4-27-2023

The Effect of Light Availability on Planktonic Communities under the Ice in Stumpf Lake

Samantha Schug
College of Saint Benedict/Saint John's University, sschug001@csbsju.edu

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Sam Schug (Assistant Greg Kelly) · Bill Lamberts

College of Saint Benedict and Saint John's University, Minnesota, USA

Introduction

- Ice cover is a very important part of the seasonal cycle in lakes that are in areas that reach temperatures under the freezing point, specifically in the Northern Hemisphere (EPA 2022).
- The length of time a lake is frozen, more specifically, the ice formation and breakup dates are key indicators of climate change (EPA 2022).
- Long-term ice data from lakes and rivers in the Northern Hemisphere show that freeze dates occur later, and thaw dates occur earlier, both at an average rate of 0.8 days to one day per decade since the mid-1800s (EPA).
- Snow cover season became shorter by almost two weeks between 1972 and 2013 in the U.S.(EPA 2022).
- Snow is exceptionally good at blocking light as it is whiter than ice and acts as a reflector, it reflects more than 80-90% of sunlight on fresh snow back into space versus the 15-35% of the sunlight reflected by ice ("Dusting" 2013).
- Lengthening of ice-free periods increase light availability in lakes, one study found that the protist community structure can shift with changing light availability (Charvet et al., 2014).
- The hypothesis for this experiment was as the light availability increased, the chlorophyll concentration would also increase and the zooplankton would avoid the light, so their numbers would decrease.

Methods

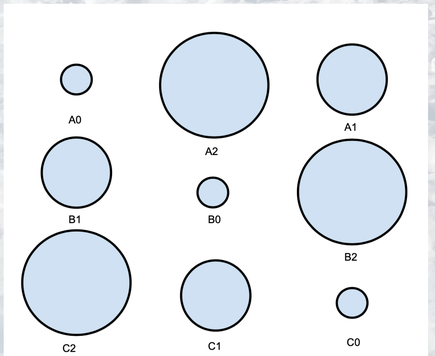

Figure 1. Plot of experiment area on Stumpf Lake.

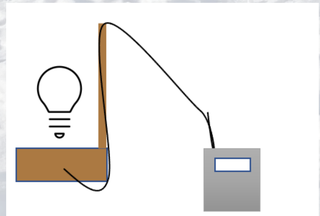

Figure 2. Makeshift Photometer.

- 9 holes were drilled into the ice, with an electric ice auger, with the center of each hole 5 meters away from the center of the surrounding holes (Figure 1).
- For three holes, no snow was removed, for three holes a 1m diameter was cleared around each hole and for three holes a 2m diameter was cleared around each hole, using a regular shovel and meter stick.
- For each day of collection, the light availability at each hole was measured at a meter deep with a makeshift photometer (Figure 2).
- For each day of collection, water was collected from each hole and brought back to the lab to measure the chlorophyll concentration, pH, turbidity and zooplankton abundance.

Results

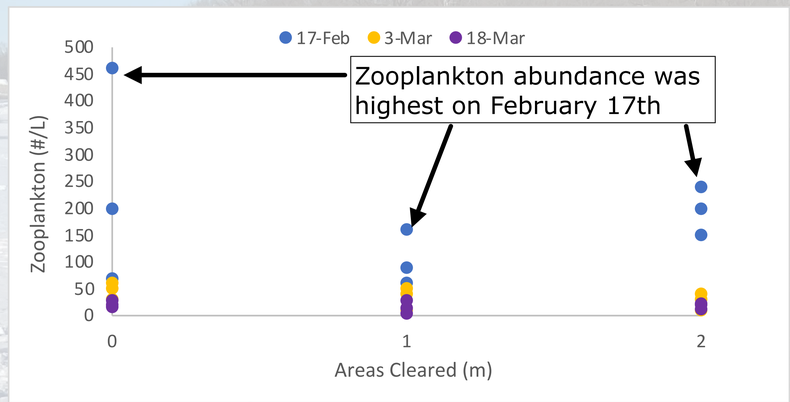

Figure 3. Individual Zooplankton abundance in 1L of water from area cleared (m) sorted by date of collection. Samples were collected on Feb 17th, Mar 3rd, and Mar 18th, 2023 (n=27).

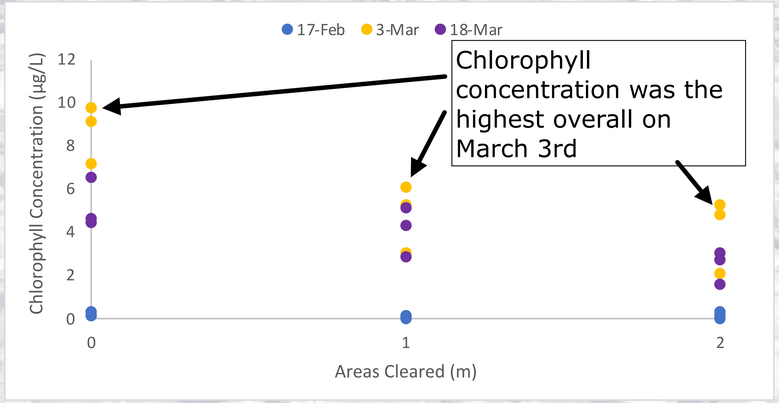

Figure 4. Chlorophyll concentration (µg/L) in each area cleared (m) sorted by date of collection. Data was collected on Feb 17th, Mar 3rd, and Mar 18th, 2023 (n=27).

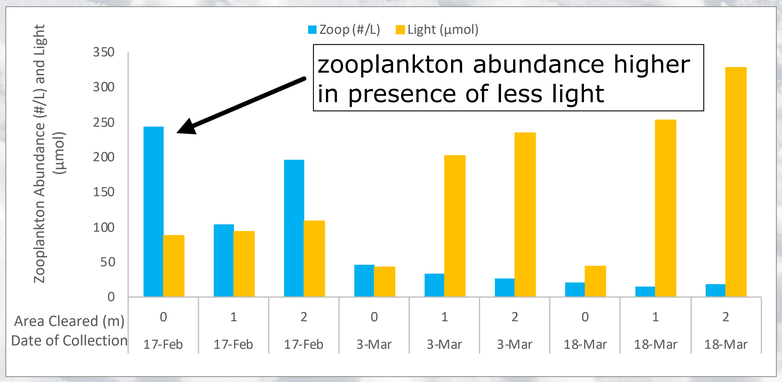

Figure 5. Average Zooplankton abundance (#/L) compared to average Light (µmol) for each area cleared (m). Samples were collected on Feb 17th, Mar 3rd and Mar 18th, 2023 (n=27).

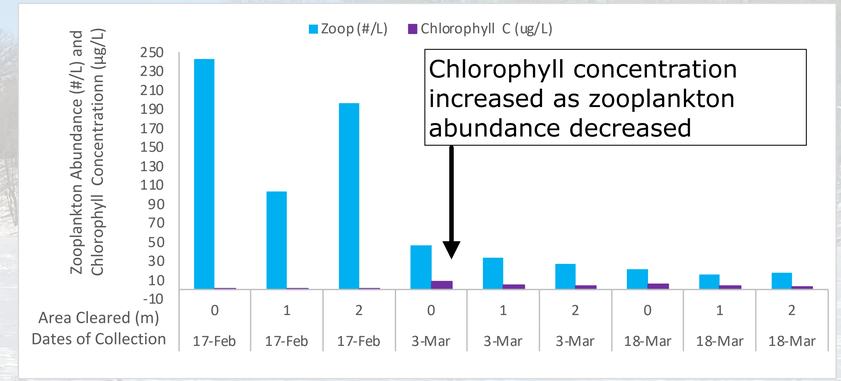

Figure 6. Average Zooplankton abundance (#/L) compared to average Chlorophyll concentration (µg/L) for each area cleared (m). Samples were collected on Feb 17th, Mar 3rd and Mar 18th, 2023 (n=27).

Discussion

- Though we had limited success in implementing the treatments consistently between water collections, as winter storms were strong and did not just include snow but also sleet. We were still able to find some interesting trends in the data.
- The zooplankton generally stayed away from the holes with a larger area cleared and chlorophyll concentration acted in the opposite trend, of having lowest concentrations at the lowest clearance area and higher concentration as the area clearance increased.
- There were also different trends depending on date of collection. February 17th, the lowest chlorophyll concentration and largest abundance zooplankton, March 3rd, had the highest chlorophyll concentration, March 18th, had the least abundance of zooplankton.

Conclusions

- The overall trends of the data did support the hypothesis that more zooplanktons would be present in less light and the opposite for chlorophyll concentration.
- For future research it would be beneficial to look at light availability changes across the whole period of ice cover and if even slight weather changes (specifically the amount of snow cover) significantly affect the amount of light available under the ice.

Acknowledgements

I would like to thank CSBSJU for giving me the opportunity to conduct this research project.

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