

# Nutrient concentrations and stable isotope values for groundwater in nearshore shelf waters off Charleston, SC from June 2018 to August 2019

**Website:** <https://www.bco-dmo.org/dataset/892997>

**Data Type:** Other Field Results

**Version:** 1

**Version Date:** 2023-04-03

## Project

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

Contributors	Affiliation	Role
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## Abstract

Nutrient concentrations and stable isotope values for groundwater were measured on selected dates from 7 June 2018 to 10 August 2019 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 nutrient concentrations 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.

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## Coverage

**Spatial Extent:** N:32.7671 E:-79.6151 S:32.7069 W:-79.6632

**Temporal Extent:** 2018-06-07 - 2019-08-06

## Methods & Sampling

Nutrient concentrations and stable isotope values for groundwater were measured on selected dates from 7 June 2018 to 10 August 2019 in nearshore shelf waters off Charleston, SC (32° 42' N, 79° 50' W and 32° 51' N, 79° 09' W). At each of the groundwater wells in the wellfield, divers collected fluids from the wells to determine well water inorganic nutrient concentrations (nitrate + nitrite, ammonium, orthophosphate) and the  $\delta^{15}\text{N}$  of well water DON, ammonium, and nitrate (when present). Sediment core samples were analyzed by HPLC. These data were used to map nutrient concentrations and assess inputs of groundwater effects on benthic microalgae.

**$\delta^{15}\text{N}$  of Nitrate:** Filtered (0.2 micrometer) samples were stored in acid-washed HDPE bottles and frozen (-20 degrees Celsius) until analysis. For any sample with more than 0.5  $\mu\text{M}$   $\text{NO}_3^-$ , the isotopic composition of  $\text{NO}_3^-$

was determined by the denitrifier method of Sigman et al. (2001) and Casciotti et al. (2002), with updates according to McIlvin & Casciotti (2011) and Weigand et al. (2016).

**$\delta^{15}\text{N}$  of Ammonium:** Filtered (0.2  $\mu\text{m}$ ) samples will be stored on dry ice in the field and shipped immediately to the lab for  $\delta^{15}\text{N}$  of ammonium analysis. Samples with more than 3  $\mu\text{M}$   $\text{NH}_4^+$  and adequate sample volume were analyzed using the hypobromite/azide method of Zhang et al. (2007).

## Data Processing Description

### BCO-DMO Processing Description:

- Missing data identifier '-9999' replaced with blank (BCO-DMO's default missing data identifier)
- Converted Longitude values from West to East to comply with BCO-DMO standards

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## Data Files

File
<b>nutrient_and_stable_isotope_data-1.csv</b> (Comma Separated Values (.csv), 1.27 KB) MD5:b020ec17d5e1d300642e051e4dff00bb
Primary data file for dataset 892997_Version 1.

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## Related Publications

Casciotti, K. L., Sigman, D. M., Hastings, M. G., Böhlke, J. K., & Hilkert, A. (2002). Measurement of the Oxygen Isotopic Composition of Nitrate in Seawater and Freshwater Using the Denitrifier Method. *Analytical Chemistry*, 74(19), 4905–4912. doi:[10.1021/ac020113w](https://doi.org/10.1021/ac020113w)  
*Methods*

Kofoid, & Campbell, A. S. (1929). A conspectus of the marine and fresh?water Ciliata belonging to the suborder Tintinninea, with descriptions of new species principally from the Agassiz Expedition to the eastern tropical Pacific 1904?1905. *Univ. Calif. Pubs Zool.*, 34, 1–403.  
*Methods*

McIlvin, M. R., & Casciotti, K. L. (2011). Technical Updates to the Bacterial Method for Nitrate Isotopic Analyses. *Analytical Chemistry*, 83(5), 1850–1856. doi:[10.1021/ac1028984](https://doi.org/10.1021/ac1028984)  
*Methods*

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*

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](https://doi.org/10.1021/ac010088e)  
*Methods*

Weigand, M. A., Foriel, J., Barnett, B., Oleynik, S., & Sigman, D. M. (2016). Updates to instrumentation and protocols for isotopic analysis of nitrate by the denitrifier method. *Rapid Communications in Mass Spectrometry*, 30(12), 1365–1383. doi:[10.1002/rcm.7570](https://doi.org/10.1002/rcm.7570)  
*Methods*

Zhang, L., Altabet, M. A., Wu, T., & Hadas, O. (2007). Sensitive Measurement of  $\text{NH}_4^+^{15}\text{N}/^{14}\text{N}$  ( $\delta^{15}\text{NH}_4^+$ ) at Natural Abundance Levels in Fresh and Saltwaters. *Analytical Chemistry*, 79(14), 5297–5303. doi:[10.1021/ac070106d](https://doi.org/10.1021/ac070106d)

*Methods*

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## Related Datasets

### IsRelatedTo

Pinckney, J. L. (2023) **Benthic microalgal photopigment concentrations from nearshore shelf waters off Charleston, SC from June 2018 to August 2021**. Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-04-10 doi:10.26008/1912/bco-dmo.892576.1 [[view at BCO-DMO](#)]

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## 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 collection	unitless
Depth	Water depth	meters (m)
d15N_bulk_sediments	d15N for bulk sediments	unitless
d15N_water_filters	d15N for particulate organic matter in the water column	unitless
TDN_well_water	Total dissolved nitrogen for groundwater	micromolar
d15N_TDN_well_water	d15N for total dissolved nitrogen for groundwater	unitless
DON_well_water	Total dissolved organic nitrogen for groundwater	micromolar
NH4_well_water	Total dissolved ammonium for groundwater	micromolar
NO3_NO2_well_water	Total dissolved nitrate and nitrite for groundwater	micromolar
PO4_well_water	Total dissolved orthophosphate for groundwater	micromolar

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## Instruments

<b>Dataset-specific Instrument Name</b>	Turner Trilogy fluorometer
<b>Generic Instrument Name</b>	Fluorometer
<b>Generic Instrument Description</b>	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.

<b>Dataset-specific Instrument Name</b>	Thermo Finnigan DeltamV isotope ratio mass spectrometer
<b>Generic Instrument Name</b>	Mass Spectrometer
<b>Generic Instrument Description</b>	General term for instruments used to measure the mass-to-charge ratio of ions; generally used to find the composition of a sample by generating a mass spectrum representing the masses of sample components.

<b>Dataset-specific Instrument Name</b>	
<b>Generic Instrument Name</b>	Self-Contained Underwater Breathing Apparatus
<b>Generic Instrument Description</b>	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: <a href="https://oceanexplorer.noaa.gov/technology/technical/technical.html">https://oceanexplorer.noaa.gov/technology/technical/technical.html</a>

<b>Dataset-specific Instrument Name</b>	Shimadzu UV-1800 uv-vis spectrophotometer
<b>Generic Instrument Name</b>	UV Spectrophotometer-Shimadzu
<b>Generic Instrument Description</b>	The Shimadzu UV Spectrophotometer is manufactured by Shimadzu Scientific Instruments (ssi.shimadzu.com). Shimadzu manufacturers several models of spectrophotometer; refer to dataset for make/model information.

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## 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.

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## Funding

Funding Source	Award
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-1736557</a>

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