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Interrelationship between nutrients and chlorophyll-a in an urban stormwater lake during the ice-covered period

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ABSTRACT

Urban stormwater lakes in cold regions are ice-covered for substantial parts of the winter. It has long been considered that the ice-covered period is the "dormant season," during which ecological processes are inactive. However, little is known about this period due to the historical focus on the open-water season. Recent pioneering research on ice-covered natural lakes has suggested that some critical ecological processes play out on the ice. The objective of this study was to investigate the active processes in ice-covered stormwater lakes. Data collected during a two-year field measurement program at a stormwater lake located in Edmonton, Alberta, Canada were analyzed. The lake was covered by ice from November to mid-April of the following year. The mean value of chlorophyll-a during the ice-covered period was 22.09% of the mean value for the open-water season, suggesting that primary productivity under ice can be important. Nitrogen and phosphorus were remarkably higher during the ice-covered period, while dissolved organic carbon showed little seasonal variation. Under ice-covered conditions, the total phosphorus was the major nutrient controlling the ratio of total nitrogen to total phosphorus, and a significant positive correlation existed between total phosphorus and chlorophyll-a when the ratio was smaller than 10. The results provide preliminary evidence of the critical nutrient processes in the Stormwater Lake during the ice-covered period.

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1. Introduction

Stormwater lakes support urban runoff management and prevent flooding and downstream erosion in urban areas. In cold regions, these lakes are ice-covered for substantial part or the entire winter. It has long been considered that the ice-covered period is the "dormant season" for lakes (Hampton et al., 2015), during which ecosystems subjected to low temperatures are "on hold" and most ecological processes are inactive until the environmental conditions become more conducive to the growth of aquatic organisms (Bertilsson et al., 2013). In the original Plankton Ecology Group's (PEG) model (an influential freshwater

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