Chlorophyll d15N in Lake Erie collected on NOAA GLERL weekly monitoring cruises from June to October 2017

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Data Type: Cruise Results
Version: 1
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Project
» The role of heterotrophic bacteria in protecting cyanobacteria from hydrogen peroxide in coastal ecosystems (Lake Erie H2O2)

Contributors	Affiliation	Role
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Abstract
Chlorophyll d15N in Lake Erie collected on NOAA GLERL weekly monitoring cruises from June to October 2017.

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Coverage

Spatial Extent: **Lat**:41.77 **Lon**:-83
Temporal Extent: 2017-06-17 - 2017-10-17

Methods & Sampling

Methodology:
Detailed sampling and analytical procedures can be found in the published paper (Kharbush et al. 2019). Briefly, nitrogen isotopes were measured in bulk organic matter and chlorophyll collected on 142mm GF/F filters (0.7 µm pore size), over the course of the summer harmful algal bloom in Lake Erie. δ15N values were corrected for a N blank originating from the HPLC solvent and from the oxidizing reagent, according to Higgins et al. (2009). Phytoplankton community composition was determined using a submersible FluoroProbe (bbe Moldaenke GmbH, Germany), which monitors in situ chlorophyll fluorescence. Isotope values were then compared with phytoplankton community composition.

Instrumentation details:
A submersible FluoroProbe, manufactured by bbe Moldaenke GmbH, Germany, was used to monitor in situ chlorophyll fluorescence and to estimate algal community composition. Used with factory calibration settings.

Chlorophyll was purified using an Agilent 1200 series HPLC equipped with multi-wavelength UV/Vis detector and two Zorbax C18 columns (dimensions 4.6 × 250 mm, 5 µm).

δ15N of chlorophyll was measured using the denitrifier method (Sigman et al., 2001), on a Delta V Advantage isotope ratio mass spectrometer with a custom built purge and trap system. Isotopic measurements were standardized to the N2 reference scale using standard reference materials IAEA N3 and USGS 34.

δ15N of biomass collected on GF/Fs was analyzed on a Thermo Scientific Flash IRMS Elemental Analyzer with EA Isolink, coupled to a Delta V Advantage IRMS through a Conflo IV universal interface. Sample δ15N values were calculated using in-house laboratory standards as well as standard reference materials USGS40 and USGS41a.

Problems reported: For samples 6/17/2017, 6/27/2017, and 7/6/2017 no Fluoroprobe community data are available because of an issue with calibration.

Data Processing Description

Data were analyzed in Microsoft Office Excel and in R Studio.

BCO-DMO Processing:
- formatted date to yyyy-mm-dd;
- renamed column headers to conform with BCO-DMO naming conventions.

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Data Files

File
chl_d15N.csv (Comma Separated Values (.csv), 1.53 KB) MD5:fbf5ee73e9c8df38af76954ac7eaf2ed Primary data file for dataset ID 793501

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Related Publications

Higgins, M. B., Robinson, R. S., Casciotti, K. L., McIlvin, M. R., & Pearson, A. (2009). A Method for Determining the Nitrogen Isotopic Composition of Porphyrins. Analytical Chemistry, 81(1), 184–192. doi:10.1021/ac8017185
Methods

Kharbush, J. J., Smith, D. J., Powers, M., Vanderploeg, H. A., Fanslow, D., Robinson, R. S., … Pearson, A. (2019). Chlorophyll nitrogen isotope values track shifts between cyanobacteria and eukaryotic algae in a natural phytoplankton community in Lake Erie. Organic Geochemistry, 128, 71–77. doi:10.1016/j.orggeochem.2018.12.006
Results

Sigman, D. M., Casciotti, K. L., Andreani, M., Barford, C., Galanter, M., & Böhlke, J. K. (2001). A Bacterial Method for the Nitrogen Isotopic Analysis of Nitrate in Seawater and Freshwater. Analytical Chemistry, 73(17), 4145–4153. doi:10.1021/ac010088e
Methods

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Parameters

Parameter	Description	Units
Sample_date_collected	Date sample was collected; format: yyyy-mm-dd	unitless
Station	GLERL Lake Erie Master Station name	unitless
Lat	Latitude	Decimal degrees
Long	Longitude; west is negative	Decimal degrees
Bulk_biomass_d15N	Average d15N value of bulk biomass collected on GF/F filters, 3 replicates	permil (‰)
Bulk_uncertainty	Uncertainty in bulk d15N measurement, 3 replicates	1 standard devation (‰)
Corr_Chl_d15N	Chlorophyll isotope values obtained after correcting for blank and Rayleigh distillation effects	permil (‰)
Corr_Chl_uncert	Uncertainty in chlorophyll values, after error propagation	1 standard devation (‰)
Epor	Isotopic offset between bulk and chlorophyll d15N (d15Nbulk biomass - d15Nchloropigment)	permil (‰)
Epor_uncert	Uncertainty in Epor after error propagation	1 standard devation (‰)
pcnt_Cyanos	Depth-integrated percentage of algal community composed of cyanobacteria	Percent (%)
pcnt_Greens	Depth-integrated percentage of algal community composed of green algae	Percent (%)
pcnt_Diatoms	Depth-integrated percentage of algal community composed of diatoms	Percent (%)
pcnt_Crypto	Depth-integrated percentage of algal community composed of cryptophytes	Percent (%)

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Instruments

Dataset-specific Instrument Name	FluoroProbe
Generic Instrument Name	Fluorometer
Dataset-specific Description	A submersible FluoroProbe, manufactured by bbe Moldaenke GmbH, Germany, was used to monitor in situ chlorophyll fluorescence and to estimate algal community composition. Used with factory calibration settings.
Generic Instrument Description	A fluorometer or fluorimeter is a device used to measure parameters of fluorescence: its intensity and wavelength distribution of emission spectrum after excitation by a certain spectrum of light. The instrument is designed to measure the amount of stimulated electromagnetic radiation produced by pulses of electromagnetic radiation emitted into a water sample or in situ.

Dataset-specific Instrument Name	Agilent 1200
Generic Instrument Name	High-Performance Liquid Chromatograph
Dataset-specific Description	Chlorophyll was purified using an Agilent 1200 series HPLC equipped with multi-wavelength UV/Vis detector and two Zorbax C18 columns (dimensions 4.6 × 250 mm, 5 µm).
Generic Instrument Description	A High-performance liquid chromatograph (HPLC) is a type of liquid chromatography used to separate compounds that are dissolved in solution. HPLC instruments consist of a reservoir of the mobile phase, a pump, an injector, a separation column, and a detector. Compounds are separated by high pressure pumping of the sample mixture onto a column packed with microspheres coated with the stationary phase. The different components in the mixture pass through the column at different rates due to differences in their partitioning behavior between the mobile liquid phase and the stationary phase.

Dataset-specific Instrument Name	Delta V Advantage
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	δ15N of chlorophyll was measured using the denitrifier method (Sigman et al., 2001), on a Delta V Advantage isotope ratio mass spectrometer with a custom built purge and trap system. Isotopic measurements were standardized to the N2 reference scale using standard reference materials IAEA N3 and USGS 34.
Generic Instrument Description	The Isotope-ratio Mass Spectrometer is a particular type of mass spectrometer used to measure the relative abundance of isotopes in a given sample (e.g. VG Prism II Isotope Ratio Mass-Spectrometer).

Dataset-specific Instrument Name	Thermo Scientific Flash IRMS Elemental Analyzer with EA Isolink
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	δ15N of biomass collected on GF/Fs was analyzed on a Thermo Scientific Flash IRMS Elemental Analyzer with EA Isolink, coupled to a Delta V Advantage IRMS through a Conflo IV universal interface. Sample δ15N values were calculated using in-house laboratory standards as well as standard reference materials USGS40 and USGS41a.
Generic Instrument Description	The Isotope-ratio Mass Spectrometer is a particular type of mass spectrometer used to measure the relative abundance of isotopes in a given sample (e.g. VG Prism II Isotope Ratio Mass-Spectrometer).

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Deployments

GLERL_2017

Website	https://www.bco-dmo.org/deployment/793643
Platform	NOAA R4108
Start Date	2017-06-17
End Date	2017-10-17
Description	2017 NOAA GLERL weekly monitoring of Western Lake Erie. Day cruises; no cruise IDs. Dates: 6/17/17, 6/27/17, 7/6/17, 7/12/17, 7/18/17, 7/25/17, 8/1/17, 8/8/17, 8/15/17, 8/22/17, 8/29/17, 9/5/17, 9/12/17, 9/19/17, 9/26/17, 10/3/17, 10/11/17, 10/17/17

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Project Information

The role of heterotrophic bacteria in protecting cyanobacteria from hydrogen peroxide in coastal ecosystems (Lake Erie H2O2)

Coverage: Western Basin of Lake Erie (41N, 83W)

NSF Award Abstract:
Toxic cyanobacterial harmful algal blooms (CHABs) are now a worldwide problem that poses dangers for humans and aquatic organisms including life-threatening sickness, beach closures, health alerts, and drinking water treatment plant closures. This project focuses on the basic science needed to understand interactions between the microorganisms present in CHABs and the chemistry of the lakes they inhabit. In particular, it will study the sources, fate, and effects of hydrogen peroxide, which is a potentially important control on the toxicity and species present within these blooms. This research will be conducted in Lake Erie, a source of drinking water for 11 million people that is threatened by CHABs annually. Results will be directly integrated into two water quality models that are widely used by water managers and other stakeholders. This project will support the training of two PhD students, including a first-generation college attendee, and undergraduate students from backgrounds that are underrepresented in the earth sciences. Research will also be integrated into outreach aimed at increasing diversity in the earth sciences by involving women and underrepresented minorities in K-12 as well as college and adult educational settings.

The overall goal of this project is to determine the influence of hydrogen peroxide (H2O2) on cyanobacterial community composition and function in nearshore ecosystems. Preliminary results from Lake Erie show that dominant primary producers rely on heterotrophic bacteria to draw down H2O2 from transiently high environmental levels that are likely inhibitory to members of the cyanobacterial community. This suggests that H2O2 plays important and still poorly understood roles in aquatic microbial ecology. A combination of field sampling, experiments, and state-of-the art "-omics" will be used to test the overall hypothesis that H2O2 decomposition by heterotrophic "helpers" is an important determinant of microbial interactions and community structure and function. Lake Erie will be studied because (i) it is a model system for shallow coastal areas receiving high terrestrial nutrient runoff, (ii) it offers strong inshore-offshore gradients of light and nutrients for comparative studies, and (iii) existing sampling infrastructure, archived samples, and preliminary data can be leveraged. Field and laboratory experiments and measurements will be integrated to answer the following questions: Q1: What drives the temporal dynamics of H2O2 concentrations? Q2: Which enzymes and organisms are responsible for protecting the community via biological H2O2 decay? Q3: How does protection from H2O2 by helpers influence the composition and function of the community? The study will perform controlled lab experiments on cultures and on natural waters during different points of the bloom. Measures of H2O2 concentrations and rates of production and decay, along with supporting chemical and biological measurements, will be used to assess the major sources and sinks of H2O2. Molecular tools will be used to determine the pathways underpinning H2O2 decay and the effect of H2O2 on cyanobacterial community composition function. In parallel, impacts of varying H2O2 concentrations on growth rates of major cyanobacteria will be assessed experimentally. These experimental results will be placed into context through comparisons with the structure and function of microbial communities from field samples across spatial, temporal, and chemical gradients in this coastal ecosystem. The approach of integrating studies of H2O2 with "-omics" in natural systems is novel, and will advance our fundamental knowledge and understanding of the relationship between microbial community composition and function.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1736629

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