Composition and phytosociological structure of macrophyte communities in different types of water basins in the watershed of the Bulgarian section of the Danube River

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Summary of PhD Thesis

The aim of the present study was researching macrophyte communities in water bodies in the Bulgarian part of the Danube River, using simultaneously standard methodology for assessment of the ecological state of the water body with BQE (bilogical quality element) macrophytes, and phytosociological approach (Braun-Blanquet, 1964) for classification of these macrophyte communities. The work towards this goal included determining the species composition and phytocoenotic structure of macrophyte communities in water basins with different hydromorphological characteristics in the floodplain terrace of the Danube River and its tributaries, as well as determining their relationship with abiotic environmental factors.

Six categories of water basins with different hydromorphological characteristics were investigated: rivers, river embayments, canals, oxbows, dams, swamps.

During the period 2014-2016, 115 plant taxa in total were identified, from 26 water basins and 31 stations. Sixteen of the observed species are rare or have a limited distribution, and are conservationally significant species. The highest species richness over the three years of the study was maintained in Lake Srebarna, Peschin Marsh, and Lake Malak Preslavets, while the lowest was observed in the oxbow lake of the Osam River and the embayment of the Danube River. The Shannon Index (H') showed the highest values for sites in Lake Srebarna, and the higher species diversity found there is characteristic of unaffected hydroecosystems. The lowest index values were recorded in the embayment of the Danube River, which is typical for impacted ecosystems. The evenness of the communities in all water bodies and across the three years of the study was high. In most water bodies, the Pielou Index (J') > 0.5, indicated dominance in the structure of the macrophyte communities. In a large part of the studied water bodies, poor or moderate ecological state/potential predominated. The average values of the Ecological Quality Ratio (EQR) in the group of swamps were the highest, while in channels and river embayments, they were the lowest.

The multivariate analyses showed that macrophyte species and their life forms spatially were related to similar environmental factors, the main of which were connectivity with the river and hydromorphology of water basins. Temperature and conductivity, in terms of species, and ammonium nitrogen, in terms of growth forms, also explained a certain percentage of spatial variations, but with smaller explanatory power. It seemed that the hydrological and morphological characteristics integrated a multitude of features, thus causing a much greater influence on macrophyte composition and structure, than single physicochemical variables.

Even less pronounced the temporal variation of macrophyte species was explained mainly by the total nitrogen and the temperature. Obviously, the dynamics of nitrogen compounds in the studied water bodies had a significant importance for macrophyte development. This was most relevant for the group of free-floating species that take up nutrients from the water column. It is possible that at low water N/P ratio they faced nitrogen limiting conditions unlike the rooted submerged macrophytes, which can take nutrients from the substrate, and thus are more competitive under nitrogen shortage. The ecological state/potential assessed on the base of macrophyte species differed between studied water bodies in line with the gradient of water conductivity. The observed relations confirmed the literature data on the requirements of some representative species to the ecological characteristics of water.

Syntaxa have been identified that belong to: 4 classes, 7 orders, 11 alliances, 33 associations, and 17 communities. Five syntaxa have been described for the first time in Bulgaria.

The analysis of environmental factors (FAMD) on the spatial variation of the described phytocenoses highlighted hydromorphology and connectivity with the river as the leading factors. In hydrophytic communities, other strong factors were substrate, nitrates, as well as pH and dissolved oxygen levels. In helophytic communities, other determinants were ammonium, total phosphorus, and substrate.

Main environmental parameters influencing the structure and composition of hydrophytic communities, according to CCA analysis, were: hydromorphology, with the strongest impact, followed by phosphate phosphorus, transparency, pH, substrate, water level, total nitrogen, and nitrates. While main environmental parameters influencing the structure and composition of helophytic communities, according to CCA analysis, were: hydromorphology, with the strongest impact, followed by pH, water level, ammonium ions, and transparency.

One possible reason for the difference between the determinants of hydrophytic and helophytic communities, as well as the participation of more nutrient related factors in helophytic phytocenoses, is that hydrophytes are more dependent on the amount of dissolved nutrients in the water, as they absorb them from the aquatic environment, unlike helophytes, which are deeply rooted in the substrate, often located above the water, and absorb nutrients from the substrate.

The obtained results about macrophytes, as main primary producers of floodplain water bodies, could be a helpful tool for understanding, and better management of these aquatic ecosystems of Lower Danube, many of which have undergone a long process of restoration.