Using a watershed modeling approach to assess changes in phosphorus loading in the Mattatall Lake watershed, Nova Scotia, Canada

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Mattatall Lake is small headwater lake located on the boundary of Cumberland and Colchester County, Nova Scotia, which has recently experienced cyanobacteria blooms. Phosphorus (P) is widely considered to be the key nutrient which influences trophic state and cyanobacteria bloom risk within freshwater ecosystems. This study attempted to characterize the primary sources of P within the watershed, and changes in P loading during the last 35 years, through a watershed modeling analysis. An adapted version of the Nova Scotia Phosphorus Loading Model was used to predict average annual Total P (TP) concentrations in the lake as a function of land-use and hydrology. The model was validated against the average annual TP concentrations measured during 2016–2017. Once validated, the model was used to assess how TP concentrations in the lake have changed since 1985, when the watershed was relatively undeveloped. The outputs from the analysis indicated that the cumulative land use change in the watershed during the time period 1985–2017 would have increased mean annual TP concentrations in the lake by 1–2 μg·L-1. The largest sources of P within the watershed are runoff export from natural landscapes and atmospheric deposition. Anthropogenic sources of P in the watershed include runoff export from roads and residential lots, increased runoff export from areas of the watershed that have been clearcut, and P loading from septic systems. The average annual TP concentrations were measured to be 9 μg·L-1, indicating the lake is just below the boundary between an oligotrophic and mesotrophic ecosystem. However, large releases of soluble reactive P from lake sediments were observed at an 11 m deep station in the headwater basin and it was hypothesized that increasing temperatures in the region may be influencing stratification processes and the potential for internal loading of P and cyanobacteria blooms.

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