



Cyanobacteria blooms and essential fatty acid transfer through the Lake Champlain food web

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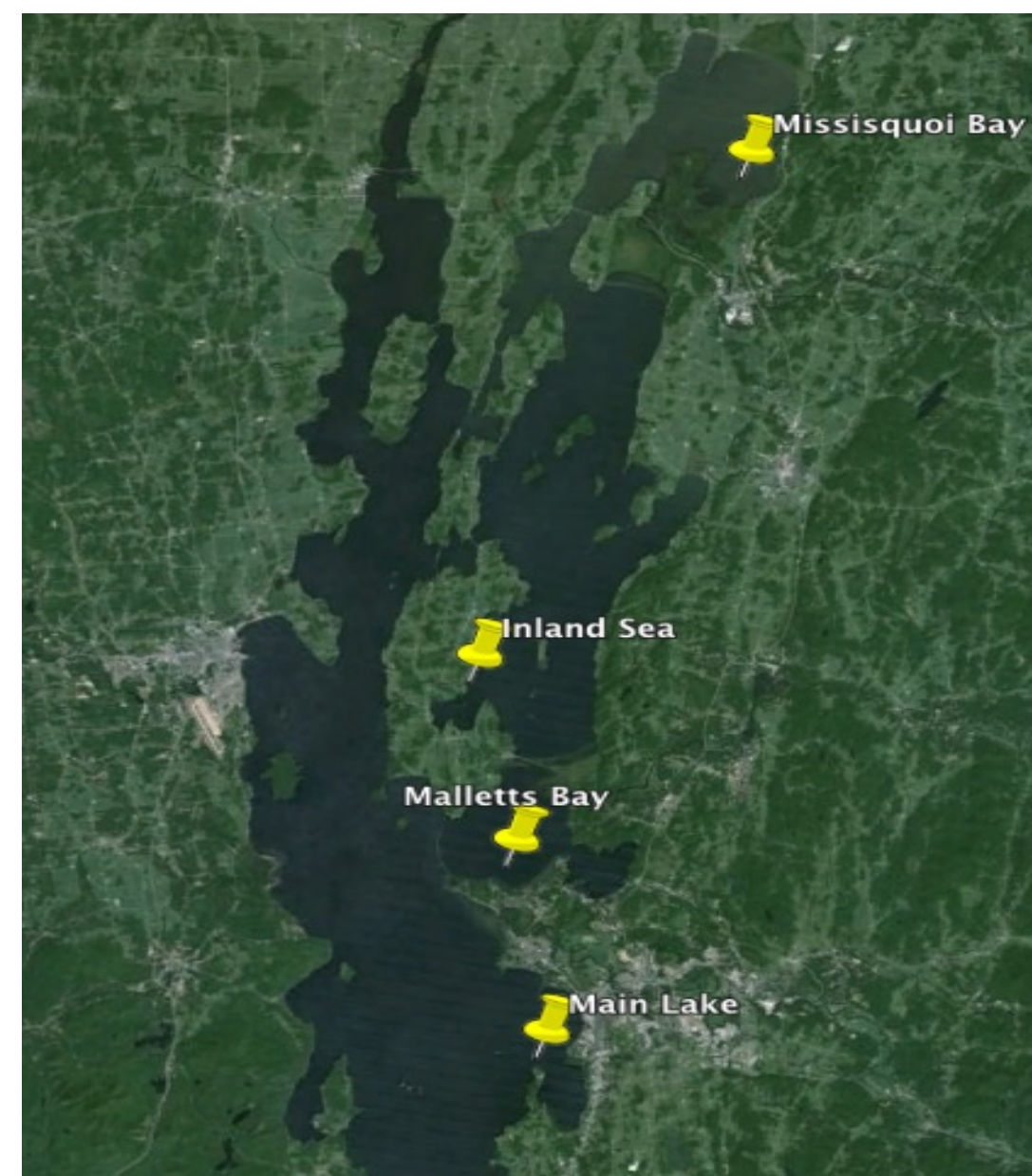
The objective of this study was to test the hypothesis that cyanobacteria blooms negatively affect essential fatty acid levels in fish.

Background

- Essential fatty acids (EFAs) are important for many metabolic processes in fish, but fish do not produce adequate amounts. Therefore, EFAs must be acquired in the diet.
- Cyanobacteria blooms are a growing concern because they affect lake enjoyment, can produce harmful toxins, and potentially disrupt food webs.
- Cyanobacteria are poor producers of EFAs. Consequently, transfer of these essential nutrients through the food web could be limited during blooms.

Experimental Design

- Target species:**
White perch (*Morone americana*)
Yellow perch (*Perca flavescens*)
- Time points:**
Jun 2013 (pre-bloom)
Aug 2013 (peak bloom)
Oct 2013 (post-bloom)
- Locations:**
Main Lake
Malletts Bay
Inland Sea
Missisquoi Bay
- Samples:**
 - 10 fish per species from each location at each time point (n=224).
 - 3 water (seston) samples per sampling event.
- Procedures:**
 - Fish were weighed, measured, and sexed.
 - Liver (n=211) and muscle samples (n=223) were collected.
 - Fatty acid analysis on muscle samples.
 - Cyanobacteria cell counts and fatty acid analysis on seston samples (n=36).
- Here we present preliminary results on muscle samples from Malletts Bay and Missisquoi Bay.



Results

- The results of a two-way ANOVA show that the EFAs eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) in white perch vary significantly between time points at different locations (**Table 1**).

Table 1: Two-way ANOVA results for white perch EFAs (EPA and DHA, in % total fatty acids). * indicates significant values

Factor	EPA	DHA
Time	<0.0001*	<0.0001*
Location	0.0016*	<0.0001*
Time X Location	0.0037*	<0.0001*

- Yellow perch EPA levels are different between time points and locations, but the interaction is not significant. DHA is not significantly different between locations, but levels vary between time points at different locations (**Table 2**).

Table 2: Same as Table 1 but for yellow perch.

Factor	EPA	DHA
Time	0.0144*	0.0001*
Location	<0.0001*	0.6340
Time X Location	0.5698	0.0066*

- DHA levels differ between species while EPA levels are more similar (**Fig. 1**).

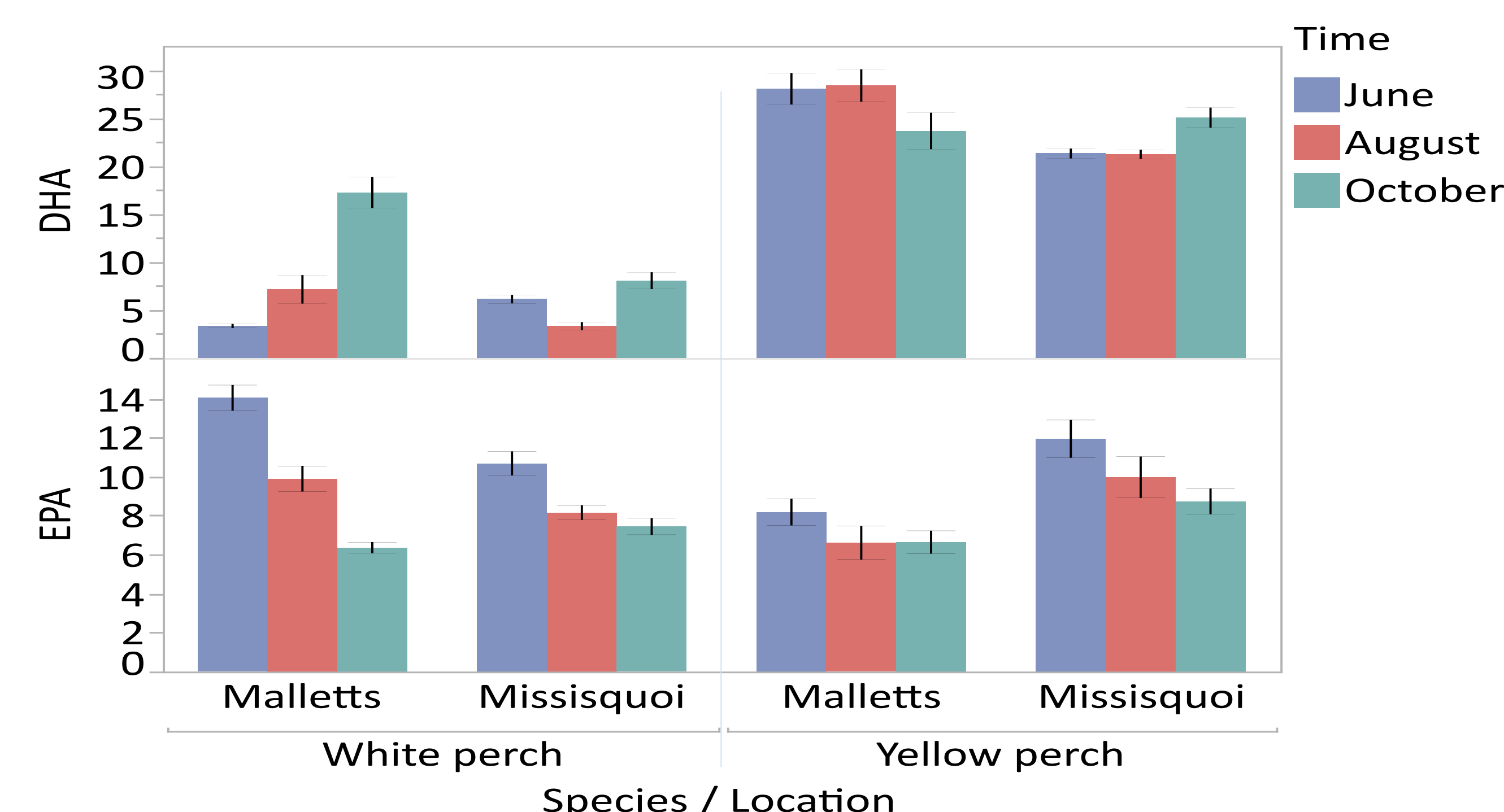


Figure 1: Mean levels (\pm SE) of EPA and DHA (in % total fatty acids) in Malletts Bay and Missisquoi Bay of white and yellow perch for June, August, and October 2013.

- EPA ($p<0.0001$) and DHA ($p<0.0001$) levels changed inversely over time in Malletts Bay white perch, which may suggest conversion of EPA to DHA (**Fig. 2**).

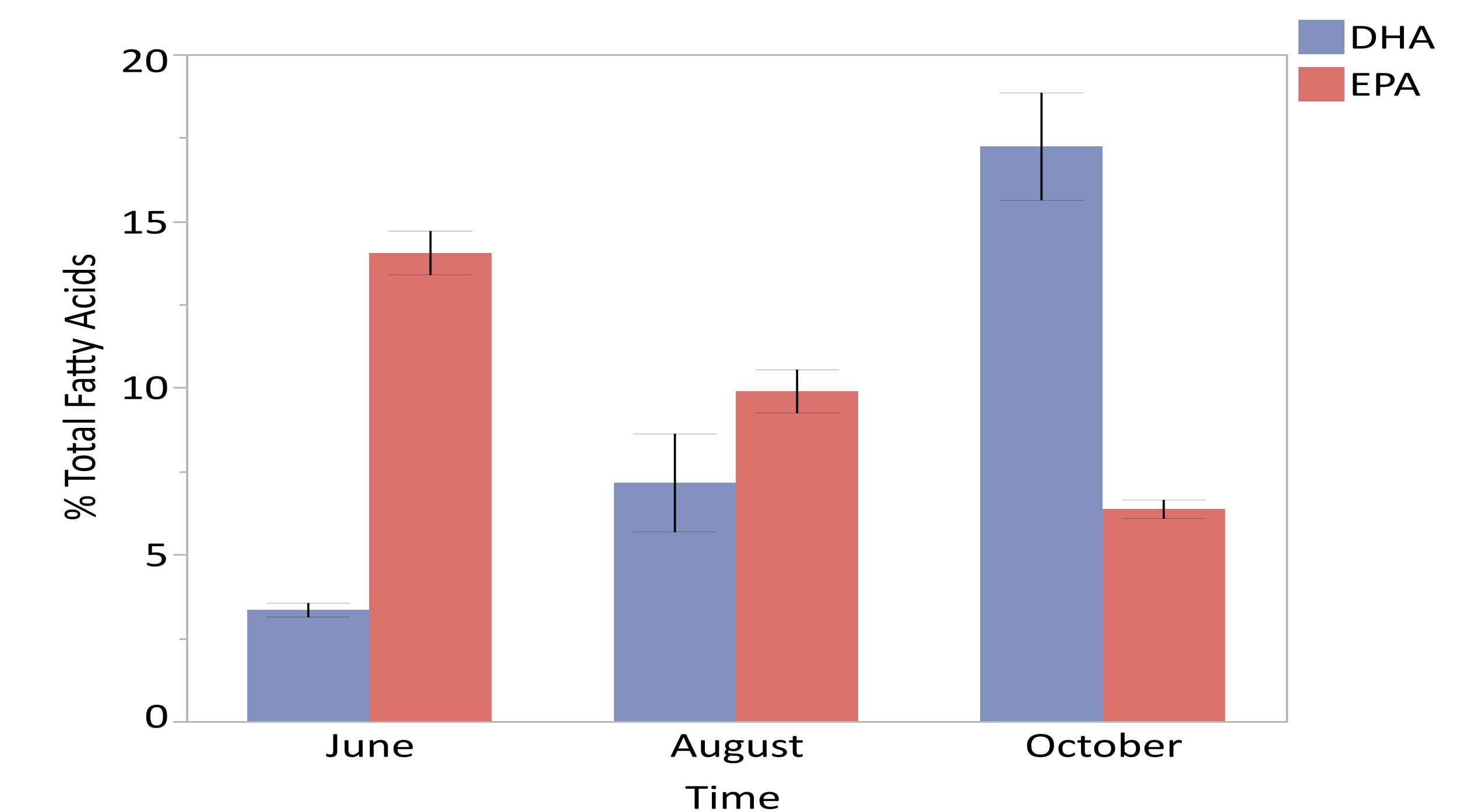


Figure 2: Mean levels (\pm SE) of EPA and DHA (in % total fatty acids) in white perch from Malletts Bay in 2013.

- EPA ($p=0.0001$) and DHA ($p<0.0001$) decreased from June to August in Missisquoi Bay white perch (**Fig. 3**).

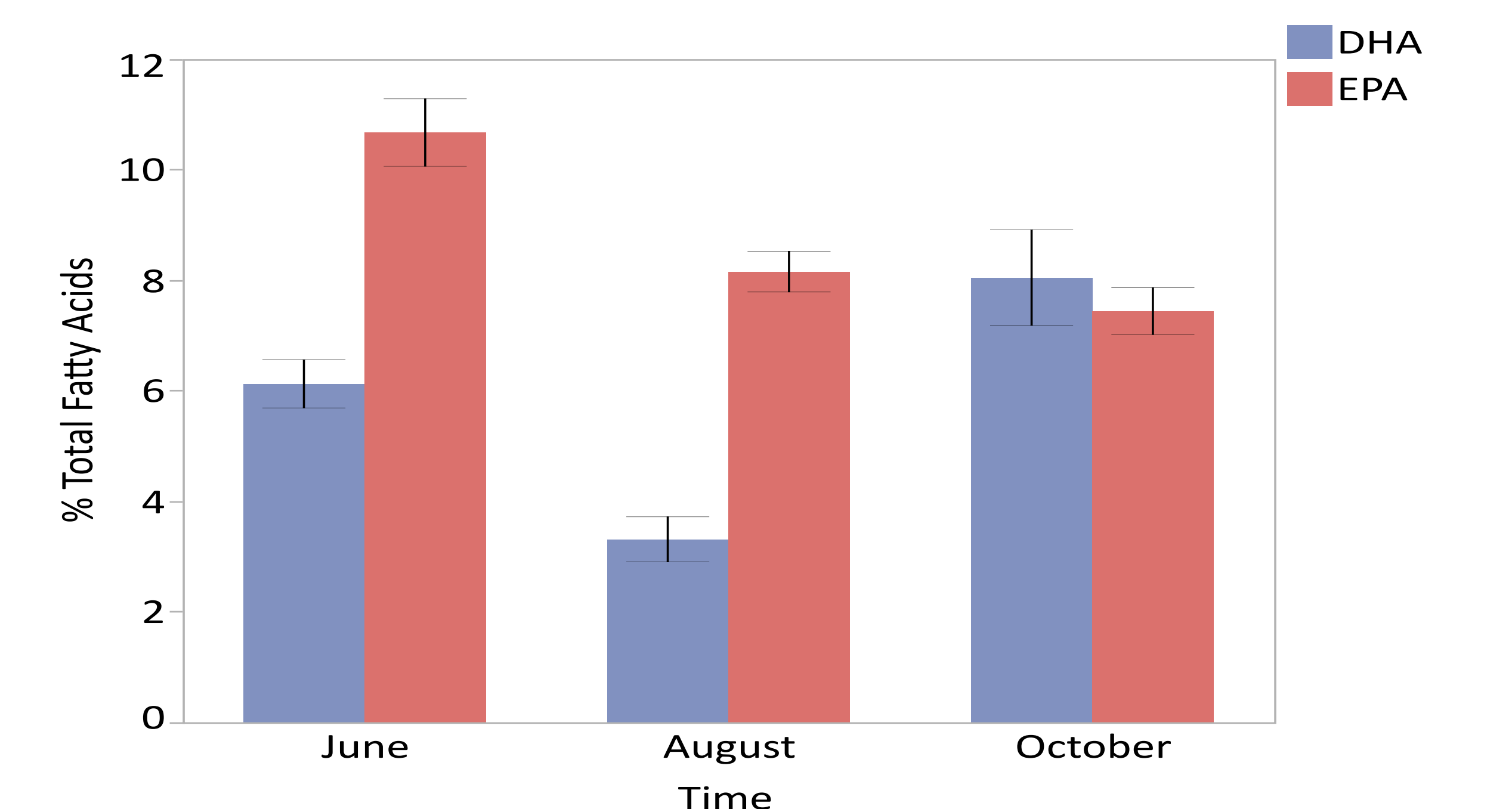


Figure 3: Mean levels (\pm SE) of EPA and DHA (in % total fatty acids) in Missisquoi Bay white perch in 2013.

Conclusion

- EFA levels are different between species, locations, and time points.
- Results support the hypothesis that locations with increased cyanobacteria blooms (Missisquoi Bay) have decreased EFA levels in August compared to areas with lower cyanobacteria density (Malletts Bay).