Paleolimnology & Lake Eau Claire

Katria Kangas, Jesse Zellmer & Grant Gabler

Field Research, 2001-2002

Abstract

This project began with the interest of protecting Lake Eau Claire's health. The paleolimnological approach gives an advantage to see past trends of the lake and compare the data from year to year. This began by taking the core sample, followed by a long extensive trial of experiments. We dated the samples to draw conclusions about Lake Eau Claire's trophic level.

Mr. Paul Garrison, of the Wisconsin DNR, has previous experience with core samples. Our group assisted the core sampling process and obtained our samples. It is here where our project began.

Introduction

Lake Recreation has been an integral part of Wisconsin's history. Lakes continue to serve as a Wisconsinite's summer destination. These numbers will begin to drop, however, if water quality is not properly addressed.

Lake Eau Claire is well known as a high activity lake. Fishermen, jetskiiers and tubers frequent the water and shore. Around July, the water turns nearly kelly green with algael blooms. These disgusting blooms cause swimmers to go elsewhere, fishermen to become disgusted with their green mucky covered fishing lines and other recreators turned off by the odor of algae baking on rocks.

Our team consisting of Katria Kangas, Jesse Zellmer and Grant Gabler decided to research Lake Eau Claire's past and present, in hopes of a brighter future. We began with paleolimnology: the study of past freshwater, saline and brackish environments. Our concentration was to find the point in time that Lake Eau Claire's water quality took a turn for the worse and what caused it.

The lake itself is located approximately 6 miles northeast from the town of Augusta, Wisconsin in the township of Bridge Creek. Located more specifically at the latitude of 44 degrees by 37' 30" and the longitude of 91 degrees by 00' 00" and 91 degrees by 07' 30". It spans 1100 acres, containing 27,878,400 cubic feet of water. The lake began as the Eau Claire River until the Army Core of Engineers built a dam in 1936 to create the present day form.

Paleolimnology began by taking a core sample from Lake Eau Claire. Paul Garrison, Wisconsin Department of Natural Resources, journeyed from Madison to teach us the value of a core sample and what it can tell you.

Garrison determined a site suitable for the core and we anchored our pontoon with multiple anchors. The position was located using GPS and recorded. The visibility depth was then found using the secchi disk method and recorded. We were then ready to take the core sample. Garrison plunged the tube, specifically designed for taking cores, into the lake bottom. With the help of pipe on top of pipe, the core reached its maximum depth. It was quickly pulled up and the bottom plugged to prevent losing and/or mixing of the sample.

The core was then taken to the shore for storage. We used plastic baggies and a spatula to section off the samples by depth. Each sample is 2 cm in depth and there are 22 total samples. Storage for the samples is refrigeration and carefully sealed baggies. This is where our testing begins.

The paleolimnological approach is where we began. It was the whole purpose of the core. From this approach we can see trophic states (general water quality levels), sediment input/output, types of sediment and the atmospheric deposition of metals, just to name a few. The goal of group Lake Eau Claire is to be able to correctly interpret the paleolimnology of our core. We want to find trends that will point us to points in time where we can pin-point a source of ecological damage.

Methods and Materials

Porosity

We began with porosity. Porosity is a simple test that should tell us how much of the sample is water. Soil is composed of solid particles of different sizes (minerals and organic matter) often glued together into tiny aggregates by organic matter, mineral oxides and charged clay particles. The gaps between the particles link together into a meandering network of pores of various sizes. Through this pore space, the soil exchanges water and air with the environment. The movement of air and water also allows for heat and nutrients to flow. The number and size of pores directly relates to soil organic matter content, texture and structure.

Percent porosity requires rubber gloves; clean, dry crucibles; clean chemical scoop; 2-4 grams of sample (straight from baggie); tongs; drying oven; balance with cover; and marking pen.

Steps for porosity:

1. Clean and dry all materials that require cleaning and drying while wearing rubber gloves.
2. Dry overnight.
3. Record the masses of crucibles while wearing gloves.
4. Select the samples to test. (We used every other one beginning with #1.)
5. Use chemical scoop to place roughly 2-4 grams of sample into each crucible.
6. Record the mass immediately.
7. Repeat as necessary.
8. Put crucibles into drying oven, arranging them so you can keep them in numerical order.
9. Copy down placement in notebook.
10. Leave samples in 24 hours, undisturbed.
11. Wearing gloves, remove crucibles.
12. Once cooled, record masses.
13. Repeat steps 8-12 until the mass remains the same.
14. Save crucibles in drying oven for future experiments.
15. Clean and put away other materials.

16. Enter data into a spreadsheet to analyze.

Chlorophyll

Chlorophyll was the next test on our list. Chlorophyll is the substance that traps the energy of sunlight for use in making food in plants. Water and carbon dioxide feed this process and produce a green color.

Chlorophyll is the primary compound in algae. The amounts of algae and types of algae are indicators of water health. High amounts of chlorophyll-a indicate a more eutrophic lake system and vice-versa.

The materials necessary for the chlorophyll-a testing are: dried samples; 30 mL test tubes; samples; and chemicals. Here is the step by step procedure.

1. Dry Sediment
2. Grind to a fine Powder
3. Weigh a known amount ____________X g
4. Put g amount in test tube
5. Cover with 10 ml acetone
6. Cork
7. Shake to mix thoroughly every hour for 3-5 hours
8. After 3-5 hours Chlorophyll a is in solution
9. Shake tube to mix
10. Pour into centrifuge tube 2 samples at a time
11. Spin down all solids
12. Remove 7ml of clear solution cold to cuvette for spectrophotometer analysis
13. Put into equation for final Ca
14. Analyze at certain wavelengths

Procedure for calculations is in appendix 1.

Phosphorous

Phosphorous pollution is a serious threat to the purity of the water system. Within a reservoir a complex ecosystem exists, including plants, microorganisms, and fish, which rely on nutrients from upstream sources. The relationship among these various organisms is tightly interconnected, but ultimately, the growth of organisms within a reservoir is directly related to the amount of nutrients flowing into the water body. One nutrient in the Lake Eau Claire reservoir is phosphorus which, if allowed to increase, would generally allow a corresponding increase in biological life (especially, plant life) in these water bodies during the warm weather growing season. In other words, phosphorus levels control the extent to which plant life can grow in the reservoir.

Phosphates are inorganic and are added directly and indirectly to aquatic ecosystems. The source of phosphorus can be certain detergents, agricultural fertilizer, chemical poisons and sewage. Phosphorus in high amounts is a serious problem. It causes plant life to run rampant and removes much of the water body's oxygen. This means the plants choke each other out and marine life slowly die off. This would spell disaster for Lake Eau Claire! Many sportsmen use the lake to fish and hunt. It would be a travesty for it to come to an end. Who wants to swim in a lake filled with nasty plants and soon rotting, dead fish and plants?! This test is very important.

For the Total Phosphorus test we used, PhosVer 3 and Acid Persulfate Digestion; Test N' Tube^{TM} Procedure. The method number 10013 from Hach DR/2000 Spectrophotometer Handbook.

Organic/Inorganic Matter

Organic and inorganic matter is a test done to find the amount of carbon in each sample layer. Inorganic carbon is the primary source of the carbon for photosynthesis by algae and larger aquatic plants. Organic matter ranges from dissolved organic compounds to large aggregates of particulate organic matter, and from living to dead material.

Organic/Inorganic Matter requires rubber gloves; clean, dry crucibles; clean chemical scoop; sample after porosity tests; tongs; kiln; balance with cover; and marking pen.

Steps for porosity test:

1. Take samples in crucibles from porosity tests
2. Record the masses of crucibles while wearing gloves.
3. Put crucibles into kiln, arranging them so you can keep them in numerical order.
4. Copy down placement in notebook.
5. Cook with temperature cone at 550 degrees Celsius for organic and 1200 degrees Celsius for $CaCO_3$.
6. Leave samples in 24 hours, undisturbed.
7. Wearing gloves, remove crucibles.
8. Once cooled, record masses.
9. Repeat steps 2-7 until the mass remains the same.
10. Save crucibles in kiln for future experiments.
11. Clean and put away other materials.
12. Enter data into a spreadsheet to analyze.

Diatom Identification

Diatom identification was done for many important reasons. Diatoms are identified as single-celled, photosynthetic organisms whose cell wall is made of amorphous, or opaline silica, much like glass. These organisms will flourish depending upon the trophic level of a water system. Certain diatoms thrive in the high nutrient states and some low nutrient levels. They are the water quality classification system used for this project was developed in 1980 by scientists Forsberg and Ryding. It is based on water chemistry, total chlorophyll, total phosphorous, water clarity, etc. The four types are listed below.

Oligotrophic: This water body has the lowest level of biological productivity. It will have clear water, few aquatic plants, few fish, not much wildlife and a sandy bottom.

Mesotrophic: This water body has a moderate level of biological productivity. It will typically have a moderate amount of aquatic plants.

Eutrophic: This water body has a high level of biological productivity. It will either have lots of aquatic plants and clear water; or it will have few aquatic plants and less clear water. In either case, it has the potential to support lots of fish and wildlife.

Hypereutrophic: This water body has the highest level of biological productivity. It has very low water clarity, the potential for lots of fish and wildlife and it may have an abundance of aquatic plants.

The diatoms live their short lives and die. They sink to the bottom of the sediment and become buried with sediment. The shells are left, and can be identified to determine the health of the water system years past. (See Appendix 2 for procedure for mounting slides.)

Procedure for data collection is very simple. You take the slide you made put it into a microscope and do transect counting and identifying the diatoms until you get to 100. You then insert the info into a spreadsheet to be analyzed.

Sedimentation

Sedimentation is the major source of water quality pollutant from agriculture. It is often accompanied by nutrients or chemicals that are absorbed to the soil particles. These additions are usually absorbed when they enter the streams and rivers as a result of erosion and continue on to the lakes. The nutrient, chemical and sediment runoff can then affect the health of the lake. The sedimentation rate can be interpreted by looking at the different layers in the sediment sample. This can reveal flood years, environmental accidents, nutrient loading and sedimentation.

While soil erosion and sedimentation are to some degree cause by natural factors such as rain win, they are also caused by land use practices such as intensive agricultural production, construction and other developmental activities.

When land use practices are conducted improperly, the consequences are often severe to the water system. For example, water quality degeneration is a serious problem. Sediment can deliver nutrients, toxic chemicals and heavy metals into the water.

It also can impact fish and wildlife. Sedimentation fills waterways, disrupts fish spawning areas and smothers fish eggs and other aquatic animals. This spells disaster for water front owners and watershed visitors.

We tested for the sedimentation by using the procedure (LaMotte soil texture studies code 1604)

Cesium Dating

Radiocarbon dating was first developed by a team of scientists led by the late Professor Willard F. Libby of the University of Chicago. It was developed immediately following World War II. This method uses half-life of the elements to determine the age of layers in the core.

The dating process we used was Cesium-137. Cesium-137 originally got into soil from nuclear fallout during the 1960's when the world was testing nuclear weapons. A quarter century of research has shown measurements of the spatial patterns of radioactive fallout. The Cesium-137 technique is the only technique that can be used to make actual measurements of soil loss and re-depositation quickly and efficiently. This method can reveal the erosion and sediment deposition in the lake bottom helping scientists, or students, obtain unique information about the landscape that can help plan techniques to conserve the quality of the soil.

Results

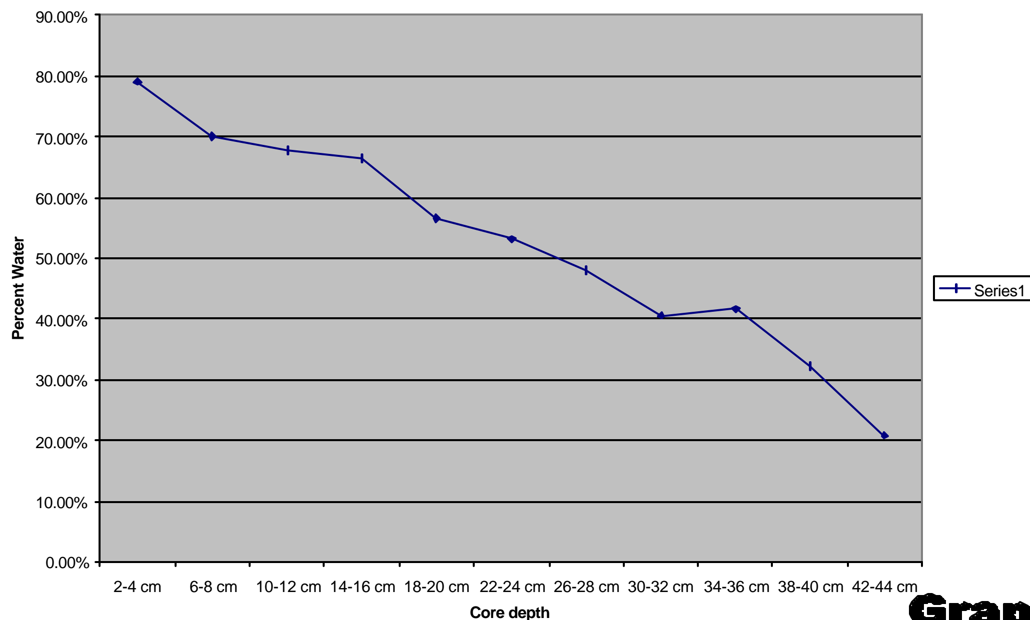
Porosity

We found that the masses had to be taken at the proper time. If the crucible was too warm, it would throw off the measurement and too cold would do likewise. The amount of water that was lost declined with each 24 hours in the drying oven until it plateaued and remained constant. The closer the sample was to the top, the higher percentage water.

Porosity Raw Data

Sample	amt. Lost 1	amt. Lost 2	amt. Lost 3	amt. Lost 4	Percent Porosity
2-4 cm	1.667	1.67	1.67	1.673	79.10%
6-8 cm	1.168	1.17	1.168	1.172	70.01%
10-12 cm	1.526	1.531	1.532	1.536	67.72%
14-16 cm	1.455	1.461	1.459	1.462	66.39%
18-20 cm	2.4	2.413	2.411	2.417	56.70%
22-24 cm	1.467	1.473	1.473	1.475	53.15%
26-28 cm	1.132	1.14	1.14	1.144	47.97%
30-32 cm	1.143	1.186	1.15	1.155	40.57%
34-36 cm	0.737	0.744	0.744	0.748	41.60%
38-40 cm	0.975	0.983	0.985	0.991	32.21%
42-44 cm	0.925	0.932	0.932	0.936	20.89%

Table 1



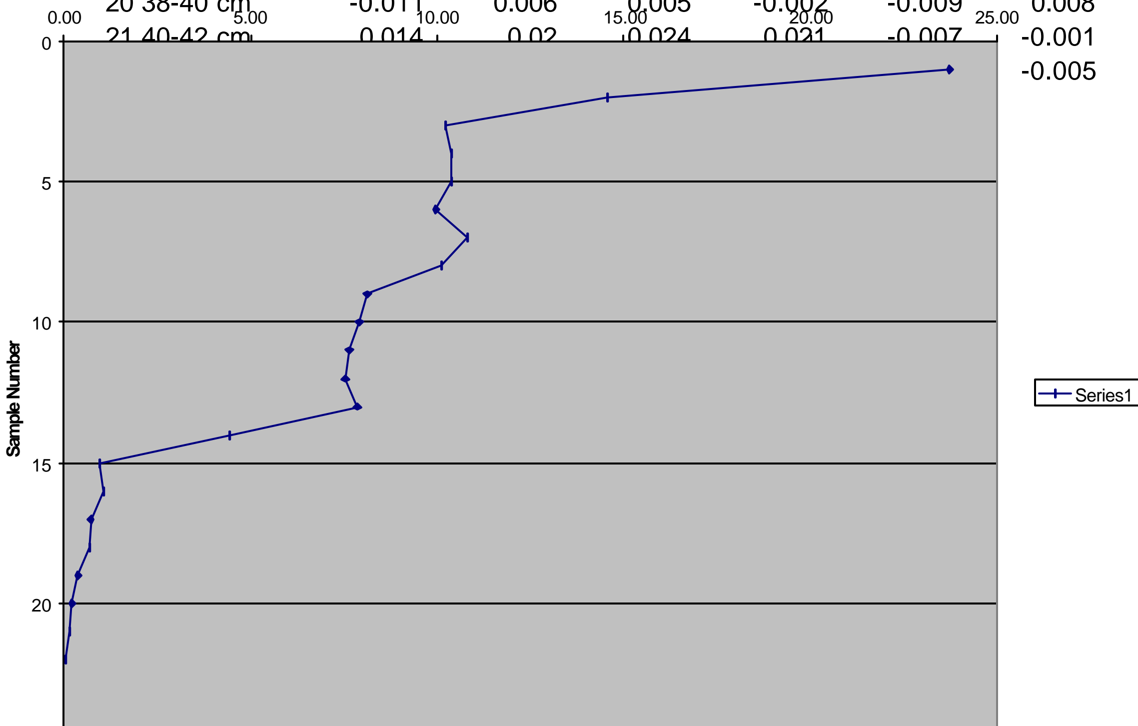
Graph 1

Chlorophyll

The chlorophyll figures are a result of the methods cited above. After we went throughout the entire test we realized that there was a cut off of chlorophyll at about sample 15 (28-30 cm).

Sample #	Depth	Wavelength 630	645	665	750	D #'s 630	D#'s 645	D#'s 665	Ca
1	1-2 cm	0.562	0.773	1.881	0.09	0.472	0.683	1.791	19.81479
2	2-4 cm	0.241	0.359	1.084	0.056	0.185	0.303	1.028	11.50197
3	4-6 cm	0.163	0.249	0.725	0.043	0.12	0.206	0.682	7.62454
4	6-8 cm	0.246	0.323	0.766	0.116	0.13	0.207	0.65	7.25063
5	8-10 cm	0.167	0.242	0.693	0.056	0.111	0.186	0.637	7.13
6	10-12 cm	0.154	0.228	0.65	0.046	0.108	0.182	0.604	6.75286
7	12-14 cm	0.148	0.23	0.681	0.032	0.116	0.198	0.649	7.25278
8	14-16 cm	0.148	0.223	0.639	0.039	0.109	0.184	0.6	6.7037
9	16-18 cm	0.091	0.163	0.459	0.01	0.081	0.153	0.449	4.99663
10	18-20 cm	0.107	0.173	0.431	0.027	0.08	0.146	0.404	4.48394
11	20-22 cm	0.083	0.151	0.39	0.011	0.072	0.14	0.379	4.20292
12	22-24 cm	0.106	0.165	0.393	0.032	0.074	0.133	0.361	4.00301
13	24-26 cm	0.093	0.13	0.371	0.015	0.078	0.115	0.356	3.96803
14	26-28 cm	0.069	0.083	0.213	0.022	0.047	0.061	0.191	2.12911
15	28-30 cm	0.047	0.042	0.07	0.032	0.015	0.01	0.038	0.4256
16	30-32 cm	0.038	0.025	0.05	0.012	0.026	0.013	0.038	0.42013
17	32-34 cm	0.003	0.025	0.034	0.007	-0.004	0.018	0.027	0.29018
18	34-36 cm	0.015	0.032	0.04	0.013	0.002	0.019	0.027	0.28803
19	36-38 cm	-0.012	0.006	0.009	-0.004	-0.008	0.01	0.013	0.13882
20	38-40 cm	-0.011	0.006	0.005	-0.002	-0.009	0.008	0.007	0.07198
21	40-42 cm	0.014	0.02	0.024	0.021	-0.007	-0.001	0.003	0.03709
							-0.005	0	0.00879

Table 2

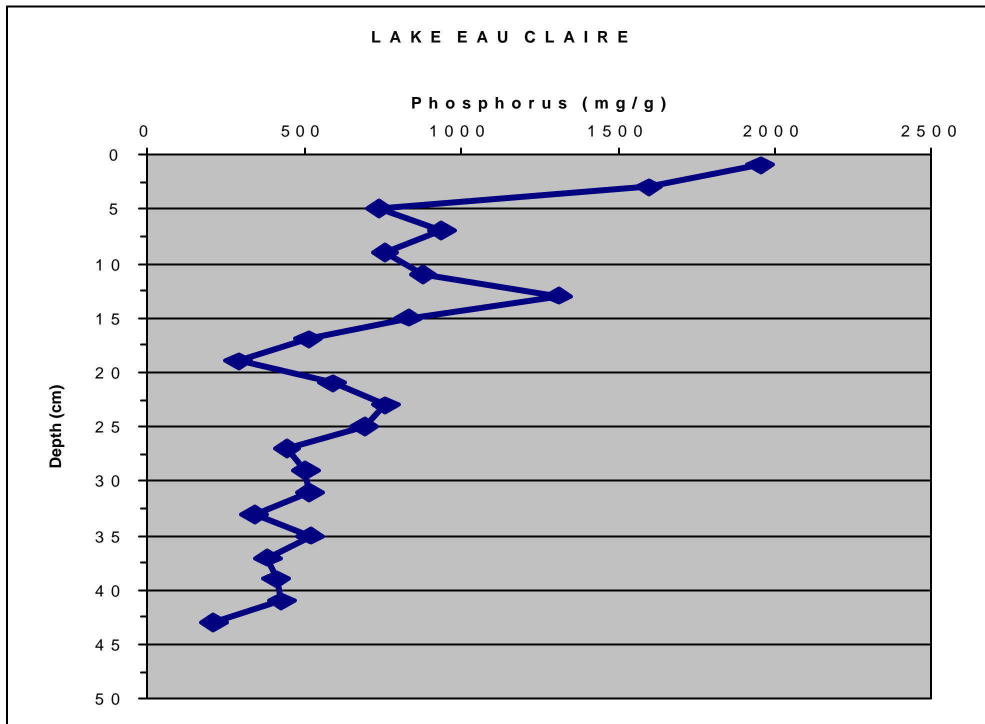


Phosphorous

With the phosphorous test the data that was collected and recorded in table 3. The data that was collected according to the method/ procedure stated above. The phosphorous levels seemed to be high for this test there for the sample was diluted for more accurate readings.

Depth	Sample #	Wavelength	Result	Final Non diluted
0-2 cm	1	890	1.76	176
2-4 cm	2	890	1.67	167
4-6 cm	3	890	0.94	94
6-8 cm	4	890	1.41	141
8-10 cm	5	890	1.18	118
10-12 cm	6	890	1.42	142
12-14 cm	7	890	2.16	216
14-16 cm	8	890	1.4	140
16-18 cm	9	890	0.99	99
18-20 cm	10	890	0.63	63
20-22 cm	11	890	1.33	133
22-24 cm	12	890	1.78	178
24-26 cm	13	890	1.71	171
26-28 cm	14	890	1.16	116
28-30 cm	15	890	1.4	140
30-32 cm	16	890	1.54	154
32-34 cm	17	890	1.01	101
34-36 cm	18	890	1.52	152
36-38 cm	19	890	1.21	121
38-40 cm	20	890	1.4	140
40-42 cm	21	890	1.58	158
42-44 cm	22	890	0.83	83

Table 3



Graph 3

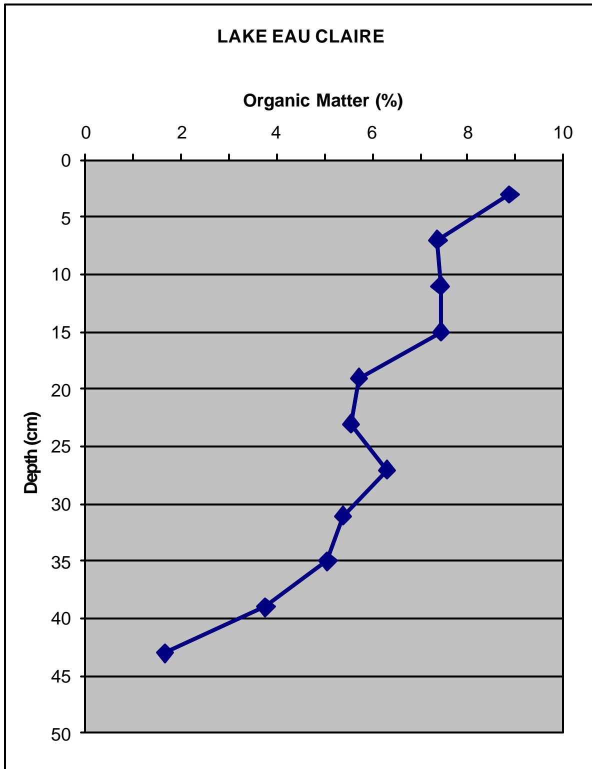
Organic/Inorganic Matter

The organic/inorganic matter experimentation was done according to the above procedure. We encountered a major problem with this experiment. The crucibles were numbered with a permanent pen. The kiln fired up to the point that the numbers were burnt off. The crucibles were not set up in numerical order. We then came up with a system to find out the numbers by re-labeling the crucibles on a diagram. After we fired them twice we cleaned them and dried them in the oven. We retook the masses and compared them to the original masses. It worked out great!

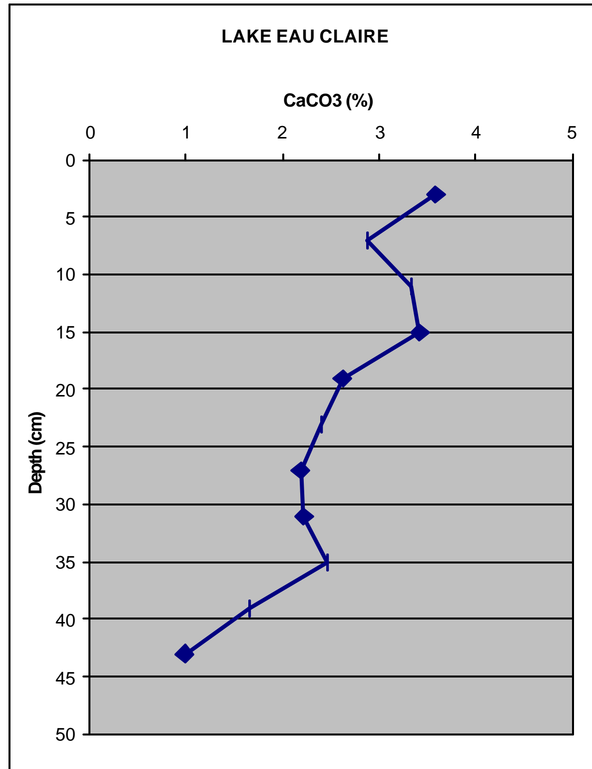
Organic/Inorganic Matter (CaCo3)

Crucible	mass after T1	Mass after T2	Difference between firings
1	0.39	0.376	0.014
2	0.453	0.44	0.013
3	0.661	0.639	0.022
4	0.672	0.649	0.023
5	1.718	1.673	0.045
6	1.208	1.179	0.029
7	1.144	1.119	0.025
8	1.578	1.543	0.035
9	0.975	0.951	0.024
10	1.992	1.959	0.033
11	3.468	3.434	0.034

Table 4



Graph 4



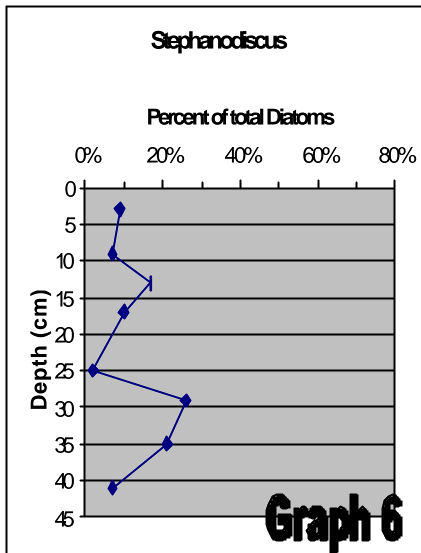
Graph 5

Diatom Identification

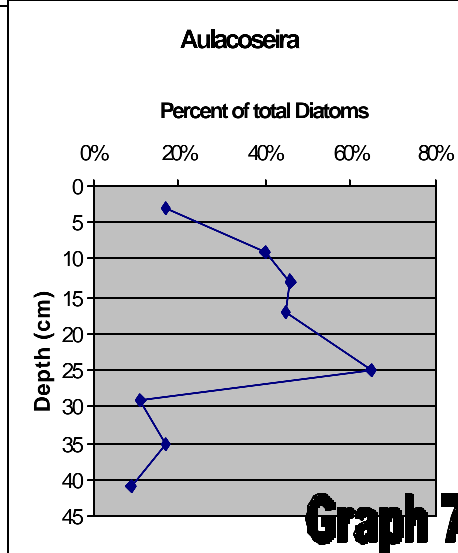
The diatom results are affected by the method specified above. The planktonic diatoms are more common at one point on all graphs and spike for levels following. The diatoms that are more common are those with higher nutrient levels. The

Diatom	2-4 cm	8-10 cm	12-14 cm	16-18 cm	24-26 cm	28-30 cm	34-36 cm	40-42 cm
Stephanodiscus	9%	7%	17%	10%	2%	26%	21%	7%
Aulacoseira	17%	40%	46%	45%	65%	11%	17%	9%
Cyclotella	10%	3%	3%	3%	4%	8%	2%	5%
Asterionella	4%	6%	6%	6%	1%	7%	4%	16%
Fragilaria	16%	12%	6%	8%	15%	14%	10%	20%
Navicula	24%	18%	16%	14%	4%	9%	20%	9%
Pinnularia	0%	2%	0%	1%	1%	4%	7%	10%
Nitzschia	4%	4%	1%	3%	0%	3%	3%	4%
Gomphonema	3%	1%	2%	2%	2%	4%	6%	5%
Cymbella	2%	0%	1%	0%	1%	0%	1%	1%
Eutonia	0%	1%	0%	0%	0%	0%	0%	0%
Achnanthes	9%	6%	1%	8%	4%	11%	9%	11%
Unknown	2%	0%	1%	0%	1%	3%	0%	3%
planktonic	40%	56%	72%	64%	72%	52%	44%	37%

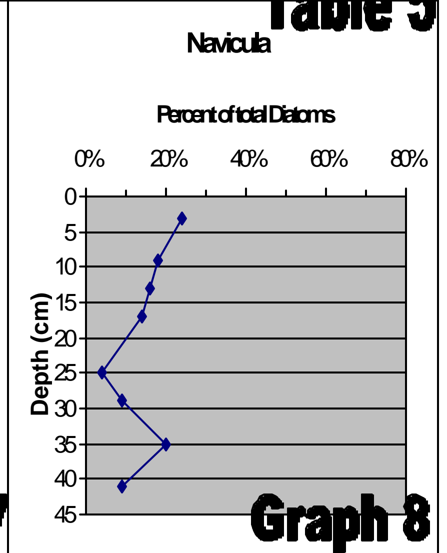
Table 5



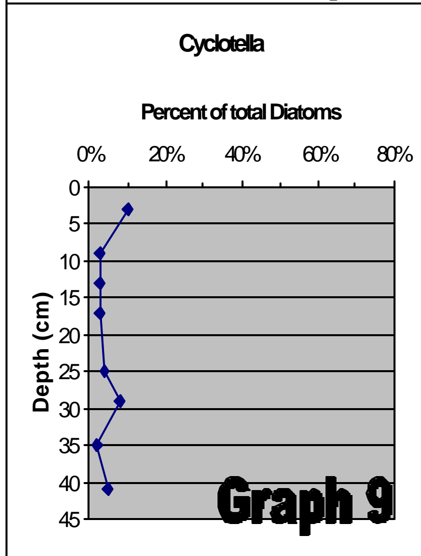
Graph 6



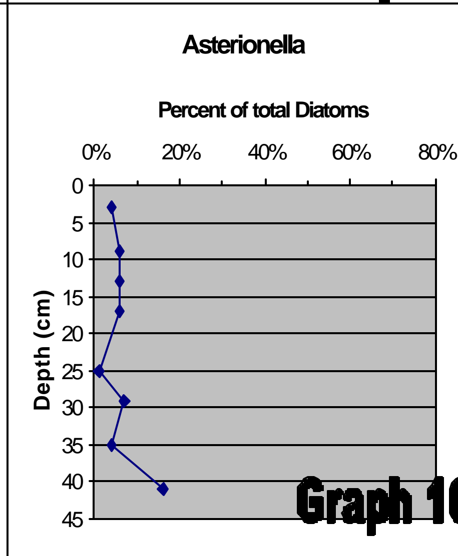
Graph 7



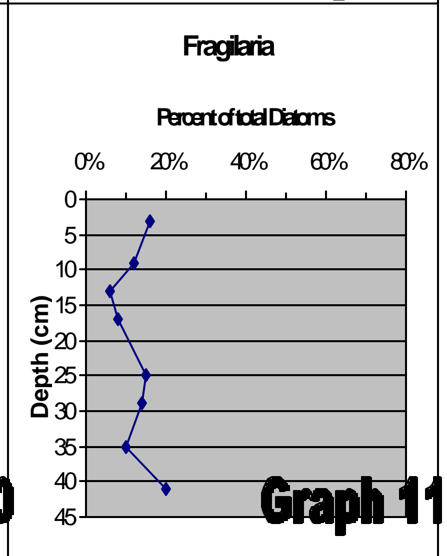
Graph 8



Graph 9



Graph 10



Graph 11

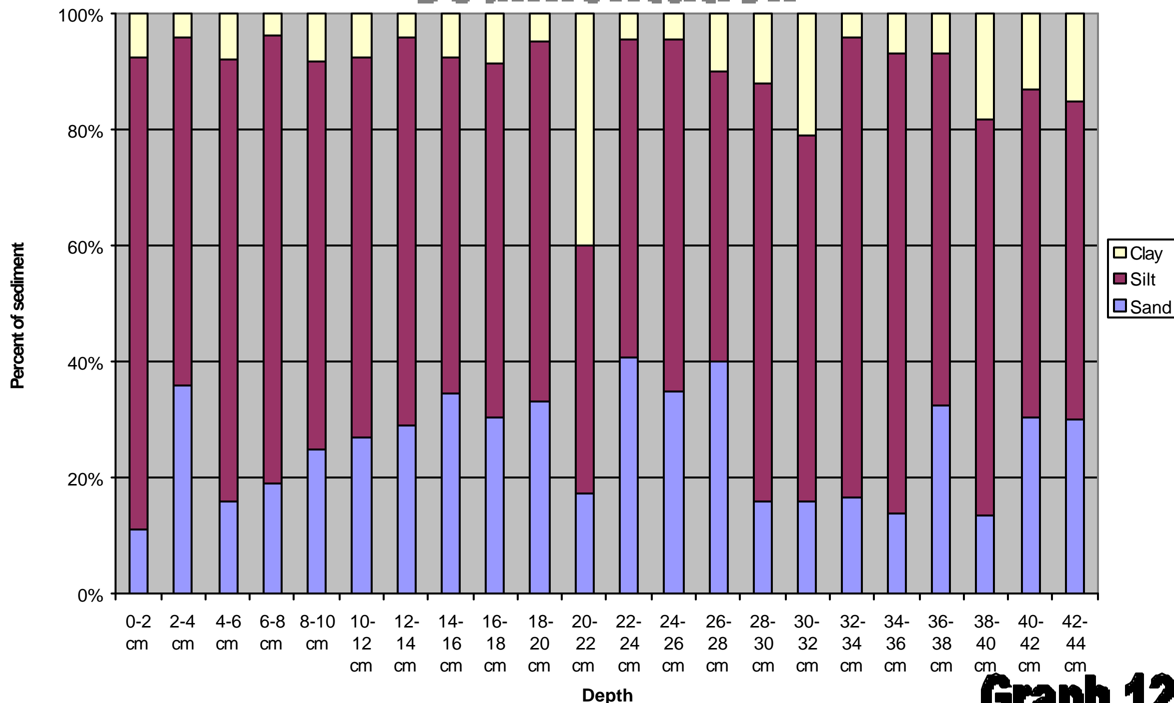
Sedimentation

Sedimentation statistics are a result of the method cited above. When we did this test originally we did not record what types of sediment there was to measure. The second time we did it we measured 3 layers. They were sand, silt and clay. We realized that the sediment from the bottom of the lake is mostly silt based upon our data.

	Sand	Silt	Clay
0-2 cm	0.3	2.2	0.2
2-4 cm	0.9	1.5	0.1
4-6 cm	0.4	1.9	0.2
6-8 cm	0.5	2	0.1
8-10 cm	0.6	1.6	0.2
10-12 cm	0.7	1.7	0.2
12-14 cm	0.7	1.6	0.1
14-16 cm	0.9	1.5	0.2
16-18 cm	0.7	1.4	0.2
18-20 cm	0.7	1.3	0.1
20-22 cm	0.7	1.7	1.6
22-24 cm	0.9	1.2	0.1
24-26 cm	0.8	1.4	0.1
26-28 cm	0.8	1	0.2
28-30 cm	0.4	1.8	0.3
30-32 cm	0.3	1.2	0.4
32-34 cm	0.4	1.9	0.1
34-36 cm	0.3	1.7	0.15
36-38 cm	0.7	1.3	0.15
38-40 cm	0.3	1.5	0.4
40-42 cm	0.7	1.3	0.3
42-44 cm	0.6	1.1	0.3

Table 6

Sedimentation



Graph 12

Cesium Dating

Paul Garrison from the Wisconsin Department of Natural Resources handled this portion.

Discussion

The data shows that the lake hit a point where experiments all indicated a spike in nutrients in the sediment. In the 1990's the nutrient level began improving. The planktonic diatoms are showing a large peak in numbers after the bulldozing (1956) and then they dropped off ever since. The planktonic diatoms consist of stephanodiscus, aulacoseria, cyclotella, and asterionella. Paul Garrison told us that these are the main indicators of nutrient levels. The more low nutrient diatoms, the less plant life and fish life. The higher nutrient diatoms indicate a eutrophic to hypereutrophic stage. The lake is not as healthy as some would like to see it but according to these diatoms the lake is starting to rebound.

The porosity data shows that the percentage of water in each sample reduced as we moved to the bottom. The jumps in between the samples were what showed us the importance of this test. We were looking for any big jumps that were not expected by flood events.

Chlorophyll showed us when the bulldozing took place based upon the fact that there was basically no chlorophyll past that point. This shows us how many nutrients are in the watershed and the lake. This helped us to find the dates because of the chlorophyll line and the date when the bulldozing took place would match up. The chlorophyll shows us how much algae is affecting the health of the lake. The test shows that over time the chlorophyll has increased.

Cesium dating was inconclusive because the instruments were unable to pick up enough radiation to find any peaks so that we would know the dates. This test was done to find the dates 1956 and 1963. These dates were when nuclear testing in the atmosphere started, and when the peak in testing took place. This test was inconclusive and we had to resort to other means.

The sedimentation tests were used to show us the percentages of the grain size of the sediment that was pulled from the different depths. This also showed us the types of soil that are present in the lakebed. We found that there was more types of soils and layers of grain sizes toward the bottom of the core.

Phosphorous is an excellent indicator of the health of the lake. It shows us that there is a lot of phosphorous in the lake and that can be attributed to the runoff from agricultural areas. The concentration has increased more toward the top, which tells us that it is getting worse. Phosphorous is a major factor in the algal blooms in the lake.

The organic/ $CaCO_3$ test determined that there is more sediment coming in to the lake and is in direct relation to the amount of algae that is produced in the summers. This showed that the organic matter (plants, roots, algae, soils) was increasing over the last decade.

Conclusion

This table below illustrates our final conclusion of the Lake Eau Claire paleolimnology. It shows the sample and the year it has been dated at.

Depth	Sample	Year
0-2	1	2001
2-4	2	1998
4-6	3	1995
6-8	4	1992
8-10	5	1989
10-12	6	1985
12-14	7	1982
14-16	8	1979
16-18	9	1976
18-20	10	1973
20-22	11	1970
22-24	12	1967
24-26	13	1963
26-28	14	1960
28-30	15	1956
30-32	16	-
32-34	17	-
34-36	18	-
36-38	19	-
38-40	20	-
40-42	21	-
42-44	22	-

The project began with the initial goal of determining the health of Lake Eau Claire. We were to use paleolimnology to research trends of past lake activity. By doing this we hoped to establish the general health and future of Lake Eau Claire.

The conclusion we have formed is that the lake is indeed unhealthy to a eutrophic level. Using the graphs and data, we found that the chlorophyll test had an obvious point in the sample where the samples went from little chlorophyll to a lot in between two samples. This gave us a benchmark for dating all the samples.

The lake was bulldozed in 1956 to prevent the fill in of the lake. By bulldozing the sediment, the layers that had formed since the creation of the dam built by the ARMY Core of Engineers in 1936, were scraped off and removed. Because of this, all dates that we can derive must begin at 1956.

We combined the chlorophyll and the bulldozing information to decide that sample 15 (28-30 cm depth) is dated from 1956. The top sample number 1 was dated the year of the core, 2001. To date the other samples, we had to average the other samples and assign a year. (See discussion.)

After the samples were dated, the trophic state could then be analyzed. The multiple tests, along with the diatom identification, led us to our conclusions. The data reveals that the health of the lake began to deteriorate after 1956. It began to improve, however slightly, in the early nineties to its present state. Not only did the chlorophyll

confirm this, but the phosphorous data follows the same trend. The trend lines for each experiment show the fact that nutrients are being loaded into the lake.

They all indicate the sample data with deteriorating health. By combining this information (see discussion), we can conclude that this conclusion is indeed correct.

As in every project, we encountered problems. This was the first year our school has attempted paleolimnology using core samples. We were unsure if the steps we were taking were entirely correct. Paul Garrison and Mr. Tweed assisted where they could and helped us along.

It is sometimes difficult to work in a group. We found that it is hard to evenly delegate tasks and can create frustration. This frustration may have been due in part to the detailed experiments we ran. Our school periods are only so long, and it was not easy to complete the tests without missing classes. Thankfully the teachers understood and we worked through it.

The Cesium-137 we had hoped to use ended up not giving us concrete evidence. We were then stuck with our method to date the core samples gone out of the window. We relayed our problem to Garrison who offered us alternative methods for dating the core and assist in our data collection and conclusion process.

Just as we encountered problems, we also had our share of successes. Our group was fortunate to attend the NALMS conference earlier this year and peer into the many resources that are available to lake and water conservationists. We learned many ways of presenting our data as well as interpretation procedures to make our project stellar.

Our group was given the chance to learn more about a high level educational course while being high school seniors. That in its self is a success. That entirely aside, I believe that our group worked well together to identify and act on a concern that benefits the community as well as our grade. We are proud to be a part of that.

If we were going to continue our project I would have to say that more testing would need to be done. Cores could be taken at various places on the lake to compare the first core sample data. Further tests could be done with high tech equipment to reveal data beyond what we could obtain. It would also help to have funds that would be at the researcher's disposal. Much time and energy are required for a project of this magnitude.

While working on the Lake Eau Claire project, many additional questions were raised. We became intrigued on the topic of nutrient sources into the lake.

We came across a site from the University of Washington. Professor Brian Tomasovich, formerly from Fall Creek, suggested that an Indian burial site was covered when the river was dammed. We contacted him for deeper detail. He replied with his theory that many Indian burial grounds were covered when lakes were dammed across Wisconsin. His thought provoked interest without any additional information found.

Should this project be continued, or picked for further research, there would be specific areas that should be focused on. We feel that the nutrient levels are too high. Not enough is being done to prevent further damage to the water system. If all of the possible nutrient sources were evaluated, then protective measures could be taken against more input. If history has taught us anything, it should be that we need to care for our water sources. Lake Eau Claire can become a healthy, productive lake.

Bibliography

1. Charles, Donald F., Smol, John P., Engerstrom, Daniel R., "chapter 13" Paleolimnological Approaches to Biological Monitering.

2. http://interactive.usask.ca/skinteractive/modules/agriculture/soils/soilphys/soilphys_sdepo.htm

3. http://oceanlink.island.net/oinfo/foodweb/zooplank.html

4. http://thalassa.gso.uri.edu/ESphytolsizeshap/shape.htm

5. http://www.members.tripod.com/wis_lakes/c-eau-eau.htm

6. Lake Eau Claire Research Report '95. pg 21 (Nick Brevik, Erik Brown & Scott Gavin)

7. Limnological Analyses 3rd Edition. Robert G. Wetzel, Gene E. Likens

8. Limnology and Oceanography v.44 no. 3 pt.2 May 1999. pgs 757-773

9. University of Florida, Institute of Food and Agricultural Sciences, pdf, pg1-4, Florida Lakewatch.

10. www.augusta.k12.wi.us/HS/dept/sci/lake/index.htm

11. www.baylor.edu/Geology/lake/sample.html

12. www.charttiff.com/pub/Dems/_WI_44091_dem.html

13. www.co.eau-claire.wi.us/parks_forest.htm (December 20, 2001)

14. www.chebucto.ns.ca/Science/SWCS/zoo.html#General

15. www.c14dating.com/int.html

16. www.encyclopdia.com/articles/03635.html

17. www.glc.org/docs/basin/opport/Wisconsin.txt

18. www.oag.state.ny.us (April 15, 2002)

19. www.indiana.edu/~diatom/paleo.html

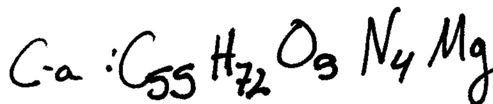
20. www.limnology.umn.edu

21. www.ucmp.berkeley.edu/chromista/bacillariophyta.html

22. www.wow.nrri.umn.edu/wow/under/primer/page13.html

Chlorophyll a Work Sheet

Spec 20



Sample Date	
Process Date	
Sample Site	
Technician	
Vol. of filtered water [in liters]	
Process time am or pm	
Volume of Acetone (ml)	7

Spec 20 Readings

Nanometers	Absorb	% Trans
630		
645		
665		
750		

Correct for turbulence in solution by subtracting the 750 reading from each of the others to get "D" numbers.

D_{630} = 0 D_{645} = 0 D_{665} = 0

Find C_a with the following equation:

$$C_a = (11.6 \times D_{665} - 0.14 \times D_{630} - 1.31 \times D_{645})$$

[D_{630} refers to the optical density at 630 nm (nanometers)]

C_a = 0 - 0 - 0 === 0

Find the concentration of Chlorophyll$_a$ in $(mg/m^3) = (C_a \times V_2) / L \times V_1)$

0 x	7 =	0		
1 x	0 =	0	#DIV/0!	mg/m^3

V_2 = The volume of acetone in ml.

V_1 = The volume of lake water filtered in liters.

L = The path length of the cuvette in cm.

DIATOM CLEANING PROCEDURE

1. After gently shaking sample, use a disposable pipette or spatula to weigh out between 0.1g and 0.2g of sample in weighing dish on scale. Pour each into a labeled 1000ml tall beaker.

2. **Process sample in a hood.** Add about 5ml of H2O2 (hydrogen peroxide) to the beaker containing the sample.

3. After a few minutes, add a partial spoon of potassium dichromate to the sample.

4. Mixture will turn a purplish-black and slowly start to fizz. Have a DIW bottle on hand to rinse sides of beaker during reaction. After the sample has finished reacting (it will be orange in color and hot), pour sample into a clean, labeled, plastic 50ml centrifuge tube.

5. Spin sample for 10 minutes at a setting of 80.

6. After sample has stopped centrifuging, carefully suck off most of liquid in hood and refill with DIW.

7. Repeat the washing until the liquid has no color and then centrifuge one more time. Usually requires 4 rinses.

8. After the final rinse, place pellet into a 50ml labeled beaker and make volume up to 20ml using washings from the centrifuge tube.

9. Take a coverslip out of the 70% EtOH solution and wipe dry. Place it on the slide warmer and add about 5 drops of DIW and disperse it across the coverslip. Using a clean disposable pipette, add drops of the sample onto the coverslip.

10. Thoroughly mix the sample on the coverslip using the empty pipette. Record the number of drops in the logbook.

11. After the sample has dried, place the coverslips on the hot plate for 10 minutes set at 2.

12. While that is happening, clean a microscope slide and label with the glass scriber. Place a drop of Naphrax on the slide and then add the coverslip (face down) and heat for another 2 minutes.

13. Take slide off heat and push gently on coverslip with 2 toothpicks to get bubbles out. When the slide has cooled, use a razor blade to scrape excess Naphrax off edges of coverslip.

14. When ready to store sample, centrifuge it into a pellet; suck off excess liquid and pour sample into a 1 dram vial. Save room to add 2 drops of formalin for preservation.