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Tracking catchment disturbance using lake thecameobians (testate amoebae): case studies from the Greater Toronto Area, Ontario, Canada

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Thecamoebians (testate amoebae) are a group of unicellular protozoans that occur in freshwater to brackish environments. They are useful for palaeoenvionmental reconstruction because they are sensitive to a wide variety of environmental variables and because their tests are generally resistant to dissolution. In lakes, faunal assemblages can be correlated with many environmental parameters including substrate changes associated with forest fires, de-forestation and land clearance, eutrophication, temperature change, salinity, pH and metal and organic pollutant contamination. We examined thecamoebians from 71 surface sediment samples collected from 21 lakes and stormwater management ponds in the Greater Toronto Area (GTA) and the surrounding region to i) better elucidate the controls on faunal distribution in modern lake environments; and ii) to consider the utility of thecamoebians in quantitative studies of water quality change. This area was chosen because it includes a high density of lakes that are threatened by urban development and where water quality has deteriorated locally as a result of contaminant inputs, particularly nutrients. Canonical Correspondence analysis (CCA) and a series of partial CCAs were used to examine species-environment relationships. Twenty-four environmental variables were considered, including water properties (e.g. pH, DO, conductivity), substrate characteristics, nutrient loading, and environmentally available metals. The thecamoebian assemblages showed a strong association with sedimentary (Olsen's) Phosphorus, reflecting the eutrophic status of many of the lakes, and locally to elevated conductivity measurements, which appear to reflect road salt inputs associated with winter de-icing operations. A transfer function was developed for Olsen P using this training set based on weighted averaging with inverse deshrinking (WA Inv). The model was applied to infer past changes in Phosphorus enrichment in core samples from several lakes, including eutrophic Haynes Lake within the GTA. Thecamoebian-inferred changes in sedimentary Phosphorus from a 210-Lead dated core from Haynes Lake are related to i) widespread introduction of chemical fertilizers to agricultural land in the post WWII era; ii) a steep decline in Phosphorus with a change in agricultural practices in the late 1970s; and iii) the construction of a golf course in close proximity to the lake in the early 1990s. This preliminary study confirms that thecamoebians have considerable potential as quantitative indicators of eutrophication and catchment disturbance in lakes and may provide an effective tool for appraising water quality and ecological restoration initiatives in lake catchments.