

Implications of rapid climate change on lake algal ecology in Acadia National Park, U.S.A.

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Introduction

Lakes and ponds in Acadia National Park are an important part of the landscape, prized for their aesthetic, recreational, and ecological value. Recent work has shown that average water clarity of lakes in Acadia has been decreasing since 1995 (Figure 1). This decline corresponds to an increase in dissolved organic carbon (DOC) concentrations across the same set of lakes.

It is believed that rapid changes in climate conditions and patterns of atmospheric deposition have resulted in these coherent shifts in DOC and water clarity in Acadia lakes. In particular, extreme precipitation events are correlated with elevated lake water DOC concentrations. These events may also alter the quality or type of DOC which can have important implications for the structure and function of aquatic ecosystems.

Much work has documented physical and chemical trends in Acadia lakes in recent decades, less is understood about associated biological trends. We have selected six important Acadia lakes with long-term biogeochemical data records on which to focus our study (Figure 2).

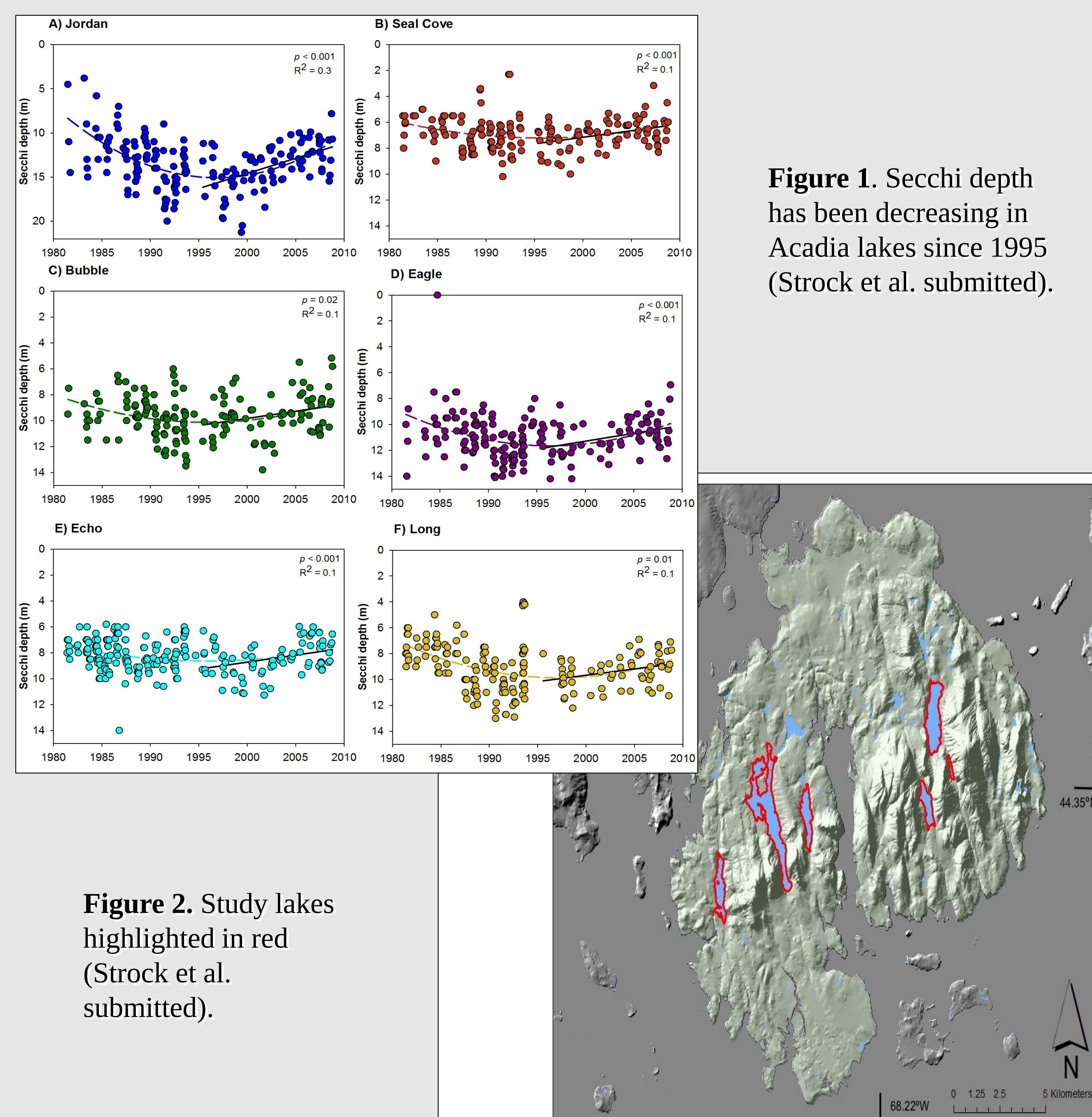
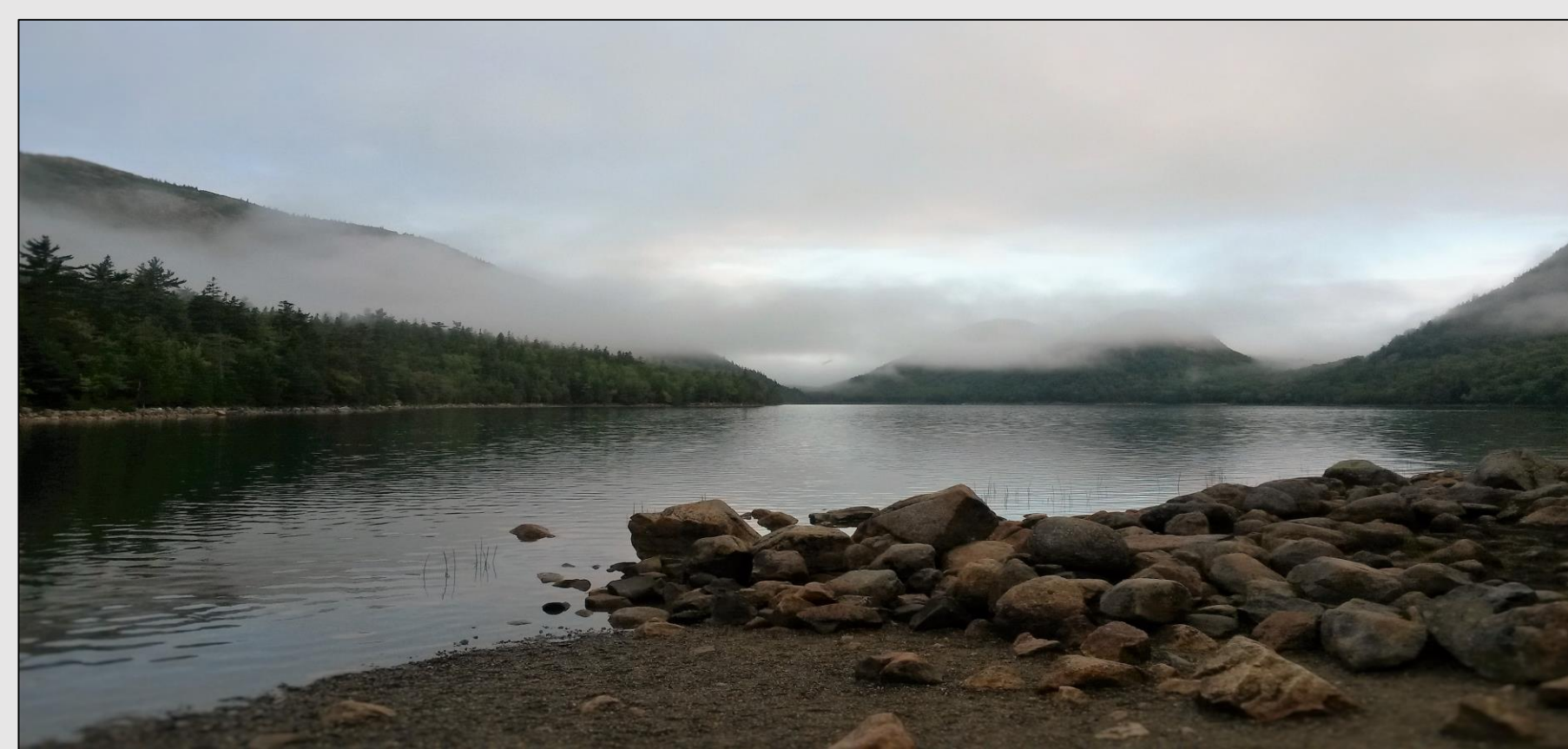


Figure 1. Secchi depth has been decreasing in Acadia lakes since 1995 (Strock et al. submitted).

Figure 2. Study lakes highlighted in red (Strock et al. submitted).

Objectives

1. Create a catalog of current algal taxa and determine species diversity across 6 Acadia lakes;
2. Evaluate changes in freshwater algal ecology and key water quality metrics (DOC quantity and quality, chlorophyll *a*, and nutrient concentrations) from extreme precipitation events in Acadia National Park;
3. Quantify longer-term climate-driven changes in algal species diversity and community structure using historical algal pigment and diatom reconstructions from sediment cores.



Jordan Pond and the Bubbles, September, 2016.

Methods

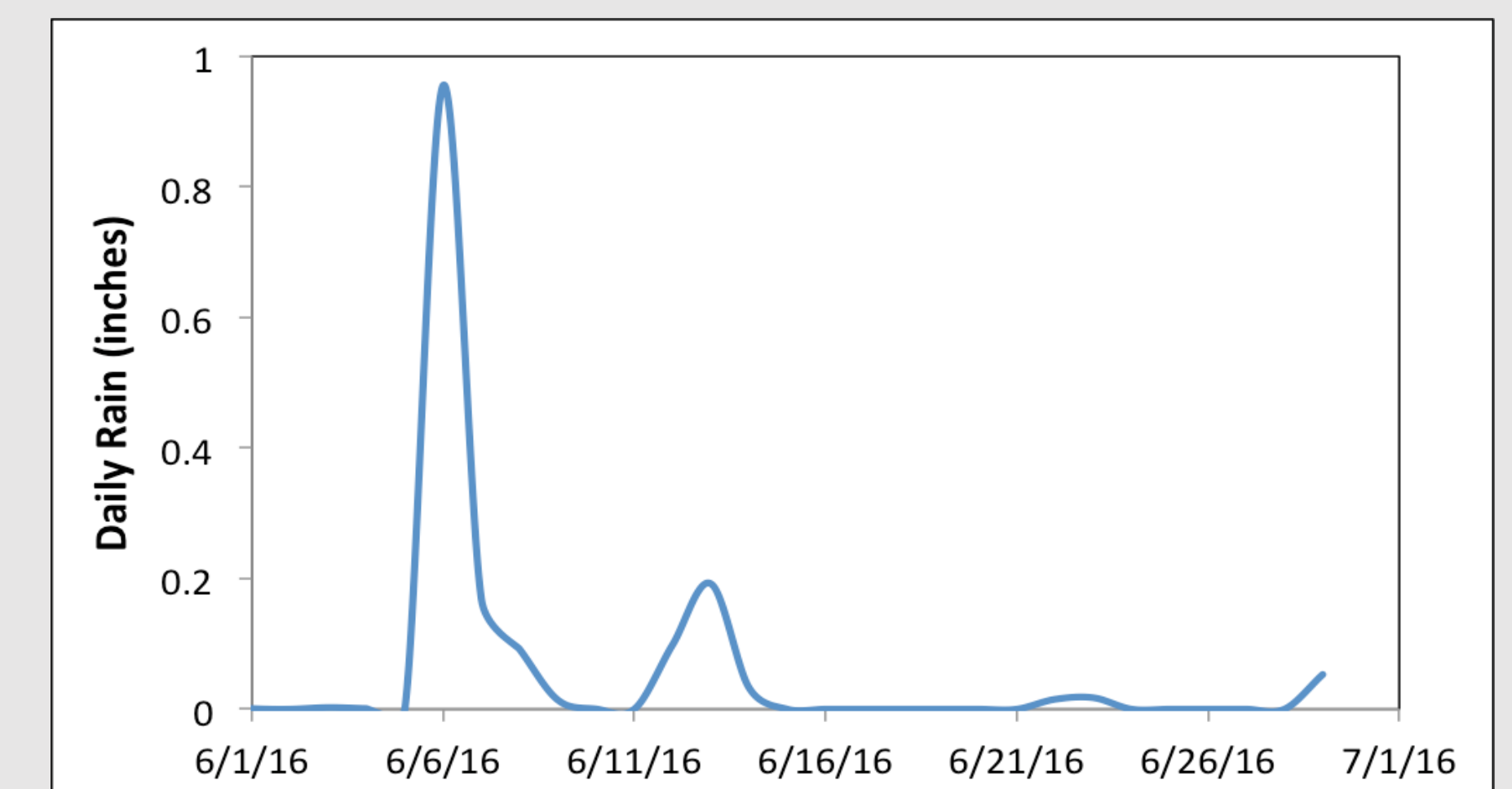
1. Seasonal: Sample the 6 study lakes in the spring, summer, and fall, and collect water samples for quantification of phytoplankton community structure and species diversity.
2. Storm: Sample 24 hours before, 24-48 hours after and 72 hours after heavy precipitation events (defined as 0.5 inch or more during a 24-hour period). Measure temperature and dissolved oxygen profiles and collect water for DOC quantity and quality, nutrient analyses and chlorophyll *a* and phytoplankton taxonomy samples.
3. Collect a sediment core from Seal Cove Pond and reconstruct changes in algal metrics over time. Pair with modern seasonal and storm samples and precipitation data to determine how water clarity may have changed in the past, and what effect climate had on these changes.



Ben Burpee with the Seal Cove Pond core, June, 2016.

Results from a spring storm event

Figure 3. Daily rain totals during June, 2016



One inch of rain fell within a 24-hour period on June 6th and only a total of 2.2 inches of rain fell over the month of June.

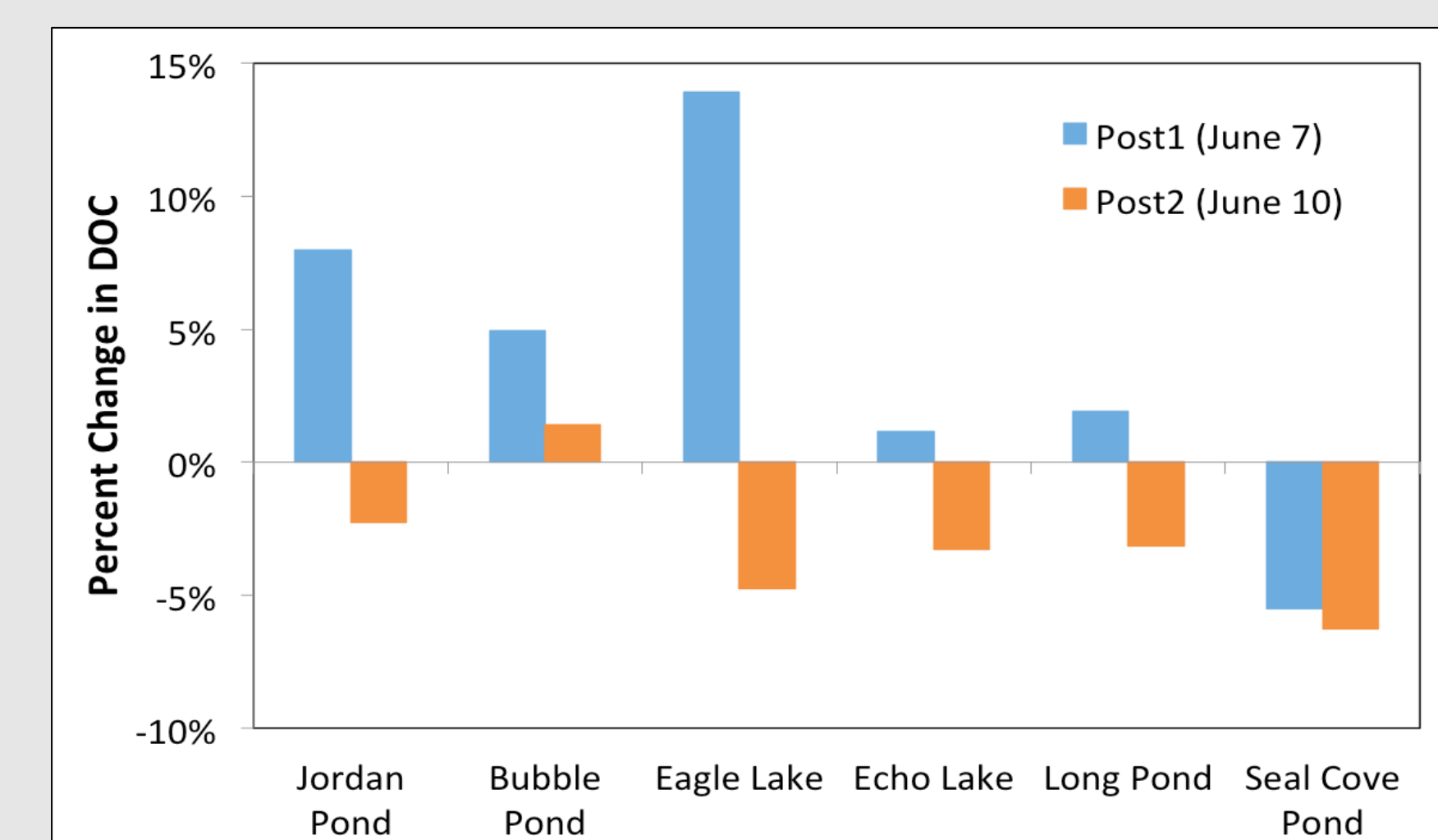


Figure 4. Percent change in DOC compared to pre-storm concentrations

DOC concentration increased in 5 of the 6 lakes in the first post-storm sampling, and notably, decreased in the second post-storm sampling. Flushing of DOC from the lakes may have led to lower concentrations of DOC in the second post-storm sampling compared to pre-storm levels. We plan to investigate contributions of within-lake processes to changes in DOC concentration, as well.

Future Directions

- Continue seasonal and storm sampling
- Analyze Seal Cove Pond core and compare cores previously collected from Jordan and Bubble Ponds to evaluate past climate changes
- Create algal species catalogue

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