

High resolution water monitoring at Acadia National Park

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Introduction

Seven seasons of near-continuous monitoring in Jordan Pond has provided our project team a more comprehensive and accurate understanding of temporal and seasonal trends in the lake’s water quality and physical properties than was possible with traditional monthly monitoring visits. We have documented considerable variation in how conditions in this oligotrophic lake respond to changes in weather and climate.

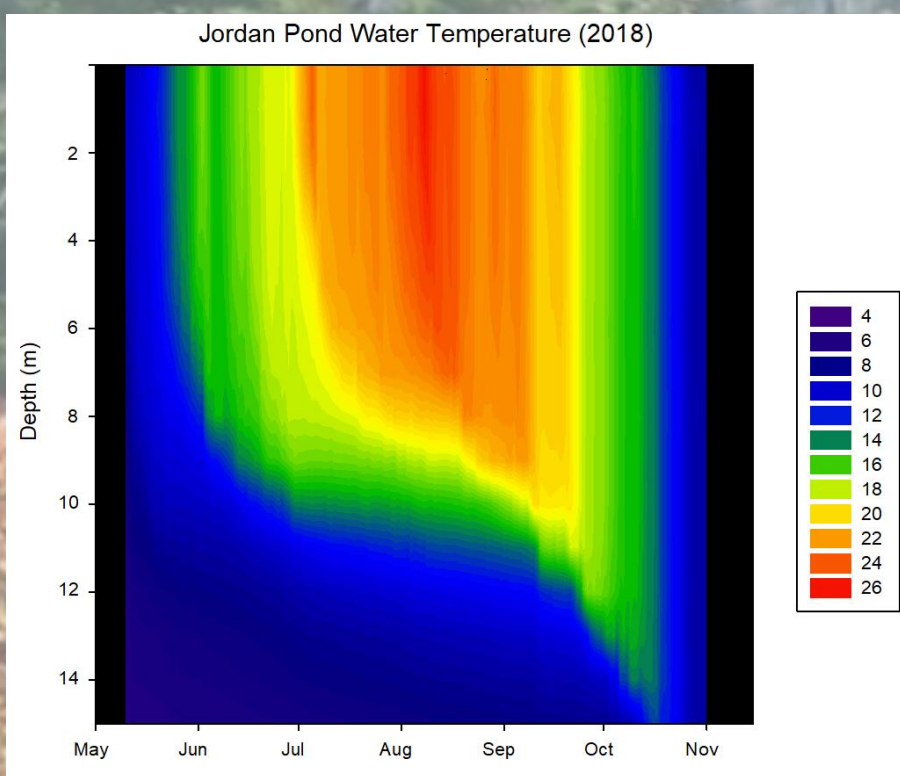
Annual Water Temperature Variation



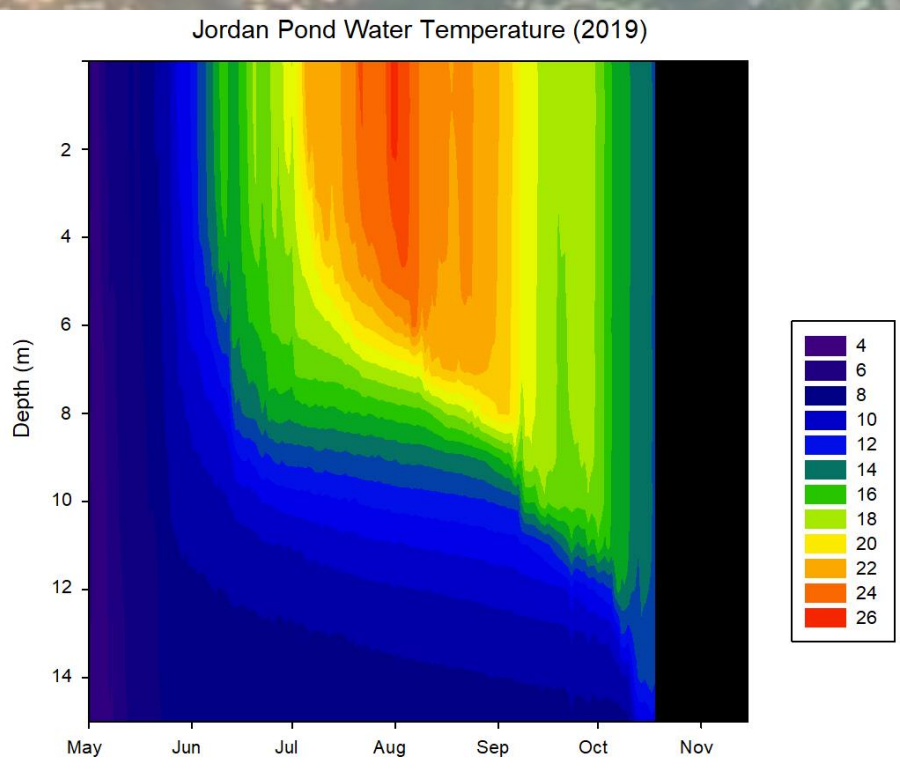
The NexSens CB-400 buoy deployed in Jordan Pond features a string of temperature probes at 1 m intervals to 16 m depth. Each year, high-frequency temperature data from each depth are recorded from May to November.

Lake thermal structure is a key factor in algal biomass and community structure, and these data provide a complete picture of Jordan Pond thermal structure throughout the entire open-water growing season.

In 2018, thermal stratification occurred at the beginning of June and the thermocline quickly dropped to 10 m depth.



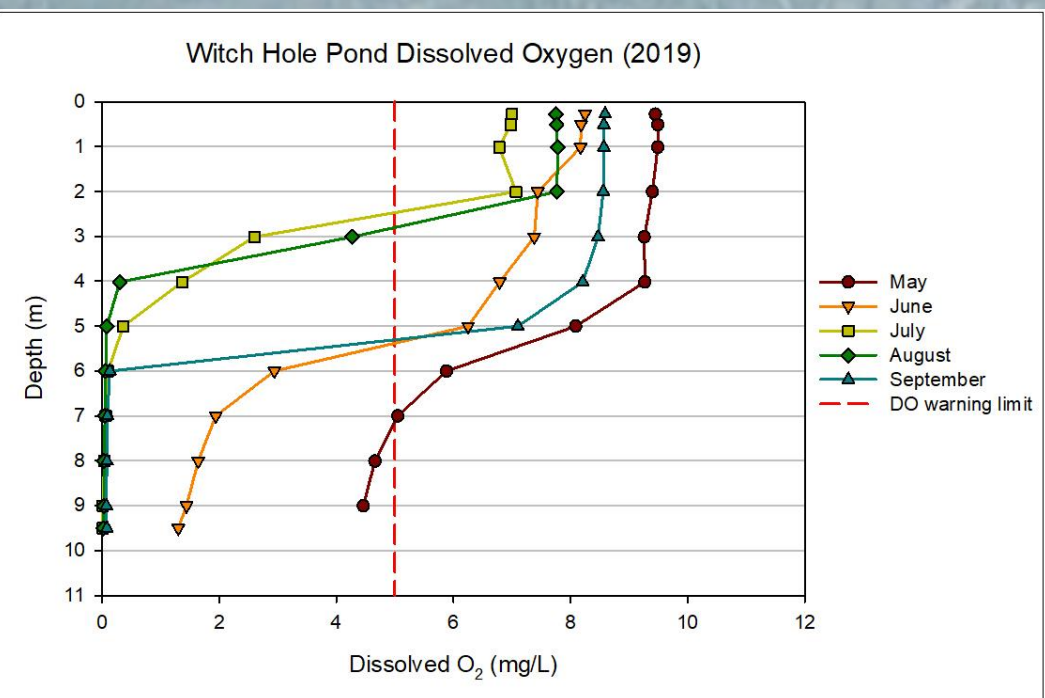
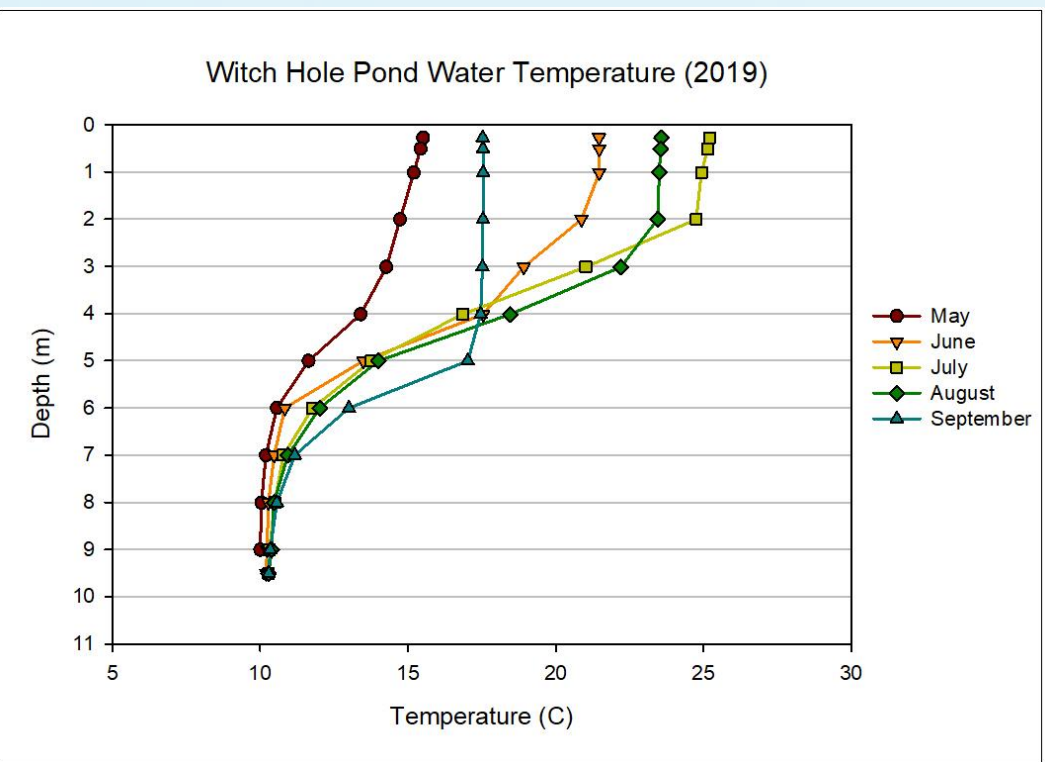
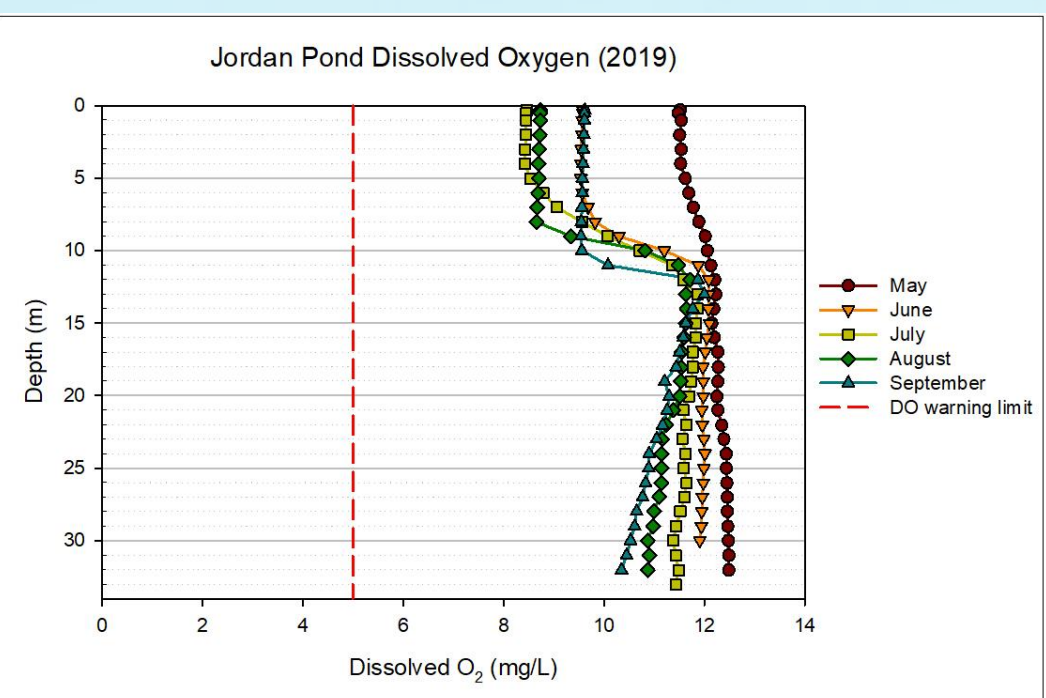
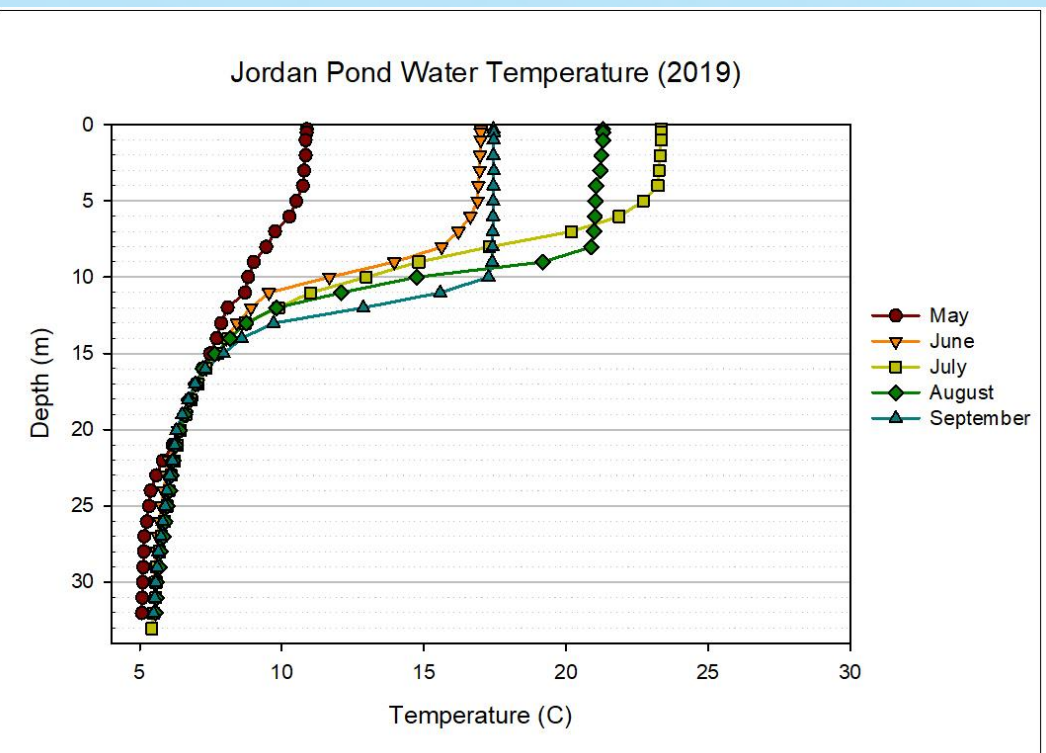
In 2019, the onset of thermal stratification occurred in mid-June, and the depth of the thermocline was shallower, approximately 8 m.



Dissolved Oxygen

Jordan Pond, an oligotrophic lake, experienced thermal stratification below 8 m for much of the 2019 open water season. It has an orthograde vertical oxygen profile, such that dissolved oxygen (DO) is primarily controlled by physical processes, like temperature.

Cold water can hold more DO than warm water, and in 2019, DO in Jordan Pond increased rapidly in the cold water below the thermocline.



In Witch Hole Pond, a eutrophic lake, thermal stratification occurred below 2 m for much of the 2019 season. Witch Hole Pond has a clinograde oxygen profile, in which DO is controlled more by biological processes, like respiration.

In 2019, DO in Witch Hole Pond decreased rapidly with depth. The concentration of DO generally needed by aquatic life to thrive is 5 mg/L.

Throughout the 2019 season, DO in Jordan Pond remained well above this warning limit, while much of the water column in Witch Hole Pond dropped below the warning limit as summer progressed.

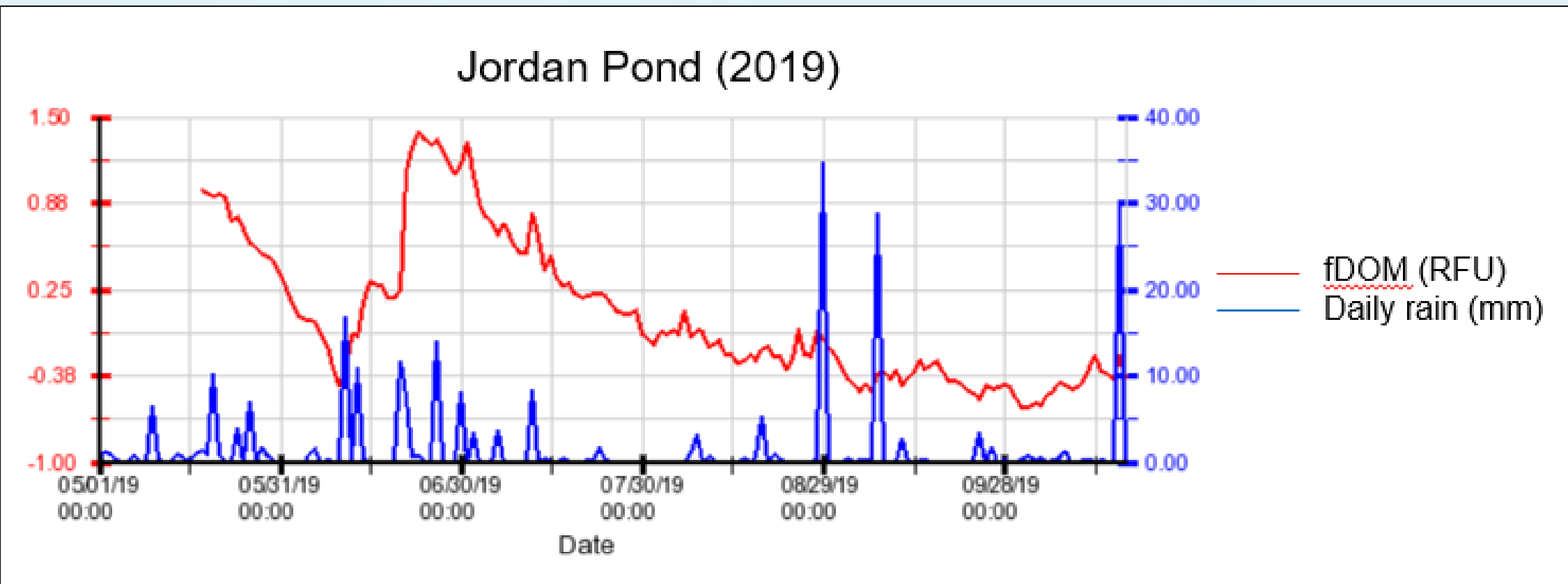
Dissolved Organic Matter

Fluorescent dissolved organic matter (fDOM), measured by a sensor on the Jordan Pond data buoy, provides a proxy for organic matter. Organic matter can regulate many ecological processes, and contributes to depth of light attenuation, nutrient availability, and heat absorption in lakes. It can be produced in-lake, or transported to a lake from the landscape.

We plotted fDOM and daily rain (measured by a weather station on the Jordan Pond House) throughout the 2019 open water season.



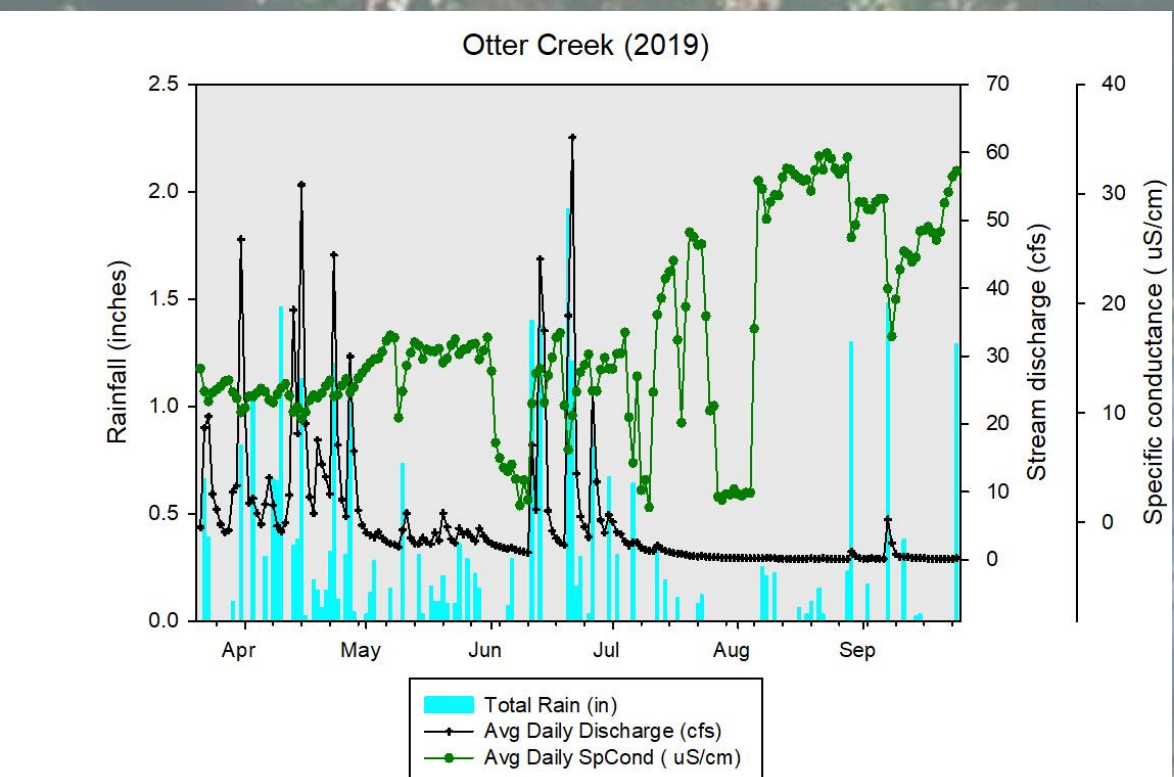
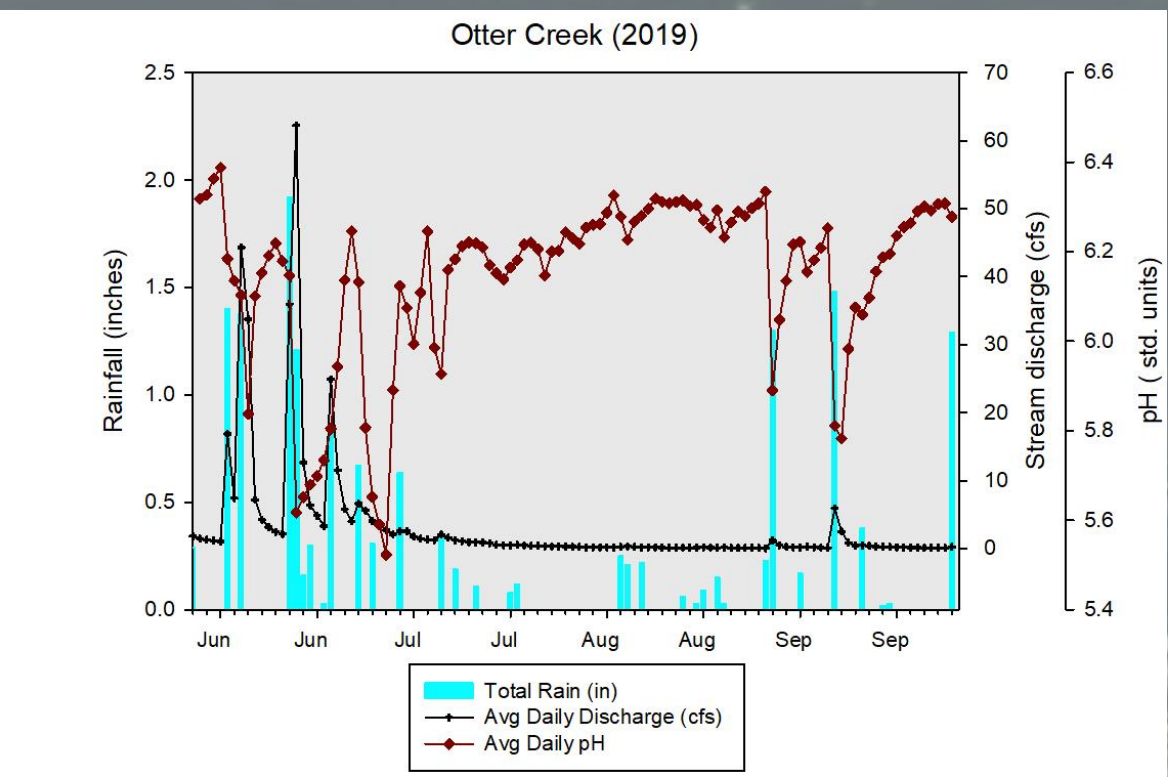
Effect of increasing dissolved organic matter on water clarity



Precipitation appeared to have a greater influence on fDOM dynamics in late spring and early summer, while rain events in late summer and fall were followed by relatively small increases in fDOM. As the intensity and frequency of storm events are predicted to increase in Maine, we are interested in understanding how episodic storm events and seasonal variation affect fDOM dynamics.

Stream Water Quality

HOBO™ pH and conductivity dataloggers were deployed at Otter Creek, adjacent to USGS Stream Gage 01022840 to document the relationship between precipitation, streamflow, and these water quality parameters.



Acknowledgements

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Conclusions

High resolution monitoring activities over the past several years have clearly demonstrated the ability to “fill in the blanks” between traditional monthly monitoring visits. Future goals include expanding the use of high resolution monitoring techniques to investigate whether similar or divergent response patterns exist in lakes with different morphometry and trophic states; and to track daily water quality conditions in streams.

Pairing continuous and monthly water monitoring data with meteorological data from the Jordan Pond House and the park air quality station can help us understand how climate warming and other stressors may impact physical, chemical, and biological processes across water bodies of varying trophic state in Acadia National Park.