Connecting inland wetlands to artificial embanked lakes to improve lake ecosystem functioning

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SEFS 13

Newcastle, England

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Ministerie van Landbouw, Natuur en Voedselkwaliteit

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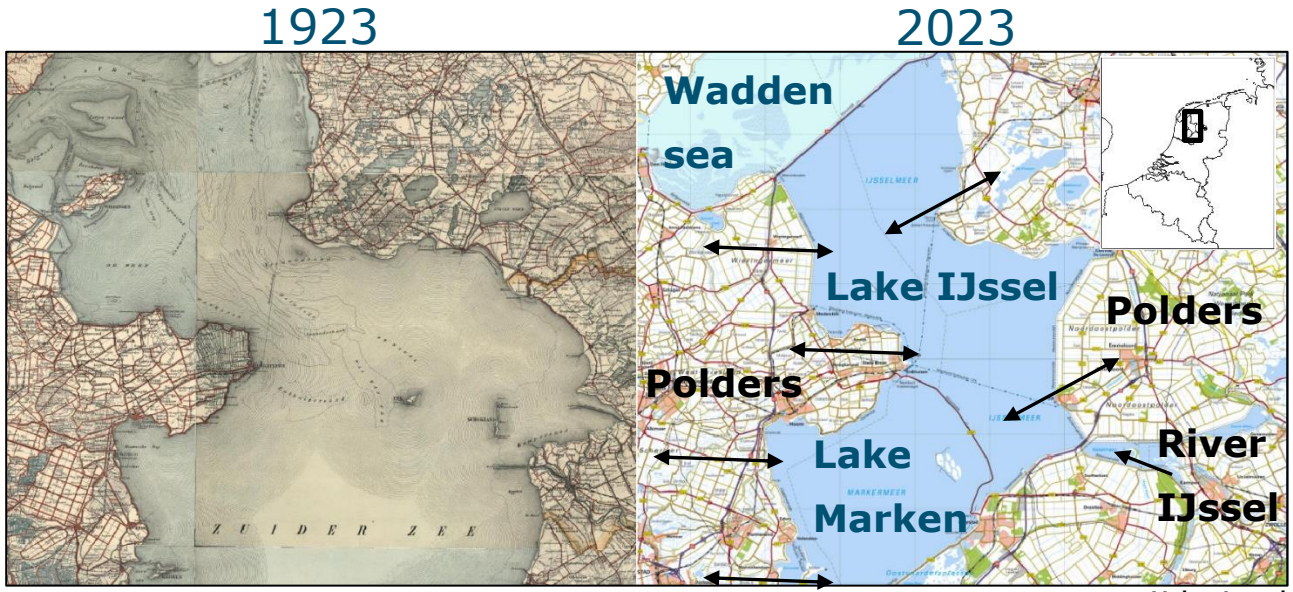
The Dutch man-made lakes IJssel and Marken

- Marine estuary transformed into two shallow freshwater lakes (1932)
- Embanked shores
- Controlled water level (inflow water river and polders)



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Summer (high, agricultural water supply)

max. 0.3 m

Winter (low, retention capacity)

~3 m

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Degradation of lake ecological quality

- Recent water quality improvement
    - Lake anthropogenic nutrient and organic load <
    - Cascading negative effect on food web: decrease in phytoplankton -> zooplankton –> fish –> birds
- A shift to dissolved organic matter (DOM) derived resources could boost productivity
    - Shoreline wetlands and other riparian ecotones are almost completely lacking!

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‘Inland shore’ restoration concept

- Example project Koopmanspolder; connecting an inland embanked wetland to lake IJssel
  - Polder water level independent of lake level: natural fluctuations
  - Level difference; pumping station connects both systems
  - Transfer of matter across systems’ boundaries?

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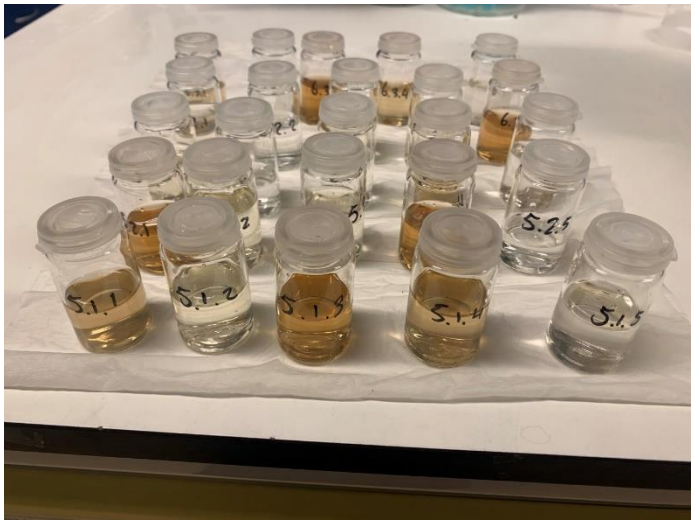
Research question (1)

- How does the inland vegetation contribute to the organic matter budget of lake IJssel and lake Marken?
    - Wetland plants (terrestrial, 2 species) versus aquatic vegetation of the lakes (1 species)
    - Dissolved organic carbon (DOC) as proxy

Method (1)

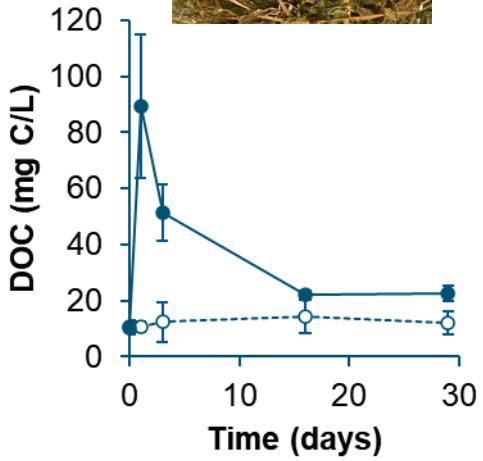
- 6.5 g dried senescent leaves per plant species submersed in 5 L unfiltered lake water
- Control treatment without leaves
- 5 replicates per treatment
- Stored in the dark at 19°C
- TOC & DOC measurements
- Measurements on day 0, 1, 3, 16, 29



Contribution of vegetation to OC flux water

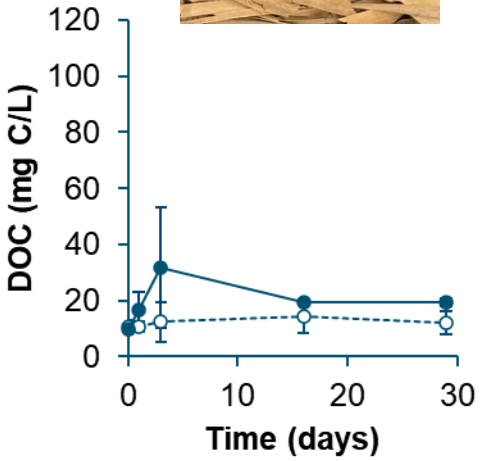
Aquatic

Potamogeton perfoliatus

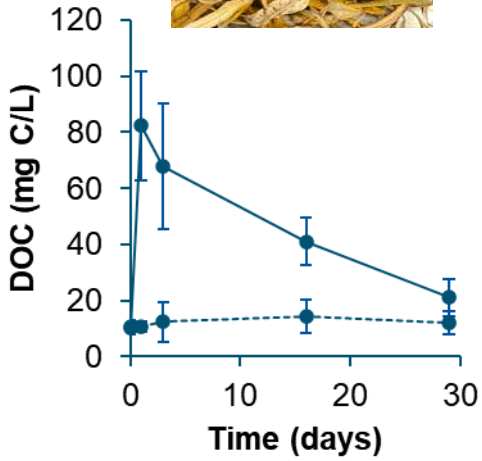


Terrestrial (wetland)

Phragmites australis



Salix repens



——— *lake water + plant material*

---------- *lake water only (control)*

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Research question and method (2)

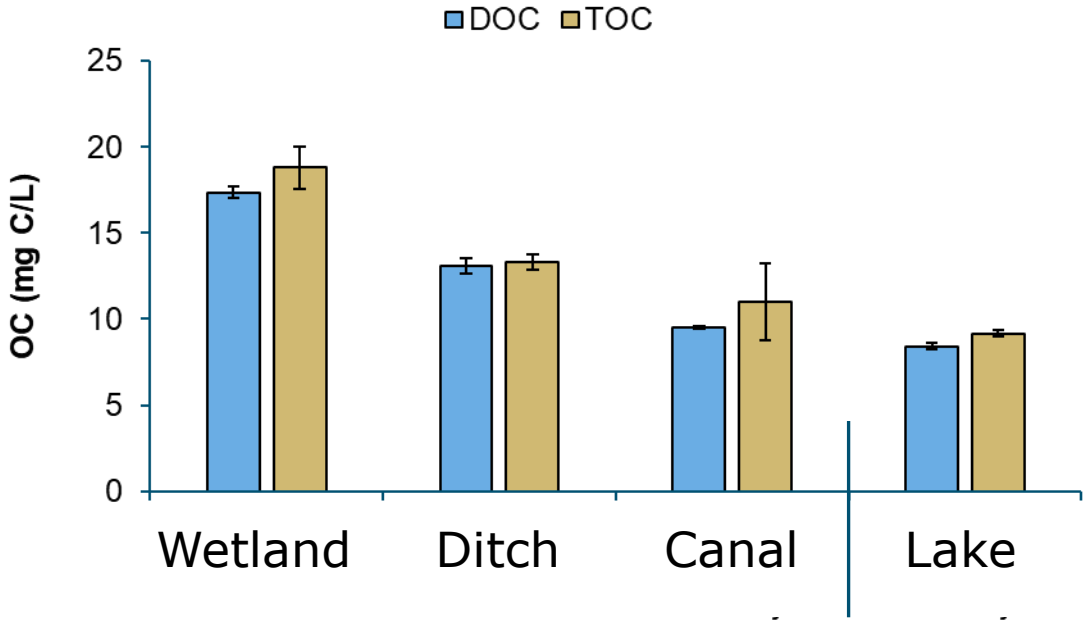
- Does transport of OC take place across ecotone boundaries?
  - OC wetland-to-lake transport along a 2-kilometer gradient?
  - Measurements of TOC & DOC concentrations at 4 sites

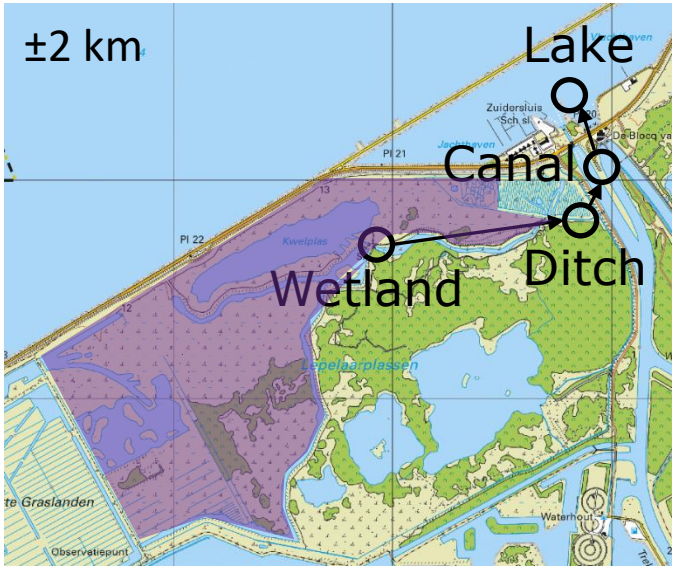



Inland wetland Lepelaarsplassen → Ditch → Canal → Embankment with pumping station → Lake Marken

Inland wetland to lake transport of OC

- DOC dominant form
- Decrease of OC-concentrations with distance from source





→ *flow direction*

○ *sampling location*

Pumping station

Conclusions: lessons learned regarding the design of inland shore to lake connections

- Species-specific DOC release of aquatic and terrestrial plant species
    - To increase lake water resource diversity heterogenous vegetation development should be stimulated.
    - From a food web perspective management focus on reedbed development (to facilitate marshland birds) at the cost of willow encroachment requires a revision.

Conclusions: lessons learned regarding the design of inland shore-to-lake connections

- OC-concentrations decrease rapidly with distance from source as a result of physical and biological processes.
- Regarding the design of wetland-lake connections this implies that travel distance should be minimized, whilst discharge from the wetland should be maximized.

Thank you for your attention

Questions?