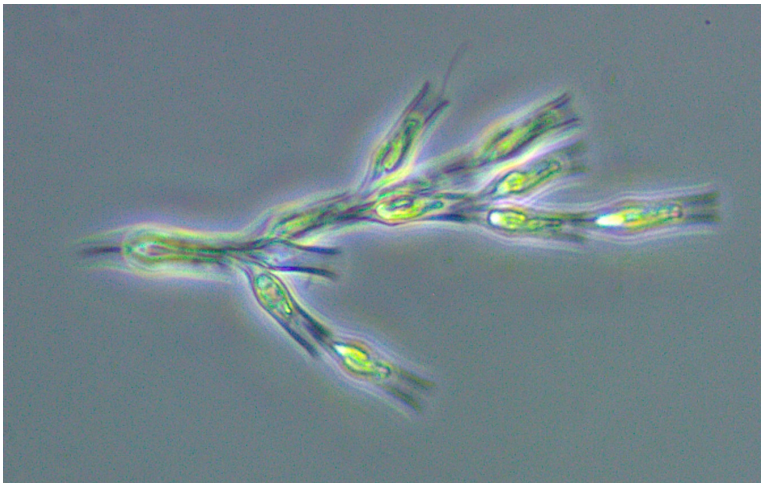
Lakes Environmental Association
2021 Water Testing Report

Chapter 4
Algae Monitoring via Fluorometer Profiles



LEA's Algae & Fluorometric 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 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.

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

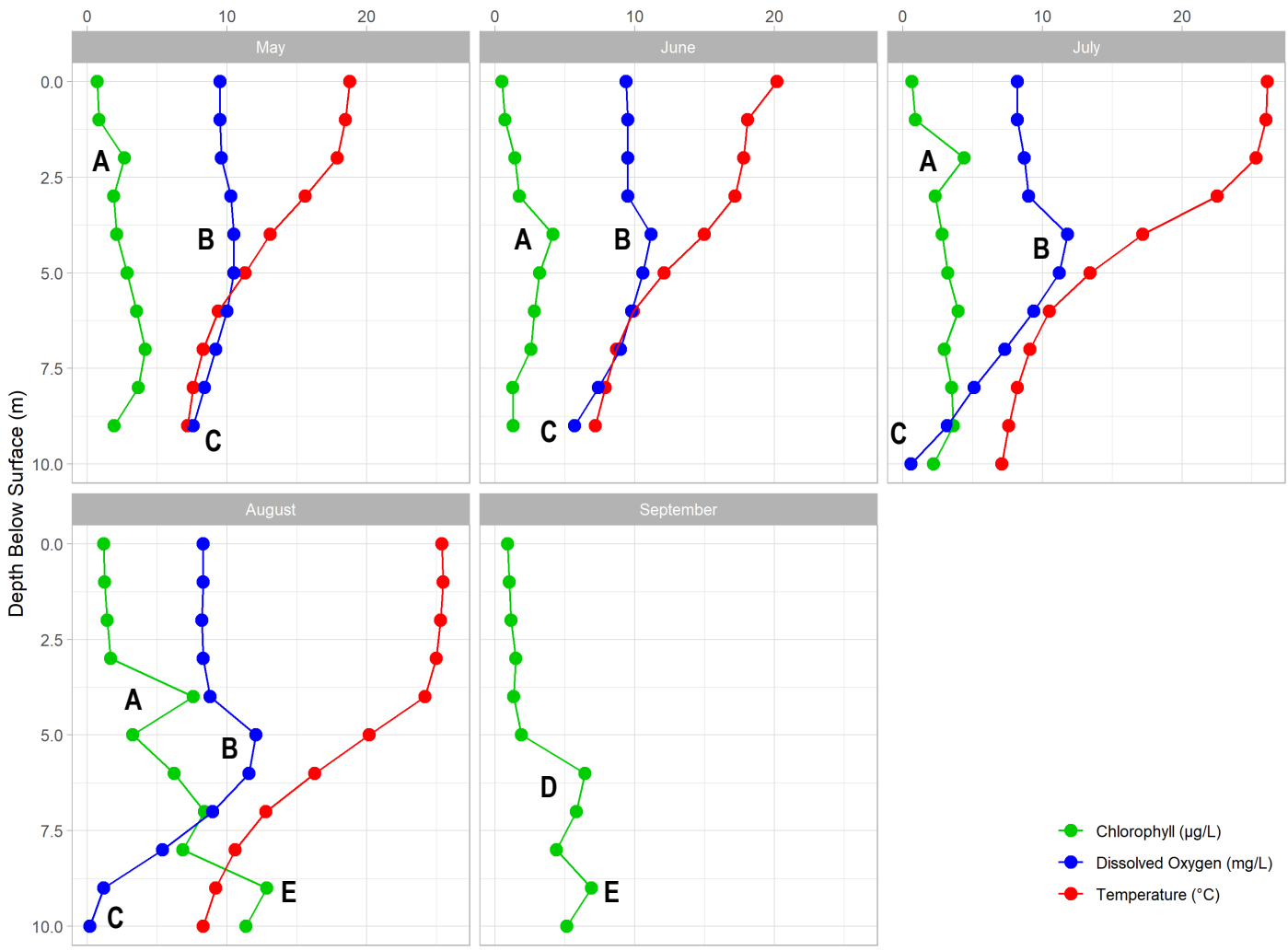
The fluorometer, which is calibrated to measure chlorophyll-a, works by emitting blue light at a specific wavelength designed to cause the chlorophyll-a molecules to enter a high-energy ("excited") state. When the molecules return to their normal state, they give off light (fluoresce) at a different 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 the lakes and ponds listed on the right 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 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.

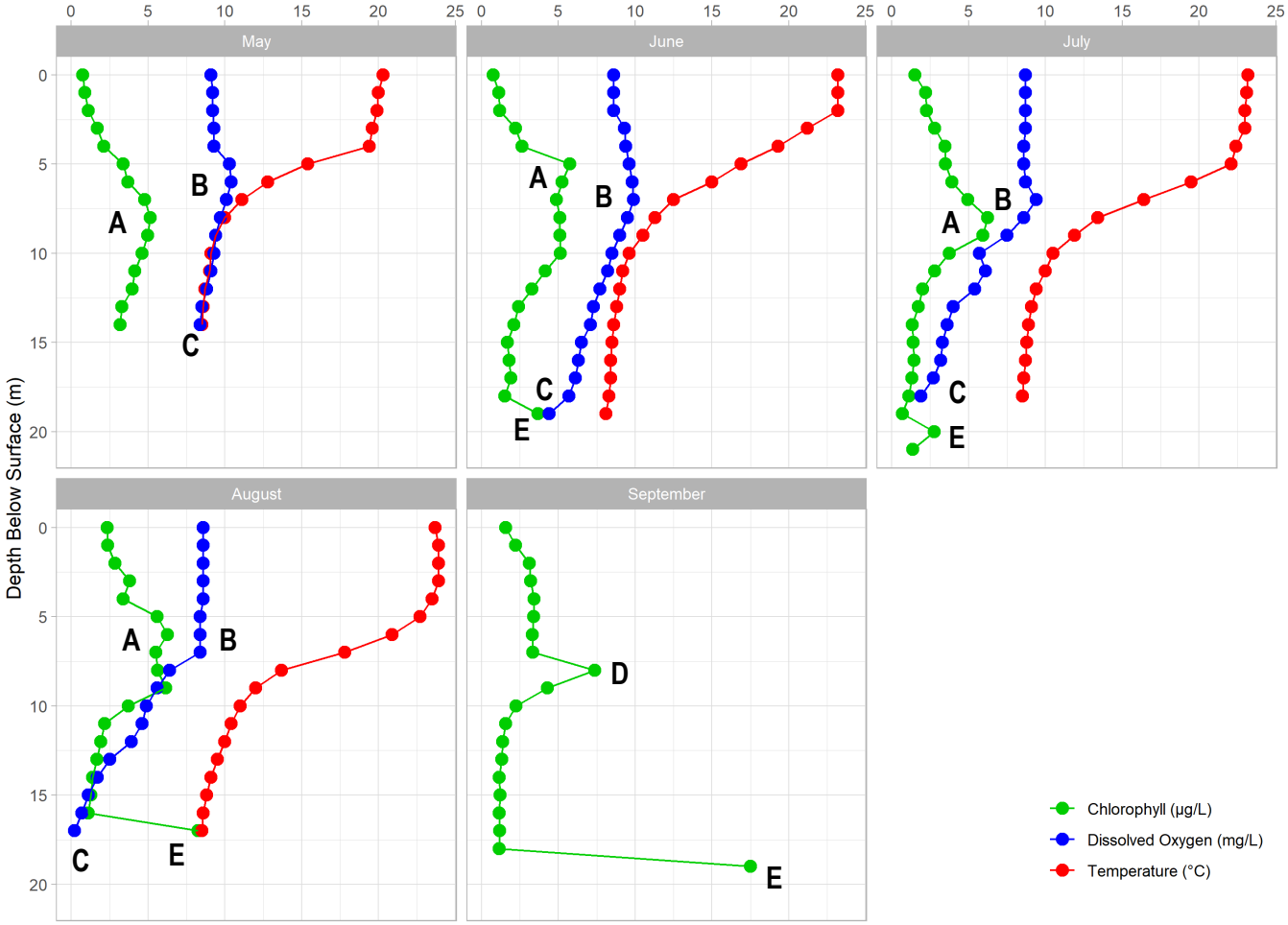
Back Pond

Monthly increases in fluorescence often occur 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 (**A**). An increase in oxygen concentration is typically noted either at or just below the fluorescence peak because algae produce oxygen as a by-product of photosynthesis (**B**). Over the course of the season, oxygen is biologically consumed by bacteria in the deep waters and the difference in water density between warm and cold waters prevent oxygen rich warm water from mixing with cold waters. This can be seen from month to month as decreasing oxygen concentrations in deep, cold waters as the season progresses (**C**). September's fluorometer profile was collected after the regular water testing season had concluded. This means that temperature and oxygen data are not available for September. However, September's florescence peak was deeper in the water column than it was in other 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' (**D**). Increased fluorescence values seen near the bottom of the pond in August and September are likely caused by interference from bottom sediments (**E**).



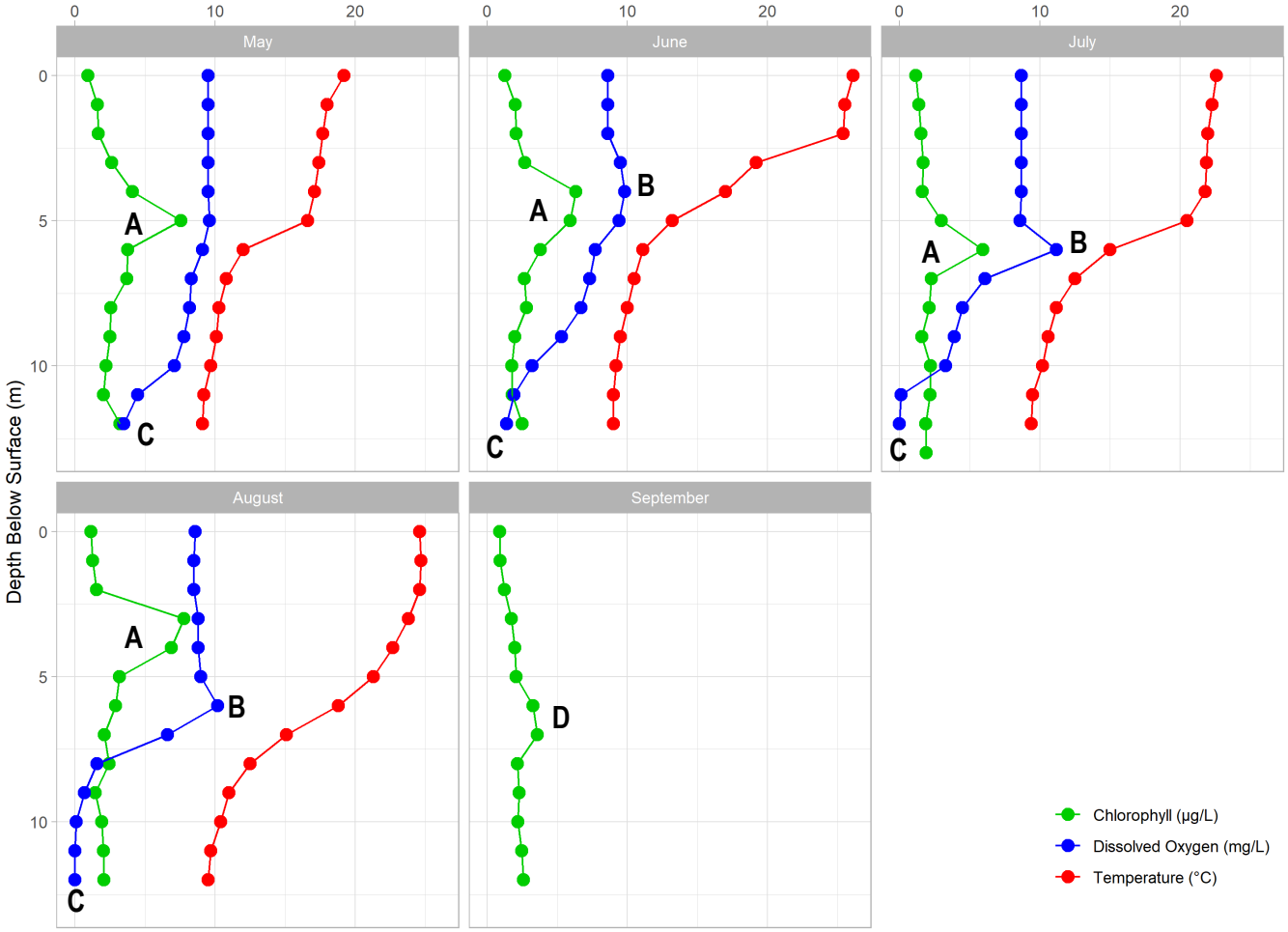
Hancock Pond

Monthly increases in fluorescence often occur 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 (**A**). An increase in oxygen concentration is typically noted either at or just below the fluorescence peak because algae produce oxygen as a by-product of photosynthesis (**B**). Over the course of the season, oxygen is biologically consumed by bacteria in the deep waters and the difference in water density between warm and cold waters prevent oxygen rich warm water from mixing with cold waters. This can be seen from month to month as decreasing oxygen concentrations in deep, cold waters as the season progresses (**C**). September's fluorometer profile was collected after the regular water testing season had concluded. This means that temperature and oxygen data are not available for September. However, September's florescence peak was about as deep into the water column as it was in other months. This is likely because Hancock Pond was still distinctly stratified in September, providing algae a place to 'sit' (**D**). Increased fluorescence values seen near the bottom of the pond in June, July, August, and September are likely caused by interference from bottom sediments (**E**).



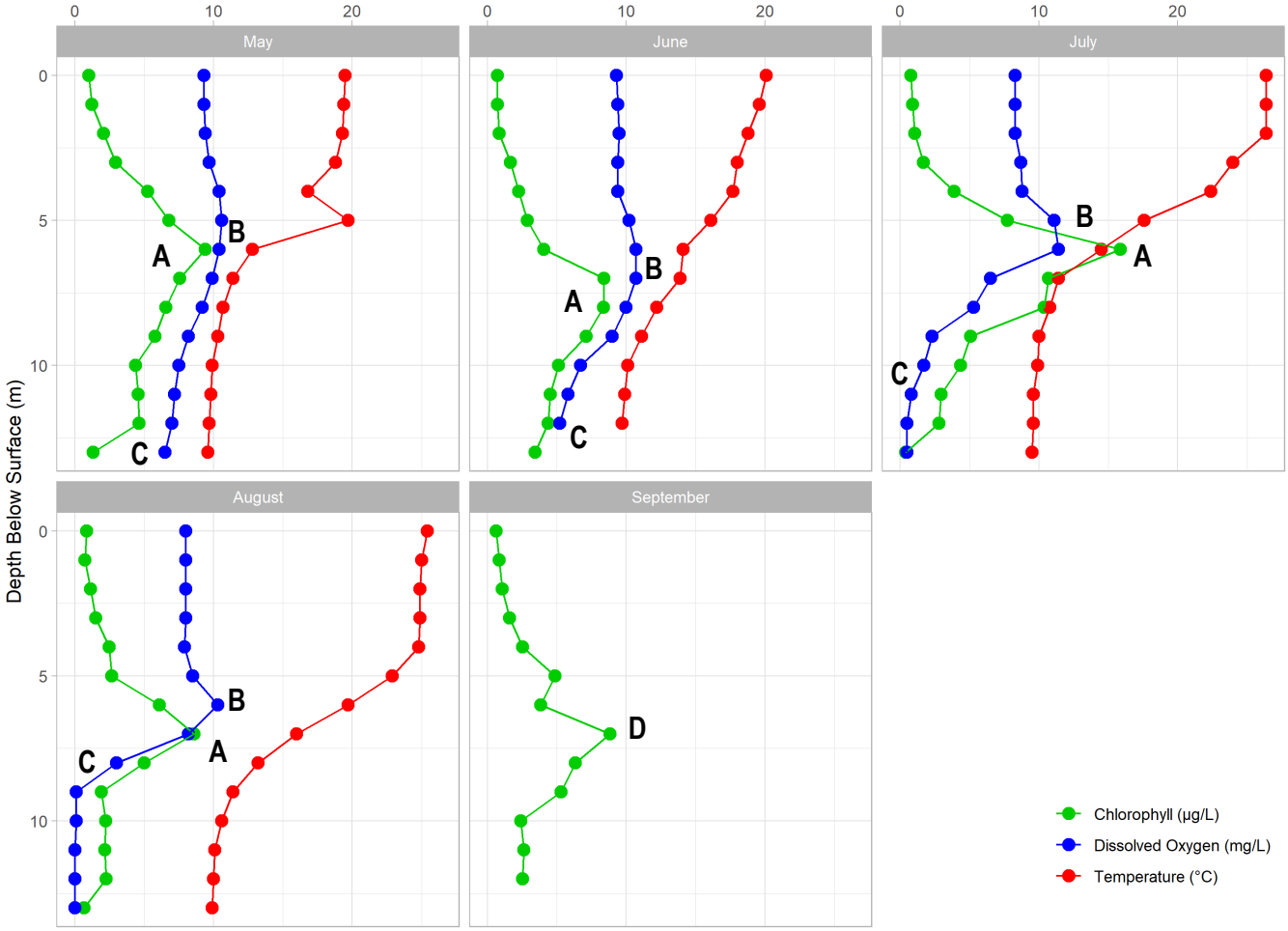
Keoka Lake

Monthly increases in fluorescence often occur 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 (**A**). An increase in oxygen concentration is typically noted either at or just below the fluorescence peak because algae produce oxygen as a by-product of photosynthesis (**B**). Over the course of the season, oxygen is biologically consumed by bacteria in the deep waters and the difference in water density between warm and cold waters prevent oxygen rich warm water from mixing with cold waters. This can be seen from month to month as decreasing oxygen concentrations in deep, cold waters as the season progresses (**C**). September's fluorometer profile was collected after the regular water testing season had concluded. This means that temperature and oxygen data are not available for September. However, September's florescence peak was deeper in the water column than it was in other 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' (**D**).



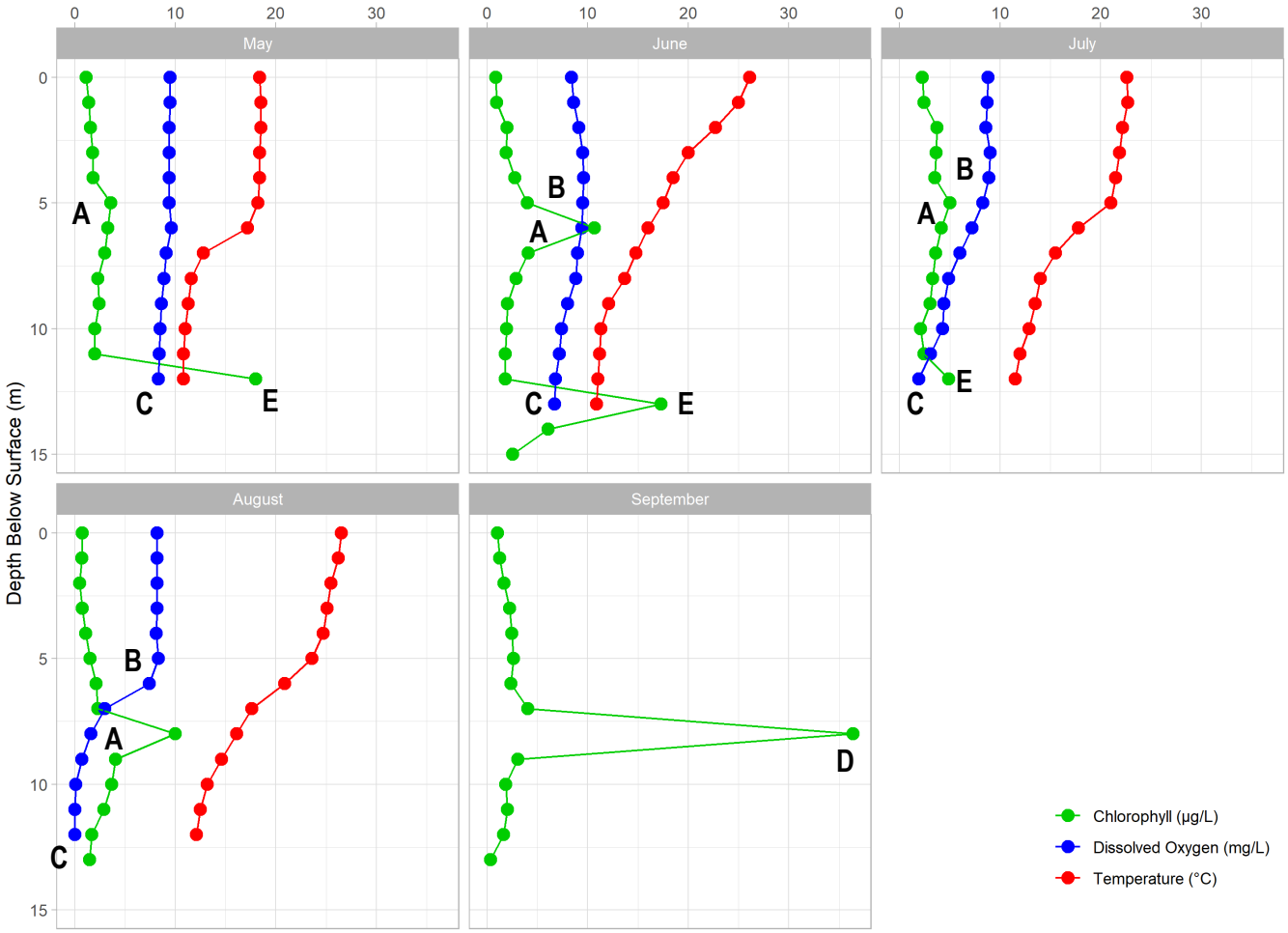
Keyes Pond

Monthly increases in fluorescence often occur 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 (**A**). An increase in oxygen concentration is typically noted either at or just below the fluorescence peak because algae produce oxygen as a by-product of photosynthesis (**B**). Over the course of the season, oxygen is biologically consumed by bacteria in the deep waters and the difference in water density between warm and cold waters prevent oxygen rich warm water from mixing with cold waters. This can be seen from month to month as decreasing oxygen concentrations in deep, cold waters as the season progresses (**C**). September’s fluorometer profile was collected after the regular water testing season had concluded. This means that temperature and oxygen data are not available for September. However, September’s florescence peak was about as deep into the water column as it was in other months. This is likely because Keye’s Pond was still distinctly stratified in September, providing algae a place to ’sit’ (**D**).



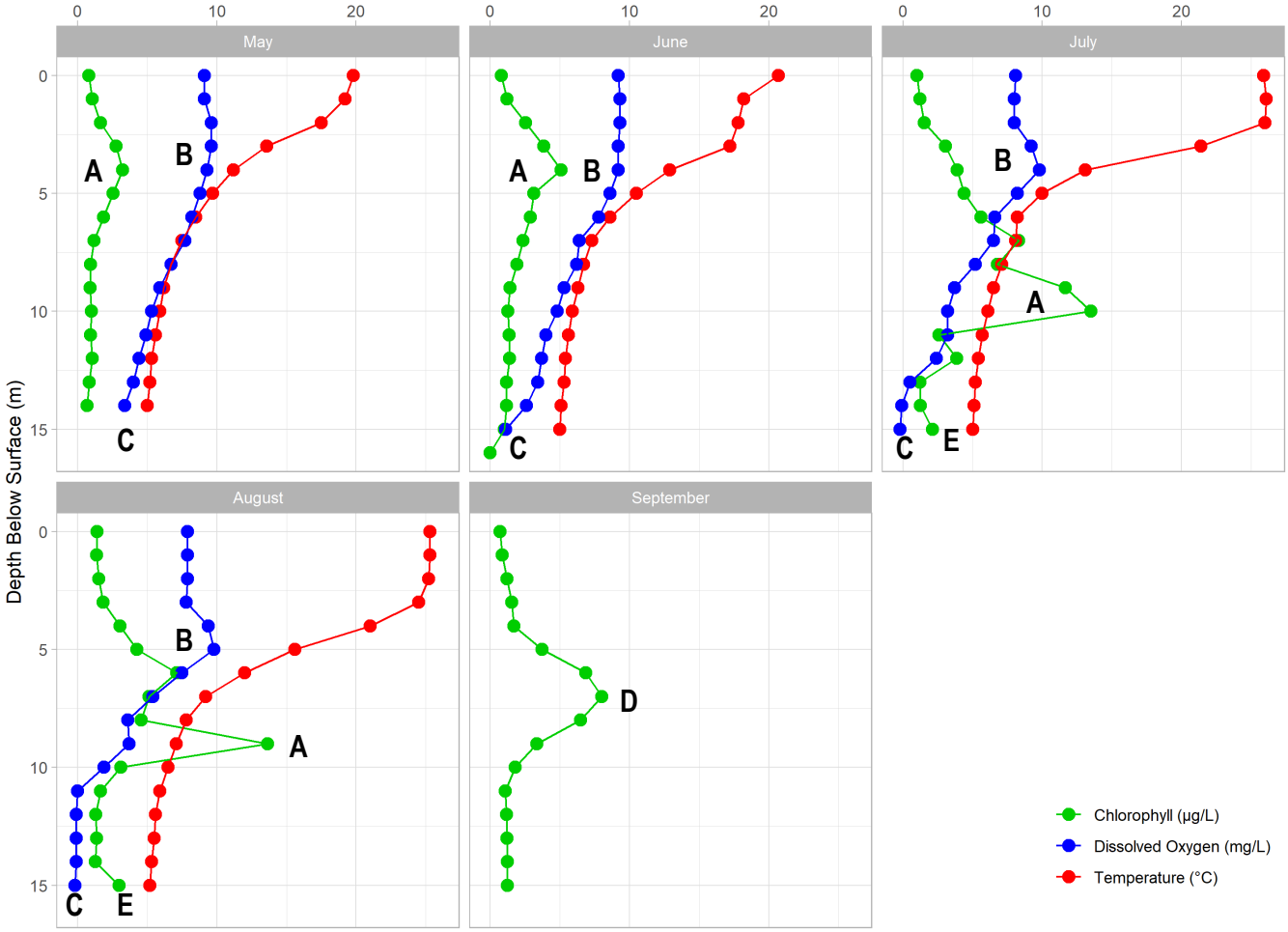
McWain Pond

Monthly increases in fluorescence often occur 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 (**A**). An increase in oxygen concentration is typically noted either at or just below the fluorescence peak because algae produce oxygen as a by-product of photosynthesis (**B**). Over the course of the season, oxygen is biologically consumed by bacteria in the deep waters and the difference in water density between warm and cold waters prevent oxygen rich warm water from mixing with cold waters. This can be seen from month to month as decreasing oxygen concentrations in deep, cold waters as the season progresses (**C**). September’s fluorometer profile was collected after the regular water testing season had concluded. This means that temperature and oxygen data are not available for September. However, September’s florescence peak was about as deep into the water column as it was in other months. This is likely because McWain Pond was still distinctly stratified in September, providing algae a place to ’sit’ (**D**). Increased fluorescence values seen near the bottom of the pond in May, June, and July are likely caused by interference from bottom sediments (**E**).



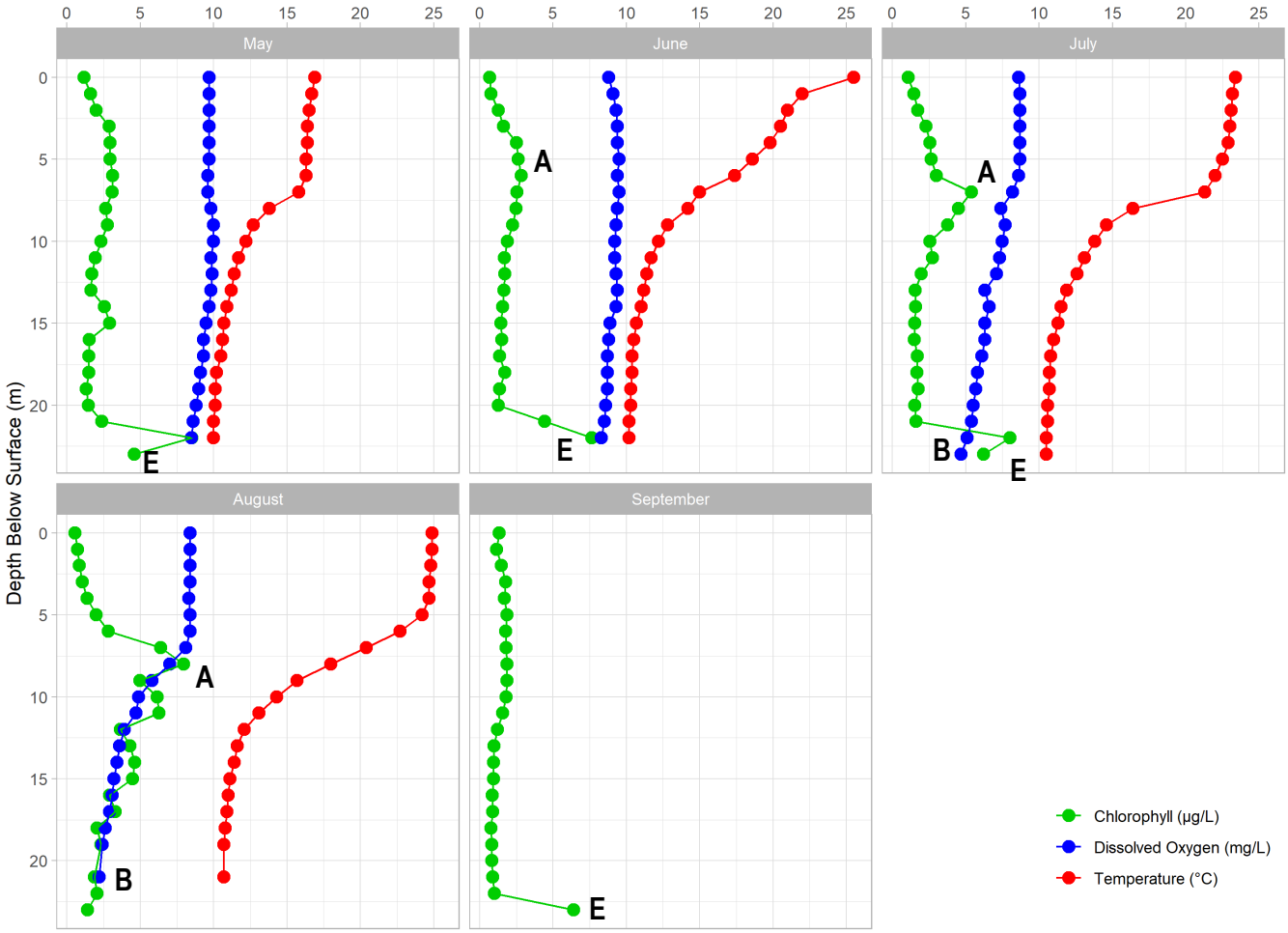
Middle Pond

Monthly increases in fluorescence often occur 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 (**A**). An increase in oxygen concentration is typically noted either at or just below the fluorescence peak because algae produce oxygen as a by-product of photosynthesis (**B**). Over the course of the season, oxygen is biologically consumed by bacteria in the deep waters and the difference in water density between warm and cold waters prevent oxygen rich warm water from mixing with cold waters. This can be seen from month to month as decreasing oxygen concentrations in deep, cold waters as the season progresses (**C**). September’s fluorometer profile was collected after the regular water testing season had concluded. This means that temperature and oxygen data are not available for September. However, the fluorescent peak at around 6 meters indicates that there is still a difference in water temperature between upper and bottom waters which provides algae a place to ’sit’ (**D**). Increased fluorescence values seen near the bottom of the pond in July and August are likely caused by interference from bottom sediments (**E**).



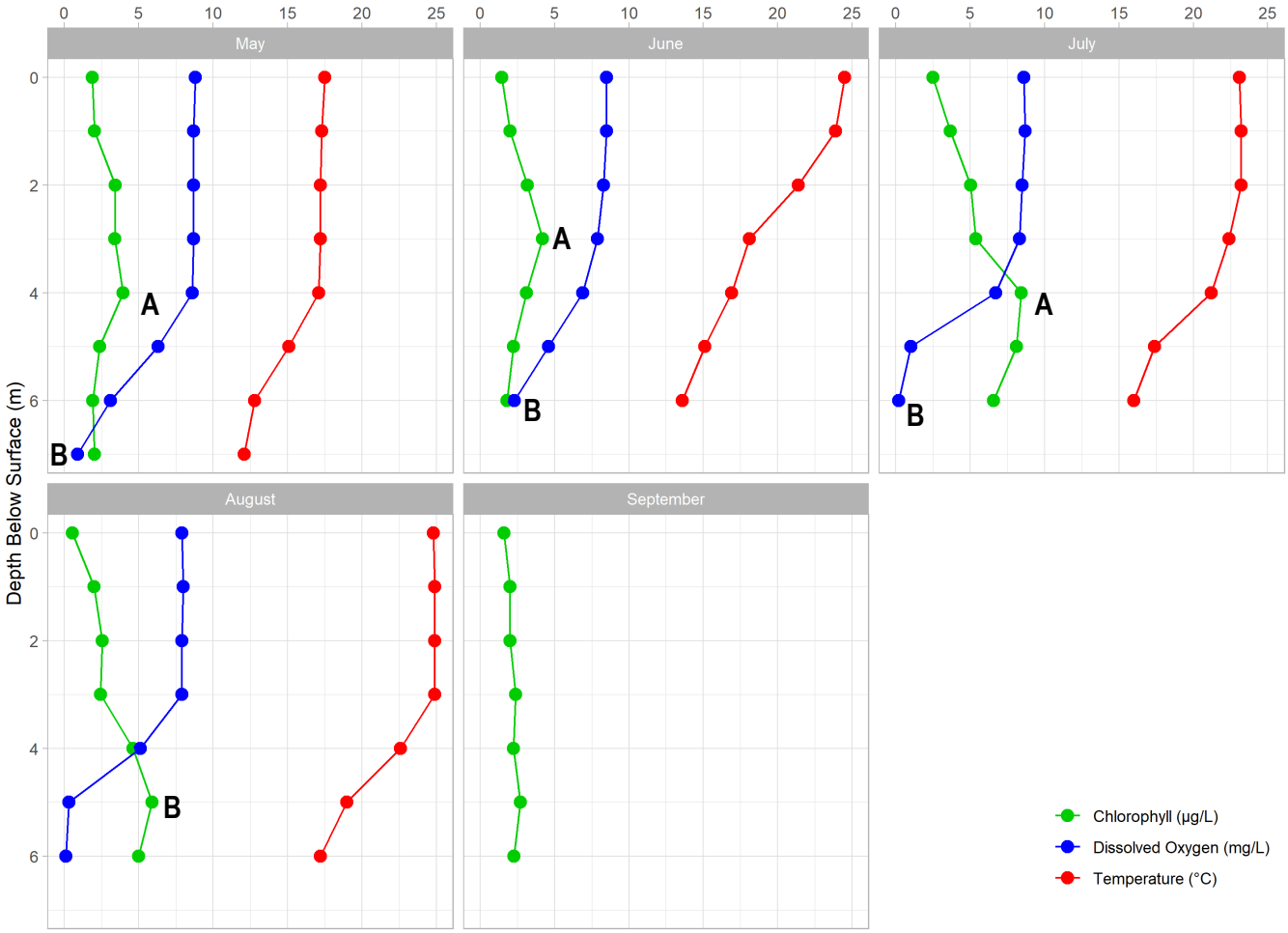
Moose Pond (middle basin)

Monthly increases in fluorescence often occur 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 (**A**). Over the course of the season, oxygen is biologically consumed by bacteria in the deep waters and the difference in water density between warm and cold waters prevent oxygen rich warm water from mixing with cold waters. This can be seen from month to month as decreasing oxygen concentrations in deep, cold waters as the season progresses (**B**). September’s fluorometer profile was collected after the regular water testing season had concluded. This means that temperature and oxygen data were not available for September. However, September’s fluorescent profile suggest the water column stratification was beginning to weaken as there was little change in fluorescence from the top to the bottom of the pond. Increased fluorescence values seen near the bottom of the pond in May, June, July, and September are likely caused by interference from bottom sediments (**E**).



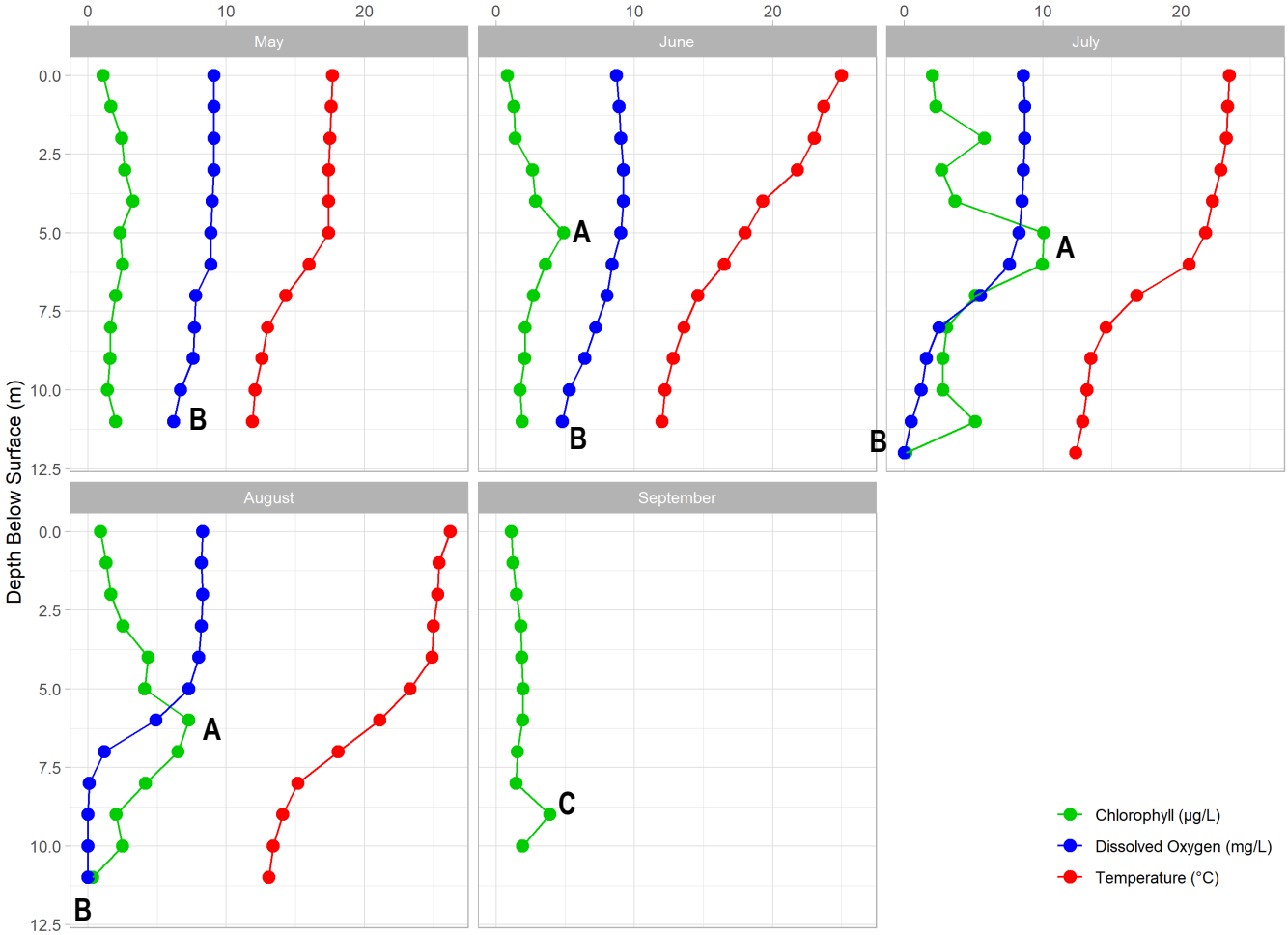
Moose Pond (north basin)

Monthly increases in fluorescence often occur 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 (**A**). An increase in oxygen concentration is typically noted either at or just below the fluorescence peak because algae produce oxygen as a by-product of photosynthesis however, there are no obvious oxygen peaks in these profiles. Over the course of the season, oxygen is biologically consumed by bacteria in the deep waters and the difference in water density between warm and cold waters prevent oxygen rich warm water from mixing with cold waters. This can be seen from month to month as decreasing oxygen concentrations in deep, cold waters as the season progresses (**B**). September's fluorometer profile was collected after the regular water testing season had concluded. This means that temperature and oxygen data are not available for September. However, September's florescence profile suggests the water column was likely uniformly mixed.



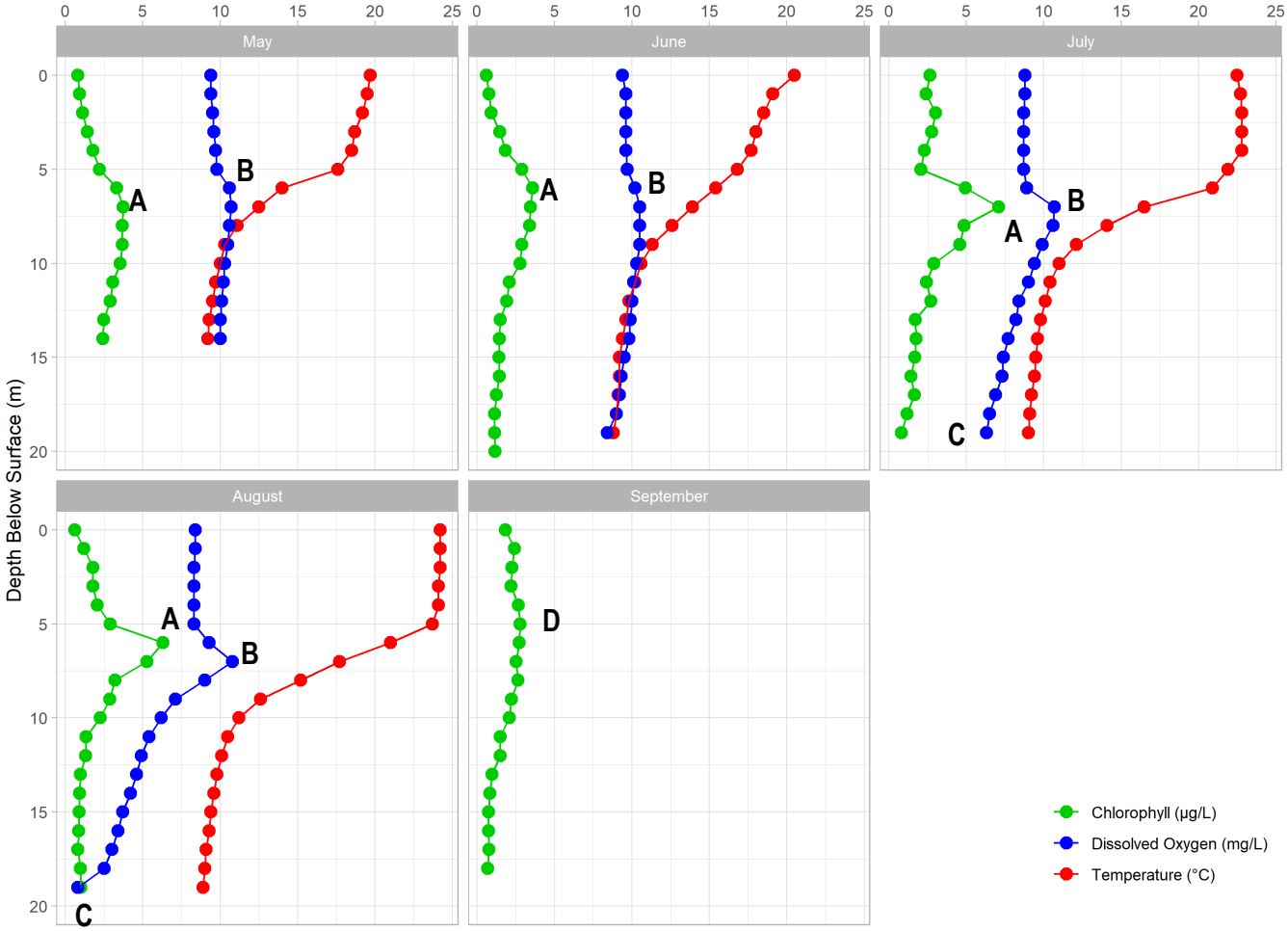
Moose Pond (south basin)

Monthly increases in fluorescence often occur 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 (**A**). An increase in oxygen concentration is typically noted either at or just below the fluorescence peak because algae produce oxygen as a by-product of photosynthesis however, there are no obvious oxygen peaks in these profiles. Over the course of the season, oxygen is biologically consumed by bacteria in the deep waters and the difference in water density between warm and cold waters prevent oxygen rich warm water from mixing with cold waters. This can be seen from month to month as decreasing oxygen concentrations in deep, cold waters as the season progresses (**B**). September's fluorometer profile was collected after the regular water testing season had concluded. This means that temperature and oxygen data are not available for September. September's fluorescence peak was deeper into the water column than previous months. This indicates Moose Pond's south basin was still distinctly stratified in September providing algae a place to 'sit'. 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' (**C**).



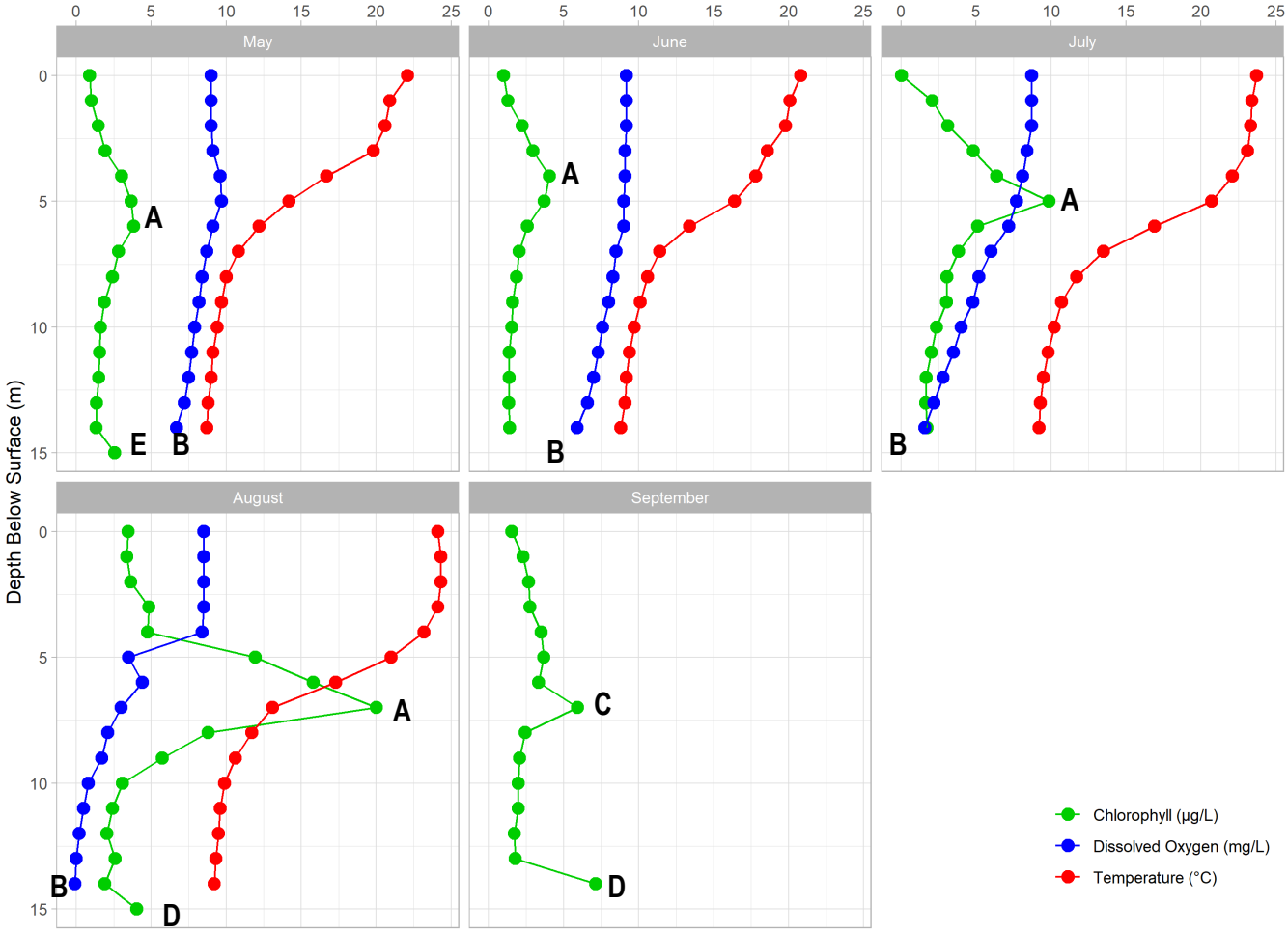
Peabody Pond

Monthly increases in fluorescence often occur 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 (**A**). An increase in oxygen concentration is typically noted either at or just below the fluorescence peak because algae produce oxygen as a by-product of photosynthesis (**B**). Over the course of the season, oxygen is biologically consumed by bacteria in the deep waters and the difference in water density between warm and cold waters prevent oxygen rich warm water from mixing with cold waters. This can be seen from month to month as decreasing oxygen concentrations in deep, cold waters as the season progresses (**C**). September's fluorometer profile was collected after the regular water testing season had concluded. This means that temperature and oxygen data are not available for September. However, September's fluorescence profile shows little change throughout the water column suggesting that stratification was weakening.



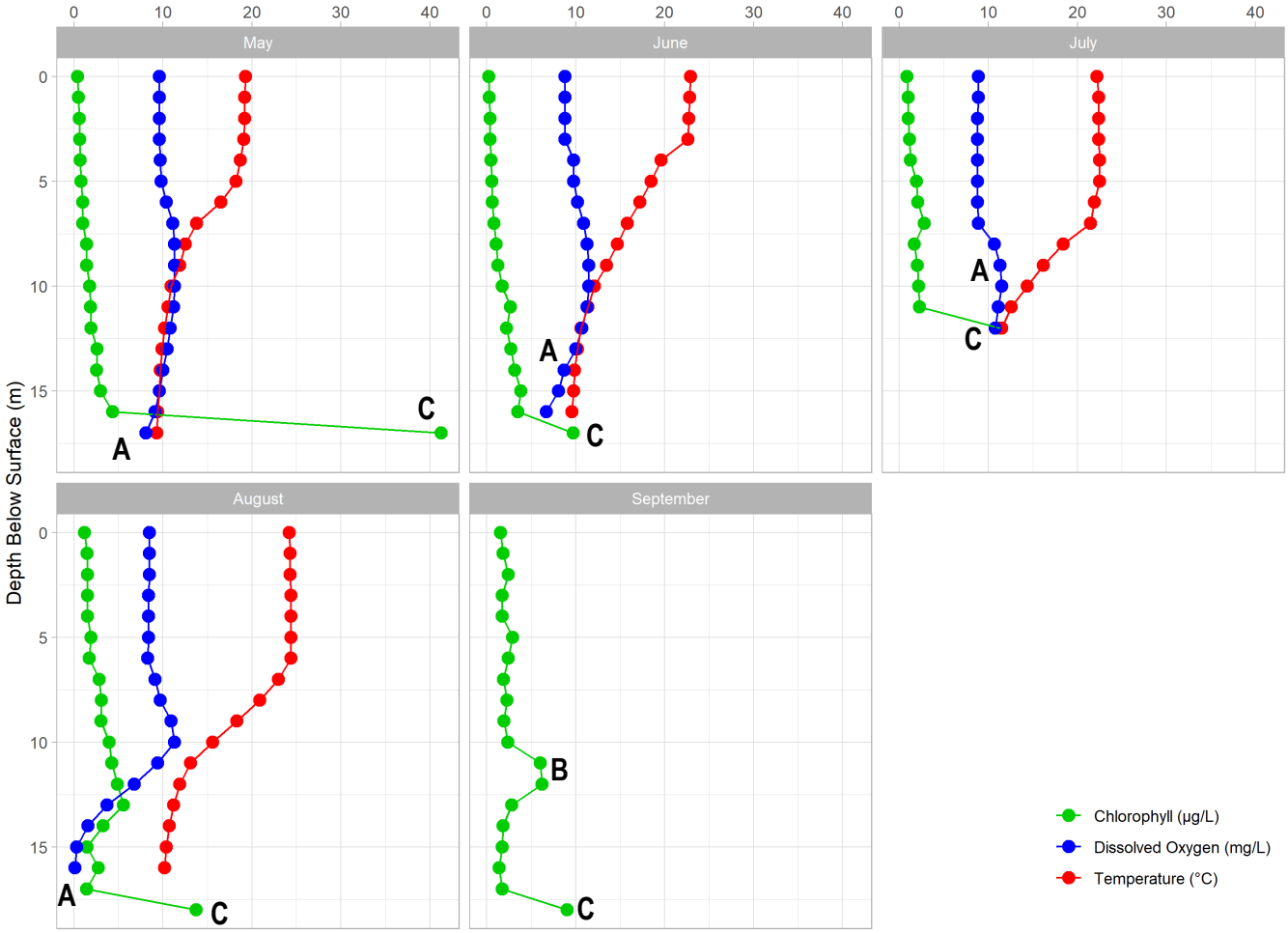
Sand Pond

Monthly increases in fluorescence often occur 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 (**A**). Over the course of the season, oxygen is biologically consumed by bacteria in the deep waters and the difference in water density between warm and cold waters prevent oxygen rich warm water from mixing with cold waters. This can be seen from month to month as decreasing oxygen concentrations in deep, cold waters as the season progresses (**B**). September's fluorometer profile was collected after the regular water testing season had concluded. This means that temperature and oxygen data are not available for September. However, September's fluorescence peak was deeper in the water column than it was in other 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' (**C**). Increased fluorescence values seen near the bottom of the pond in August and September are likely caused by interference from bottom sediments (**D**).



Trickey Pond

For most of the monitoring season, 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. Over the course of the season, oxygen is biologically consumed by bacteria in the deep waters and the difference in water density between warm and cold waters prevent oxygen rich warm water from mixing with cold waters. This can be seen from month to month as decreasing oxygen concentrations in deep, cold waters as the season progresses (**A**). September's fluorometer profile was collected after the regular water testing season had concluded. This means that temperature and oxygen data are not available for September. However, September's florescence peak was pronounced and deep in the water column. This is likely because surface waters had begun to mix in September which pushes the thermocline down. The difference in water temperature between upper and bottom waters provides algae a place to 'sit' (**B**). Each month, an increase in fluorescence values is seen near the bottom of the pond which is likely caused by interference from bottom sediments (**C**).



Woods Pond

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 and cold waters prevent oxygen rich warm water from mixing with cold waters. This can be seen in July and August as decreasing oxygen concentrations in deep, cold waters (**A**). September's fluorometer profile was collected after the regular water testing season had concluded. This means that temperature and oxygen data are not available for September. However, September's slight fluorescence peak suggests the water column, which mildly stratified in July and August, was now uniform again in temperature and pressure allowing nutrients to spread throughout the water column and algae populations to increase slightly.