
STRUCTURE AND FUNCTIONING
OF AQUATIC SYSTEMS

Long-Term Dynamics of Suspended Matter in Naroch Lakes: Trend or Intervention

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Abstract—The long-term dynamics of suspended matter in the Naroch lakes has been analyzed with the help of autoregressive integrated moving average (ARIMA) models. A comparison of the models showed that, apart from seasonal fluctuations, all Naroch lakes have been affected by dramatic impact, which has resulted in a rapid decrease in absolute values and fluctuation decrease of seston concentration. The models indicate that, in contrast to lakes Naroch and Myastro, the dynamics of the seston concentration in Lake Batorino is characterized by a longer period of stabilization after the impact that occurred in 1991.

Keywords: suspended matter (seston), long-term dynamics, ARIMA model, trend, intervention, eutrophication, benthification, phytoplankton, chlorophyll

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INTRODUCTION

The lakes of the Naroch group are a system of three lakes subject to long-term hydroecological investigations. Over the last 60 years, several stages in the evolution of structural and functional organization of the lakes can clearly be seen [11]. Detailed investigations into principal hydroecological parameters revealed in the long-term dynamics a period of intensive eutrophication: from the 1970s to the middle of 1980s. Since the early 1990s, an increase in water transparency and decrease in concentration of N and P has been recorded. Against the background of a decrease in major biogenous elements, the parameters characterizing the quantitative development of main pelagic biological communities decreased: the content of chlorophyll decreased, as did the biomass of phyto-zoo-, and bacterioplankton. This indicates that, in Naroch lakes, clear signs of oligotrophication or signs of de-eutrophication of the water body in the general understanding appeared. While the eutrophication period was caused by increasing anthropogenic impact, the subsequent changes were principally caused by two factors: by a ~30% decrease in external biogenous load on the ecosystem of lakes resulting from the State Program of Ecological Sanitation in the middle 1980s and by the introduction of an efficient filter-feeder—the mollusk *Dreissena polymorpha* Pallas—in the lakes in the late 1980s. The decrease in external biogenous load and active distribution of

Dreissena over three lakes resulted in the displacement of processes of matter transformation from the open water to the bottom layer [11] or to benthification of the ecosystem [10, 18, 19].

The processes of eutrophication, like the opposite processes of de-eutrophication or oligotrophication, as well processes of benthification taking place in Naroch lakes, influenced all links of the trophic chain and all hydroecological parameters.

One of the principal parameters integrating functional traits of lake ecosystems is the content of suspended matter (seston). All aspects of the biotic turnover are closely related to this component of the ecosystem: production, transformation, and mineralization of organic matter. Seston comprises numerous ingredients and may functionally be considered a higher hierarchic level than its components—living plankton and dead fraction (detritus) [9]. Principal factors controlling the content and transformation cycle of seston in water are the inflow of organic matter from the drainage area, the photosynthetic activity of plankton, the production of subsequent links of the trophic chain, the sedimentation and resuspension of bottom sediments, and the biological and physicochemical destruction of matter [23]. In its turn, the key parameters of aquatic ecosystems, including the quantity and structure of phyto-, zoo-, and bacterioplankton; the development of benthic communities and macrophytes; and the interaction of