Springfield Expeditionary Learning School, gr. 6-12

2007 REPORT ON WATER QUALITY AND FUTURE USE OF LOON POND

June 13th, 2007

Researched and Written by 9th Grade Students

`Introduction

The Springfield Expeditionary Learning School, funded in part by the Bill and Melinda Gates Foundation, is a college-bound middle-high school (grades 6-12). The school will ultimately enroll 600-700 students in grades sixth through twelve. It offers a rigorous academic community within a personalized environment and prepares all students for academic success in the future.

Dr. Stephen Mahoney, the principal of the school, says "the schools' mission is to provide a rigorous academic program for college-bound students in a small, personalized setting that impels and supports students to use their mind well, to care for themselves and others, and to rise to the challenging duties of citizenship."

At the Springfield Expeditionary Learning School (SELS), students undertake tasks that require perseverance, fitness, craftsmanship, imagination, self-discipline and significant achievement. The teachers' tasks are to help students overcome their fears and help them realize they can achieve more than they think possible. Learning is a personal process of discovery and a social activity. Everyone learns at their own individual pace, and SELS provides a way to encourage both students and teachers to be responsible for directing their own personal and collective way of learning.

All students will participate and succeed within and academic program typically considered "honors" level work. The school calendar is organized by trimesters, while the schedule features an extended day. Intensives are one-week courses held between the end and beginnings of trimesters that provide opportunities for remediation or enrichment, depending on the student's academic process.

Expeditions, in-depth examination of a compelling epic topic, are the core experience within the academic program. The expedition this trimester is about helping the city reopen Loon Pond as a local swimming pond. The city officials plan to transform the former Jam's Beach, a private running swimming pond with a cocktail lounge, thus ending a three-year skirmish with would-be condominium developers. David B. Pan Gore, chief, said the city would award $625,000 in damages for the public whose homes were owned by the BB Holding Inc. City parks director Patrick J. Sullivan said the unnamed park is prepared to open in July. Additional funds will be spent for improvements of the grounds and swimming areas. City officials say Loon Pond holds some of the cleanest urban water in the state, but it has been the source of controversy over the past two decades.

Loon Pond is a twenty-nine acre warm water pond with an average depth of twelve feet and a maximum depth of twenty-five feet. There is less than a mile shoreline and 40% of it is developed while the bottom is a mixture of sand and gravel.

A fish population assessment of nine species found that largemouth bass were the only game fish found. Non-game fish included yellow perch, blue gill, red breasted sunfish, golden shiners, white suckers, and killifish.

As an inner city pond, Loon Pond is managed as a high production small bass pond to provide maximum angling recreation. The pond receives intensive fishing pressure for fish bass and pan fish alike. Yellow perch are abundant and show good growth rates with many fish nine inches or longer. Loon Pond is stocked yearly with trout. The pond can be located in U.S.G.S. topographical squad map titled "Springfield North". If you would like to access Loon Pond, it is located in the north end of Springfield to the right of Boston Road on Pasco Street.

In 1980, 1989, and 2000-2001, the Loon Pond water was tested in categories such as turbidity, pH, alkalinity, nitrogen, phosphorus, temperature, chlorophyll, ammonium nitrate, macro invertebrates, storm water and bacteria. After testing was finished and conclusions were made, it was decided that the pond should be tested at least twice a year for changes in these categories.

The purpose of our work at Loon Pond was to help the city of Springfield. By doing this, we can give our results and let the city know what needs to be fixed in the pond. The pond is frequently used by the locals and they don't know the possible dangers of the pond. Some of the dangers of the pond can be very unhealthy to the wildlife and the public. Our goal was to test the water over a three month period, March, April and May, to see if Loon Pond was safe enough to swim in and for aquatic life. We had done different test to monitor how safe it is. The tests are as followed: Alkalinity, Macroinvertebrates, Chlorine, Ammonia nitrogen, Nitrate nitrogen, pH, phosphorus, Dissolved Oxygen and temperature.

Alkalinity addresses the problem for the lake to buffer in rapid changes in pH.

pH addresses the acidic, neutral, or basic characters are in the water.

Macroinvertebrates are small invertebrates, and they give a clue to the status of the lake. Macroinvertebrates are either pollution tolerant, pollution sensitive or wide range, meaning they can live in either type of water.

Chlorine addresses the salt concentrations in the pond and is used to check for the presence of water that has been treated for human use.

Ammonia Nitrogen addresses decay of organic material like manure, dead plants and animals, and helps algae and plants grow.

Phosphorus addresses the issue of promoting algae growth, and how much dissolved oxygen is used by the plants.

Dissolved Oxygen addresses the issue of survival for Macroinvertebrates and organism to use the dissolved oxygen to survive.

Nitrate nitrogen addresses algal growth and can be from pollution.

Temperature measures the air and water temperature.

For our studies, we used the Massachusetts Department of Environmental Protection Water Quality Standards. They are as follows for inland waters:

Class A-

These water are designated as a source of public supply. To the extent compatible with this use they shall be an excellent habitat for fish, other aquatic life and wildlife, and suitable for primary and secondary contact recreation. These waters shall have excellent have excellent aesthetic."

1. Dissolved Oxygen-

A. Shall not be less than six mg/l unless background conditions are lower;

2. Temperature-

A. Shall not exceed 68° F (20 C) in cold water fisheries, nor 83° F (28.3° C) in warm water fisheries, and the rise in temperature due to a discharge shall not exceed 1.5 F (0.8 C); and

B. Natural seasonal and daily variations shall be maintained. There shall be no changes from background conditions that would impair any use assigned to this Class, including site-specific limits necessary to protest normal species diversity, successful migration, reproductive functions or growth of aquatic organism.

3. pH-

A. Shall be in the range of 6.5 through 8.3 standard units but not in more than 0.5 units outside of the background range. There shall be no change from background from background conditions that would impair designated uses.

Class B-

These waters are designated as a habitat for fish, other aquatic life, and wildlife, and for primary and secondary contact recreation. Where designated they shall be suitable as a source of public water supply with appropriate treatment. They shall be suitable for irrigation and other agricultural uses and for compatible industrial cooling a process uses. These waters shall have consistently good aesthetic value.

1. Dissolved Oxygen-

A. Shall not be less than 6.0 mg/L in cold water fisheries nor less than 5.0mg/L in warm water fisheries unless background conditions are lower;

B. Natural seasonal and daily variations above these levels shall be maintained; levels shall not be lowered below 75% of saturation in cold water fisheries nor 60% of saturation in warm water fisheries due to a discharge; and

2. Temperature-

A. Shall not exceed 68° F (20° C) in water fisheries nor 83° F (23.3° C) in warm water fisheries, and the rise in temperature due to a discharge shall not exceed 3 ° F (1.7° C) in rivers and streams designated as cold water fisheries nor 5° F (2.8° C) in rivers and streams designated as cold water fisheries (based on the minimum expected flow for the month); in the lakes and ponds the rise shall not exceed 3° F (1.7 ° C) in the epilimnoin (based on the monthly average of maximum daily temperature); and

B. natural seasonal and daily variations shall be maintained. There shall be no changes from background conditions that would impair any use assigned to this Class, including site-specific limits necessary to protest normal species diversity, successful migration, reproductive functions or growth of aquatic organisms.

3. pH-

A. Shall be in the range of 6.5 through 8.3 standard units and not more than 0.5 units outside of the background range. There shall be no change from background conditions that would impair any use assigned to this Class.

Overall Method

Over the course of a three month period, Springfield Expeditionary Learning School went to Loon Pond twelve times. The student body was separated into four sections, each section was responsible to test their own division of the pond. Each division of the pond (south, north, southwest and northwest) was split again into approximately six smaller sections which would give the division of the pond more accurate results. The students were only given permission to test the public area of the pond and were excluded from the testing the eastern privately owned area of the pond. Every section would go three times to the pond, one day in each of three months. The sections would each get their own day at the pond so that no other groups could distract them. These visits were scheduled for March 26-29 April 24-27 and May 8-11.

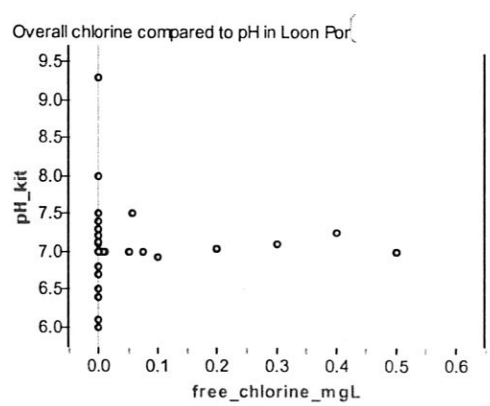
Upon arrival at Loon Pond, the individual testing groups would each go to one of the sites with their test kit and rotate around the sites testing until each predetermined site was tested. The test groups followed the method described for their test in their specific testing kit. (See Appendixes A-I, section; Methods for individual test kit models.)

Summary of Results

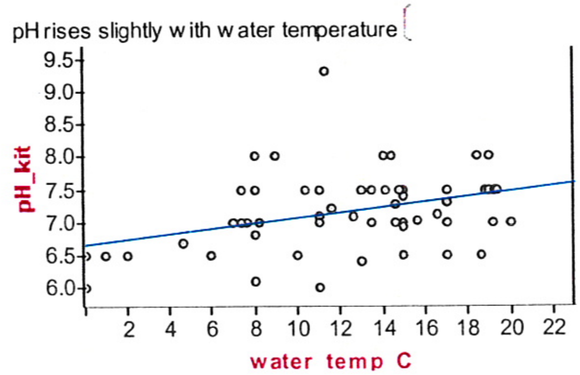
Throughout the testing of Loon Pond the weather varied from day to day. During the earlier dates we had slightly colder temperatures and the pond was frozen, or in the process of unfreezing. We also had a few days with moderate to severe rain showers, when the testing had to be moved inside. The weather eventually warmed up and the pond had no ice.

For Chlorine most of the sites at Loon Pond had a general reading of 0.2mg/L or below with outliers of 0.4mg/L and 0.5mg/L. 0.0mg/L was the only data recorded on the following dates March 26-28, April 25-27, and May 8, 10-11. These results were found on the Northern, Southwestern banks of Loon Pond. The Northern bank test results varied from 0.0mg/L. These tests were done on March 29, April 24, and May 9.

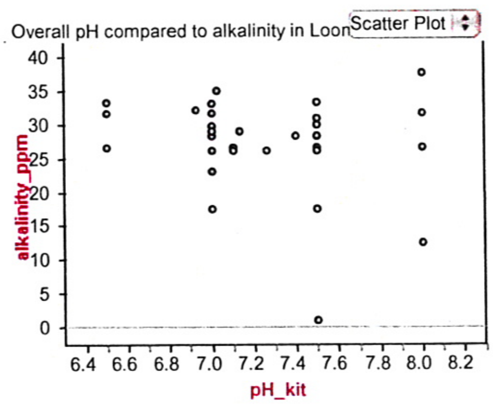
Free chlorine can be toxic, particularly as the pH level drops. In this figure, the pH stayed relatively stable while the chlorine level rose to 0.5mg/L..



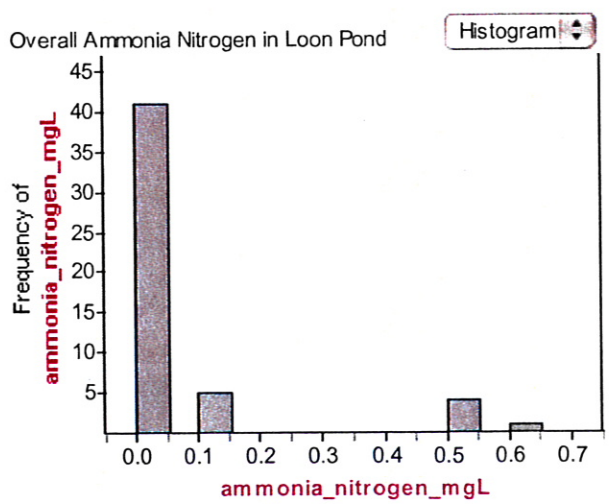
The pH range was from 6 to 9.3. The majority of the results were 7. The average pH for the southeast shore was 6.94. The average pH for the north is 7. The average pH for the northwest shore was 7.46.The average pH for southwest is 7.093. The overall average for the whole pond is 7.12. From the beginning to end of the testing with the pH kit the results rose as the temperature got higher, and on April 25 it went to the highest level of 9.5.



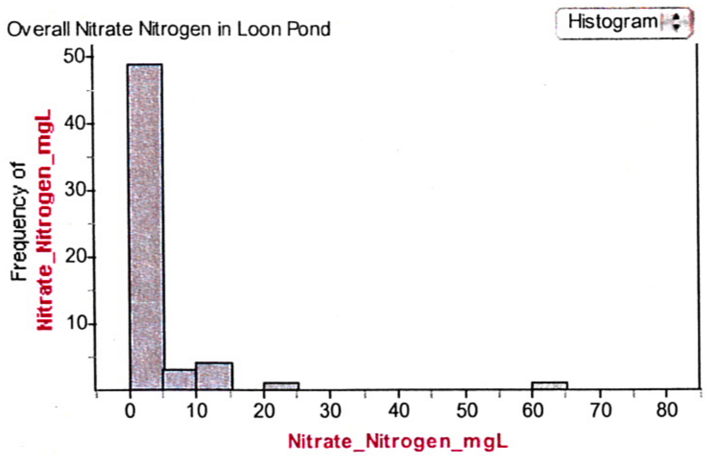
The majority of the alkalinity levels are near 30 ppm, which is above the minimum level of 20 ppm. We expect high alkalinity to be associated with low pH, but this is only mildly the case as shown in the graph below.



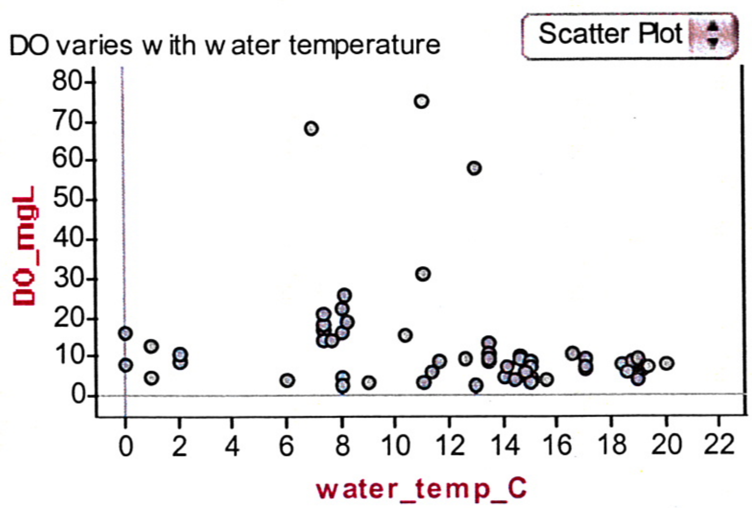
The general amount of Ammonia Nitrogen was mostly around 0 mg/L. In the northern and southern shores the results stayed at 0 mg/L. In contrast, the north western shore had a few spikes in data which reached a maximum of 0.6 mg/L which. There is no current data on the southwestern shore.



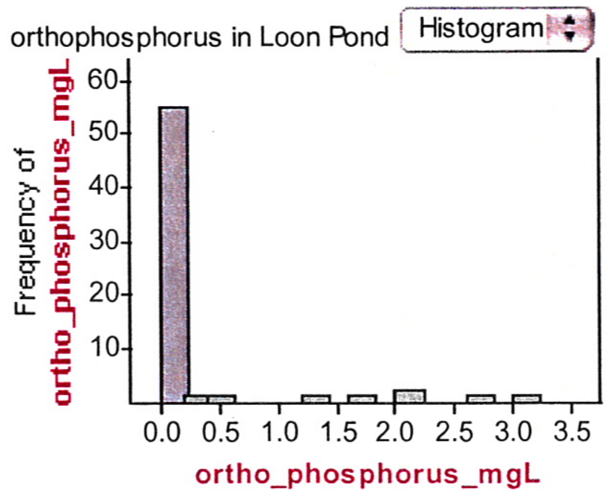
After looking at the overall test results of nitrate nitrogen in Loon Pond, the majority of the results are between 0 mg/L and 5 mg/L. Comparing from day to day, there is the same trend, though site-to-site comparisons showed a change. Although it more commonly ranged from 0mg/L to 5mg/L there are some inconsistencies. In the northwest shore the most common amount is 4.5mg/L, compared to the other shores where the majority is 0mg/L.



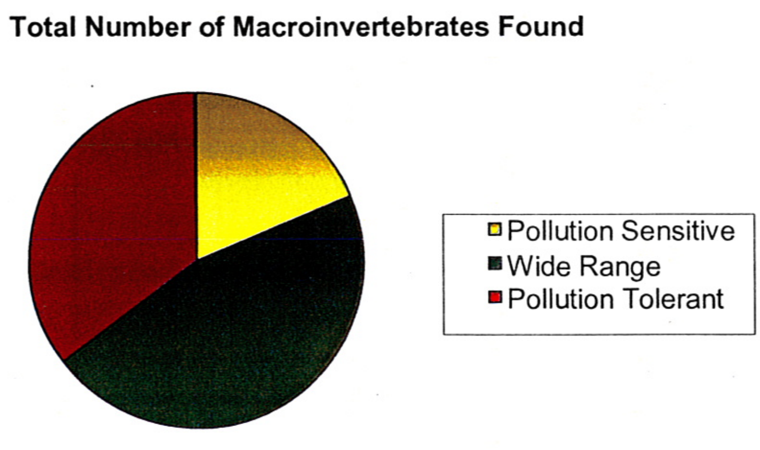
At Loon Pond, an extreme variation of data for Dissolved Oxygen was collected. The amounts collected varied from 0 to 80 mg/L, but the majority of the results ranged from 0 to 35mg/L. In the North shore the majority of the results varied from 7.5 to 23.5 mg/L. In the Northwest shore the majority of the dissolved oxygen varied from 3 to 19 mg/L. In the South shore the majority of the results varied from 2.5 to 5.5mg/L. In the Southwest shore the majority of the results varied from 2.5 to 12.5mg/L. Dissolved oxygen has a generally negative correlation with water temperature in our data.

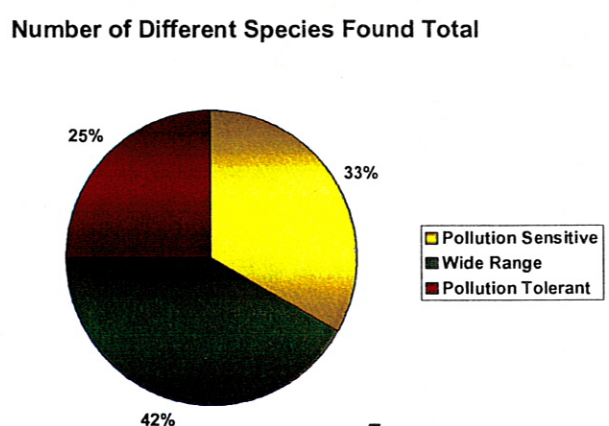


The majority of results for overall phosphorus between March 26th and April 24th was 0 mg/L or very close to 0.2 mg/L. There was a spike rising from 0.1 to 1.3 mg/L on April 25th, which lowered back to 0.1 mg/L on the same day. There is another increase from 1.7 to 3.3 mg/L on May 5th, which lowered to about 0.3 mg/L between May 15th and May 19th. Each section of the pond varied with the different levels of phosphorus. The north shore had the least levels of phosphorus while the west shore had the high levels of phosphorus.



Overall, 33% of the species of macroinvertebrates collected were pollution sensitive, although it was only 19% of the total number of actual macroinvertebrates collected and identified. Only 25% of the species found were pollution tolerant, however, 35% of all individual macroinvertebrates were in the tolerant category. The majority of both species and individuals were in the wide range category at 42% and 46% respectively.





Conclusions and Recommendations

Dissolved oxygen levels were at about 10 mg/L, which makes them fall into the Class A Water Quality Standards according to Appendix B of the Massachusetts Water Quality Standards for Inland Water. Chlorine levels did not meet the recommended maximum total chlorine level of 0.01 ppm for all aquatic life, as the highest level tested was .20 mg/L. From the macroinvertebrates data, the water quality appears to be moderate due to the majority of species being in the wide-range category.

According to the nitrate nitrogen data, most of the sites are safe for aquatic life since the maximum Nitrate Nitrogen for drinking water is 10 mg/L. The two safest sites were the northwest and the southwest shores. These areas had no connection to circumstances which could have increased Nitrate Nitrogen levels, such as leaking septic tanks, sewage runoff, or runoff from lawn fertilizers. However, the north and the south sites, which were near residential homes and commercial business, respectively, had unsafe Nitrate Nitrogen levels of over 10 mg/L. These areas should not be used for recreational purposes and the exceedingly high readings, such as 60 mg/L, should not be taken into consideration, as these results could not be replicated and are therefore considered mistakes. The north shore was close to residential homes, and had some readings greater than 10 mg/L. This may have been caused by leaking septic tanks or runoff from fertilized lawns. The south shore was located behind commercial businesses and a busy roadway, so the unsafe Nitrogen levels were most likely caused by sewage runoff.

Ammonium nitrate levels were gauged around 10 mg/L, the northwest and southwest shores were below 10 mg/L which is safe for aquatic life but the north and south shores had readings above 10 mg/L that aren't safe. The average alkalinity levels for Loon Pond were above the minimum level of 20 ppm (parts per million), but there are some outliers below that.

Loon Pond has a low amount of phosphorus, well below the desired level of 10 ppb (parts per billion) and hence it is healthy and safe to swim in for both aquatic and humans a like. There was a lot of waste (rotten food, dead animals, fans, piles of wood, used condom, etc) left at the shore of Loon Pond, most of which originated from illegal dumping. Thought there was an increase in the amount of phosphorus, this could be due to human error. There is also a slight chance that water located in the middle of the pond (higher with phosphorus) slowly surfaced because of rain and flowed towards the shore.

Loon pond is an urban landmark within the city, but if it is to be used for recreational purposes, there should be major changes done to the pond immediately. We have a few recommendations. If the city were to provide willing people like ourselves, or others interested in community service, with equipment to pick up trash that would help out a lot with the human waste. Also, it seems that there is too little police enforcement and it would be of great interest to invest in protection of Loon Pond. Regularly scheduled monitoring of the shorelines would help in maintaining the trash pick-up.

Having designated fishing zones would help because when we were at Loon Pond, there were a great number of hooks scattered along the beach. Also, for the swimmers, a dock out on the pond would be a nice addition. For food, there you could build a snack hut which would attract more people of the community who could walk around the pond or bike around it, making it an oasis in the city. Continuing to stock the pond with trout would attract fisherman.

Primarily, there should be trash barrels placed around the perimeter of the pond. Rubbish build up has been a reoccurring and hazardous problem not only to the pond but to the aquatic organisms that live in the pond as well. Garbage that is found on the floors of the pond should be thrown away. Reduced litter will help make the pond a clean and safe environment for everyone's benefit. Even though the water at Loon Pond is safe place to swim there should be something to be aware of.

Continuing to monitor the pond will be important. The pH level at Loon Pond should stay at the acceptable range of 6.5-8.5. To help this, add finely ground limestone to the pond, which will both boost alkalinity and will keep the pH in check, and reduce the toxic effect of metals in the water, if there are any. Liming the pond is fairly cheep, but a permit may be needed based on the city and state policies.

Additionally if Loon Pond is to be used as a swimming and fishing area, buoys should be put out to signal swimmers and fisherman where the shallow end of the pond starts to run deeper. A life guard and several security guards should also be present at all times to make sure that visitors are obeying the rules and are staying out of harm's way. A small fishing dock near the boat launch will be a nice asset and because of erosion it would help the pond if the boat launch was paved.

Since our research was done in early spring, there is little known about the vegetation and how many non-native species are present. Native plants should be replanted along the shoreline to ensure organisms can have a change of survival and thrive as the vegetation and population of the aquatic life expand. This will also attract birds, butterflies and other species.

Finally, the southern shore appears to be the most polluted area, perhaps due to the proximity to the businesses and the parking lot that is often used as a shortcut to Boston Road. We believe that the area needs to be better monitored to make sure the businesses are not illegally dumping. It also appears that run-off from Boston Road is negatively affecting the health of the pond.

In addition to these monitoring needs, we think it would be helpful if the communities of Springfield would help keep the pond clean because when we first visited Loon Pond this place was in bad condition. This may be in part because of ignorance about how the pond is affected by the civilian's actions. Putting up a sign somewhere might help keep the public in the loop or having signs around the pond explaining about the ecosystem and work that has been done there might help people understand. If we all gather together and make the Springfield community believe we can all make this a better place to enjoy.

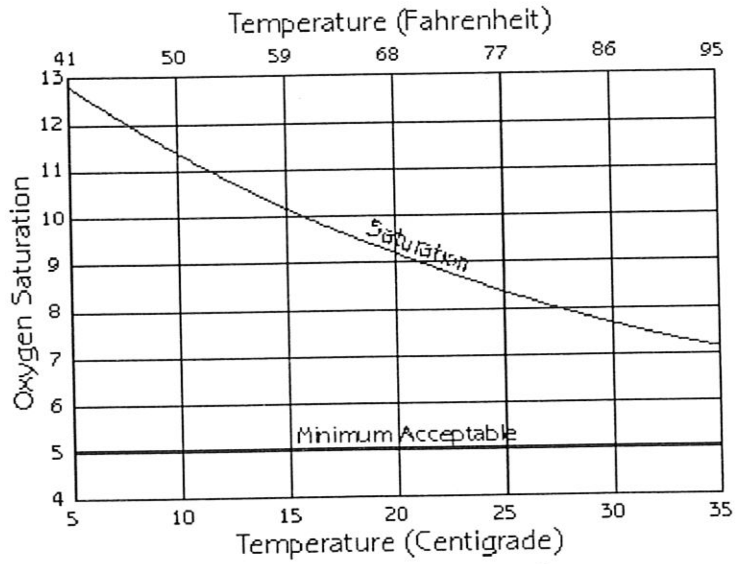
Appendix

Appendix A: Dissolved Oxygen

Introduction

Dissolved Oxygen (D.O.) is a measure of the quantity of micro-bubbles of oxygen present in the pond. Dissolved oxygen is important because it determines the number of organisms that can survive in the pond. According to appendix B of the Massachusetts Water Quality Standards, there must be at least 6 mg/L for the pond to qualify to be class A, and at least 5 mg/L to qualify as class B inland water. A high value would imply that many organisms can survive in the pond, while a low value would support few, if any, organisms in the pond.

Dissolved oxygen is correlated with both temperature and macroinvertebrate populations. When the temperature of the water is higher, less oxygen will remain dissolved; and the less dissolved oxygen there is, the less will be available to macroinvertebrates for their metabolism. Also, in comparison to a stream, pond water is still, causing less contact with the atmosphere, and thus producing lower levels of dissolved oxygen. Dissolved oxygen comes from the atmosphere and plant life in the environment. For example, during photosynthesis, algae release oxygen that diffuses into the pond. Therefore, the more algae there are in the pond, then the higher the concentration of dissolved oxygen will be.



This graph shows the maximum amount of oxygen (mg/L) that can be dissolved in fresh water at a variety of water temperatures. From www.vcnet.com/koi_net/do.html

Method

Water samples were tested using the La Motte Dissolved Oxygen testing kit, code 5860. One sample was taken at each site. Eight drops of each manganous sulfate solution and alkaline potassium iodide was added to each sample. After the floc settled to the neck of the water sampling bottle, eight drops of sulfuric acid were added. Then 20 mL of the sample was transferred to the titration tube. The sample was titrated with sodium thiosulfate until the color turned a pale yellow. Eight drops of starch indicator were added, turning the sample a dark blue. Titration was completed and the final amount of sodium thiosulfate was read. This number was the concentration (in mg/L) of dissolved oxygen. For accuracy, the process was replicated two more times.

Results

The visual representation below shows the final results of all the dissolved oxygen tests. The mode of the concentration is 10 mg/L – that is, 10 mg/L was the most common measurement. During early testing, some of the results were altered due to human error, so that data is not included in the graphs.

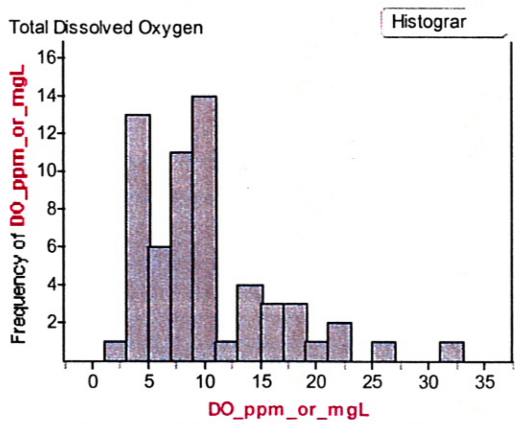


Figure 1 This graph describes the total DO concentration of all the collective shores.

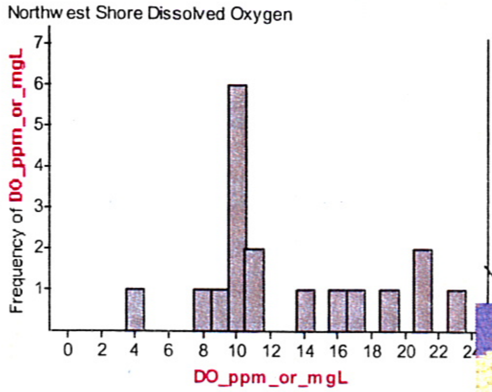


Figure 2 This graph shows that 10mg/L o DO was by far the most common measurement in the northwest portion of the pond.

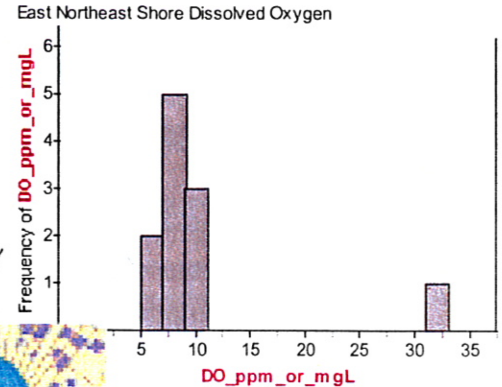
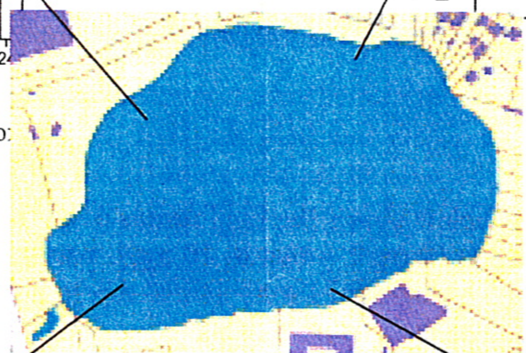


Figure 3 For the East Northeast shore of Loon Pond, the concentration of DO is generally between 5 and 10 mg/L.



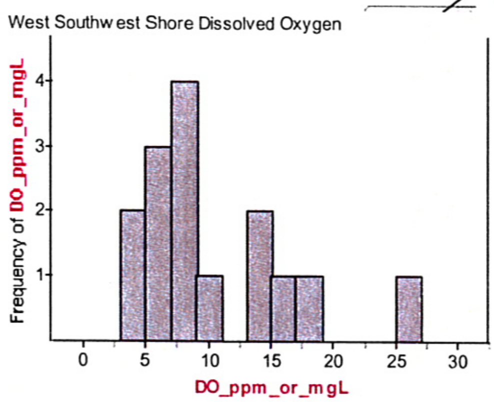
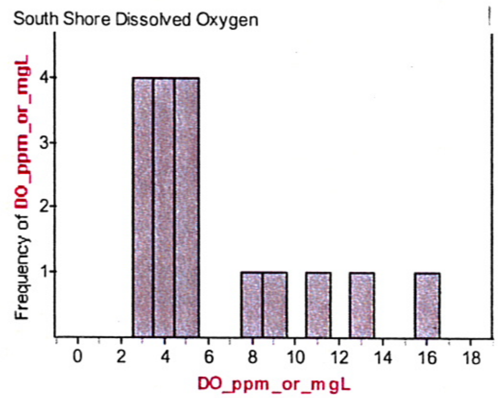


Figure 4 This graph makes clear that there is a lot of variability, from 5 to 25 mg/L, in DO levels in the southwest corner of the pond.

Figure 5 The multiple results below 5 mg/L in this graph challenge the qualification for class A or class B water.



This visual representation, showing the DO data compared to the dates when the tests were taken, shows that the typical results were between 5 and 15 mg/L for most dates, and dissolved oxygen levels are falling as early spring progresses into warmer May.

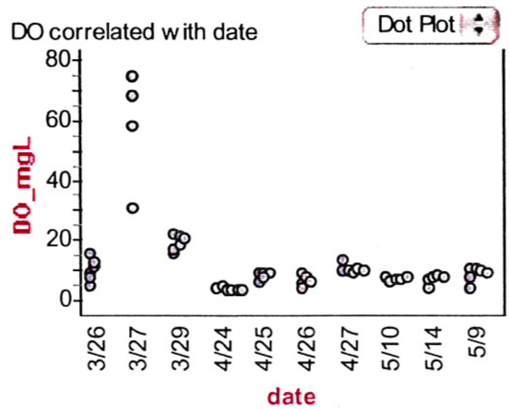


Figure 6 This graph shows the correlation between time and dissolved oxygen.

Conclusions and Recommendations

Figure 1 shows that 10 mg/L dissolved oxygen is a typical level for Loon Pond. Since the qualification for being class A water is at least 6mg/L, this would mean that this body of water satisfies the definition of class A water for dissolved oxygen, according to appendix B of the Massachusetts Water Quality Standards for inland water.

There is little data for the southwest section because, as seen on the graph of DO correlated with date, on March 27th the testing equipment was not functioning properly and gave implausibly high results. On March 26th the results were a little high, perhaps due to human error or temperature; it was quite cold in March and when cooler temperatures produce higher dissolved oxygen levels.

Appendix B: Temperature

Introduction

Temperature is a measure of the intensity of heat content; air temperature taken from atmosphere and water temperature taken from the water. Temperature measures how warm, moderate, or cool our environment is and is important because it affects the health of people and all other living things in the city.

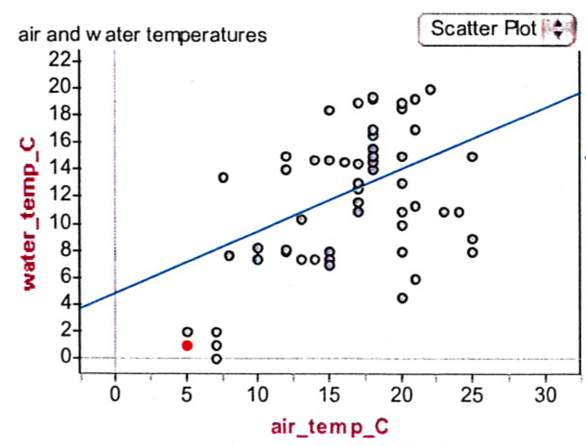
Air and water temperatures influence each other, heating unevenly in the sunlight and then sharing that heat so that they tend toward the same temperature. Pond organisms are primarily affected by water temperature. They are unable to survive the cold if it slows their metabolism too much or causes cell fluids to freeze and destroy the cell wall. Similarly, pond organisms are unable to survive the heat if it reduces the dissolved oxygen in the water too much, or if it overheats the organism and destroys necessary proteins for cell function.

Method

Measuring the temperature of Loon Pond was not a major challenge. The only materials necessary were thermometers. The type of thermometer that was used was a common one that can be read in both Celsius and Fahrenheit. Air temperature is taken simply by exposing the thermometer to the air for at least two minutes. After air temperature, the water temperature was taken by holding the thermometer in the water for four minutes with the bulb clear of the pond's ground surface. The air temperature is taken first to avoid evaporative cooling of the thermometer once it has been in the water. For accuracy, the process was repeated three times at each site. Once each site was completed and accurate data was collected, that data was recorded onto data sheets.

Results

The results of both air and water temperature were within an acceptable range to support typical Massachusetts pond organisms. Because air temperature affects water temperature, it was unsurprising that low air temperatures coincided with low water temperatures (Figure 1). For example, a result recorded for air temperature was five degrees with a water temperature of 1 degree (shown in red at right). Cold precipitation, such as freezing rain and ice, impacted some results. Other days were sunny and warmer in both the air and the water.



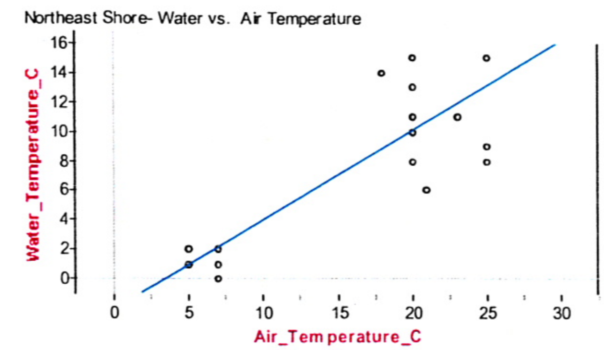


Figure 2: This graph shows the data collected on the northeast side of Loon Pond, and a positive correlation between water and air temperatures.

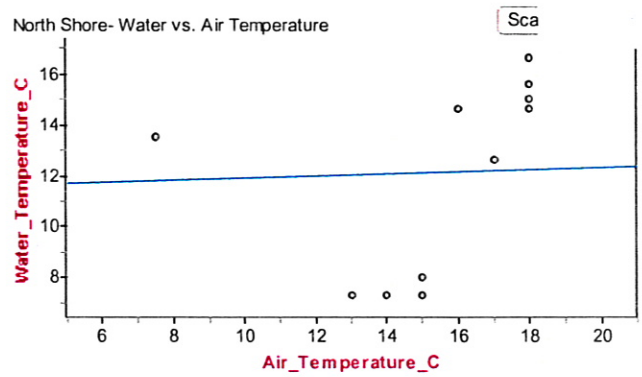
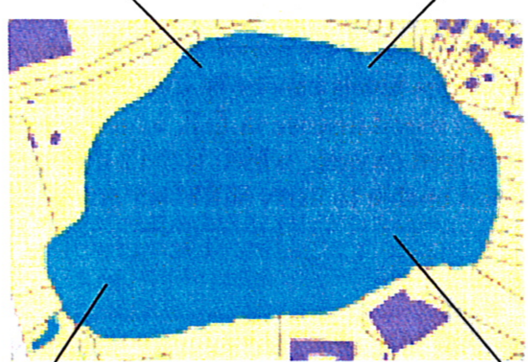


Fig 3: This graph shows the data collected on the north side of Loon Pond. The fit line for this data is much less steep because of an influential outlier.



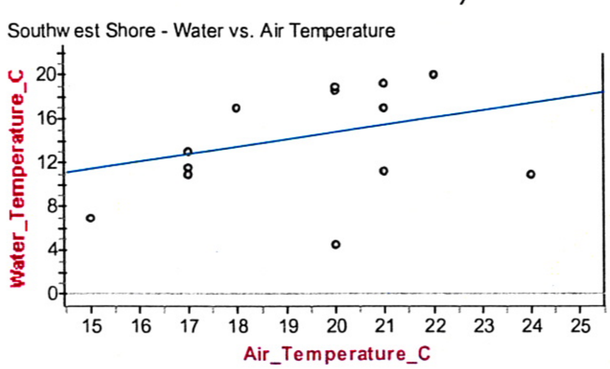


Fig 4: This graph shows the data collected on the southwest side of Loon Pond.

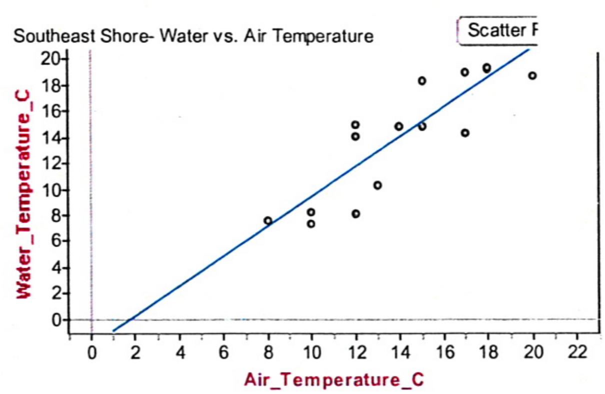


Fig 5: This graph shows the data collected on the southeast side of Loon Pond. It has the tightest correlation of any of the four areas.

Appendix C: Nitrate Nitrogen

Introduction

Nitrogen is an essential component of amino acids, proteins, and nucleic acids that are in all living things. Nitrate nitrogen affects aquatic plants if a high level of phosphorus is in the water. When phosphorus is not the limiting factor in algal growth, nitrate nitrogen can be that factor. If there is too much nitrate nitrogen, that can cause a lot of algal growth in the pond. This is a problem because when the algae and aquatic plants die, a bacterium decomposes the plant matter and uses up the oxygen in the water in the process. This process is called eutrophication. Because eutrophication lowers dissolved oxygen levels and dissolved oxygen is essential for aquatic life, high levels of nitrate nitrogen can be extremely damaging to aquatic animals.

Nitrate nitrogen is naturally produced when bacteria break down ammonia and organic matter that contains nitrates. Nitrogen is important because it helps plants grow and is the main ingredient in fertilizers, but it can easily be washed away from farm fields, lawns, and golf courses into groundwater and streams. Humans can cause increases in the amount of nitrate nitrogen through sewage treatment. The Massachusetts Water Quality Standards do not have a standard for nitrate levels in freshwater, but in our drinking supplies the nitrate nitrogen levels cannot be over 10 mg/L. High concentrations of nitrates can cause brown blood disease in fish, which causes fish to suffocate despite a normal amount of dissolved oxygen, which is 5-12 milligrams per liter, because the disease makes the blood unable to carry sufficient amount of oxygen to the fish body.

Method

Loon Pond in Springfield, MA, provided samples that were tested for nitrate nitrogen at each sample site using Hach Test Kit Model NI-11. The researchers followed the directions provided with the test, then, the results were recorded on the data sheets. Tests were replicated three times, unless the first test results were zero, in which case the tests were then replicated only once more. There were groups of four students and the groups divided the work into equal shares.

There were several steps that were followed to ensure the success of the testing. These steps were as follows: first, two water samples were collected in two separate test tubes from the test site; one served as the control sample, the other was the test sample. Then, the control sample was placed in the left slot of the Hach Kit Color Comparator. Next, the contents of one NitraVer Nitrate Nitrogen Reagent Packet were added to the test sample and shaken vigorously for one minute. The sample was then allowed to sit undisturbed for one minute. The test sample was then placed in the right slot of the Hach Kit Color Comparator. Finally, the Hach Kit Color Comparator was held up to a light source and the color wheel was matched to the color of the test sample. The results were recorded, and then the test was repeated.

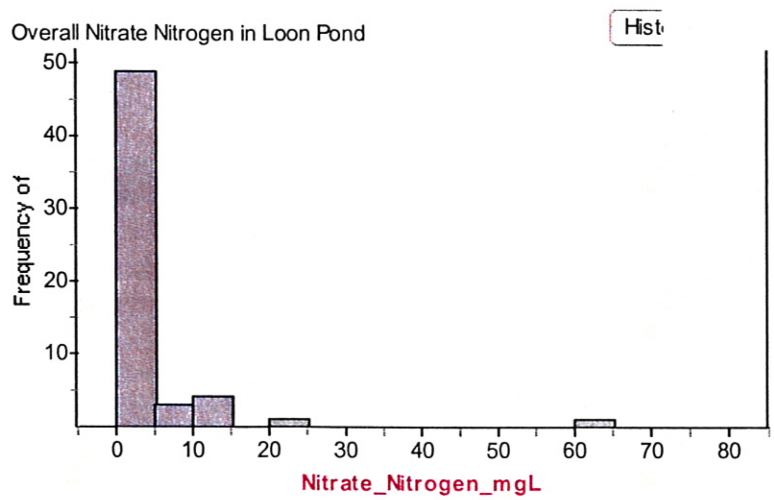
There were several materials that were used during the course of the testing. These were a Hach Test Kit Model NI-11, two test tubes, NitraVer Nitrate Nitrogen Chemical Reagent Packets,

The pond was spilt into four testing sections. This way data could be taken from the entire pond, and the health and safety could be accurately assessed. At the pond, observations were made about how unclean the water looked and how unsafe it was thought to be. Trash was collected to partially remedy this situation. This trash was used as a set of data that can be important to Loon Pond results.

Results

The majority of the nitrate nitrogen measurements were below 10 mg/L, which is ideal for swimming. There were a few exceptions, including one reading at 60 mg/L, which is extremely dangerous for aquatic life. However, there was only one reading of 60 mg/L, and it is perhaps a measurement or recording error. Overall, most of the results from the sites are acceptable for swimming and meet the class-A water standard of being below 10 mg/L, but there were a few exceptions to this.

Figure 1:
Overall Nitrate Nitrogen in Loon Pond
This graph makes clear that the majority of the measurements were below 5 mg/L, and only two measurements were above 20 mg/L.



Most of our results stay in the range of 0 mg/L to 5 mg/L, with an outlier of 60 mg/L. Loon Pond has very low levels of nitrate nitrogen in most places. In some areas of the pond, however, there are some abnormally high amounts of nitrate nitrogen in the water.

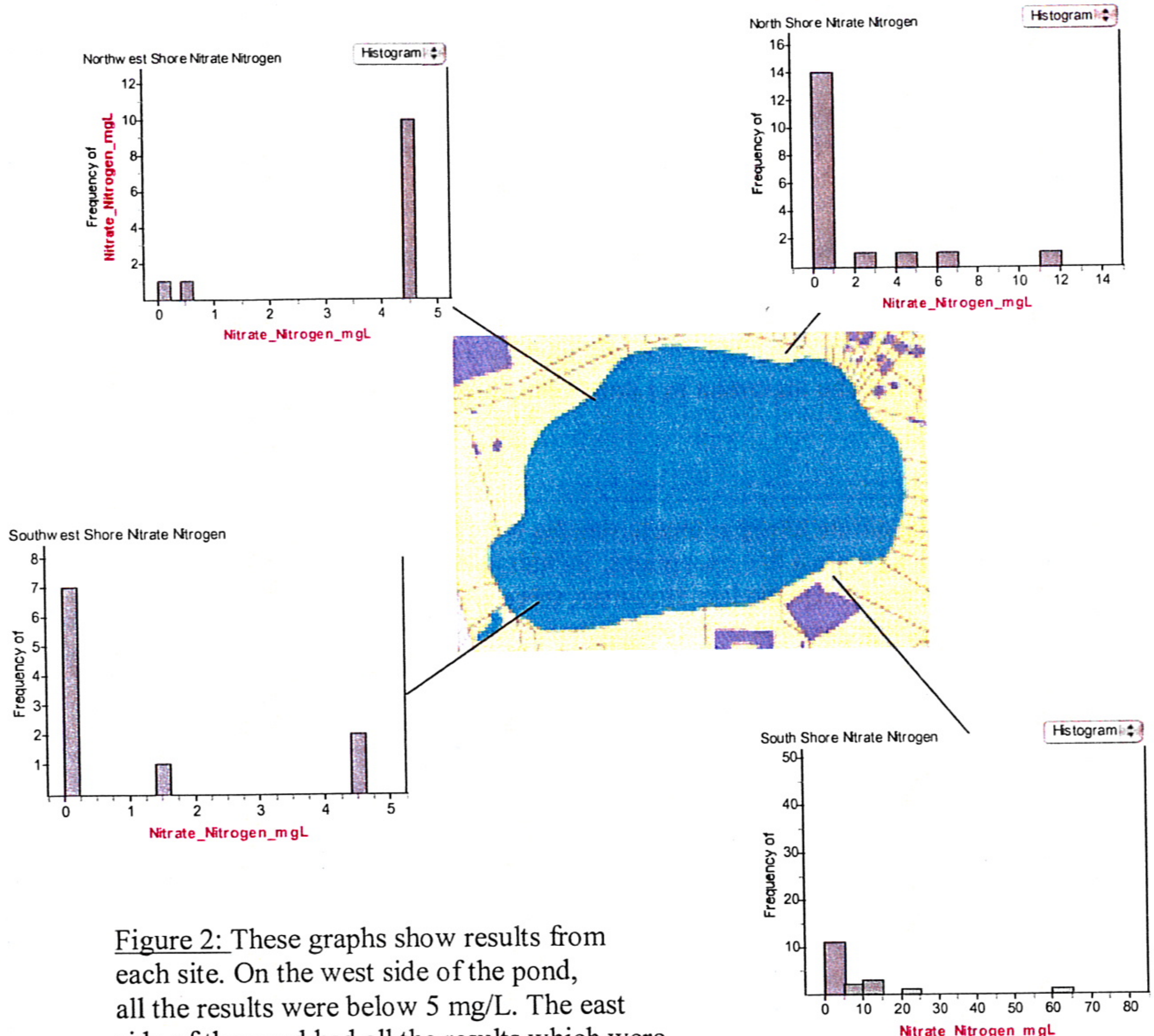
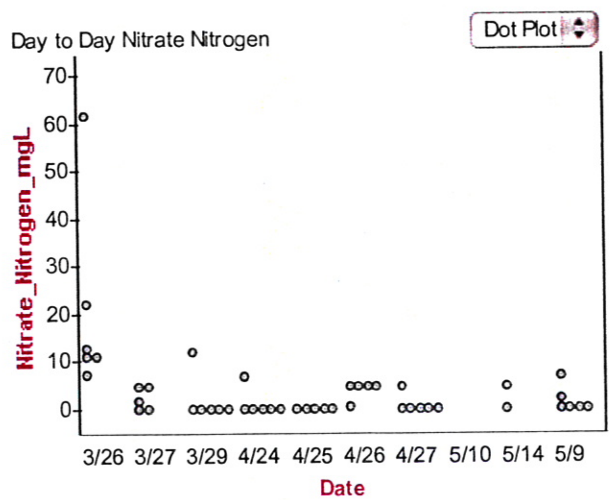


Figure 2: These graphs show results from each site. On the west side of the pond, all the results were below 5 mg/L. The east side of the pond had all the results which were in the double digits.

Figure 3:
Day to Day Nitrate Nitrogen
The first few days of testing produced extremely high results. After the initial testing days, most of the results settled down into the range of 0 mg/L through 5 mg/L, with few exceptions.



Conclusions

Most of the readings taken at the separate sites were in the range of 0 mg/L through 5 mg/L. Since the maximum nitrate nitrogen level for class-A water is 10 mg/L for drinking water, these sites are safe for human use. The two safest sites for human use were the northwest and the southwest shores. These areas had little or no circumstances which would have increased nitrate nitrogen levels, such as leaking septic tanks, sewage runoff, or runoff from lawn fertilizers. However, the north and the south sites, which were near residential homes and commercial business, respectively, had unacceptably high nitrate nitrogen levels of over 10 mg/L. These areas should not be used for recreational purposes and the exceedingly high readings, such as 60 mg/L, should not be taken into consideration, as these results could not be replicated and are therefore considered mistakes. The north shore was close to residential homes, and had some readings greater than 10 mg/L. This may have been caused by leaking septic tanks or runoff from fertilized lawns. The south shore was located behind commercial businesses and a busy roadway, so the unsafe nitrogen levels were most likely caused by sewage runoff.

Recommendations

After testing Loon Pond for Nitrate nitrogen levels, we decided to make the pond presentable to the public. First we would add a smoking zone and non-smoking zones to forbid smoking all over the premises except for a designated area. Dumpsters would also be asset to the pond because they would reduce littering and illegal dumping. Illegal dumping can be prevented by adding surveillance cameras around the pond. We suggest the sites continue to be tested and safety precautions taken for the wildlife and people that may swim in the pond, such as residents being more cautious about fertilizer use and septic tank quality.

Appendix D: Ammonia Nitrogen

Introduction

Ammonia Nitrogen is a dissolved form of nitrogen found in water that usually comes from decay of organic material like manure, dead plants and animals, and helps algae and plants grow. Ammonia is the most dissolved form of nitrogen and is found where there is not a lot of dissolved oxygen. Ammonia may be higher in ponds, wetlands, or slow moving rivers because of decaying matter that is located in the vicinity. If ammonia nitrogen is found in flowing water, it may indicate the sewage input, farm runoff, or heavy fertilizer use in the area. Depending on temperature and the waters pH level, too much ammonia can kill the fish and aquatic life in the water. As the levels rise above 0.05 mg/l it causes more and more damage and at 2.0 mg/l fish will die. It is not good for fish and aquatic life to live in high levels of ammonia nitrogen. High temperature and pH make the ammonia more harmful to the aquatic life. This is important because we need the aquatic life in the water, so we know that the water is safe for something to live in, and plus aquatic life helps the water. Aquatic life does many important environmental jobs. For example, they recycle nutrients, purify water, recharge ground water, and they are used for humans enjoyment. If we did not have the aquatic life, we wouldn't have any of this.

High ammonia levels can cause overgrowth of plants and algae and can show that there is pollution. If there is a lot of pollution in the water, nobody is going to want to swim in it because it will be over crowded with plants and algae. Low levels of ammonia can be bad for the gills of fish, and it can cause fish to get skin and gill hyperplasia (a growth of a part of the body, caused by too many cells being produced), which can kill the fish. It's bad if all of the fish are dead because then the dead bodies will attract more bacteria and contaminate the water.

Ammonia nitrate interacts with a lot of other features such as temperature, pH, plantation, macro-invertebrates, and alkalinity. For pH and temperature, the ammonia will become harmful if the temperature and pH is too high. For plants and algae, if the ammonia levels become dangerously high or low, then it can either cause the plants to over grow or die. For aquatic life, if there is too much or too little ammonia, then the fish and other aquatic life will die. Lastly, for alkalinity, if all of the plantation and aquatic life overgrows, then the water will not be clear, and people will not want to swim in it.

Method

Two sample tubes were rinsed with water from the area of the lake that was tested. The two test tubes were then filled up with the same water. The Ammonia Salicylate Reagent Powder Pillow was opened and poured into only one of the tubes. Then, the cap is placed on the tube and shaken for about three minutes, or until the powder pillow is dissolved. Once three minutes were up, an Ammonia Cyanurate Powder pillow was poured into the same tube. The tube would then be shaken and left alone for fifteen minutes, or until color was visible. When fifteen minutes were up, the two tubes were placed in the color compactor (black box). The chemical free tube was placed in the right side of the color compactor, and the water sample with the chemicals was placed on the left side of the color compactor. The color compactor was then held up to the light, and the color wheel was adjusted so there was a color match between the two water samples. Once a color match was found, the results were found on the color wheel, through the scale window. The results were recorded as milligrams per liter (mg/L)

Results

The results of the ammonia nitrogen test never got above 1mg/L. Though, the results did vary in different parts of the pond. In some parts of the pond, the ammonia nitrogen level is high, up to .6 mg/L, and in others it was all 0 mg/L. In the North section of the pond, the results were consistently 0mg/l. In the North West section of the pond, the results were not consistent and they went up and down. There was a spike in the data and the levels went high. In the south west section of the pond, there was no data. In the south section of the pond, the results were pretty consistent and it never got above .03 mg/L. Overall, the results were low, and it only went up to high levels at one site of the pond.

Figure 1: Overall Ammonia Nitrogen
This graph shows the overall levels of ammonia nitrogen from different sections of the pond. As the concentration rises above 0.05 mg/l it causes more and more damage and at 2.0 mg/l fish will die. Its not good for fish and aquatic life to live in.

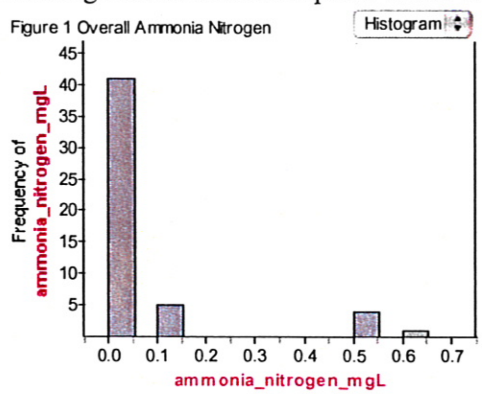
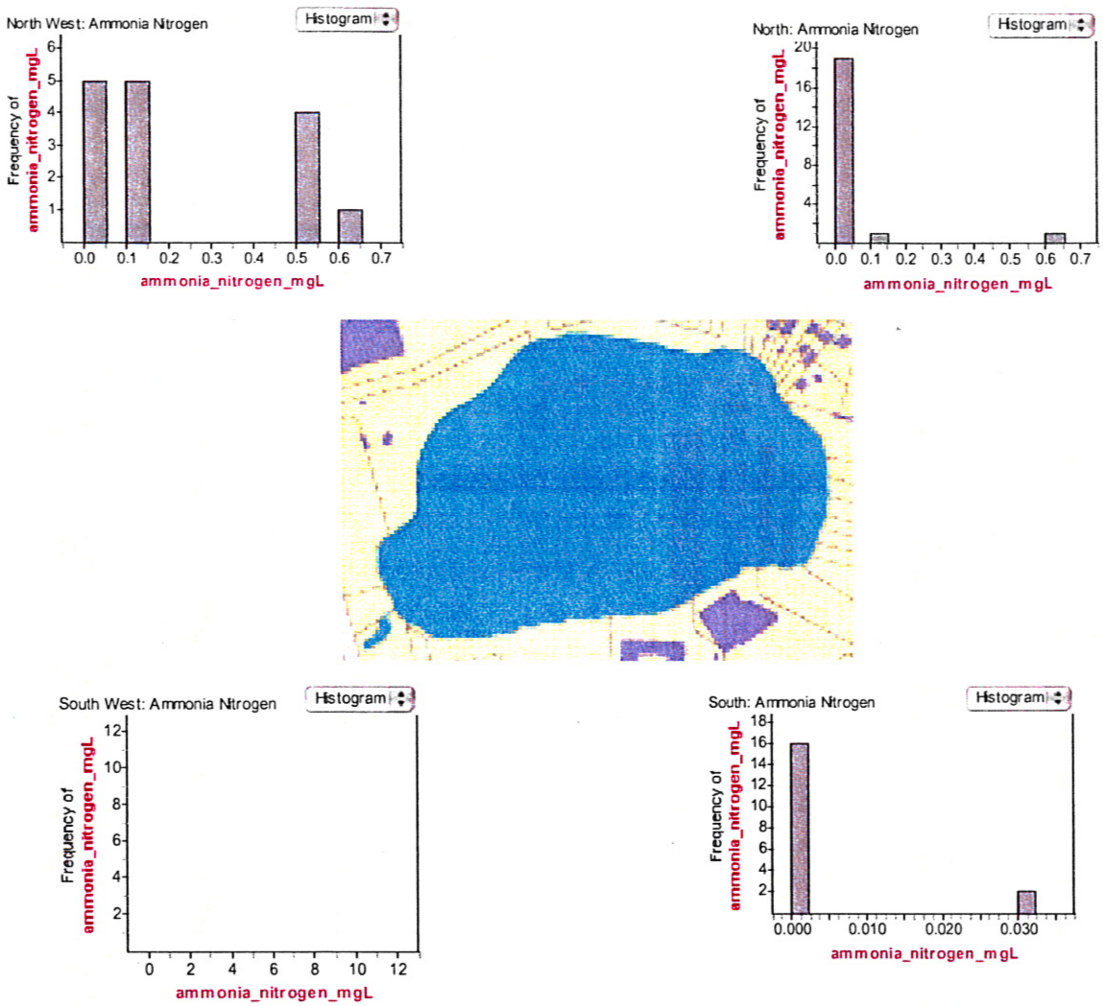
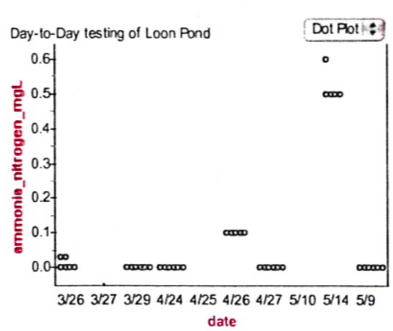


Figure 2:
This figure shows the different sections of the pond and the results gathered.



Almost every day that we tested the water, the ammonia nitrogen levels stayed pretty steadily similar. When the water started getting warmer, as the days went on, the ammonia nitrogen levels went up. Different parts of the pond got lower and higher levels of ammonia nitrogen. In the North West section of the pond, on May 14, 2007, there was a high level of ammonia nitrogen that could be toxic. This may have been because of inflow/outflow, or pollution from a local factory, or it could be a human mistake.

Figure 3: Day-to-Day testing of ammonia nitrogen
This graph shows the overall amount of ammonia nitrogen data collected each day.



Conclusions and Recommendations

Overall, the levels of ammonia nitrogen are swim able. In the North West section of the pond, on May 14, 2007, there was a high level of ammonia nitrogen that could be toxic. This may be because of runoff from the surrounding businesses, or it could be that we made an error on the testing for one day, or any other reason. We recommend that swimming is not permitted in this section of the pond.

Sources:

1. Ammonia Nitrogen Handout
2. www.lagoonsonline.com
3. www.water- research.com

Appendix E: Alkalinity

Introduction

Alkalinity is a measure of a capacity of a substance to neutralize acids. Alkalinity measures the buffering capacity, or the ability of a body of water to resist drastic changes in pH levels. When an acid is added to the water, the alkalinity level drops so the pH level does not need to. Without a sufficient amount of alkalinity (between 20 and 200 ppm), the pond's life forms are harmed by large changes in pH. The most important compound in water that determines the alkalinity levels is calcium carbonate ($CaCo_3$).

Method

The test were completed by using the LaMotte testing kit, model WAT-DR, Code 4491-DR. Each site was tested repeatedly during the months of March, April, and May. The steps taken were first to obtain five milliliters of sample water. Then one BCG-MR indicator tablet was added to the sample water and swirled until it became a shade of green. Then Alkalinity Titration Reagent B was added using a needle-less syringe. About two drops were added at a time and the sample was swirled until it became a shade of purple. A marking on the needle–less–syringe indicated the alkalinity level the test was replicated two times each site. The results were recorded on a data sheet.

Results

The alkalinity results ranged from 1 to 37.5 ppm, both of which only appeared once in the data collection. Most of the data was ranged between 26 ppm and 33 ppm. Overall the levels of alkalinity are above the minimum (20 ppm), but there are still a few spots with alkalinity below that level.

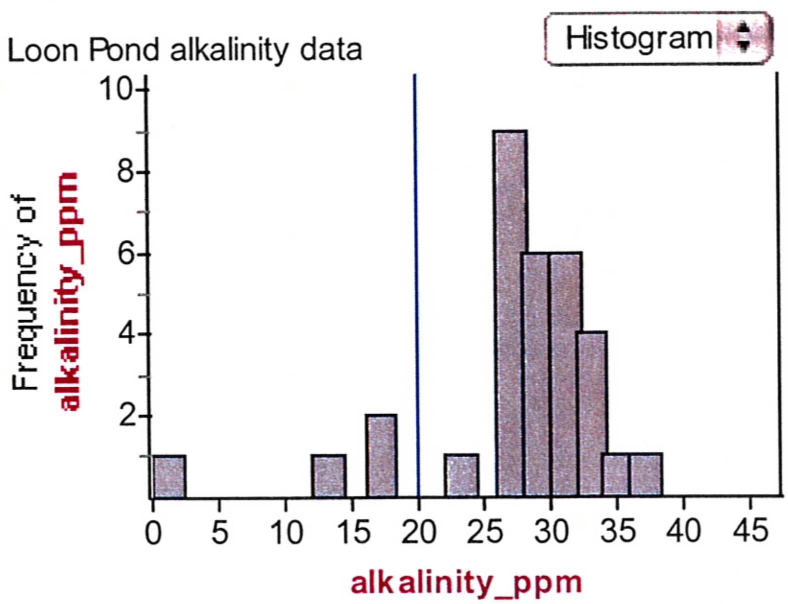


Figure 2

The time series was checked to see if the levels of alkalinity changed as the seasons went by, but the results seemed to stay the same throughout testing except for one day of wide variation in May.

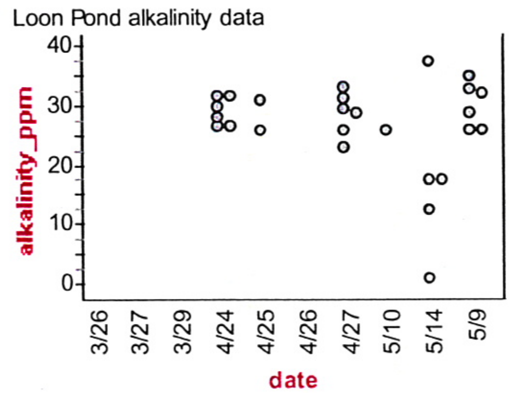


Figure 2

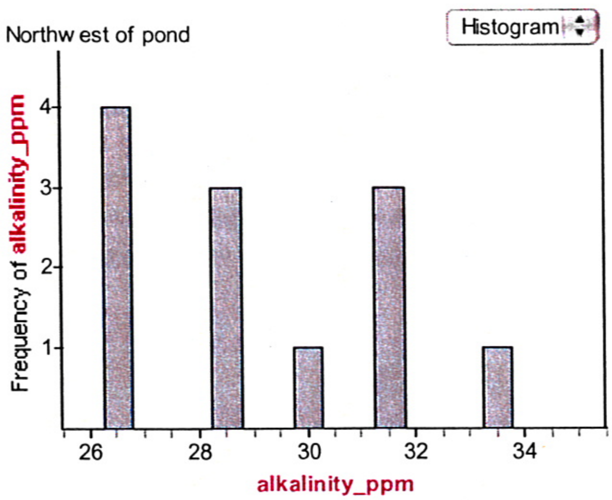


Figure 3 at left shows the data for the Northwest shore of the pond. The large gaps in the data presented suggests either that the test was done correctly and the outcomes were highly varied, for either a climate factor or a different day, or the test was done incorrectly with the result that data was just all over the place.

Conclusions and Recommendations:

According to the results, most of the test showed the overall alkalinity level of Loon Pond was over the 20 ppm minimum for class A water. Only 10% of the results showed that the alkalinity levels were lower than the minimum. Though 90% of the results are above the minimum, a majority of those are close to 30 ppm, so just barely above considering the 20 to 200 ppm range of the test. One test resulted in an alkalinity level of zero, which is thought to be a testing or human error.

Our classes suggest adding limestone to Loon Pond. That would protect the pond against rapid changes in pH level. It will also reduce the poisonous effects of metal in the water. Fine agricultural limestone should be used, because it is easy to find and inexpensive. Very fine lime dissolves in water quickly. The amount needed is between one to two tons per acre of surface area. A permit may be needed to add limestone to Loon Pond.

Appendix F: pH

Introduction

Power of hydrogen, pH, is a measure of how acidic or basic a solution is, and it affects the organisms and chemistry of the specified water, at a given temperature. Acid is a substance that is a proton donor (H+), while a base is a proton acceptor. Water is H_2O and it can dissociate to form hydroxyl, H^+, and hydroxide, OH^-, ions. Hydroxide, OH^-, is a base, since it can accept the H^+ to form H_2O, which is neutral. If the water has a pH between 7 and 14, the water is basic; if the water has a pH between 0 and 7, it is acidic. The pH value 7 means neutral water – equal amounts of H^+ and OH^-, which is generally good for organisms living in the water.

Aquatic organisms can be very sensitive to high or low pH values, especially values less than 6.5 or greater than 8.5. Adult organisms may continue to live but they are unlikely to produce any young. The pH of a body of water can be raised or lowered to dangerous levels by a variety of processes. Algal blooms can raise pH, in extreme cases, to values greater than 9. Many industrial processes result in release of acidic or basic effluent that will raise or lower the pH of the water it flows in to. Combustion of fossil fuels in engines often release sulfides and nitrous oxides, which cause acid rain when mixed with water and lower the pH.

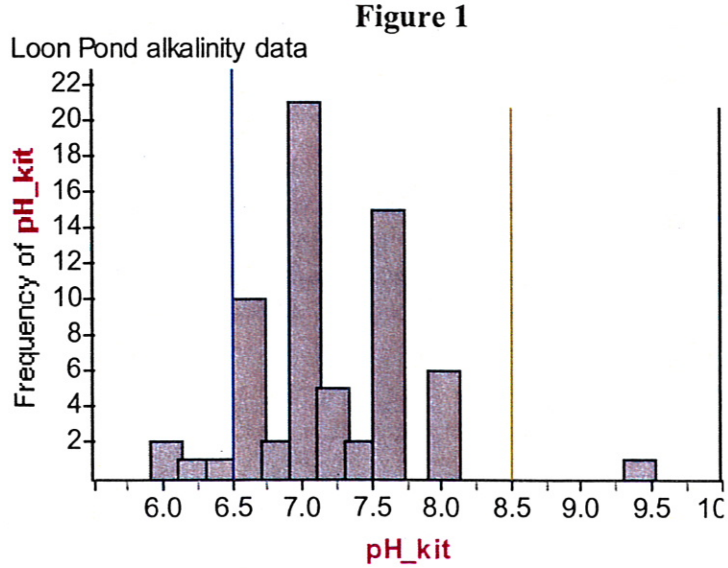
Method

Air and water temperatures were taken at each site as soon at the beginning of each testing session. The four classes of students each went to the pond three times, once a month in March, April, and May. Each class had a different part of the pond to test, and one part of the pond was not tested due to the concerns of the private landowners. Each group chose sites in their area of the pond to divide it up. These divisions were equally spaced where possible, but some test sites were specifically located to catch runoffs that would affect the water quality. Other sites were chosen for their easy access or because some feature made them distinct from other sites tested. At each site, the water's pH was measured following the instructions with the Hach Wide Range Indicator pH kit, range: 4-10 Model 17-N.

Results

The overall pH (see Figure 1), including samples throughout the pond, has an average pH of 7.12. This water has come to be neutral, like tap water with a scale number of 7 overall. It is worth noting, however, that there is significant variation around this average, from values well below 6.5 to one value over 8.5.

Figure 1



Considering the various areas of the shoreline, the average pH in the south area (Figure 2) of the pond was 7. Many of the tests measured mildly acidic water and a slightly smaller collection of observations were basic. The average of the north area (Figure 3) was 6.99 with much less variation. This north shore water tests solidly neutral. The average in the northwest area (Figure 4) is 7.47 with a higher spread. One outlier (removed) found the pH to be 9, but the rest of northwest results showed acidic water. In the southwest area of the pond (see Figure 5) the average pH was 7.39, indicating neutral to basic pH.

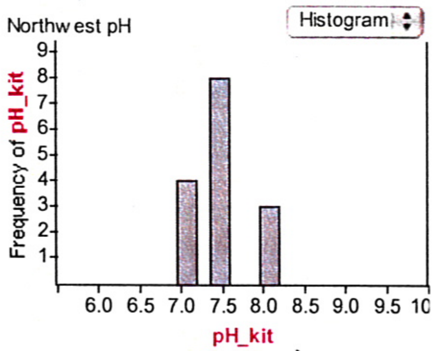


Figure 4.

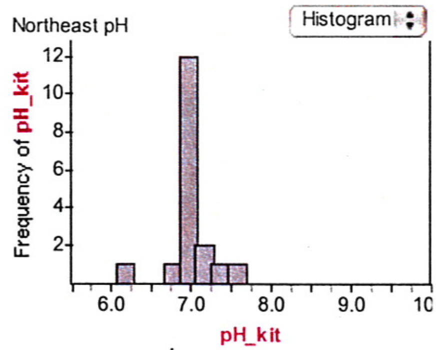
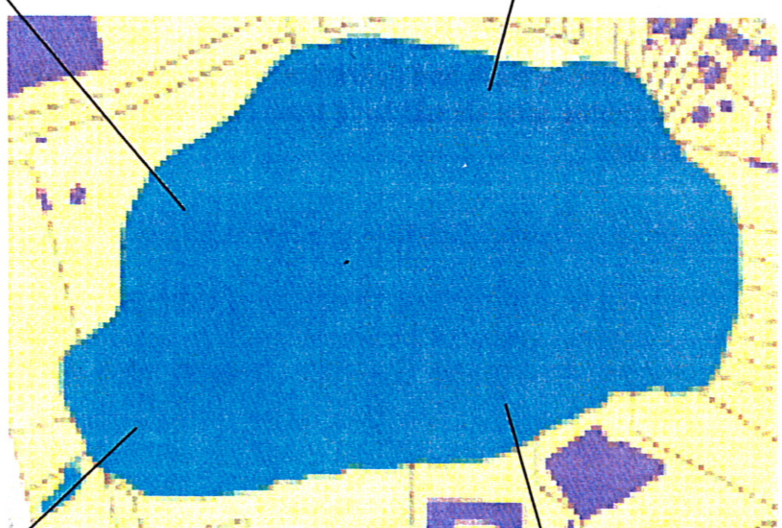


Figure 3



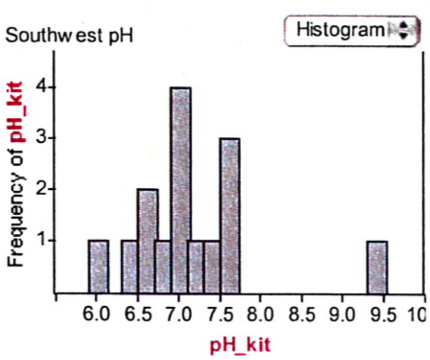


Figure 5

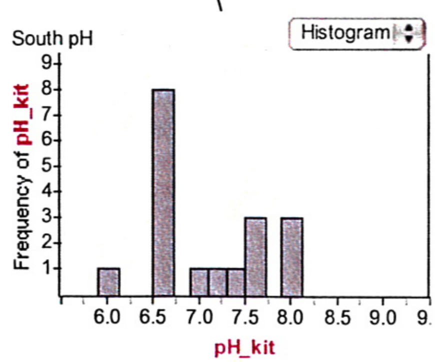


Figure 2

Figure 6, the time series of pH results, shows a rise in the measured pH over the course of the spring testing period.

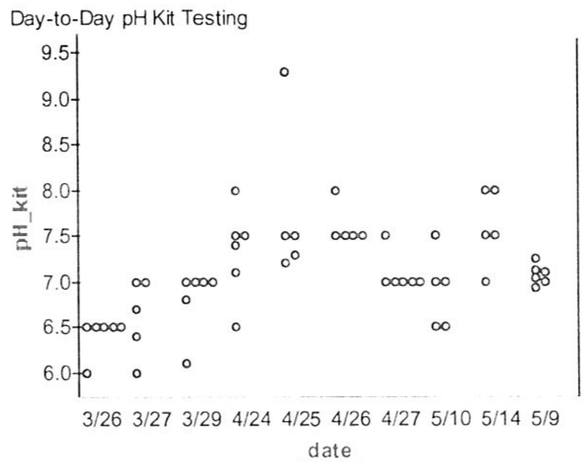


Figure 6

Conclusions and Recommendations

The tests documented in this report found the water in Loon Pond to range generally from neutral to mildly basic. The testing team believes that the runoff that leads straight into the pond explains a significant portion of the acid/ base imbalance in the water. Rock and dirt fill in the pipes would slow the flow of water, pollution and chemicals from cars into the pond. If a fence were installed to border the pond area, it might help keep more trash found at higher elevations from ending up in the pond. The pond needs to be cleaned up to remove trash and debris that have already made their way into the water. The new swimming area should have trash barrels and restrictions to keep the food inside the beach house.

Appendix G: Chlorine

Introduction

Chlorine is the abiotic factor that does not interact with any other factors in the pond and is an essential nutrient in nature primarily as salts (chloride) which naturally enters streams as rocks erode. Chloride concentrations are an indication of natural salt concentrations, in addition to sewage and other sources of contamination. Chloride measurement is used to monitor human activity in the watershed and to check for the presence of water that has been treated for consumption.

Sea water contains about 27,000 mg/L of chloride while "clean" rivers and lakes contain 20-50 mg/L of chloride. Chloride levels will increase if a chloride-containing product is introduced such as fertilizers, drinking water, and swimming pools. Street runoffs from a city may increase the chloride level by several magnitudes because it contains pollutants that could harm the stream and the dirt that is eroded into the water could smother fish eggs, larvae and bugs, and ruin the ecosystem. Additionally, the salt from the runoff can kill algae and prevent vegetation from growing and can also be hazardous to the aquatic life that ingests it. Chlorine becomes more toxic as the pH levels of the water drop. Marine (saltwater) organisms are used to high concentrations of chloride jjgjhyfn fresh water organisms are not. High concentrations can kill many forms of life in freshwater. The lethal amount varies with species. For example, 400 mg/L is deadly to trout but bass can tolerate up to 40,000 mg/L.

Total chlorine is the sum of the free chlorine and combined chlorine levels in the water which should be no greater than 11.6mg/L. It is typically measured to determine the total chlorine content of treated wastewater. Free chlorine is measured in drinking water disinfections to find whether or not the water has enough disinfectant.

Since chlorine is one of the micronutrients needed by every living cell, it is essential to all ecosystems. Large amounts of chlorine are used to produce pesticides and insecticides such as DDT. Some of the compounds in the insecticide are difficult for the bacteria in the water to degrade and have become very troublesome for the environment. Although DDT has been banned in America for 30 years, this insecticide and its derivatives are still in the sediments of streams and rivers.

Method

Four different ninth grade classes went to Loon Pond on three different dates on March 26th, 27th, 28th, 29th, April 24th, 25th, 26th, 27th and May 8th, 9th 10th and 11th. The weather was sunny with a few rainy days, and in one case, when the teacher had to go to Loon Pond, retrieve sample from all the sites and return to the school for the students to test the water.

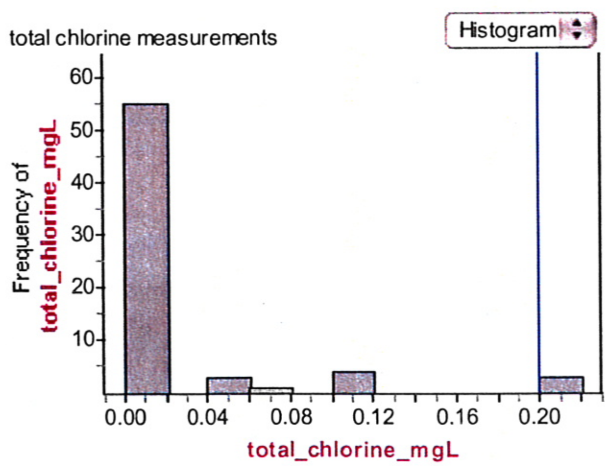
Sections of the pond were assigned to each ninth grade class and the shores were divided into five to six different sites depending on the size of the shore. Sites were picked based on the size of the site and how evenly spaced apart they were from each other.

Chlorine, both total and free, were tested at Loon Pond. The concentration of free and total chlorine is measured using a Hach Free and Total Chlorine Test Kit and the steps are as follows:

Free Chlorine Test:
The first step is to fill a test tube up with water from the site. This will be the sample water used to compare to the other test tube. Then, place the sample tube in the top left opening of the color comparator and fill another tube with the same sample water. Next, add the contents of one DPD Free Chlorine Reagent Powder Pillow to the second tube. Read the result within one minute of the addition of the powder. Swirl the tube to fully dilute the powder and place the second tube in the top right opening of the color comparator. Hold the comparator up to a light source and rotate the disc until the color wheel matches the color of the second tube. Read the mg/L free chlorine in the scale window and record.

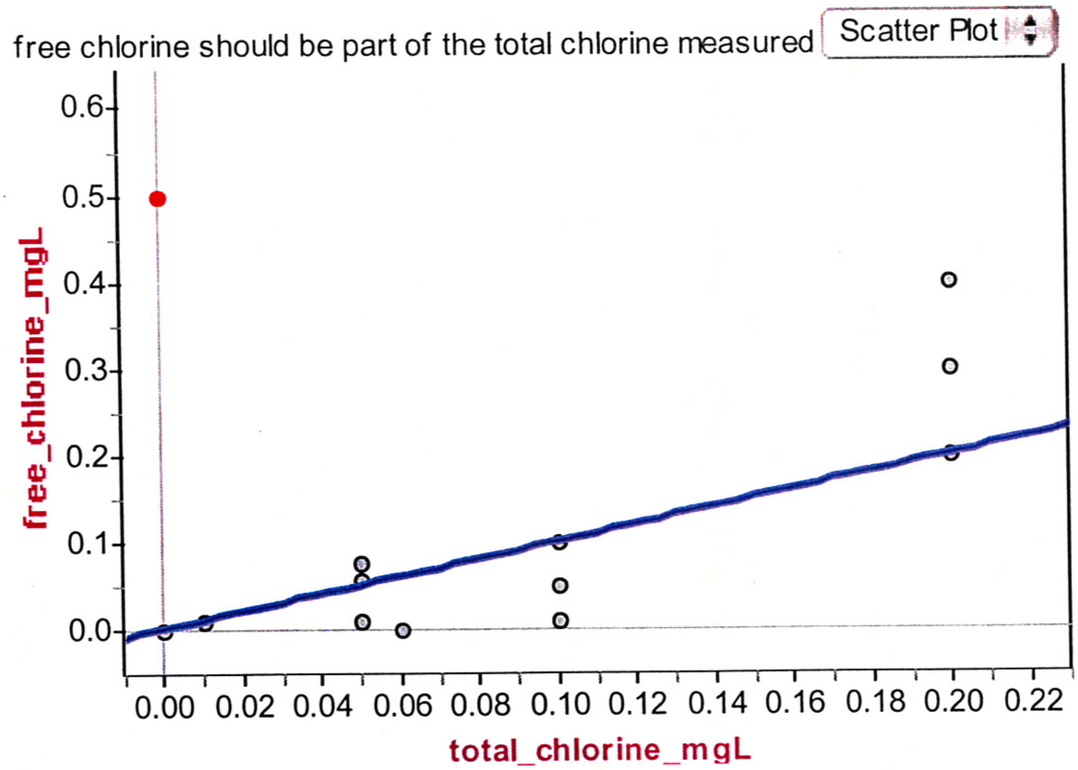
Total Chlorine Test:
The first step is to fill a test tube up with water from the site. This will be the sample water used to compare to the other test tube. Then, place the sample tube in the top left opening of the color comparator and fill another tube with the same sample water. Next, add the contents of one DPD Total Chlorine Reagent Powder Pillow to the second tube. Read the result within one minute of the addition of the powder. Swirl the tube to fully dilute the powder and place the second tube in the top right opening of the color comparator. Hold the comparator up to a light source and rotate the disc until the color wheel matches the color of the second tube. Read the mg/L free chlorine in the scale window and record.

Results

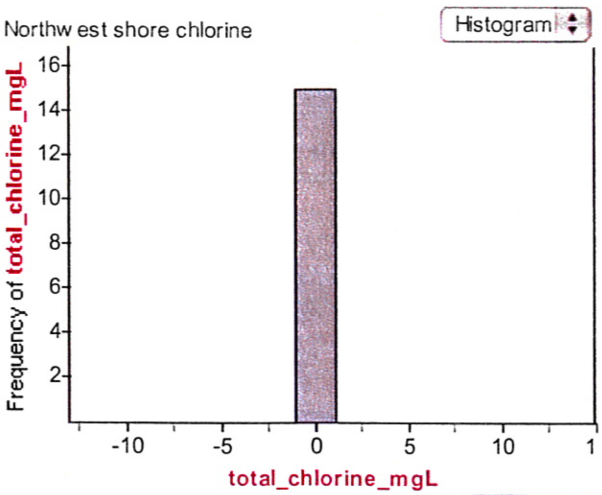


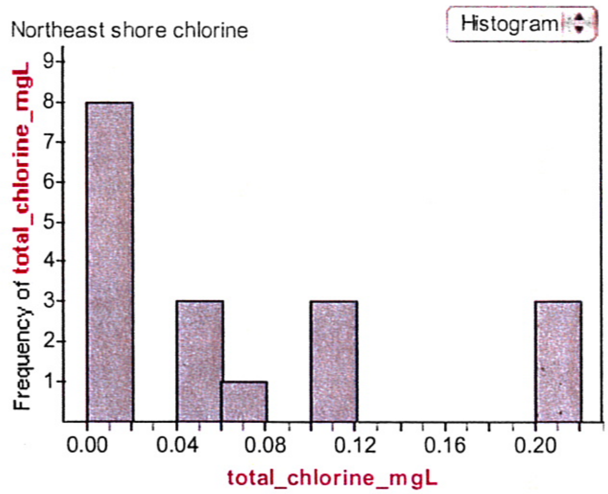
As seen in the graph above, most of the measurements at Loon Pond gave a reading of 0.2 mg/L or below with outliers of 0.4 mg/L and 0.5 mg/L. Chlorine levels for class-A water is recommended to be at most 11.6 mg/L, far above any reading obtained at Loon Pond.

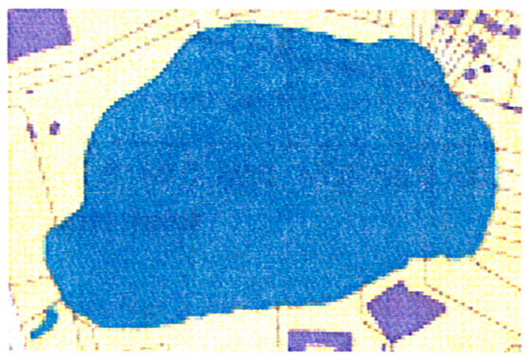
The graph below invites some questions about the reliability of our test results. A number of the free chlorine measurements are greater than the total chlorine measured at the same site on the same date.

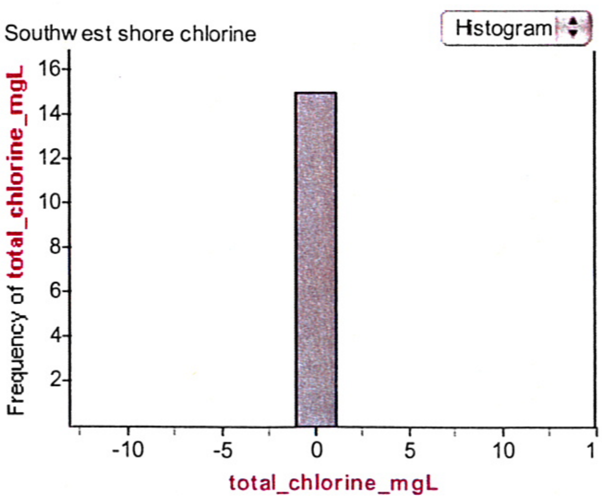


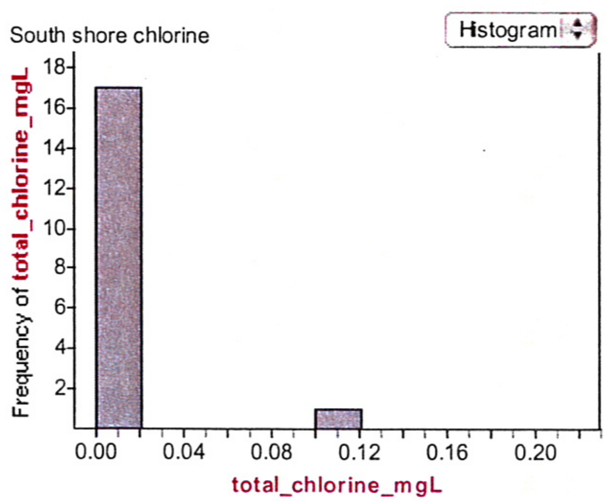
The graphs below show how the readings varied at the different locations around Loon Pond. The northwestern shore of Loon Pond did not produce any readings above 0.0 mg/L. Like the northwestern shore, the southwestern shore yielded no measurable chlorine. The south shore's readings were below 0.1 mg/L with the exception of a single outlier at 0.1 mg/L. It was the northeastern region of the bank, below a residential area, where there were found to be measurable amounts of chlorine in the water, but even here no measurement exceeds the water quality standard of 11.6 mg/L





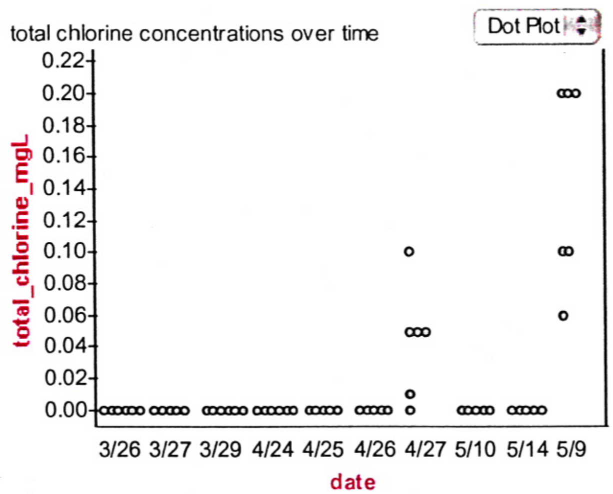






Throughout testing we had various weather conditions. During the earlier date we had slightly colder temperatures and later dates we had warmer weather and one slightly rainy day. 0.0 mg/L was the only data recorded on the following dates, March 26-28, April 25-27 and May 8, 10-11. This data occurred on the northern, southwestern, and southern banks of Loon pond. The northern bank was tested on March 29th, April 24th, and May 9th. The results from this bank on those dates varied from 0.0 mg/L to 0.5 mg/L.

Figure 6
Chlorine vs Date



<u>Conclusions</u>

The results of this experiment clearly state that there is no chlorine in Loon Pond. In order for there to be swimming in Loon Pond there must be 11.3 mg/L of chlorine in the water. However the levels of chlorine that were found from testing were between 0-0.5 mg/L. This states that the chlorine level is too low for the water to be clean enough to swim in. Since the chlorine levels are so low, that means that the pond is dirty, it is full bacteria. Also, since there is a very low level of Chlorine in the pond, that means that there are fresh water organisms swimming around in the pond. Even throughout many test in different types of weather, the level of chlorine stayed about the same.

<u>Recommendations</u>

In order for Loon Pond to be turned into a beach area, the amount of should be increased. You can increase the amount of Chlorine by filtering the water and even by adding some chlorine to the water. If it is increased, then the amount of bacteria in the pond will decrease. Thus the pond will be safe for people to swim in. Also, by increasing the level of Chlorine, all the fresh water organisms in the pond will in danger. Therefore, if there are no fresh water organisms in the pond, the fresh water organisms can no longer create bacteria in the pond.

Appendix H: Phosphorus

Introduction

Most fresh water is naturally deficient in phosphorus and algal growth is limited. An increase in phosphorus can cause water quality to deteriorate, and cause an increase in the growth of algae. When the algae dies, decomposition uses up oxygen and produces odors and toxins. In most uncontaminated lakes, the phosphorus level is 0.01 – 0.03 mg/L.

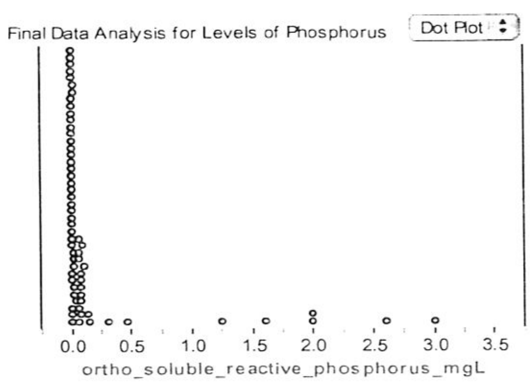
It's important to keep track of phosphorus because it can tell you whether or not the area is safe to swim in or even if animals can sustain life within the body of water. If too high (around 10mg/L) algae will grow in large numbers which, as stated before, can be lethal. First algae will consume all of the dissolved oxygen, pH will certainly have a negative spike, and eventually it will cause a domino effect for all factors of loon pond. Low amounts of phosphorus are a very good sign for both aquatic life and humans alike.

Method

Water samples were tested using the Hach Orthophosphate test kit, Model PO-19. Two samples were taken at each site; one for control and the other sample had reagents added to it. Following the directions of the test kit the phosphorus present in the water sample was recorded onto the data sheet.

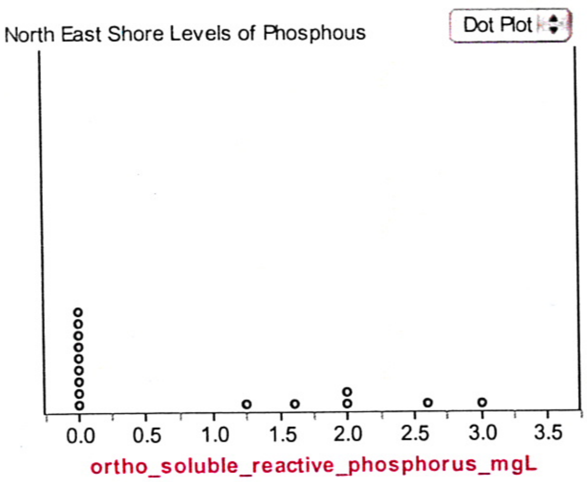
Results

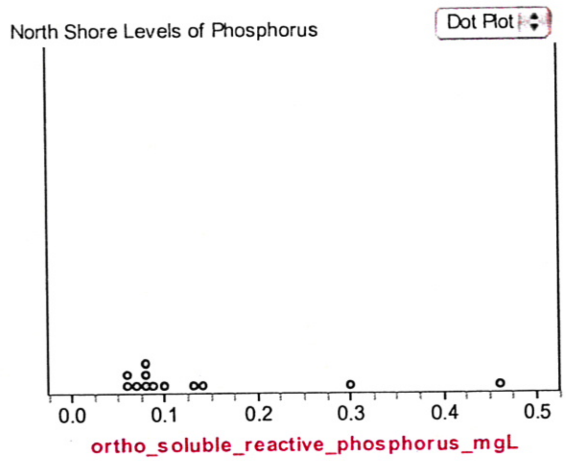
The phosphorus concentrations ranged from 0 to 3.3 mg/L. The results are bimodal due to the frequency of results ranging with one mode of 0 to 0.06 mg/LP and the second 1.3 to 2.3 mg/LP. This can be seen in the graph as two mounds in the data (one much larger than the other). The majority of results were 0 mg/L. The most extreme results are 2.7 and 3.2 mg/L. This is a dangerously high level of phosphorus in Loon Pond.

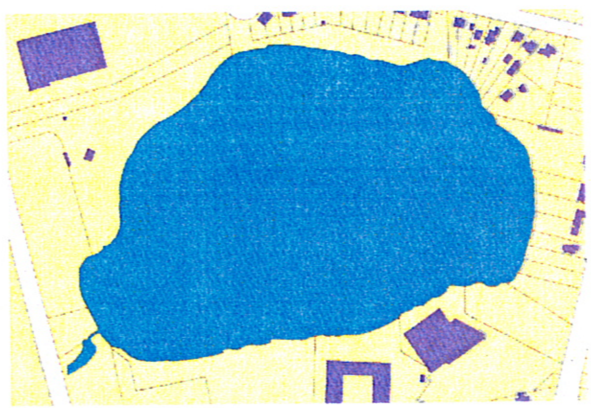


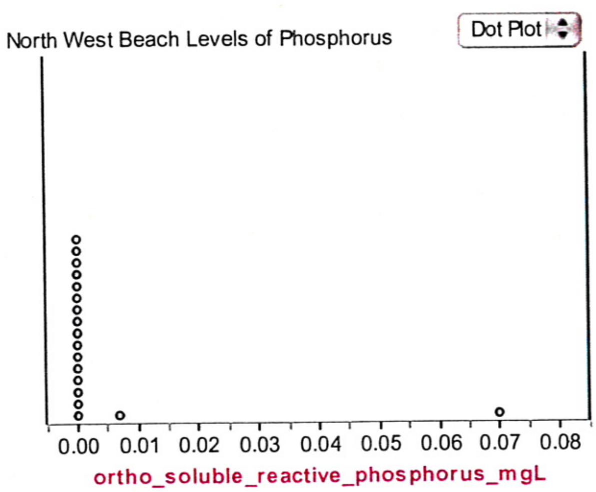
Each section of the pond varied with the different levels of phosphorus. The north shore had the lowest levels of phosphorus while the west shore had the highest levels of phosphorus.

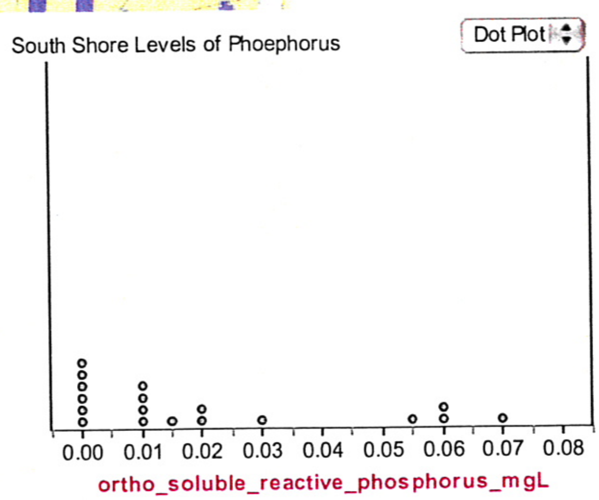
The first days at Loon Pond, the results came up to be mostly zero, but as spring arrived and the ice melted, the results came up to be more than zero. It seemed that at 3/26 to 4/27 the water was still in the transition from winter to spring. The first and second time the water was tested, the water was still covered with ice, but at 4/25 the water had some phosphorus. As soon as May came up, the water started to become warm and the phosphorus in the water increased.











Conclusion

Loon Pond has a low amount of phosphorus, near the 0.01 – 0.03 mg/L standards of uncontaminated bodies of water and hence it is healthy and safe to swim in for both aquatic and humans a like. The high amounts of phosphorus could be run-off from people treating their lawns or from goose droppings in the summer (perhaps why we did not find high levels in the spring). Also, runoff from parking lots (such as on the South side) could be affecting the phosphorus levels of the pond. There was a lot of waste (rotten food, dead animals, fans, piles of wood, used condom etc.) left at the shore of Loon pond, most of which originated from illegal dumping, but of all things there, no trash can was in site. If the city were to provide willing people like ourselves with equipment to pick up trash, that would help out a lot with the waste created by human visitors. Also, it seems that there is too little police enforcement and it would be of great interest to invest in protection of Loon Pond. It would also be of great help if there was an annual check up on both the pond and its shores.

Appendix I: Macroinvertebrates

Introduction

Macroinvertebrates are living organisms with no backbone living in an aquatic environment; their presence indicates various types of water quality. Macroinvertebrates fall into three categories; pollution sensitive, wide range, and pollution tolerant. Pollution sensitive organisms are sensitive to pollution. Wide range Macroinvertebrates are found in a wide variety of water quality conditions. Pollution tolerant macroinvertebrates could survive in polluted waters. Physical, chemical, and biological conditions are factors that affect pollution sensitive macroinvertebrates; therefore many show the impact of habitat loss not detected by traditional water quality assessments.

Method

Samples were taken with dip-nets from each site. A dip-net, a bucket, and an ice tray were used. The net was dipped into the water and filled up half way. When the bucket was half way full, the net was dipped into the water, to picking the leaves up from the bottom of the pond. Leaves from the bucket were carefully examined in order to gather macroinvertebrates. Each macroinvertebrate found was carefully placed in an ice cube container with water. After the macroinvertebrates were identified using a field guide, the data was recorded on a data sheet. They were then dumped back into the water (making sure not to harm the macros or the living environment) and moved onto a different section and started from the beginning.

Results

There was a total of 502 individual macroinvertebrates collected and identified, of which they belonged to 13 species. Overall, 33% of the species found were pollution sensitive, 25% were pollution tolerant and 42% were wide range. Of the individual macroinvertebrates, 19% of the total number were pollution sensitive, 35 % were pollution tolerant and 46% fell within the wide range category (**see Figure 1**).

By Individual Macroinvertebrates:
In the first week of testing pollution tolerant macroinvertebrates had the highest percentage of macroinvertebrates with a 45 percent. Wide range macroinvertebrates were the second highest with a percentage of 28, and pollution sensitive macroinvertebrates had the lowest with a percentage of 27 (**see figure 2**).

In the second week pollution tolerant macroinvertebrates still had the highest with a percentage of 45. The wide range macroinvertebrates were still the second highest with a percentage of 40, and pollution sensitive macroinvertebrates still had the lowest with a percentage now of 15 (**see figure 3**).

In the third week wide range macroinvertebrates had the highest now with 58 percent. Pollution tolerant was the second highest, but still pollution sensitive was lowest with an 18 percent (**see figure 4**).

By species:
In the first week we had three pollution sensitive macroinvertebrate species, three wide range species, and two pollutions tolerant species (**see figure 2**). In the following week there were five wide range macroinvertebrate species, two pollution sensitive species, and three pollution tolerant species (**see figure 3**). In the third week there were three pollution sensitive species, four pollution tolerant species, and four wide range species (**see figure 4**). In total 33 % of the species found were pollution sensitive, 42 % were wide range species and a 25 % were pollution tolerant macroinvertebrates (**see figure 1**).

Figure 1: Overall Species and Individuals Found

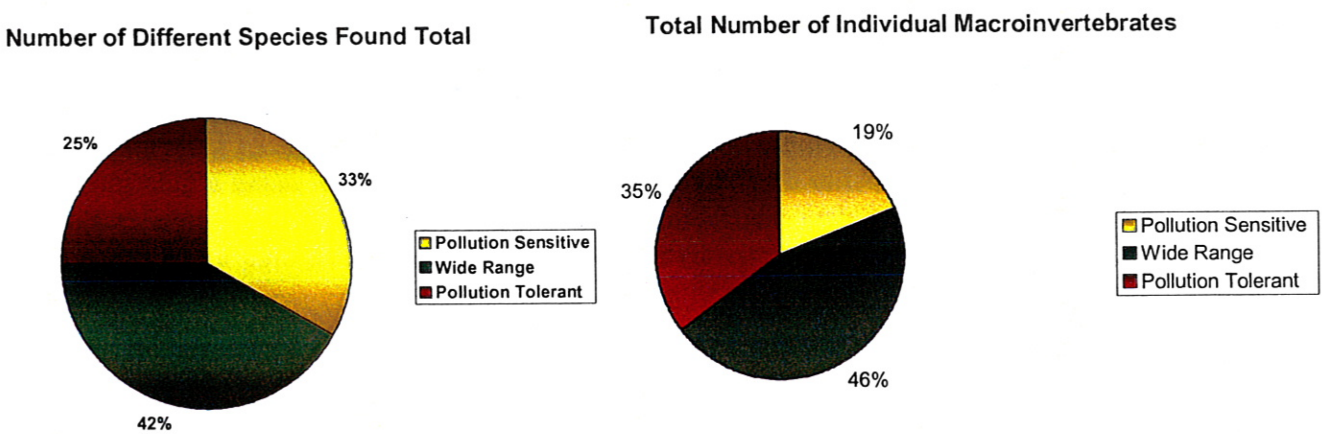


Figure 2: Species and Individuals Found Week 1

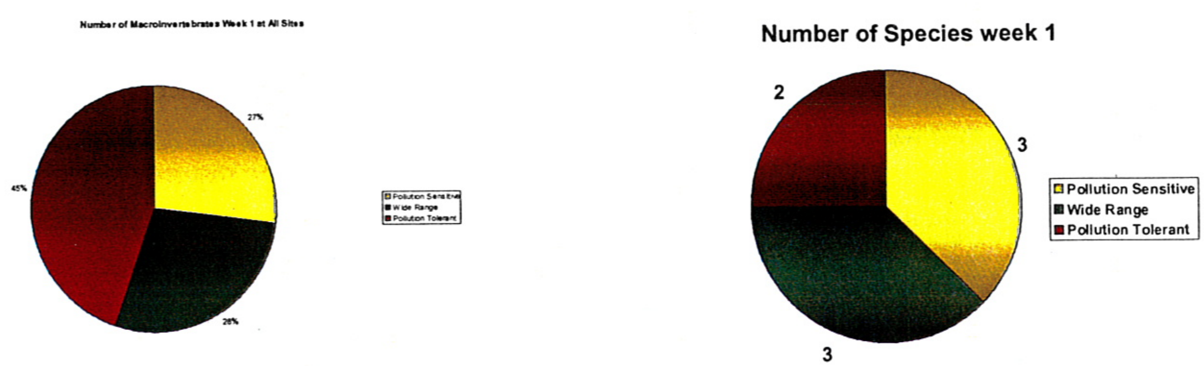
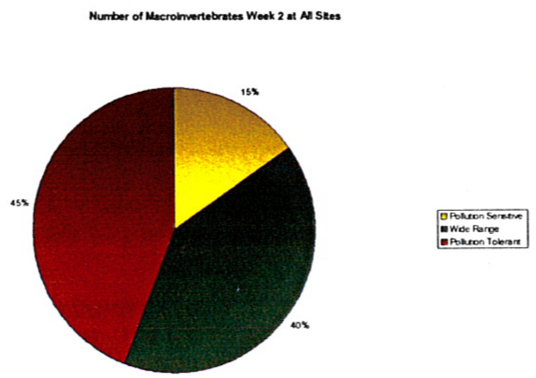


Figure 3: Species and Individuals Found Week 2



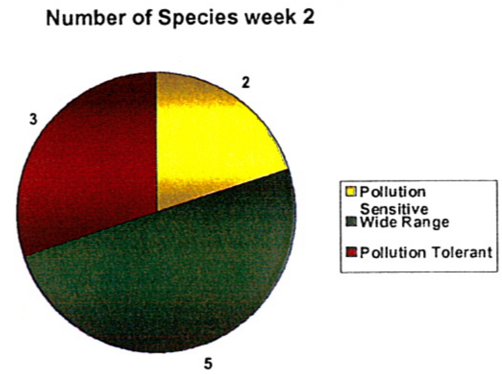
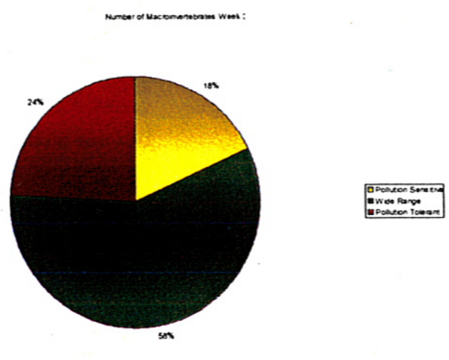
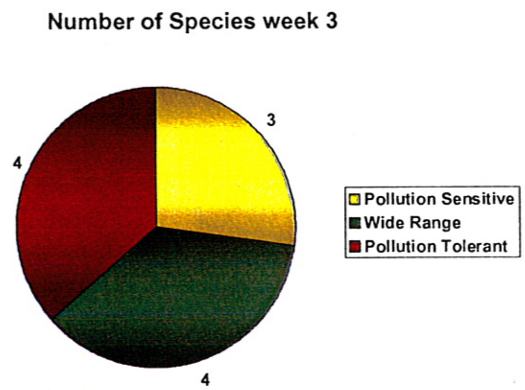


Figure 4: Species and Individuals Found Week 3





Conclusions and Recommendations

Overall, based on the data from the results found, this is a relatively healthy ecosystem. Most of the macroinvertebrates found in Loon Pond were either pollution sensitive or wide range. The only area of the pond that has the poorest water quality is the southern region. We recommend to the city to focus on the southern shoreline in its' clean up efforts.

Acknowledgements

The bulk of the research for this project was taken from the Riparian and Aquatic Ecosystem Monitoring: A Manual of Field and Lab Procedures. 4th Edition, 2003. Student Watershed Research Project

9th Grade SELS Students

These students participated in the data collection and the writing of the report.

Michael Allende
Henry Alston
Sayeh Azizi-Bonakdar
Jacob Bates
Victor Battistini
Robert Belbin
Alexa Brunton
Chad Buntin
Gabriel Cartegena
Sara Carter
Danielle Cassista
Laura Chavez
Natalia Cintron-Alejandrino
Brianna Cortes
Shawn Daniels
Medalie Davila
Kenneth Dearborn
Joey Demaria
Lena Diaz
Melissa Dorn
Ashley Dutton
Antonio Flores
Tayana Flores
Aidan Garcia
Tim Garner
Richaud Garvin
Ana Gonzalez
Amanda Greaves
Stephanie Guzman
Stephanie Halgas
Alana Hans-Bodden
Natalia Henry
Robert Hernandez
Dawn Holland
Ben Jacques
Terrell James
Yolanda James
Jelissa Jefferson
Rosalba Jimenez
Julian Jiminian
Rodcliff Jones
Keturah Joseph-Morgan
Mike Kazalis
Hillary Kos
Alex Lamarche
Andrew Lambert
Chris Larson
Jennifer Lee
Andrew Lopera
Brittain Lea
Ruth Lopez
Avery MacGregor
Haley Mack
David Markham
Maria Martinez
Mercedes Martinez
Nick Martinez
Shaun McCaffrey
Celso Melendez-Vazquez
Dashay Miles
Laurien Miles
Remey Murchison-Brown
Christa Nilsen
Travis Norrington
Brianne Nurse
Tito Olmeda
Angelina Ortiz
Yashira Ortiz
Yoselin Osuba
Anthony Parmer
Arbellio Ramos
Yajaira Ramos
Rebecca Peloquin
Manuela Perez
Arbellio Ramos
Yajaira Ramos
Kathleen Rivard
Mike Rodgers
Francesca Rodriguez
Jazmin Rodriquez
Lenin Rodriguez
Talia Rodriguez
Merry Rosa
Joe Ryan
Carlina Santana
Bethany Santiago
Brittany Santiago
Angel Serrano
Zainab Shakil
Breahn Talbert
Cody Tatro
Anthony Thomas
Jessica Torres
Bianca Vazquez
Steven Villanueva
William Wanczyk
Matthew Warren
Cameron White
Malachi Woods