Urea in lake ecosystem: the origin, concentration and distribution in relation to trophic state of The Great Mazurian Lakes (Poland)

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INTRODUCTION

Urea is one of the most important components of dissolved organic nitrogen (DON) pool in marine and freshwater environments. Aquatic habitats are supplemented with this compound by variety of catabolic processes carried out by almost all heterotrophic organisms. Permanent input of urea to dissolved organic N (DON) pool is ensured by the ubiquity of urea precursors (such as proteins, nucleic acids and their derivatives) (Siuda et al. 1998, Kiersztyn and Siuda 2007) accompanied with their commonly high decomposition rates (Siuda and Chrost 2000, Siuda et al. 2007). On the other hand, urea is often used as a nitrogen source by planktonic microorganisms (MacCarthy 1972, MacCarthy et al. 1982). Because possibility of direct assimilation and fast intracellular hydrolysis that provides two atoms of N in „ready for use” reduced form, the role of urea in nitrogen cycling can be especially important in N-poor oceanic waters and N-limited highly eutrophicated freshwater habitats. Concentrations of urea (expressed as μM of urea) in open oceanic waters commonly not exceed 2 μM. However, in extremely polluted coastal waters they can reach even 24.2 μM (Glibert et al. 2006).

Unlike marine and coastal environments, the origin, distribution, spatial and temporal dynamics of urea in lakes were only barely studied (Solomon et al. 2010). In general, urea concentrations observed in lakes and ponds were similar or only slightly higher than those found in marine environments and most commonly varied from 0.5 to 5.5 μM (Berman 1974, Mitamura and Saijo 1981, 1986, Presing et al. Bogard et al. 2012). In environments that undergo strong human impact, urea concentrations reflect a balance between external input of this compound and its internal biological recycling (Lomas et al. 2002). The range of external supplementation of aquatic habitats with urea is difficult

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ABSTRACT

The distribution, concentrations and origin of urea were studied in surface and profundal waters of meso-eutrophic and highly eutrophic parts of The Great Mazurian Lake System (GMLS) during spring – autumn period. Urea concentrations varied from 0.25 μM in surface layer to 3.36 μM in profundal zone of studied lakes and were in the range of concentrations noted in other non-polluted freshwater habitats. In the photic zone of lakes of GMLS Urea N made up to 10 % the total DON pool and often exceeded 2-3 times of NH₄⁺-N concentrations. Pattern of changes in urea concentrations observed during three-years study excludes external urea input and suggests supplementation of lake waters with this compounds by phytoplankton decomposition processes. Generally, urea concentrations were negatively correlated with the trophic state index calculated from “algal” as well as from “bacterial” determinants. However, more detailed analysis showed that the relationships between production and assimilation of urea by various plankton components as well as the ecological role of this compound in meso- and eutrophic lakes could be different.

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