Could continuous-cover forestry represent paludiculture in boreal peatland forests?

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What is paludiculture?

- From Latin palūs ("mire"), "wet cultivation", where "the preservation of peat is always the most important/main objective"
- To produce such crops on peatlands that can be grown under high water-table levels (WT), natural or near-natural of mires
  - Reed, Sphagnum
- Considered so far mostly for rewetted former grasslands and croplands in Central Europe
  - Cultivation of alder (*Alnus glutinosa*) given as a further example, however
Why consider it for peatland forests?

<table>
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<tr>
<th>Region</th>
<th>Of land area</th>
<th>Peatland</th>
<th></th>
<th>Drained</th>
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<tr>
<td></td>
<td></td>
<td></td>
<td>%</td>
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<td>1001</td>
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</table>

*Finland*  
| Finland              | 29           | 4112           | 4650| 53      |
What are the WTs in boreal, undrained peatlands as in Finland?

![Graph showing stand volume and median WT for different site types.]

**Stand volume**

- V, m³ ha⁻¹
- WT

**Open/treed site types**
- LhK
- RhK
- MK
- PK
- Kgr
- KR
- IR
- RhSR
- VSR
- TSR
- TR
- RhsN
- RharN
- VSN

**Forested site types**
- LhK
- RhK
- MK
- PK
- Kgr
- KR
- IR
- RhSR
- VSR
- TSR
- TR
- RhsN
- RharN
- VSN

**Median WT, cm**
- -40
- -35
- -30
- -25
- -20
- -15
- -10
- -5
- 0
What are the WTs in boreal, forestry-drained peatlands as in Finland?

- Plots from the 8th National Forest Inventory = “regular” forestry-drained sites
- Average frost-free season water table (WT) ranged from ~0 to 80 cm
- WT mostly between 15 and 45 cm – not so different from undrained forested peatlands
Could we have peatland forestry without ditching or ditch network maintenance?

- WTs in drained sites are not so different from undrained forested peatlands in many cases
- Disturbing the soil causes loading of watercourses
- Deeper WTs increase C loss from soil
- Ditching, DNM, artificial regeneration = costs
- No clear-cuts, no DNM – system representing paludiculture in forestry?
Why ditch?

• Ditching with 1-m deep ditches in wet sites usually resulted in an initial lowering of the WT of 10-20 cm
  – Low hydraulic conductivity, subsidence of the surface
• This is enough for the (shrub and) tree stand to start to develop (Laiho et al. 2003, Holmgren et al. 2015)
Why ditch?

• Ditching with 1-m deep ditches in wet sites usually resulted in an initial lowering of the WT of 10-20 cm
  – Low hydraulic conductivity, subsidence of the surface
• This is enough for the (shrub and) tree stand to start to develop (Laiho et al. 2003, Holmgren et al. 2015)
• Raised WTs may still kill young seedlings; ditches prevent that
• Continued stand development contributes to drainage through rain interception and evapotranspiration
• Ditches may become unnecessary, at least temporarily:
How tree stand size affects WT (here late summer WT)

- Stand volume the strongest single expl. variable
- Strongest influence btw 10-100 m³ ha⁻¹
Weather conditions obviously play a role

Extremely wet summer, Ps 120 mm
Mean summer Ps: 75 mm in southern, 65 mm in northern Finland
Dry summer, Ps 40 mm
The role of ditch network maintenance in established stands

- DNM increases stand growth when WT is higher than 35–40 cm below the soil surface (Sarkkola et al. 2012)
- DNM has highest growth response in stands where WT is higher than 25–30 cm
- Ditches are more needed in northern Finland due to lower evapotranspiration than in the south

\[
y = 5.2314 + \frac{103.5916}{1 + e^{-(x-25.1573)/4.6817}}
\]

\[r^2 = 0.651\]
The idea of continuous-cover forestry on peatlands

- With selective cutting cycles maintaining the tree stand volume at 100-200 m$^3$ha$^{-1}$, could we have a system where the WT remains at or just slightly lower than 30-40 cm, and the stand regenerates continuously?
  - No artificial regeneration, no soil preparation
  - No ditch network maintenance
  - No or low CH$_4$ emissions
  - Maintained soil C storage
  - = lower costs, lower environmental detriments
- Resembles the most productive undrained forested peatlands
- No real data to support this so far
- Experiments with varying levels of retained stand on-going
Shift into CCF

Multia, Havusuo
Ruutu 2

Number of stems

Stem diameter at 1.3 m, cm

Initial stand

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Shift into CCF

Multia, Havusuo
Ruutu 2

Number of stems vs. Stem diameter at 1.3 m, cm
Shift into CCF

Multia, Havusuo
Ruutu 3

Number of stems

Stem diameter at 1.3 m, cm

Initial stand
Shift into CCF

Multia, Havusuo
Ruutu 3

Number of stems

Stem diameter at 1.3 m, cm

Retained stand
Risks

• If the retained stand is too small to keep the WT down, especially during wet summers, the stand may die
• WT up =>
  – Artificial regeneration, soil preparation, drainage needed to get back to forestry use
  – Loading of watercourses
• Storm damages?
• Wetter soils – problems for harvesting when no soil frost
• Root rot (*Heterobasidion*) spreading to/in peatland forests with frequent (no-frost) harvests?
References


