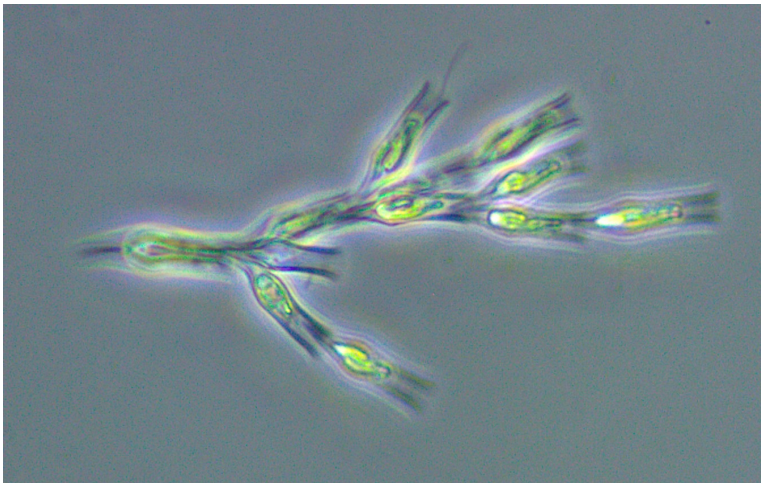
Lakes Environmental Association

2022 Water Testing Report

Chapter 4

Algae Monitoring via Fluorometer Profiles



Introduction to LEA's Fluorometric Chlorophyll Monitoring Programs

Algae either directly or indirectly support much of the life existing in a lake and are considered foundation of aquatic food webs. Of course, algae are also the source of algal blooms, which usually result from an over-abundance of nutrients and can cause a host of problems within a lake system. Algae, along with cyanobacteria and all other plants, use a pigment called chlorophyll-a (chlorophyll for short) to produce their own food through a process called photosynthesis. Generally, larger algae populations will result in more chlorophyll in the environment.

Chlorophyll is a fluorescent compound. This means that, when exposed to certain wavelengths of light, it will respond by emitting light at a different, longer wavelength (a process called fluorescence). LEA uses a fluorometer to measure chlorophyll fluorescence in the water column. The fluorometer works by emitting blue light, which causes chlorophyll molecules to enter a high-energy ("excited") state. When the molecules return to their normal state, they give off red light. The fluorometer then measures the strength of this red fluorescence; the stronger the fluorescence, the more chlorophyll is present.

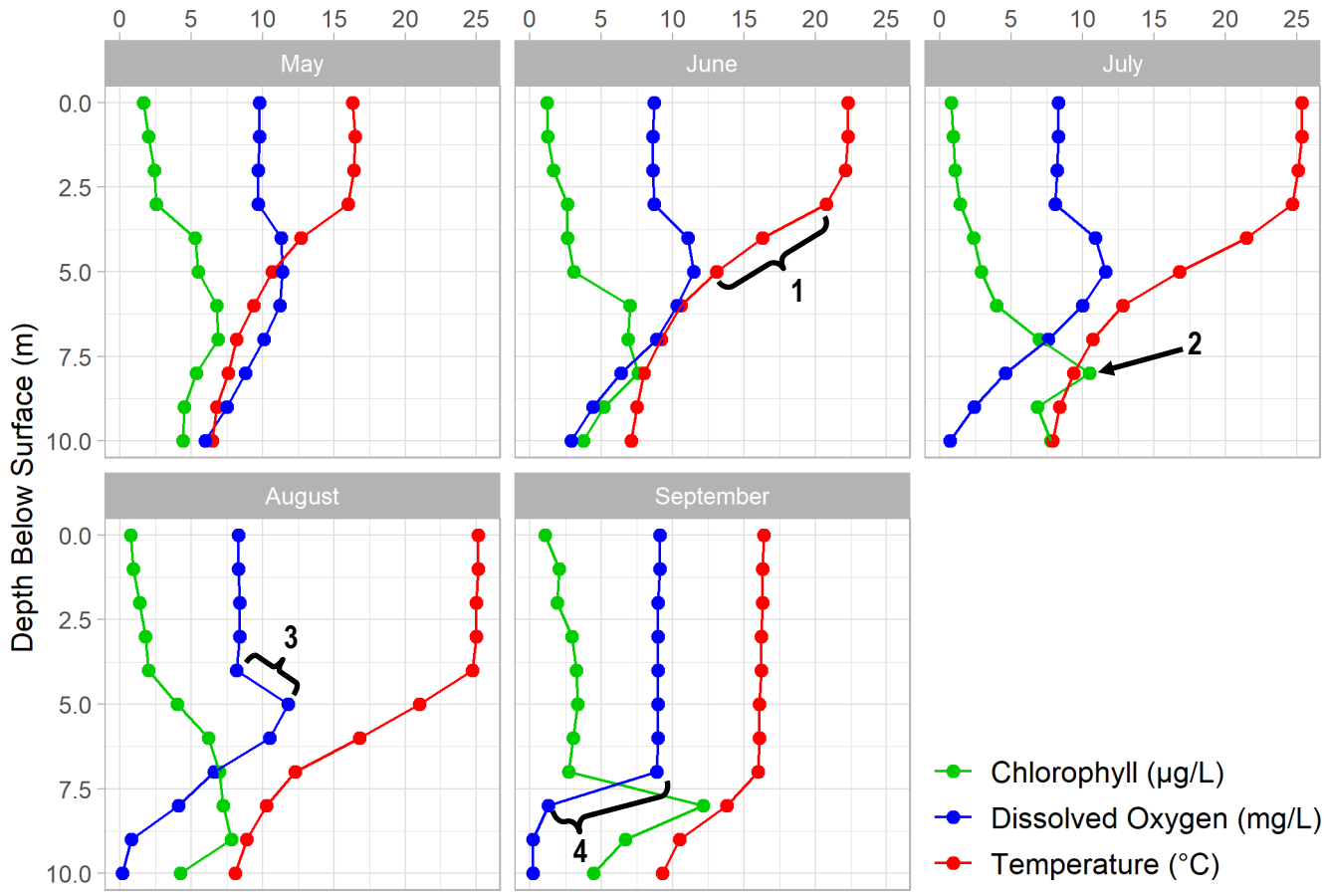
The fluorometer produces output that is a concentration value with units of µg/L. This measurement is only a relative chlorophyll concentration and not a direct comparison to the lab-based chlorophyll-a concentrations determined for each lake during regular water testing. LEA uses the latter measurements as a proxy for algae abundance (reported in chapter 1). Chlorophyll concentrations measured by the fluorometer are considered approximate; this data is not as accurate as the lab-based measurements, but is very useful for viewing patterns within a lake.

Monthly flourometer profiles were collected from the lakes and ponds listed on the right from May through September. Each summary contains a graph of the lake's results. Many lakes contain a chlorophyll maximum near the thermocline. There are a few reasons why this tends to happen. One, is that there is a large density difference between the warm upper-layer water and cold bottom-layer water, so algae that sink down from the upper layer tend to be slowed down at the thermocline and accumulate. Another reason is that some algae prefer the area near the thermocline. While the thermocline is a common place to see algae, algae can, and do, grow deeper in the water column where there are often more nutrients.

Sample Sites
Back Pond
Hancock Pond
Keoka Lake
Keyes Pond
McWain Pond
Middle Pond
Moose Pond (Main basin)
Moose Pond (North Basin)
Moose Pond (South Basin)
Peabody Pond
Sand Pond
Trickey Pond
Woods Pond

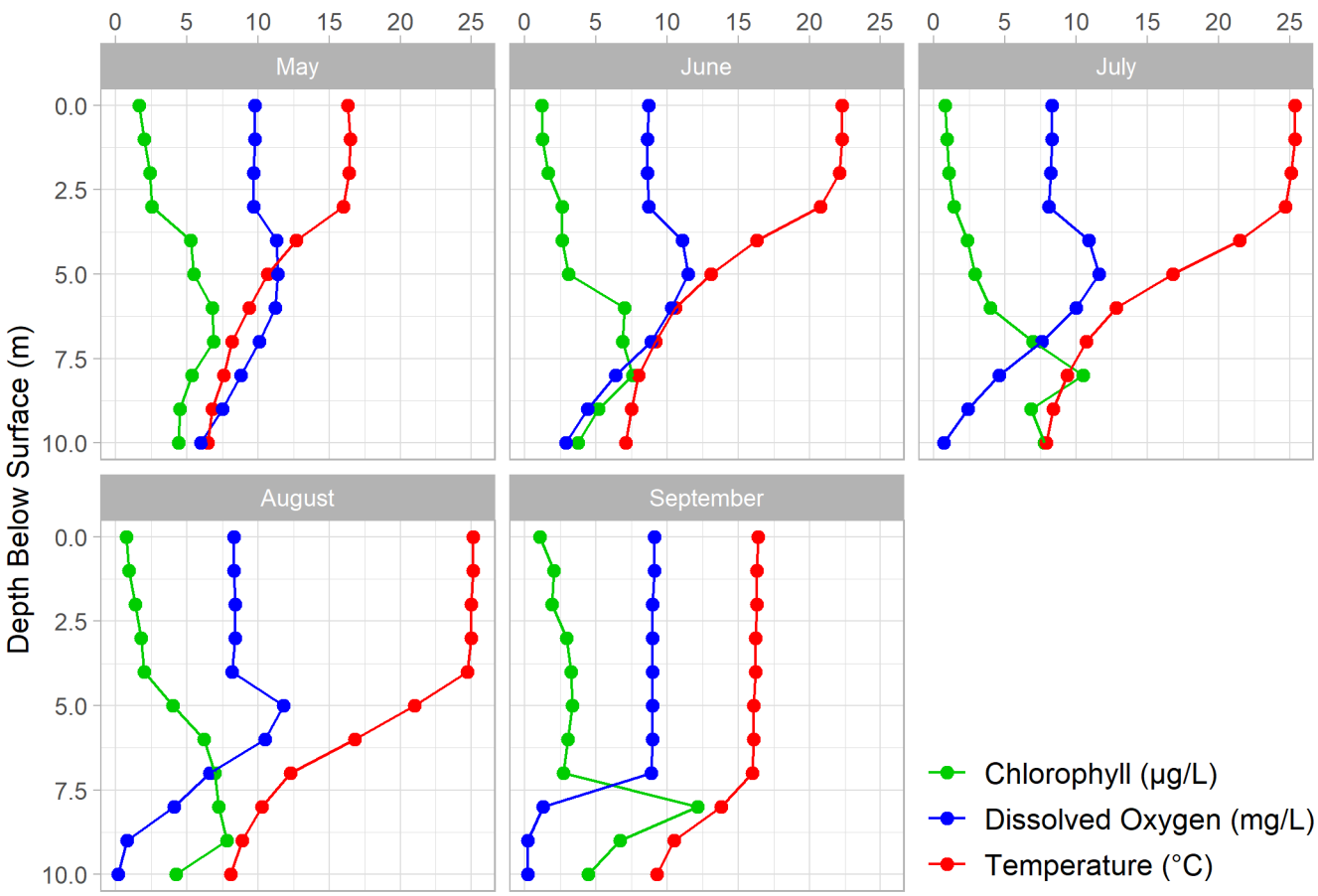
Interpreting Data Graphics

Graphs have been included for each test site to visually compare flourometer, temperature, and oxygen profiles from May through September. The vertical axis (y-axis) indicates depth below the surface while the horizontal axis (x-axis) represents reported values. Three different parameters are being reported on the same graph, which results in the value units for the horizontal axis varying, based on parameter. Units are noted in parentheses in the legend.



Each graphic contains 5 graphs, one for every month in LEA's water monitoring season. Each graph contains a green line, representing chlorophyll concentration, a blue line, representing dissolved oxygen concentration, and a red line, representing temperature. The shape of each line changes from month to month as each parameter changes.

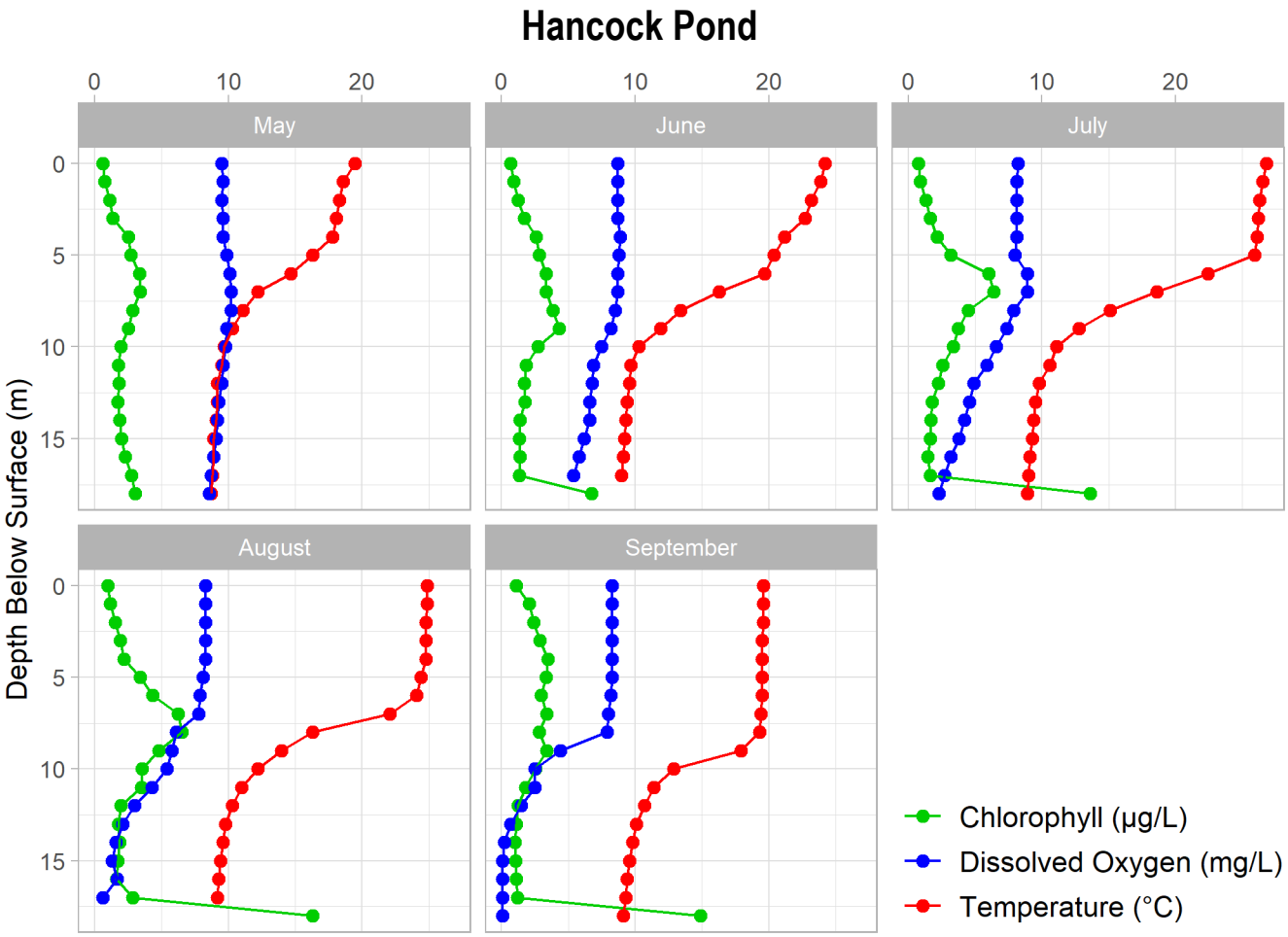
1. Rapid decrease in temperature with depth (thermocline)
2. Fluorescence peak
3. Oxygen increase with depth
4. Oxygen decrease with depth



Back Pond's monthly fluorescence, temperature, and oxygen profiles. Chlorophyll concentration (green line), dissolved oxygen concentration (blue line), and temperature data were collected at every meter from the surface to the bottom from May through September.

2022 Data Highlights

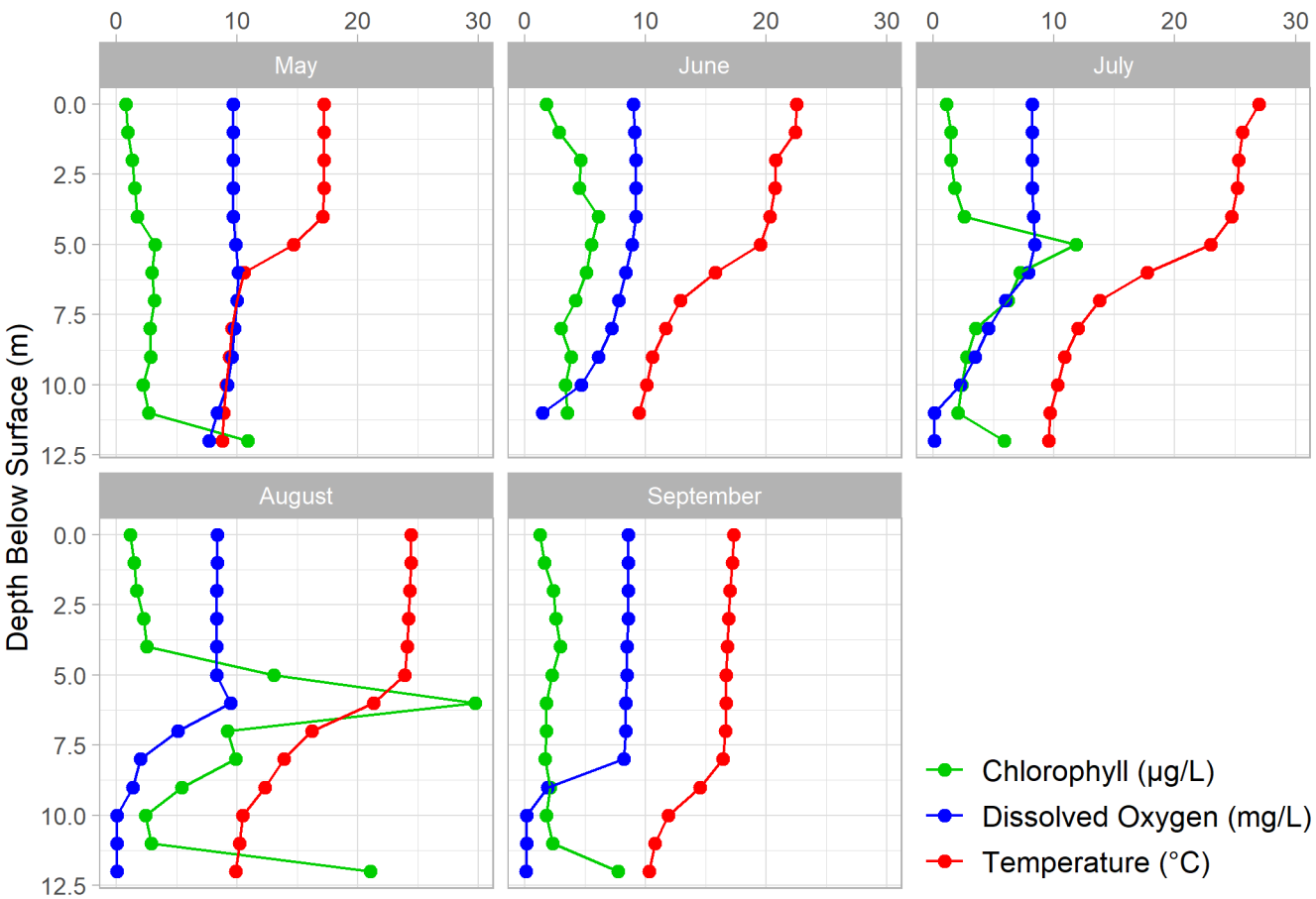
Monthly increases in fluorescence often occur near a rapid decrease in water temperature and can be seen in each of Back Pond's monthly profiles. This fluorescence increase is likely a result of algae "sitting" on top of denser cold water and photosynthesizing. The increase in oxygen concentration is noted near the fluorescence peak in May, June, July, and August is caused by the oxygen produced by algae as a by-product of photosynthesis. Over the course of the season, oxygen within the water is biologically consumed by bacteria in deep waters. The difference in water density between warm and cold waters prevent warm, oxygen rich shallower water from mixing with cold, deep waters. This can be seen from month to month as deep water oxygen concentrations decline. Surface waters had begun to mix in September which pushed the thermocline down however a fluorescence peak is noted near the bottom because Back Pond had not yet fully mixed resulting in a temperature difference high enough between upper and bottom waters to provide algae a place to 'sit'. While fluorescence levels were elevated in the deeper waters, in July and August, they were not at a level of concern.



Hancock Pond's monthly fluorescence, temperature, and oxygen profiles. Chlorophyll concentration (green line), dissolved oxygen concentration (blue line), and temperature data were collected at every meter from the surface to the bottom from May through September.

2022 Data Highlights

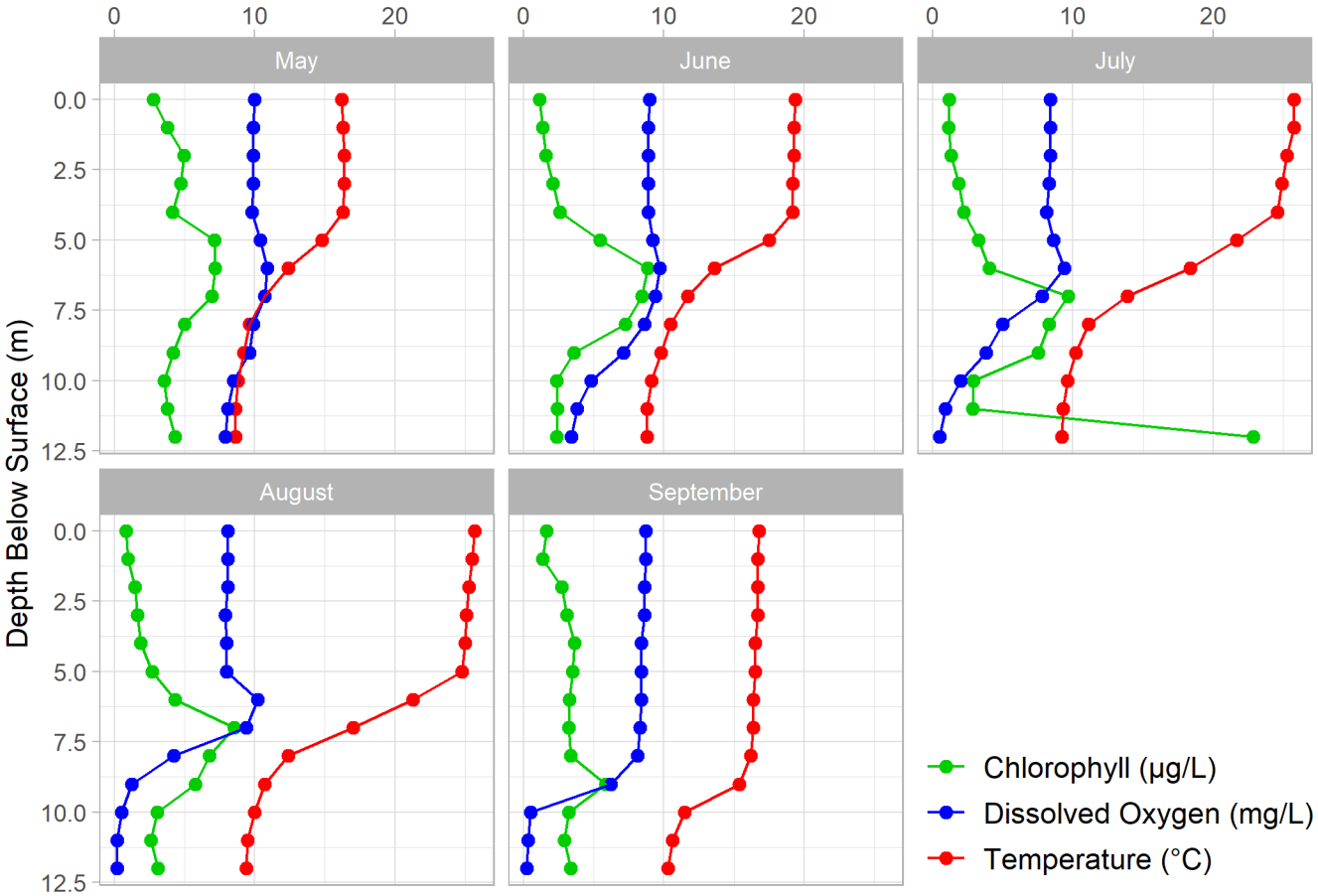
Monthly increases in fluorescence often occur near a rapid decrease in water temperature as seen in May, June, July, and August. This fluorescence increase is likely a result of algae "sitting" on top of denser cold water and photosynthesizing. An increase in oxygen concentration is noted in July near the fluorescence peak because algae produce oxygen as a by-product of photosynthesis. Over the course of the season, oxygen is biologically consumed by bacteria in the deep waters and the difference in water density between warm, shallower waters and cold, deeper waters prevent oxygen rich warm water from mixing with cold waters. This can be seen from month to month as deep water oxygen concentrations decline. Increased fluorescence values seen near the bottom of the pond in June, July, August, and September are likely caused by interference from bottom sediments. Overall fluorescence levels in the water column were low to moderate but were not at a level of concern.



Keoka Lake's monthly fluorescence, temperature, and oxygen profiles. Chlorophyll concentration (green line), dissolved oxygen concentration (blue line), and temperature data were collected at every meter from the surface to the bottom from May through September.

2022 Data Highlights

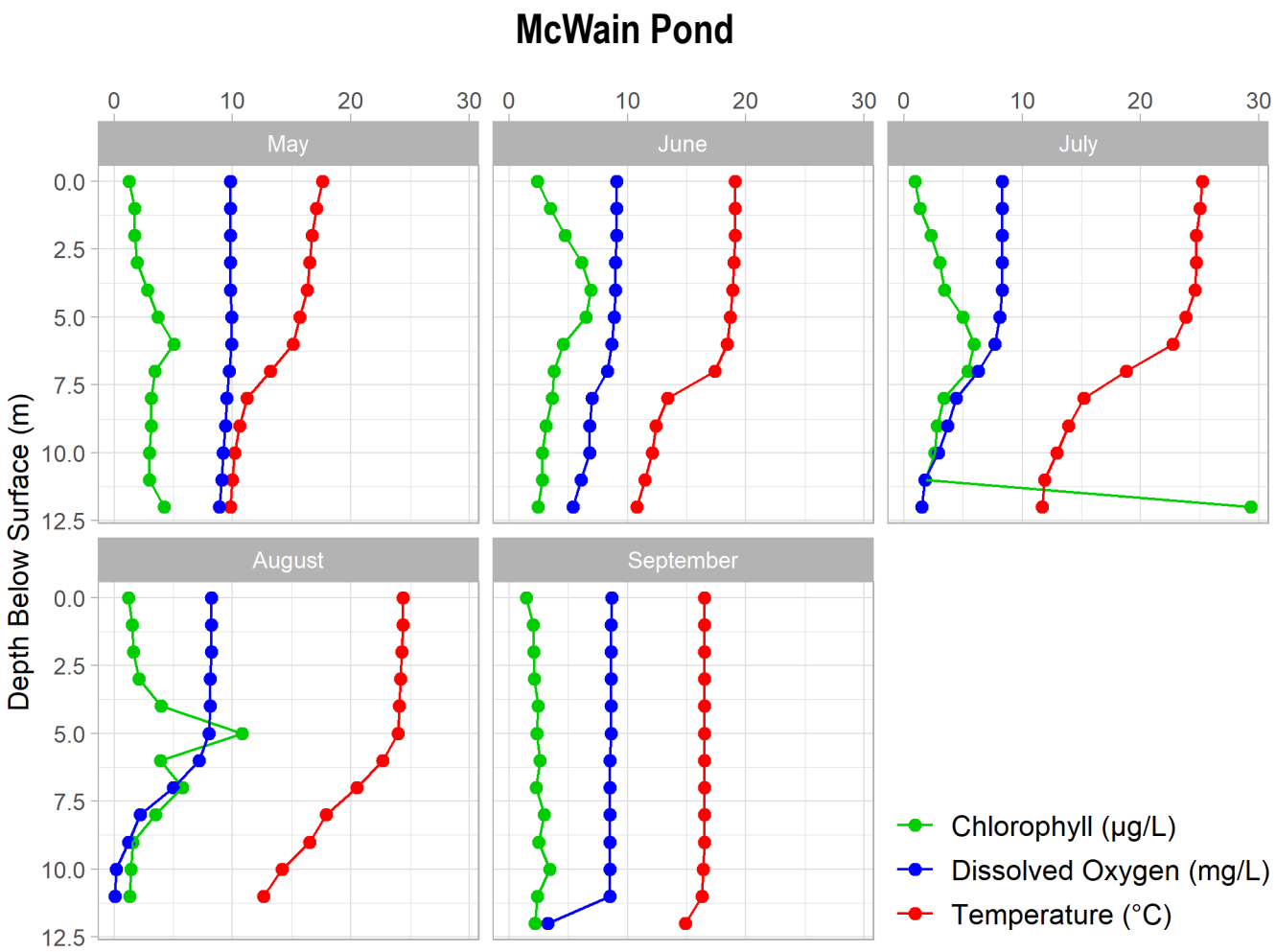
Monthly increases in fluorescence often occur near a rapid decrease in water temperature as seen in July and August. This fluorescence increase is likely a result of algae "sitting" on top of denser cold water and photosynthesizing. An increase in oxygen concentration is seen at the fluorescence peak in August because algae produce oxygen as a by-product of photosynthesis. Over the course of the season, oxygen is biologically consumed by bacteria in the deep waters and the difference in water density between warm, shallower water and cold, deeper water prevent oxygen rich warm water from mixing with cold waters. This can be seen from month to month as deep water oxygen concentrations decline. Increased fluorescence values seen near the bottom of the pond in May, July, August, and September are likely caused by interference from bottom sediments. Fluorescence levels near the thermocline were unusually high in August, and to a lesser degree, in July. This is not typically seen in Keoka lake and will continue to be monitored.



Keyes Pond's monthly fluorescence, temperature, and oxygen profiles. Chlorophyll concentration (green line), dissolved oxygen concentration (blue line), and temperature data were collected at every meter from the surface to the bottom from May through September.

2022 Data Highlights

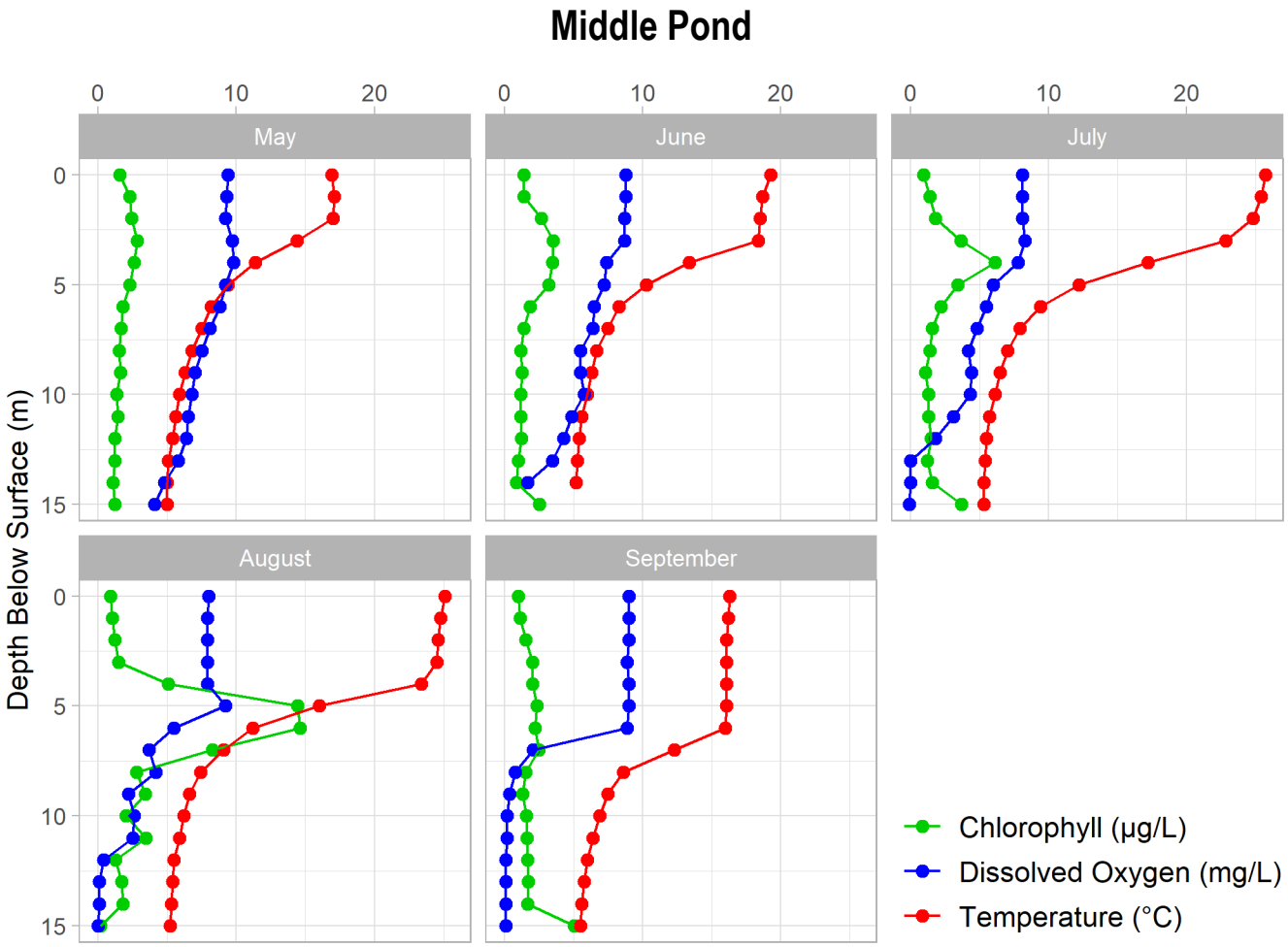
Monthly increases in fluorescence often occur near a rapid decrease in water temperature as seen in each of this season's profiles. This fluorescence increase is likely a result of algae "sitting" on top of denser cold water and photosynthesizing. An increase in oxygen concentration seen in May, June, July, and August is noted near the fluorescence peak because algae produce oxygen as a by-product of photosynthesis. Over the course of the season, oxygen is biologically consumed by bacteria in the deep waters and the difference in water density between warm, shallower water and cold, deeper water prevent oxygen rich warm water from mixing with cold waters. This can be seen from month to month as deep water oxygen concentrations decline. Surface waters had begun to mix in September which pushed the thermocline down however a fluorescence peak is noted near the bottom because the lake had not yet fully mixed resulting in a temperature difference high enough between upper and bottom waters to provide algae a place to 'sit'. Increased fluorescence values seen near the bottom of the pond in July are likely caused by interference from bottom sediments. While fluorescence levels were elevated near the thermocline throughout the season, they were below any level of concern.



McWain Pond's monthly fluorescence, temperature, and oxygen profiles. Chlorophyll concentration (green line), dissolved oxygen concentration (blue line), and temperature data were collected at every meter from the surface to the bottom from May through September.

2022 Data Summary

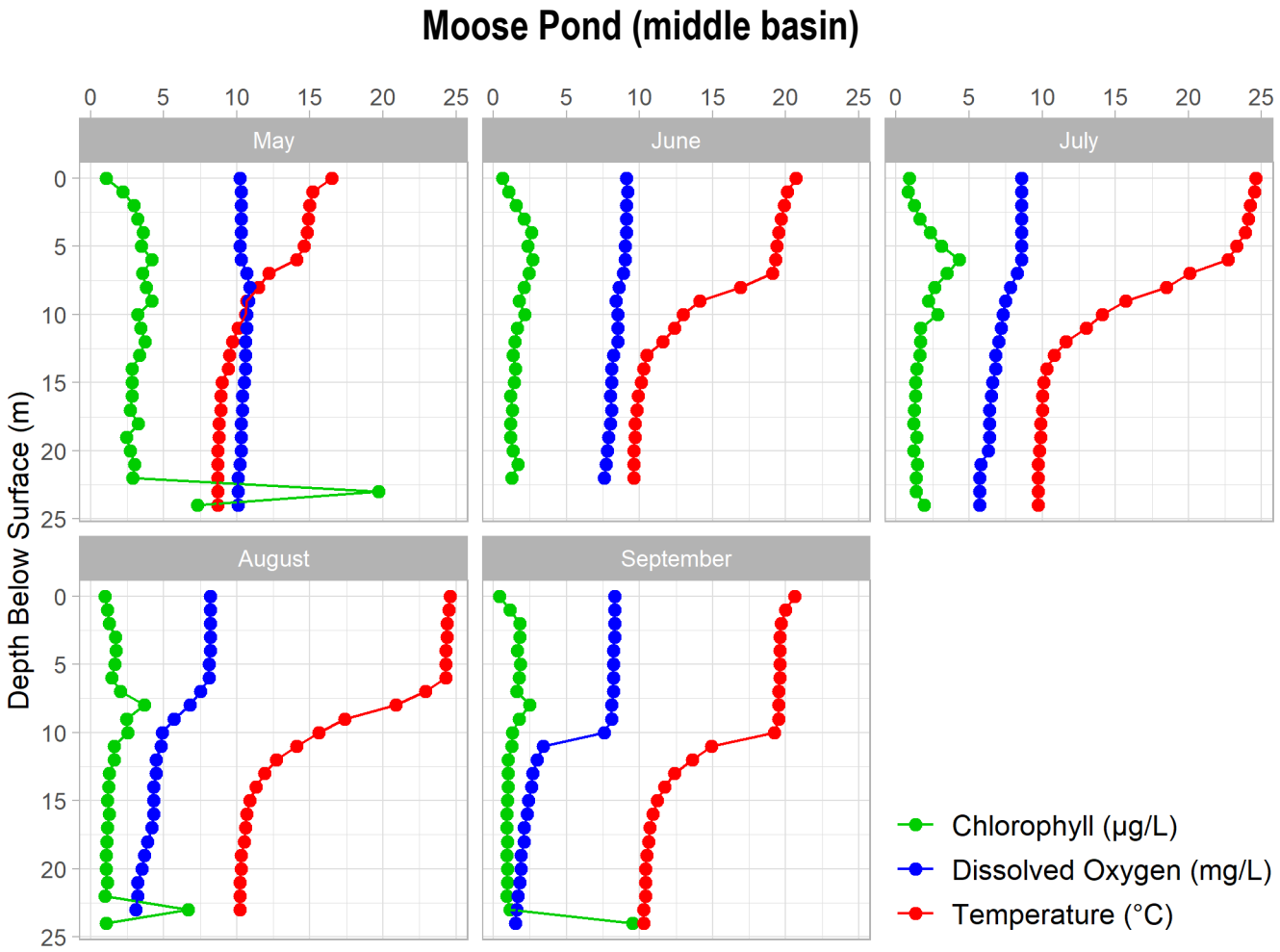
Monthly increases in fluorescence often occur near a rapid decrease in water temperature as seen in May, June, July, and August. This fluorescence increase is likely a result of algae "sitting" on top of denser cold water and photosynthesizing. Over the course of the season, oxygen is biologically consumed by bacteria in the deep waters and the difference in water density between warm, shallower water and cold, deeper water prevent oxygen rich warm water from mixing with cold waters. This can be seen from month to month as deep water oxygen concentrations decline. The lack of a florescence peak in September indicates McWain Pond was mostly mixed in September. Increased fluorescence values seen near the bottom of the pond in July are likely caused by interference from bottom sediments. While fluorescence levels were elevated near the thermocline in August, overall levels were below any level of concern.



Middle Pond's monthly fluorescence, temperature, and oxygen profiles. Chlorophyll concentration (green line), dissolved oxygen concentration (blue line), and temperature data were collected at every meter from the surface to the bottom from May through September.

2022 Data Highlights

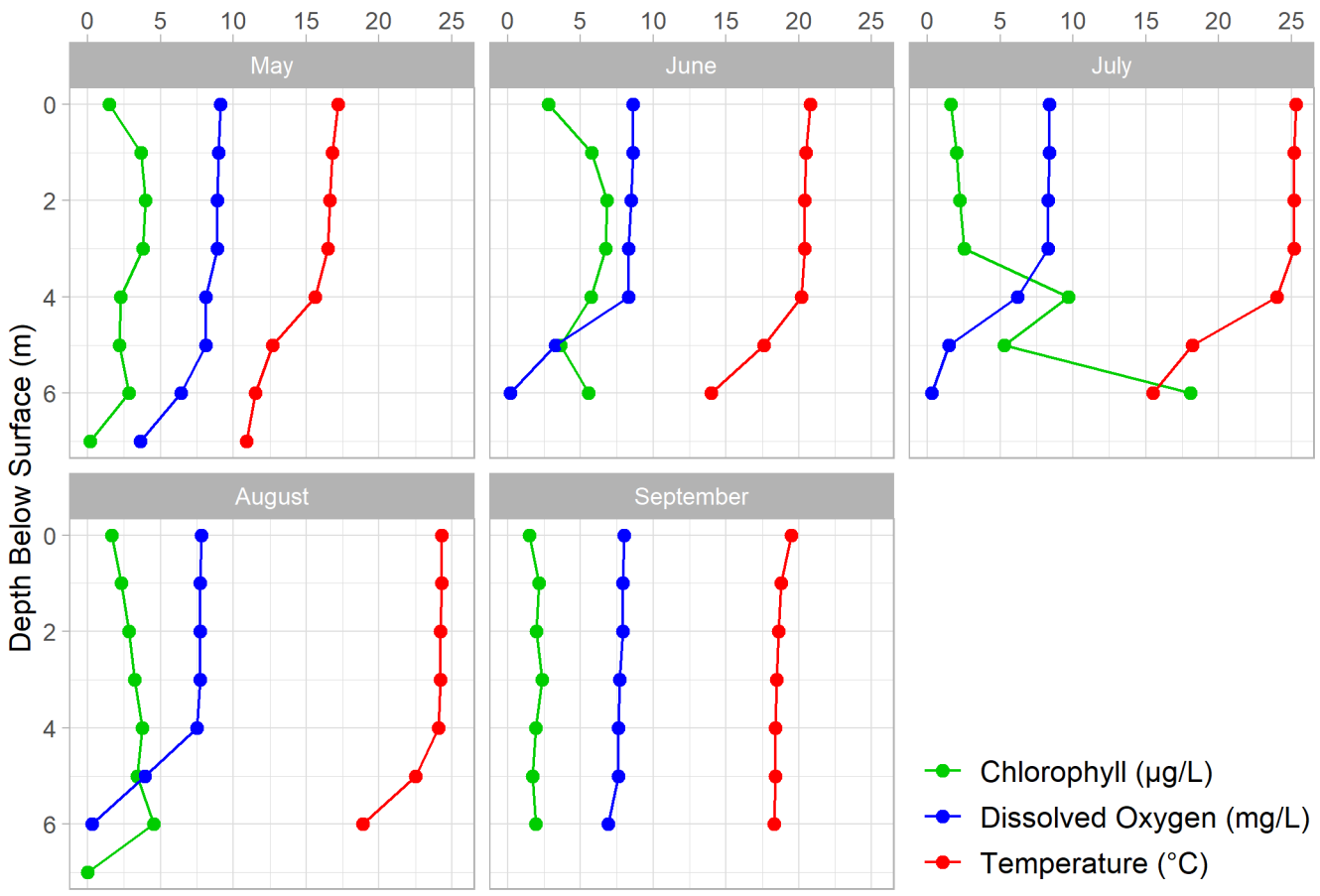
Monthly increases in fluorescence often occur near a rapid decrease in water temperature as seen in June, July, and August. This fluorescence increase is likely a result of algae "sitting" on top of denser cold water and photosynthesizing. An increase in oxygen concentration, seen in July and August, is typically noted near the fluorescence peak because algae produce oxygen as a by-product of photosynthesis. Over the course of the season, oxygen is biologically consumed by bacteria in deep waters and the difference in water density between warm, shallower water and cold, deeper water prevent oxygen rich warm water from mixing with cold waters. This can be seen from month to month as deep water oxygen concentrations decline. Increased fluorescence values seen near the bottom of the pond in June, July, and September are likely caused by interference from bottom sediments. Elevated fluorescence levels near the thermocline in August have been observed in past years and are something that we will continue to monitor.



Moose Pond's (middle basin) monthly fluorescence, temperature, and oxygen profiles. Chlorophyll concentration (green line), dissolved oxygen concentration (blue line), and temperature data were collected at every meter from the surface to the bottom from May through September.

2022 Data Highlights

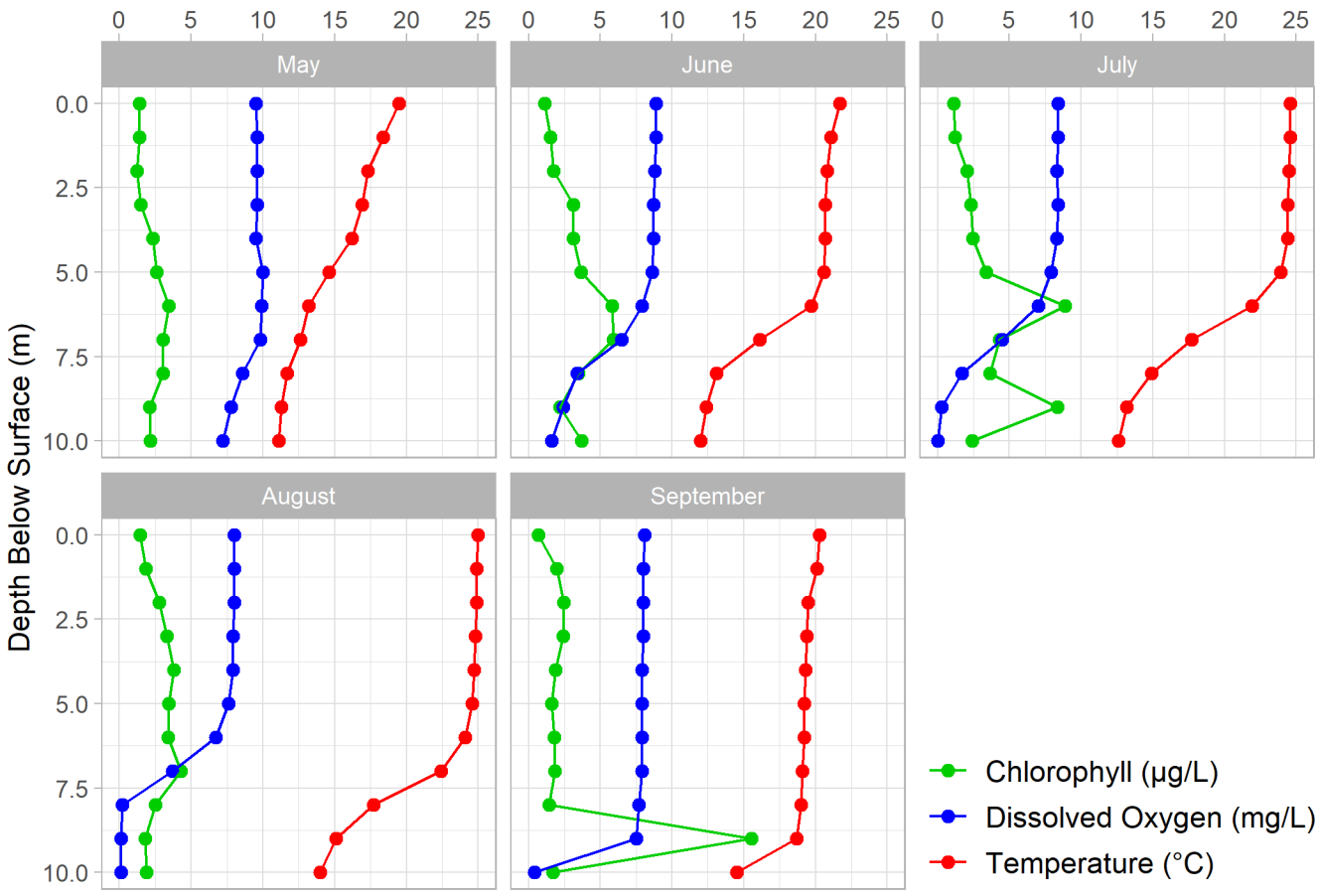
Monthly increases in fluorescence often occur near a rapid decrease in water temperature as seenin July, August, and September. This fluorescence increase is likely a result of algae "sitting" on top of denser cold water and photosynthesizing. Over the course of the season, oxygen is biologically consumed by bacteria in the deep waters and the difference in water density between warm, shallower water and cold, deeper water prevent oxygen rich warm water from mixing with cold waters. This can be seen from month to month as deep water oxygen concentrations decline. This is an important parameter to monitor for Moose Pond's valuable cold water fishery. Increased fluorescence values seen near the bottom of the pond in May, August, and September are likely caused by interference from bottom sediments. Overall fluorescence values within the water column were low and below any level of concern.



Moose Pond's (north basin) monthly fluorescence, temperature, and oxygen profiles. Chlorophyll concentration (green line), dissolved oxygen concentration (blue line), and temperature data were collected at every meter from the surface to the bottom from May through September.

2022 Data Highlights

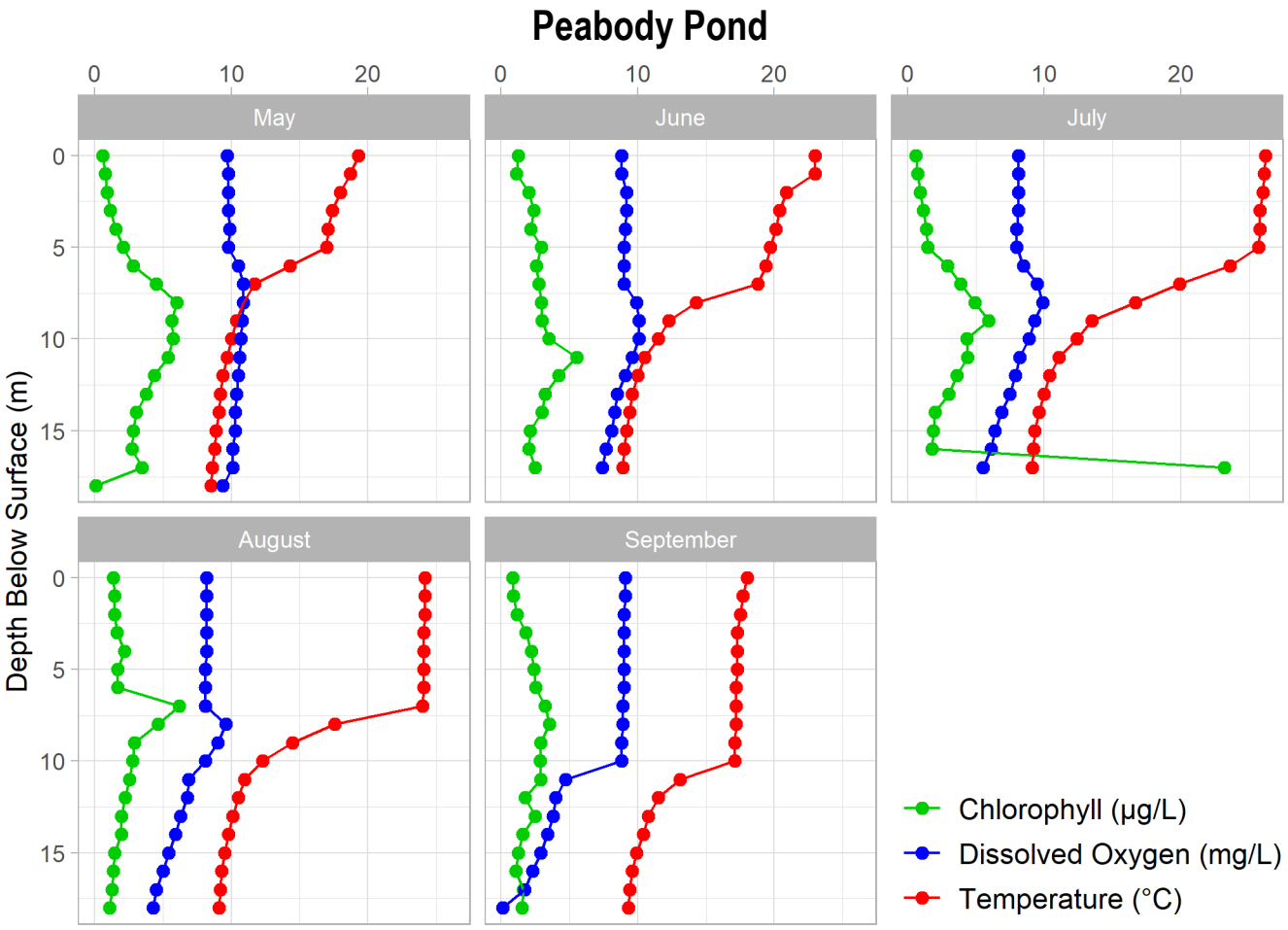
The North basin of Moose Pond does not stratify (divide into layers) as stringently as the main basin. However, similar to the main basin, higher chlorophyll values were seen in July. Over the course of the season, oxygen is biologically consumed by bacteria in the deep waters and the difference in water density between warm, shallower water and cold, deeper water prevent oxygen rich warm water from mixing with cold waters. This can be seen from June through August as decreasing oxygen concentrations in deep, cold waters. September's uniform fluorescence, temperature, and oxygen profiles suggests the water column was likely uniformly mixed. Elevated chlorophyll values in the deep waters in July were likely caused by interference from bottom sediments. Overall fluorescence values within the water column were low and below any level of concern.



Moose Pond's (south basin) monthly fluorescence, temperature, and oxygen profiles. Chlorophyll concentration (green line), dissolved oxygen concentration (blue line), and temperature data were collected at every meter from the surface to the bottom from May through September.

2022 Data Highlights

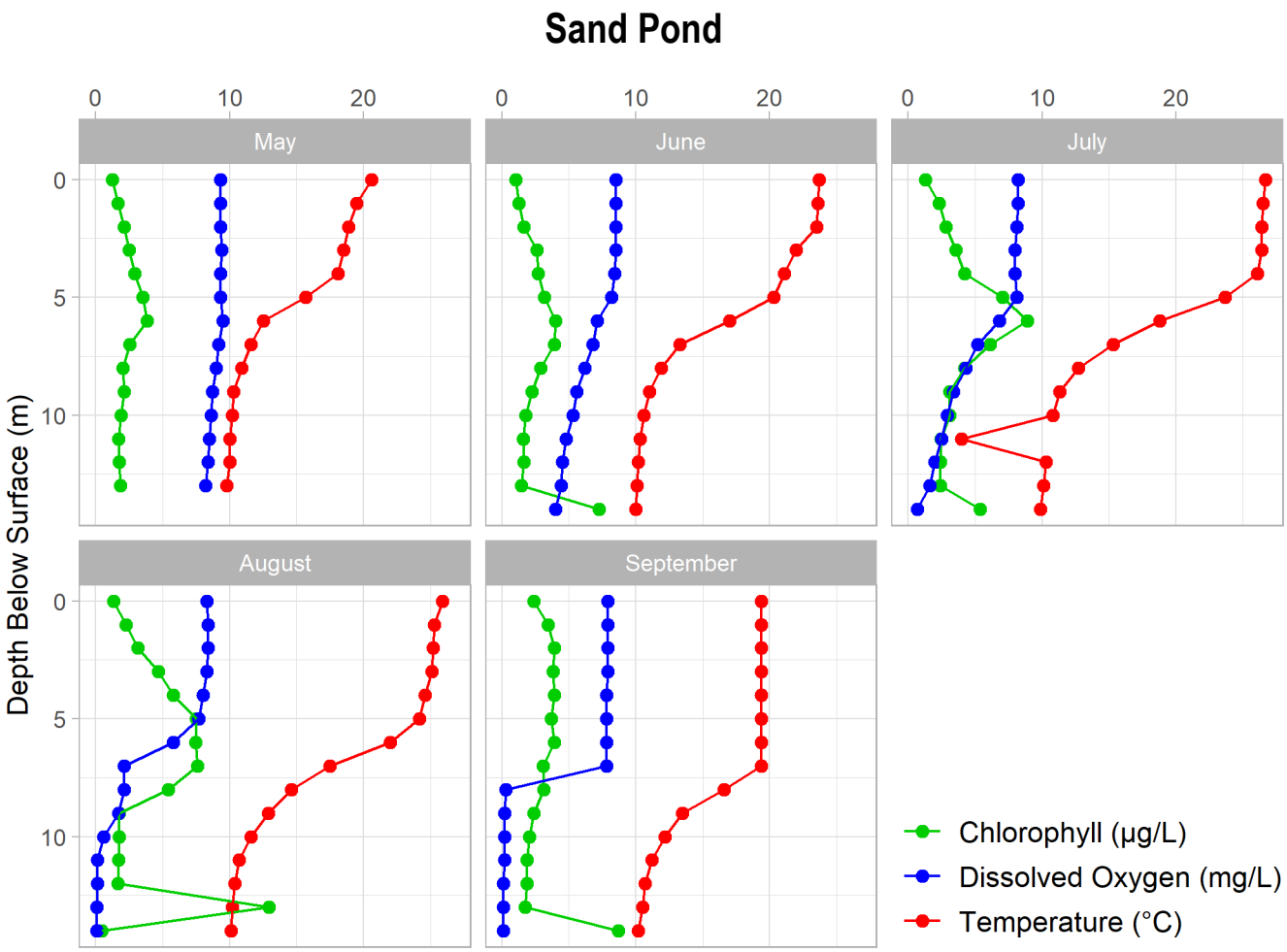
Monthly increases in fluorescence often occur near a rapid decrease in water temperature as seen in June, July, August, and September. This fluorescence increase is likely a result of algae "sitting" on top of denser cold water and photosynthesizing. Over the course of the season, oxygen is biologically consumed by bacteria in the deep waters and the difference in water density between warm, shallower water and cold, deeper water prevent oxygen rich warm water from mixing with cold waters. This can be seen from month to month as deep water oxygen concentrations decline. September's fluorescence peak was deeper into the water column than previous months. This is likely because surface waters had begun to mix in September which pushes the thermocline down, however, there is still a difference in water temperature between upper and bottom waters which provides algae a place to 'sit'. With the exception of Septembers deep water peak, overall fluorescence values within the water column were low and below any level of concern. The higher chlorophyll levels seen September are not typically seen in the south basin and will continue to be monitored.



Peabody Pond's monthly fluorescence, temperature, and oxygen profiles. Chlorophyll concentration (green line), dissolved oxygen concentration (blue line), and temperature data were collected at every meter from the surface to the bottom from May through September.

2022 Data Highlights

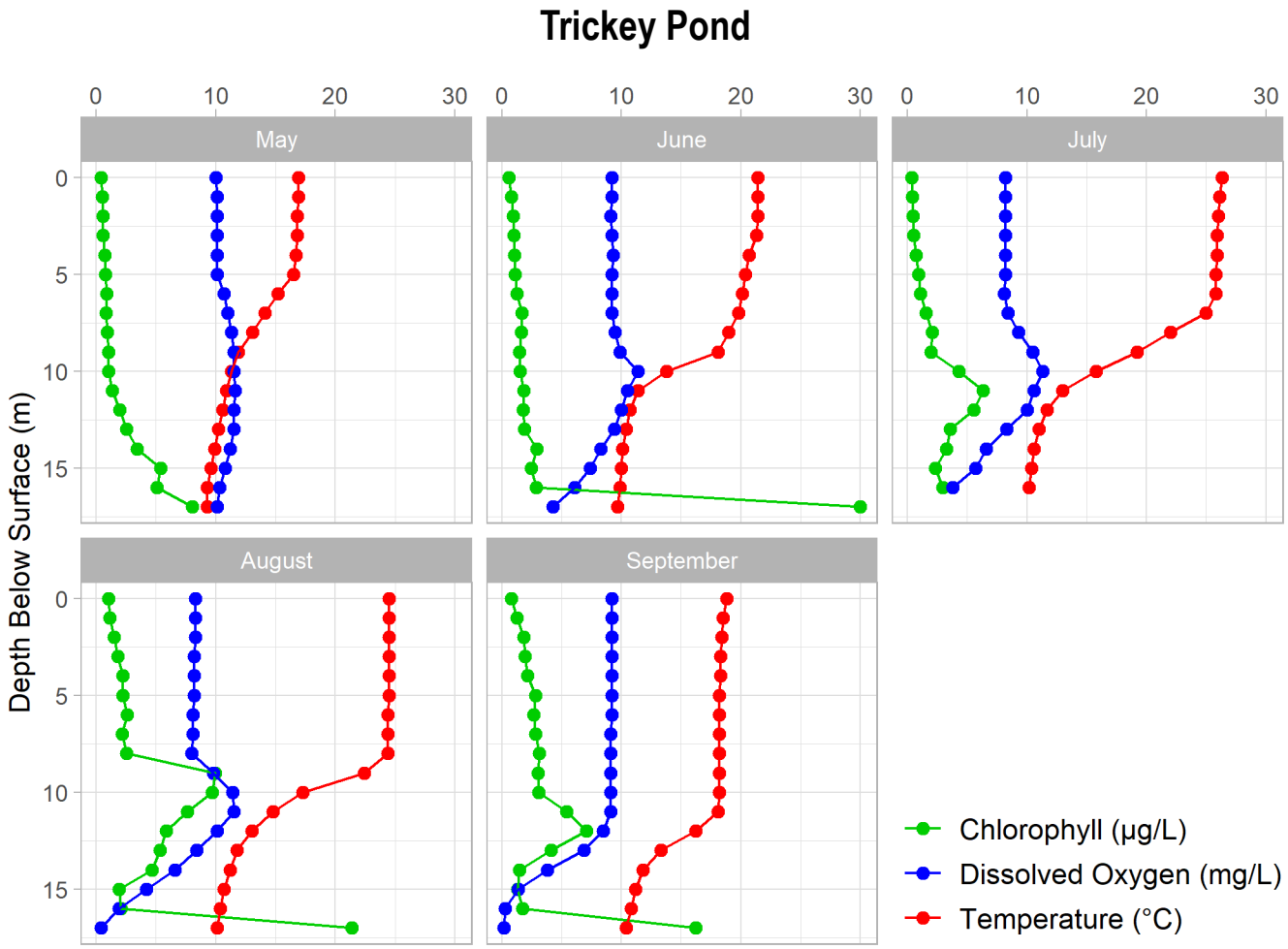
Monthly increases in fluorescence often occur near a rapid decrease in water temperature. This can be seen in May, June, July, and August profiles. This fluorescence increase is likely a result of algae "sitting" on top of denser cold water and photosynthesizing. An increase in oxygen concentration is typically noted near the fluorescence peak was observed in all profiles except for Septembers. This is caused by algae creating oxygen as they photo-synthesize. Over the course of the season, oxygen is biologically consumed by bacteria in the deep waters and the difference in water density between warm, shallower water and cold, deeper water prevent oxygen rich warm water from mixing with cold waters. This can be seen from month to month as deep water oxygen concentrations decline. Increased fluorescence values seen near the bottom of the pond in July and September are likely caused by interference from bottom sediments. Overall fluorescence values within the water column were low and below any level of concern.



Sand Pond's monthly fluorescence, temperature, and oxygen profiles. Chlorophyll concentration (green line), dissolved oxygen concentration (blue line), and temperature data were collected at every meter from the surface to the bottom from May through September.

2022 Data Highlights

Monthly increases in fluorescence often occur near a rapid decrease in water temperature as seen in May, June, July, and August. This fluorescence increase is likely a result of algae "sitting" on top of denser cold water and photosynthesizing, which creates oxygen. Over the course of the season, oxygen is biologically consumed by bacteria in the deep waters and the difference in water density between warm, shallower water and cold, deeper water prevent oxygen rich warm water from mixing with cold waters. This can be seen from month to month as deep water oxygen concentrations decline. Increased fluorescence values seen near the bottom of the pond in June, July, August, and September are likely caused by interference from bottom sediments. Overall fluorescence values within the water column were low and below any level of concern.



Trickey Pond's monthly fluorescence, temperature, and oxygen profiles. Chlorophyll concentration (green line), dissolved oxygen concentration (blue line), and temperature data were collected at every meter from the surface to the bottom from May through September.

2022 Data Highlights

Throughout May and June fluorescence was nearly uniform throughout the water column (with exceptions discussed below). This is likely due to low overall algae concentrations, low nutrients, and excellent clarity. However, throughout July, August, and September increases in fluorescence occurred near a rapid decrease in water temperature. This fluorescence increase is likely a result of algae "sitting" on top of denser cold water and photosynthesizing. An increase in oxygen in concentrations is seen near the flourometer peak in July and August. This is caused by algae creating oxygen as they photosynthesize. Over the course of the season, oxygen is biologically consumed by bacteria in the deep waters and the difference in water density between warm, shallower water and cold, deeper water prevent oxygen rich warm water from mixing with cold waters. This can be seen from month to month as deep water oxygen concentrations decline. Increased fluorescence values seen in May, July, August, and September are likely caused by interference from bottom sediments. Fluorescence levels near the thermocline were moderately high in July, August, and September This is not typically seen in Trickey Pond and will continue to be monitored.

Woods Pond's monthly fluorescence, temperature, and oxygen profiles. Chlorophyll concentration (green line), dissolved oxygen concentration (blue line), and temperature data were collected at every meter from the surface to the bottom from May through September.

2022 Data Highlights

Unlike other nearby ponds, fluorescence varied little throughout Woods Pond's water column. This is likely due to a fairly well mixed water column for most of the season. Over the course of the season, oxygen is biologically consumed by bacteria in the deep waters and the difference in water density between warm, shallower water and cold, deeper water prevent oxygen rich warm water from mixing with cold waters. This can be seen in June, July, and August as decreasing oxygen concentrations in deep, cold waters. September's uniform florescence, temperature, and oxygen profiles suggests the water column was uniformly mixed. Overall fluorescence values within the water column were low and below any level of concern.