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Conference Abstract

Beyond Phosphorus: Salinization as a driver of eutrophication symptoms in North American lakes

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Abstract

The acceleration of global urbanization continues to fuel concerns surrounding water quality impairments in urban lakes, particularly eutrophication. Eutrophication of freshwater environments is generally assumed to be driven by increased anthropogenic phosphorus (P) supplies which can alleviate limitations on primary production. Salinization is also recognized as a stressor on urban freshwater quality, particularly in cold temperate climate regions where salts are applied to road surfaces as de-icing agents. While the ecological damages caused by P enrichment and salinization to freshwaters are both well established, thus far, their impacts on water quality have only been considered independently. Although improvements to the management of urban stormwater and wastewater have decreased P inputs to freshwater systems in recent decades, many lakes worldwide remain eutrophic, as indicated by declining dissolved oxygen (DO) concentrations and rising dissolved inorganic P (DIP) concentrations in the hypolimnion. Our previous study of an urban freshwater lake in Ontario, Canada, showed that persistent eutrophication symptoms are linked to salinization associated with impervious land cover expansion, rather than increased external P loading. In this research, we present a multiple decade of water chemistry data analyses for several other urban lakes in Ontario, Wisconsin, and Minnesota to determine how increased lake salinization rates intersect with

water temperature and morphometry to alter water column stratification, thus, increasing eutrophication symptoms. Our trend analysis shows progressive salinization (observed through significant increases in chloride or electrical conductivity) of all the lakes investigated. Calculations of lakes mixing indices over time show that, on average, lake stratification is becoming more stable with increased salinity playing a crucial role in enhancing lake stratification. Overall, salinity is becoming a stronger regulator of water density than temperature in the cold temperate urban freshwater lakes of North America. The increasing salinity trends are accompanied by increasing hypolimnion hypoxia and increasing DIP to total P (TP) ratios in all lakes, thereby demonstrating the mechanistic link between salinization and internal P loading. Rising salinity intensifies water column stratification, in turn, reducing the oxygenation of the hypolimnion and enhancing internal P loading from the sediments. These results highlight that stricter management of de-icing salt application rates should be considered to control lake eutrophication symptoms in cold climate regions.

Keywords

salinization, phosphorus, internal loading, anoxia, eutrophication symptoms

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We would like to be considered for an oral presentation.

Conflicts of interest

The authors have declared that no competing interests exist.