Geophysical Research Abstracts,
Vol. 11, EGU2009-4434-1, 2009
EGU General Assembly 2009

Effects of 500 years of eutrophication and flooding control on lowland lake development

E. Kirilova (1), M. van Hardenbroek (1), O. Heiri (1), H. Cremer (2), and A.F. Lotter (1)

(1) Palaeoecology, Institute of Environmental Biology, Utrecht University, Laboratory of Palaeobotany and Palynology, Budapestlaan 4, 3584 CD Utrecht, The Netherlands, (2) Netherlands Organization for Applied Scientific Research TNO, Geological Survey of the Netherlands, Princetonlaan 6, 3584 CB Utrecht, The Netherlands

Nutrient enrichment and the ecology of surface waters have been intensively studied in lowland regions. However, detailed palaeolimnological reconstructions of the trophic and flooding history of floodplain lakes are still rare. In the Netherlands dike-breaches caused by high floods of the river Rhine formed a new type of lake since the Middle Ages. These dike-breach lakes were strongly impacted by the development of channel systems in their catchment, agriculture, and repeated flooding events. Here we present a multiproxy palaeolimnological study of past nutrient loading and ecology of the dike-breach lake De Waay which is located on the Rhine-Meuse delta (The Netherlands). The lake was created in A.D. 1496 as a result of damage done to a dike by floating ice and the subsequent dike-breach due to a flooding event.

A sediment core of 11.5 m was recovered from Lake De Waay and diatoms, Cladocera, and geochemistry were analyzed in the sediment. From the beginning of the lake's existence to the end of the 18th century diatom-inferred total phosphorus (TP) concentrations were above 300 μg/l, suggesting hypertrophic conditions. Cladoceran assemblages reflect the lake's pioneer stage and suggest a lack of rooted aquatic macrophytes resulting from low water-transparency, possibly caused by frequent floods. Until the late 18th century floods occurred regularly in the area, as shown by the elevated Ti values in the sediments, indicative of high erosion from the floodplain and runoff from the surrounding agricultural catchment. This caused the exceptionally high sedimentation rates and elevated nutrient contents of the lake waters. Since the beginning of the 19th century sewage input and flooding frequency were strongly reduced by the construction of new ditches, canals, and dikes. The improved sewage and dike systems are reflected by decreased TP concentrations of 40-150 μg/l. The increased stability of littoral habitats led to an increased diversity in the Cladocera assemblages. The phase with the lowest inferred TP concentrations lasted from the end of the 19th to the mid-20th century. During this period direct nutrient sources were no longer connected to the lake and TP concentrations consequently decreased to 40 μg/l. Dike construction was highly developed and flooding events no longer affected this region. However, a renewed eutrophication with TP values reaching 100 μg/l was registered in the sediment record since the mid-20th century. The increased TP concentrations are most likely related to increased agricultural activity in the vicinity of the lake.

Our results show that Lake De Waay was eutrophic to hypertrophic during much of its history. The lake was formed as a consequence of human activity and never existed in an undisturbed state. Restoration of lakes to an "undisturbed" natural state, as required by the European Water Framework Directive, can therefore not be recommended for strongly modified lowland lakes such as De Waay.