Benthic microalgal photopigment concentrations from nearshore shelf waters off Charleston, SC from June 2018 to August 2021

Website: https://www.bco-dmo.org/dataset/892576
Data Type: Other Field Results
Version: 1
Version Date: 2023-04-10

Project
» Groundwater sources of "new" N for benthic microalgal production in the South Atlantic bight (SAB BMA)

Contributors	Affiliation	Role
Pinckney, James L.	University of South Carolina	Principal Investigator, Contact
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Abstract
Benthic microalgal photopigment concentrations were measured on selected dates from 7 June 2018 to 10 August 2021 in nearshore shelf waters off Charleston, SC. The survey area was located in the region of 32° 42’ N, 79° 50’ W and 32° 51’ N, 79° 09’ W. Sediment core samples were analyzed by HPLC. These data were used to map the benthic microalgal biomass and assess inputs of groundwater effects on benthic microalgae. Results may be of interest to others conducting research projects off Charleston, SC. Data were collected and interpreted by Jay Pinckney at the University of South Carolina, Columbia, SC.

Table of Contents

Coverage

Spatial Extent: **N**:32.7878 **E**:-79.2124 **S**:32.5862 **W**:-79.6632
Temporal Extent: 2018-06-07 - 2021-08-10

Methods & Sampling

Samples for Benthic microalgal photopigment analysis were collected by SCUBA divers from the R/V *Trinity* in nearshore waters of Charleston, SC using 1 square centimeter x 10 centimeter (cm) plastic core tubes gently pushed into the sediment to minimize disruption of the surface layers. Tubes were capped and carefully removed from the sediment. Ten cores were obtained randomly within a 1 square meter area at select locations for each sample date. The upper 1 centimeter of the core was extruded, frozen at -80 degrees Celsius, and analyzed within 30 days after collection. Sediments were dried and sieved for grain size analysis.

High-performance liquid chromatography (HPLC) was used to determine chemosystematic photosynthetic pigments. Samples were lyophilized for 24 hours at -50 degrees Celsius, placed in 90 percent acetone (1 milliliter), sonicated on ice for 30 seconds, and extracted at -20 degrees Celsius for 18 to 20 hours. Filtered

extracts: 0.45 micrometers, 250 microliters were injected into a Shimadzu 10AD HPLC equipped with a monomeric (Rainin Microsorb-MV, 0.46 x 10 centimeters, 3 micrometers) and a polymeric (Vydac 201TP54, 0.46 x 25 centimeters, 5 micrometers) reverse-phase C18 column in series. A nonlinear binary gradient of 80 percent methanol: 20 percent 0.50 M ammonium acetate and 80 percent methanol:20 percent acetone was the mobile phase (Pinckney et al. 1996, 2001). Absorption spectra and chromatograms (440 ± 4 nanometers) were acquired using a Shimadzu SPD-M10av photodiode array detector. Pigment peaks were identified by comparison of retention times and absorption spectra with pure carotenal and chlorophyll standards (DHI, Denmark). The synthetic carotenoid β-apo-8'-carotenal (Sigma) was used as an internal standard.

Data Processing Description

BCO-DMO Processing Description:
- Longitude values were converted to decimal degrees where negative values denote the Southern hemisphere

[table of contents | back to top]

Data Files

File
hplc_data-1.csv (Comma Separated Values (.csv), 30.85 KB) MD5:77697757e6736b0adbdfe986610ac84a Primary data file for dataset 892576, version 1.

[table of contents | back to top]

Related Publications

Pinckney, J. L., Zaunbrecher, S., Lang, S., Wilson, A., & Knapp, A. (2022). Seasonality of benthic microalgal community abundance in shallow shelf waters. Continental Shelf Research, 244, 104797. https://doi.org/10.1016/j.csr.2022.104797
Results

[table of contents | back to top]

Related Datasets

IsRelatedTo

Pinckney, J. L. (2023) **Nutrient concentrations and stable isotope values for groundwater in nearshore shelf waters off Charleston, SC from June 2018 to August 2019.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-04-03 doi:10.26008/1912/bco-dmo.892997.1 [view at BCO-DMO]

[table of contents | back to top]

Parameters

Parameter	Description	Units
Location	Sample location identifier	unitless
Cruise_Number	Cruise identifier	unitless
Latitude	Latitude of sampling site North (South is negative)	decimal degrees
Longitude	Longitude of sampling site East (West is negative)	decimal degrees
Date	Date of sampling	unitless
Depth	Depth of core sample	millimeters (mm)
Fucoxanthin	Fucoxanthin pigment	micrograms per gram of dry sediment
Zeaxanthin	Zeaxanthin pigment	micrograms per gram of dry sediment
Chlorophyll_b	Chlorophyll b pigment	micrograms per gram of dry sediment
Chlorophyll_a	Chlorophyll a pigment	micrograms per gram of dry sediment

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Self-Contained Underwater Breathing Apparatus
Generic Instrument Description	The self-contained underwater breathing apparatus or scuba diving system is the result of technological developments and innovations that began almost 300 years ago. Scuba diving is the most extensively used system for breathing underwater by recreational divers throughout the world and in various forms is also widely used to perform underwater work for military, scientific, and commercial purposes. Reference: http://oceanexplorer.noaa.gov/technology/diving/diving.html

Dataset-specific Instrument Name	Shimadzu 10AD HPLC
Generic Instrument Name	Ultra high-performance liquid chromatography
Dataset-specific Description	Shimadzu 10AD HPLC equipped with a monomeric (Rainin Microsorb-MV, 0.46 x 10 cm, 3 µm) and a polymeric (Vydac 201TP54, 0.46 x 25 cm, 5 µm) reverse-phase C18 column in series.
Generic Instrument Description	Ultra high-performance liquid chromatography: Column chromatography where the mobile phase is a liquid, the stationary phase consists of very small (< 2 microm) particles and the inlet pressure is relatively high.

[table of contents | back to top]

Project Information

Groundwater sources of "new" N for benthic microalgal production in the South Atlantic bight (SAB BMA)

Coverage: South Atlantic Bight (32 N, 79 W)

NSF Award Abstract:
Continental shelves are highly productive, with both ecological and economic importance. Benthic microalgae (BMA) are key primary producers in these location. As much as 6x the water column biomass of primary producers is compressed into a layer only a few mm thick on the sediment surface. The source(s) of fixed nitrogen (N) supporting such highly concentrated BMA biomass is currently unknown. Recent studies of sub-seafloor groundwater flow at the University of South Carolina have demonstrated that upwelling saline groundwater likely supplies high concentrations of nutrients in the ridge-swale habitats in the South Atlantic Bight (SAB). The investigators suggest that groundwater input of fixed N into surficial sediments is the primary source of N supporting BMA biomass and production in the mid-shelf region of the SAB. The purpose of this project is to determine the primary source of fixed N supporting BMA biomass in the surface sediments of the shallow shelf waters (<30 m), using the SAB as a field area. A secondary objective is to apply novel and innovative methods to directly quantify groundwater inputs of N into surficial sediments. Research results will fully document the spatio-temporal distributions of BMA and phytoplankton biomass and community structure in the mid-shelf region of the SAB and relate the observed patterns to groundwater inputs of fixed N sources as well as hydrographic and climatic conditions. This research will provide full support and tuition for 2 graduate students, summer support for undergraduate assistants, and involve upper level undergraduates as lab interns. The study team will also work with the Baruch Institute and other partners to develop an "Ocean Schoolyard" program to meet the needs of teachers, students, and community audiences. The project will also provide partial support for Girls Go for I.T., a coding summer camp designed to attract middle-school-aged girls to careers in I.T. and STEM fields.

The specific objectives of the study are to (1) quantify spatial and temporal variations in N fluxes associated with hydrodynamic exchange and upward groundwater flow (2) document spatial and temporal variations in BMA biomass and (3) measure the delta15N of fixed nitrogen sources (well water, porewater and water column ammonium and nitrate; sediments), the BMA, and phytoplankton. The sampling area will be restricted to the 10 - 30 m isobath region of the SAB off the coast of Charleston, SC. Samples will be collected at both the existing groundwater well field and other regions of the shelf. At each of the groundwater wells in the well field, SCUBA divers will collect fluids from the wells to determine well water inorganic nutrient concentrations (nitrate + nitrite, ammonium, orthophosphate, silicon) and the delta 15N of well water ammonium and nitrate (when present). In nearby sediments, samples will be collected for BMA biomass and community composition, surface porewater inorganic nutrients (nitrate + nitrite, ammonium, orthophosphate, silicon), C and N of sediments, sediment grain size analysis, and delta 15N of BMA, ammonium, nitrate (when present), and sediments. Line transects, consisting of 5 sampling locations along a 50 m transect, will be conducted in each of the 4 depth strata. At 10 m intervals along each transect, divers will collect samples the same as above for the well field. Water column samples will be collected for HPLC measurements of phytoplankton biomass and community composition, inorganic nutrient concentrations (nitrate + nitrite, ammonium, orthophosphate, silicon), seston CHN, delta 15N of phytoplankton, and the delta 15N of ammonium and nitrate. The researchers will use heat as a tracer to map the depth of hydrodynamic exchange and monitor the rate of vertical groundwater flow. Results from that analysis will also allow them to then simulate transport of a conservative tracer that can be compared to observed nutrient concentrations to BMA abundance and community composition.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1736557

[table of contents | back to top]