Hydrologic data from field sampling sites in the Neuse River Estuary, Pamlico Sound, and Onslow Bay in the coastal North Atlantic, offshore from North Carolina, USA, in 2021 and 2022

Website: https://www.bco-dmo.org/dataset/935794
Version: 1
Version Date: 2024-08-19

Project
» Collaborative Research: Vitamin B1 Limitation and Advantageous Use of B1-related Compounds by Marine Bacterioplankton (VBLAM)

Contributors	Affiliation	Role
Paerl, Ryan	North Carolina State University (NCSU)	Principal Investigator
Curtis, Nathaniel	North Carolina State University (NCSU)	Student
York, Amber D.	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This dataset contains hydrologic data from field sampling sites in the coastal North Atlantic, offshore from North Carolina, USA, during 2021 and 2022. Study description: This study collected physical, chemical, and biological parameters measured from field sampling locations within the Neuse River Estuary the Neuse River Estuary (NRE180), Pamlico Sound (PS), and Onslow Bay (OB1). Measurements were made from near-surface waters (0.5m). See "Related Datasets" section for data from coordinated sampling efforts. Vitamin B1 amendment bottle experiments were conducted using the sample surface water, as well as collections for metagenomes and transcriptomes. Water was collected by N. Curtis and A. Zhou with the assistance of the UNC-IMS MODMON staff.

Table of Contents

Coverage

Location: Coastal N. Atlantic offshore from Morehead City, NC, USA (stn: OB1: 34.609368, -76.6771), Pamlico Sound (stn: PS5: 35.1225, -76.2006), Neuse River Estuary (stn: NRE180: 35.06413, -76.526). Near surface waters (0.5m).
Spatial Extent: **N**:35.1225 **E**:-76.2006 **S**:34.609368 **W**:-76.6771
Temporal Extent: 2021-09-27 - 2022-08-29

Methods & Sampling

Sampling summary:
Discrete samples were all obtained from ~0.2m using a diaphragm pump and weighted, marked hose. All containers were kept in dark coolers at ambient temperature during transport to the laboratory. All filtration was done within a few hours of collection and when conditions permitted, on board the research vessel.

Water sampling was conducted bi-weekly. When the collection was split over two days, a single date was used based on the upstream or majority stations.

Methodology summaries corresponding to data columns in the dataset:

In-situ YSI sampling (YSI_* columns):

In situ measurements were performed at discrete depths on the sunlit side of the research vessel using a Yellow Springs Instruments (YSI Incoporated, Ohio) multiparameter sonde (Model 6600 or 6600 EDS-S Extended Deployment System) equipped with a YSI conductivity/temperature probe (Model 6560), a YSI chlorophyll probe (Model 6025), a YSI pH probe (Model 6561 or 6566), a YSI pulsed dissolved oxygen probe (Model 6562), a self cleaning YSI turbidity probe (Model 6026 or 6136), and beginning on the 07/30/2003 sampling date, a flat Li-Cor sensor (UWQ-PAR 6067). The YSI sonde was coupled to a either a YSI 610 DM datalogger or a YSI 650 MDS Multi-parameter Display System datalogger. The data were stored on the datalogger and downloaded to Ecowin software upon return to the laboratory.

"PAR" column:

The diffuse light attenuation coefficient, Kd, was calculated from depth profiles of photosynthetically active radiation (PAR, 400-700 nm). Prior to the 07/30/2003 sampling date, PAR measurements were performed with a spherical underwater quantum sensor (LI-COR LI-193SA) coupled to a LI-COR LI-1000 datalogger. Beginning on the 07/30/2003 sampling date, a flat underwater quantum sensor (LI-COR LI-193SA) attached to a Yellow Springs Instruments YSI 6600 or YSI 6600 EDS-S sonde was used to measure PAR. Measurements of PAR were performed on the sunlit side of the research vessel in 0.5 meter depth increments, beginning just below the water surface. The diffuse attenuation coefficient is the slope of the linear regression between natural log transformed PAR data and depth.

"POC" and "PN" columns:

Particulate organic carbon (POC) and Particulate Nitrogen (PN) concentrations were determined by elemental analysis of material collected on pre-combusted Whatman GF/F glass fiber filters. Carbonates were removed from the filters by vapor phase acidification using concentrated hydrochloric acid (HCl). After drying at 60 0C, the filters were rolled in tin disks and injected into a PE 2400 Series II CHNS/O Analyzer calibrated with acetanilide ending in June 2014. Starting on the Neuse River sample date of June 2, 2014, a Costech Analytical Technologies, Inc. Elemental Combustion System CHNS-O ECS 4010 was used for elemental analysis by "flash combustion/chromatographic separation and multi-detector techniques". The Costech Instrument utilizes EAS Clarity Software. Atropine standards are used to develop a calibration curve (C 70.56%, N 4.84%, and carbon response ratio of 0.025 +/-0.003). NIST Buffalo River Sediment Reference Material 8704 (C 3.351% +/-0.017, N 0.20% +/-0.04) and/or Acetanilide Bypass (C 71.09%, N 10.36%, carbon response ratio of 0.055 +/- 0.003) may used for calibration or a check standard.

"DOC" column:

Dissolved organic carbon (DOC) concentration was measured using a Shimadzu TOC-5000A Analyzer: Water samples were vacuum filtered (less than 25 kilopascal) using pre-combusted Whatman glass microfibre filters (GF/F). The filtrate was stored in pre-combusted glass scintillation vials with Teflon closures and frozen at -20 degrees Celsius until analysis. The Shimadzu TOC-5000A Analyzer uses high temperature catalytic oxidation followed by non-dispersive infrared analysis of the CO2 produced. Samples were acidified to a pH less than 2 and sparged with air before they were analyzed for non-volatile organic carbon.

"DIC" column:

Dissolved inorganic carbon (DIC) was measured on samples held overnight in research pond by acidification followed by infrared analysis of carbon dioxide (CO2) on a Shimadzu Total Organic Carbon Analyzer (TOC-5000A) in IC mode and calibrated with sodium carbonate standards. Previously run ModMon samples resulted in standard error analysis measurement (RSD) of DIC +/- 0.94%.

"NO3_NO2" column:

Nitrate/nitrite (NO3- / NO2-) concentration was determined using a Lachat/Zellweger Analytics QuikChem 8000 flow injection autoanalyzer (Milwaukee, WI, USA) using method FIA 31-107-04-1-C: Water samples were vacuum filtered (less than 25 kiloPascals) using pre-combusted Whatman glass microfibre filters (GF/F). The filtrate was stored in high-density polyethylene bottles and frozen at -20 degrees Celsius until analysis. Two replicates were run from the same bottle. Method detection limits (MDL, µg L-1) were 0.71 on 1/25/2020.

"NH4" column:

Ammonium (NH4+) concentration was determined using a Lachat/Zellweger Analytics QuikChem 8000 flow injection autoanalyzer (Milwaukee, WI) using method FIA 31-107-06-1-A/B: Water samples were vacuum filtered (less than 25 kiloPascals) using pre-combusted Whatman glass microfibre filters (GF/F). The filtrate was stored in high-density polyethylene bottles and frozen (-20 degrees Celsius) until analysis. Two replicates were run from the same bottle. Method detection limits (MDL, µg L-1) were: 6.99 on 1/25/2020.

"TDN" column:

Total dissolved nitrogen (TDN) was measured by in-line digestion using the Lachat/Zellweger Analytics QuikChem 8000 flow injection autoanalyzer (Milwaukee, WI, USA) using method FIA 31-107-04-3-B for low total nitrogen for brackish/fresh waters (detection level: 0.1 - 5.0 milligrams nitrogen per liter): Water samples were vacuum filtered (less than 25 kiloPascals) using pre-combusted Whatman glass microfibre filters (GF/F). The filtrate was stored in high-density polyethylene bottles and frozen at -20 degrees Celsius until analysis. Two replicates were run from the same bottle. Total dissolved nitrogen by in-line digestion works by oxidizing all the nitrogen compounds to nitrate by heating to 100 degrees Celsius and adding energy via UV light. The pH is dropped from 9.1 to 3 during the decomposition. The entire digestion occurs prior to the injection valve. The nitrate/nitrite concentration is then determined using standard colorimetric techniques similar to the strict nitrate/nitrite manifold. Method detection limits (MDL, µg L-1) were 11.75 on 1/25/2020.

"DON" column:

Dissolved organic nitrogen (DON) was calculated by subtracting dissolved inorganic nitrogen (DIN) from total dissolved nitrogen (TDN). If the DIN value used in the calculation was below the detection limit, it was taken to be zero for this calculation. At one point DON was determined by high temperature oxidation using the Antek 7000N or Antek 7000V analyzer.

"PO4" column:

Orthophosphate (PO43-) was determined using a Lachat/Zellweger Analytics QuikChem 8000 flow injection autoanalyzer (Milwaukee, WI) using method FIA 31-115-01-1-F/G: Water samples were vacuum filtered (less than 25 kiloPascals) using pre-combusted Whatman glass microfibre filters (GF/F). The filtrate was stored in high-density polyethylene bottles and frozen at -20 degrees Celsius until analysis. Two replicates were run from the same bottle. Method detection limits (MDL, µg L-1) were 6.56 on 1/25/2020.

"SiO2" column:

Silicic acid (SiO2) was measured after vacuum filtration (< 25 kPA) of the collected water samples through pre-combusted (3-4 hours at 450 0C) Whatman GF/F glass fiber filters. The filtrate was stored in high-density polyethylene bottles and frozen (-20 0C) until analysis. Two replicates were run from the same sample bottle. Nitrate plus nitrite concentrations were determined using a Lachat QuikChem 8000 flow injection autoanalyzer (Milwaukee, WI, USA). Method detection limits (MDL, µM) were 1.17 on 1/25/2020.

"PPR" column:

Primary Productivity rate was measured using an adaptation of Steeman Nielsen's (1952) 14C bicarbonate method (Paerl et al. 1998). This method of measuring primary productivity allows direct measurement of carbon uptake and measures only net photosynthesis: Water samples were stored in 10 Liter high density polyethylene containers overnight in the research pond, a flow through system that receives water from the adjacent Bogue Sound, thereby simulating ambient water temperatures. The following morning the water samples were removed from the pond and transported to the laboratory for analysis. Water samples (76 milliliters) were added to three clear plastic square bottles to determine light uptake of carbon in triplicate and to 1 dark bottle to determine dark uptake of carbon. A solution of radioactive carbonate (300 microliters) was added to each bottle. The bottles were incubated for 4 hours in the pond. The light bottles were incubated underneath a field light simulator, while the dark bottles were incubated in a covered perforated bucket that was submerged in the pond. The FLS was used to simulate the ambient light conditions that phytoplankton are exposed to in the estuary (mixing conditions). The FLS is comprised of a rotating wheel with varying levels of screening. During the incubation period, photosynthetically active radiation (PAR) measurements were performed using a 2 pi Li-Cor LI-192SA spherical quantum sensor attached to a Li-Cor data logger. After the incubation period, the samples were returned to the laboratory, shaken and the entire contents were gently vacuum filtered (less than 25 kilopascals) using 25 mm Whatman glass microfibre filters (GF/F). The filters were placed in wooden drying trays and treated with concentrated hydrochloric acid fumes for 40 minutes to an hour to remove inorganic 14C. The filters were folded in half and placed in 7 milliliter plastic scintillation

vials. Five milliliters of liquid scintillation cocktail (ecolume or cytoscint) was added to the vials. The vials were capped, shaken, stored in the dark for 3-24 hours and then assayed for radioactivity using a Beckman liquid scintillation counter. In addition to the samples, triplicate voucher samples were used to quantify the radioactivity of the 14C added. Voucher samples consisted of 100 microliter of 14C and 100 microliters of phenylethylamine. These vials also received 5 milliliters of liquid scintillation cocktail. A background vial and two 14C background standards were used. The quantity of carbon fixed is proportional to the fraction of radioactive carbon assimilated. (Paerl, H.W., J.L. Pinckney, J.M. Fear, and B.L. Peierls 1998. Ecosystem responses to internal and watershed organic matter loading: consequences for hypoxia in the eutrophying Neuse River Estuary, North Carolina, USA. Marine Ecology Progress Series 166: 17-25; Steemann Nielsen, E. 1952. The use of radio-active carbon (C14) for measuring organic production in the sea. Journal du Conseil permanent international pour L'Exploration de la Mer 18: 117-140).

"Correct_Chla_IV" column:

Chl a concentration was measured using the modified in vitro fluorescence technique in EPA Method 445.0 (Welshmeyer 1994, Arar et al. 1997): Each water sample was vacuum filtered (less than 25 kilopascals) in duplicate at low ambient light conditions using 25 mm Whatman glass microfibre filters (GF/F). The filters were blotted dry, wrapped in foil and frozen immediately at -20 degrees Celsius until analysis. Chlorophyll a was extracted from the filter using a tissue grinder and 10 mL of 90 percent reagent grade aqueous acetone (v/v with deionized water, Fisher Scientific NF/FCC Grade). The samples remained in the acetone overnight at -20 degrees Celsius. The extracts were filter-clarified using a centrifuge and analyzed on a Turner Designs Trilogy fluorometer. The value reported is the average chlorophyll a concentration measured from the two filters. MDL 0.025 ug/l. 7200-046 Chl a extraction non acid module, 436 EX/685 EM (460 LED). The fluorometer was calibrated with a known concentration of pure Chl a that was determined using a Shimadzu UV-160U spectrophotometer and the extinction coefficients of Jeffrey and Humphrey (1975). The calibration was checked daily against a solid secondary standard (Turner Designs, proprietary formula).

Diagnostic phytoplankton photopigments were identified, separated and quantified by high performance liquid chromatography (HLPC) coupled to an in-line photodiode array spectrophotometer (Jeffrey et al. 1997). See "Related Datasets" section for the HLPC data and methods).

Data Processing Description

Formatting and organization of data was completed in Excel (Microsoft).

BCO-DMO Processing Description

BCO-DMO Data Manager Processing Notes:
* Data from source file BLAMM_METADATA_7_3_24_RWP.xlsx Sheet "Hydrologic_conditions" were imported into the BCO-DMO data system with "-7777" (meaning no data) and "-9999" (meaning below detection limit) values in numeric columns imported as blank (null) values.
* Additional *_flag columns added to provide information about what type of missing data each blank value corresponds to. For example PO4_flag indicates if the blank value in the PO4 column is due to below detection limit (BDL) or not analyzed/measured/recorded (NA).
** Missing data in the BCO-DMO system displays as a blank (null values) by default and will vary depending upon the file format downloaded (blank in csv files, NaN in .mat matlab files, etc).
* Additional DOC_Comment column added to capture a note provided below the table in the original excel sheet "*data from NRE160 (adjacent station) used, NRE180 measurements not taken." These asterisks were removed from four values in the DOC column and a corresponding comment added to new DOC_comment column. Metadata note about the DOC measurements is provided in the "Problems/Issues" section.

* Parameters (column names) renamed to comply with BCO-DMO naming conventions. See https://www.bco-dmo.org/page/bco-dmo-data-processing-conventions

* Site name (geolocation), lat, lon were added to the data table from an additional sheet provided in the excel file.

* DateTime (UTC) column added in ISO 8601 format using local date and time provided (assumed to be EST/EDT but confirming with the data provider). Date and time format changed to ISO 8601 format.

Problem Description

NRE180 DOC measurements were not taken, values in the DOC column for station NRE180 use data from NRE160 (adjacent station).

[table of contents | back to top]

Related Publications

Arar, E. J., Budde, W. L., & Behymer, T. D. (1997). Methods for the determination of chemical substances in marine and environmental matrices. National Exposure Research Laboratory, US Environmental Protection Agency, Cincinnati, OH.
Methods

Jeffrey, S. W., Mantoura, R. F. C., Wright, S. W., International Council of Scientific Unions., & Unesco. (1997). Phytoplankton pigments in oceanography: Guidelines to modern methods. Paris: UNESCO Pub.
Methods

Pinckney, J. L., Millie, D. F., Howe, K. E., Paerl, H. W., & Hurley, J. P. (1996). Flow scintillation counting of 14C-labeled microalgal photosynthetic pigments. Journal of Plankton Research, 18(10), 1867–1880. doi:10.1093/plankt/18.10.1867
Methods

Welschmeyer, N. A. (1994). Fluorometric analysis of chlorophyll a in the presence of chlorophyll b and pheopigments. Limnology and Oceanography, 39(8), 1985–1992. doi:10.4319/lo.1994.39.8.1985
Methods

[table of contents | back to top]

Related Datasets

IsRelatedTo

Paerl, R., Curtis, N. (2024) **HPLC data from field sampling sites in the Neuse River Estuary, Pamlico Sound, and Onslow Bay in the coastal North Atlantic, offshore from North Carolina, USA, in 2021 and 2022.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-08-19 http://lod.bco-dmo.org/id/dataset/935786 [view at BCO-DMO]
Relationship Description: Data from the same study and field sampling locations within the Neuse River Estuary the Neuse River Estuary (NRE180), Pamlico Sound (PS), and Onslow Bay (OB1).

[table of contents | back to top]

Parameters

Parameter	Description	Units
Station	Sampled station	unitless
Trip_Code	Individual trip code	unitless
Site	Site name (geolocation)	unitless
Lat	Site latitude	decimal degrees

Lon	Site longitude	decimal degrees
Date	Date when the in situ measurements were made. When the collection was split over two days, a single date was used based on the upstream or majority stations. (local time zone EST/EDT)	unitless
YSI_Time	Time when the in situ measurements were made. This time is an approximate water sampling time. (local time zone EST/EDT).	unitless
ISO_DateTime_UTC	Timestamp when the in situ measurements were made. This time is an approximate water sampling time. (UTC time zone, ISO 8601 format).	unitless
YSI_Depth	Exact depth (meters) where the in situ measurements were made.	meters (m)
YSI_Temp	In situ water temperature.	degrees Celsius
YSI_SpecCond	In situ specific conductivity.	milliSiemens per centimeter (mS/cm)
YSI_Salinity	In situ salinity.	parts per thousand (ppt)
YSI_Dosat	In situ dissolved oxygen saturation.	percent (%)
YSI_DO	In situ dissolved oxygen concentration.	milligrams per liter (mg/L)
YSI_pH	In situ pH.	unitless
YSI_Turbidity	In situ turbidity (NTU).	Nephelometric Turbidity Unit (NTU)
Correct_Chla_IV	Extracted chlorophyll a. Chlorophyll a concentration measured by in vitro fluorometry.	micrograms per liter (mg/L)
YSI_BP	Surface barometric pressure (millimeters of mercury).	millimeters of mercury (mm Hg)
PAR_Depth	Depth of PAR measurement based on YSI 6600 or 6600 EDS-S sonde.	meters (m)
PAR	Photosynthetically Active Radiation (PAR).	micromoles per square meter per second (umol m-2 s-1)

POC	Particulate organic carbon concentration (micrograms of carbon per liter).	micrograms per liter (ug/L)
PN	Particulate nitrogen concentration (micrograms of nitrogen per liter).	micrograms per liter (ug/L)
C_to_N	Calculated molar ratio of particulate organic carbon (POC) to particulate nitrogen (PN).	unitless
DOC	Dissolved organic carbon concentration (micromolar).	micromolar (uM)
DOC_Comment	Additional comment column to describe went subsituted values used in the DOC column.	unitless
DIC	Dissolved inorganic carbon concentration (milligrams of carbon per liter).	milligrams per liter (mg/L)
NO3_NO2	Nitrate plus nitrite concentration (micrograms of nitrogen per liter).	micrograms per liter (ug/L)
NO3_NO2_flag	NO3_NO2 flag. Indicates if the blank value in the NO3_NO2 column is due to below detection limit (BDL) or not analyzed/measured/recorded (NA).	unitless
NH4	Ammonium concentration	micrograms per liter (ug/L)
NH4_flag	NH4 flag. Indicates if the blank value in the NH4 column is due to below detection limit (BDL) or not analyzed/measured/recorded (NA).	unitless
TDN	Total dissolved nitrogen concentration (organic plus inorganic species in micrograms of nitrogen per liter).	micrograms per liter (ug/L)
DON	Calculated dissolved organic nitrogen concentration (micrograms of nitrogen per liter).	micrograms per liter (ug/L)
PO4	Orthophosphate concentration (micrograms of phosphorus per liter).	micrograms per liter (ug/L)
PO4_flag	PO4 flag. Indicates if the blank value in the PO4 column is due to below detection limit (BDL) or not analyzed/measured/recorded (NA).	unitless
SiO2	Silica concentration.	micromolar (uM)

PPR	Primary productivity by light/dark 14C bicarbonate incorporation (milligrams of C per meter cubed per hour).	milligrams per cubic meter per hour (mg C m-3 hr-1)

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Costech Analytical Technologies, Inc. Elemental Combustion System CHNS-O ECS 4010
Generic Instrument Name	Costech International Elemental Combustion System (ECS) 4010
Generic Instrument Description	The ECS 4010 Nitrogen / Protein Analyzer is an elemental combustion analyser for CHNSO elemental analysis and Nitrogen / Protein determination. The GC oven and separation column have a temperature range of 30-110 degC, with control of +/- 0.1 degC.

Dataset-specific Instrument Name	PE 2400 Series II CHNS/O Analyzer
Generic Instrument Name	Elemental Analyzer
Generic Instrument Description	Instruments that quantify carbon, nitrogen and sometimes other elements by combusting the sample at very high temperature and assaying the resulting gaseous oxides. Usually used for samples including organic material.

Dataset-specific Instrument Name	Lachat/Zellweger Analytics QuikChem 8000 flow injection autoanalyzer (Milwaukee, WI, USA)
Generic Instrument Name	Flow Injection Analyzer
Generic Instrument Description	An instrument that performs flow injection analysis. Flow injection analysis (FIA) is an approach to chemical analysis that is accomplished by injecting a plug of sample into a flowing carrier stream. FIA is an automated method in which a sample is injected into a continuous flow of a carrier solution that mixes with other continuously flowing solutions before reaching a detector. Precision is dramatically increased when FIA is used instead of manual injections and as a result very specific FIA systems have been developed for a wide array of analytical techniques.

Dataset-specific Instrument Name	
Generic Instrument Name	LI-COR Biospherical PAR Sensor
Dataset-specific Description	spherical underwater quantum sensor (LI-COR LI-193SA) coupled to a LI-COR LI-1000 datalogger
Generic Instrument Description	The LI-COR Biospherical PAR Sensor is used to measure Photosynthetically Available Radiation (PAR) in the water column. This instrument designation is used when specific make and model are not known.

Dataset-specific Instrument Name	YSI multiparameter sonde (Model 6600 or 6600 EDS-S Extended Deployment System) ...
Generic Instrument Name	Multi Parameter Portable Meter
Dataset-specific Description	In situ measurements were performed at discrete depths on the sunlit side of the research vessel using a Yellow Springs Instruments (YSI Incoporated, Ohio) multiparameter sonde (Model 6600 or 6600 EDS-S Extended Deployment System) equipped with a YSI conductivity/temperature probe (Model 6560), a YSI chlorophyll probe (Model 6025), a YSI pH probe (Model 6561 or 6566), a YSI pulsed dissolved oxygen probe (Model 6562), a self cleaning YSI turbidity probe (Model 6026 or 6136), and beginning on the 07/30/2003 sampling date, a flat Li-Cor sensor (UWQ-PAR 6067). The YSI sonde was coupled to a either a YSI 610 DM datalogger or a YSI 650 MDS Multi-parameter Display System datalogger. The data were stored on the datalogger and downloaded to Ecowin software upon return to the laboratory.
Generic Instrument Description	An analytical instrument that can measure multiple parameters, such as pH, EC, TDS, DO and temperature with one device and is portable or hand-held.

Dataset-specific Instrument Name	Antek 7000N or Antek 7000V analyzer
Generic Instrument Name	Particulate Organic Carbon/Nitrogen Analyzer
Generic Instrument Description	A unit that accurately determines the carbon and nitrogen concentrations of organic compounds typically by detecting and measuring their combustion products (CO2 and NO).

Dataset-specific Instrument Name	Shimadzu UV-160U spectrophotometer
Generic Instrument Name	Spectrophotometer
Generic Instrument Description	An instrument used to measure the relative absorption of electromagnetic radiation of different wavelengths in the near infra-red, visible and ultraviolet wavebands by samples.

Dataset-specific Instrument Name	Shimadzu TOC-5000A Analyzer
Generic Instrument Name	Total Organic Carbon Analyzer
Generic Instrument Description	A unit that accurately determines the carbon concentrations of organic compounds typically by detecting and measuring its combustion product (CO2). See description document at: http://bcodata.whoi.edu/LaurentianGreatLakes_Chemistry/bs116.pdf

[table of contents | back to top]

Project Information

Collaborative Research: Vitamin B1 Limitation and Advantageous Use of B1-related Compounds by Marine Bacterioplankton (VBLAM)

Coverage: Pamlico Albemarle Sound System, NC and Coastal N. Atlantic Ocean.

NSF Award Abstract:
Planktonic marine bacteria significantly impact global elemental cycling, productivity, and water quality. Recent evidence shows that abundant and diverse marine bacterioplankton require external vitamin B1 or precursors (B1 herein) to survive, and addition of these nutrients stimulates bacterial production. This suggests that it is favorable for most marine bacteria to rely on supplied B1, making B1 dynamics an environmentally relevant test case to study nutrient exchanges within the planktonic microbiome. Notably though, links between extracellular B1 availability and the composition, function, and fitness of marine bacteria are poorly understood. This project sheds light on 1) which activities and interactions are modulated by B1 availability, and 2) the benefits of exogenous B1 use by ubiquitous marine bacterioplankton. Experiments are being conducted to address uncertainty regarding B1 limitation of natural bacterioplankton, help predict plankton responses to natural or anthropogenic increases in B1 and reveal more on the rules governing nutrient exchange between plankton. Greater knowledge of the advantages of bacterial B1 use will benefit fields beyond oceanography, such as synthetic biology which focuses on streamlined microbial product generation. B1-deficiency in animals is a current concern in marine ecosystems. Greater knowledge of costs and quotas at the microbial level will best position the larger community to ask deficiency questions at other trophic levels. The teaching and training components of this project include support for graduate students and a post-doctoral scholar. The major outreach component is a newly conceived Mobile Aquatic Microbial Laboratory (MAML) that seeks to improve public awareness of aquatic microbes and their ecosystem impact, as well as convey concepts of nutrient limitation and why cells need vitamins. Pre- and post-assessment and social distancing measures are integrated into MAML, as are incentives for participants to share via social media images and contribute to the program.

This project investigates the impact of vitamin B1 and B1 congeners on bacterioplankton in marine ecosystems where vitamins have garnered little recent consideration as influential nutrients. The work is conducted in the Neuse River estuary, the second largest estuary in the lower USA, and in the offshore coastal ocean. Nutrient amendment experiments are being conducted to test whether B1/congeners modulate bacterioplankton growth, composition, and gene transcription (reflecting putative function). Complementary lab-based experiments with wildtype and genetically engineered bacterioplankton are being conducted to test whether use of exogenous B1/congener significantly improves cell fitness and to address why reliance upon exogenous B1/congener is so prevalent among wild bacterioplankton. Additional lab experiments with isolates are being conducted to examine the protein-related cost of B1 *de novo* biosynthesis versus exogenous B1/congener use as well as cell quotas of B1 and precursors using mass spectrometry techniques. The work reaches beyond recent genome-based extrapolations to address how exogenous B1/congener availability shapes bacterioplankton metabolism, community structure, microbial interactions, and fitness.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-2049388

[table of contents | back to top]