Estuarine forest restoration for society and the environment

- ECSA Focus Meeting –

From catchment to coast with an emphasis on the estuaries and coastal waters of SW England

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Introduction

The UK is a world leader in willow domestication and conservation (Long Ashton Research; Rothamsted Research; FAO 2014); e.g., Somerset hosts willow producer and estuarine willow stands. Willow forests are both biodiversity hot spots and ecosystem service providers. Willows and wetlands sequester large amounts of carbon and serve in phytoremediation. Early flowering willows provide food for pollinators and soil surface roughness for protection from hazards including flood risk reduction from catchment to coast.

Willows serve as host plants, bird nesting sites, niches for insects, reduced flow (e.g. for the Elbe water dropwort in the Elbe estuary). Willows are adapted to changing water levels in the riverine and estuarine environment. Juvenile and mature white willows and basket willows show a salinity tolerance up to brackish conditions (Markus-Michalczyk et al. 2014), experimentally to tidal flooding at least up to 60cm (Markus-Michalczyk et al. 2016) and in the field (Markus-Michalczyk et al. 2018)

The willow branches show high bending capacity (Markus-Michalczyk, Zhu, Bouma 2019). They reduce the flow velocity, in particular behind the willows and in dormance during the storm surge season (Markus-Michalczyk, de Smit, Zhu, Mchedlishvili, van Bree, Bouma). However, willow forests are fragmented and restoration of is required.

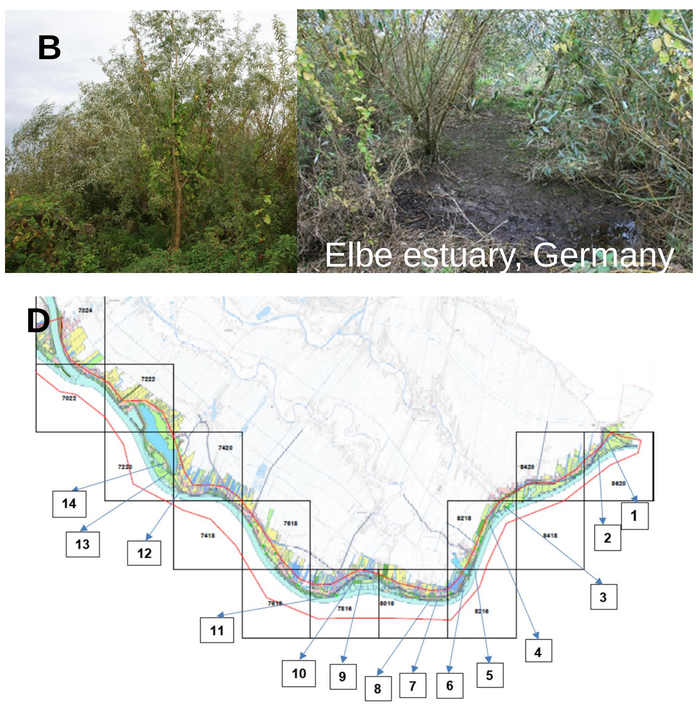
The willow at the Baltic Sea Coast
Photo © Matthias Michalczyk

Estuarine forest restoration principles

Estuarine management measures according to the hypothesis by Wolanski and Elliott (2015) were studied regarding floodplain forest restoration in estuaries. We suggest three important principles:

- disturbance and hydrological processes regulate the structure of the estuarine floodplain forest biota;
- ecological functioning and ecosystem services evolve from interacting biota of ecological structure;
- the biotic floodplain forest structure and functioning will induce feedback loops which detemine estuarine landscape formation

Integrated estuarine management measures should be applied based on these floodplain forest restoration principles to achieve corresponding SDG´s.



Restoration of estuarine willow forests

A Disturbance induced bar ground where tidal forest developed via succession by small but abundant willow seeds in a flood control area with reduced tide;

B Tidal forest evolved from planted cuttings in a abandoned meadow in tidal freshwater wetlands;

C Floodplain forest willow plantation (100 m width, 600 m length) for enhanced flood control in front of the dike

D Floodplain forest restoration sites along the tidal freshwater stretch of the Elbe estuary, GER. Estuarine Restoration is required (e.g., EU HD, compensation measure) and implemented according to the Integrated Management Plan Elbe Estuary (IBP 2012)

Discussion and Conclusion

The essence of Ecohydrology is the role of the environment in influencing organisms and vice versa – of the organisms building, filling and altering niches (Wolanski and Elliott, 2015). Willows are engineering species which (Corenblit et al. 2011; Corenblit 2018):

- drive, organize, stabilize the construction of floodplains
- support regeneration after destructive floods
- control sediment flow

Ecohydrology achieves ecological and societal benefits, firstly by engineering the physics to produce niches (Type A). Secondly, by engineering the ecology by replanting, in turn creating habitats or allowing engineering species to modify habitats, thus enhancing the physical-biological links (Type B) (Elliott et al. 2016). We suggest choosing either Type A (image **A**) or B (image **B**) for estuarine restoration in adaptation to space and time.

Numerous estuaries are densely populated and conventionel engineering may also negatively affect societies. Restoring estuarine willow forests may help achieve social goals, human safety and property and produce a ‘win-win’ for economy (**C**) and ecology or even ‘triple wins’ by including human safety.

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References:
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