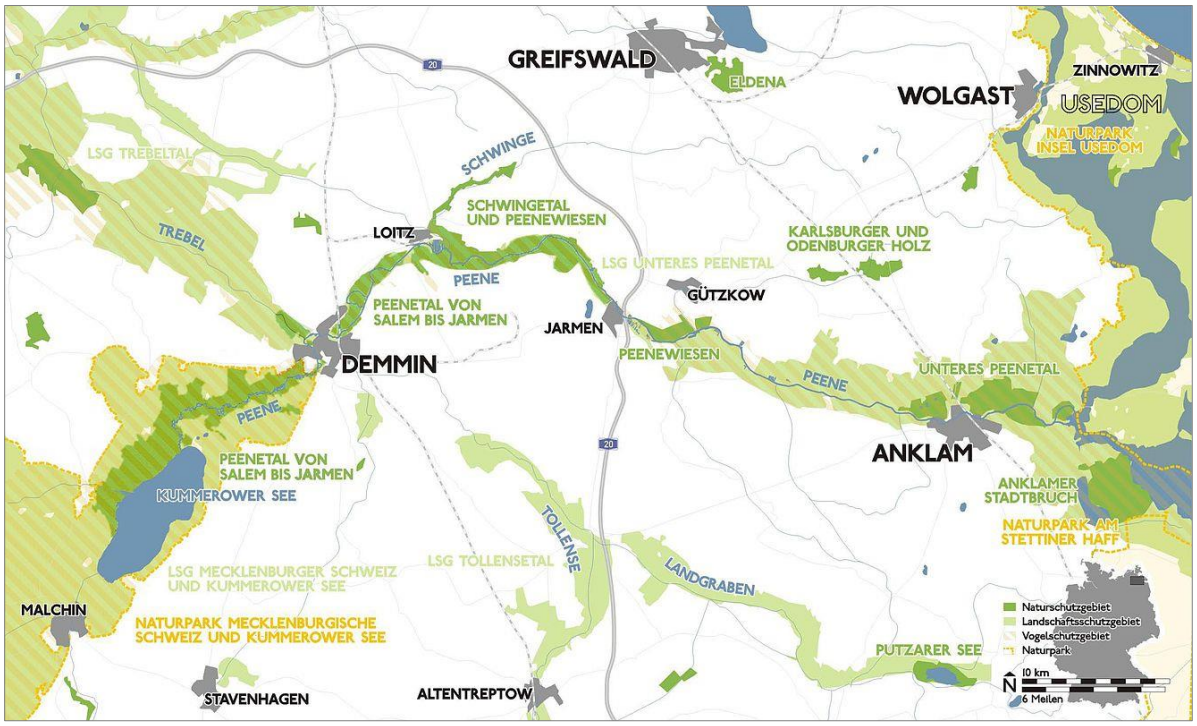
### Land use history

Traditionally, the undrained or slightly drained peatlands at the Peene River mouth were used for grazing, hay-making and locally also for peat cutting. Most parts of the mire have been under continuous use since medieval times. The limited size of the peatland made it easily accessible and enabled an early use. During 1300-1800, the mire was part of the common land (German: Allmende) and land use was hardly differentiated, a general characteristic of agriculture at that time. Land use intensity varied with social problems, political directions, and population density. Meadows occupied 23 % of the mire. About one-half of the meadows that was located closer to the villages was mown annually; the rest was mown less frequently. The largest part of the mire was used as pasture, mainly for cattle – 22 % were grazed regularly and 55 % only sporadically. Both meadows and pastures were characterized by superficial drainage. After the medieval tradition of common lands ceased, the now private land was parceled and used more intensely. Levelling and improved drainage allowed the exclusive use as meadows. Until the mid-19th century, the huge and still wet common pastures were transformed into small patches of better-drained meadows interrupted by peat pits - and the traditional paludiculture use ceased. In the 1920s, the state initiated and funded the formation

of cooperatives responsible for largescale drainage of the mire. Until World War II, large areas were poldered and used as high-intensity grassland after ploughing. After complex melioration programs in times of the DDR including intensified drainage, half of the peatland was used for high intensity grassland monoculture. After 1995, the polder system was abandoned and large parts of the peatlands were left to nature. This initiated the transition towards a landscape dominated by wetlands and forest swamps.

**Current land use**

Today, while a part of the peatlands is still used as high intensity grassland, the rewetted parts are either abandoned, used for conservation mowing or for reed cutting. Conservation mowing is implemented on ca. 150 ha of wet peatland at the Peene River mouth by a local nature conservation NGO (Förderverein Naturschutz im Peenetal e.V.) in cooperation with local farmers and supported by the foundation OSTSEESTIFTUNG. Reed cutting for thatch is currently practiced on ca. 80 ha of the Peene River mouth. In the region of Vorpommern, in total 10 companies are active in reed cutting on a total area of ca. 550 ha. In 2017, the Federal state strategy for paludiculture was launched in order to find alternative ways to cultivate land under wet conditions.




Peene River valley with its nature reserves.

**Nature conservation**

The Peene is the best-preserved river valley mire in Germany and a refuge for rare plant and animal species (see introduction above). Therefore, the Peene River valley obtained the status of a Special Protected Area (SPA, since 1990). The nature reserve “Unteres Peenetal (Peenetalmoor)” is an important bird area (IBA, since 1988). Between 1992 and 2009, the large-scale conservation and restoration project “Peenetal/Peene- Haff-Moor” has been implemented to create a protection area of 45,000 ha covering the whole valley mire and including a core area of 20,000 ha of strict nature reserves. The nature park Peene valley was

founded in 2011 and covers 33,400 ha. In 2017, an alliance of the Greifswald Mire Centre together with regional NGOs has proposed to designate the Peene valley as Ramsar site (decision at the level of the federal state of Mecklenburg-Vorpommern is still pending). From 1992 to 2008, large areas of fens in the Peene valley were rewetted, creating an outstanding nature conservation area.

**Research**

Several research-projects are taking action in the region. Since 2006, a local nature conservation NGO (Förderverein Naturschutz im Peenetal e.V.) is studying the effects of summer conservation mowing at the Peene river mouth. With the EU project REPEAT, partners from Antwerp, Warsaw and Greifswald universities studied the effect of machine mowing on peat formation in fens in 2017/2018. Vegetation composition, soil and root properties as well as decomposition rates were compared at paired mown and unmown plots in Recknitz and Peene valleys.

**Further reading**

REPEAT project: www.repeat.paludiculture.com

**Box 3: Greifswald Mire Centre (GMC)**

The GMC is the interface for science, policy and practice in all peatland related questions – locally and globally. More than 50 peatland experts of various disciplines are concentrated in one place, offering science-based solutions for social challenges such as

- Climate protection: Reduction of greenhouse gas emissions from peatlands and ecosystem-based adaptation
- Biodiversity: Conservation and restoration of peatlands worldwide
- Sustainable use: Paludiculture and innovative financing such as carbon credits

Partners in the Greifswald Mire Centre:

- University of Greifswald
- DUENE e. V. (nonprofit association)
- Michael Succow Foundation

Further information: https://greifswaldmoor.de/home.html

## Excursion site Kamp – Typha harvesting and utilization

**The Polder Kamp**

Kamp is a little village nearby the mouth of the Peene River, which discharges into the Szczecin lagoon between Usedom island and the mainland. The village is surrounded by peatlands. Some of these peatlands are rewetted, other parts are still under drainage-based intensive use as grasslands. Within the EU project CINDERELLA, partners from Aarhus, Halmstad, Nijmegen and Greifswald installed a study site near Kamp for transdisciplinary research on crop production with *Typha*. Large *Typha* stands had developed here after natural rewetting took place. Research included soil, climate conditions and genetic characteristics, as well as nutrient removal and supply, biogeochemistry – of soil, water and carbon dynamics. Results show that the production of *Typha* on rewetted peatlands can, at optimal water table, combine high biomass productivity, high nutrient uptake and low emission of greenhouse gases. The project also included sustainability as well as micro- and macro-economic assessments. In Kamp harvesting trials, biomass processing and use as building materials is monitored and integrated into a broader economic analysis and a life cycle assessment. Using a balloon-tyred "Seiga" machine, ca. three ha of *Typha* were harvested as bundles in winter 2016/17, yielding 7.5 t DM/ha.

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Field days with demonstration of *Typha* harvest in Kamp (W. Wichtmann).

**Box 4: The CINDERELLA project**

In the climate change debate, peatlands and their role for the global climate are more or less neglected – like Cinderella in the fairy tale. In order to change this, the international, transdisciplinary research project CINDERELLA, funded by ERA-NET FACCE-JPI (The Joint Programming Initiative on Agriculture, Food Security and Climate Change), was initiated. The project was carried out as a joint effort between scientists and practitioners from Sweden, Denmark, The Netherlands, and Germany, to further explore and acquaint paludiculture. The transdisciplinary research program included field and laboratory investigations as well as legal and economic studies to develop recommendations for site adapted management of wet peatlands, but also decision support for stakeholders and politicians. The main objective was to extend the scientific base for a sustainable, productive land use of wet peatlands and to make alternative forms of use accessible to farmers and land authorities. Furthermore, the project investigated the productive use of rewetted peatlands and the simultaneous restoration of ecosystem services, including reduction of greenhouse gas (GHG) emissions and land subsidence, water and nutrient retention, and water purification.

Key scientific findings and outputs of the CINDERELLA project:

- Growing and harvesting paludicrops like *Typha* and *Phragmites* is – with adequate water management and soil conditions - economically feasible on the farm-scale, at least when the provision of ecosystem services is rewarded.
- Retention of nutrients in agricultural run-off increases productivity of paludicrops and substantially mitigates farm-born N, P and down-stream GHG emissions.
- Laboratory and field studies as well as literature reviews verified that paludiculture provides various ecosystem services including GHG emission reduction, nutrient retention and water storage, in addition to biomass production.
- National and EU policies hamper the cultivation of crops like reed, cattail and *Sphagnum* mosses, which are considered not eligible for direct payment under the First pillar of the Common Agricultural Policy (CAP). Obligations to maintain permanent grassland impede the rewetting of grassland for permanent paludicultures. Regulatory adjustments on national and EU levels are needed.
- Second Pillar funding is used to co-finance a wide range of restoration and maintenance measures linked to achieving agri-environment-climate objectives on peatlands and can be used and refined to support paludiculture. Genetic background of different ecotypes of *Phragmites australis* as well as *Typha latifolia*, *T. angustifolia* and *Arundo donax* affects plant productivity and preferred site conditions.
- Growth and productivity of different species and ecotypes of paludicrops depend on nutrient availability and fertilization as well as the genetic background of the plants.
- Various applications of *Typha* and *Phragmites* (food and fodder, construction material, fuel) were tested. The harvested biomass of paludicrops (*Typha* and *Phragmites*) can be processed and used for fodder, building materials, biogas and heating by direct burning.
- Management needs, productivity, and various economic utilization alternatives of paludiculture have been analyzed.

**Further reading:** www.moorwissen.de/de/paludikultur/projekte/cinderella/cinderella.php

**Box 5: Paludiculture Crops**

**Reed canary grass** *(Phalaris arundinacea)*
is growing fast, the yields are high, and it burns well. Therefore, it is highly suitable to produce energy. Reed canary grass meadow can also be used as a wetland buffer zone for nutrients; water is directed from the drainage ditches of agricultural lands to re-vegetated peatlands. In this way, reed canary grass can be fertilised and nutrients removed. It is worth noting that the Estonian variety "Pedja" is cultivated as forage plant, and in Sweden, for example, paper is produced of reed canary grass.

**Cattail** *(Typha* spec.*)*
can be used as fodder and energy plant, additionally it is often used as insulation material and for boards in the eco-construction sector. As a pioneering species of wet and muddy lands, it grows well in the restored peatlands and rapidly forms a dense plant cover.

**Common reed** *(Phragmites australis)*
can be used as a construction material e.g. for roof thatching or construction boards, in handicrafts, and as fuel in heating plants. Because the common reed can withstand brackish water, this plant can be collected also from coastal wetlands. It has good combustion properties e.g. calorific value comparable to wood, mineral contents in comparison to reed from peatlands is lower than e.g. in agricultural straw from mineral soils what means less ash during combustion, if harvested in winter low contents in problematic substances, see also Box 6.

**Sedges** *(Carex* spec.*)*
are used both as energy and forage plants, but also as a raw material for paper. Compared to the reed canary grass or the common reed, the sedges are more tolerant towards the nutrients found in soil.

**Peat mosses** *(Sphagnum* spec.*)*
are adapted to the nutrient poor and acid conditions in rainfed mires (bogs). The resulting slightly decomposed nutrient poor and acid *Sphagnum* peat (White peat) is the most important substrate in industrial horticulture. See also last excursion point: Hankhausen.

**Tourist house in Kamp**

In 2014, the Dutchman Aldert van Weeren bought a 19th century house in Kamp, which will also be visited during the excursion. His intention was to use it as a guesthouse for nature lovers that are attracted by the beautiful landscape of the Peene River mouth. Using local building material from rewetted peatlands was an obvious (but still rarely practiced) approach in the construction sector.

In cooperation with the University of Greifswald, a local farmer, local reed cutters and two factories in Prenzlau and Waren teamed up to produce 75 m³ blow-in insulation made from cattail, and fire proof construction panels made from waste incurring during the production of

thatching reed. These building materials were used for the renovation of the guesthouse. Due to its sponge-like tissue, including a large amount of air-filled cells (aerenchyma), cattail biomass is an outstanding natural insulation material.

**The Wetland Products Foundation**

Inspired by his findings, Aldert van Weeren founded the Wetland Products Foundation. The foundation's objective is to develop and promote building materials from wetland plants in Germany and The Netherlands.

**Further Reading**

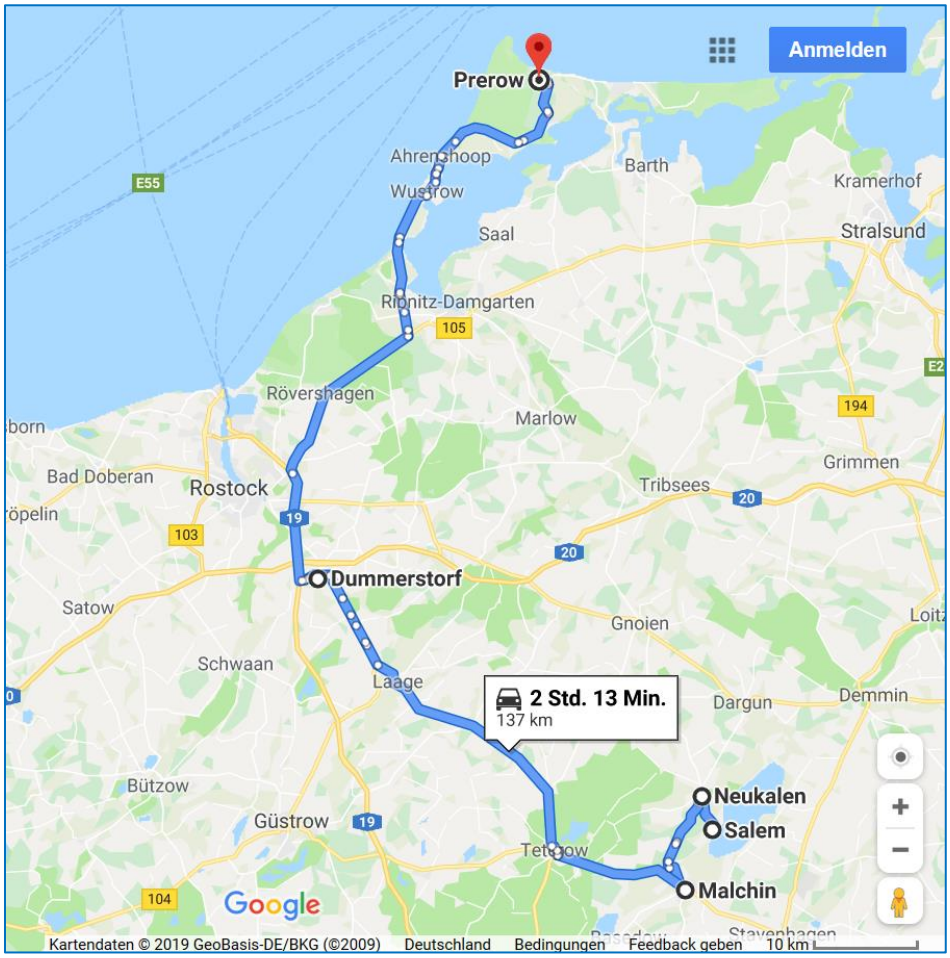
Stiftung Wetland Products: www.wetlandproducts.com

Getting lost during research activities in the *Typha* field near Kamp (W. Wichtmann).

Different products made of common reed and cattail (www.wetlandproducts.com).

# Excursion Day 2 – Tuesday, 22nd October

## Route and schedule




| Time | Location or event | Remarks |
|---|---|---|
| 8:00 | | Check out from Hotel. |
| 8:15 – 8:30 | Lake Kummerow near Neukalen wet meadows (drive through) | Hay making sites in wet peatlands, Tractor transport to the field site |
| 8:30 – 8:45 | Bus Neukalen - Malchin | |
| 8:45 - 9:30 | Heating plant Malchin | Thermal utilization of hay bales |
| 9:30 – 11:30 | Bus to Neukalen (20 Min.), *Typha* plantation field site from PRIMA project | |
| 11:30 – 12:30 | | Bustransfer 60 Min. |
| 12:30 – 13:30 | Lunch | |
| 14:00 - 18:00 | Workshop on paludiculture strategies for implementation, potential inclusion of paludiculture in agricultural policies | Dummerstorf: Mecklenburg Vorpommern Research Centre for Agriculture and Fisheries (LfA) and FBN |
| 18:00 - 19:15 | Bus transfer to Prerow/Darss (75 Min.) | |
| | Dinner, enjoy the site … | Check in at hotel |

## Excursion site meadows “Neukalener Seewiesen”

The area of Neukalener Seewiesen (ca. 400 ha) is characterized by peatland meadows and fens. It has been drained for agricultural use in former times and nowadays (since >15 years) it is a re-wetted peatland with dominating sedge-meadows. Further, some mosaics of Reed Canary Grass meadows occur, as well as Reed Mannagrass *(Glyceria maxima)* dominated patches. Small areas are covered by Common Sedge or Black Sedge. Red List species like Marsh stitchwort *(Stellaria palustris)*, Ragged-Robin *(Lychnis flos-coculi)*, Brown Sedges (e.g., *Carex disticha*) as well as Common Meadow-Rue (*Thalictrum flavum)* are remarkable.

The Neukalener Seewiesen, Lake Kummerow in the background.


Harvesting Neukalener Wiesen in late July 2018 with adapted machinery (tandem axis, wide tires with low pressure) at groundwater tables of 25 - 35 cm below soil surface.

The area of the wet meadow complexes notably increased after the pumping station was closed down. As, since that time, the groundwater tables are corresponding with the water tables of the Lake Kummerow, from time to time the peatland is fully inundated, depending on the wind direction and water table conditions of the lake. The change in water level affected the species composition of the sites, resulting in decreased fodder quality unsuitable for cattle feeding. The agricultural enterprise of Hans Voigt was forced to switch to an alternative. Therefore, they pioneered in using sedge and reed biomass for powering a district heating unit. The hay that is meanwhile grown and harvested on the site is used as fuel in the biomass heating plant in Malchin (detailed information see below).

## Excursion site Malchin – Biomass heating plant

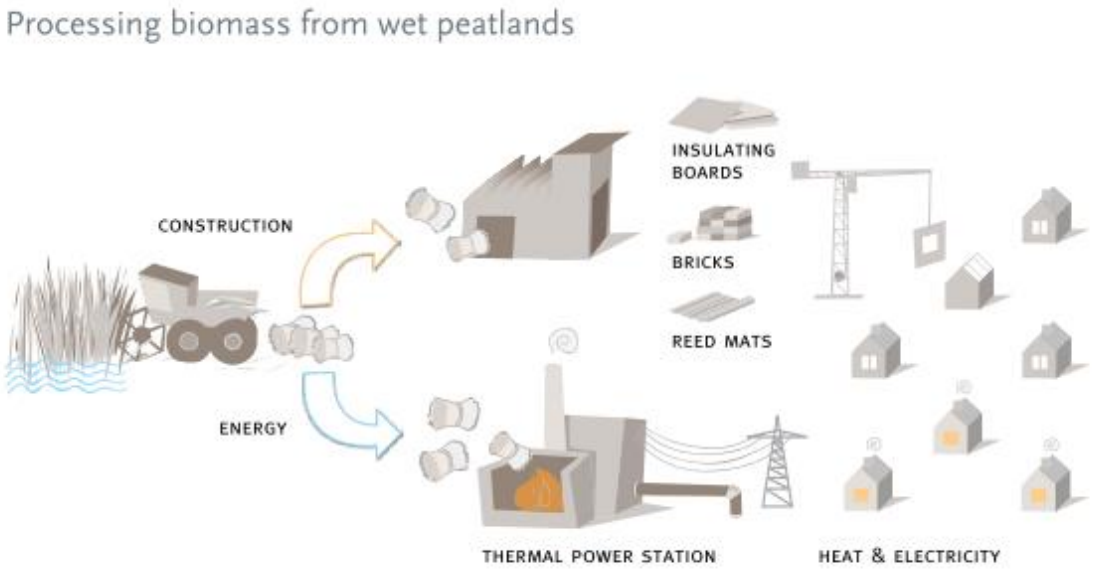
**Biomass heating plant Agrotherm Ltd. Malchin**

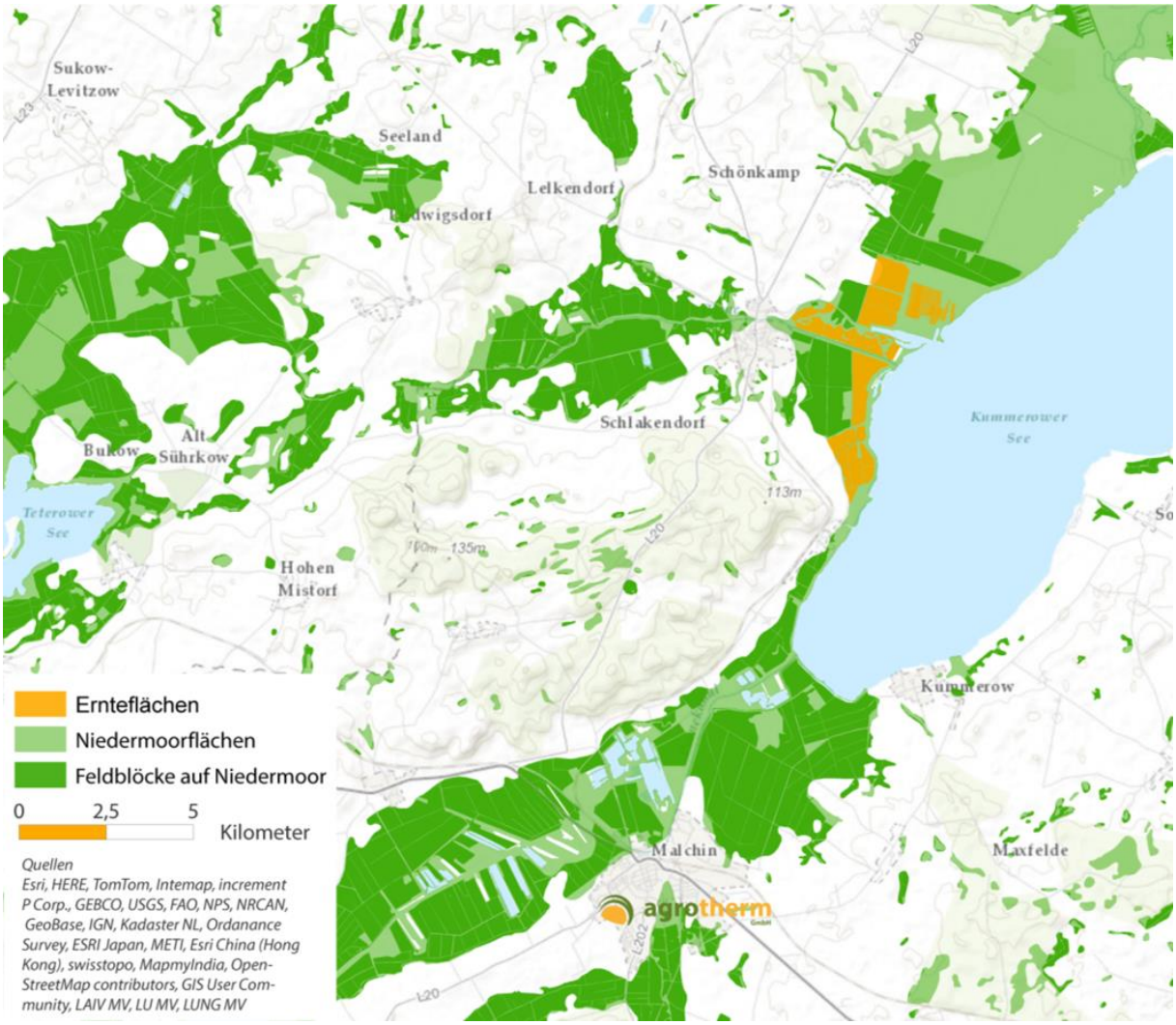
The decision to build up a heating plant to use the hay from wet meadows of Neukalener Seewiesen as fuel was motivated by several reasons. Due to the re-wetting, and because of the ban on fertilizers, biomass quality was no longer good enough to feed suckler cows. Therefore an alternative use for the biomass, now mainly sedges, reed and reed canary grass, was needed. After several years of planning, and due to successful cooperation with ongoing research projects at the University of Greifswald, the thermal utilization of fen biomass was chosen as a promising alternative.

An optimal scheme for harvesting hay as fuel on 250-350 ha could be elaborated, which provides the regular demand of a regional heating plant with biomass. The local energy provider could be convinced to cover the basic load for heat provision of about 500 households, a school and a kindergarden in the city of Malchin by using bioenergy. With site-adapted machinery the 2-4 t of biomass per hectare can be cut, swathed and baled in summer during dry periods. Approximately 6,000 bales, each with a weight up to 250-300 kilograms, are harvested per year. In the exceptionally warm and dry summer of 2018, sites that are normally not accessible could be reached for harvest, and totally around 11,000 Bales were processed.

The heating plant has been constructed by Ludwig Bork to convert this fen biomass to heat. In addition to the reduction of the emissions from the formerly drained peatland, the 1,000 t of harvested fen biomass provide a total energy supply of 4 GWh and replace 375,000 l of fossil heating oil. Thermal utilization of fen biomass enabled farmer Hans Voigt – and its successor Henning Voigt – to continue the use of their land, keep their employees and preserve the nature heritage. Local production of sustainable biofuels increases regional collaboration. However, to increase acceptance of peatland re-wetting and restoration for climate and regional development, it is vital to create local networks between land users, administration, district heating stations and energy users.

Biomass fuel storage in Neukalen and inundated grasslands at Lake Kummerow (W. Wichtmann).




Location of Agrotherm, meadows Neukalener Wiesen (orange), and peatland area (green).

**Box 6: The BOnaMoor project (2018 – 2021)**

In November 2018, Greifswald University (Greifswald Mire Centre) in collaboration with the Hochschule für Technik und Wirtschaft (HTW; engl.: University of Applied Sciences) in Berlin started a research project to study the production of biomass on wet peatland sites and the optimization of the thermal utilization of such biomass resources. This joint project BOnaMoor, funded by the Federal Ministry of Agriculture (BMEL) via the Agency for Renewable Resources (FNR), investigates possibilities of optimizing the provision, processing and thermal utilization of biomass from wet moor sites. Based on the previous use in the context of landscape conservation and the thermal utilization of hay from landscape management, the project aims to optimize and further develop the cultivation of energy crops on wet fen sites. The individual objectives of the project are as follows:

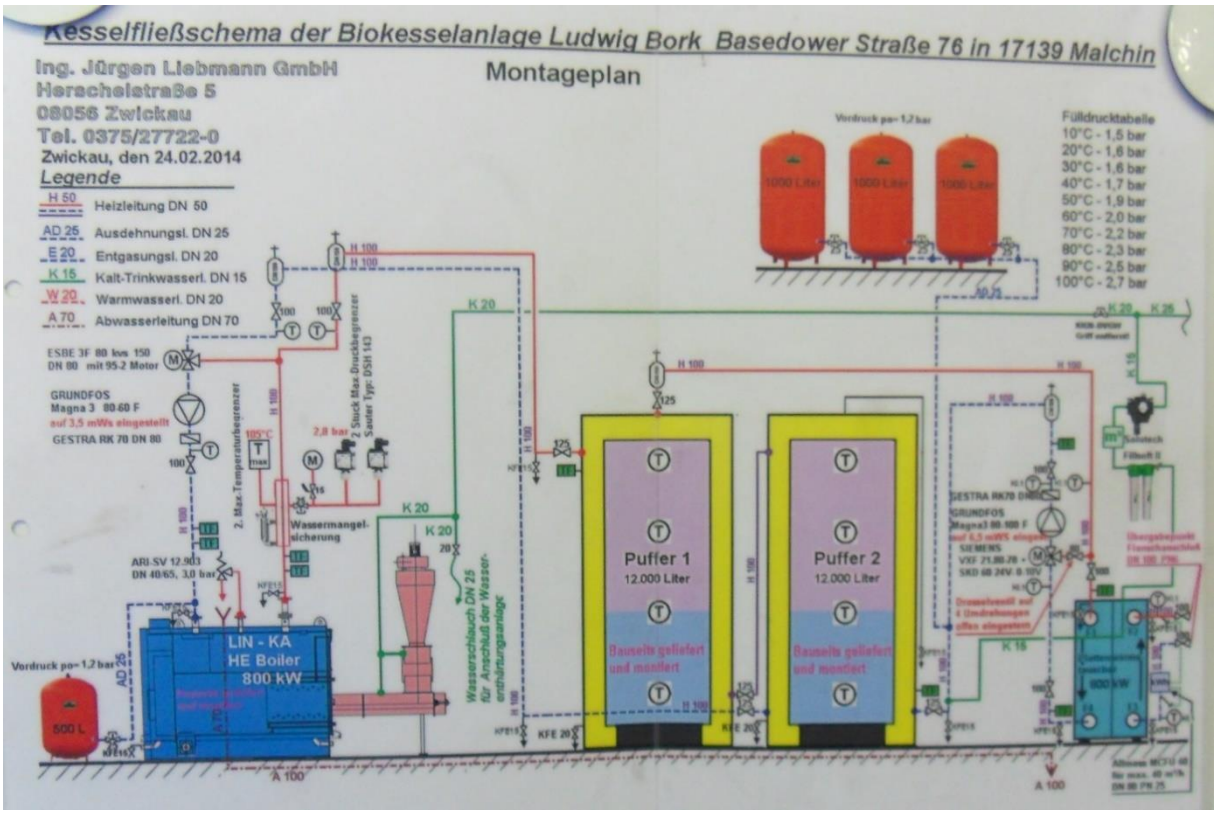
- Development of sustainable and economically viable cultivation systems and value chains for biomass from wet fen sites,
- Optimization of the production of renewable raw materials on wet fens,
- Optimization of the thermal utilization of biomass from wet fens.

The area for the production of biomass is located on the shore side of Lake Kummerow and has been used for many years, first by grazing of suckler cows. Rewetting began about 15 years ago. Data on the long-term development of plant communities after the abandonment of drainage-based management (sedges, reed-grass, wet grassland) are still lacking. Studies on yield and locations for different dominant stands are carried out in order to estimate long-term yield expectations. The availability of biomass from wet peatland sites is limited to sites where summer haymaking is possible. Due to the high water levels, there is a special dependence on the weather and the available technology. In order to exploit the existing and future potential, the harvesting system for the production of energy biomass must be further optimized. Corresponding recommendations will be developed by the project.

First combustion tests were carried out at the 800°kW heating plant for community heating in Malchin (Mecklenburg-Vorpommern) to determine the quality-relevant properties of the fuels with their respective effects on the combustion process (water content, calorific value, ash content, volatile components, coke content). Furthermore, the physico-mechanical properties for the paludi-biomass (reed, sedges, reed canary grass and their mixtures) were analyzed. Through the close cooperation between research and practice, the BOnaMoor project ensures that the questions examined are oriented towards the requirements of practice. In this way, recommendations for action can be directly derived and proposals for optimization can be developed.

**Further reading:**
https://www.moorwissen.de/de/paludikultur/projekte/bonamoor/index.php

| Main features of Agrotherm | |
|---|---|
| **Location** | Heat supply grid Malchin |
| **Performance** | 800 KW (thermal) |
| **Biomass need** | 800-1.000t/year |
| **Biomass origin** | Rewetted fen peatland sites in the Peene River valley |
| **Harvest area (yield)** | 400 ha (~ 4 - 5 t/ha) |
| **Substitution effect** | 290.000-380.000 l Oil |



Boiler flow diagram of the heating plant Malchin (W. Wichtmann).


Conveyor and disintegration unit for round bales (W. Wichtmann).

## Excursion site Neukalen – Paludi-PRIMA project

Paludi-PRIMA puts paludiculture into practice: From May 2019 onwards, paludiculture is implemented and studied on fen sites in the frame of the new project “Bringing paludiculture into practice: integration – management – cultivation”. The three-year joint project is carried out by four working groups of the University of Greifswald in cooperation with the Research Centre for Agriculture and Fisheries Mecklenburg-Vorpommern, and funded by the German Federal Ministry of Food and Agriculture (BMEL).
Paludi-PRIMA investigates the cultivation of cattail (*Typha latifolia, Typha angustifolia*) and common reed (*Phragmites australis*). A demonstration site of approx. 10 ha was established in NE Germany near Lake Kummerow to gain large-scale experience on the implementation of paludiculture. Additionally, a mesocosm experiment investigates the effect of genetics, water levels and nutrient availability on the development of plants and their biomass quality, e.g. the suitability as thatching reed. PRIMA aims at improving the framework conditions of paludiculture, organizes field days and develops practical guidelines and recommendations.

Interim storage of *Typha* plants on the test site, waiting for planting (W. Wichtmann).

Left: Planting *Typha* in Neukalen (T. Dahms). Right: PRIMA project site before rewetting (S. Wichmann).

Mesocosms in the Botanical Garden/Arboretum in Greifswald (W. Wichtmann).

**Project progress**

In August and September 2019, construction works were carried out to prepare the pilot site for the rewetting (see table below). 50,000 *Typha* seedlings, grown by a commercial nursery specialized in wetland plants, were delivered in mid-September 2019 and mechanically planted with two tractors and planting machines from forestry on the pilot site near Neukalen. Subsequently, the site was rewetted. If plants establish well, the first harvest will take place in winter 2020/21. By monitoring stand establishment, nutrient uptake, water balance, biomass quality, and cost data, the field trial will generate practical information on the technical implementation, plant growth, and economic efficiency of cattail and reed paludiculture within the next 2.5 years.

| PRIMA – practical information | |
|---|---|
| **Type of peatland** | Fen peatland (up to ~4-5 m of peat) |
| **Previous use** | Until summer 2019: grassland for grazing of suckler cows, production of winter fodder |
| **Preparatory work** | Hydrological feasibility study conducted end of 2018 → basis for planning of construction work and permit application (water law);<br>Needed for permit according to nature conservation law: assessment of breeding bird species, EU habitats directive preliminary audit (location of the site in SPA), intervention-compensation balance, exception from regulations of the landscape conservation area |
| **Construction** | High effort, since the pilot site is a wet island in drained surroundings:<br>Building bunds for water retention, digging new ditch outside the pilot site to collect seepage water and prevent rewetting of surrounding grassland, build irrigation infrastructure (pump + inflow during spring/summer, using water from the river Teterower Peene), two outflows to regulate water table |
| **Land ownership** | Pilot site rented from the local farmer for duration of the project (3 years) |
| **Planting design** | Two species: *T. latifolia*, *T. angustifolia*; each with two densities: 1 plant per m² (2 x 0.5 m) and 0.5 plants per m² (2 x 1 m) |
| **Products** | Wide range of utilization avenues, e.g. construction and insulation material |

**Further reading:**
https://www.moorwissen.de/en/paludikultur/projekte/prima/index.php

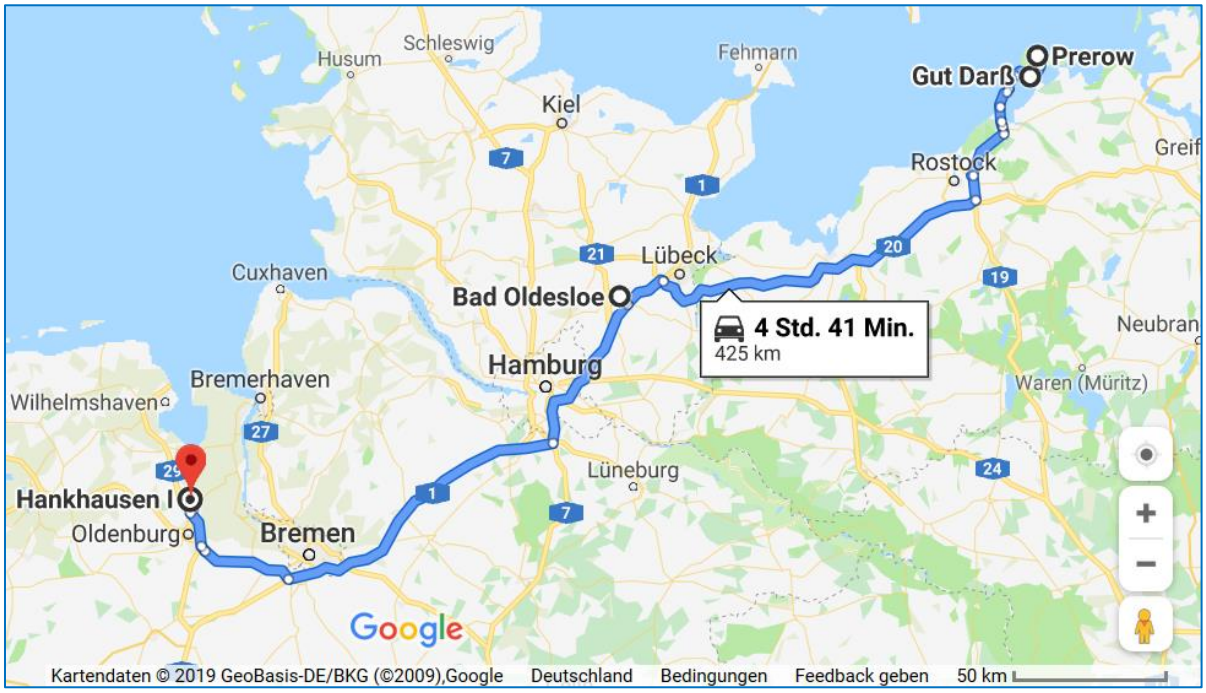
## DESIRE workshop in Dummerstorf

**Date:** Tuesday, 22nd of October 2019
**Place:** Mecklenburg-Vorpommern Research Centre for Agriculture and Fisheries (LfL), resp. Leibniz Institute for Farm Animal Biology (FBN), Wilhelm-Stahl-Allee 2, 18196 Dummerstorf

| **14:00 – 15:45** | **Short presentations** | | |
|---|---|---|---|
| **Time** | **Topic** | **Name** | **Organisation** |
| 14:00 | Welcome | Prof. Dr. Wimmers, Dr. Peter Sanftleben | FBN Research Centre for Agriculture and Fisheries M.-V. |
| 14:10 | Peatland related opportunities of the research Centre, PRIMA project | Dr. Telse Vogel, Dr. Matthias Dietze | Research Centre for Agriculture and Fisheries M.-V. |
| 14:25 | The DESIRE project: Aims, methods and desired outcomes | Dr. Wendelin Wichtmann | GMC/Succow Foundation and University Greifswald |
| 14:40 | Potential of nutrient elimination/ reduction by rewetting of peatlands and implementation of paludiculture | Jelena Lange, Dr. Mateusz Grygoruk | GMC/University Greifswald, SGGW Warsaw, Poland |
| 14:55 | Strategy for paludiculture Mecklenburg-Vorpommern | Monika Hohlbein, Dr. Thorsten Permien | GMC/University Greifswald Ministry for Agriculture and Environment M.-V. |
| 15:10 | Outcomes of paludiculture Feasibility study in the Baltics | Dr. Jūratė Sendžikaitė, Nerijus Zableckis, Andreas Haberl | LfN Vilnius, Lithuania GMC/Succow Foundation |
| 15:25 | Products from paludiculture | Aldert van Weeren | Wetland products |
| 15:40 | Discussion | | |
| 16:00 | Break | | |
| **16:15 – 17:15** | **Parallel discussions on paludiculture implementation and policies** | | |
| **A:** 16:15 | Impulse talk on implementation of rewetting and paludiculture | Dr. Wendelin Wichtmann | GMC/University Greifswald |
| 16:20 | Administrative implications for implementation of paludiculture | Susanne Abel | GMC/Succow Foundation |
| **B:** 16:15 | Impulse talk on policies | Jan Peters | GMC/Succow Foundation |
| 16:20 | Policies to incentivise paludiculture | Tomasz Wilk | OTOP, Poland |
| 17:15 | Reporting and summarising | | |
| 17:45 | Wrap up, closing remarks | Jan Peters, Dr. Wendelin Wichtmann | |

# Excursion Day 3 – Wednesday, 23rd October

## Route and schedule




| Time | Location or event | Remarks |
|---|---|---|
| 8:00 | | Check out from hotel, Bus transfer (15 Min.) |
| 8:30 – 11:00 | Gut Darss, Born | Coastal peatland management with water buffaloes, production and marketing of water buffalo meat for regional market |
| 11:30 - 13:00 | Lunch in Born | |
| 13:00 - 15:30 | Bus transfer (150 Min.) | |
| 15:30 - 17:00 | Bad Oldesloe: Company Hiss Reet - construction materials from reed | |
| 17:00 - 20:00 | Bus transfer (180 Min.) | |
| 20:00 | Restaurant near Hankhausen | Dinner with thematic paludiculture round table working group sessions with contributions from Polish, Lithuanian and Russian experts and stakeholders (see participants list).<br>Check in at hotel. |

## Excursion site Born – Water buffaloes at Gut Darss

**Gut Darss**

The farm “Gut Darss” is a certified organic farm situated in the village of Born in the Eastern part of the Darss peninsula that produces and markets organic food products. The main branch of the enterprise is suckler cow husbandry with 4,700 cattle in total. The cattle is kept on the pastures for at least eight months per year and only self-produced fodder consisting of hay and wilted silage are used. The farm does not use synthetic nitrogen fertilizers or pesticides, genetic engineering, or any products that artificially enhance growth or performance. Additionally to the cows, they breed sheep, goats, and water buffaloes. In total, “Gut Darss” manages 4,500 ha of pastureland for grazing and for making grass silage (18 - 20,000 t annually). The farm leases 2,000 ha from the National Park “Vorpommersche Boddenlandschaft” and manages the land for landscape maintenance purposes with low intensity grazing by cattle, and by grazing with water buffaloes on an area of 300 ha of peatland. Beside managing reed encroachment of peatland areas with special floating harvesters, especially site management with water buffaloes turned out to be very effective.

Gut Darss is supported by the European Agricultural Fund for Rural Development (EAFRD, period 2014-2020) of the European Union and the Federal State of Mecklenburg-Vorpommern. The farm promotes itself as “adventure farm”, offering meat products, houses for rent and touristic events.

**Water buffaloes**

“Gut Darss” started with water buffalo breeding in 2007 with a herd of ~20 water buffaloes. Since then, the herd grew rapidly, reaching about ~240 water buffaloes today. There are about 70 farms with 1,500 water buffaloes in Germany in total. Due to their wide claws, the animals can move well on wet pastureland that cannot be pastured by cattle.

In the marketing branch of the enterprise, the water buffalo meat sells like hot cakes. Local restaurants make good deals with the exotic and locally produced organic water buffalo products not only during the tourist season; the top seller for example is the “Büffel-Burger”. We will visit grazing sites with water buffaloes on Darss peninsula and large flocks of migrating cranes.

**Suppressing reed encroachment by site management with water buffaloes**

The coastal marshes of the southern Baltic region are typically influenced by brackish water from periodical flooding of the Baltic Sea. Brackish reed beds constitute the natural climax vegetation in these coastal marshes, but grazing by domestic animals has transformed this natural vegetation into an anthropo-zoogenic salt marsh. Grazing has kept the habitat open and created a mosaic of tidal creeks, seasonal pools, brackish pioneer vegetation, salt marshes and reed beds. The spatial variety in diverse habitats encountered in these salt marshes likely supports a more species rich plant and animal community than the apparently monotonous brackish water reed beds. Regular grazing has created a typical salt marsh with many rare species on Schmidt-Bülten, a 28 ha large island in the Vorpommern lagoon (Saaler Bodden). Abandonment or reduced grazing pressure would cause the vegetation – with its high conservational value – to be lost to succession towards reed beds. In recent years, management of the island focused on grazing by suckler cows with low livestock density (0.6 livestock units per hectare, LU $ha^{-1}$). However, low reed beds developed in the wetter areas (soil moisture class 5+) and regular grazing remained restricted to the drier parts of the island

(soil moisture class 3+). Parts of the dry area were even overgrazed, resulting in decreased species richness. Since June 2010, water buffaloes have been used for grazing on the island in order to restore the typical salt marsh vegetation and to suppress the encroaching reed beds. A livestock density of 1.0 – 1.3 LU $ha^{-1}$ and 123 – 148 grazing days per season proved sufficient to reduce the area of reed beds by 30%. Like suckler cows, water buffaloes preferred the drier parts of the island with its high-quality fodder at the beginning of the grazing season. Nonetheless, the animals did disturb the reed beds already early in the season by regular trampling and some grazing on young shoots. As the amount of available fodder dwindles during the course of the grazing season, the buffaloes more regularly feed on the young reed culms, allowing understory plants to benefit (mainly *Agrostis stolonifera* ssp. *maritima* and *Juncus gerardii*). Meanwhile, the suppression of reed has led to an increase in the grazing area (which, in 2012, required a slight increase in the livestock density) in order to keep grazing pressure at the required level (Horn et al. 2016).

**Literature and further reading:**

Horn, S., Sweers, W., Frase, T. (2016): Suppressing reed by grazing water buffalo. In: Wichtmann, W., Schröder, C., Joosten, H. (eds., 2016): Paludiculture – Cultivation of wet peatlands. Schweizerbart Science Publishers, Stuttgart. 272 p.

Gut Darss Website (in German): http://gut-darss.de/

Website of the European Commission - Agriculture and rural development - Rural development 2014-2020: https://ec.europa.eu/agriculture/rural-development-2014-2020

**Box 7: Water buffaloes**

The water buffalo was domesticated 6000 years ago and returned to Central Europe after extinction about 200 years ago. In Germany, until 1998, buffaloes were exclusively hold in zoos whereas other European countries (Romania, Bulgaria, Hungary, Italy) already used them for milk production and as working animal. Buffaloes reach a maximum age of 40 years and weights of 600 – 1000kg. Water buffaloes are very social animals, living in family groups and seem to like the contact with humans.

**Box 8: Management of fen meadows with cattle**

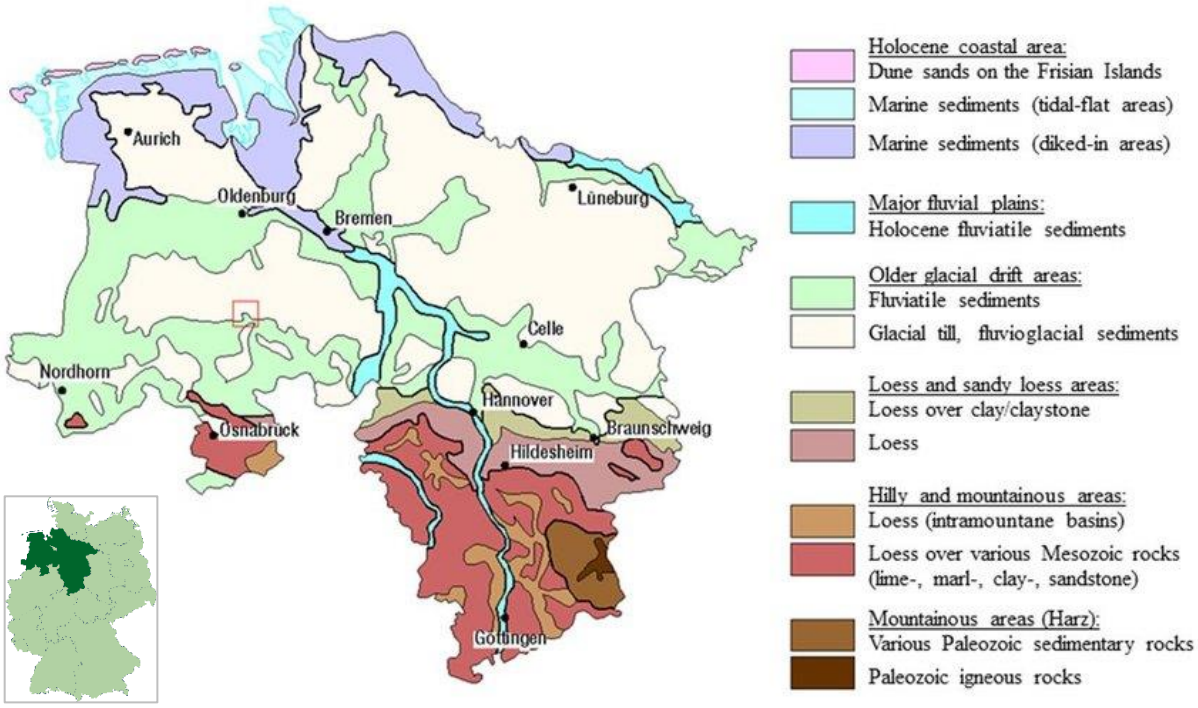
Since the “Wende” (German reunification) in 1989, the cattle population of northeastern Germany has decreased considerably. Consequently, the demand for grassland declined and large areas were abandoned. Revenues from drained fen grasslands failed to balance the costs, thus their utilization relies on subsidies (direct payments, agro-environmental schemes, premium for organic farming). Consequently, many fen grasslands were abandoned and left to natural succession, making them attractive for re-wetting projects. Others are farmed at very low intensity, keeping the drainage systems functioning. Several research projects at Greifswald University addressed the sustainable use of re-wetted fen peatlands, including cattle grazing. Results showed that extensive grazing with cattle is more effective than static proceeding of mowing. With their feeding behaviour cattle create a diverse pasture landscape which creates refuges for other animals and therefore contribute to the biodiversity. In return, to finance these intense and longterm nature conservation activities, animals are marketed.

Migrating cranes nearby the Saaler lagoon (W. Wichtmann).

## Introduction – Schleswig-Holstein and Lower Saxony

### Landscape

This part of the excursion takes place in the northwestern part of Germany: Schleswig-Holstein and Lower Saxony. This region was shaped by the last glaciation and is thus characterized by deposits of ground moraines, mainly sandy boulder clay or till, which were partly covered by drifting sand and river deposits. After the ice age, large areas paludified and fens, and in particular bogs due to high precipitation rates, developed. The northwest part is the main distribution area of bogs in Germany, and consequently the region with the main peat extraction activities. This region is characterized by humid and oceanic (atlantic) climate.




Geological units of Lower Saxony, and below its location in Germany.

### Land use history

In medieval times, bogs of this region were used for small-scale peat cutting. Slightly decomposed *Sphagnum* peat (white peat) was used as litter, while black peat was mainly used as fuel. At the end of the 17th century, large-scale bog cultivation started and land use on peat soils became more intensive. In the 19th and beginning of 20th century peat cutting activities increased in large mire complexes. Particularly remarkable was the buckwheat fire cultivation on bogs, which caused substantial air pollution by smoke. In 1868, M.A.F. Prestel published a scientific paper „On the fire cultivation in peatlands in East Frisia“ in which he documented the peatland fires induced by the buckwheat culture on drained peatlands and the distribution of haze plumes in central Europe. The environmental problems of this drainage based peatland utilization led to the establishment of the Mire Experimental Station Bremen (in northwest Germany) in 1877, where peatlands and peatlands utilization was investigated. In particular, the “German raised bog cultivation” was developed and studied. Bogs were mainly used as grassland and to a small extent as arable land. Before the Second World War peat cutting

changed from manual to industrial extraction techniques. Under the NS-regime in the first half of the 20th century, prosecuted Jewish and political imprisoners and prisoners of the Second World War were forced to do exhausting peatland reclamation and drainage works in 15 concentration camps of the Emsland region. Today, the memorial site Esterwegen reminds of the fate of the forced laborers and the crimes of the NS-regime. After the Second World war, agricultural use was intensified with more effective drainage systems and heavy agricultural machinery of the Company Ottomeyer in particular during the 1950- 1970s.

**Current land use**

Peat extraction activities decreased over the past 30 years and will substantially decrease within the next few years, as the slightly decomposed peat ('white peat'), the most valuable raw substance for substrates in professional horticulture, is getting exhausted. Moreover, it becomes more difficult to get permits for extraction due to policy changes and refusal by the local population. Current licenses for white peat excavation are fading within the next years and new licenses are not issued. A sensitive issue is the cultivation of corn *(Zea mays)* as energy crop for production of "Biogas" on drained peatland. This widespread practice is subsidized by bioenergy programs in Germany, causing up to 8-10 times more emissions of GHGs as the direct combustion of coal. Nowadays the total bog area in Lower Saxony is around 208,000 ha and only < 1 % is in a natural state. More than 50 % of the bog area is agriculturally used, including 44 % of bog grassland and around 8 % for peat extraction. To cover the increasing demand of worldwide urbanization, the cultivation of vegetables, fruits and flowers takes place in pre-prepared growing media, consisting mainly of slightly decomposed *Sphagnum* peat, which is mined from peatlands. Currently, peat provides 92 % of the German demand. In Germany, approximately 4 million cubic meters of white peat is used annually for professional horticulture and hobby gardening.

**Nature conservation**

The rapid loss of natural bog areas led to the initiation of the "Moorschutzprogramm" (program for peatland conservation; part 1- 1981 and part 2- 1986) of Lower Saxony, where priority areas for peat extraction and for nature conservation as well as the restoration by rewetting of cut-over bogs were specified. Major aims were to protect around 50,000 ha of not extracted and 31,000 ha of extracted bog areas as well as several small bogs as nature conservation sites.

**Research**

In the past years, the use of *Sphagnum* biomass as a raw material for growing media in modern professional horticulture has been successfully tested. In some cases, it even demonstrates better results than the peat-based substrates developed over many years.

**Further reading**

Distribution of the peatland fires between 1848-1863:
http://reader.digitale-sammlungen.de/en/fs1/object/display/bsb10298347_00031.html

Monument Esterwegen: https://www.gedenkstaette-esterwegen.de/english/

Short Movie about peat extraction by Company Ottomeyer/Pyrmont 1970:
https://www.youtube.com/watch?v=hk-ktzVIK9Y

## Excursion site Bad Oldesloe – Company “Hiss Reet”

The family-owned company Hiss Reet (Schilfrohrhandel GmbH) was founded in Bad Oldesloe in 1833. It has been trading reed since the 1920s and has grown to become the biggest merchant for reed in Germany. Subsidiary companies in Turkey, Romania and Hungary harvest the reed and are responsible for its processing. The reed products are directly distributed to Germany, The Netherlands, England, Ireland, and Denmark via ship or truck. The company further trades complementary products of other manufacturers, for example dormer windows, wall heatings, and fastening material. In addition to the traditional trade with thatch reed, a growing focus is put on the trade with other reed products. Due to the constantly growing demand, Hiss Reet founded the sector of natural building material in 2004. Clients also revealed a stronger interest for the sector of Hiss Reet garden products, which hence was extended by new products.

Harvest procedure at the company Hiss Reet.

**Box 9: Utilization of Common Reed *(Phragmites australis)***

Common reed *(Phragmites australis)* is a globally distributed emergent wetland plant. It has been traditionally used for thousands of years by people from all over the world. Traditional applications, such as the production of schnapps, coffee and boats are meanwhile less popular than in the past. Reed as constructing material has a long tradition in many cultures. Entire buildings, garments, mats, and boats were and are still made of reed. Especially in Europe, reed-thatched roofs are still widespread. Many traditional fishing villages in the Fischland-Darss-Zingst area (northeastern Germany) are still characterized by the typical architecture with reed-thatched roofs. Nowadays the touristic region is keen to maintain the traditional scenic appearance of the fisher villages. Traditional craftsmanship for the harvest of reed and the construction of thatch roofs is still present in enterprises and workshops in the region and is also applied in contemporary modern architecture. Local demand for thatch reed cannot be satisfied by local reed resources only. Land degradation and nature conservation restrictions limit the availability of suitable reed beds for the harvest of thatch reed and therefore imports from Eastern Europe and China are necessary.


Left: Reed house in Born/Darss (https://www.reetdachhaus-darss.de). Right: Hiss Reet depot in Bad Oldesloe (W.Wichtmann).

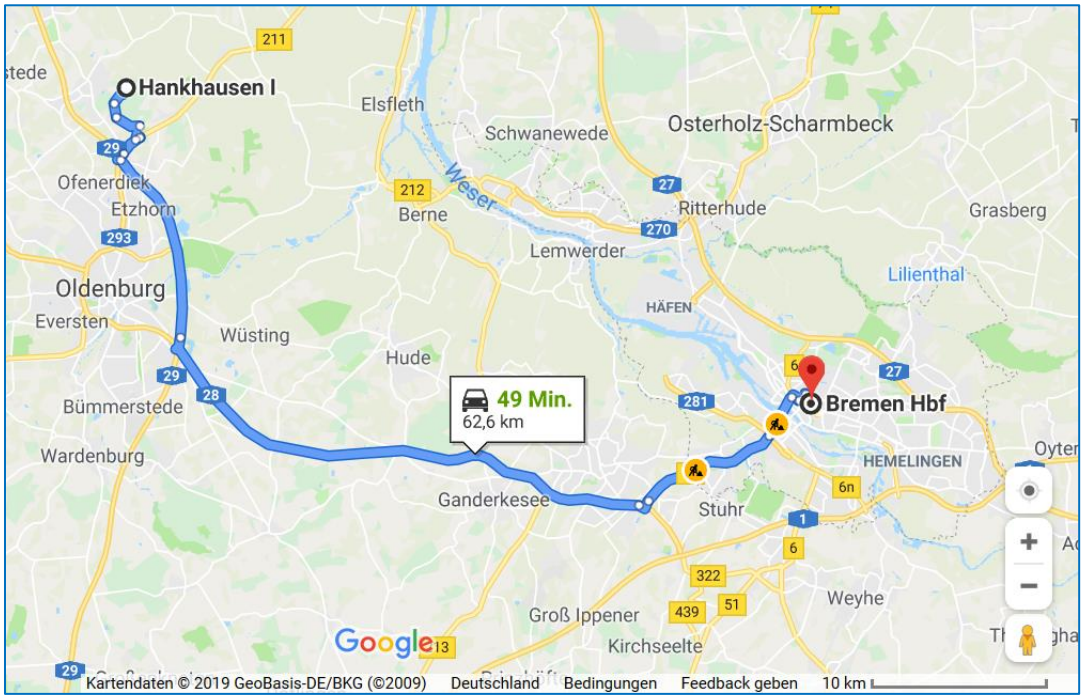

Barn of Hiss Reet company with some reed products (W. Wichtmann).

## Further reading

J. Köbbing & S. Wichmann 2015: Common reed for thatching—A first review of the European market, Industrial Crops and Products 77:1063-1073 (DOI: 10.1016/j.indcrop.2015.09.027)

# Excursion Day 4 – Thursday, 24th October

## Route and schedule




| Time | Location or event | Remarks |
|---|---|---|
| 08:00 | | Check out from hotel |
| 8:30 - 11:00 | Hankhausen: *Sphagnum* farming pilot site of Greifswald University / Moor Kultur Ramsloh (MoKuRa – peat substrate producer) | |
| ~12:00 | Wrap up and lunch | |
| 12:00 – 13:00 | Bus transfer to Bremen (60 Min.) | |
| After 13:00 | Train from Bremen to Berlin | |

## Excursion site Hankhausen – *Sphagnum* farming pilot site

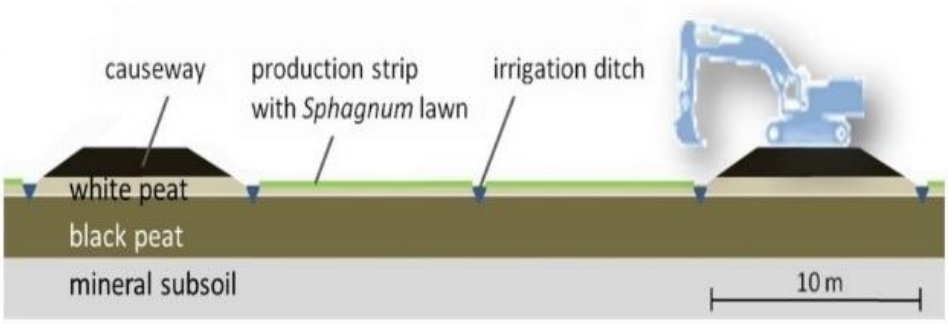
**General Information**

The peatland “Hankhauser Moor” is located near the city of Oldenburg in Lower Saxony. In 2011, there was a *Sphagnum* farming pilot site installed by the peat company Torfwerk Moorkultur Ramsloh GmbH & Co. KG (MoKuRa) in cooperation with the University of Greifswald. This area of former bog grassland was strongly degraded after decades of intensive use as grassland for dairy farming with deep drainage, leading to 1 m of subsidence since 1958. Today, the region is situated 0.5 m below the sea level and drainage water has to be pumped out actively to the North Sea.

Aerial view of the peatland Hankhausen (www.lensescape.org).

**Project progress**

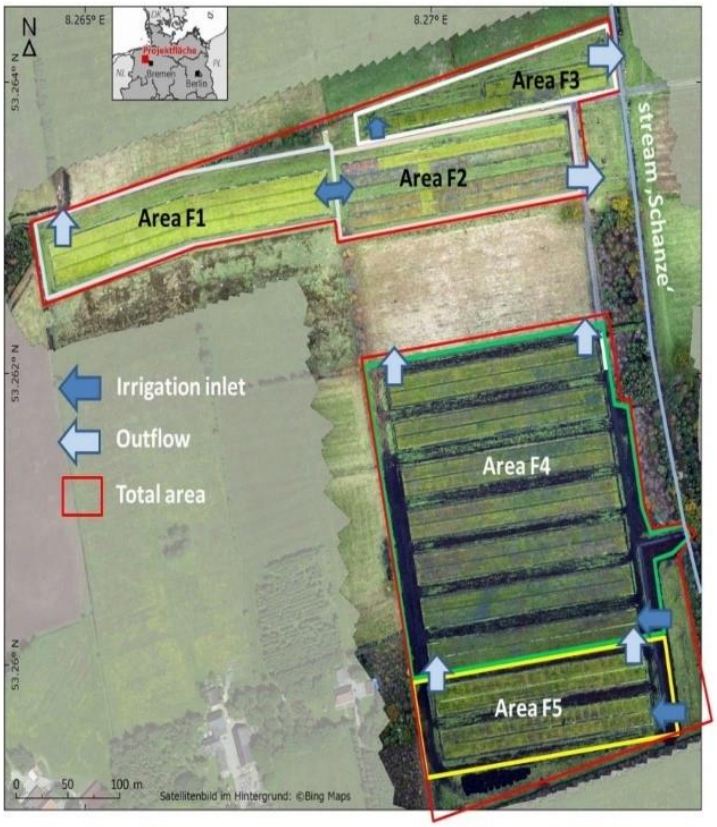
For installation of the trials over 4 ha (10 acres) the upper highly mineralized peat layer (~30 cm) was removed and used for constructing dams, resulting in 10 m wide production strips bordered by irrigation ditches. After site preparation, *Sphagnum* fragments were spread on the bare peat and subsequently covered with straw. Afterwards, the site was re-wetted and irrigation water was pumped from the adjacent channelized “Schanze” rivulet east of the study site, which drains the entire surrounding territory. One and a half years after initial establishment, *Sphagnum palustre, S. papillosum* and *S. fallax* already covered 95% of the area with mean lawn height of 8.3 cm (maximum 22.4 cm). *Sphagnum* productivity is high with a dry mass of around 8.7 t ha-1 yr-1 after the lawn establishment. In 2016, five years after field installation first mechanical harvest of the *Sphagnum* mosses was carried out by the peat company Moorkultur Ramsloh GmbH & Co. KG. Harvest of the mosses was done by an excavator reaching into the cultivation site from the installed causeways with a long arm and mowing bucket. Two-thirds of the upper *Sphagnum* mosses were cut, as former experience showed that *Sphagnum* regenerates fast if residual stems are left. The material was directly spread on newly prepared fields in order to enlarge the cultivation area to 14 ha.




Schematic cross section of the *Sphagnum* farming area consisting of causeway, ditch and production strip with *Sphagnum* lawn on white peat above black peat and the mineral subsoil.

**Box 10: *Sphagnum* Farming**

*Sphagnum* farming is the cultivation of peat moss (*Sphagnum)* aiming for the production and harvest of peat moss biomass. For this purpose, *Sphagnum* is cultivated in order to gain renewable raw material for the production of horticultural growing media. Blueprints for modern technology and hydro-engineering date back to the early stage of the soviet union in the beginning 20th century, when Lenin installed hords of engineers to develop schemes and technology to realise his vision of a modern and electrified Russian empire, also with the exploitation of the huge Russian peatlands for energy and material utilisation. Nowadays almost all vegetable and decorative plants and flowers that are grown in professional horticulture are potted in substrates based on white peat. The Netherlands and the Federal State of Lower Saxony in Germany have largely depleted their white peat resources and continue to exploit the resource in the Baltics. We literally eat our way through the peatlands in a Northeast expansion. Paludiculture with peat mosses cultivate *Sphagnum* as a renewable raw material in exploited peat mining areas of drained agricultural peatland after rewetting. The fresh *Sphagnum* biomass can be harvested in short cycles of ~5 years and can replace white peat in horticultural substrates and thus reduce the need for new peat extraction sites. Cultivation tests have shown its feasibility, but the initial production volumes are small and currently cannot provide enough raw material to substitute all horticultural peat. Further technological and economic research and development needs to be carried out to scale-up existing cultivations and to provide future horticulture markets with high quality and affordable *Sphagnum* biomass that is able to compete with the well established productions schemes and markets for white peat.




Aerial photo of the Sphagnum farming pilot site in the peatland "Hankhauser Moor" with the parts installed in 2011 (Area F1+F2) and 2016 (Area F3-F5) and the irrigation system (stream 'Schanze' as water source, inlets and outflows).

**Project results**

Up to now, experiments in the "Hankhauser Moor" have convincingly proven the feasibility of large-scale *Sphagnum* farming already during the establishment phase. The pilot site now allows developing methodologies and testing machines for further upscaling of the cultivation and harvest of *Sphagnum* biomass.

Furthermore, many sundew (*Drosera rotundifolia*) plants are spontaneously growing in the *Sphagnum* culture. Recently, pharmaceuticals containing *Drosera* sp. (dried above-ground plant parts) are used to medicate respiratory diseases. The plants are mainly collected from wild populations in intact peatlands, even though nowadays all *Drosera* species are endangered in Europe (Baranyai & Joosten 2016). Possibilities of *Drosera* cultivation in combination with Sphagnum farming are investigated at the Sphagnum farming site in Hankhausen. Research on germination, survival, biomass growth and content of medicinal ingredients is carried out at the University of Greifswald.

**Box 11: Current applications of *Sphagnum* fresh biomass**

***Sphagnum* vegetation restoration**
aims to re-establish *Sphagnum* dominated vegetation on degraded bogs (including sites where peat extraction has occurred) for nature conservation, erosion control or carbon sequestration with no intention to harvest the re-established mosses.

***Sphagnum* gathering**
is the collection of *Sphagnum* (e.g., for orchid cultivation) from wild populations which are not (or minimally) managed to maintain or increase yields.

***Sphagnum* farming**
aims to cultivate *Sphagnum* biomass for harvest, originally as founder material for restoration, but nowadays increasingly as an agricultural crop, e.g. as a raw material for agricultural growing. This new type of paludiculture includes the selection of highly productive species and active management to maximise yields, see also Box 10: *Sphagnum* farming.

Field site research area for *Sphagnum* farming in Hankhausen (W. Wichtmann, 2018).

**Further reading**

Blievernicht, A., Irrgang, S., Zander, M. & Ulrichs, C. 2013. Sphagnum biomass - the next generation of growing media. Peatlands International 1/ 2013: 32-35.

Emmel, M. 2008. Growing ornamental plants in Sphagnum biomass. Acta Horticulturae 779: 173-178.

Gaudig, G., Fengler, F., Krebs, M., Prager, A., Schulz, J., Wichmann, S. & Joosten, H. 2014. Sphagnum farming in Germany – a review of progress. Mires and Peat 13: Art. 8.

Muster, C., Gaudig, G., Krebs, M. & Joosten, H. 2015. Sphagnum farming: the promised land for peat bog species? Biodiversity and Conservation 24 (8), pp 1989-2009.

Wichmann, S., Prager, A. & Gaudig, G. 2017. Establishing Sphagnum cultures on bog grassland, cut-over bogs, and floating mats: procedures, costs and area potential in Germany. Mires & Peat 20, Art. 3.

Moor Kultur Ramsloh: www.moorkultur-ramsloh.de/

Sphagnum Farming: www.sphagnumfarming.com