University of Bialystok

Faculty of Biology

Adam Więcko

Influence of catchment area and physicochemical properties of water on the mycoplankton biomass in north-eastern rivers of Poland

Doctoral dissertation

Promoter: prof. Ph.D. Andrzej Stefan Górniak
Auxiliary promoter: Ph.D. Anna Pieryczuk

Białystok, 2023

SUMMARY

The turn of the 20th and 21st centuries was a period of rapid growth in interest in the biology and ecology of aquatic fungi, thanks to the use of molecular biology techniques and the possibilities of using fungi in biotechnological processes. The role of fungi in the transformation of organic matter in aquatic ecosystems in the face of global changes in the carbon cycle, as well as interorganismal and habitat interactions, are particularly important. Therefore, a fundamental issue in understanding the scale of the impact of mycobiota on other elements of the environment is the quantitative evaluation of its biomass and the role of catchment factors that co-shape the ecological condition of water. The main aim of the presented doctoral dissertation was to determine the biomass of seston aquatic fungi in the waters of small rivers in north-eastern Poland and to indicate the relationship between the physico-chemical properties of water, the structure of water catchment use, and the biomass of mycoplankton present. Field research was conducted in 2010-2012, twice in four phenological seasons. Throughout the entire research period, a total of 144 samples were collected for analysis from 18 small rivers in north-eastern Poland, with various morphometric and water quality parameters and different catchment characteristics. The most important parameter tested in a laboratory was a chromatographic determination of the concentration of ergosterol in river water, which is necessary to determine the biomass of aquatic fungi. The remaining hydrochemical analyzes concerned the determination of the concentrations of selected forms of nutrients and organic matter in the studied rivers. To assess the impact of catchment parameters on the biomass of aquatic fungi, data from the land use analysis in the Corine Land Cover program were used. The research carried out shows that in the years 2010-2012, in small rivers of north-eastern Poland, the average biomass of aquatic fungi was $0,43 \pm 0,22$ μg· dm^{-3}, ranging from 0,05 to 1,15 μg dm^{-3}. In spring and summer, higher mycoplankton biomass was found in small rivers in north-eastern Poland than in autumn and winter. The overall dynamics of mycoplankton development largely correlated with the biomass of algae present in the tested river waters, nevertheless the average amount of phytoplankton was on average three orders of magnitude higher than the biomass of seston aquatic fungi. The conducted analyzes confirmed the stimulating role of biogenic substances in the development of mycoplankton. A significant increase in its biomass occurs with increased water content in both nitrogen and phosphorus, and this beneficial effect is most clearly revealed in the synergistic increase in the concentration of both these biogenic elements.

The biomass of aquatic fungi has a positive correlation with the content of seston organic carbon, in contrast to the total form of carbon and its total inorganic and organic forms. However, the stimulating effect of seston carbon compounds becomes more important when river water is rich in biogenic substances. The spring increase in river flow and increased mycoplankton biomass is most pronounced in catchments with a dominant share of meadows, pastures and wetlands. In summer, plant pollen may be a source of nutrient-rich, fine-molecular organic matter, which is an excellent substrate and habitat for the development of aquatic fungi. In autumn, the positive impact of deciduous forests on the development of mycoplankton was revealed. The modern trend of warmer and snowless winters may disrupt the existing annual rhythm of water outflow from the catchment, nutrient load and seasonality of river mycobiota. The analyzed connections of the hydrological and geochemical system with river mycoplankton indicate significant interactions with other hydrobionts and the structure of the riparial zone, often modified by humans, destabilizing the balance of running water ecosystems.