The Effect of Multiple Days of Water Sampling on the Amount of Chemicals Causing Pollution

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Introduction

This investigation studied the effects that certain chemicals may have on a natural water source. In today's world, a lot of the Earth's natural bodies of water have been polluted due to rain washing chemicals into water sources. This can be determined by testing a suspected body of water over a period of time to see if they have high volumes of specific chemicals. Chemicals that frequently pollute water sources include nitrates, nitrites, and phosphates. These chemicals usually appear in water when humans add, fertilizer for example, to a particular area. The rain washes the chemicals in the fertilizer into the soil which seeps into a large water source such as a pond, lake, or river. These chemicals can affect the dissolved oxygen of the water. Dissolved oxygen is what underwater plants and animals need in order to thrive in their environment. Without a sufficient amount of dissolved oxygen, the plants and underwater wild life will eventually die. These chemicals could also cause an algae bloom, which grows on the very surface of the water. An algae bloom also prevents dissolved oxygen from coming in the water and blocks the sunlight from plants that may be on the bottom of the water source. The purpose of this investigation is to determine whether the Cove River is polluted or not. Throughout the school year, once a month from September to April, water was sampled from a downstream site of the Cove River in West Haven, Connecticut. The water was then tested for temperature, pH, high range pH, ammonia, nitrates, nitrites, phosphates, dissolved oxygen, and conductivity.

Hypothesis Statement:

If the Cove River is polluted, then there will be excess amounts of phosphates, nitrates, and nitrites because these chemicals are the result of man-made objects such as fertilizers which cause an algae bloom. This algae bloom causes a significant drop in the dissolved oxygen in water, and can terminate any other life forms living in it.

IV: Multiple Days of Water Sampling

DV: Amount of Chemicals Causing Pollution

Materials

- Thermometer
- Fresh Water Master Test Kit
- Vernier Probe-ware
- Phosphate Test Kit

- Bucket
- Water Sampling Container

Procedures

(For each day of collecting data)

1. Gather Materials
2. Walk to the testing site
3. Use to bucket to gather the water
4. Put the thermometer in the water immediately
5. Record temperature in degrees Celsius immediately
6. Use Vernier Probe-ware to test for dissolved oxygen and conductivity immediately
7. Record probe-ware readings
8. Place some water from the bucket and place it in the water sampling container
9. Take container back to the lab
10. Use Fresh Water Master Test Kit to test for pH, high range pH, nitrate, nitrite, and ammonia
11. Record test results
12. Use Phosphate Test Kit to test for phosphates
13. Record test results
14. Dispose of the tested water samples by handing them to the person in charge of disposing of chemicals
15. Clean up the lab station

Observations

September 30, 2011

Last night there was ample rainfall. However, today it is sunny and clear, but a little hazy. The leaves have not changed yet, and the canopy is full. There was a hurricane that hit in late August that could affect the canopy.

October 21, 2011

Today is beautiful with five to ten percent cloud coverage. The clouds are mixed white d grey cumulus clouds. The temperature outside is 14.7°C and very windy.

November 18, 2011

The temperature outside is 10°C. It rained a little bit last night, but today it is sunny and there are no clouds. There are few leaves on the trees. The leaves are not "pretty colors" most likely due to the fact the hurricane was blowing the sea salt in the air.

December 9, 2011

There are hazy clouds in the sky covering approximately 50% of the sky. The temperature outside is 6°C.

January 20, 2012

It is sunny, but very cold. There are no clouds in the sky. The outside temperature is -1°C. The ground is dusted in snow.

February 17, 2012

Cloud coverage is approximately 60% with all types of clouds at different heights, but it is still sunny. It rained last night and this morning. The outside temperature is 12°C and there is no canopy cover

March 30, 2012

It is sunny today with no clouds in the sky. It is relati9vely warm and last week the trees started to bud. We did not take a water sample because we did not have the probe-ware.

Date	Temp. °C	pH	High range pH	Ammonia (ppm)	Nitrate (ppm)	Nitrite (ppm)	Phosphates (ppm)	Dissolved Oxygen (mg/L)	Conductivity
9/30/11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10/21/11	14.4	6.4	7.6	0.5	5.0	0.0	0.0	2.6	302.2
11/18/11	9	6.6	7.6	0.35	2.5	0.0	N/A	-12.9	N/A
12/9/11	7	7.2	N/A	0.5	0.0	0.25	0.0	8.5	N/A
1/20/12	1.2	6.6	7.4	0.5	0.25	0.2	0.0	8	N/A
2/17/12	6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/30/12	N/A	N/A	N/A	N/A	0.0	N/A	N/A	N/A	N/A

Conclusion

This investigation did not support the hypothesis, if the Cove River is polluted, then there will be excess amounts of phosphates, nitrates, and nitrites because these chemicals are the result of man-made objects such as fertilizers which cause an algae bloom. The data showed the pH stayed relatively the same over the period of time. This is an indicator that there was no acid rain affecting the river. The nitrate reading fluctuated from 5ppm on October 21 to 0ppm on March 30. The data also revealed there were no phosphates or Nitrites in the Cove River. This shows that the Cove River has not been exposed to anytime of run-off which could have occurred from humans interfering with the environment. The dissolved oxygen levels seemed to fluctuate as the weather become cold, but the readings were not peculiar. All in all, the data shows that the Cove River is not polluted. West Haven, Connecticut has not been using any fertilizers or other chemicals that have ended up in the river. It has been shown that the Cove River is healthy and teeming with life. In order to improve this investigation, one should continue to observe this site within the following years since it has only been followed once a month for the past six months. Another way to improve this investigation would be to

test multiple times a month, and after specific weather patterns. For example, say testing after a snow storm, a rain storm, and when it has been sunny and hot for an extended period of time.

Error Analysis

Random Error

Random errors may have occurred due to an inaccurate reading of instruments such as the thermometer. Another source of random error is the fact that the water sample was taken in a bucket to the probe-ware. During this time, the temperature could have changed causing the dissolved oxygen to fluctuate, and showing an inaccurate reading. Random error could have also occurred while testing for ammonia, pH, high range pH, nitrates, nitrites, and phosphates. These chemicals were determined by a kit where drops of solution were added to small samples of the water, then the color was matched to the card. This would cause error because the color of the sample may not have exactly been the color on the card

Systematic Error

All of the probe-ware may not have been 100% accurate For example, the equipment used to calculate dissolved oxygen in the water may not have given an exact reading due to the calibrating of the instrument.

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GLOBE Rough Draft Lab Report
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The Effect of the Presence of Eutrophication on the Water Quality of the Cove River

Introduction/Abstract:

The objective of this research is to determine if the Connecticut Cove River is being effected by Eutrophication. Eutrophication is excessive richness of nutrients in a lake or other body of water, frequently due to runoff from the land, which causes a dense growth of plant life (Nastopoulos). "The excessive amount of nutrients favors the growth of algae [also known as phytoplankton]" leading to algal blooms which have many adverse effects on the water (Vijayvergia). The effects of Eutrophication, overall, include the increased biomass of phytoplankton, toxic or inedible phytoplankton species, decreases in water transparency (increased turbidity), and water treatment problems (Vijayvergia). Further consequences of eutrophication are fish mortality because of the dissolved oxygen depletion, blue green coloration because of the algae surface, foul odor, mosquito production, and decrease in recreational values, according to previous international studies (Vijayvergia).

Slow moving rivers, such as the Cove River, are most susceptible to algal blooms, great increases of phytoplankton in a water body ("Algal"). Phosphate or nitrate compounds can cause algal bloom, which, in turn, causes dissolved oxygen depletion as large numbers of dead algae decay ("Water"). The three key effects of the alga bloom are that: floating algae mass can serve as physical barrier to oxygen between atmosphere and water, it can prevent light penetration to oxygen producing algae living below the water surface, and aerobic bacteria can use up the remaining dissolved oxygen in water while decomposing the large mass of dead algae ("Algal"). This eutrophication can, thus, cause the water to be hypoxic, contain severe oxygen depletion, which can cause fish and other marine animals to suffocate (Smith). Algal bloom can also cause odor and unattractive appearance, such as murkiness, in the water body (Vijayvergia).

Blooms of toxic species of algae, for example cyanobacteria, accumulate and form scum on the surface and close to the shore of the body of water ("Algal"). These toxic species produce bio-toxins which can cause gastroenteritis, if toxin is ingested, and lung irritation, if toxin becomes aerosolized and hence airborne ("Algal"). If animals consume these bio-toxins caused by the algal bloom, it could cause them death because of the toxicity as well ("Algal").

Runoff from agriculture and development, pollution from septic systems and sewers, and other human-related activities increase the flow of both inorganic nutrients and organic substances into ecosystems (Nastopoulos). Eutrophication can be caused by soil retention of nutrients from human activities that run off eventually into the water, nitrogen removed through storm drains and sewage runs-off, and the combustion of fossil fuels which contribute to atmospheric nitrogen pollution (Nastopoulos). All of these activities cause the release of excess nutrients into the water, thus allowing the algae to thrive.

54% of water bodies in Asia, 53% in Europe, 48% in North America, 41% in South America, and 28% in Africa are eutrophic bodies of water (Vijayvergia). This clearly demonstrates that this is an international issue and we are extremely interested in how West Haven ranks with these statistics. Eutrophication can greatly impact the town if not detected and addressed. The fish mortality can affect fishing in the river, the bio-toxins that can be produced

can harm humans and animals, and the pollution can cause changes in the river that make it an unattractive recreational place.

"The excessive amount of nutrients in the water bodies along with higher temperature favors the growth of algae and aquatic weeds" (Vijayvergia). Low turbidity, how clear the water also indicates the formation of algae on the surface of the water as a result of algal bloom (Vijayvergia). More than a 100ppm measure of TDS, total dissolved solids, indicates eutrophication (Vijayvergia). However, as a substitution for the measure of TDS in this experiment conductivity of the water which has a direct relation to TDS will be measured. A conductivity from 200-2000 microSiemens/cm indicates no eutrophication, while any measure above that does. pH can increase the solubility of phosphates which contributes to the excessive nutrients that cause the algal bloom (Vijayvergia). Therefore, in healthy water the pH is near 7, in a eutrophic river the pH can be expected to be more acidic, so below 7pH. Also high water temperatures favor algal blooms.

The dissolved oxygen (DO) in the river water is an important factor to measure because low concentrations of dissolved oxygen indicate algal blooms which result in DO depletions (Vijayvergia). Nitrates and phosphate levels are also important in eutrophication research. If their concentrations surpass the regular concentrations they are supposed to have, 1ppm to 4ppm for nitrates and .04ppm to .2ppm for phosphates, then this is a direct indication of eutrophication, since phosphorus along with nitrogen cause explosive growth of algal species that lead to eutrophication ("Methods").

Water coloration, odor of water, and mosquito production are consequences of eutrophication that prove its existence. The fish mortality rates are also eutrophication indications. Eutrophication contributes to fish mortality because of the lack of dissolved oxygen available for the fish, it can cause the release of serious bio-toxins that can cause very harmful health problems, such as gastroenteritis and lung irritation, and even animal mortality through the consummation of the water. With this experiment we can determine the actions that need to be taken to secure the environmental integrity of the river.

Problem Statement:

In this research, I will measure the levels of turbidity, temperature, conductivity, DO, nitrates, and phosphates. This will be by using Vernier probeware, API aquarium pharmaceuticals freshwater master test kit, and thermometers.

The independent variable is the water quality of the Cove River. The dependent variables are water temperature, total dissolved solids, transparency, chloride levels, pH, dissolved oxygen levels, and nitrate and phosphate levels, water coloration, fish mortality, odor of water, and mosquito production.

The hypothesis is: If the West Haven Cove River is tested, then it will not show the presence of eutrophication, because it will lack factors that according to past research and the Environmental Protection Agency (including the reasons previously stated) lead to eutrophication such as high water temperatures, low turbidity, conductivity over 200-

2000mS/cm, low pH, low concentration of dissolved oxygen, high amounts of nitrates and phosphates, a blue green coloration of the water, a foul odor, and mosquito production changes.

Materials:
API Aquarium Pharmaceuticals Freshwater Master Test Kit
API Aquarium Pharmaceuticals Freshwater Phosphate Test Kit
Vernier Probeware
Thermometer
Test Tubes
Pipettes
Safety Goggles
Lab Apron
Cove River Monthly Water Samples
Bucket tied to rope
Medium water containers

Procedure:
1. Head down to the CT Cove River and find a location downstream from which a water sample can be taken.
2. Make note in a table of the water turbidity, any mosquito production, the water color, odor and any other environmental observations.
3. Put on goggles and lab apron for safety
4. Submerge the bucket tied to rope into the river water and pull up the bucket now filled with water.
5. Quickly use the Vernier probeware to get measures of the DO of the water, conductivity of the water, and the temperature (also using the thermometer). It is important to do so quickly because DO levels change as the water gets warmer in the bucket due to it adjusting to the atmospheric temperature.
6. Place samples of water into medium containers to take back to the laboratory.
7. Once in the laboratory, follow the instructions of the API Aquarium Pharmaceuticals Freshwater Master Test Kit and the Phosphate Test Kit to determine the levels of nitrates, nitrites, phosphate, and pH. Copy all results onto a data table.
8. Dispose of the water safely and clean up all of the testing kits.

Observations/Results:

During this research, I observed that the water was very clear. I also observed that there was one instance of marine life in the form of a tadpole in the winter of 2011. Moreover, I observed no foul odor coming from the water. There were no mosquitoes present at the time of any of our research days. There was always minimal cloud cover and when it had rained the day

before the pH still managed to remain constant from 6-7pH. The water is not necessarily clean but it is not a blue-green color and showed no algal blooms on the surface.

Data Tables:

DATE	Water Temperature (ºC)
2008, 10/10	14.2
2008, 11/07	12.6
2009, 02/13	2.6
2009, 05/08	15.2
2009, 10/02	12.7
2009, 11/20	13.2
2010, 02/02	1.5
2010, 05/07	14.5
2010, 06/07	17.3
2011, 02/04	3.4
2011, 05/06	11.8
2011, 10/21	14.5
2011, 11/18	9.2
2011, 12/09	7.0
2012, 01/20	1.1
2012, 02/17	6.0

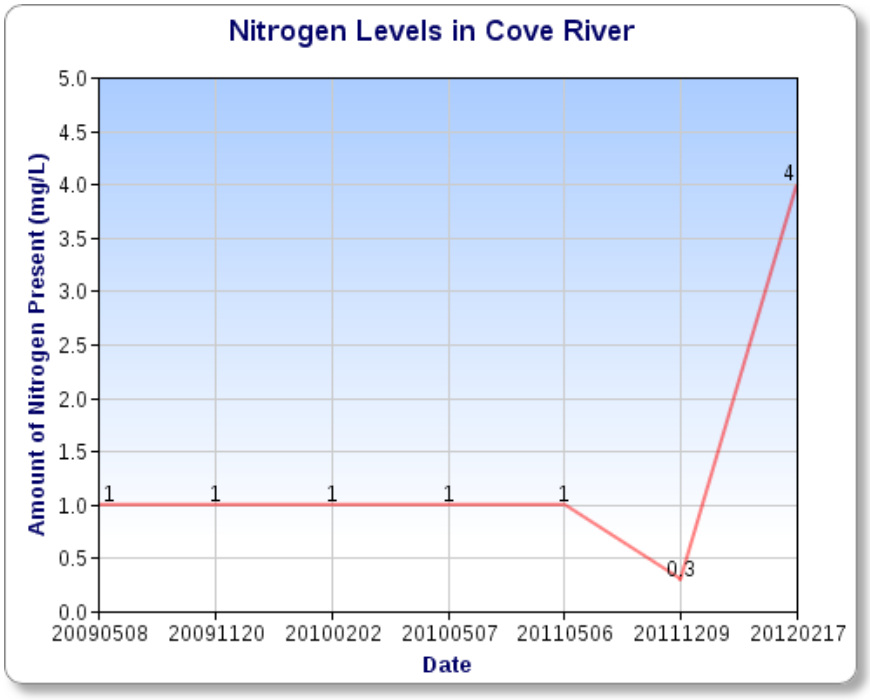
DATE	Water pH
2008, 10/10	6.5
2008, 11/07	6.5
2009, 02/13	6.1
2009, 05/08	6.0
2009, 10/02	6.7
2009, 11/20	8.3
2010, 02/02	6.1
2010, 05/07	7.5
2010, 06/07	7.3
2011, 02/04	6.8
2011, 05/06	6.5
2011, 09/30	6.5
2011, 10/21	6.3
2011, 11/18	7.1
2011, 12/09	7.2
2012, 01/20	7.1
2012, 02/17	7.4

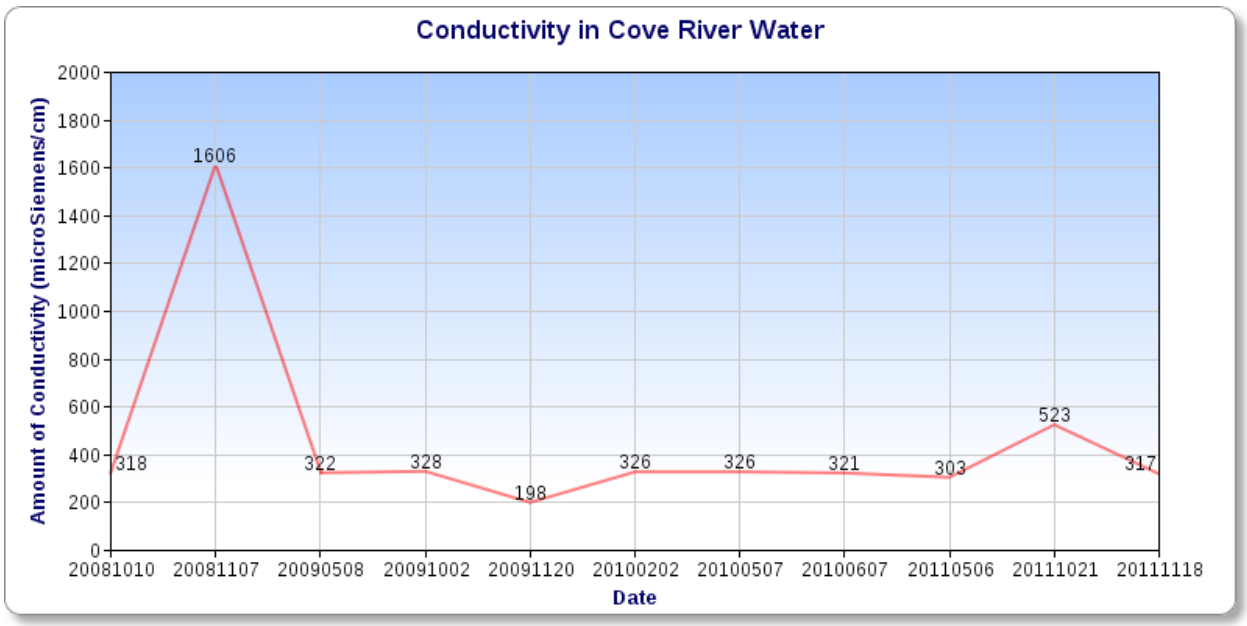
DATE	Total Nitrogen (mg/L)	Nitrite	Nitrate
2009, 05/08	1.0	-	1.0
2009, 10/02	-	1.0	-
2009, 11/20	1.0	-	1.0
2010, 02/02	1.0	-	1.0
2010, 05/07	1.0	-	1.0
2011, 05/06	1.0	-	1.0
2011, 12/09	0.3	-	0.3
2012, 02/17	4.0	-	4.0

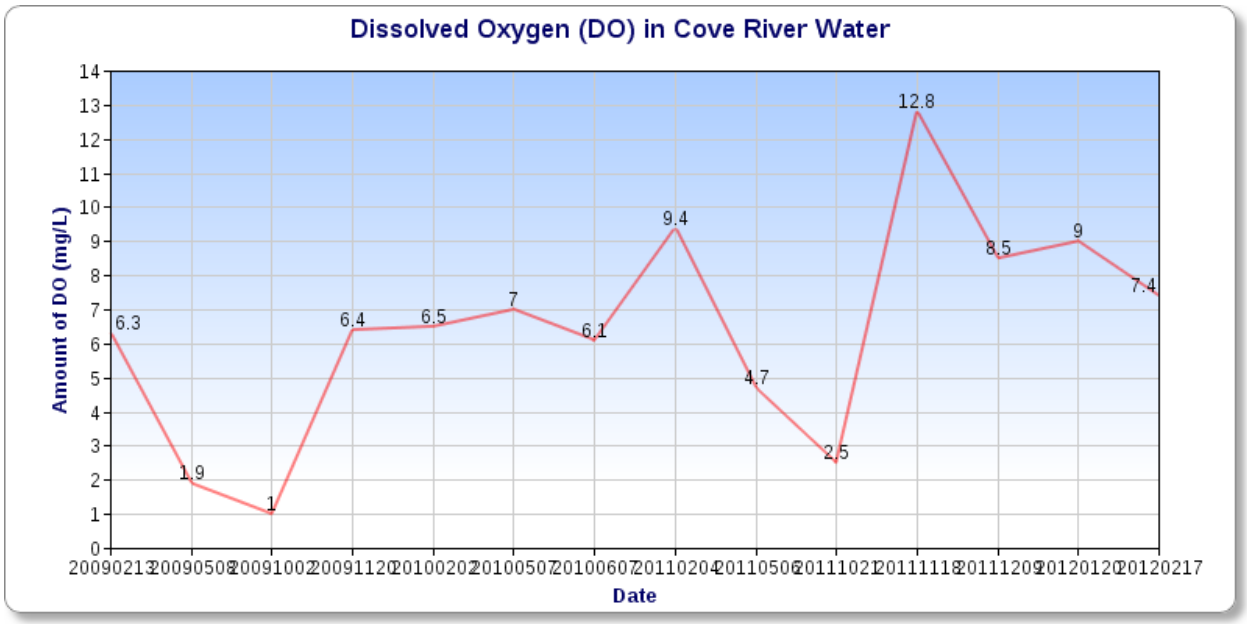
DATE	Dissolved Oxygen (mg/L)
2009, 02/13	6.3
2009, 05/08	1.9
2009, 10/02	1.0
2009, 11/20	6.4
2010, 02/02	6.5
2010, 05/07	7.0
2010, 06/07	6.1
2011, 02/04	9.4
2011, 05/06	4.7
2011, 10/21	2.5
2011, 11/18	12.8
2011, 12/09	8.5
2012, 01/20	9.0
2012, 02/17	7.4

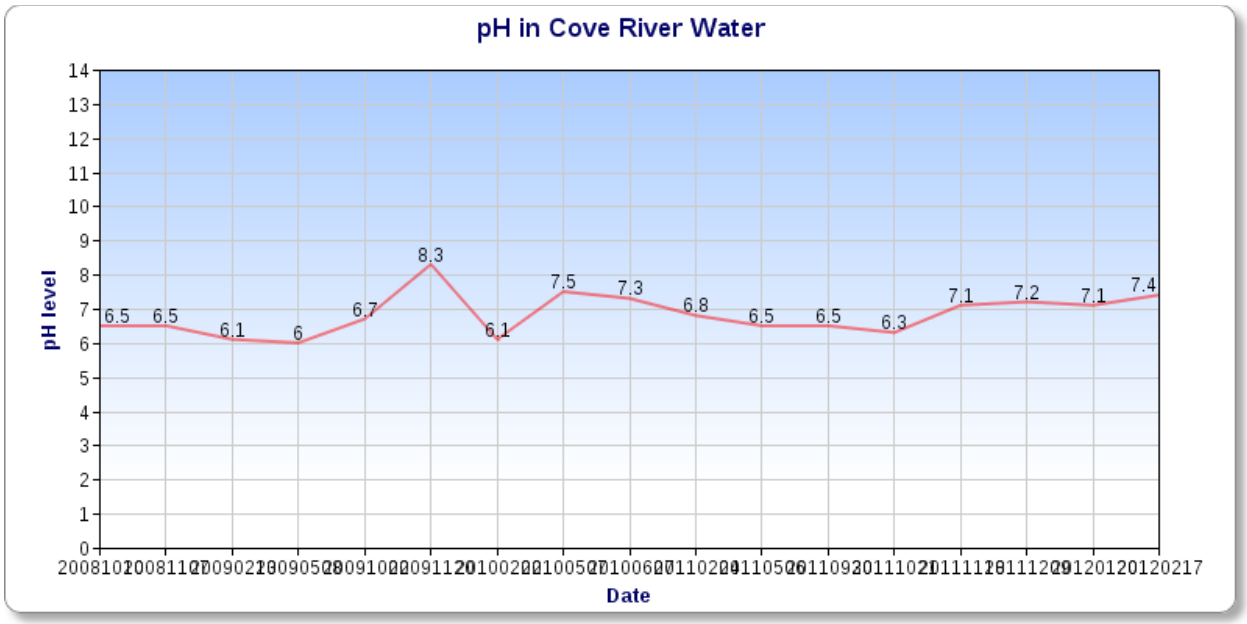
DATE	Water Conductivity (microSiemens/cm)
2008, 10/10	318
2008, 11/07	1606
2009, 05/08	322
2009, 10/02	328
2009, 11/20	198
2010, 02/02	326
2010, 05/07	326
2010, 06/07	321
2011, 05/06	303
2011, 10/21	523
2011, 11/18	317

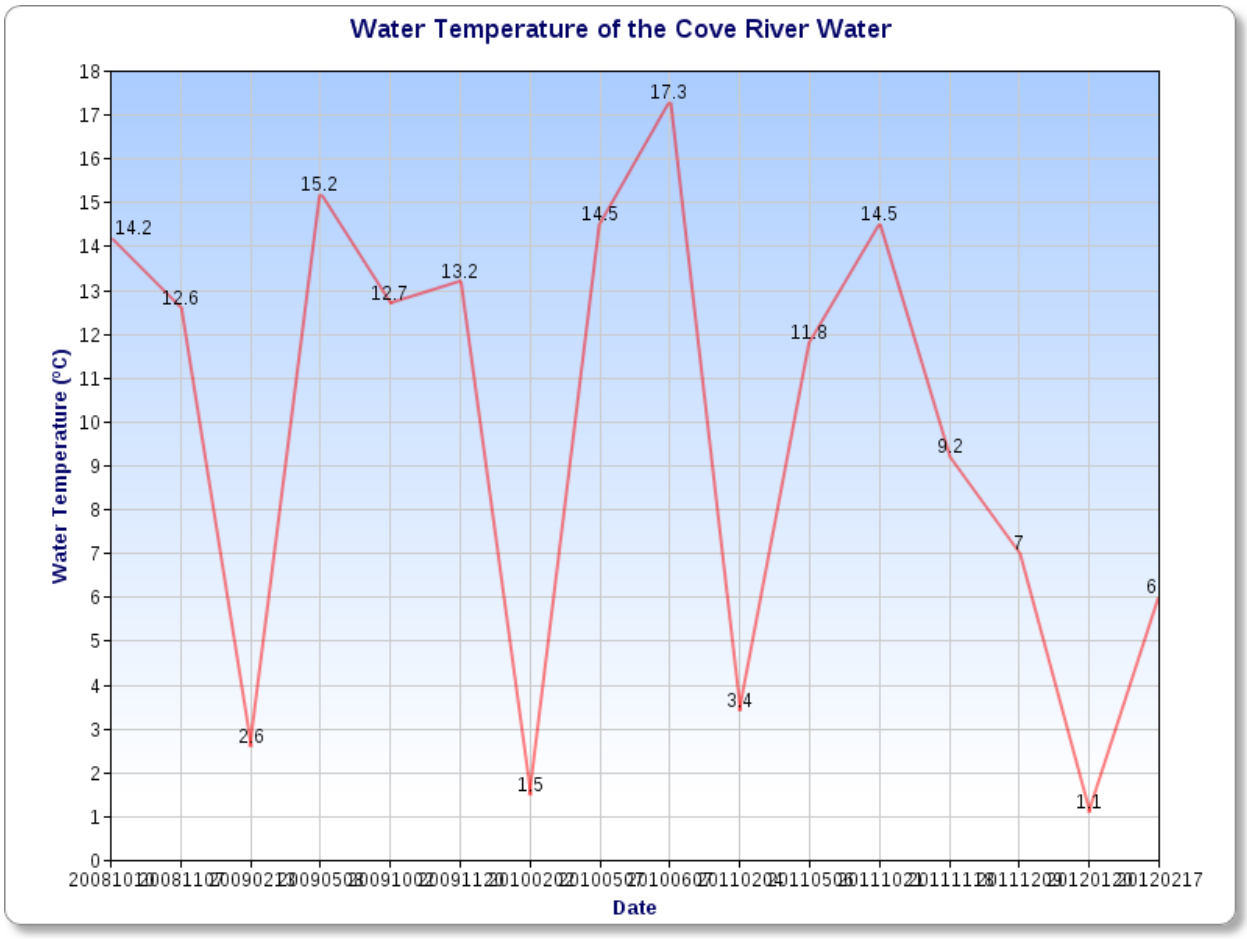
Graphs:


Nitrogen Levels in Cove River
Amount of Nitrogen Present (mg/L)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
1
1
1
1
0.3
4
20090508
20091120
20100202
20100507
20110506
20111209
20120217
Date


Conductivity in Cove River Water
Amount of Conductivity (microSiemens/cm)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
318
1606
322
328
198
326
326
321
303
523
317
20081010
20081107
20090508
20091002
20091120
20100202
20100507
20100607
20110506
20111021
20111118
Date


Dissolved Oxygen (DO) in Cove River Water
Amount of DO (mg/L)
Date
6.3
1.9
1
6.4
6.5
7
6.1
9.4
4.7
2.5
12.8
8.5
9
7.4


pH in Cove River Water
pH level
Date
6.5
6.5
6.1
6
6.7
8.3
6.1
7.5
7.3
6.8
6.5
6.5
6.3
7.1
7.2
7.1
7.4



Data Analysis: This data shows that the temperature ranged from 17.3°C to 1.1°C. Also, the pH ranged from 6.0 to 8.3pH. The total nitrogen levels were consistently 1mg/L except for two times when it was at .3 and 4mg/L; these are both extraneous data points. 12.8 to 1.0mg/L was the range for DO in the water, thus indicating both the high and low presence of DO. 198-1606microSiemens/cm was the range for water conductivity, with a main constant of the 300microSiemens/cm range, with even 326microSiemens/cm appearing twice in February and May of 2010.

Conclusion:

Based on the data in the experiment, the hypothesis predicting if the West Haven Cove River is tested, then it will not show the presence of eutrophication, because it will lack factors that according to past research and the Environmental Protection Agency (including the reasons previously stated) lead to eutrophication such as high water temperatures, low turbidity, conductivity over 200-2000mS/cm, low pH, low concentration of dissolved oxygen, high amounts of nitrates and phosphates, a blue green coloration of the water, a foul odor, and mosquito production changes was supported.

There were little low DO levels that would signify eutrophication. Only three days showed low DO levels at 1.9mg/L, 1.0mg/L, and 4.7mg/L in May 2009, October 2009, and May 1012, respectively. These are only three dates out of 14 days. All of the other days show a consistent 6.3 to 7.4mg/L DO range, which is high and healthy. Furthermore, water conductivity is well within the non-eutrophicated water standards of 200-2000microSiemens/cm with conductivity levels ranging from 318-1606microSiemens/cm. However, there is one instance when the water conductivity level was at 198microSiemens/cm on November 20, 2009, yet this is not enough to prove that eutrophication is present in the Cove River. All water temperatures taken are well below 25°C, with the highest temperature being 17.3°C, therefore there are no high temperatures that can contribute to the algal blooms that lead to eutrophication. pH did have some indication of eutrophication with 6.0pH levels in 2008 and 2011 (May-October). Acidic pH levels indicate eutrophication, but because 6.0pH is close to 7.0pH, which is the healthy pH for water, there is really no substantial evidence to say that there is eutrophication. Nitrite and nitrate levels were all within the 1-4mg/L limit which indicates that there is no access of nitrites and nitrates, thereby not allowing an algal bloom to develop. Overall, through observations it was determined that there was no change in mosquito production and that there is a moderate transparency level. There is also no foul odor present and the water color appear to be a clear color that is not blue-green.

There are many different types of sources of error in this experiment. One source of error is that the water DO levels were not always measured right after the water sample was taken from the river and because the DO levels change as the water gets warmer in the bucket, the DO levels may not have been entirely accurate. Furthermore, another source of error in the data is that the GLOBE website does not allow extreme data divergences to be entered therefore some of the data that could have indicated eutrophication can be missing. This is something the GLOBE website should work on fixing, so that all data is accurate.

Overall, the results in the experiment were accurate because the results are consistently within the same range of each other. For example, for pH the data consistently shows the 6.0 range, which shows that there is a large probability that the data for these dates is accurate.

This research can be improved by contacting other organizations that are doing similar research in other areas such as the University of Maryland and getting some feedback on how they are conducting their research and their findings. Furthermore, this data can be improved if the GLOBE website would allow more range on the data entry so that all data can be entered.

This research can be expanded on through the addition of research on soil profiles such as the pH of the soil, which can allow us to know whether or not there is soil contamination (phosphates and nitrates excess from fertilizer) that can potentially lead to eutrophication. This soil research is especially important because there is a leaking oil tank underground that is located at a nearby gas station. Furthermore, the obtaining of levels of phosphates more readily and the observation of marine life could better help determine if eutrophication is present and if there are any effects of eutrophication, such as the dying of marine life, present.

This relates back to AP Biology because when we learned about ecology we touched upon algal blooms that can block sunlight to plants and decrease photosynthesis in those plants causing them to die. This is exactly what eutrophication leads to and being able to apply this concept to hands-on work is extremely beneficial to understanding it.

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