Testing for Low Levels of Dissolved Oxygen in Upper City Lake

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Abstract

After observing a decrease in aquatic plant life in Upper City Lake we decided to run several tests to investigate what could have caused it. When comparing GLOBE data from the spring of 2016 and our own from the spring of 2017, we had noticed a dramatic decrease in the amount of dissolved oxygen in the water. Intrigued, we continued to tested the lake and did some outside research on what could cause dissolved oxygen levels to fluctuate. We discovered that the decrease in the amount of hydrilla we observed, rainfall, and air temperatures were some common factors that could cause the levels of dissolved oxygen in water to change. By gathering data on local rainfall and temperature from the spring of 2016 and 2017 we found that the rainfall and air temperature did have a slight correlation to the decreasing dissolved oxygen levels of the water. However, due to their little effect, we were able to rule them out as the major factors contributing to the decreasing dissolved oxygen levels in the lake. More tests should be conducted to understand why the hydrilla is dying and why the levels of dissolved oxygen in the water are decreasing.

Research Question

Upper City Lake, a commonly used recreational lake in Palestine Texas, appeared to be in a healthy state; however, after noticing a dramatic decrease in aquatic plant life we got concerned for the lake's health. We decided to investigate further by comparing past GLOBE data from spring of 2016 and the spring of 2017 to see what could have caused this. According to the data gathered this year and last, the levels of dissolved oxygen in the water have drastically decreased. This made us wonder. Why have dissolved oxygen levels in the lake decreased in the past two years and what other factors of the lake could this phenomenon affect?

Hypothesis

Based on the data collected in spring of 2016 and 2017, as well as our own observation of the lake, we hypothesise that the levels of dissolved oxygen could be decreasing due to rainfall, the loss of aquatic plants, a fluctuation in air temperature, or even the amount of nitrates present in the water. In order to find this out we can gather information on local rainfall and temperatures from the spring of 2016 and spring of 2017 to see if there is a correlation between them and the lowering dissolved O2 levels in the water.

Investigation Plan

Our plan for investigating the cause for the decrease of dissolved oxygen in the water.

1. Test the water at a given location in Upper City Lake for dissolved oxygen once a week for three weeks in both March and April.

2. Find the average dissolved oxygen levels collected each month in the spring of 2016 as well as the spring of 2017.
3. Compare and analyze the average levels of dissolved oxygen data from both years
4. Research what factors cause dissolved oxygen levels to fluctuate and apply this knowledge to other data gathered and look for a comparison.

Research Methods

Testing water for dissolved oxygen:

1. Collect water in water sampling bottle (make sure not to grab surface water)
2. Add 8 drops of both Manganous Sulfate solution(4167) and Alkaline potassium Iodide Azide(7166).
3. Cap the bottle and mix it by inverting the bottle.
4. Let the precipitate settle below the shoulder of the bottle.
5. Add 8 drops of Sulfuric Acid, 1:1 (6141 WT)
6. Cap the bottle and invert gently until dissolved
7. Fill titration tube (0608) to 20 ml line with the fixed solution from the sample bottle.
8. Collect Sodium Thiosulfate 0.025N (4169) in plunger and fill to 0 ml line (if the fixed solution is already a pale yellow, skip step 9)
9. Depress plunger (0377) slowly into titration tube and gently swirl until the liquid is a pale yellow
10. Add 8 drops of the Starch Indicator Solution(4170WT)
11. Continue depressing plunger until liquid turns clear
12. Read the scale on the side of the titrator barrel and find what number the large ring on the plunger reaches.
13. Record as ppm Dissolved Oxygen

Additional Research Information

From further research we discovered that there are many factors that could lead to a large decrease in dissolved oxygen. The main factors being temperature, a decrease in photosynthesis, and decomposition of plants in the water. Cold water holds higher concentrations of dissolved oxygen; therefore, as the water temperature increases the dissolved oxygen levels decrease. Additionally, aquatic plants are big contributors of dissolved oxygen as they photosynthesize and release oxygen into the water. However, when those plants die and decompose they remove oxygen from the water in a process known as Carbonaceous Biochemical Oxygen Demand (CBOD).

Data

Spring 2016

Spring 2017

Date	Average Dissolved O2
April of 2016	11.26ppm
March of 2017	7.16ppm
April of 2017	5.95ppm

Table 1

Date	Dissolved O2
4/4/16	8.1ppm
04/12/16	12.9ppm
04/19/16	12.8ppm
3/3/17	7.1ppm
3/27/17	7.3ppm
3/31/17	7.1ppm
4/12/17	6.1ppm
4/19/17	5.8ppm

Table 2

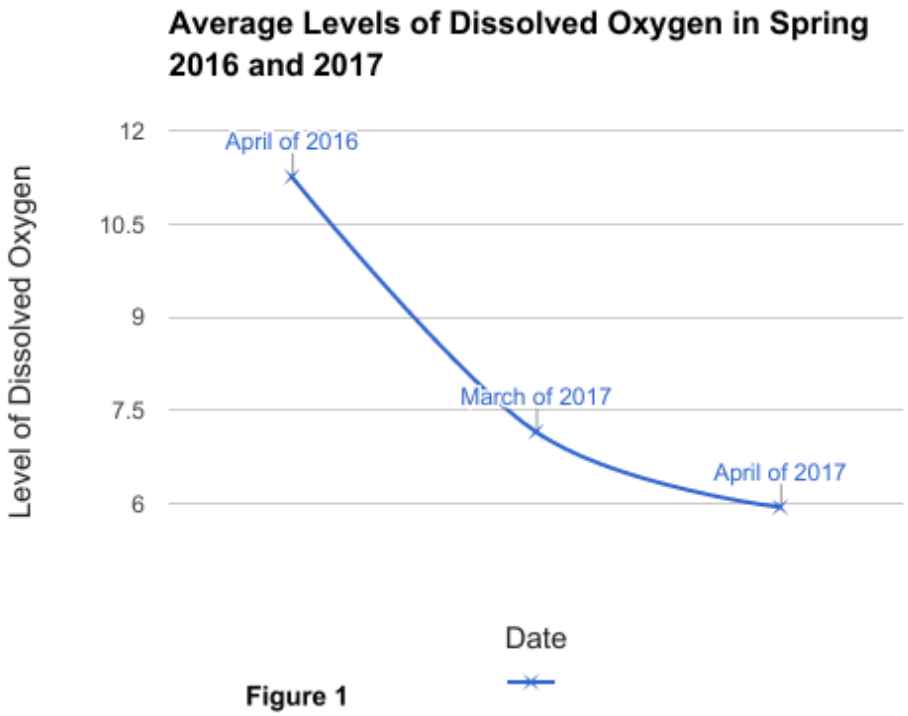

Figure 1

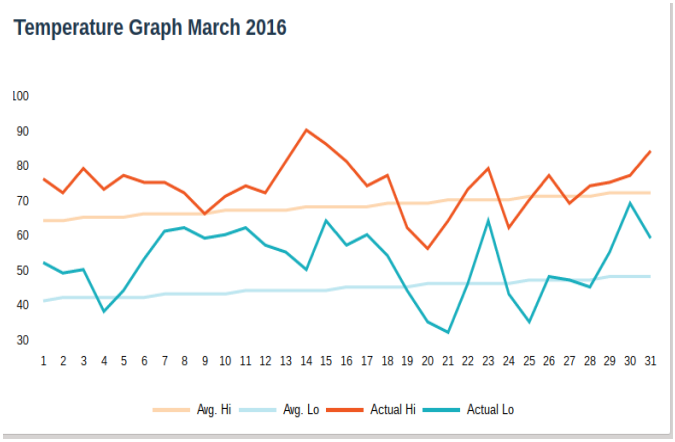

Figure 2

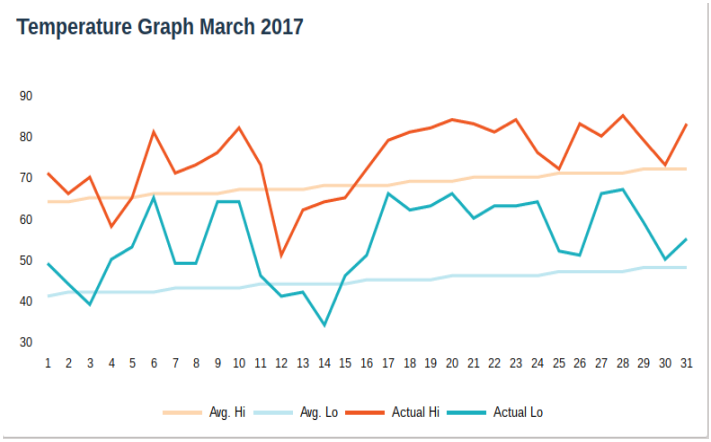

Figure 3

Palestine, TX. (n.d.). Retrieved April 28, 2017, from http://www.accuweather.com/en/us/palestine-tx/75801/march-weather/335927?monyr=3%2F1%2F2016

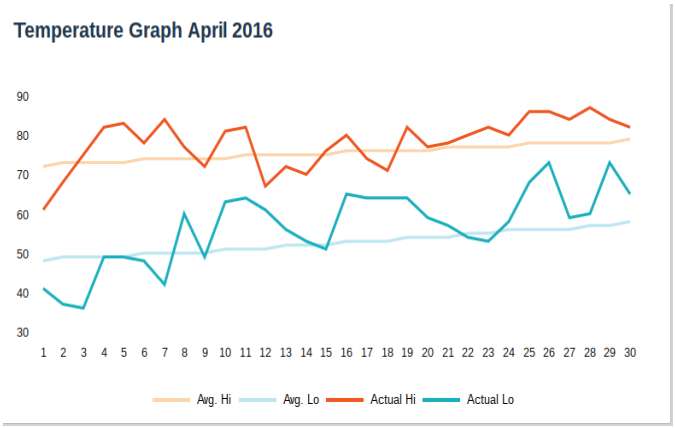

Figure 4

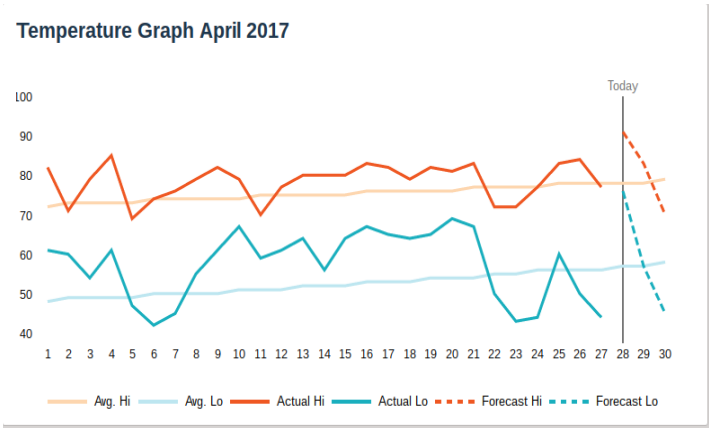

Figure 5

Palestine, TX. (n.d.). Retrieved April 28, 2017, from http://www.accuweather.com/en/us/palestine-tx/75801/march-weather/335927?monyr=3%2F1%2F2016

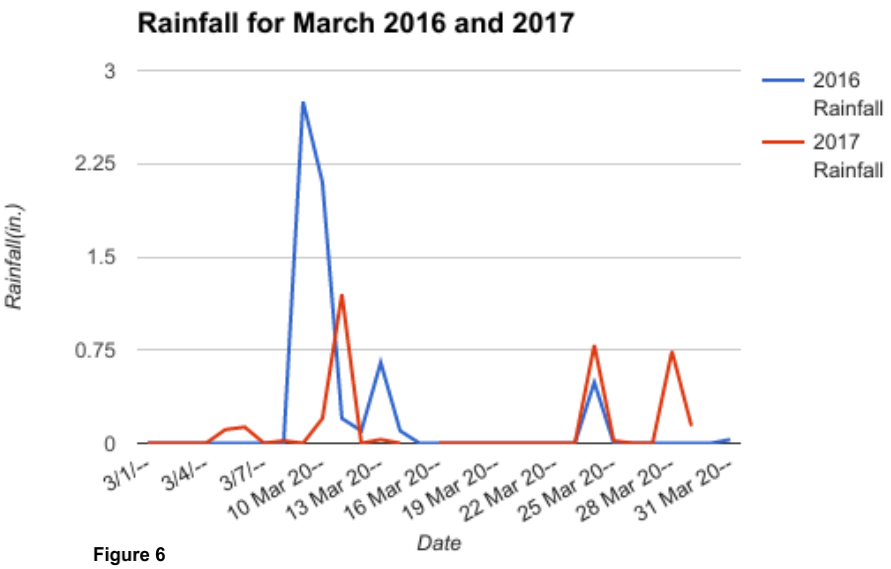

Figure 6

Date	2016 Rainfall	2017 Rainfall
3/4/--	0	0
3/5/--	0	0.11
3/6/--	0	0.13
3/7/--	0	0
3/8/--	0	0.02
3/9/--	2.75	0
10 Mar 20--	2.1	0.2
11 Mar 20--	0.2	1.2
12 Mar 20--	0.1	0
13 Mar 20--	0.65	0.03
14 Mar 20--	0.1	0
15 Mar 20--	0	-
16 Mar 20--	0	0
17 Mar 20--	0	0
18 Mar 20--	0	0
19 Mar 20--	0	0

Table 3

Date	2016 Rainfall	2017 Rainfall
4/1/--	0.02	0
4/2/--	0	0.13
4/3/--	**0.44**	0
4/4/--	0.01	0
4/5/--	0	0
4/6/--	0	0
4/7/--	0	0
4/8/--	0	0
4/9/--	0	0
4/10/--	0	0
4/11/--	-	0.01
4/12/--	**0.37**	**0.53**
4/13/--	0.03	0.17
4/14/--	-	0.01
4/15/--	0	0.02
4/16/--	0	0
4/17/--	0	0
4/18/--	0.11	2

Table 4

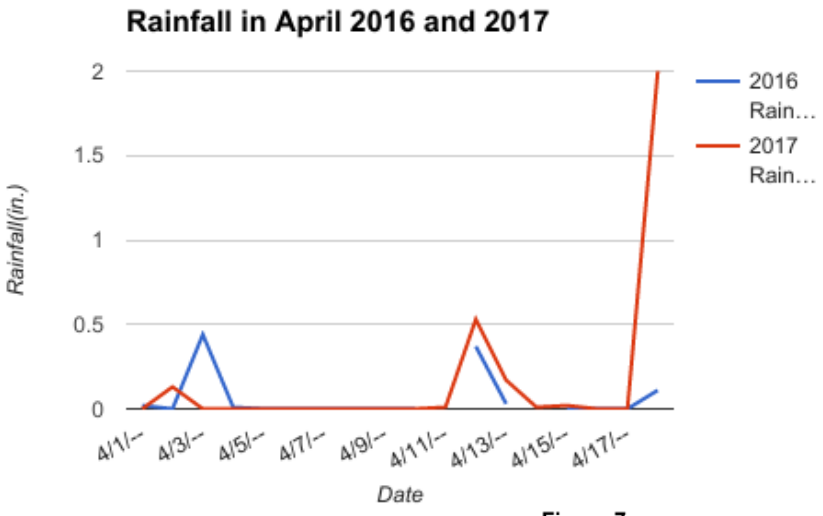

Figure 7

Data Analysis

When comparing the levels of dissolved oxygen in the months of March and April in 2016 and 2017 (see figure 1 and tables 1 and 2), we noticed a distinct decline of about 5.31 ppm between the two years. The air temperature (figures 2-5) and rainfall data (figures 5 and 6 and tables 3 and 4) that was gathered for the two months in question revealed a slight correlation to the dropping dissolved oxygen levels as well. This data shows us that rainfall and air temperature do have a slight influence on the dissolved oxygen levels of water. However, due to their little effect, we can also infer that they are not the contributing factors to the decreasing dissolved oxygen levels in the lake.

Conclusion

After gathering data on the dissolved oxygen levels in the lake, we found that there was a dramatic decrease in dissolved oxygen levels between the spring of 2016 and 2017. We were unable to identify the causes of this phenomenon, but ruled out the possibility of it being due to temperature and rainfall. Our data shows that rainfall and outside temperatures did have an effect on the dissolved oxygen levels; however, they were not dramatic enough to be the only factors at work. Although we speculate that the decrease in hydrilla this year could be also a major reason for this decline, we were unable to test it due to a lack of resources. Future research is needed in order to find out what other variables have caused this decline in dissolved oxygen so that our lake can effectively support the ecosystem that thrives in it and the community that uses it.

Limitations and Sources of Error

Our data was just as limited as was our testing time, so solid evidence is hard to come by. Our theory that the hydrilla could be dying and not reproducing like they should be is a stretch because of our limited testing. Although, there are many other factors that could cause a fluctuation in dissolved oxygen levels, we were unable to test for them due to limited resources. There is much more hydrilla under the surface of the water, as well as data that we were unable to collect, which could potentially obscure a perfect diagnosis of what might be happening. However, with the data that we have, we are unable to come to a conclusive cause to this phenomenon.

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Upper City Lake