Species diversity and QR-modelling of the state of zooplankton and macrozoobenthos in different categories of water bodies.

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(Summary of the Ph.D. thesis)

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Motivation. The objective of the WFD is to achieve at least a "good" ecological state (or potential) for all surface waters by 2015. Therefore, determining the current environmental state of different categories of water bodies is extremely important. This knowledge is essential to develop effective management plans to recover the water bodies which have not yet achieved a "good" state.

Goal. This thesis reports on the investigation and QR-modelling of species diversity of zooplankton (ZP) and macrozoobenthos (MZB) and the assessment of the ecological state (or potential) of different types of surface fresh water bodies.

Methods. In 1987, 2009, 2011 and 2012, 75 MZB samples were collected using a hydrobiological net and Peterson and Eckmann dredge, and 33 ZP samples were collected using a Juday quantitative net (mesh size 55 mm). The results were analysed using Canonical Correspondence Analysis. Policy recommendations to mitigate anthropogenic impacts were implemented as QR-simulation models using the DynaLearn software.

Results and conclusions. The taxonomic composition of the studied communities in the different categories of water bodies were as follows. In Meshtitsa Reservoir, 27 ZP and 37 MZP taxa were identified. During the succession after the refilling of Meshtitsa, the species composition showed a consistent increase in both diversity and abundance.

In Srebarna Lake 77 taxa were identified, 11 of which were not previously found in this lake. The results suggest that the fluctuations of the water level are crucial for the species composition in the lake. The taxonomic composition was enriched by both drift organisms (from the Danube River) and through "fringing" communities.

In the middle reaches of the Tundzha River, 157 taxa were registered between 1987 and 2012. 132 new taxa were registered between 2009 and 2012, and 14 taxa were not found after 1987. Formation of the species composition was determined by complex interactions of the environmental factors. These factors include disruption of the river continuum and replacement

of major parts of lotic with lenthic conditions, pollution from industrial and communal waste water, changes in river hydro-morphology, diffuse pollution from agricultural areas, etc. Due to these conditions, the MZB communities in the middle section of the river cannot stabilize.

The dynamics of the abundance and cenotic structure of the studied communities in all the three categories of water bodies seem to be determined by seasonality (in the absence of anthropogenic pressure) or by the prevailing environmental situation as a result of typical anthropogenic impacts and pressures.

In general, the ecological status and ecological potential, based on physical-chemical and biological factors, were assessed as follows. The ecological potential of Meshtitsa was found to be "very bad". The ecological status of Srebarna Lake was assessed as "very bad". The environmental situation in the middle section of Tundzha at the points Pavel banya and Gavrailovo were evaluated as worse than "moderate" in 2011, but improved to "moderate" for Pavel banya and "good" for Gavrailovo in 2012. At Samuilovo, the worst environmental situation was observed ("very bad" state).

Several types of anthropogenic pressures and impacts were identified: (1) regulation of the water level in Srebarna Lake, (2) hydro-morphological pressures due to quarrying and organic load from point sources in the middle reaches of the Tundzha River, and (3) nutrient pollution that leads to eutrophication in Meshtitsa Reservoir.

The MZB in Meshtitsa consistently change with the fluctuating conditions of the environment. After the complete refilling of the reservoir, the reconstruction of the MZB started. After the development of Dragaika canal in 1995, the water level in Srebarna Lake remained relatively constant. Our investigation shows that, as a result, the MZB communities completely recovered. Under the new environmental conditions in Tundzha after 1989, which resulted from its good self-purification potential, significant changes occurred in the species composition, which can be defined as a “regime-shift”.

QR-models were developed to describe the mechanisms of eutrophication (Meshtitsa), changing water levels (Srebarna) and inert pollution (Tundzha) and the impact which they have on the structure of communities. These descriptions consist of the structure defining these systems, causal relationships between important quantities, and "critical moments" at which changes are initiated. The simulations show the deterioration of the environmental situation. Policy recommendations were modelled to show how such deteriorations can be averted.