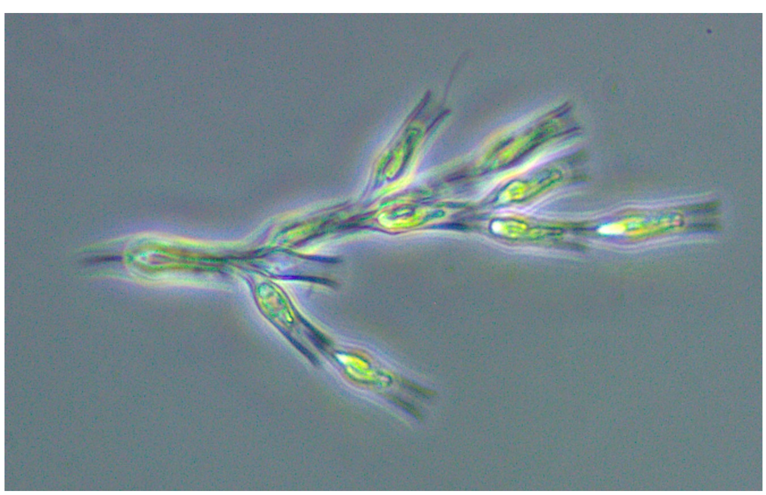
Lakes Environmental Association
2020 Water Testing Report

Chapter 4
Algae Monitoring via Fluorometer Profiles



LEA's Algae & Fluorometric Chlorophyll Monitoring Programs

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

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 during 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.

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 1°C 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 result in Relative Fluorescence Units (RFUs). This measurement result 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 among 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.

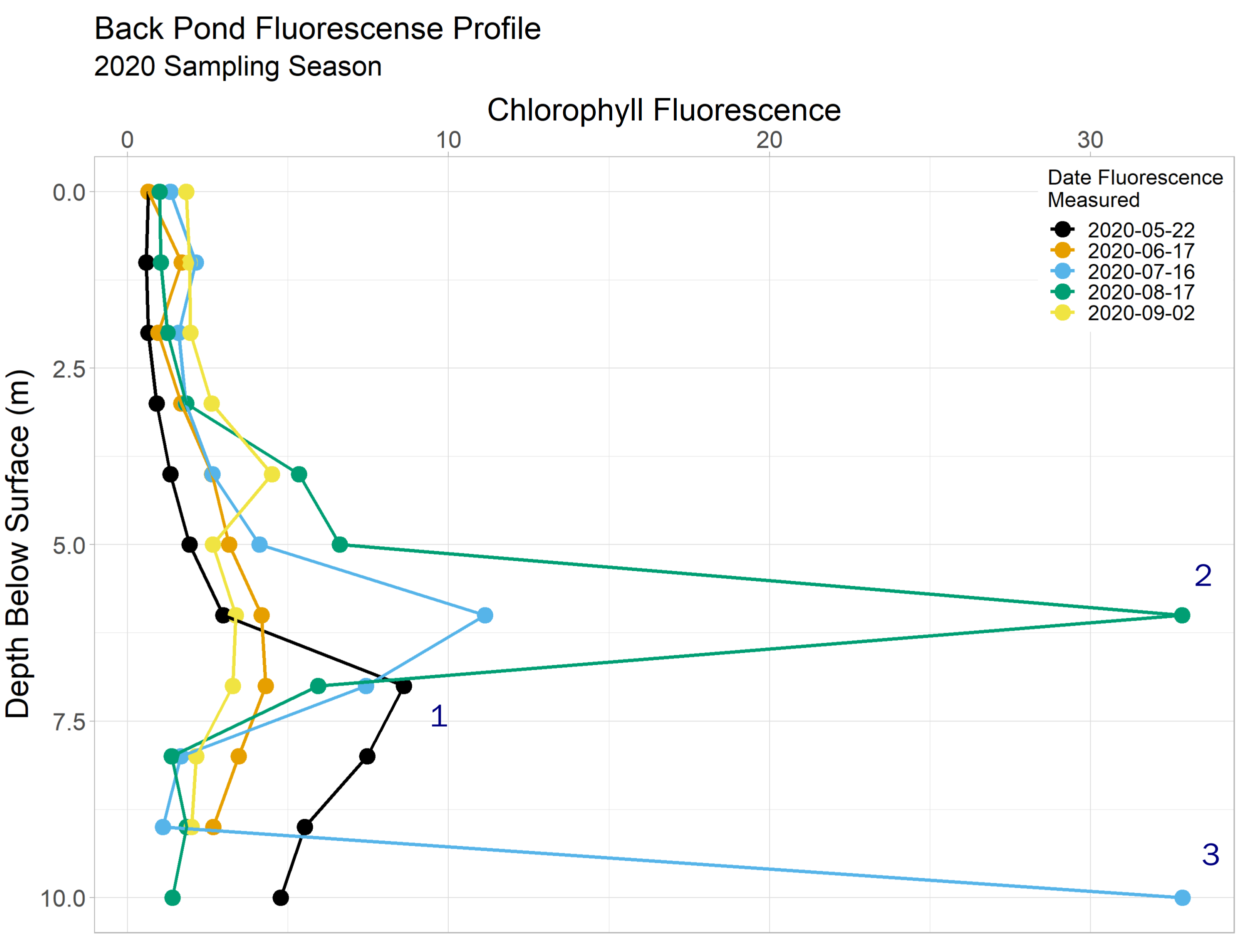
Back Pond

Summary

Each month, except June and September, 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 likely a result of algae "sitting" on top of the denser cold water and continuing to photosynthesize. The largest fluorescence peak was 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 July and August, when water temperatures were highest.

The following events can be seen in the graph below:

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



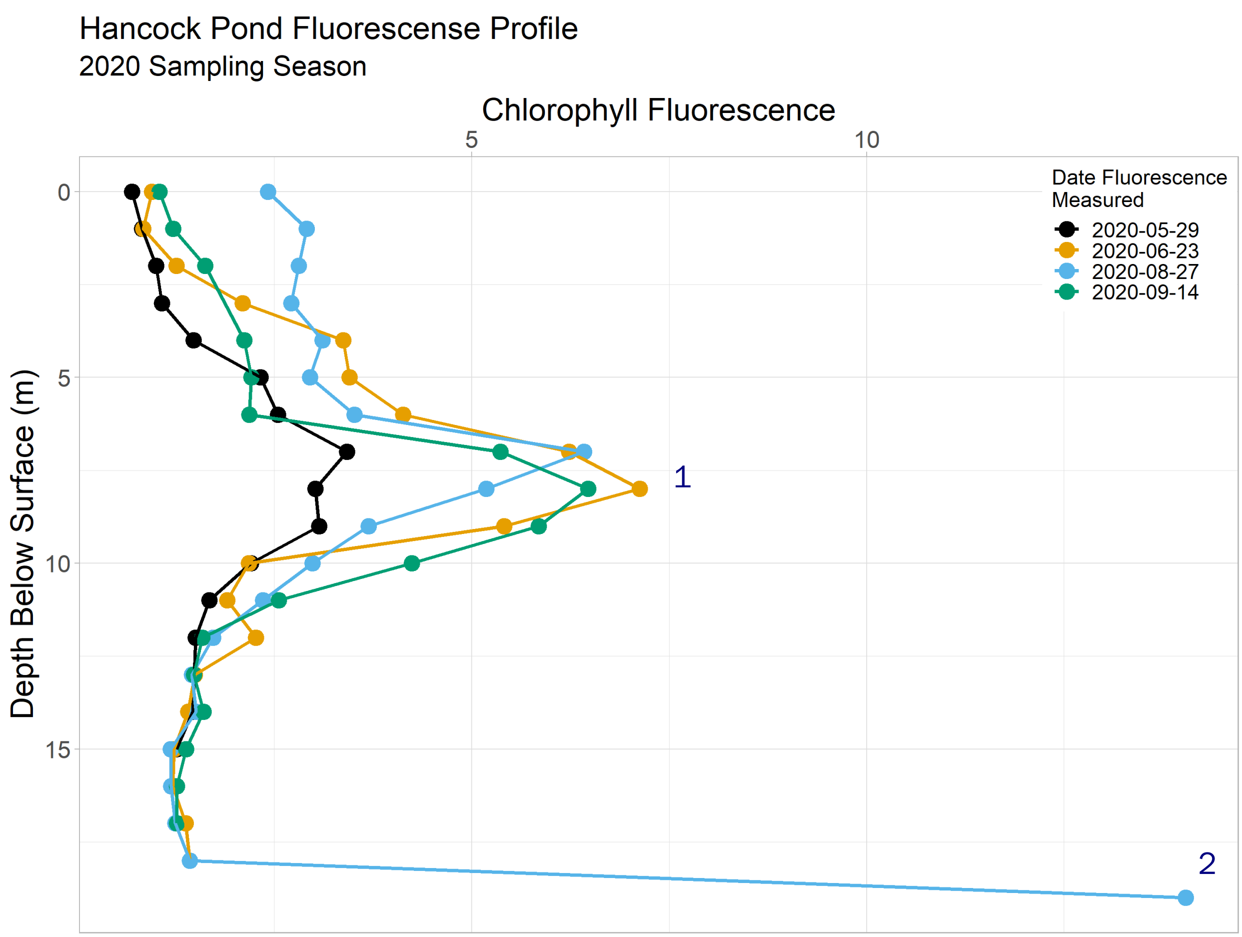
Hancock Pond

Summary

Each month, peak fluorescence (and therefore chlorophyll-a) is observed near the thermocline (the zone of rapidly changing temperature and density that separates a lake's upper and lower layers during stratification). The largest fluorescence peak was seen in June, although the reading from July is missing. 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 mid summer, when water temperatures were warmest. In 2020 peak readings were similar in July, August and September with the highest reading in June.

The following events can be seen in the graph below:

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



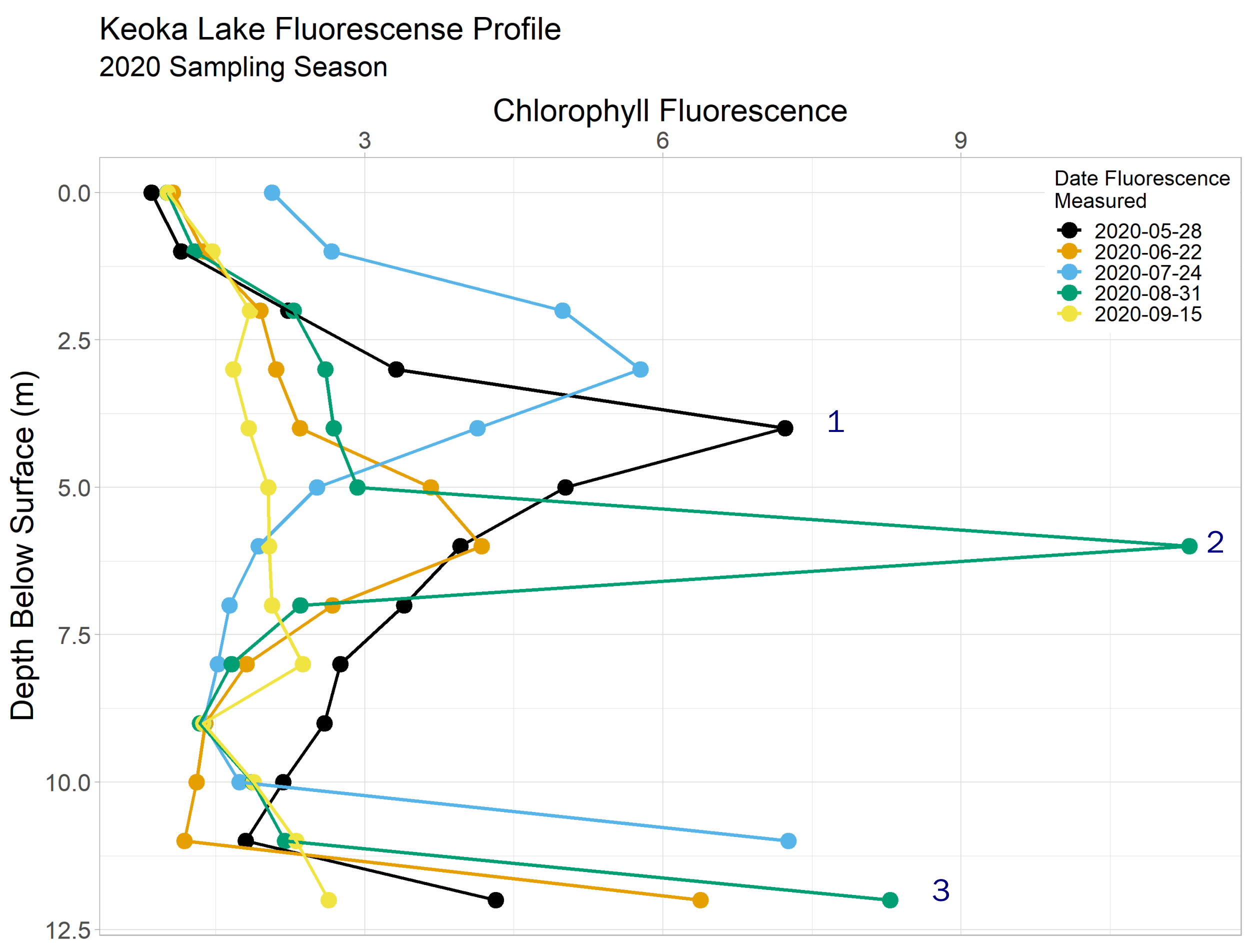
Keoka Lake

Summary

Each month, a fluorometric profile was taken to identify approximate chlorophyll-a concentrations via strength of fluorescence signal. 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 most months. This phenomenon is common in many of the lakes we monitor and is likely 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.

The following events can be seen in the graph below:

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



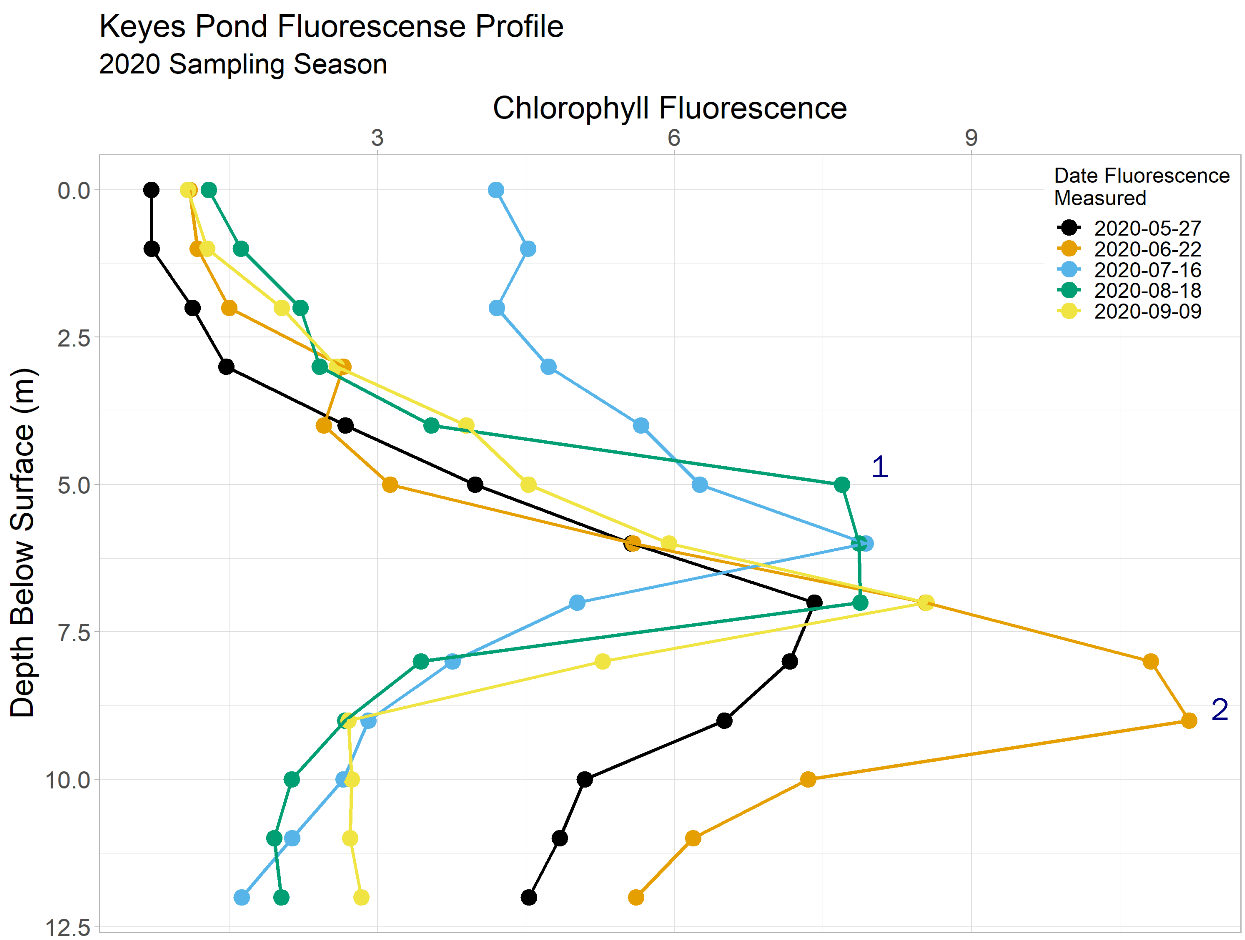
Keyes Pond

Summary

Each month, a fluorometric profile was taken to identify approximate chlorophyll-a concentrations via strength of fluorescence signal. 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 each month. This phenomenon is common in many of the lakes we monitor and is likely 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 mid-summer, when waters were reaching their highest temperatures.

The following events can be seen in the graph below:

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



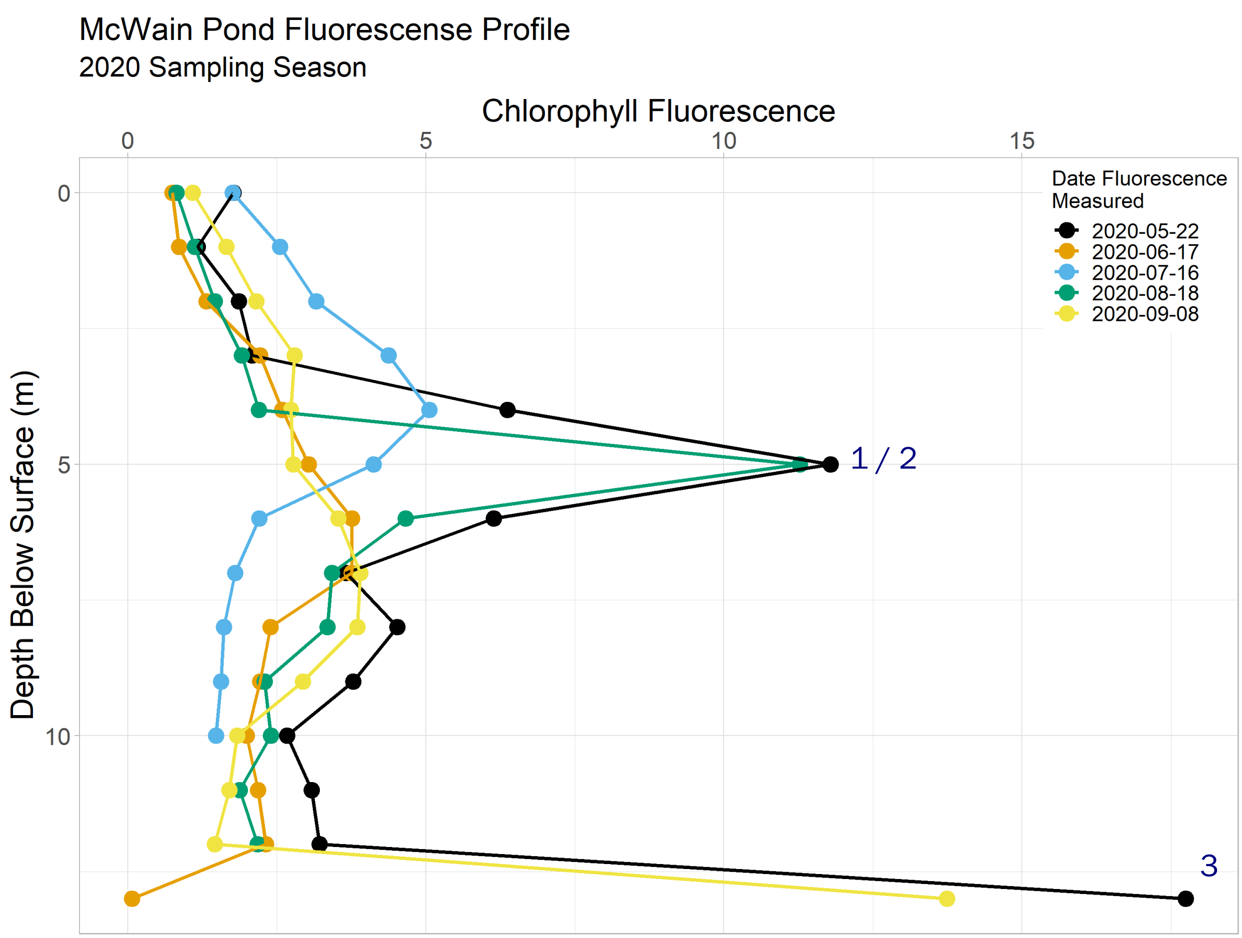
McWain Pond

Summary

Each month, a fluorometric profile was taken to identify approximate chlorophyll-a concentrations via strength of fluorescence signal. 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 most months. This phenomenon is common in many of the lakes we monitor and is likely a result of algae "sitting" on top of the denser cold water and continuing to photosynthesize. Peak florescence was seen n May and August. The May peak was likely augmented by the fact that colder temperatures result in better florescence. The August peak was likely a result of more algae biomass in the water because warmer water is conducive to fast growing algae.

The following events can be seen in the graph below:

1. Early season fluorescence peak likely due to stronger flurometric signals in colder water.
2. Peak chlorophyll fluorescence occurred in May and August.
3. The spike in fluorescence seen near the pond bottom in September is likely caused by interference from bottom sediments.



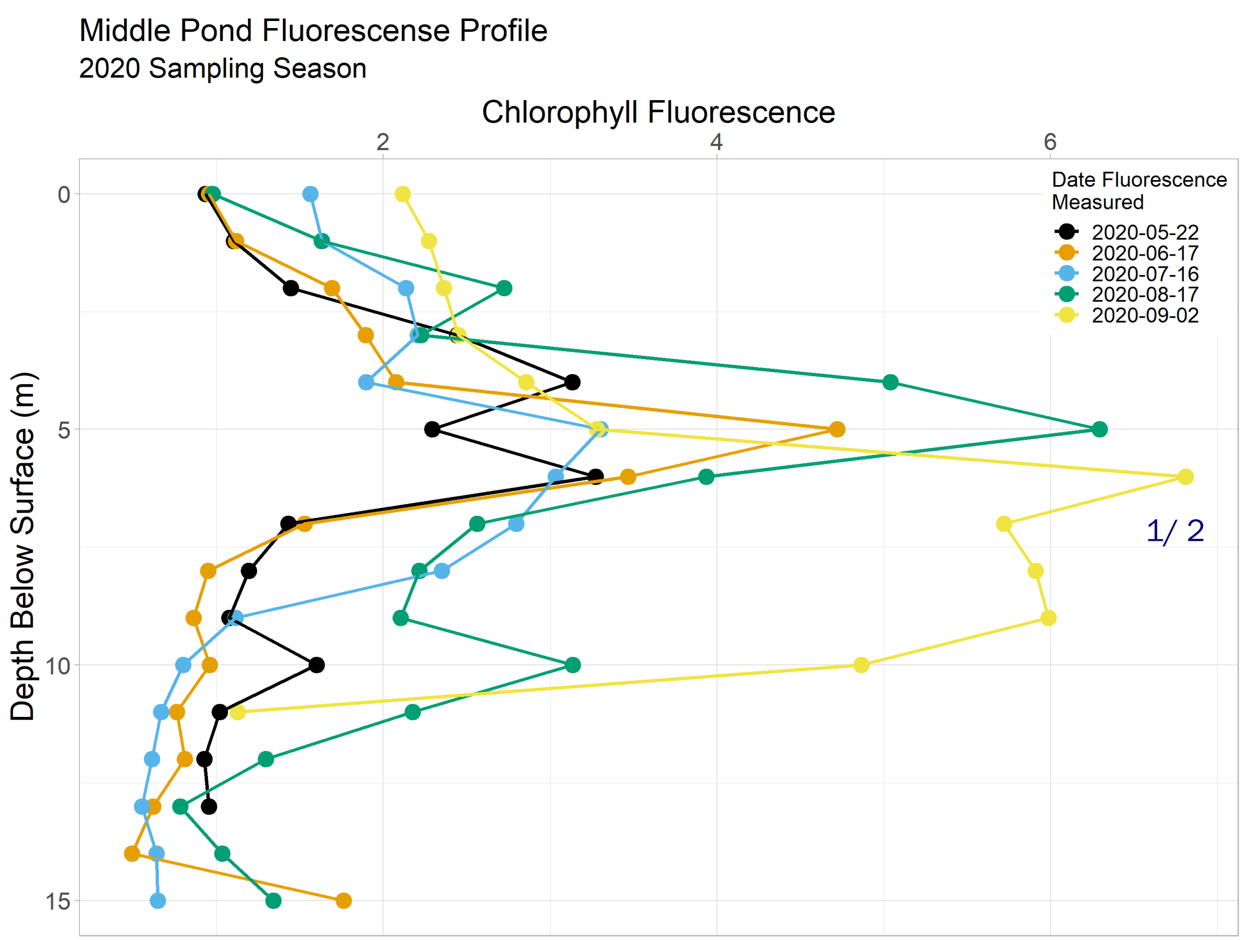
Middle Pond

Summary

Each month, a fluorometric profile was taken to identify approximate chlorophyll-a concentrations via strength of fluorescence signal. 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 most months. This phenomenon is common in many of the lakes we monitor and is likely 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 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 September



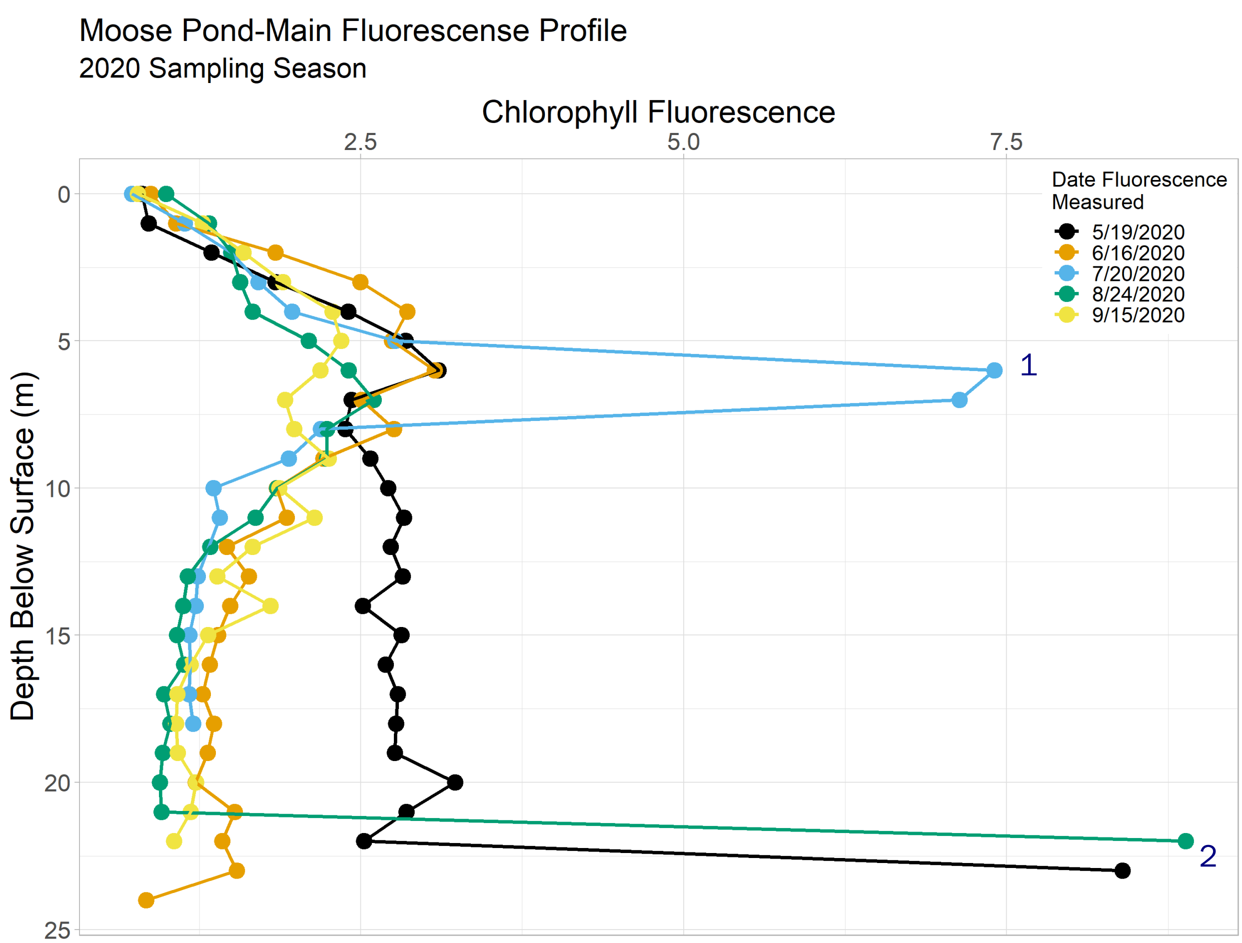
Moose Pond (middle basin)

Summary

Each month, a fluorometric profile was taken to identify approximate chlorophyll-a concentrations via strength of fluorescence signal. 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 most months. This phenomenon is common in many of the lakes we monitor and is likely 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 late July, when waters were reaching their highest temperatures. Flurometric values were high in the bottom waters during May and August but this is likely caused by interference from bottom sediments.

The following events can be seen in the graph below:

1. Chlorophyll fluorescence spiked in July.
2. The spike in fluorescence seen near the pond bottom in May and August is likely caused by interference from bottom sediments.



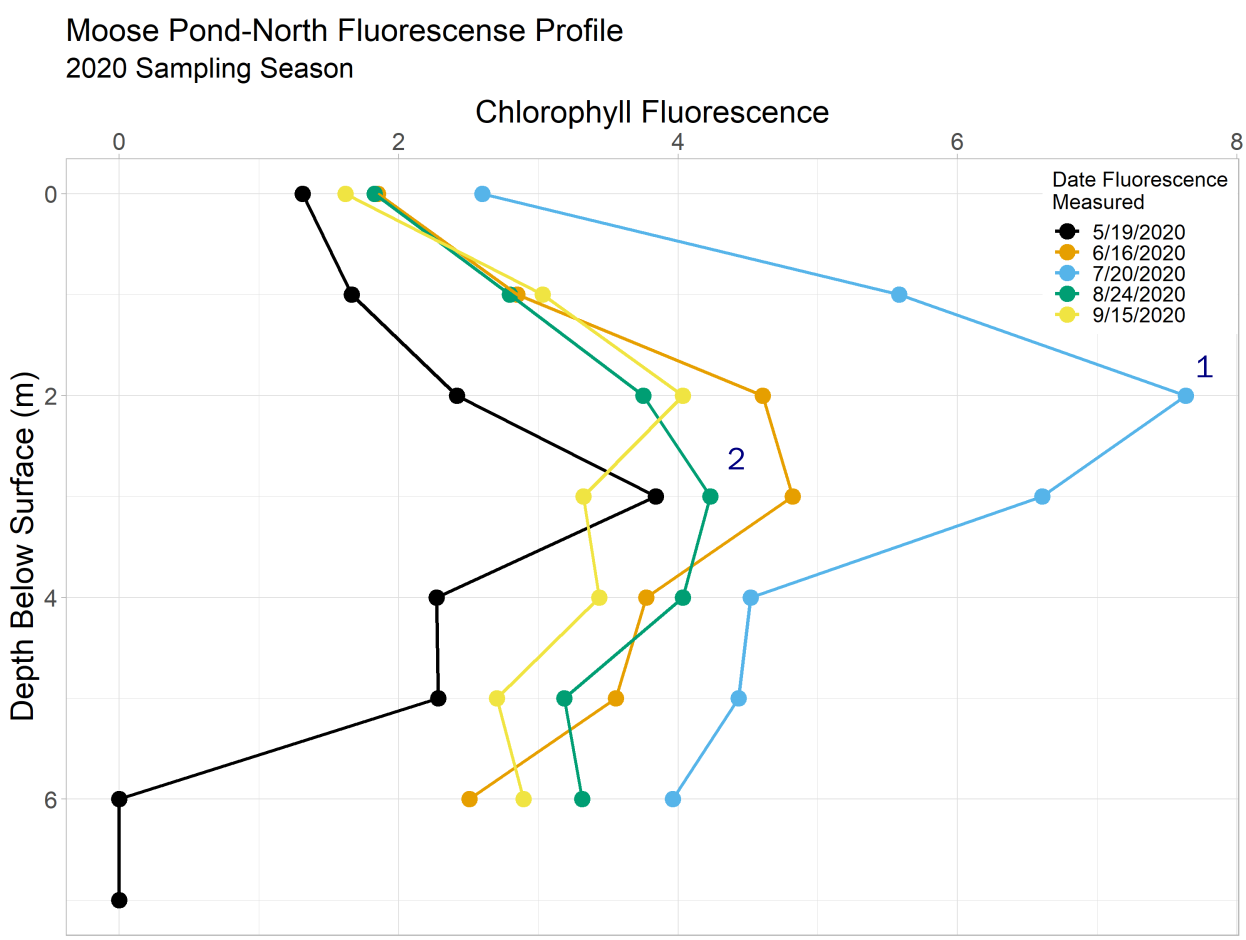
Moose Pond (north basin)

Summary

Each month, a fluorometric profile was taken to identify approximate chlorophyll-a concentrations via strength of fluorescence signal. 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 months. This phenomenon is common in many of the lakes we monitor and is likely 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 July, when waters were reaching their warmest temperatures.

The following events can be seen in the graph below:

1. Peak chlorophyll fluorescence occurred in July.
2. Sustained chlorophyll fluorescence lasting several meters in June through August.



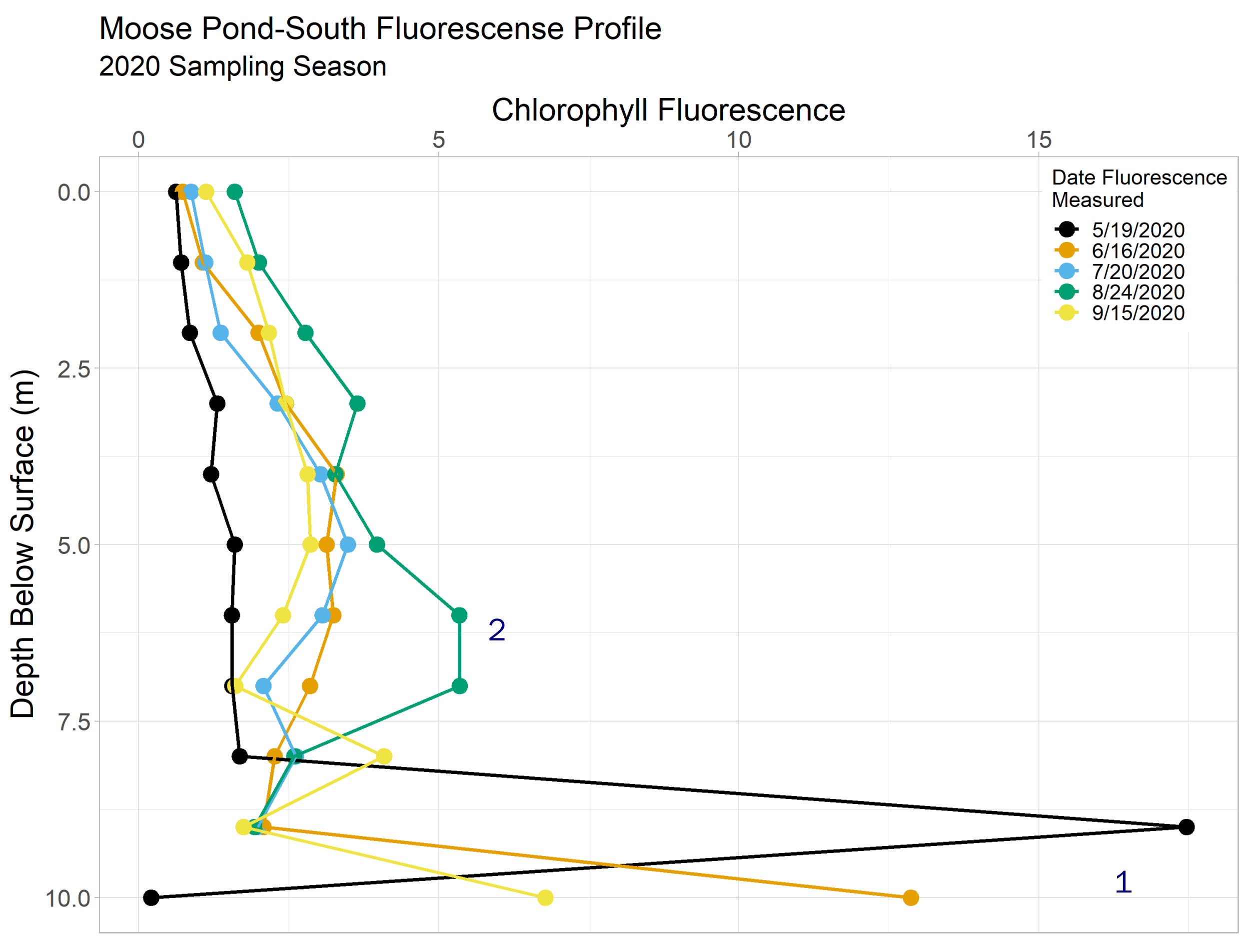
Moose Pond (south basin)

Summary

Each month, a fluorometric profile was taken to identify approximate chlorophyll-a concentrations via strength of fluorescence signal. 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 most months. This phenomenon is common in many of the lakes we monitor and is likely a result of algae "sitting" on top of the denser cold water and continuing to photosynthesize. Unlike Moose Pond's other basins, flurorescence in Moose Pond's south basin wasn't as pronounced near the thermocline. Peak florescence was seen n May. The May peak was likely augmented by the fact that colder temperatures result in better florescence. The August peak was likely a result of more algae biomass in the water because warmer water is conducive to fast growing algae.

The following events can be seen in the graph below:

1. Peak chlorophyll fluorescence in May, June, and September were likely caused by interference from bottom sediments.
2. Flurometric between 6-7 meters in August were likely the "true" peak for the season.



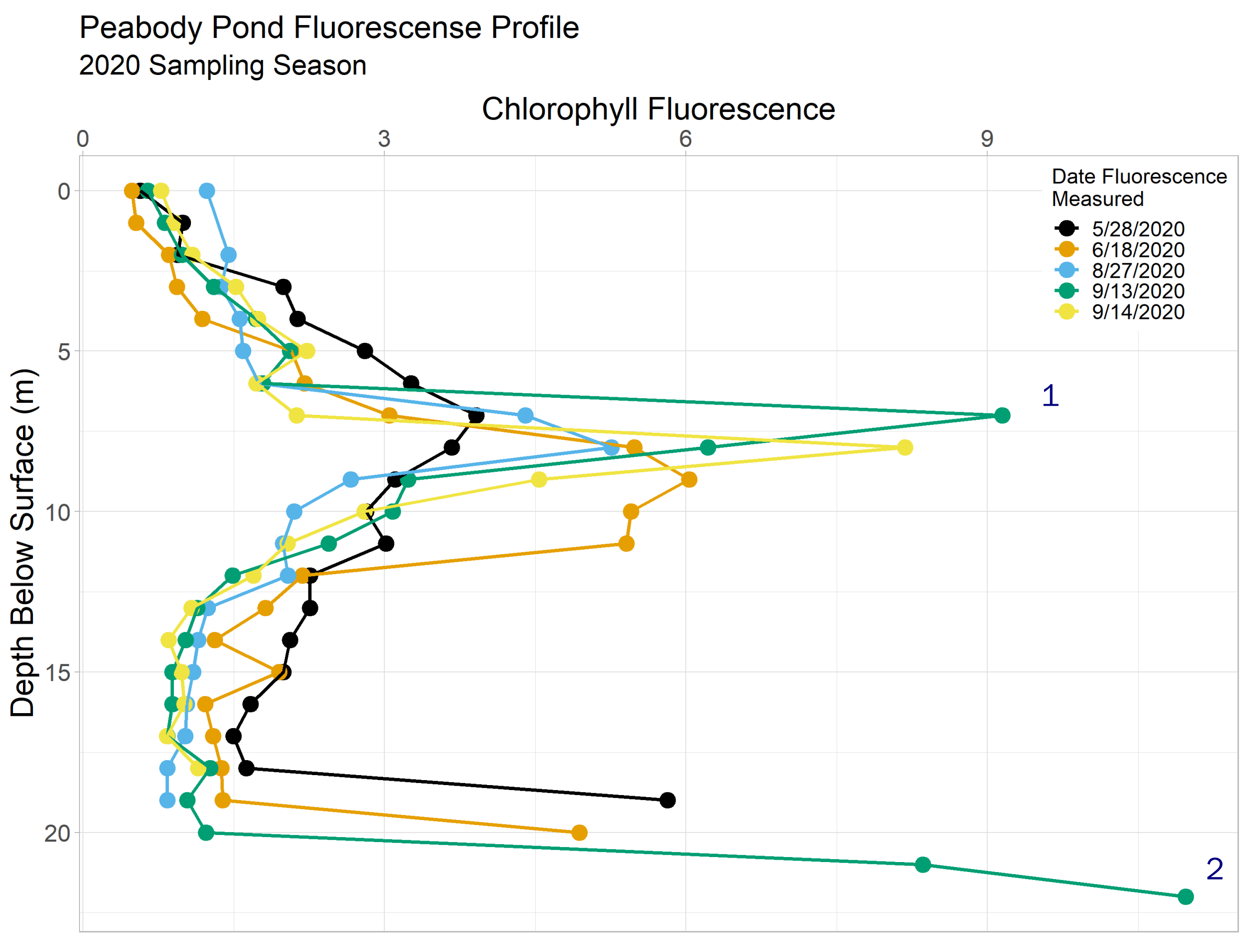
Peabody Pond

Summary

Each month, a fluorometric profile was taken to identify approximate chloorphyll-a concentrations via strength of fluorescence signal. 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 each month. This phenomenon is common in many of the lakes we monitor and is likely 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 September.

The following events can be seen in the graph below:

1. Peak chlorophyll fluorescence occurred in September.
2. The spike in fluorescence seen near the pond bottom in May, June, and September was likely caused by interference from bottom sediments.



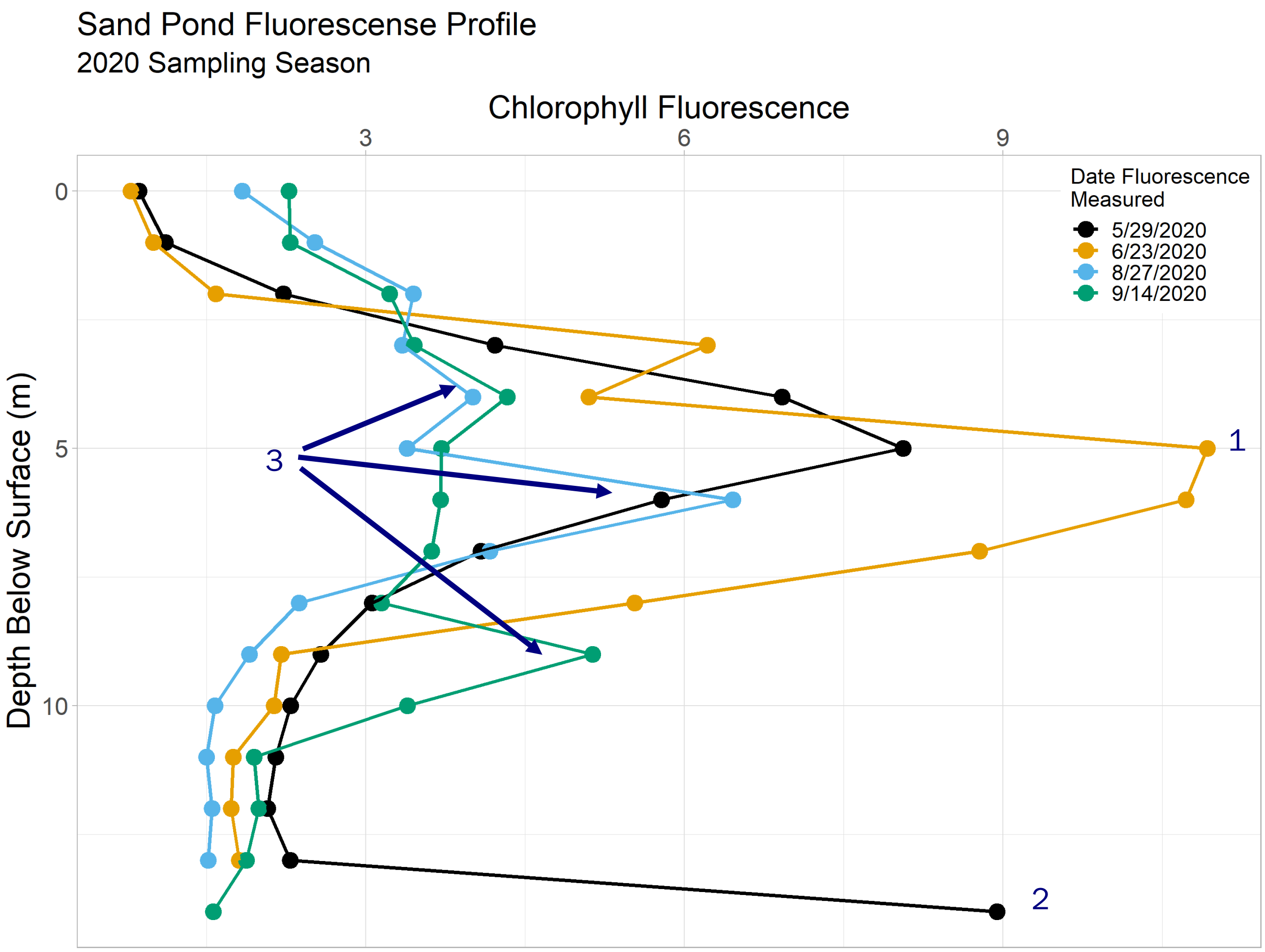
Sand Pond

Summary

Each month, a fluorometric profile was taken to identify approximate chlorophyll-a concentrations via strength of fluorescence signal. 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 each month. This phenomenon is common in many of the lakes we monitor and is likely a result of algae "sitting" on top of the denser cold water and continuing to photosynthesize. Peak fluorescence values were seen in late June. Although the fluorescence signal is less strong in warmer waters, these temperatures are more conducive to fast-growing algae, and this likely contributed to the June peak.

The following events can be seen in the graph below:

1. Peak chlorophyll fluorescence occurred in June.
2. The spike in fluorescence seen near the pond bottom in May is likely caused by interference from bottom sediments.
3. Both August and September had 2 peaks, one in the upper waters and one near the thermocline.



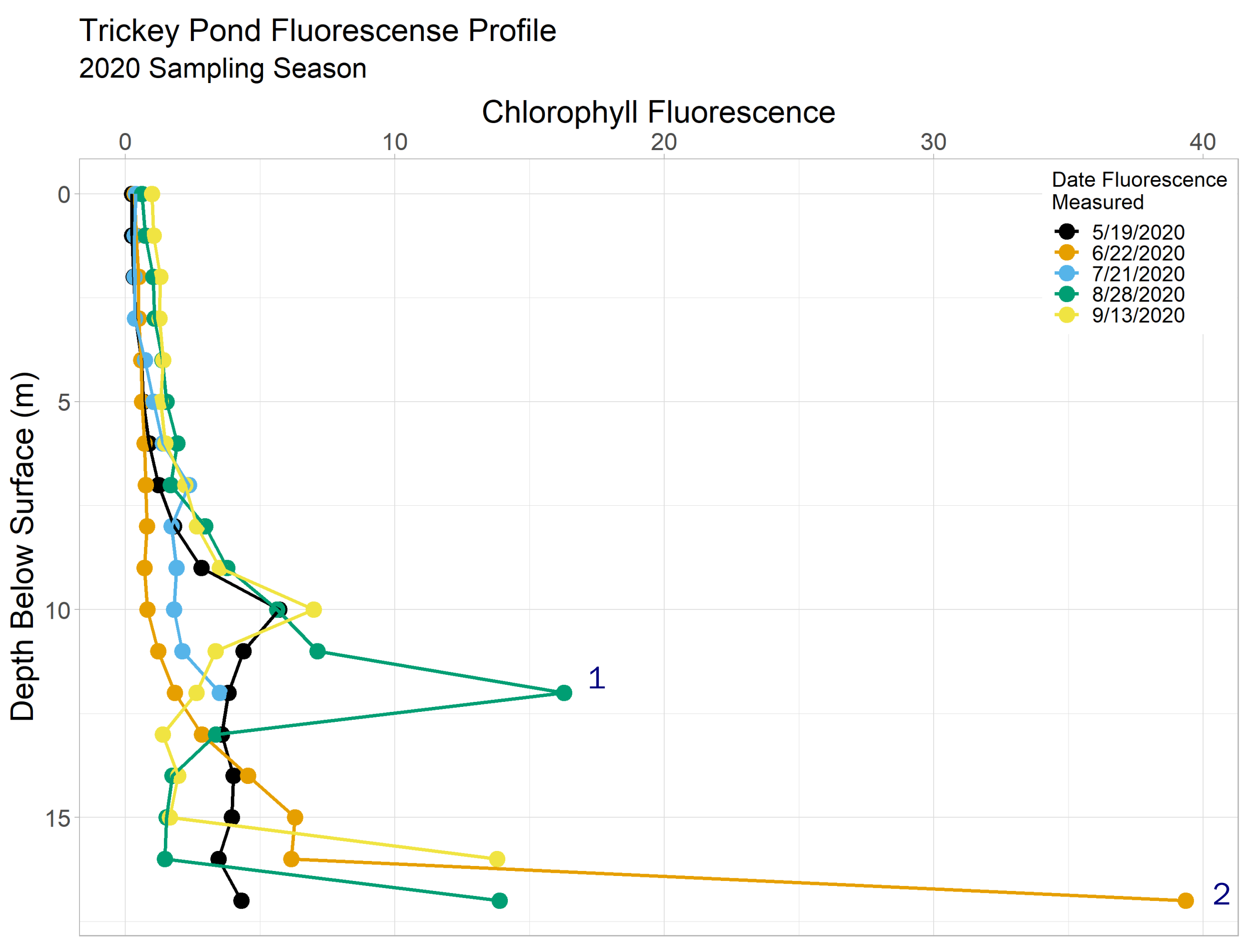
Trickey Pond

Summary

Each month, a fluorometric profile was taken to identify approximate chlorophyll-a concentrations via strength of fluorescence signal. 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 May, August, and September. This phenomenon is common in many of the lakes we monitor and is likely 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. 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. Peak chlorophyll fluorescence occurred in August.
2. The spike in fluorescence seen near the pond bottom in June, August, and September is likely caused by interference from bottom sediments.



Woods Pond

Summary

Each month, a fluorometric profile was taken to identify approximate chlorophyll-a concentrations via strength of fluorescence signal. 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 most months and was prominent in May, June, and July. This phenomenon is common in many of the lakes we monitor and is likely a result of algae "sitting" on top of the denser cold water and continuing to photosynthesize. Peak fluorescence values were seen in June. Although the fluorescence signal is less strong in warmer waters, these temperatures are more conducive to fast-growing algae.

The following events can be seen in the graph below:

1. Early season fluorescence peak likely due to stronger flurometric signals in colder water.
2. Peak chlorophyll fluorescence occurred in June.