Phytoplankton standing stock

- There is no response in phytoplankton standing stock (measured as Carbon or chlorophyll-a) to changes in phosphorus concentration.

- Cell stoichiometry (P:C ratio) is often used to identify the nutrient status of phytoplankton and decreases during phosphorus limitation.

- Can cell stoichiometry be used to determine which factor limits phytoplankton growth in Lake Superior?

Hypothesis

Does cell stoichiometry allow us to determine when phytoplankton are limited by phosphorus and when by light and temperature?

1) Testing the hypothesis

- Water samples were collected with a Niskin bottle at a sampling station (indicated in red at right) located 26 km offshore.
- The samples were analyzed in the lab for chlorophyll-a, particulate organic carbon, soluble reactive phosphorus, and particulate phosphorus concentrations.
- Water column light and temperature profiles were taken with a Seabird CTD25.
- The hypothesis is tested by comparing the seasonal P:C ratio to the light and temperature regime.

2) Seasonal dynamics in cell stoichiometry

- The system is completely mixed before and after stratification.
- Stratification causes cells to remain in the warmed and irradiated surface waters (epilimnion), eliminating limitation by light and temperature.
- The P:C ratio decreases as the season progresses and phytoplankton become extremely phosphorus starved.
- Phosphorus reserves built up over a ten month period are exhausted in two.
- A decreasing P:C ratio during period I and II suggests phosphorus limitation which ceases in period III.

- During this period phytoplankton are limited by light and temperature.
- A decreasing P:C ratio seems to suggest phosphorus has become the limiting factor.
- During this period light and temperature are not limiting, the decreasing P:C ratio indicates phosphorus limitation.
- The P:C ratio is slowly increasing, suggesting phosphorus ceased to be the limiting factor.

3) Conclusion

- Changes in the P:C ratio indicates when growth of phytoplankton in Lake Superior is limited by phosphorus and when by light and temperature.
- The results suggest that most of the year phytoplankton are not phosphorus limited but become rapidly phosphorus starved when light and temperature cease to limit growth.