# Restoration projects and biomanipulation (BM) practice in Estonia

Ain Järvalt[1], Lea Tuvikene[1], Tiia Pedusaar[2], Ilkka Sammalkorpi[3], Arto Hautala[4]

[1] *Estonian University of Life Sciences, Centre for Limnology, Rannu, 61117, Estonia*
[2] *Tallinn University of Technology, Department of Environmental Engineering, Ehitajate tee 5, 19086, Tallinn, Estonia*
[3] *Finnish Environment Institute, Water Resources Management Division, P.O.Box 140, FIN-00251, Helsinki, Finland*
[4] *University of Jyväskylä, Department of Biological and Environmental Sciences, P.O. Box 35, FIN-40351, Finland*

The first lake in Estonia where rearrangement of fishery took place was shallow (mean depth 2.8 m) and eutrophic lake Võrtsjärv (270 $km^2$). In the 1950s and 1960s L. Võrtsjärv was regarded as a ruffe lake because the bulk of the fish caught these consisted of small bream, ruffe, young perch and roach. Attempts to reduce the abundance of these undesirable fishes by intensive trawling were unsuccessful. Fine-meshed trawl damaged the stocks of valuable fish (first of all, pikeperch) and therefore their numbers become scanty (except for bream). At the end of the 1960s trawling was stopped, elvers were regularly introduced into the lake and the protection of commercial fishes was improved. As a result of these measures, the total each of fish decreased in the 1970s, but the stocks and catches of commercial fishes (above all those of pikeperch and eel) began to grow rapidly. The increasing pressure of predatory fishes (mainly pikeperch and pike) led to a sudden fall in the abundance of less valuable small fish. Annual by catch of non-valuable fish (60-70% small bream) is 150-200 tons.

In the beginning of 1990s real BM as a restoration method, was first used in Lake Harku, situated in Tallinn, and having significant recreational value. Unfortunately the amount of removed fish was insufficient and due to lack of funding the sediment removal was not performed.

Recent experience of BM in Estonia is from the fourth largest lake in Estonia shallow (975 ha, mean depth 3.4 m, max 5.5 m) and eutrophic (TP 30-60 mg/m3) natural hardwater lake Lake Ülemiste. Improving the water quality of Lake Ülemiste, the raw water source of the City of Tallinn by biomanipulation has been considered as a management alternative by AS TallinnaVesi since 2001. Lake Ülemiste was biomanipulated after reduction of external loading and the shifts in water quality were studied during the active-phase of the measure. The main aim of this project was to reduce the chemical and energy costs of treatment caused by high phytoplankton biomass. Cyprinid´s stock was reduced from 200-250 kg $ha^{-1}$ to about 70 kg $ha^{-1}$ in the period of 2004-2008. Conduction of pre- and during manipulation comparison revealed that phosphorus availability in the lake decreased, achieving the target level (<50µ$gl^{-1}$) on the last intervention year. Predomination of filamentous cyanobacteria were replaced by co-domination of picocyanobacteria in summer months and more diverse vernal phytoplankton composition in the lake. Zooplankton grazing was not likely involved in the water quality improvement. Until now only some preliminary results are available.