Do Past Experiments Accurately Model Diatom Growth in Response to Episodic Iron Addition?

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Introduction and Methods

Phytoplankton productivity supports Northern Gulf of Alaska food webs and fisheries, [1] but is iron-limited in high nitrate – low chlorophyll (HNLC) waters.[2] Iron is sporadically sourced by river plumes and subsequent cross shelf exchange with effects not fully characterized.[3] This study revealed different community responses to natural (Copper River) and synthetic ($FeCl_3$) sources of iron.

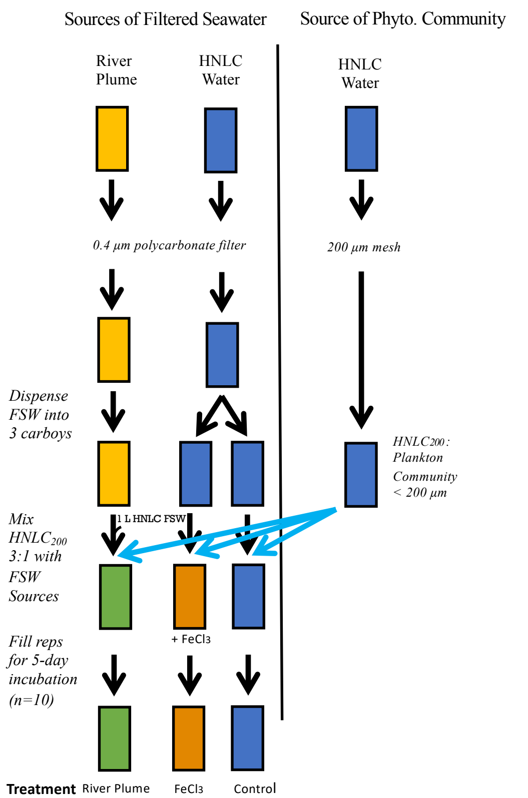

Fig. 1. Experimental set-up. The HNLC phytoplankton community was screened (200 µm) to remove large zooplankton then combined with different Fe sources.

When compared to a freshwater source, $FeCl_3$ may not represent diatom response to iron input

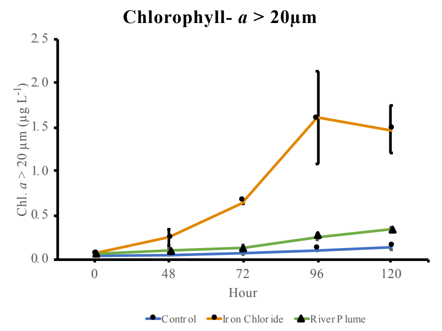

Fig. 2. **Net growth of phytoplankton > 20 µm was highest in the $FeCl_3$ treatment**; growth in the River Plume treatment diverged from the Control after 72 hours. Error bars: ±1 SD.

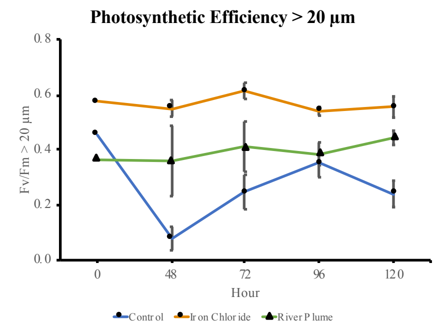

Fig. 3. **Fv/Fm of phytoplankton >20 µm was consistently highest in the $FeCl_3$ treatment**; increased Fv/Fm at Hour 0 indicates rapid response to iron additions. Error bars: ±1 SD.

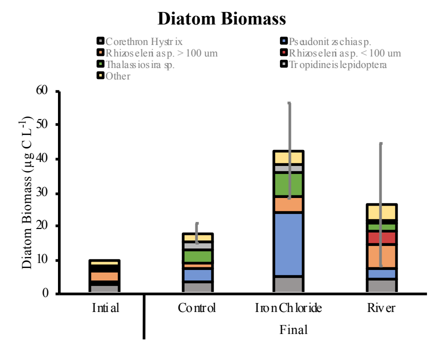

Fig. 4. A diatom bloom occurred in the $FeCl_3$ treatment, mainly *Pseudo-nitzschia* spp. **Though Control and River Plume diatom biomass were similar, community composition was not.** Error bars: ±1 SD.

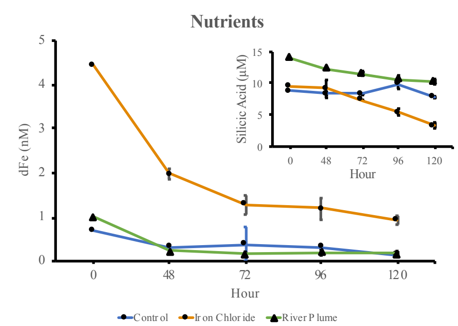

Fig. 5. **Diatom growth and physiology differed between Control and River Plume treatments despite similar dissolved Fe drawdown**; silicic acid (inset) drawdown mirrored trends in diatom growth. Error bars: ± 1 SD.

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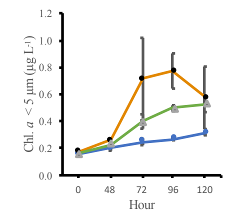
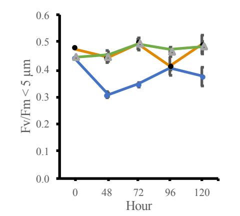
3. Wu, J., A. Aguilar-Islas, R. Rember, T. Weingartner, S. Danielson, and T. Whitledge. 2009. Size-fractionated iron distribution on the northern Gulf of Alaska. Geophysical Research Letters **36**.

Small Phyto. Also Benefit From Fe Addition

1. Net growth of phytoplankton < 5 µm was highest in the $FeCl_3$ treatment (Fig. 6)
2. Fv/Fm was similar in $FeCl_3$ and River Plume treatments; lower in the Control (Fig. 7)





3. Oxidative stress higher in Control for eukaryotes, but not for *Synechoccocus* (Fig. 8)

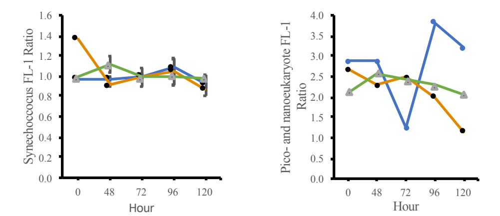


Fig. 8. Reactive oxygen species production was used as a proxy for oxidative stress. Green fluorescence (FL-1) of the CellROX™ ROS probe was measured using flow cytometry. Fl-1 was normalized by "ratioing" to a parallel "non-probed" sample. Higher FL-1 ratios indicate higher intracellular ROS concentrations. Error bars: ± 1 SD.

Conclusions

"Not all iron sources are created equal"

- Fv/Fm and ROS data indicate physiological stress in control treatment
- $FeCl_3$ may be more bioavailable to diatoms compared to natural sources
- **Fe from HNLC water, river plume, and $FeCl_3$ represent three distinct pools differing in bioavailability and community response**