Does Light Climate Influence Macrophyte Chlorophyll Content?

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Introduction:

- As turbidity increases through eutrophication, the quantity of photosynthetically available radiation (PAR) decreases with depth within the water column
- Differences in light climate between lakes are reflected in differences in photosynthetic pigments for phytoplankton
- Different pigments and chlorophylls are more efficient at absorbing certain wavelengths of light

Hypothesis: Differences in light climate may be reflected in the chlorophyll ratios of macrophytes at different depths within the water column

Objective:

1. Evaluate relationship between chlorophyll content and macrophyte depth
2. Determine light availability trends between lakes of varying productivity

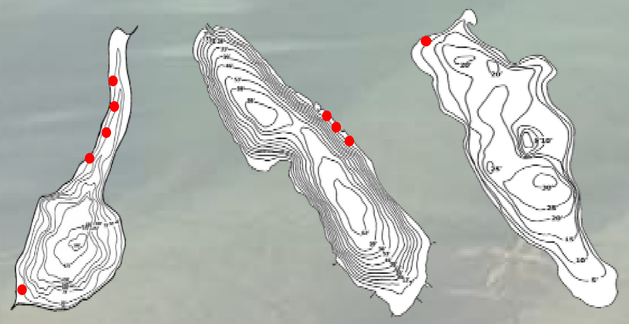


Figure 1: Bathymetric maps of Green lake (left), Onondaga Lake (center), and Song Lake (right). Macrophyte samples collected at multiple points 5 meters from lake shoreline (red dots).

Methods:

- Measured irradiance trends of each lake using spherical PAR detector (Licor)
- Macrophytes collected. Water depth, substrate type, location recorded (Figure 1)
- Identified samples to lowest taxonomic level and air dried over seven day period.
- Ground samples with mortar and pestle; Added to 10 mL 90% acetone solution for 24 hour period
- Measured light absorbance of macrophyte pigments using spectro-photometer at various wavelengths
- Calculated chlorophyll and phaeo-pigment content

Figure 2: Macrophyte collection in Onondaga Lake.

Figure 3: Dried macrophyte samples after grinding

Figure 4: Note taking during macrophyte biomass weighing.

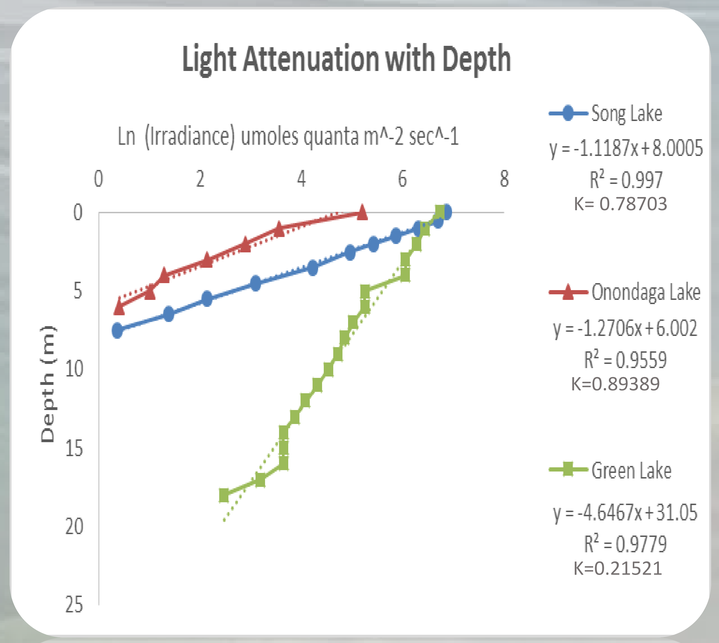


Figure 5: Light attenuation coefficient (k) determined from slope of PAR trend line for each lake. Light attenuation was highest in Onondaga Lake (k = 0.89389) and smallest in Green Lake (k = 0.21521) High R^2 values demonstrate strong relationships between depth and light availability in the water column

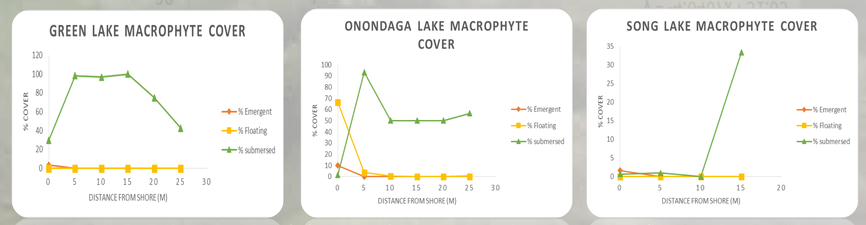


Figure 6: Macrophyte percent (%) cover of emergent, submergent, and floating species in Green Lake (left), Onondaga Lake (center), and Song Lake (right). Relative cover of submergent macrophytes represents the amount of PAR within the water column and is inversely proportional to light attenuation (Figure 5). Green Lake and Onondaga Lake have similar submergent % cover, while Song Lake has low submergent % cover.

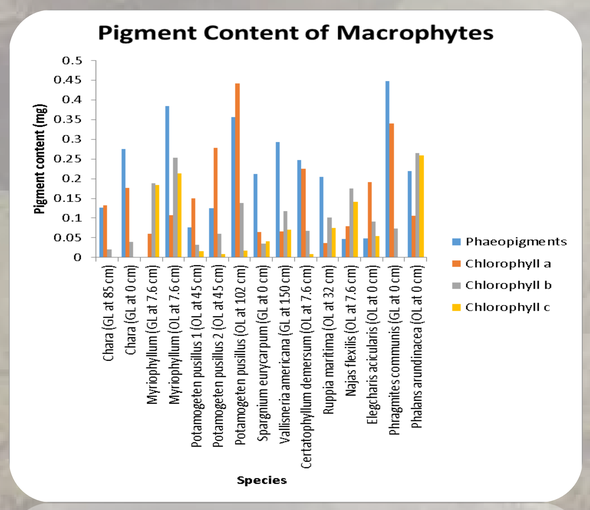


Figure 7: Pigment content of 15 macrophyte samples collected from Onondaga Lake (OL), and Green Lake (GL)

Results:

- Macrophyte samples from Song Lake were unable to be analyzed due to miscommunications between lab practicum groups
- Onondaga Lake had a higher submergent macrophyte cover than expected based on the high light attenuation coefficient (Figure 6)
- 8 of 15 species had more phaeopigment content than chlorophyll-a, indicating high macrophyte degradation (Figure 7)
- Linear regression analysis (α=0.05) indicates that there is no statistically significant correlation between chlorophyll content and depth of macrophyte sample.

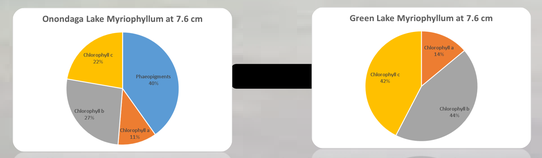
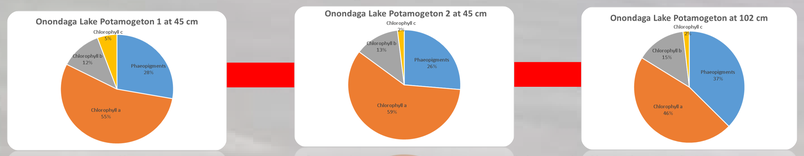


Figure 8: *Myriophyllum* at Onondaga Lake was highly degraded while *Myriophyllum* found at the same depth at Green Lake was not degraded



- **Figure 9:** All Potamogeton were found to have greater chlorophyll a than phaeopigment content. Both *Potamogeton* samples found at 45 cm displayed similar chlorophyll contents to each other, while the *Potamogeton* sample found at 102 m was more degraded than both samples found at 45 cm

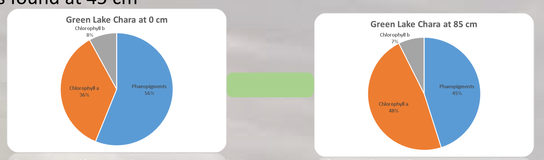


Figure 10: *Chara* collected at Green lake were found to be more degraded at a greater depth (82 cm) when compared to a shallower depth (0 cm)

Conclusion:

- No statistical correlation was observed between chlorophyll content and depth (regression analysis)
- The hypothesis that chlorophyll content will reflect differences in light climate was not supported by the distributions of macrophytes sampled in each lake
- Light attenuation coefficients (k) of the lakes indicate differences in productivity and turbidity (Figure 5). This may be due to differences in watershed management between lakes
- The experimental design may have been ineffective in isolating light as a variable by not considering other growth factors
- Freezing samples after identification may reduce macrophyte degradation and provide more accurate results
- Larger sample size of macrophytes at different depths would allow for substantial analysis of factors contributing to variance of chlorophyll content.
- Differences between macrophytes of different species were more influential than differences between similar species that occur at different depths. Therefore future research should be focused on studying chlorophyll content with depth for one species.