
A paleolimnological record of anthropogenic impact on water quality in First Lake, Lower Sackville, Nova Scotia

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Lakes situated in urban environments are subject to a variety of anthropogenically induced pressures including nutrient loading, erosion, metal and salt inputs, and hypolimnetic anoxia. Since the 1920s, First Lake in Lower Sackville, Nova Scotia has been the focus of watershed development and degradation of lake water quality is an ongoing concern. A time stratigraphic, multi-proxy, geochemical investigation was conducted on a sediment core from First Lake in order to determine pre- and post-development water quality conditions. A year-long study of limnological conditions, local weather conditions, and existing historical data was conducted in 2012. First Lake is 82 ha in size with a maximum depth of 23m. Survey results indicate shallow secchi depths (< 2 m), strong stratification (~6 m) and neutral pH values (6.48–8.67). Oxygen-deprived bottom waters (< 5%) commonly develop as the summer progresses. Water temperature trends indicate continual mixing in the epilimnion.

Atmospheric Pb concentrations found within the sediment core were used to approximate sedimentation rates. Pre-development (pre-1920) data indicates a mesotrophic lake that may have experienced occasional eutrophic conditions. Post-development proxy data indicates higher $\delta^{15}\text{N}$ values and lower C/N ratios indicative of increased primary productivity within the lake as a result of increased nutrient input from early agricultural development during the 1920s. Changes in concentrations of Ti, Cu, K, loss-on-ignition, and magnetic susceptibility values indicate landscape instability and increased sediment and toxin transfer into the lake associated with urbanization in the 1960s. Collectively, these data indicate that though First Lake was a moderately productive lake before development, recent water quality degradation is strongly linked to specific anthropogenic activities in the watershed, an understanding of which is a fundamental factor in developing effective lake management strategies.