

LAKE VÖRTSJÄRV - PCLAKE

Characteristics Lake Võrtsjärv

Water level	Variable water level
Marsh area	1,230 ha
Average water depth	2.8 m
Surface	270 km ²
Fetch	7.1 km
Residence time	300 days
Soil type	Peat
Additional information	Period of ice cover

Sebastiaan Schep (Witteveen+Bos): 'One of the particular advantages of this modelling approach was that it was possible to simulate specific conditions of Lake Võrtsjärv by the adjustment of just a couple variables. Hence, our perspective on the role of water depth with regard to macrophyte growth in lakes with loose sediments suspended solids altered.'

➤ INTRODUCTION AND MANAGEMENT QUESTIONS

Lake Võrtsjärv in Estonia is a large eutrophic lake with a highly organic type of sediment and a large fetch size. Given the considerable wind fetch, and a loose organic sediment type, suspended solids play an important role in the light climate of the lake giving it a turbid and yellowish appearance. The loading of phosphorus and nitrogen in the lake is relatively low, but have come down from much higher historical loadings during the 80's when the use of fertilizers was at its peak.

The aim of this study is to evaluate the potential for growth of aquatic macrophytes in lake Võrtsjärv with the ecosystem model PCLake.

➤ RESULTS OF THE WATER SYSTEM ANALYSIS

Lake Võrtsjärv receives water from tens of inflows, with the Emajõgi, Öhne, Tarvastu, and Tännasilma rivers being the largest. The difference in the lake volume between high and low water levels can be threefold. The nutrients, nitrogen and phosphorus originate from the surrounding arable lands and, with sewage, from several small towns and villages. In the southern part the lake bottom is covered with a mud layer up to 5.5 m thick, which is gradually being replaced by sandy mud and sand in the northern direction. The lake is covered on average for 135 days a year with with ice, from the end of November till the end of April. Water is turbid, yellowish-green, with an average transparency of about 1m. Mud particles stirred up by the wave action contribute to turbidity.

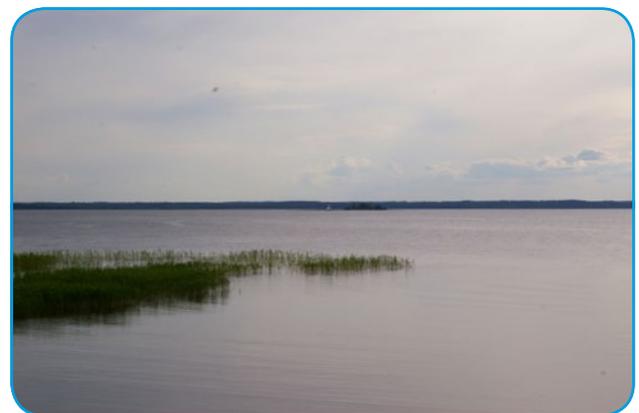
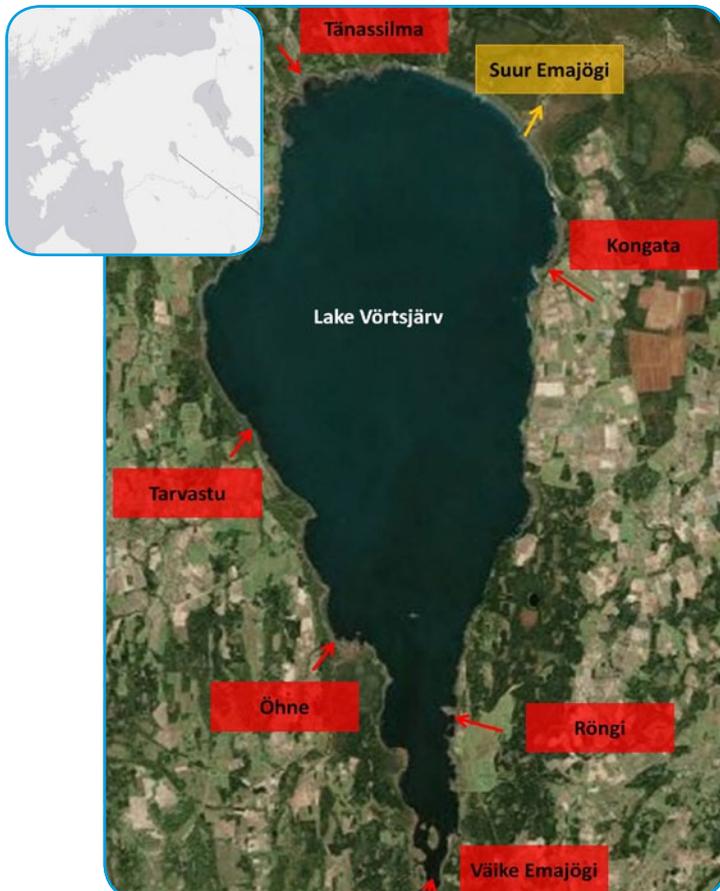


Photo: Lake Võrtsjärv (H. Tammart, Centre for Limnology, Estonia).

Figure 1: Hydrological schematisation of Lake Võrtsjärv.

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Vegetation cover is low with an exception of riparian vegetation. The conclusion of the water system analysis is that Lake Vörtsjärv is in a turbid phytoplankton dominated state due to high concentrations of (organic) suspended solids.

➤ APPLICATION OF PCLAKE

PCLake was applied to study the potential growth of aquatic macrophytes by varying water depth, fetch length, rate of resuspension and relative area of marshland. The study focussed on whether the lake remains in a turbid phytoplankton dominated state or in a transparent vegetated state. The modelling results reveal that the concentration of suspended solids increased with lower water levels. This is in concurrence with field observations. As a result, suspended solids may not only hamper macrophyte growth in lakes like Lake Vörtsjärv, but in addition lowering lake levels to promote macrophyte colonization may even be counterproductive. Only at sites with low fetch size in combination with shallow water (< 2m depth), such as observed in the sheltered southern part of the lake and on the western shore, clear water with macrophytes may be possible. This also in line with field observations. The model simulations suggest that a macrophyte cover and transparent water is not a likely scenario for Lake Vörtsjärv.

SEE FIGURE 2

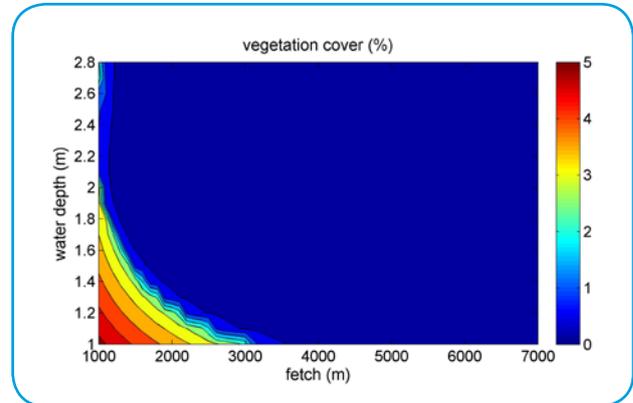


Figure 2: Modeled submerged macrophyte cover dependant on fetch (m) and water depth (m) in Lake Vörtsjärv. The lower the fetch and water depth, the higher the percentage vegetation cover.

➤ BENEFITS OF THE MODEL

The application of the PCLake model was found to be a strong tool to disentangle the key driving forces of the water quality in Lake Vörtsjärv. The modeling results changed the perspective on the role of water depth with regard to macrophyte growth in lakes with loose sediments suspended solids. The results show us that different mechanisms may underly the dynamics of macrophyte and phytoplankton cover. A thorough understanding of a particular lake system may help lake managers in setting realistic targets and evaluation restoration scenarios.



Photo: Lake Vörtsjärv.