Functional groups of benthic macroinvertebrates in a large hydropower reservoir: Do they provide answers to the ecological assessment and management of the reservoir?

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Introduction. One of the unresolved problems in water management is how to determine the ecological conditions of reservoirs. A recent European Guide proposes a common methodological framework for defining and assessing the good ecological condition of heavily modified water bodies, which includes two approaches: the reference approach and the mitigation measure approach. In this study, we test both approaches using functional groups of benthic macroinvertebrates and evaluate their applicability and suitability to assess reservoirs` ecological conditions and to propose relevant management measures.

Riga HPP reservoir

Methodology. Riga HPP reservoir on a large lowland river Daugava (catchment area of 24 700 km^2) in Latvia was built in 1974 and long-term ecological monitoring in the reservoir has been carried out since 1976; it is a LTER (Long-Term Ecosystem Research in Europe) and ILTER (International Long-Term Ecosystem Research network) network site since 2004. Benthic invertebrate samples were taken annually in September at 3 sites (right bank littoral, profundal and left bank littoral) at one cross-section by Ekman bottom sampler (2 replicates at each site; 1/40 m^2). The depth of sampling sites: 0.5 - 6.5 m at the right bank, 13 - 17 m at the profundal and 0.5 m - 9 m at the left bank.

Results. Significant differences were found between ASPT index at both banks in 1976-1991 and 2001-2018-time periods. Nutrient concentrations show decreasing tendency since early 1990-ties.
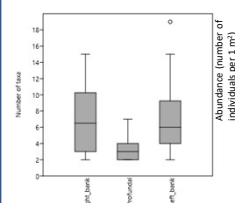

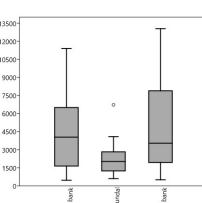**Fig. 1.** Box-plots of the total number of taxa (except Oligochaeta species) in the whole study period.

Fig. 2. Box-plots of the abundance (number of individuals per 1 m^2) in the whole study period.
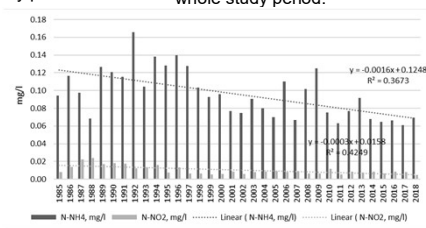

Right bank · Profundal · Left bank

Fig. 3. Box-plot of ASPT (Average Score per Taxon) in 1976-1991 and 2001-2018-time period.

$y = -0.0016x + 0.1248$
$R^2 = 0.3673$

$y = -0.0003x + 0.0158$
$R^2 = 0.4289$

N-NH4, mg/l · N-NO2, mg/l · Linear (N-NH4, mg/l) · Linear (N-NO2, mg/l)

Fig. 4. Annual mean values of N-NH$_4^+$ (mg/l) and N-NO$_2^-$ (mg/l) the Riga's HPP reservoir, 1985-2018.

$y = -0.0263x + 1.2984$
$R^2 = 0.5618$

$y = -0.0389x + 2.4882$
$R^2 = 0.3576$

N-NO3, mg/l · Ntot, mg/l · Linear (N-NO3, mg/l) · Linear (Ntot, mg/l)
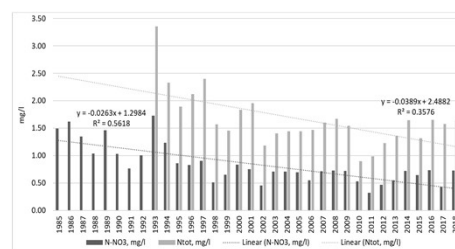
Fig. 5. Annual mean values of P-PO$_4^{3-}$ (mg/l) and P$_{tot}$ (mg/l) in the Riga's HPP reservoir, 1985-2018.

Conclusions. Despite the disturbance of hydropeaking the abundance and species diversity were higher at the littoral zone of the reservoir. At the profundal zone, the most significant ecological group of benthic invertebrates was pelophilous gatherers/collectors. Active filter feeders occupy significant part of the benthic food web (e.g. *Dreissena polymorpha*), grazers-scrapers were common, but less abundant.

ASPT index showed significant differences in ecological state of the reservoir at two study periods, which could be explained by socio-economic changes and reduction of point-source and diffuse pollution loads.

Long-term dataset analysis indicate that the percentage of the dominant functional feeding groups were not changing significantly over several years period, while year-to-year variations were found, and substrate preference types were more variable.

In general, percentage of the main functional feeding groups indicated the overall stability of the large river reservoir ecosystem.