Dells Mill Pond Paleolimnology

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Field Research 2001-2002

Introduction

What can sediment tell us about the history of Dells Mill Pond? The sediment can give you a very good description of what was going on at certain points in history like when floods were, when agriculture became predominant, and what kind of nutrients the water holds. By the peaks of Cesium 137, dating of the sediment is possible to match all these events with the correct date/years. Data was gathered over a period of time between November 2, 2001 to April 11, 2002 for paleolimnology of Dells Mill Pond. The coring took place on Dells Mill Pond, but most of the research was done in the Biology Lab at Augusta High School. The dating was done at the State Lab of Hygiene.

Methods and Materials:

Coring

A sediment core was taken from Dells Mill Pond (Figure 1) in Eau Claire County, Wisconsin on November 2, 2001 from a depth of 3.5 meters at 44° 43.365 North latitude and 091° 08.827 West Longitude. The core was collected with a piston corer with and inside diameter of 8.8 centimeters. The core was extracted by filling core tube with water then pushing the corer into the sediment at the bottom of the pond until the core tube could go no farther. Pulling the sample up until

the bottom is almost out of the water, keeping it submerged while plugging the bottom of the core piston with rubber stopper. Finally pulling the sample out of the water. Upon returning to shore the core was pushed from the bottom to the top and scraped off every 2 centimeters and put into plastic bags labeled *DP-1 xcm-ycm* then stored in a refrigerator at Augusta High School in the Biology lab.

Chlorophyll

The chlorophyll method used was “Chlorophyll Estimation” Appendix A.

Porosity

Beginning by taking thirteen samples of sediment and putting it into crucibles then massing the samples. Then dried the samples at 100 degrees Fahrenheit in the drying oven, mass samples once again. Repeat drying and massing until there is no change in mass. Found porosity by taking [(original mass-final mass)/original mass x 100].

Percent Organic Matter

Reground the pre-dried porosity sediment samples then mass. Then put into kiln with temperature cone at 550 degrees Celsius. Massed this to see how much

organic matter was burned off. Used the equation [(original mass-final mass)/original mass x 100] to find grams of organic matter.

Percent Calcium Carbonate ($CaCO_3$)

Reground organic matter sediment samples and then massed the samples. Put samples in kiln with temperature cone at 1200 degrees Celsius. After the Calcium Carbonate ($CaCO_3$) was burned off, mass again. Then to ensure all the moisture is off put into drying oven at 100 degrees Fahrenheit overnight. The massed again to make sure that the mass had not changed. To convert the number we had found to grams of $CaCO_3$ found balanced equation $CaCO_3$-→ $CaO + CO_2$ and used stoichiometry to from grams of Carbon Dioxide (CO_2) to grams $CaCO_3$

$$\text{X grams } CO_2 \;\; \frac{1 \text{ mole } CO_2}{44.0 \text{ g g } CO_2} \;\; \frac{\text{I mole } CaCO_3}{1 \text{ mole } CO_2} \;\; \frac{100 \text{ g } CaCO_3}{1 \text{ mole } CaCO_3} = \text{g } CaCO_3$$

Figure 1.1 *Stoichiometry*

Grainsize

Dried sediment on aluminum foil. Then the dehydrated sample was crushed with mortar and pestle into a fine powder. Placed in tube to the 2cm mark. Then water was added to the 6cm mark. 5 drops of reagent were added then the

sample was capped and shaken for 2 minutes. The next day the sediments different layers and grainsizes were measured.

Phosphorus

Using the Total Phosphorus test, PhosVer 3 and Acid Persulfate Digestion; Test N' Tube™ Procedure. Method number 10013 from Hach DR/2000 Spectrophotometer Handbook.

Soil Extraction

Using Soil Extraction for phosphate and potassium Acid/Fluoride Method, Using Soil Extractant 1 from Hach DR/2000 Spectrophotometer Handbook.

Radioisotopes

Radioactive Cesium (^{137}Cs) was measured at the State Laboratory of Hygiene in Madison, Wisconsin. Sediment samples were analyzed by gamma radiation emitted from the samples. The cesium profile is used to determine the date 1954 when atmospheric testing of nuclear weapons began and 1963 when the atmospheric testing peaked.

Diatoms

Diatoms were analyzed from eight depths through out the core. Four depths were chosen evenly throughout the core, the others were chosen to find when the differences occurred. Before slides could be made the sample had to be cleaned. After gently shaking sample, a spatula was used to weigh out between .1g and .2g of sample in weighing dish on scale. Each was poured into a labeled 1000ml tall beaker. For safety; sample was processed in a hood. Adding about 5ml of Hydrogen Peroxide (H_2O_2) to the beaker containing the sample the solution was swirled. After a few minutes, a partial spoon of potassium dichromate was added to the sample. Mixture turned a purplish-black and slowly started to fizz. A distilled water bottle was on hand to rinse sides of beaker during reaction although it was not used. After the sample finished reacting (it was orange in color and hot), sample was poured into a clean, labeled plastic ten milliliter centrifuge tube. Sample was spun for ten minutes. After sample had stopped centrifuging, carefully sucking off most liquid in the hood, tube was refilled with distilled water. Repeating the washing until the liquid had no color and then was centrifuged one more time. After the final rinse, pellet was placed into a labeled beaker and made a volume up to twenty milliliter using washings from the centrifuge tube. A cover-slip was taken out of the 70 % EtOH (Ethyl Alcohol) solution and wiped dry. Placing it on the slide warmer and adding about 5 drops of distilled water to disperse it across the cover-slip. Using a clean

disposable pipette, added drops of the sample onto the cover-slip. Thoroughly mixing the sample on the cover-slip using the empty pipette. Recorded the number of drops in the logbook. After the sample had dried, the cover-slips were placed on the hot plate for ten minutes. While that was happening, a microscope slide was cleaned and labeled with the glass scriber. Placing a drop of Naphrax on the slide and then adding the cover-slip (face down) and heat for another two minutes. Take slide off heat and push gently on cover-slip with two toothpicks to get bubbles out. When the slide cooled, a razor blade was used to scrape excess Naphrax off edges of cover-slip. Once slide was prepared, diatoms were counted under microscope on high power in oil immersion.

Results:

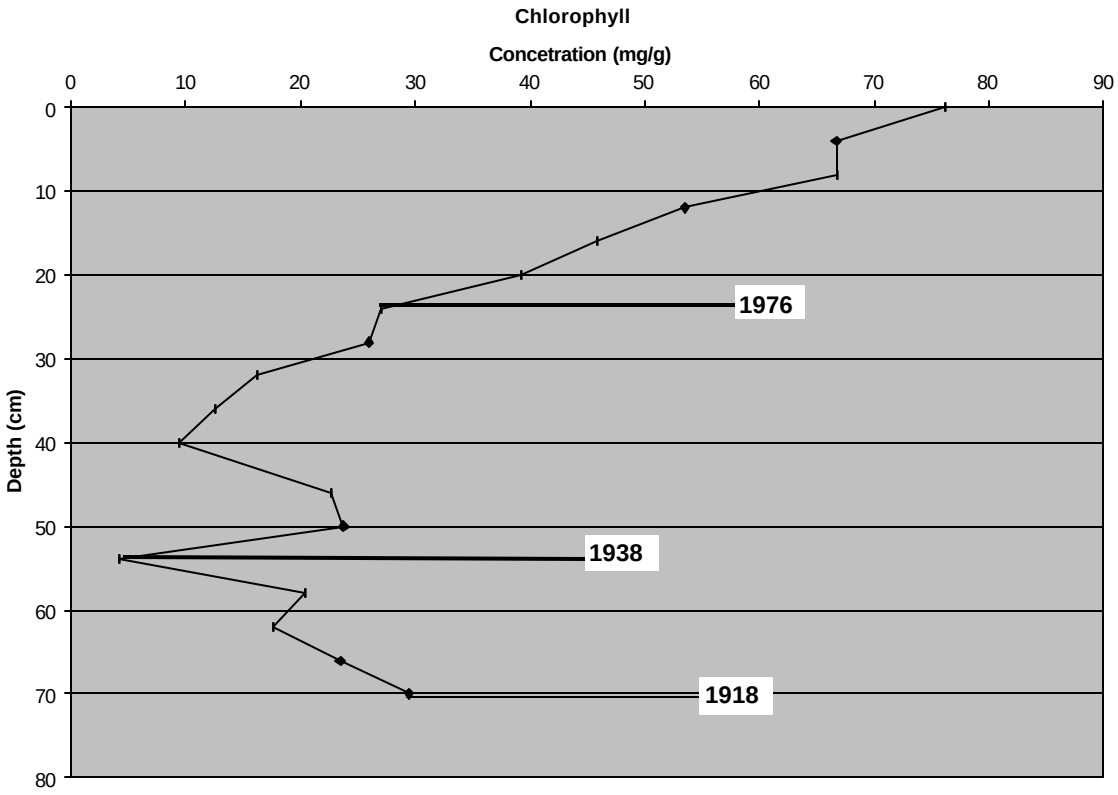
Dating

There are two ways that was tried to derive the date from the core. Cesium-137 was released in the 1950's and 1960's through atmospheric testing of nuclear weapons. In this study there was no peak anywhere. Comparing the porosity data of the core with the annual rainfall recorded dates were estimated. Flood events are expected to deliver a large amount of course sediment.

Significant floods were found in 1938 and 1975. Also a low sedimentation rate happened in 1976. Matching 1938 with the depth of 54cm and the year of 1976 with the depth of 24 cm creates a sedimentation rate that can be used to date the

rest of the core. The sedimentation rate found was about one centimeter of sediment per 1.2 years.

Chlorophyll

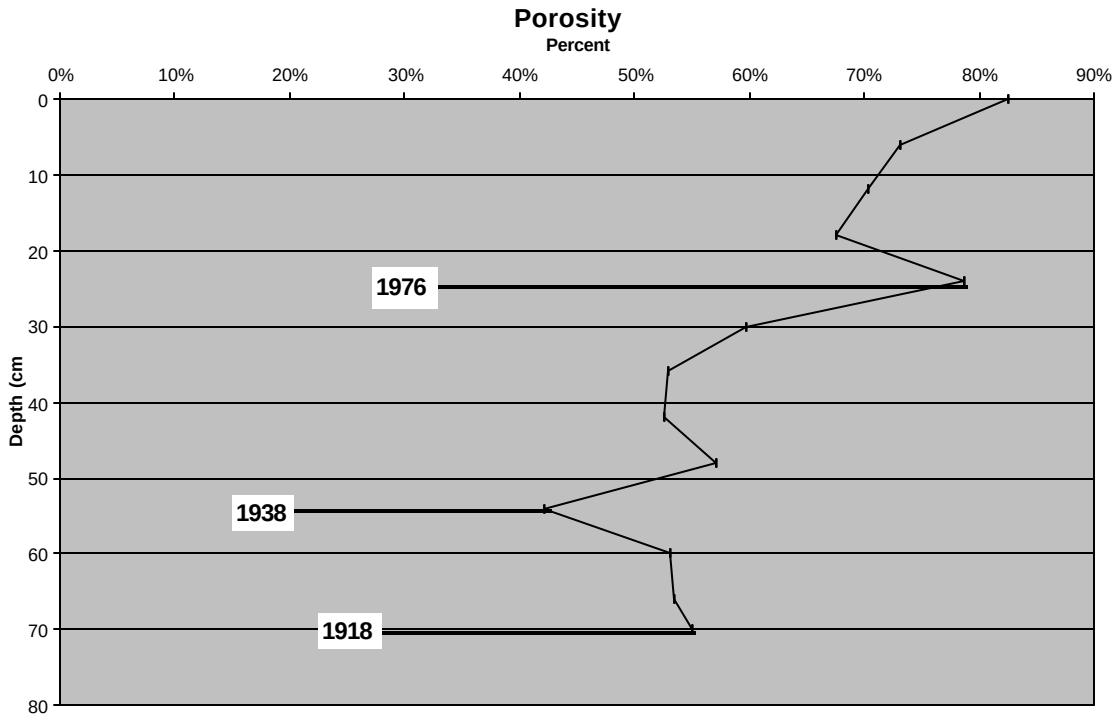


Graph 1-1

The chlorophyll showed depressions at depths at 40 centimeters and 54 centimeters in Graph 1-1and gradually increased from 40 centimeters to the top of the core. This increase of chlorophyll is from the algal blooms, or any other aquatic plant life in the pond.

Porosity

Porosity data showed the amount of water retained in the sediment, and this directly corresponded with the annual precipitation data. The depressions in



porosity (Graph 1-2) show floods because more sand and other sediment erodes into the lake. These different sediment types hold more water than others.

Graph 1-2

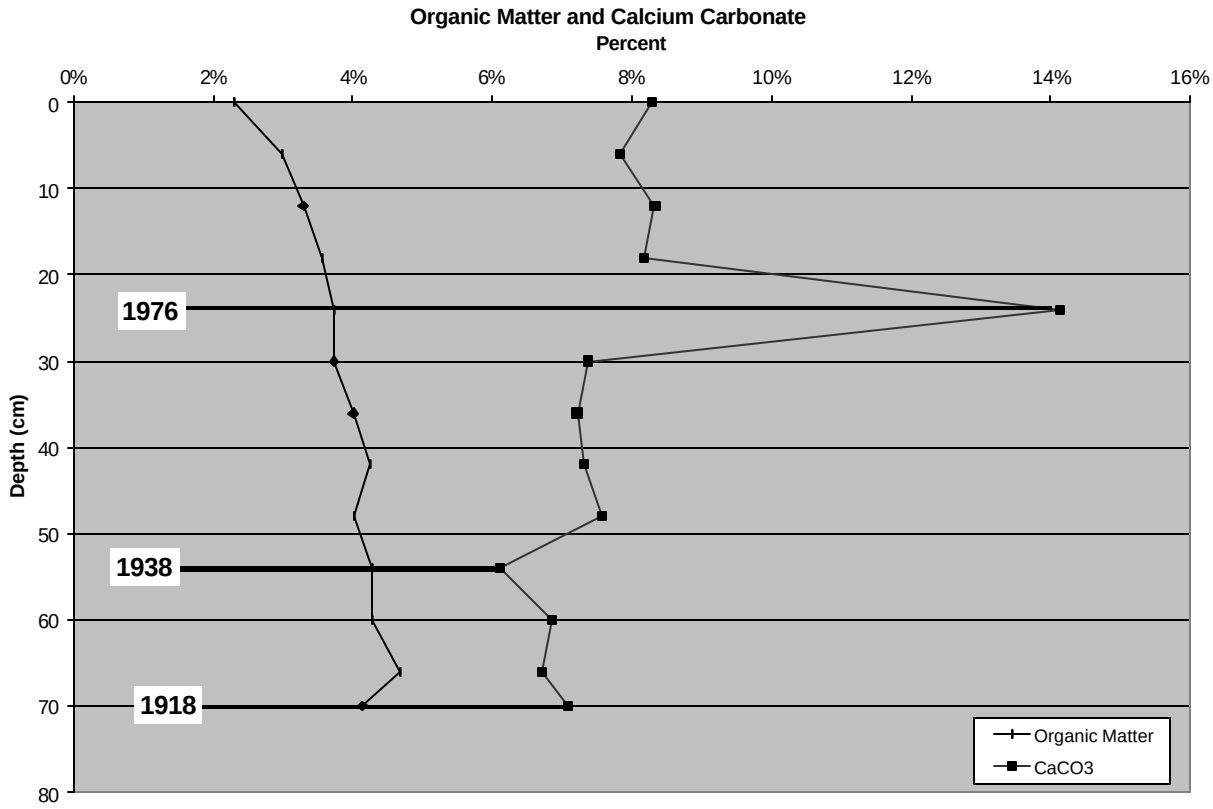
Percent Organic Matter

Organic matter (Graph 1-3) shows a steady decline in percent of the sediment through out the years. The nutrient level of the pond has been going down ever

since the 1950's when they constructed a sewage treatment plant for the city of Augusta. Decreased even more readily after they modernized the plant in 1981.

Percent Calcium Carbonate ($CaCO_3$)

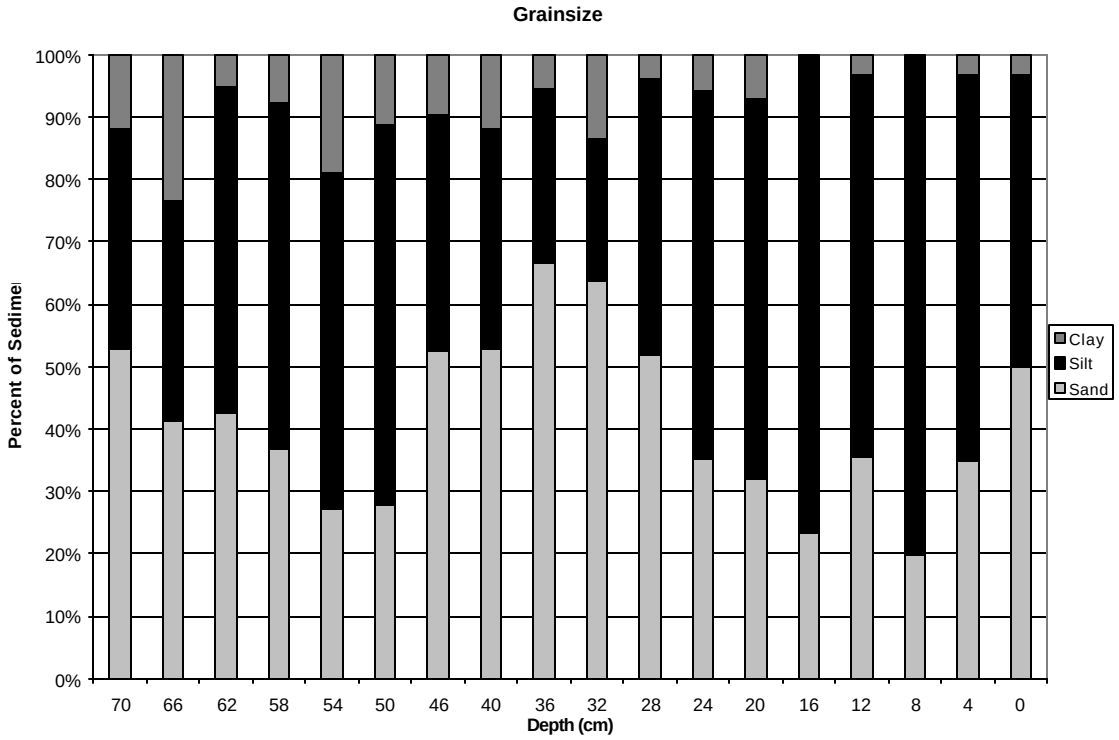
Calcium Carbonate comes in at a steady rate each year. If there were peaks or depressions it would be due to high or low amounts of precipitation corresponding directly with the level of Calcium Carbonate in the watershed. In 1938, there is a depression that corresponds to the flood in that year. In 1976 there is a peak when rainfall was down (Graph 1-3). This information correlates with the porosity depression and peak.



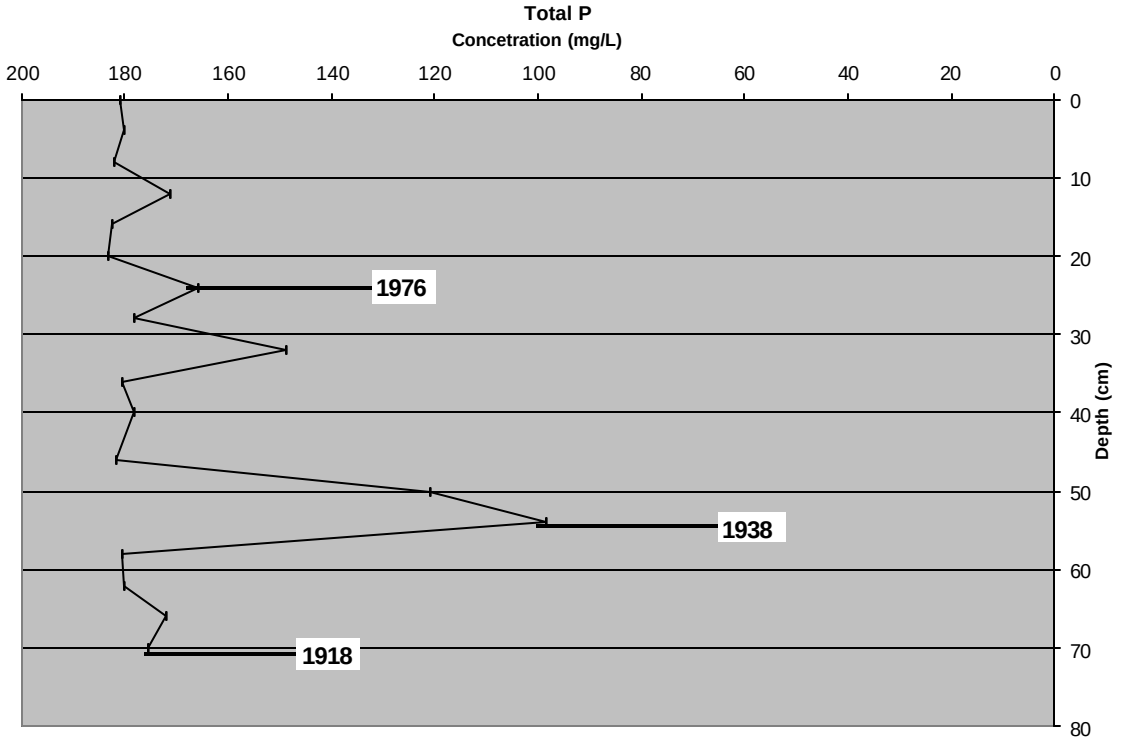
Graph 1-3

Grainsize

The data received from measuring grainsize and amount of clay, silt, and sand was inconclusive. There was little difference in the amounts and percentages.



Graph 1-4

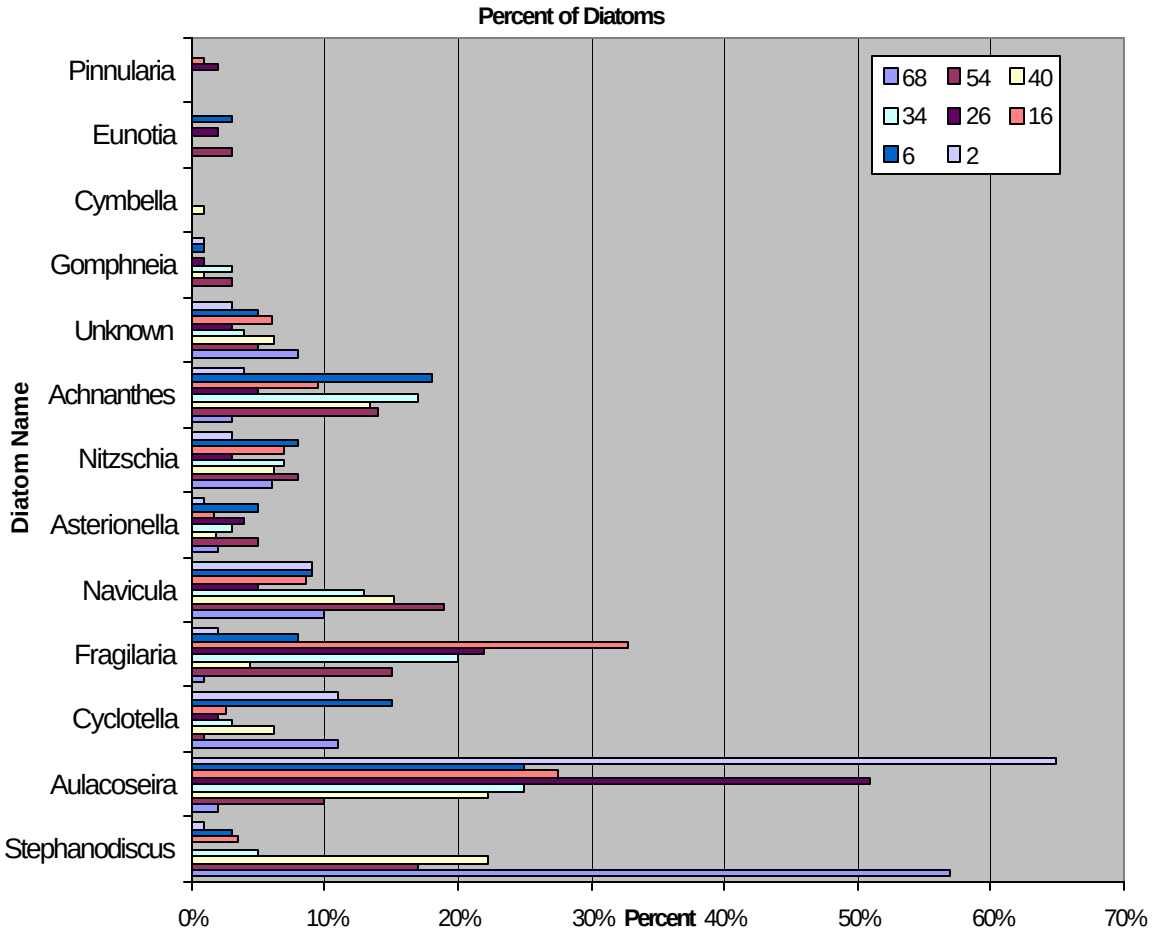


Graph 1-5

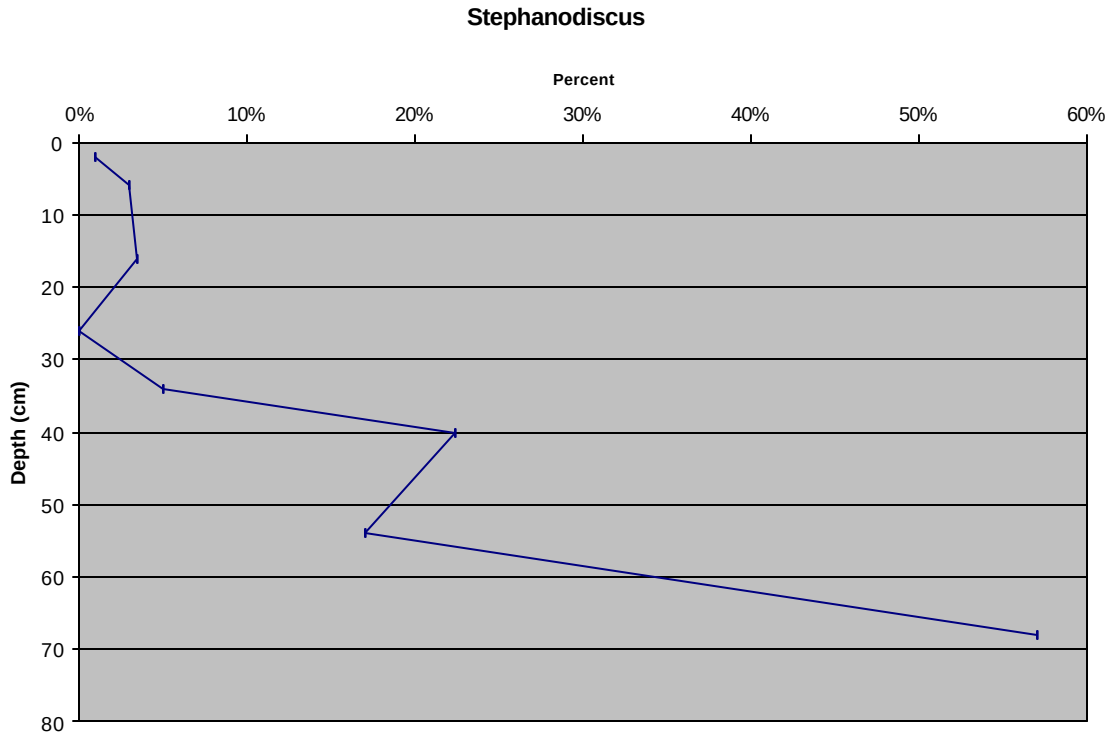
Phosphorous

This phosphorus data reinstated the fact of the flood in 1938 where there is a severe depression where the phosphorus was diluted. Other than this the levels of phosphorus remain somewhat constant.

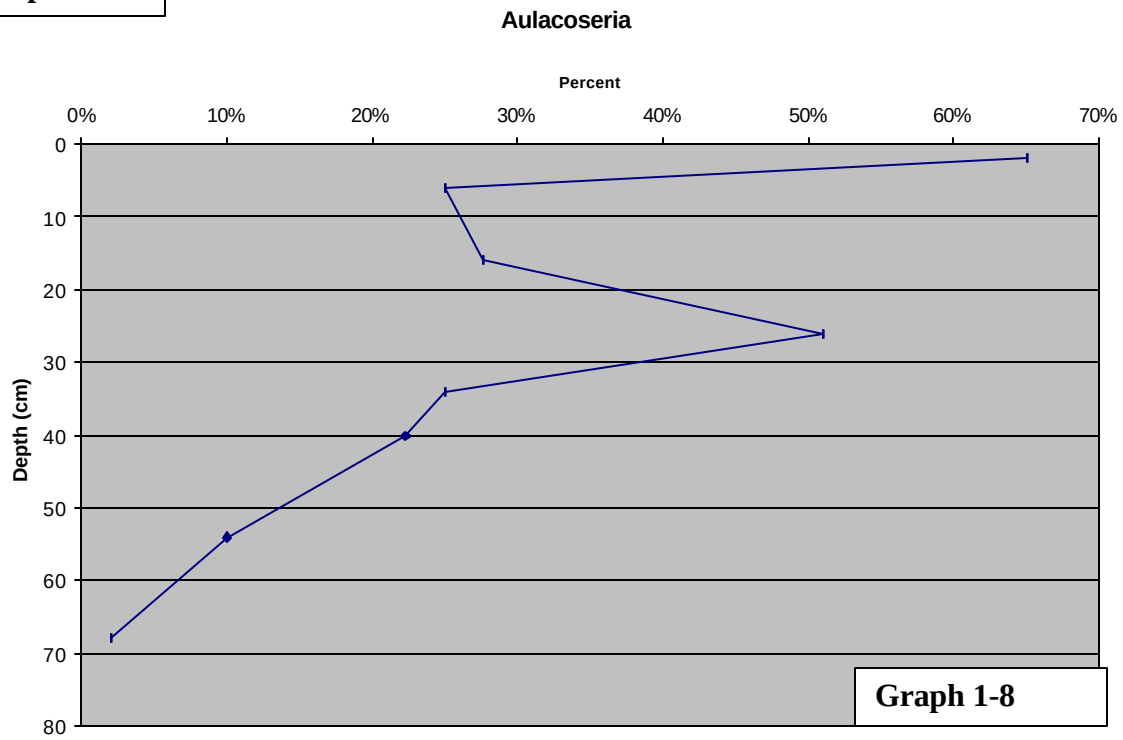
Diatoms



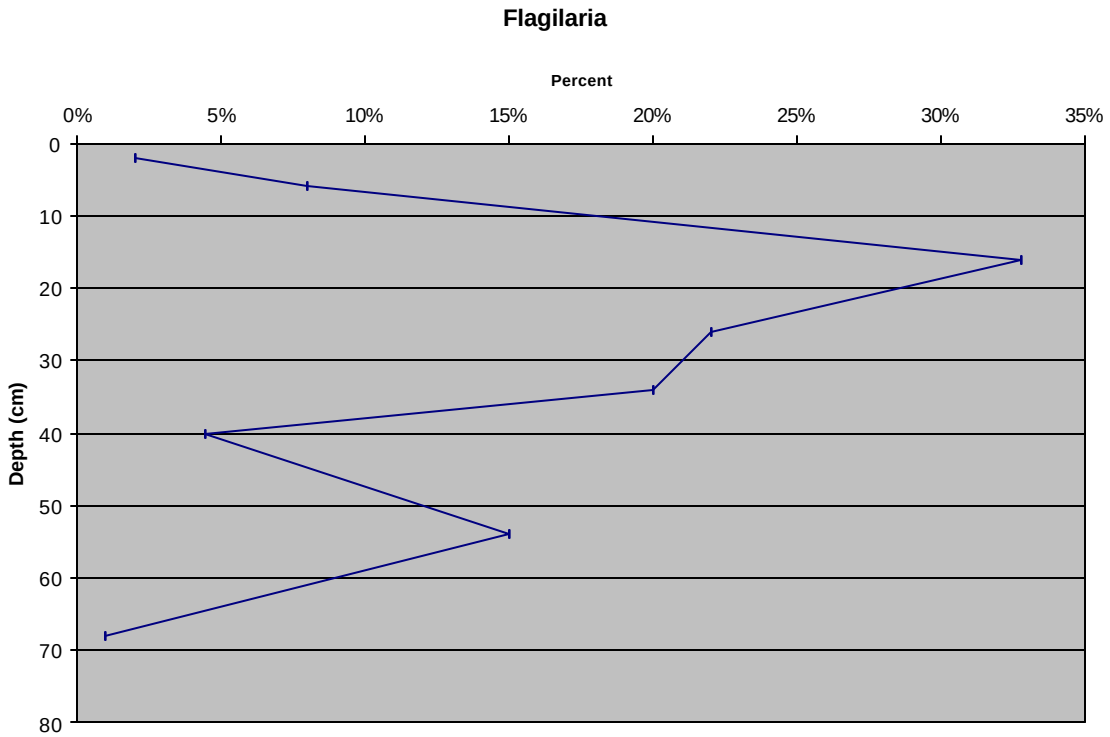
Graph 1-6



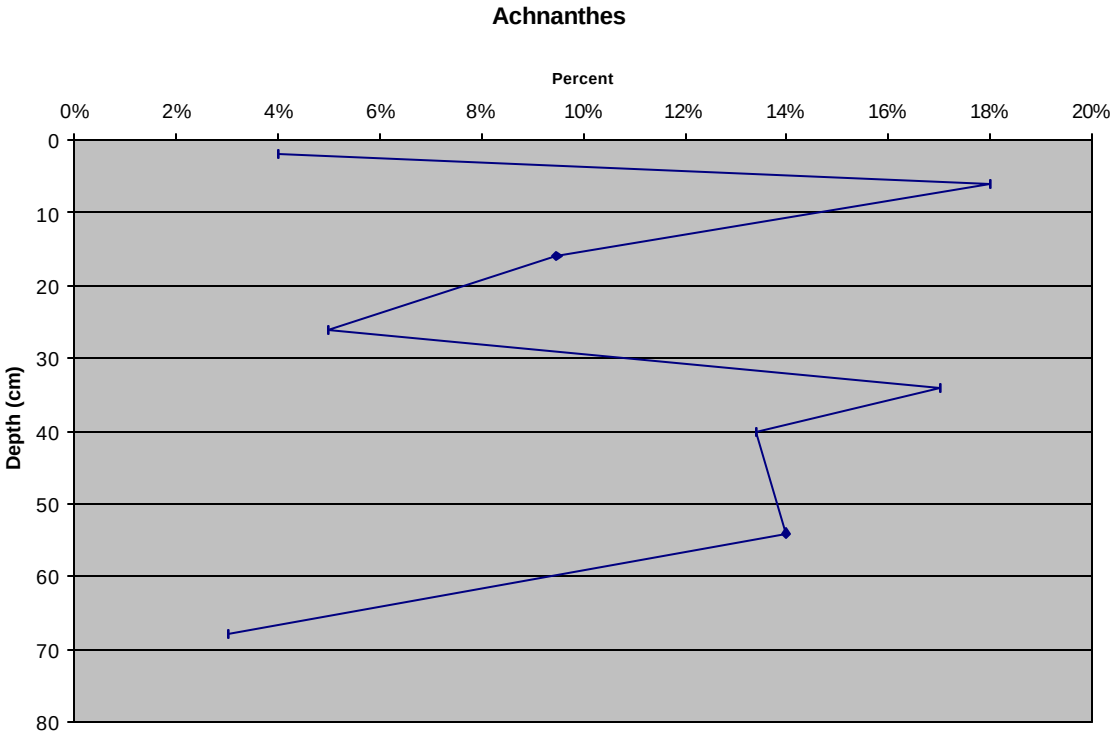
Graph 1-7



Graph 1-8



Graph 1-9



Graph 1-10

Diatoms can be useful in interpreting past environmental changes because many of the species are found only under specific and narrow environmental conditions. Such as Stephanodiscus, which is more prevalent at the bottom of the core, shows that the pond had high nutrient levels until 1956 when nutrient levels started to decline. At the same time the numbers of Stephanodiscus were declining the amount of Aulocoseria started to increase showing more moderate nutrient levels. These changes start at about 1951 when the city of Augusta instituted the sewage treatment plant upstream, instead of letting raw nutrients run into the stream.

Discussion and Conclusion:

Dells Mill Pond sediment provides data for the time between 1918 and 2001. This information gives a good record of what has happened in that time period. Dates were found by porosity and rainfall data. The flood diluted the chlorophyll and phosphorous. Such a high amount of phosphorous is probably from the agriculture in the surrounding area. Soil erosion has been on a slight increase. Diatoms recreated the water quality. So it is possible to learn a lot from the sediment of a pond.

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