The effects of fire on aquatic phytoplankton of the Yukon-Kuskokwim Delta, Alaska

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INTRODUCTION

Wildfires are occurring more frequently and with more severity throughout the world, including the Arctic. We have gained some understanding of how these fires influence terrestrial landscapes, however, little is known about how aquatic communities may respond. Changes in phytoplankton abundance and composition as a result of fire would impact higher trophic levels, including economically important fisheries.

OBJECTIVE

to better understand the impacts of fire on phytoplankton communities in lakes in the Yukon-Kuskokwim Delta.

HYPOTHESIS

Nutrients will increase in lakes after fire, leading to higher concentrations of chlorophyll a, nitrate, and phosphate.

METHODS

water samples were collected for analysis of nitrate, ammonium, and phosphate concentrations. Dissolved oxygen (DO) was measured in the field using a YSI multimeter. Water samples were filtered for chlorophyll a analysis. Phytoplankton net tows were launched to collect samples for community composition. Over the course of two weeks, 12 lakes were sampled, 6 in an unburned area and 6 from an area that burned in 2015. In the lab, chlorophyll a was extracted from filters with acetone and analyzed on a Turner Designs Fluorometer.

Figure 1. Lake sampling using a phytoplankton tow net.

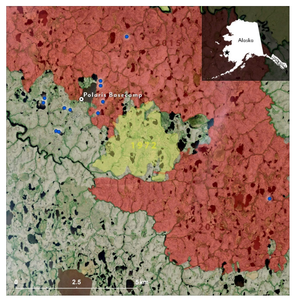

Figure 2. Map of study site. 2015 Burned areas in red and lakes surveyed in blue.

RESULTS

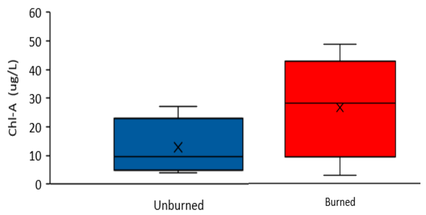

Figure 3. Estimates of chlorophyll-a from burned and unburned lakes. Burned lakes were higher in Chl-A than unburned lakes. (p-value = 0.05961)

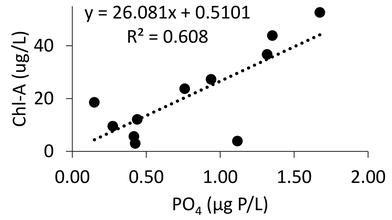

Figure 4. Relationship between chlorophyll a and phosphate (PO_4) concentrations of lakes in the YK Delta.

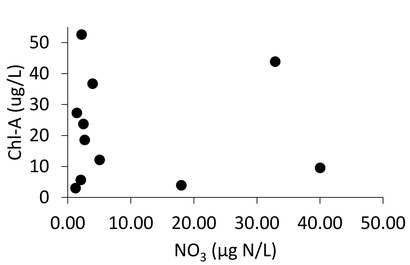

Figure 5. Relationship between Chlorophyll a and nitrate (NO_3) concentrations in lakes in the YK Delta.

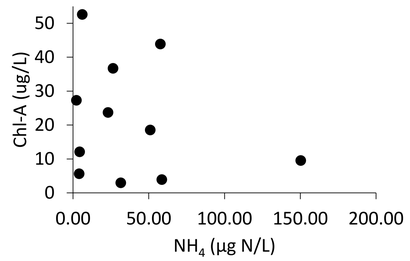

Figure 6. Relationship between Chlorophyll a and ammonium (NH_4) concentrations in lakes in the YK Delta.

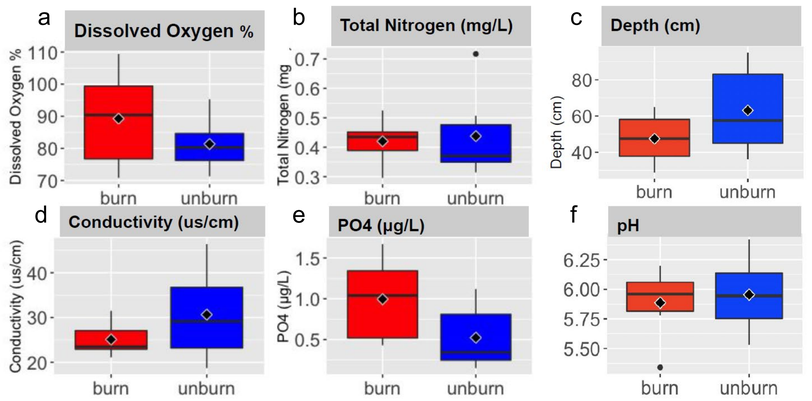

Figure 7. Average (a) Dissolved Oxygen (%) (b) Total nitrogen (mg/L) (c) Depth of lake (cm) (d) Conductivity (us/cm) (e) Phosphate (PO_4) (ug/L) and (f) pH from burned and unburned lakes in the Yukon-Kuskokwim Delta, Alaska.

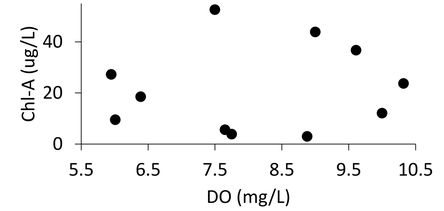

Figure 8. Relationship between chlorophyll a and DO concentrations in lakes in the YK Delta.

Figure 8. Asterionella sp. Found in a 2015 burned lake.

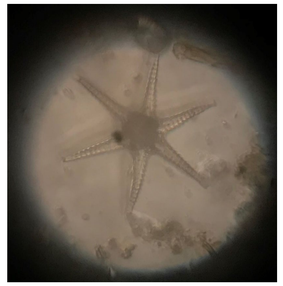

Figure 9. Staurastrum sp. Found in a 2015 burned lake.

SUMMARY

These results demonstrate that tundra fires can impact phytoplankton activity, as demonstrated by an increase in chlorophyll a in burned lakes. In addition, aquatic nutrient data suggest that phytoplankton biomass in lakes of the Yukon-Kuskokwim Delta are more likely limited by phosphorus than nitrogen. Higher PO4 in burned lakes supports this conclusion. An increase in phytoplankton activity after fire may indicate an increase in resources for higher trophic levels in these Arctic lakes. Further research is necessary to understand how the individual phytoplankton taxa may themselves be shifted as a result of the increase in nutrients.

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