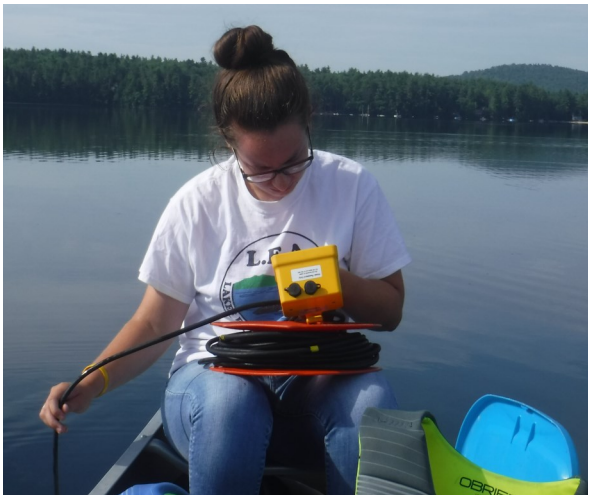
Lakes Environmental Association
2019 Water Testing Report

Chapter 4
Algae Monitoring via Fluorometer Profiles



LEA's Fluorometeric Chlorophyll Monitoring Programs

Chlorophyll-a is a pigment found in all plants, including algae. Because all algae contain chlorophyll-a, it can be used as a proxy for algae abundance. Algae use this pigment in the process of photosynthesis, which produces oxygen as a by-product. Monitoring is essential to understanding the water quality status of lakes, since high chlorophyll-a concentrations can indicate algae blooms and declining water quality conditions.

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

Traditional sampling measures chlorophyll-a from a composite sample of the top layer of the lake, so any variability with depth cannot be seen. When lakes stratify in the summer they have a top layer—the epilimnion—which is the warm, sunlit, mixed layer. The middle layer, or thermocline, is a zone of rapid temperature and density change. The bottom layer is known as the hypolimnion and is cold, dark, and in many lakes, prone to oxygen depletion.

The fluorometer, which is calibrated to measure chlorophyll-a, works by emitting blue light at a specific wavelength designed to cause the chlorophyll -a molecules to enter a high-energy ("excited") state. When the molecules return to their normal state, they give off light (fluoresce) at a different wavelength. The instrument measures the strength of this return wavelength. The stronger it is, the more chlorophyll-a there is. However, fluorometer readings can be affected by water temperature and light levels. According to the fluorometer manufacturer, chlorophyll fluorescence decreases by 1.4% for every 1oC rise in temperature. Algae respond to low light levels by pushing chlorophyll-a to the surface of their cells, which means that a reading in low light may actually fluoresce more than in bright light, when the algae don't have to work as hard to photosynthesize.

The fluorometer reports results in Relative Fluorescence Units (RFUs). This measurement results is not a direct comparison to data obtained through the chlorophyll sampling done on each lake during regular water testing. The fluorometer provides qualitative data, rather than quantitative. Data collected by the fluorometer must therefore be treated as estimates, which are very useful for viewing trends and comparing between lakes.

Monthly fluorometer profiles were collected from each lake and pond in this chapter for five months. 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 here and accumulate. Another reason is that some algae actually preferred 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 nutrient resources in the deeper layer of the lake.

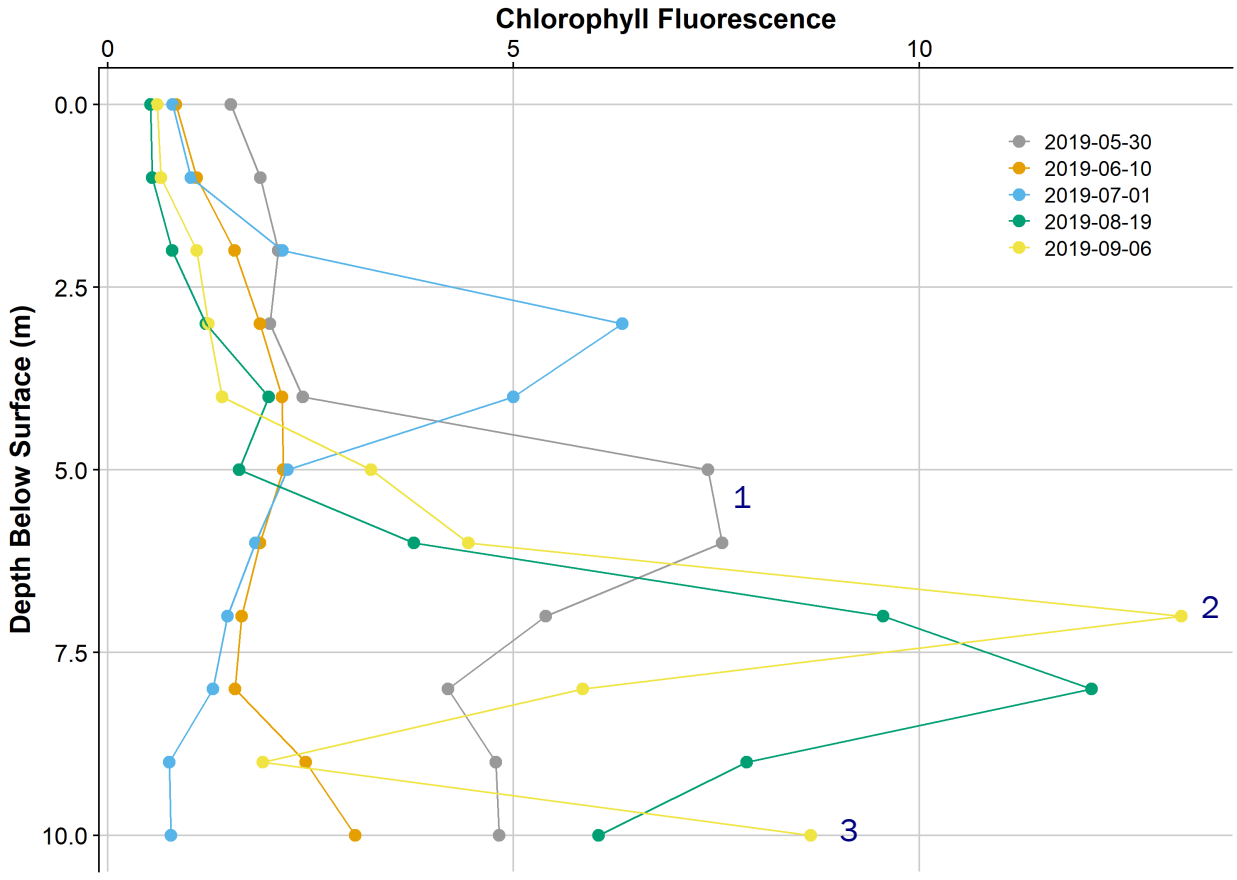
Back Pond

Summary

Each month, except June, an increase in fluorescence (and therefore, chlorophyll-*a*) near the thermocline, the zone of rapidly changing temperature and density that separates a lake's upper and lower layers during stratification, is seen. This phenomenon is common in many of the lakes we monitor and is a result of algae "sitting" on top of the denser cold water and continuing to photosynthesize. A larger fluorescence peak was seen in May than in June and July. This is likely due to the fact that colder temperatures result in a better fluorescence signal. Peak fluorescence values in July, August, and September are deeper than those in earlier months because the pond had become more stratified, pushing the thermocline further down into the water column. Although the fluorescence signal is less strong in warmer waters, these temperatures are more conducive to fast-growing algae, and for this reason, we see the highest readings in August and September.

The following events can be seen in the graph below:

1. Early season fluorescence peak was likely due to colder water temperatures.
2. Peak chlorophyll fluorescence occurred in September.
3. The spike in fluorescence seen near the pond bottom in September is likely caused by interference from bottom sediments.



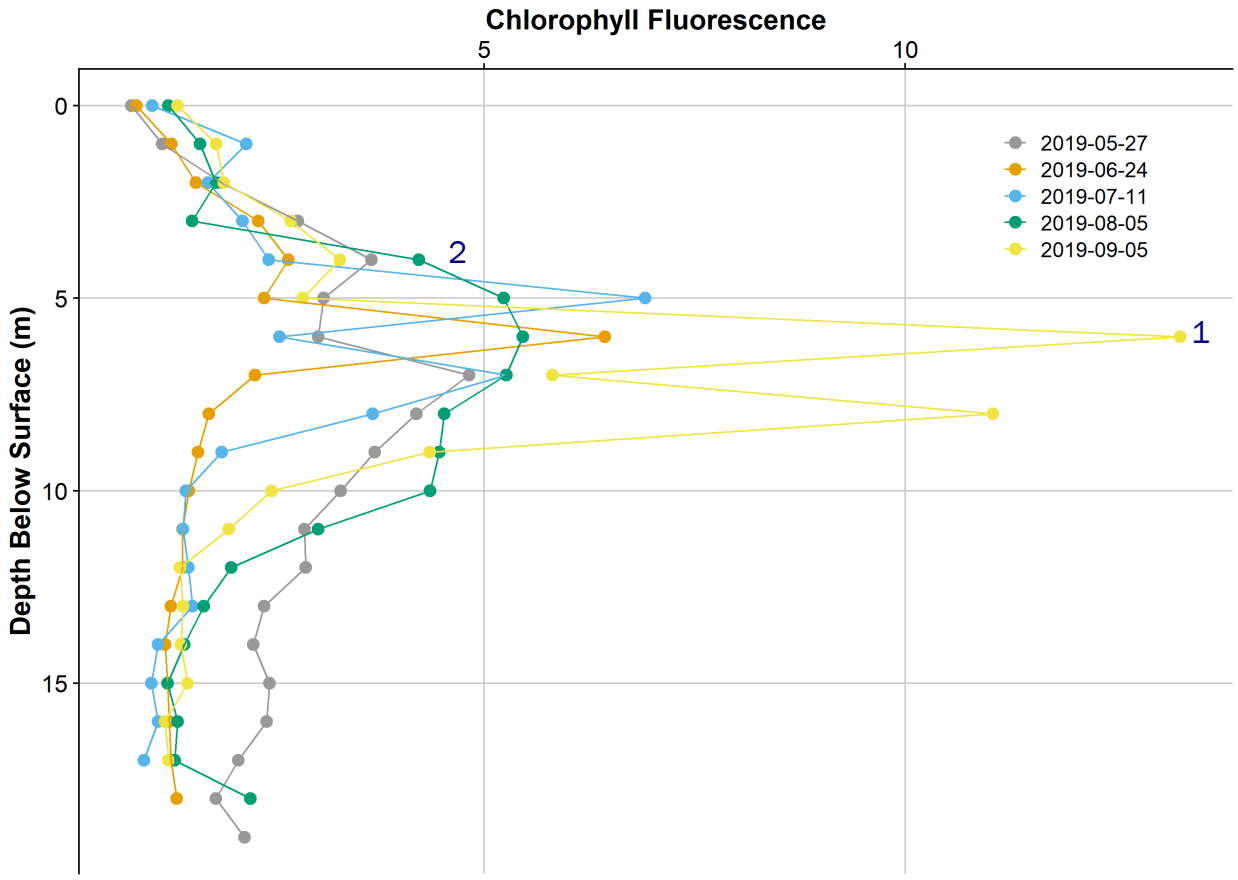
Hancock Pond

Summary

Each month, an increase in fluorescence (and therefore, chlorophyll-*a*) near the thermocline, the zone of rapidly changing temperature and density that separates a lake's upper and lower layers during stratification, is seen. This phenomenon is common in many of the lakes we monitor and is a result of algae "sitting" on top of the denser cold water and continuing to photosynthesize. Peak fluorescence values in each month hover just below the thermocline. Although the fluorescence signal is less strong in warmer waters, these temperatures are more conducive to fast-growing algae, and for this reason, we see the highest readings in September.

The following events can be seen in the graph below:

1. Peak chlorophyll fluorescence occurred in September.
2. Sustained chlorophyll fluorescence lasting several meters in August



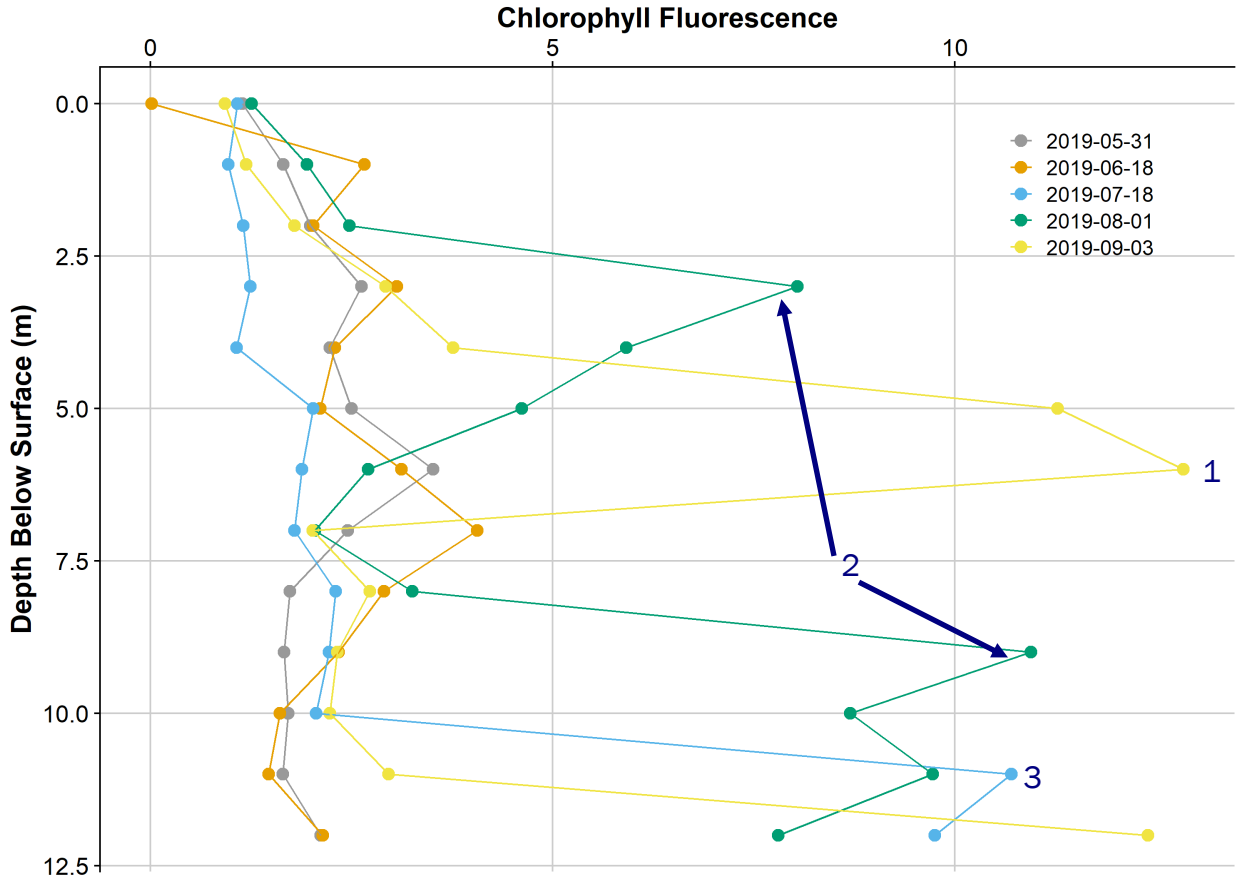
Keoka Lake

Summary

Each month, an increase in fluorescence (and therefore, chlorophyll-*a*) near the thermocline, the zone of rapidly changing temperature and density that separates a lake's upper and lower layers during stratification, is seen. This phenomenon is common in many of the lakes we monitor and is a result of algae "sitting" on top of the denser cold water and continuing to photosynthesize. Although the fluorescence signal is less strong in warmer waters, these temperatures are more conducive to fast-growing algae, and for this reason, we see the highest readings in August and September.

The following events can be seen in the graph below:

1. Peak chlorophyll fluorescence occurred in September.
2. Chlorophyll fluorescence peaked twice in August, once near surface waters and again below the thermocline.
3. Unusual deep water fluorometric spike was seen in July.



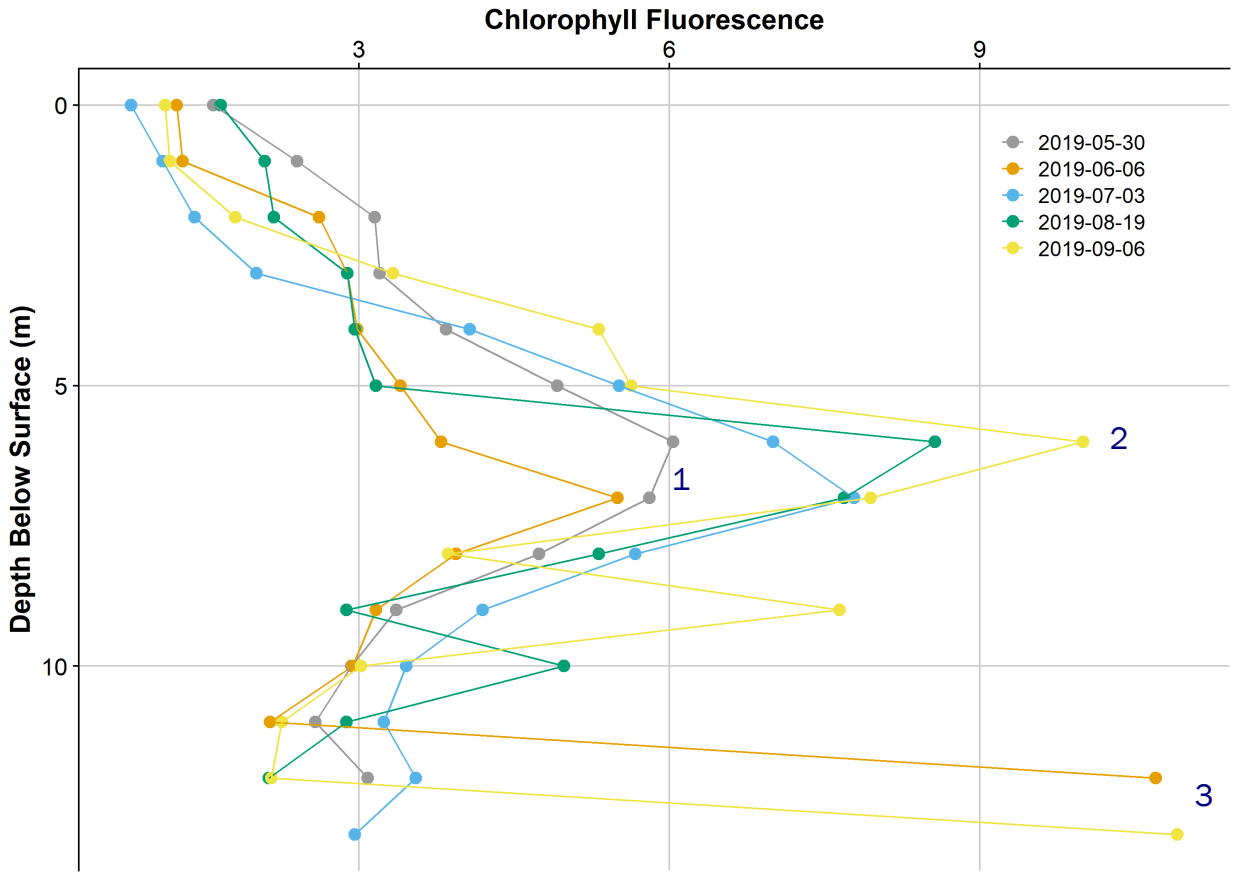
Keyes Pond

Summary

Each month, an increase in fluorescence (and therefore, chlorophyll-*a*) near the thermocline, the zone of rapidly changing temperature and density that separates a lake's upper and lower layers during stratification, is seen. This phenomenon is common in many of the lakes we monitor and is a result of algae "sitting" on top of the denser cold water and continuing to photosynthesize. A larger fluorescence peak was seen in May than in June. This is likely due to the fact that colder temperatures result in a better fluorescence signal. Although the fluorescence signal is less strong in warmer waters, these temperatures are more conducive to fast-growing algae, and for this reason, we see the highest readings in August and September.

The following events can be seen in the graph below:

1. Early season fluorescence peak was likely due to colder water temperatures.
2. Peak chlorophyll fluorescence occurred in September.
3. The spike in fluorescence seen near the pond bottom in September was likely caused by interference from bottom sediments.



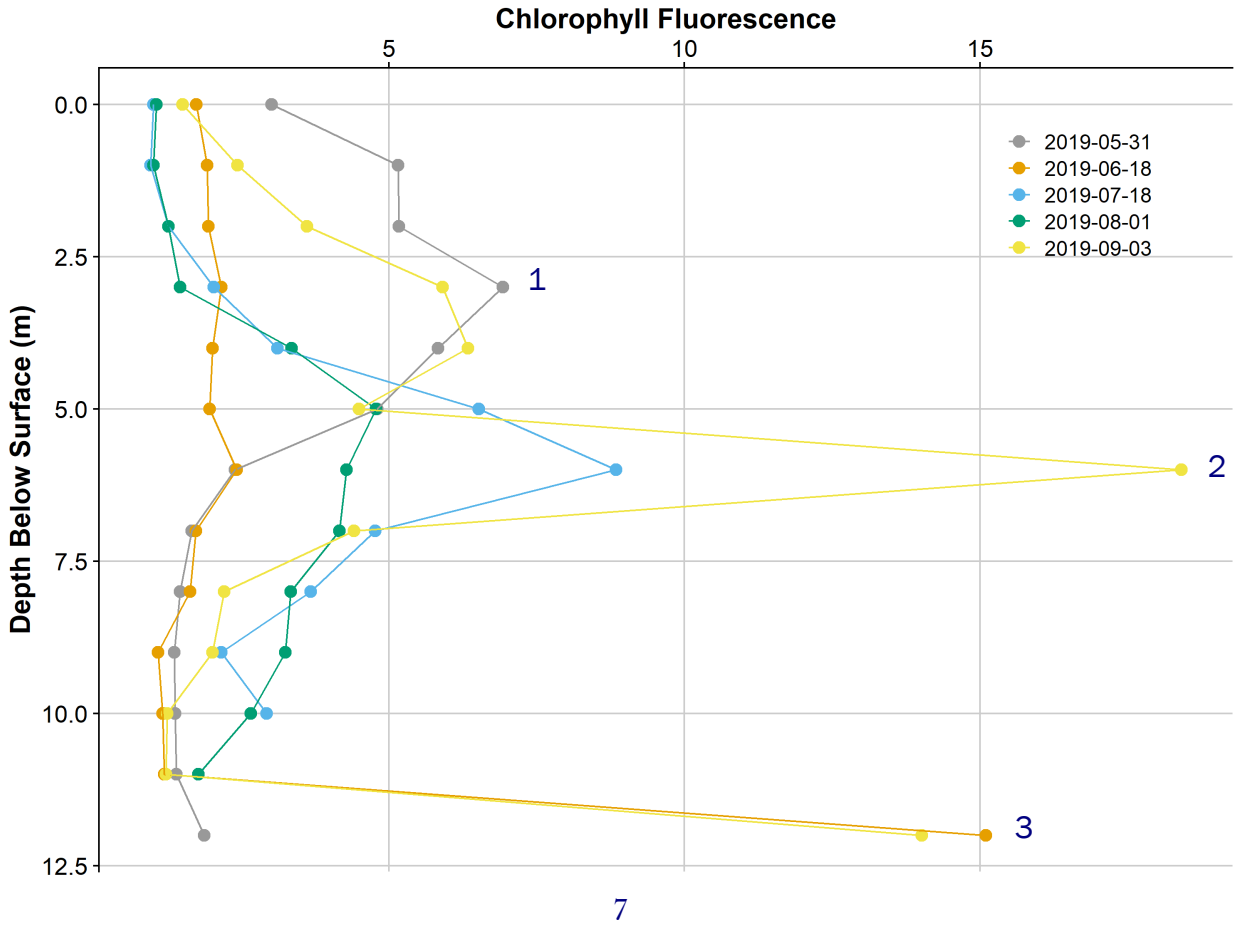
McWain Pond

Summary

Each month, an increase in fluorescence (and therefore, chlorophyll-*a*) near the thermocline, the zone of rapidly changing temperature and density that separates a lake's upper and lower layers during stratification, is seen. This phenomenon is common in many of the lakes we monitor and is a result of algae "sitting" on top of the denser cold water and continuing to photosynthesize. A larger fluorescence peak was seen in May than in June and August. This is likely due to the fact that colder temperatures result in a better fluorescence signal. Peak fluorescence values in September are deeper than those in earlier months because the pond had become more stratified, pushing the thermocline further down into the water column. Although the fluorescence signal is less strong in warmer waters, these temperatures are more conducive to fast-growing algae, and for this reason, we see the highest readings in September.

The following events can be seen in the graph below:

1. Early season fluorescence peak was likely due to colder water temperatures
2. Peak chlorophyll fluorescence occurred in September.
3. The spike in fluorescence seen near the pond bottom in September is likely caused by interference from bottom sediments.



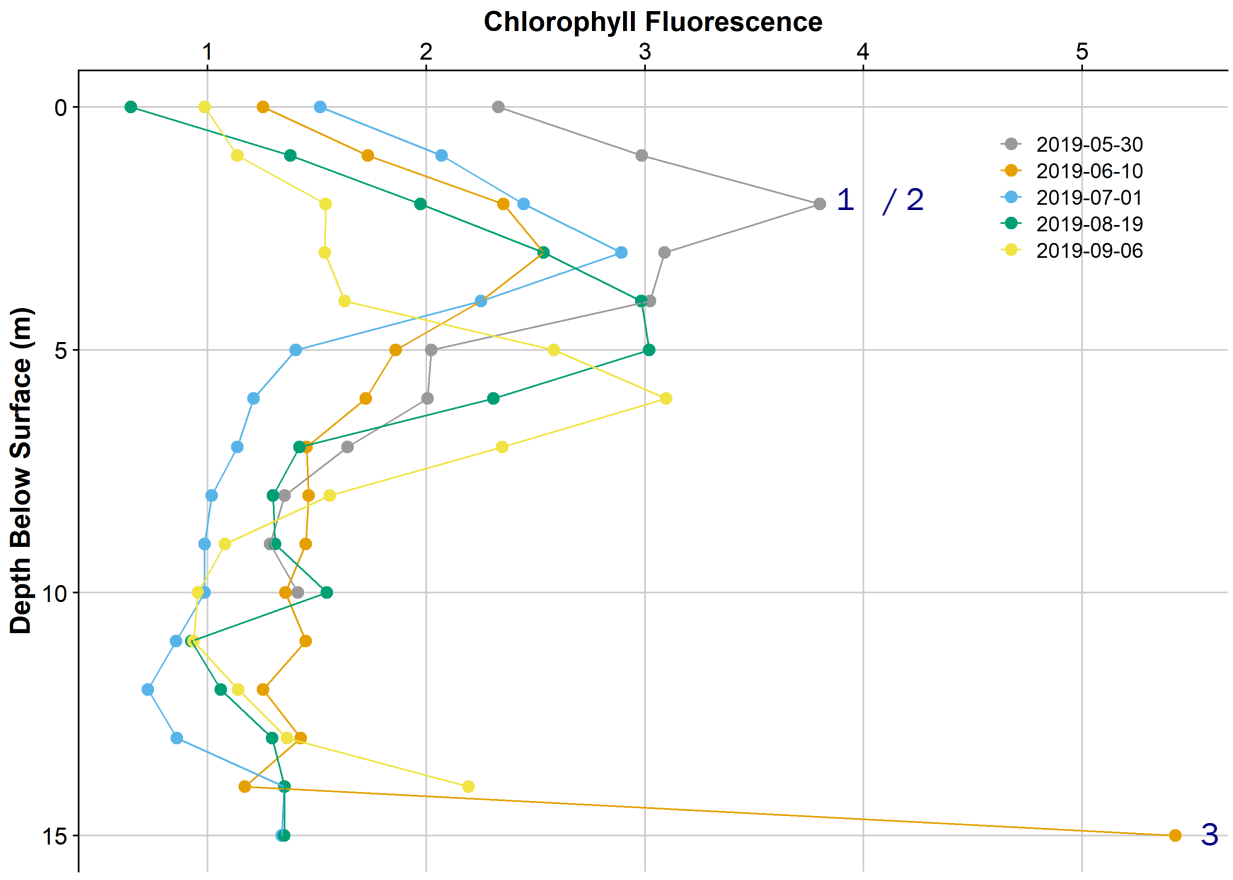
Middle Pond

Summary

Overall, all fluorescence readings (and therefore, chlorophyll-*a* concentrations) were very low. The highest reading in the water column was observed in May. This is likely due to the fact that colder temperatures result in a better fluorescence signal. The spike near the bottom in June was likely interference from bottom sediments. While cold water allows for a better fluorescence signal, peak readings on most waterbodies are usually observed in September or August. This was not the case on Middle Pond and may be a result of its highly colored waters inhibiting algae growth during the warmer months. As the summer progressed, peak fluorescence values occur deeper in the water column because the pond had become more stratified, pushing the thermocline further down into the water column.

The following events can be seen in the graph below:

1. Early season fluorescence peak was likely due to colder water temperatures.
2. Peak chlorophyll fluorescence occurred in May.
3. The spike in fluorescence seen near the pond bottom in June is likely caused by interference from bottom sediments.



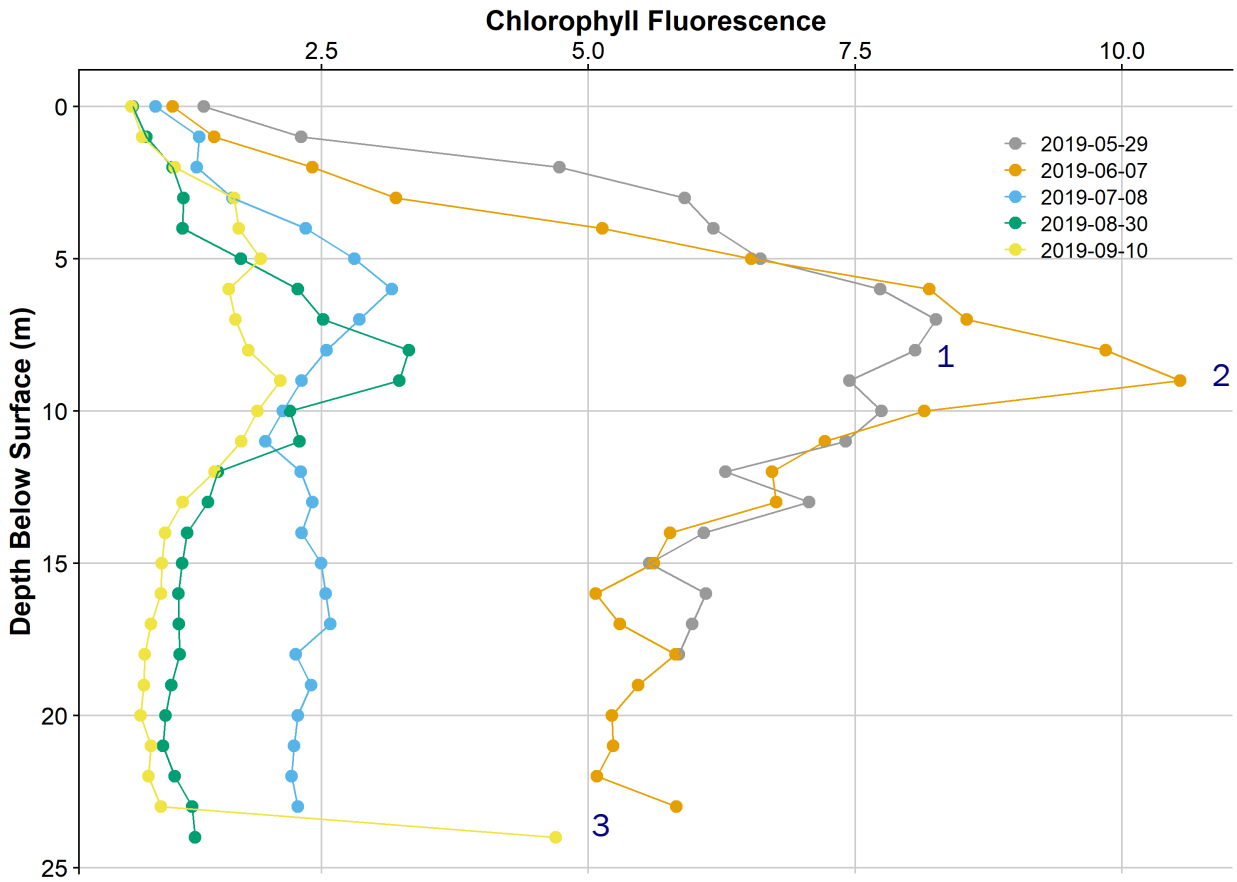
Moose Pond (Middle Basin)

Summary

Each month, an increase in fluorescence (and therefore, chlorophyll-*a*) near the thermocline, the zone of rapidly changing temperature and density that separates a lake's upper and lower layers during stratification, is seen. This phenomenon is common in many of the lakes we monitor and is a result of algae "sitting" on top of the denser cold water and continuing to photosynthesize. The highest fluorometric values were observed in May and June. This is unusual, as the highest readings are typically found in the months of August and September when the water is warmer and more conducive to fast growing algae.

The following events can be seen in the graph below:

1. Early season fluorescence peak was likely due to colder water temperatures.
2. Unusual early season peak chlorophyll fluorescence occurred in June.
3. The spike in fluorescence seen near the pond bottom in September is likely caused by interference from bottom sediments.



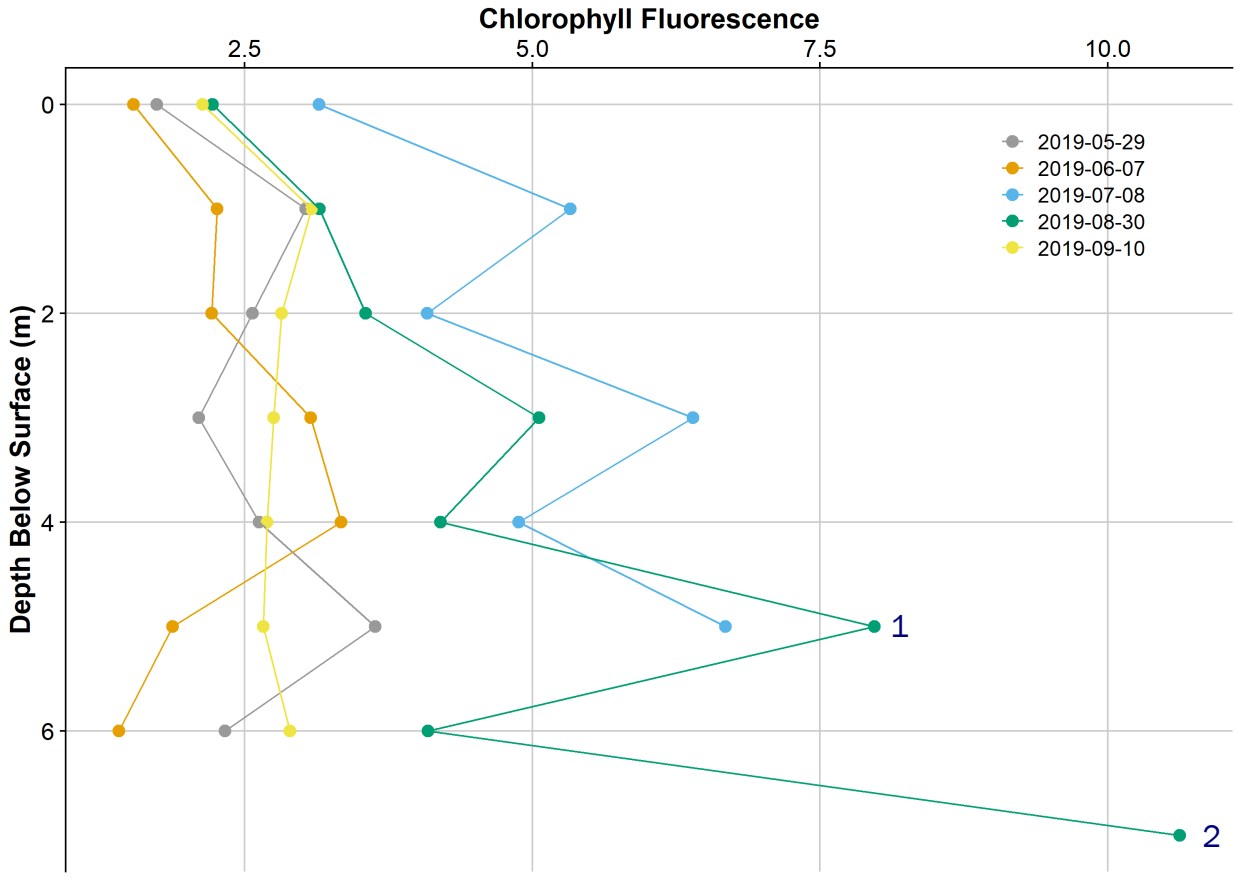
Moose Pond (North Basin)

Summary

Each month, an increase in fluorescence (and therefore, chlorophyll-*a*) near the thermocline, the zone of rapidly changing temperature and density that separates a lake's upper and lower layers during stratification, is seen. This phenomenon is common in many of the lakes we monitor and is a result of algae "sitting" on top of the denser cold water and continuing to photosynthesize.

The following events can be seen in the graph below:

1. Peak chlorophyll fluorescence occurred in August.
2. The spike in fluorescence seen near the pond bottom in August was likely caused by interference from bottom sediments.



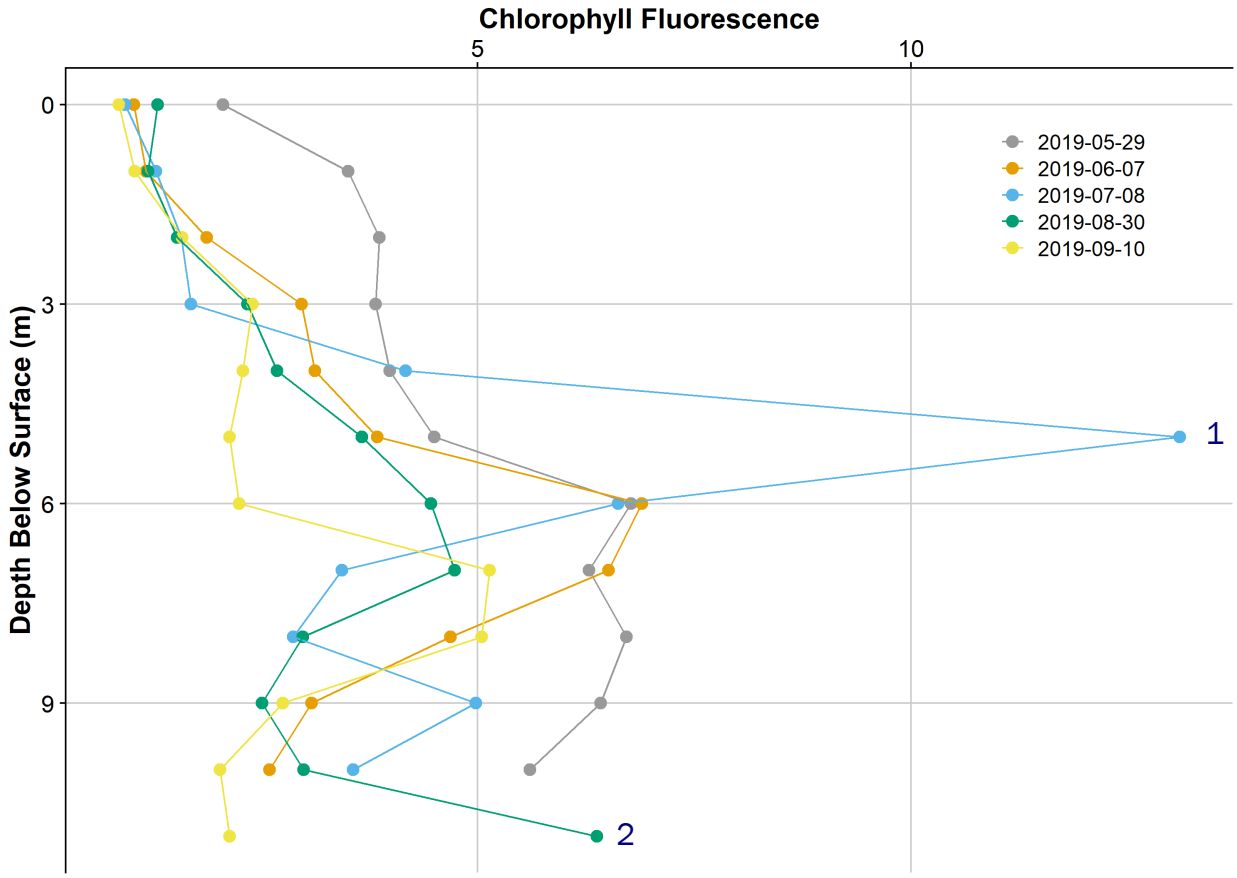
Moose Pond (South Basin)

Summary

Each month, an increase in fluorescence (and therefore, chlorophyll-*a*) near the thermocline, the zone of rapidly changing temperature and density that separates a lake's upper and lower layers during stratification, is seen. This phenomenon is common in many of the lakes we monitor and is a result of algae "sitting" on top of the denser cold water and continuing to photosynthesize. Peak fluorescence values in August and September are deeper than those in earlier months because the pond had become more stratified, pushing the thermocline further down into the water column. The highest fluorometric values were observed in July. This is unusual, as the highest readings are typically found in the months of August and September when the water is warmer and more conducive to fast growing algae.

The following events can be seen in the graph below:

1. Peak chlorophyll fluorescence occurred in July.
2. The spike in fluorescence seen near the pond bottom in August is likely caused by interference from bottom sediments.



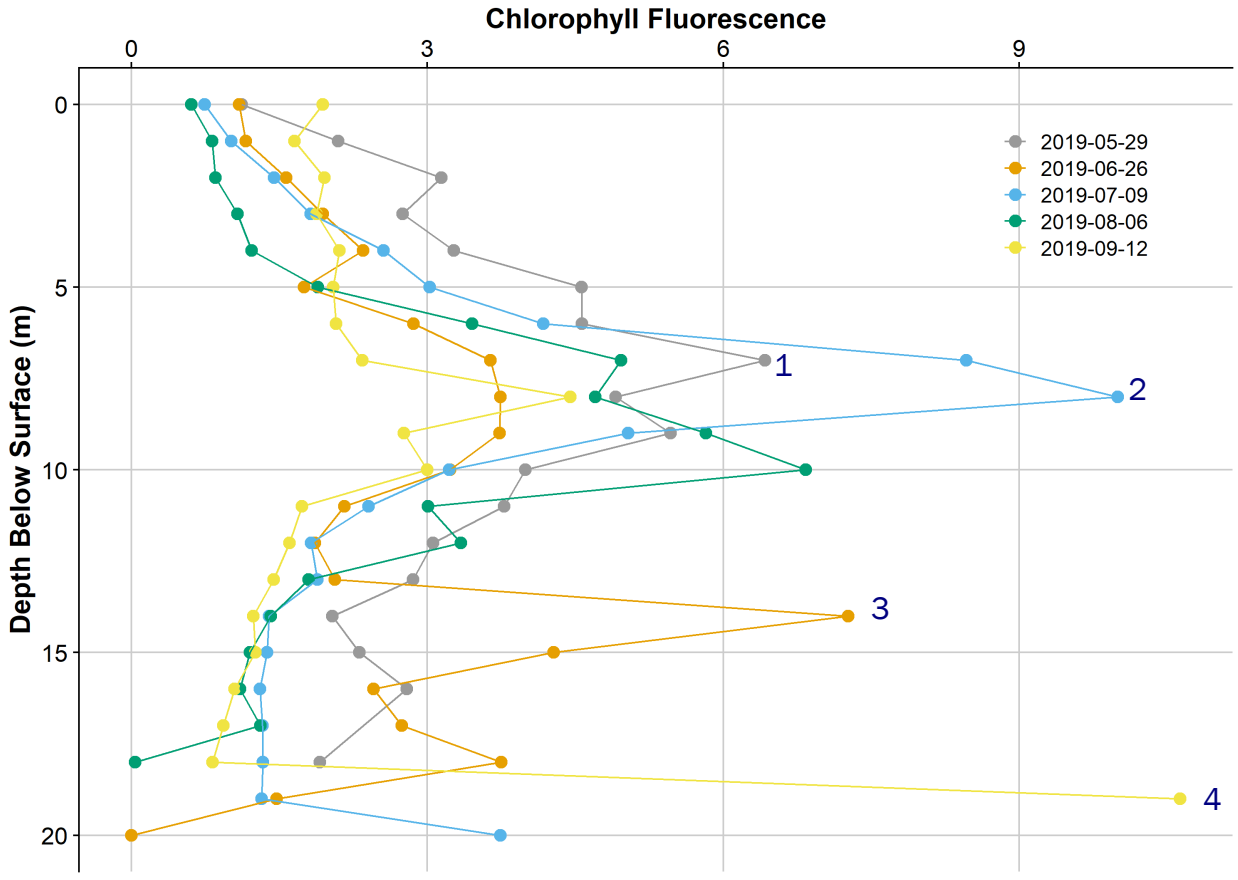
Peabody Pond

Summary

Each month, an increase in fluorescence (and therefore, chlorophyll-*a*) near the thermocline, the zone of rapidly changing temperature and density that separates a lake's upper and lower layers during stratification, is seen. This phenomenon is common in many of the lakes we monitor and is a result of algae "sitting" on top of the denser cold water and continuing to photosynthesize. Peak fluorescence values in June, July, August, and September are deeper than those in May because the pond had become more stratified, pushing the thermocline further down into the water column. There was a second, deeper peak seen in June at about 15 meters deep. This is unusual and could not be explained by other monitoring parameters collected that day. While peak fluormetric readings, and therefore chlorophyll concentrations, are typically seen in August and September, the peak this year came in the month of July.

The following events can be seen in the graph below:

1. Early season fluorescence peak was likely due to colder water temperatures.
2. Peak chlorophyll fluorescence occurred in July.
3. An unusual deep water fluorescence peak was seen in June.
4. The spike in fluorescence seen near the pond bottom in September is likely caused by interference from bottom sediments.



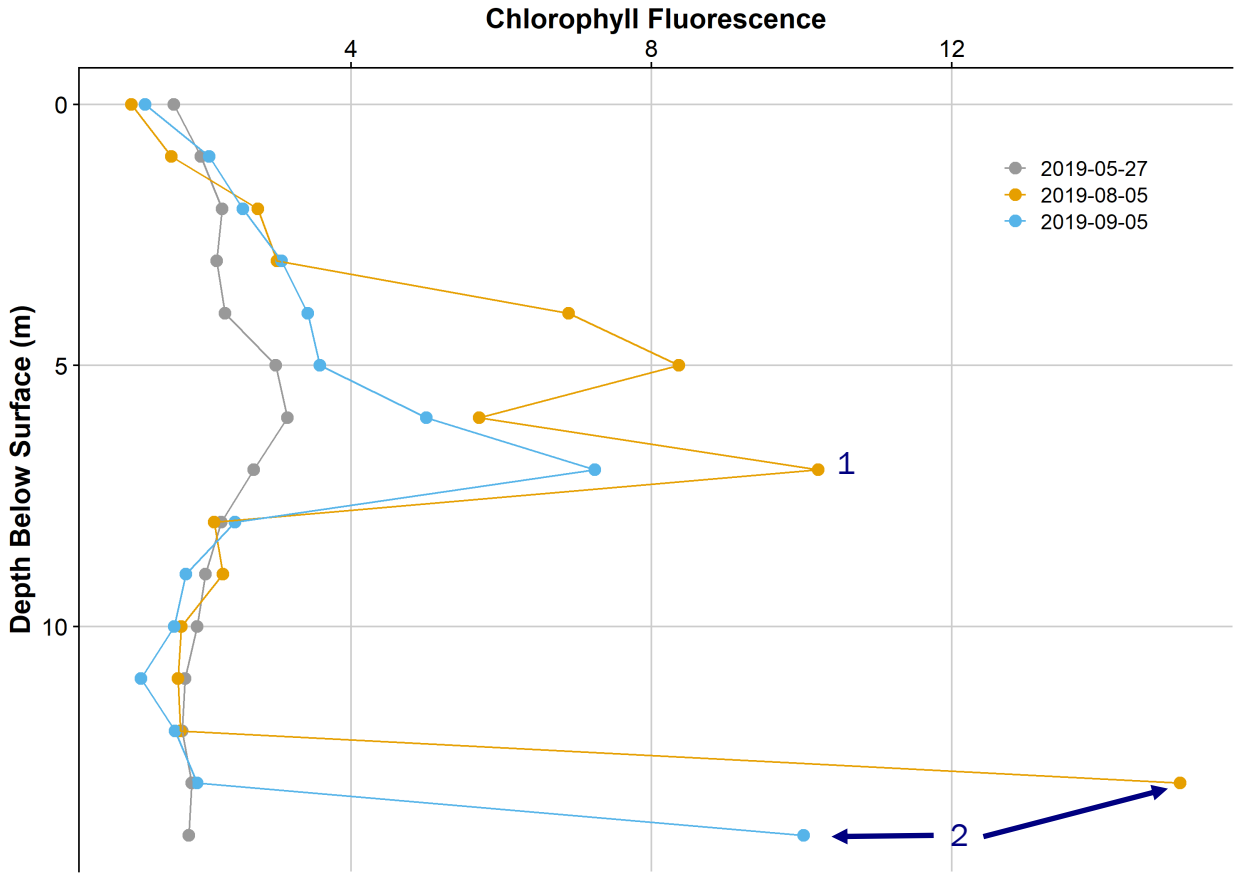
Sand Pond

Summary

An increase in fluorescence (and therefore, chlorophyll-*a*) near the thermocline, the zone of rapidly changing temperature and density that separates a lake's upper and lower layers during stratification, is seen in August and September and, to a lesser extent, in May. This phenomenon is common in many of the lakes we monitor and is a result of algae "sitting" on top of the denser cold water and continuing to photosynthesize. Peak fluorescence values were seen in August. Although the fluorescence signal is less strong in warmer waters, these temperatures are more conducive to fast-growing algae, and for this reason, we see the highest readings in August and September. Fluorescence data are missing for June and July due to sampling errors.

The following events can be seen in the graph below:

1. Peak chlorophyll fluorescence occurred in August.
2. The spike in fluorescence seen near the pond bottom in September is likely caused by interference from bottom sediments.



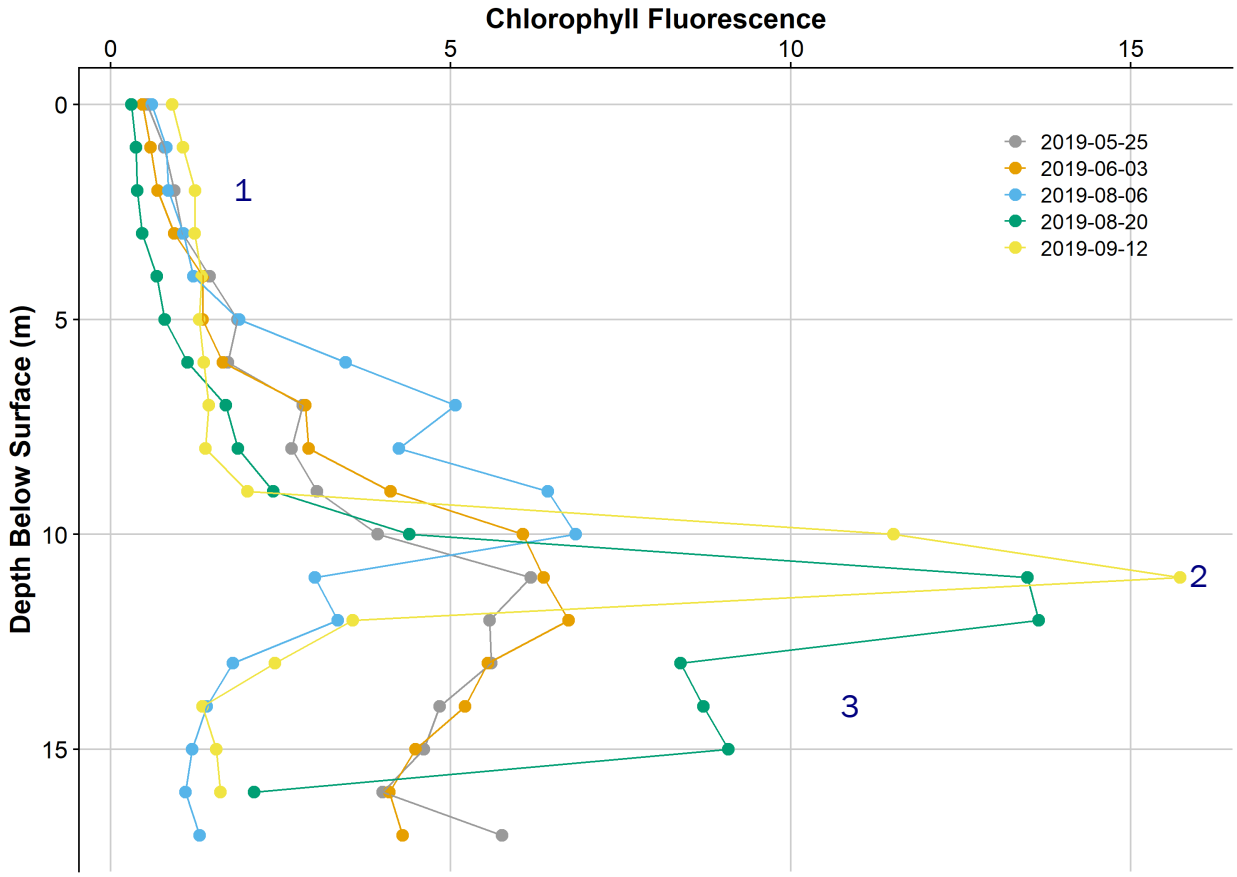
Trickey Pond

Summary

Each month, an increase in fluorescence (and therefore, chlorophyll-*a*) near the thermocline, the zone of rapidly changing temperature and density that separates a lake's upper and lower layers during stratification, is seen. This phenomenon is common in many of the lakes we monitor and is a result of algae "sitting" on top of the denser cold water and continuing to photosynthesize. Although the fluorescence signal is less strong in warmer waters, these temperatures are more conducive to fast-growing algae, and for this reason, we see the highest readings in August and September. Due to Trickey Pond's clear waters, algae concentrations, as seen in fluorometric peaks, are seen much deeper in the water column compared to other water bodies.

The following events can be seen in the graph below:

1. Chlorophyll-*a* values, as seen through fluorescence, are very low in the upper waters of Trickey Pond.
2. Peak chlorophyll fluorescence occurred in September.
3. Sustained chlorophyll fluorescence lasting several meters in September



Woods Pond

Summary

Each month, an increase in fluorescence (and therefore, chlorophyll-*a*) near the thermocline, the zone of rapidly changing temperature and density that separates a lake's upper and lower layers during stratification, is seen. This phenomenon is common in many of the lakes we monitor and is a result of algae "sitting" on top of the denser cold water and continuing to photosynthesize. The fluorescence peak seen in May is less pronounced than in other months because the water column is not yet fully stratified. The largest fluorescence peak was seen in June. This is likely due to the fact that colder water temperatures result in a better fluorescence signal. On most water bodies, peak fluorescence is observed in August or September. However, on Woods Pond the peak has been documented earlier in the season for the last two years. This is likely a result of low overall values combined with a stronger fluorometric signal in colder water.

The following events can be seen in the graph below:

1. Early season fluorescence peak was likely due to colder water temperatures.
2. Peak chlorophyll fluorescence occurred in June.
3. Sustained chlorophyll fluorescence lasting several meters in September