Species protection by paludiculture: 
*Sphagnum* cultures as surrogate habitats

Matthias Krebs, Greta Gaudig & Christoph Muster
- **Europe** is the continent with world wide largest proportional **loss of mires**

- In **Germany**: 99% of the 1.4 Mio ha of peatlands have been **drained** for land use
Bogs in Europe are mainly situated in the North
Raised bog regions: most densely populated areas
Majority has been destroyed or strongly affected by human activity
Bog grassland: drained and used for dairy farming
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- sowing of a few graminoid fodder species
  - species poor
  - dominance of *Poa pratensis, Holcus lanatus, Alopecurus pratensis*

- drainage and changes in hydrology
  - dry site conditions
Corn cultivation: monoculture with Mexican origin
Agricultural use: partly devastation of bogs
Peat extraction: removal for growing media

Bog utilisation
• no site conditions comparable with natural bog
→ habitat loss
→ many bog species are currently endangered
other degraded bogs:
shrubs, heath land, in restoration process

→ only partly suitable habitats for bog species
natural bogs in Germany: only 2%

- habitats necessary to maintain species diversity
  → surrogate habitats become more and more important
Sphagnum farming site as surrogate habitats?

Sphagnum farming
- use of *Sphagnum* biomass
- aimed cultivation as an agricultural plant
- paludiculture on degraded bogs
Mosaic of different Sphagnum farming types on degraded bogs

on bog grassland since 2010

on cut-over bog 2004-2014

on flooded cut-over bog

• Investigations on biodiversity at two Sphagnum farming sites

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study site cut-over bog: before installation

Foto: D. Kamermann
study site cut-over bog: site preparation

Foto: D. Kamermann
study site cut-over bog: spreading of mosses and straw

- *Sphagnum papillosum*
- initial cover ~95% (brownish mosses)
- fragment length 0.5-2 cm
study site cut-over bog: after installation

Foto: D. Kamermann
study site cut-over bog: development

Foto: Uni Greifswald

Fotos: D. Kamermann
study site cut-over bog: 6 years after installation
Green field in the peat extraction area, size: 1,200 m²
study site bog grassland: before installation
study site bog grassland: spreading of mosses and straw

- applied *Sphagnum* species:
  
  *S. papillosum*, *S. palustre*, *S. fallax*
study site bog grassland: after installation
study site bog grassland: 3 years after installation
90% *Sphagnum* cover after 1.5 to 3.75 years

*Sphagnum* species: bog grassland $n = 6$, cut-over bog $n = 5$

*S. palustre*, *S. papillosum*, *S. magellanicum*, *S. fallax*, *S. cuspidatum*, *S. fimbriatum*, *S. teres*

Gaudig & Krebs 2016, BIUZ
Vascular plants on Sphagnum farming sites

- *Rhynchospora alba*
- *Drosera rotundifolia*
- *Erica tetralix*

Foto: Uni Greifswald
Vascular plants on Sphagnum farming sites after *Sphagnum* lawn establishment

- **Cut-over bog**
  - 13 species
  - Total cover 27%
  - Dominant species: *Erica tetralix* (cut-over bog), *Molinia caerulea*, *Drosera rotundifolia*, *Calluna vulgaris*, *Juncus effusus*, others

- **Bog grassland**
  - 39 species
  - Total cover 13%
  - Dominant species: *Juncus effusus* (bog grassland), *Drosera rotundifolia*, *Agrostis stolonifera*, *Molinia caerulea*, others

- Mixture of bog and 'non-bog' species
- More species on former bog grassland
- Dominant species: *Erica tetralix* (cut-over bog), *Juncus effusus* (bog grassland)

Gaudig & Krebs 2016, BIUZ
Vascular plants on Sphagnum farming sites
development on cut-over bog (9 years)

- Mainly <30% total cover due to regular mowing
- Decrease of species number and 'non bog' species

Gaudig & Krebs 2016, BIUZ
Vascular plants on Sphagnum farming sites
development on **former bog grassland** (4 years)

- Mainly <20% total cover due to regular mowing
- Decrease of species number and 'non bog' species

Gaudig & Krebs 2016, BIUZ
Vascular plants on *Sphagnum* farming sites

→ in irrigation channels

*Utricularia vulgaris*

Foto: Uni Greifswald
Spiders on Sphagnum farming sites

Good indicators of early stages of ecosystem development

Foto: Uni Greifswald
Spiders on Sphagnum farming sites

→ Rare species on cut-over bogs sites

*Pardosa sphagnicola*  
*Bathyphantes setiger*
Spiders on Sphagnum farming sites
succession on former bog grassland

1\textsuperscript{st} year: high proportion of aeronautic pioneer species
\textit{Erigone atra, E. dentipalpis} and \textit{Oedothorax fuscus} (77%)

2\textsuperscript{nd} and 3\textsuperscript{rd} year: strong change in species composition
dominant species: \textit{Pirata piraticus} (42%) in 2\textsuperscript{nd} year

Muster et al. 2015, Biodiv. Conserv.
Spiders on Sphagnum farming sites
succession on former bog grassland

Assemblage compared to first year:

- More diverse with large proportion of peatland species
- First peatland specialists and red list species
  *Pardosa sphagnicola, Hygrolycosa rubrofasciata, Erigonella ignobilis*
- Number of species and individuals increased

Muster et al. 2015, Biodiv. Conserv.
Badhamia lilacina

other species groups on Sphagnum farming sites

Foto: Uni Greifswald
other species groups on Sphagnum farming sites

Birds, e.g. *Tringa ochropus, Vanellus vanellus, Gallinago gallinago*
other species groups on Sphagnum farming sites

→ Current investigations on dragonflies
Factors for biodiversity on Sphagnum farming sites

- **Origin of the seeding material**
  - moss material collected from natural sites include parts of animals (eggs, living individuals) or plants (e.g. seeds, sprouts)
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- **Origin of the seeding material**
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- **Input from the surroundings**
  → Plant parts and animals reach via air, water and soil

- **Conditions of the surficial soil**
  → Vascular plant colonize faster at bare peat areas

- **Age of the Sphagnum farming site**
  → Succession leads to more bog specific species

- **Management**
  → Expansion of vascular plants is limited by regular mowing

- **Harvest method and frequency**
  → current investigations

Gaudig & Krebs 2016, BIUZ
Conclusions

Sphagnum farming sites

- are valuable surrogate habitats for bog species
- can strengthen bog conservation
  a) by wet agriculture in the surroundings of nature reserves
  b) by the creation of corridors between wet 'nature'
Thank you for your attention!

www.sphagnumfarming.com