



Examining the Influence of Raritan River-Bay Dissolved Organic Matter (DOM) and Extracellular Enzymes on Methylmercury (MeHg) in Phytoplankton



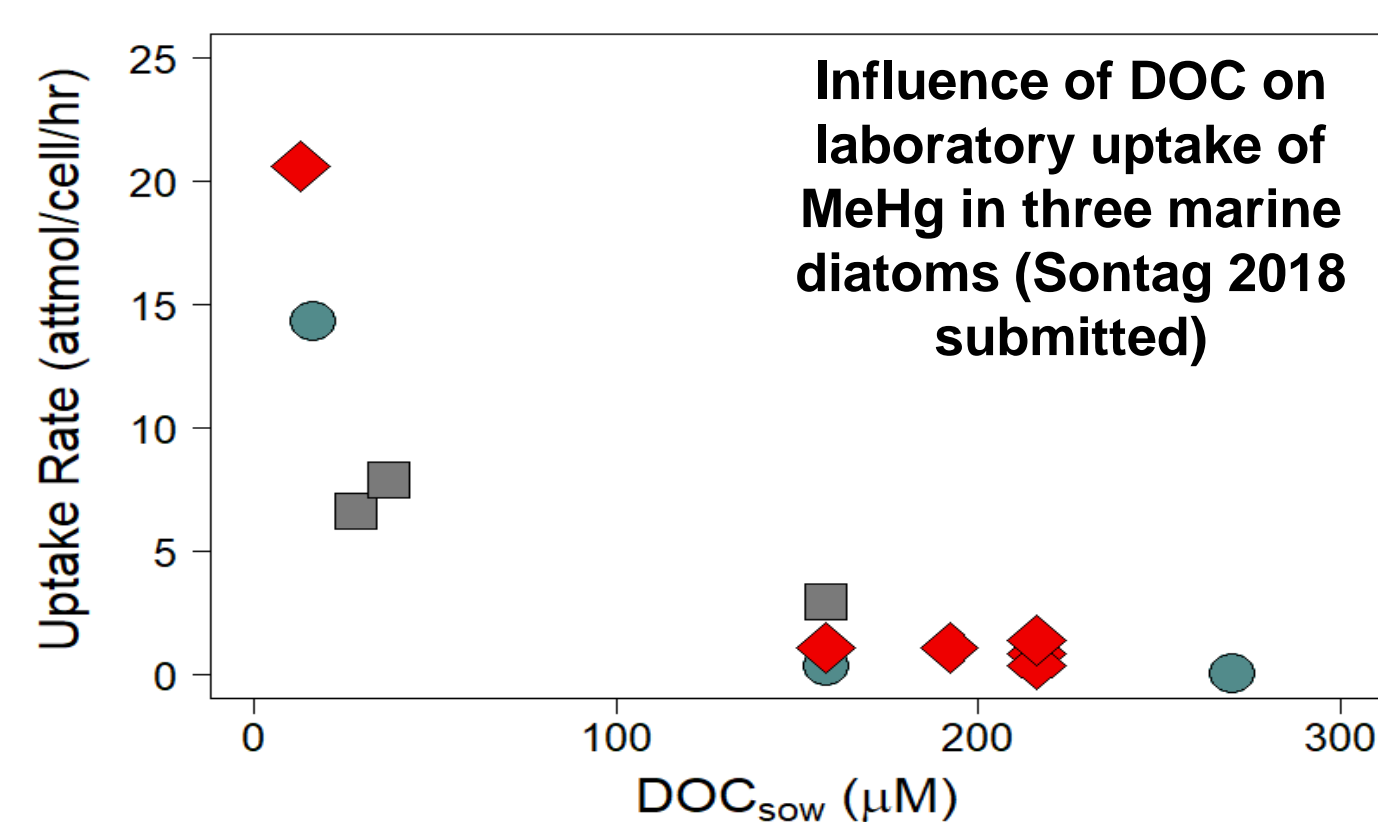
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Abstract

Primary field measurements of enzyme activity and laboratory manipulations with estuarine water collected from the Raritan Bay, New Jersey were carried out to study the effects of enzyme hydrolysis on the entrance of MeHg into the Raritan Bay food web. Additions of natural DOM and spikes of the synthetic β -glucosidase enzyme were tested in Raritan River and Bay water to examine the effects on MeHg uptake rates in cultured phytoplankton. A trend towards slower uptake was seen at higher concentrations of measured Raritan Bay DOC with little effect of enzyme hydrolysis. In contrast, incubations from the Raritan River yielded higher MeHg uptake following hydrolysis of freshwater DOM by the β -glucosidase enzyme. Uptake of MeHg by natural phytoplankton assemblages was found to be dose-dependent as MeHg uptake was negligible at a lower exposure.

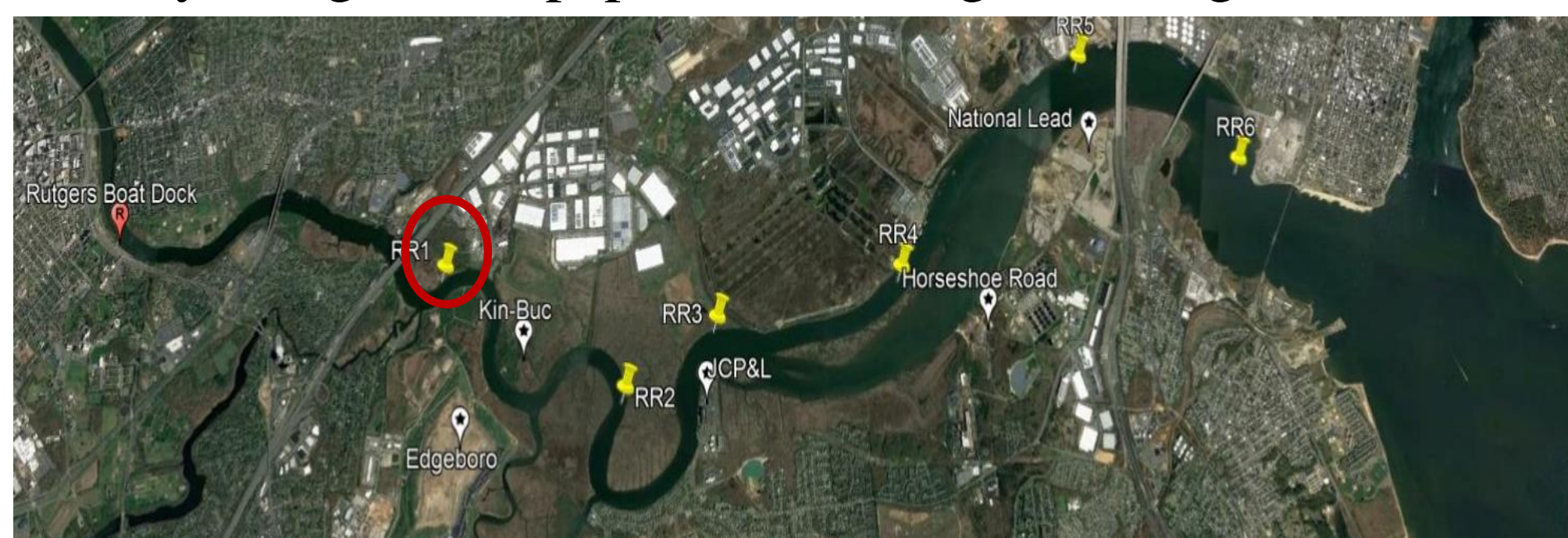
Introduction



- Higher concentrations of DOC are known to slow the rate of entry of MeHg into phytoplankton (uptake).^{1,2,3}
- Little is known about the effect of natural DOM quality and age on MeHg uptake.
- This study aims to study the influence of DOM hydrolysis on uptake of MeHg in natural and laboratory phytoplankton.

Methods

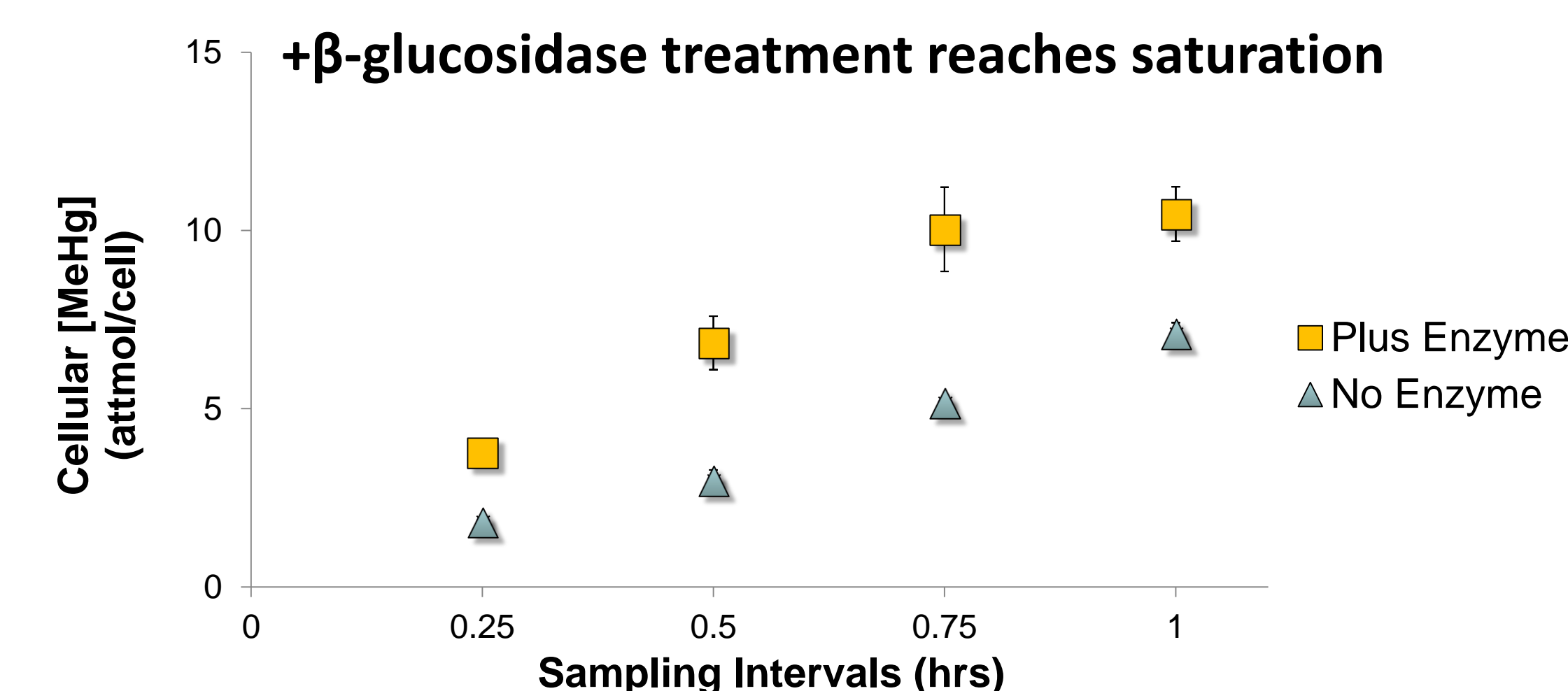
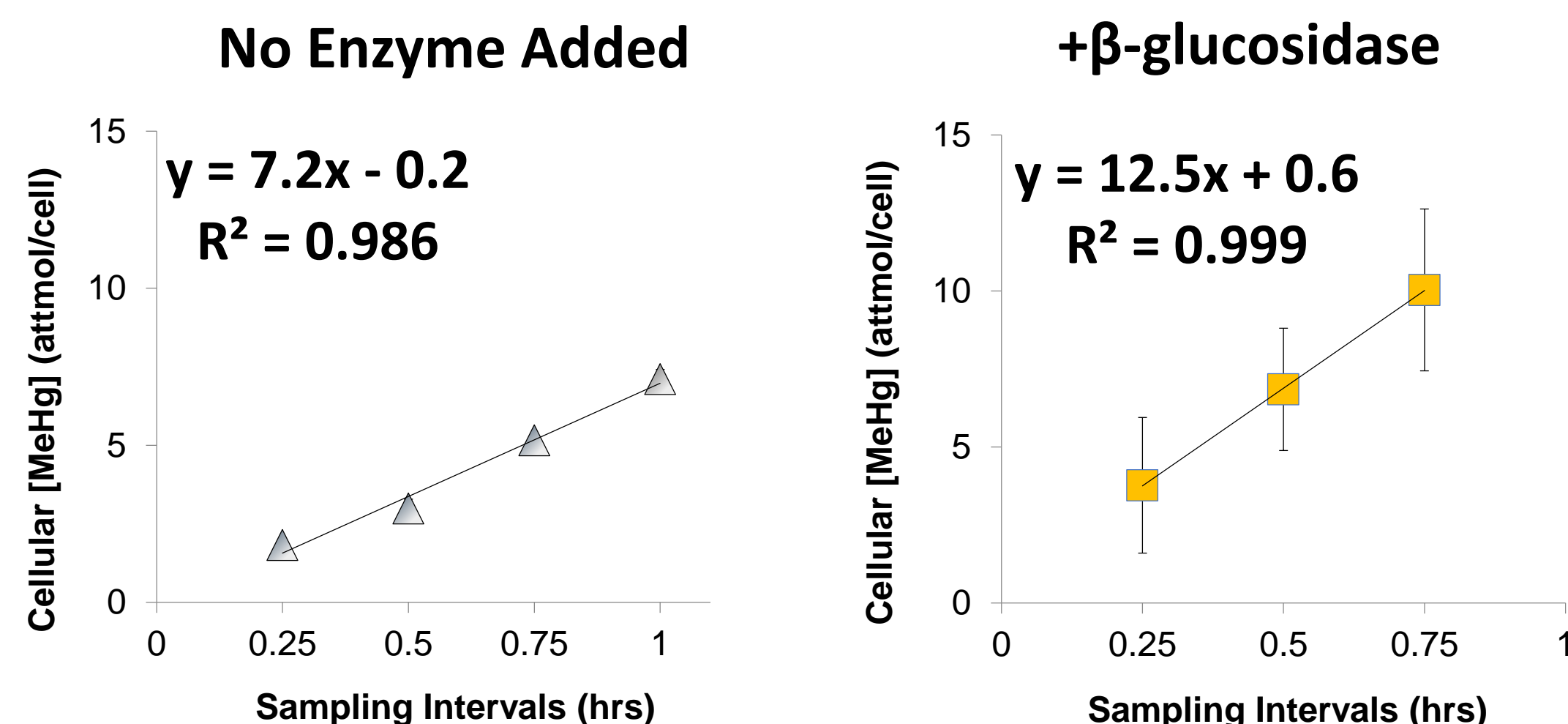
- Collect surface Raritan River-Bay water using double diaphragm pump and trace metal clean Teflon tubing attached to the Seabird CTD for filtration (GF/F, QF/F), on-deck MeHg uptake experiments, and *in-situ* fluorescence measurements of extracellular enzymes.
- Filter large volumes of Raritan River-Bay water for laboratory incubations of MeHg uptake with cultured phytoplankton
- Analyze particulate and dissolved field samples for carbon, nitrogen, total mercury (THg), and MeHg.
- Standardize on-deck fluorescence measurements as enzyme activity using model peptidase and sugar fluorogenic substrates.



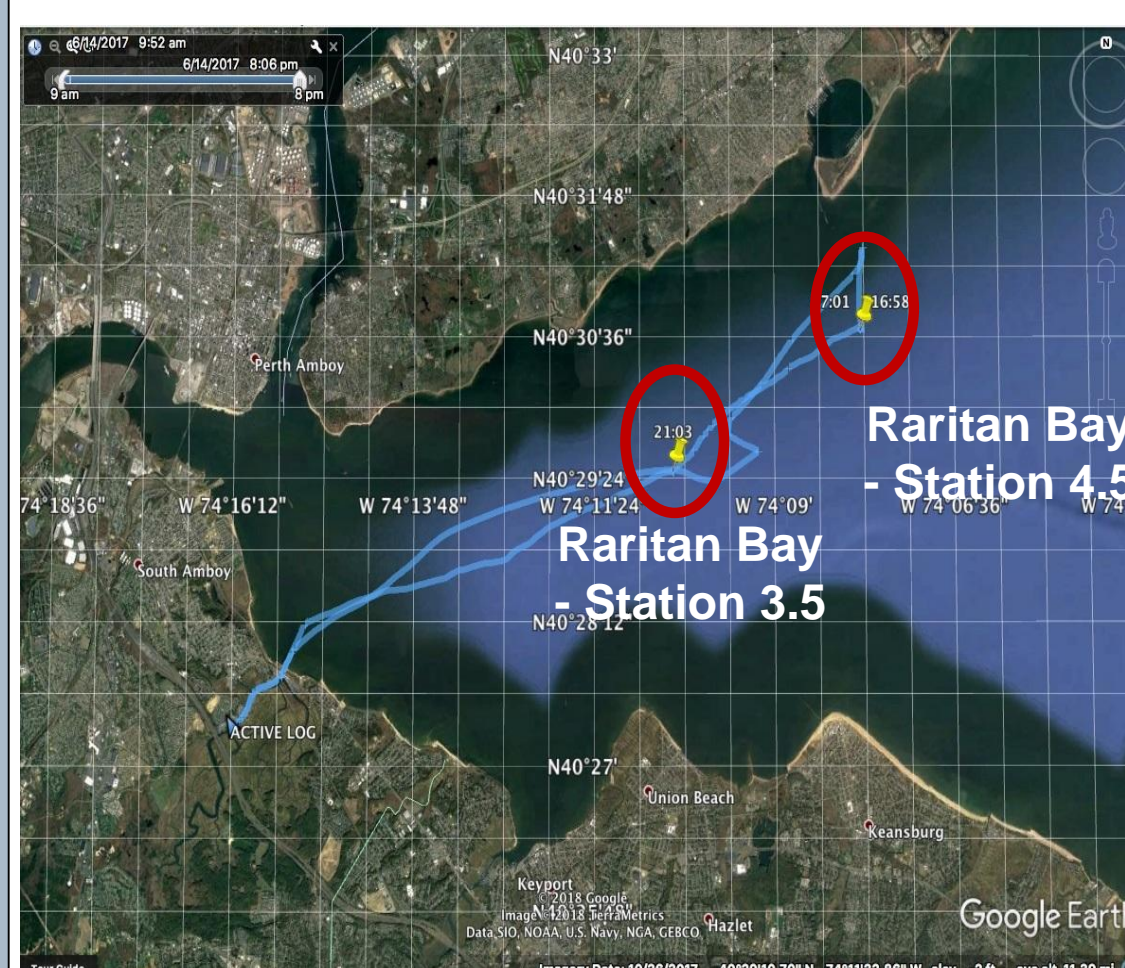
Spring 2018 Raritan River Sampling. Red circle indicates sampling site

Results

Raritan River DOM - MeHg Uptake – Cultured Green Algae (*Ankistrodesmus*)

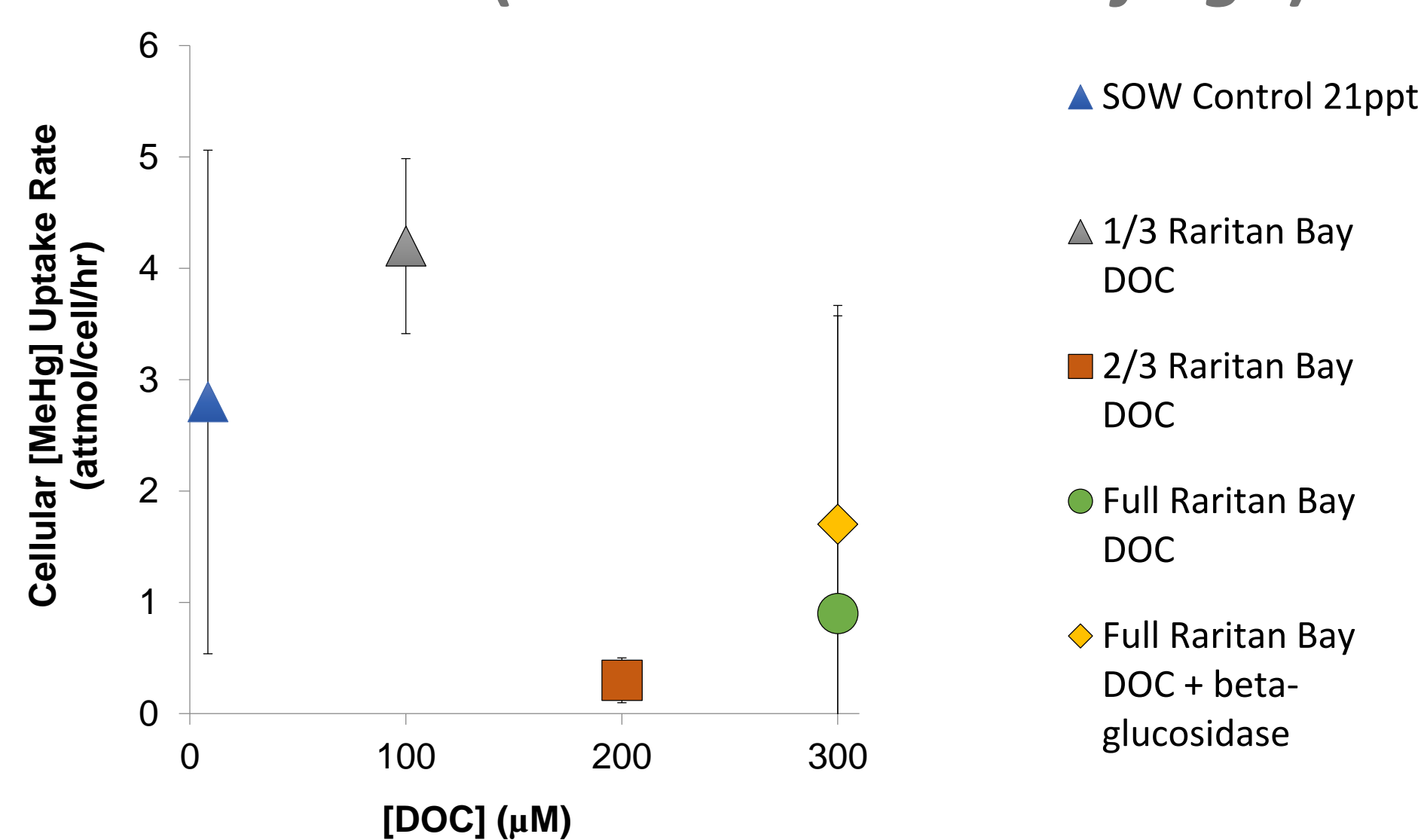


Summer 2017 Raritan Bay “Mini-Cruise”



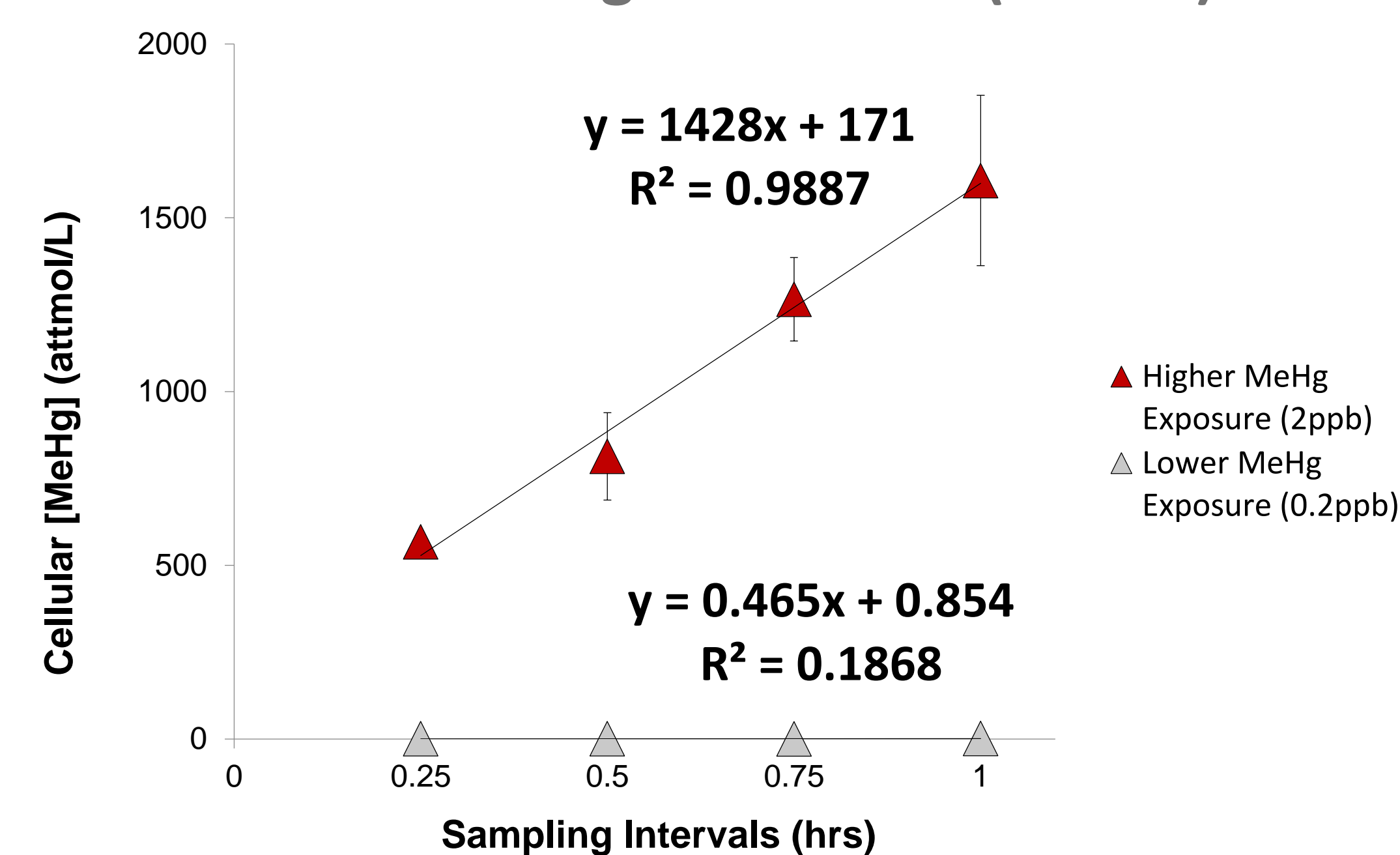
Measurement	St. 3.5	St. 4.5
MUF - β - glu activity ($\mu\text{mol/L/hr}$)	0.056 0.021	0.143 ND
MUF - α - glu activity ($\mu\text{mol/L/hr}$)	0.027 ND	ND ND
Leu - AMC activity ($\mu\text{mol/L/hr}$)	0.300 0.054	0.752 0.036
C:N	5.7 \pm 0.2	6.4 \pm 0.1
DOC ($\mu\text{mol/L}$)	4.2	3.6

Raritan Bay (St. 3.5) DOM - MeHg Uptake – Marine Diatom (*Thalassiosira weissflogii*)



Summer 2017 Raritan Bay MeHg-NPOM Data		
Measurement	St. 3.5	St. 4.5
Filtered Particulate [MeHg] pM	0.25	0.22
Cellular [MeHg] uptake rate (attmol/L) @ 2 ppb exposure	1428	8349
Cellular [MeHg] uptake rate (attmol/L) @ 0.2 ppb exposure	0.465	326
Phytoplankton Assemblages	Picoplankton, cyanobacteria	Nanoplankton, Diatoms

Raritan Bay (St. 3.5) - MeHg Uptake - Natural Particulate Organic Matter (NPOM)



Conclusions

- Enzymatic hydrolysis of Raritan River DOM increases MeHg uptake in a green algae
- Freshwater phytoplankton may reach cell saturation of MeHg in contaminated sites with high enzymatic rates
- Cell-associated and free enzymes may elicit different responses to DOM remineralization in the Raritan Bay estuary
- Increasing concentrations of Raritan Bay DOC likely decrease MeHg at the base of Raritan Bay food webs
- Cellular uptake and accumulation of MeHg may differ between sampling locations of Raritan Bay

Future Research

Future research will focus on amino peptidase enzyme activity and the role of nitrogen demand on MeHg uptake in the Raritan Bay

Acknowledgments and References



Patrick Murray - on-deck measurements, communication
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 Youki Soto - on-deck experiment
 Alexandra Sontag - equipment manager

References: ¹Zhong and Wang 2009; ²Fisher et al. 2017; ³Schartup et al. 2018