An Analysis of Eutrophication in Wetlands Adjacent to Lake Matoaka

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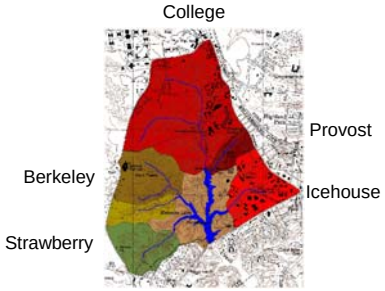
Introduction

Lake Matoaka, located on the campus of The College of William & Mary, is a eutrophic system. Eutrophication, roughly translated as “well fed” in Greek, refers to the effects of an elevated concentration of nutrients (e.g. nitrogen and phosphorus) in an ecosystem. High nutrient levels in a body of water facilitate proliferation of phytoplankton and aquatic vegetation. As these primary producing organisms die, their subsequent decomposition depletes the water of oxygen. Sufficiently high quantities of plant and phytoplankton decomposition create suboxic zones. Often, the excess chemical nutrients responsible for eutrophication originate from anthropogenic sources. Fertilizers, both agricultural and residential, are rich in limiting nutrients such as phosphorus. When these chemicals enter the watershed in runoff, they are transported via the fluvial network. During flood events in which bankfull discharge is exceeded, nutrients in the water are deposited in floodplain sediments. Storage of such sediment is especially pronounced in wetland environments. In this project, I measured phosphorus in wetland sediments from streams on both the east and west sides of Lake Matoaka. This comparison evaluates developed watersheds (Provost Creek, College Creek, Icehouse Creek) and undeveloped watersheds (Strawberry Creek, Berkeley Creek). I hypothesized that increased nutrient runoff associated with developed watersheds would result in elevated phosphorus levels in the eastern wetland sediments relative to the undeveloped western sediments. I also compared all wetland sediments to samples derived from the bottom of the lake, including cypress swamp sediment predating the formation of Lake Matoaka in the early 18th Century.



Lake Matoaka Watersheds

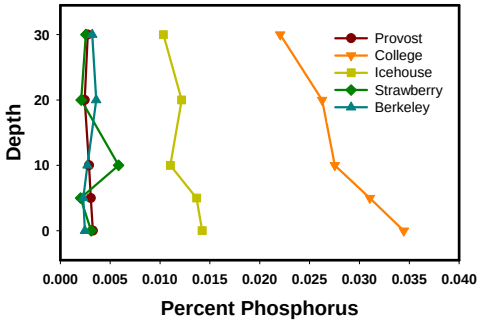
Methods

A total of 45 samples from each site were analyzed. Sites were divided into three transects: one closest to the lake outlet, one intermediary, and one farthest from the outlet. At each transect, three cores were taken: one closest to the channel, one intermediary, and one farthest from the channel. From each core, five samples were taken at depths of 0cm, 5cm, 10cm, 20cm, and 30cm. Each sample was freeze dried, ashed, suspended in 0.2M HCl, treated with a combined reagent, and analyzed via spectrophotometry. Lake cores had been previously extracted; I performed the same analysis on these samples.

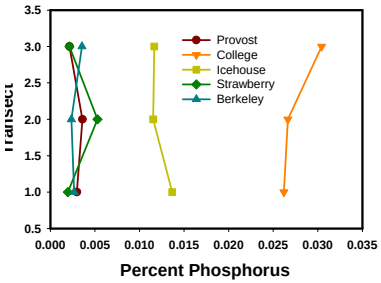
Results

Statistical analysis was performed to compare percent phosphorus to the variables of wetland, transect, core, and depth. Of these factors, only wetland was shown to have a statistically significant influence on phosphorus.

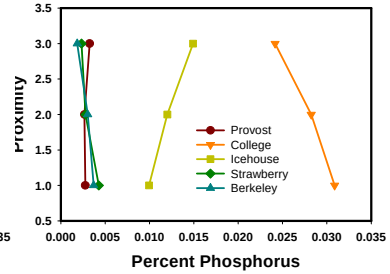
Phosphorus vs. Depth



Phosphorus vs. Transect

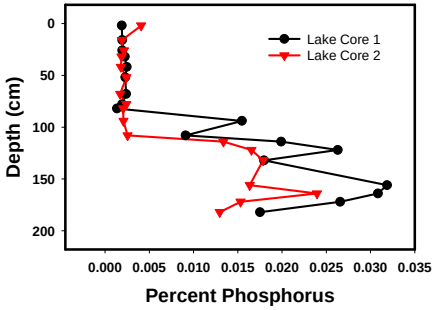


Phosphorus vs. Proximity to Channel



Ancient cypress swamp sediment contained phosphorus levels comparable to modern developed watershed sediment.

Lake Core Phosphorus vs. Depth



Discussion

The statistical significance of percent phosphorus versus watershed supports the hypothesis that degree of development serves as a control on phosphorus level. The lack of statistical significance among other variables indicates that phosphorus deposition is relatively consistent over space and time.

The significantly elevated phosphorus concentration in ancient cypress swamp sediment, however, is inconsistent with this conclusion. The age of this sediment (pre-1750) far predates industrialization and significant land use change. Anthropogenic inputs are therefore nonexistent in this wetland. It is possible, then, to infer that cypress swamps act as particularly effective phosphorus sinks. The large quantity of organic matter retained in such environments sequesters organic phosphorus. The creation of modern wetland environments mimicking the ecological conditions of this ancient cypress swamp may mitigate the effects of nutrient pollutants in transport through a watershed. This suggestion is especially pertinent to the Virginia coastal plain, as pollutants from this region are deposited in the already-threatened Chesapeake Bay.

Acknowledgements

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