Towards sustainable populations of fen species in the Netherlands;
Ecohydrological modelling of fragmented fens

Universiteit Utrecht

Utrecht Centre of Geosciences

Arnaut van Loon, Hester Soomers, Yuki Fujita and Martin Wassen

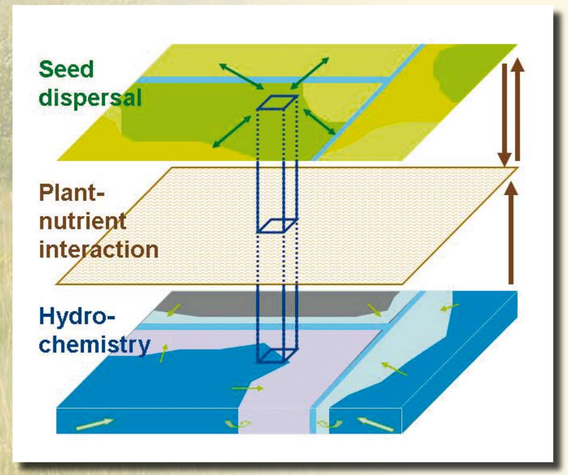
COPERNICUS Institute for Sustainable Development and Innovation, Environmental Sciences,
Faculty of Geosciences, Utrecht University, PO Box 80.115, NL-3508 TC UTRECHT, the Netherlands

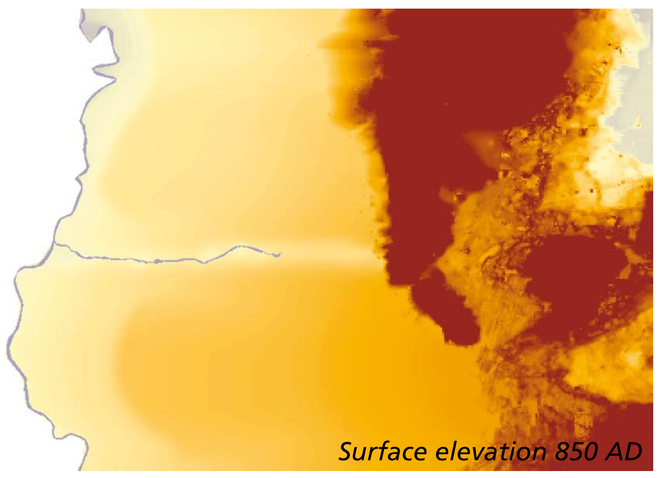
m.wassen@geo.uu.nl

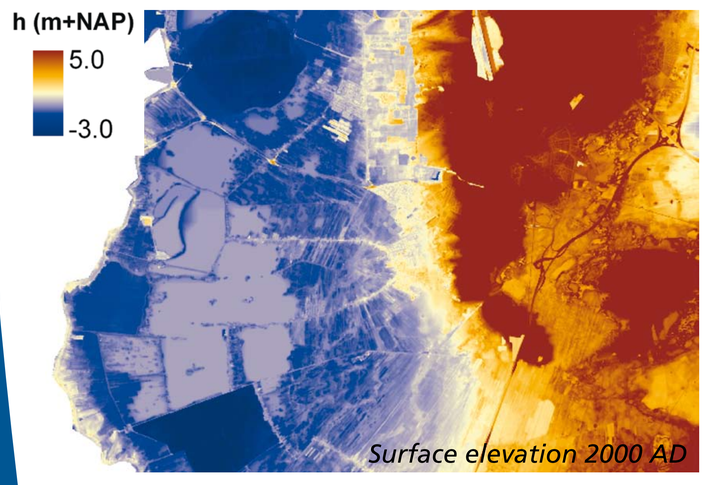
Introduction

Low-productive fens are species-rich ecosystems that have become threatened worldwide. Intensive land use and human interference in hydrology have caused a decrease in suitable habitat for these fens. As a consequence, remaining habitat patches have become fragmented, causing a decrease in connectivity of sub-populations. Therefore, a multidisciplinary approach, involving both hydrological and ecological measures is necessary to restore these ecosystems.

This project aims at disentangling the hydrochemical and ecological processes causing fen ecosystem decline. This is achieved by cooperation of three PhD's focusing on hydrology, hydrochemistry, plant-nutrient interaction and seed dispersal on both local and regional scales. The project started in March 2005.



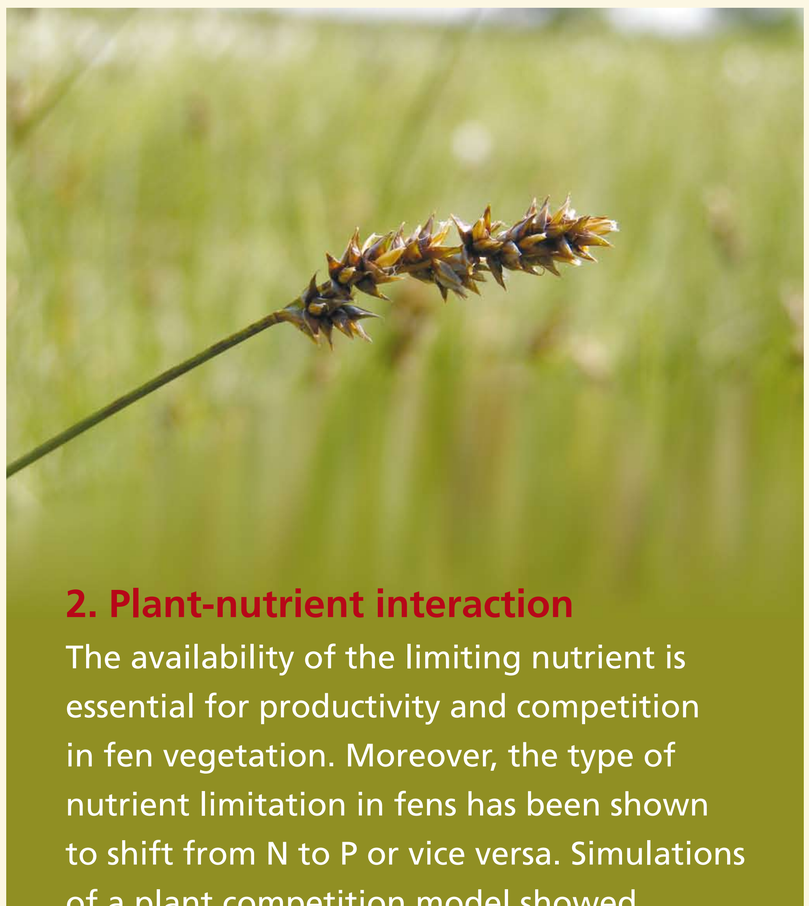

Surface elevation 850 AD



Surface elevation 2000 AD

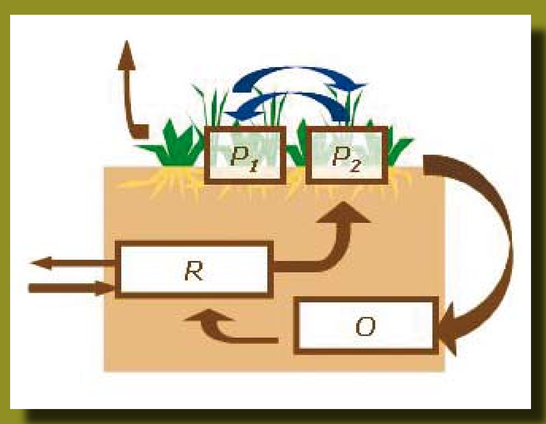
1. Hydrology and hydro-chemistry

Supply of groundwater is directive in setting proper abiotic conditions for fen ecosystems. However, changes in land use and water management have transformed natural groundwater flow and hydro-chemical conditions of fens. A palaeo-hydrological reconstruction indicates transformations of landscape-hydrological conditions in the past. Moreover, a hydro-chemical monitoring campaign indicates an increased dominance of rainwater in fragmented fens.



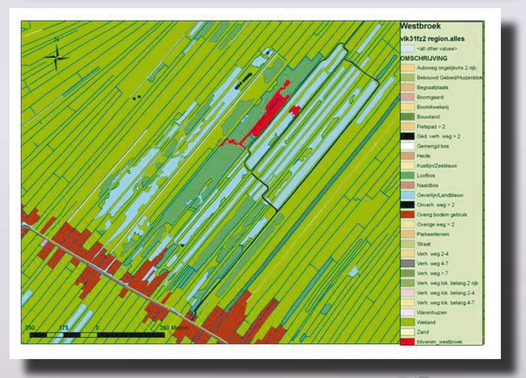
2. Plant-nutrient interaction

The availability of the limiting nutrient is essential for productivity and competition in fen vegetation. Moreover, the type of nutrient limitation in fens has been shown to shift from N to P or vice versa. Simulations of a plant competition model showed that species performance under various nutrient conditions (type of limitation and availability) depends on species trait values, such as growth rate and height. Greenhouse experiments and database analysis will further clarify the mechanisms how species with different strategies response to changing nutrient conditions.



3. Seed dispersal

In fragmented habitats, such as the Dutch fens, dispersal capacity can limit plant occurrence. Preliminary results from a statistical analysis demonstrate the negative effect of fragmentation on fen plant species viability and the dependency of these species to discharge of calcareous groundwater. To assess the dispersal and colonization capacity of the considered fen species, field experiments are conducted and a mechanistic seed dispersal model will be developed.



Challenges

In this project a new step is taken in integrated ecohydrological modelling of fens. Mechanistic modelling of connectivity via seed dispersal and competition between species under N and P limitation is coupled to dynamic hydrological models. This will enable us to assess the effect of changes in land use and water management on fens in a spatially explicit approach.

Both, subproject 2. and 3. started from an analysis of species functional traits such as nutrient acquisition, nutrient use efficiency and nutrient conservation, light competition and seed dispersal via wind and water. This led to experimental set ups currently undertaken.

The hydro-chemical monitoring campaign was extended by tritium analyses. Results indicate large-scale presence of relatively young water although hydrochemistry of this water appeared to resemble groundwater.

Geosciences

Layout: Geomedia • Faculty of Geosciences • ©2007 6936