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Dissolved Oxygen Content in Cedar Lake

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Dissolved Oxygen Content in Cedar Lake

Department of SCIENCE AND MATHEMATICS CEDARVILLE UNIVERSITY

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Introduction

In aquatic systems there is a balance between the production and consumption of oxygen. Oxygen is produced by photosynthetic microorganisms, and is taken directly from the atmosphere; it is consumed by the respiration of aquatic animals, decomposers, and a myriad of other chemical reactions. The biochemical oxygen demand (BOD) is the amount of oxygen consumed by organisms and is measured as dissolved oxygen (DO). The types of animals that can live in an aquatic system are dependent upon the level of DO in the water.

DO concentrations are affected by numerous physical factors. Cold water and running water hold more oxygen than warm or still water. Changes in altitude also cause changes in DO levels; an increase in altitude causes a decrease in DO levels. In lakes and other still bodies of water, DO levels are likely to express change in the vertical water column, whereas moving bodies like streams and rivers will show differences horizontally. DO levels fluctuate seasonally and diurnally.

Hypothesis

We expect to see higher levels of dissolved oxygen at the surface of the lake due to the closer proximity to the atmosphere and the churning effect of the wind. Although the water at the bottom of the lake would likely be colder, and therefore able to hold more oxygen, it is also being consumed rapidly by decomposers.

Methods

To conduct our measurements of DO in Cedar Lake we used a dissolved oxygen meter (YSI DO probe). We measured DO (percent and mg/L) and temperature at 0.5m intervals for numerous sites around the lake. We also measured wind speed and air temperature for each site.

Site description

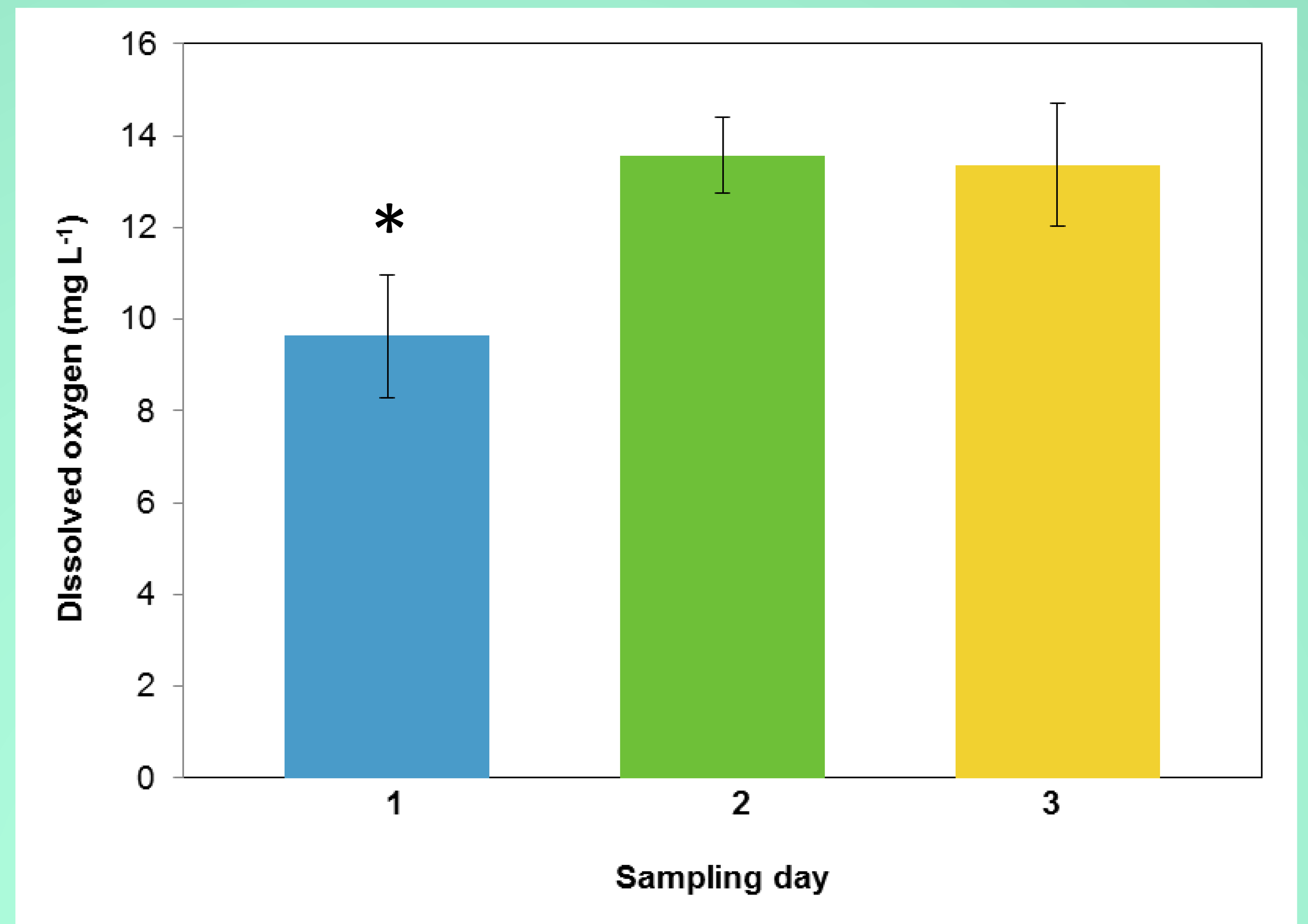
Cedar Lake has an area of 24,637 square meters and a volume of 41,179 m^3. At its deepest point, the lake is 3.06 meters, and the shoreline varies between 0.5-0.9 meters in depth. The lake is widest and deepest at its southern-most end. We measured the variables listed above at these eleven locations around the lake.

Data Analysis

We performed a two-way ANOVA test, assessing the factors of day and depth in relation to the response variable, DO. We used post-hoc tests (Tukey) to evaluate significant difference ($p < 0.05$) among factors.

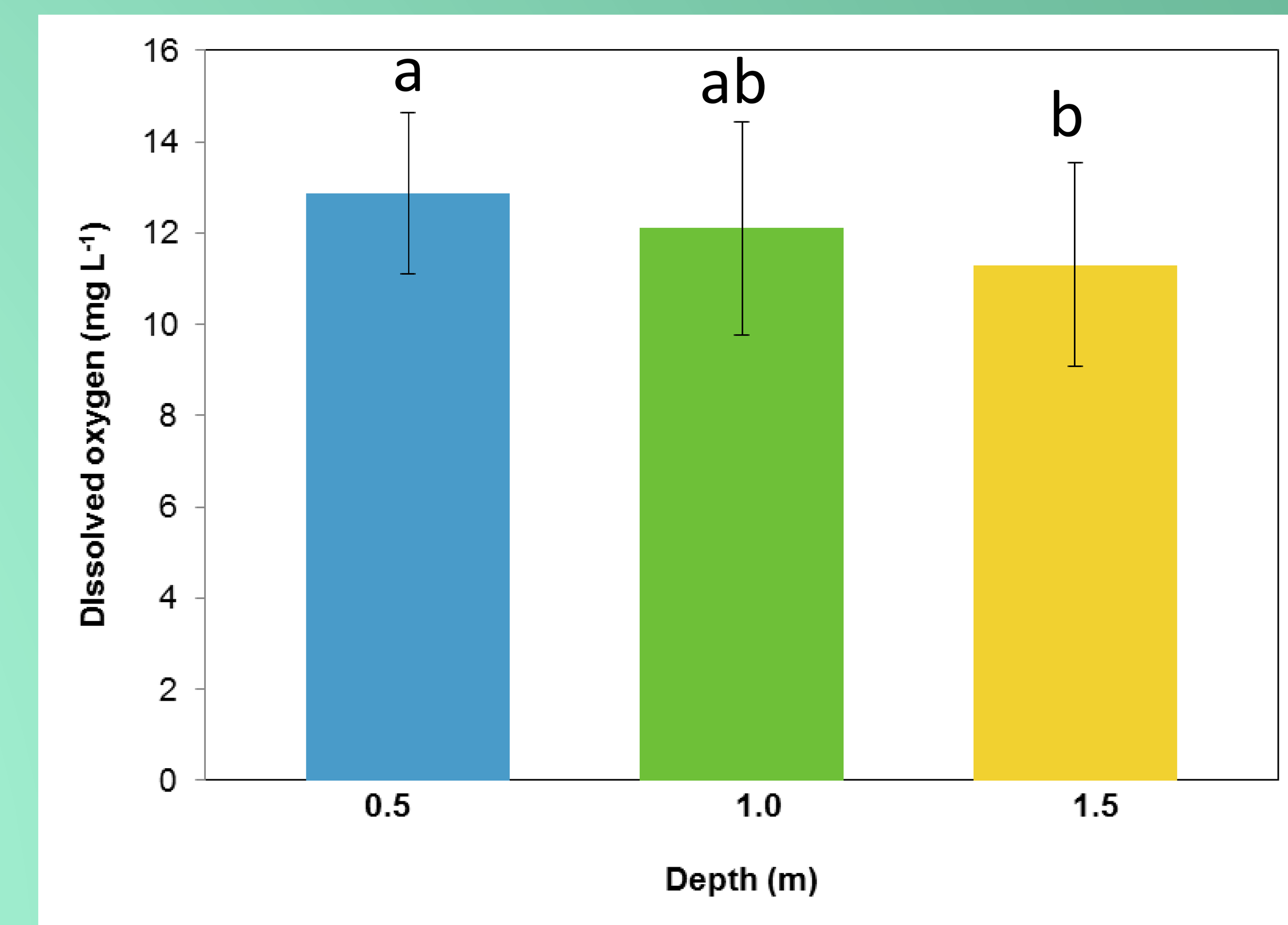
Results

Depth of sampling



Based on our measurements we found that samples taken on our first sampling day had significantly lower ($p < 0.001$) dissolved oxygen content. Mean dissolved oxygen (mg/L ± SD) was 9.6 ± 1.3 on day 1 as compared to Day 2 and 3 with 13.6 ± 0.8 and 13.4 ± 1.3. Windspeeds were greater on Day 1 & 2 (31 and 27 mph) as opposed to just 12 mph on Day 3. In contrast, water temperature (°C) was lowest on Day 1 at 14.3 C as compared to 23.3 and 20. 7 °C on Day 2 & 3.

Depth of sampling



We found that dissolved oxygen was significantly different ($p < 0.001$) at 0.5 meters and 1.5 meters, but that samples taken at 1 m were not significantly different from either ($p = 0.054$ and 0.076, respectively). Averaging over sampling day we found that mean (± SD) dissolved oxygen content mg/L was greatest at 0.5 m (12.9 ± 1.8), lowest at 1.5 m (11.3 ± 2.2) and intermediate at 1 m (12.1 ± 2.3)

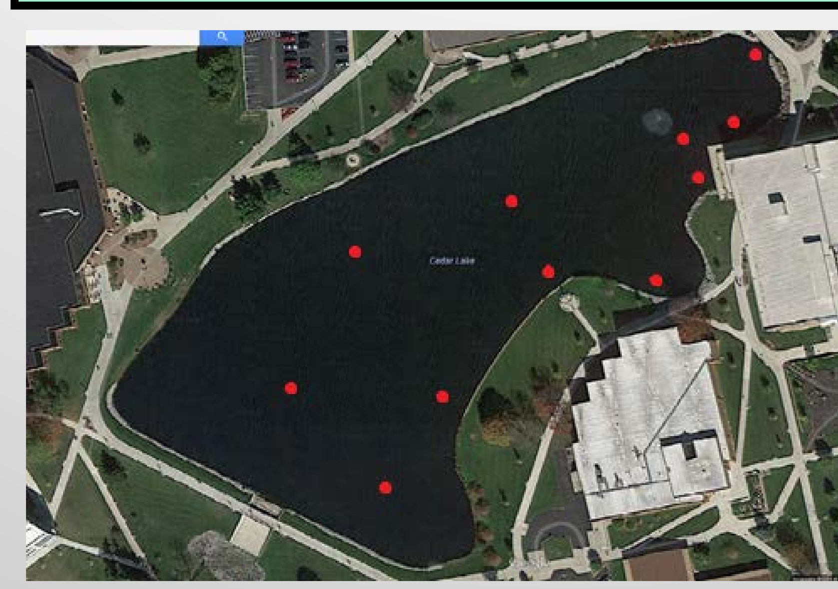


Figure 1. Sampling locations in Cedar Lake (above) and a view from the bow of the boat on the third day of data collection (right).

Conclusions

Our data offer general support for our original hypothesis that dissolved O_2 would be greatest at the surface and decline with depth. This trends suggests varying levels of biotic activity as well as physical mixing of this shallow lake. We concluded that the dissolved oxygen levels were significantly lower on day 1 because of the high winds and low temperature (stormy conditions) as compared to the calmer, warmer conditions on days 2 and 3. Further studies should account for this variability by considering weather (winds and temperature) as well as over a longer time period to capture seasonal variability.