

Water column nutrients, porewater nutrients, sediment percent organic content and C:N ratio collected at Smith Island, Virginia in August of 2013 (Oyster Reef N2O Emission project)

Website: <https://www.bco-dmo.org/dataset/721950>

Data Type: Other Field Results

Version:

Version Date: 2018-03-19

Project

» [Microbial Regulation of Greenhouse Gas N2O Emission from Intertidal Oyster Reefs](#) (Oyster Reef N2O Emission)

Contributors	Affiliation	Role
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Coverage

Spatial Extent: Lat:37.14919 Lon:-75.88523

Temporal Extent: 2013 - 2013

Dataset Description

This dataset contains nutrients in the water column and porewater as well as sediment % organic content and C:N ratio from Smith Island and Smith Island Bay, VA in 2013.

These data were utilized in the following publication:

Smyth, A. R., Murphy, A. E., Anderson, I. C., & Song, B. (2017). Differential Effects of Bivalves on Sediment Nitrogen Cycling in a Shallow Coastal Bay. *Estuaries and Coasts*, 41(4), 1147–1163 DOI: [10.1007/s12237-017-0344-9](https://doi.org/10.1007/s12237-017-0344-9)

See related Smith Island Datasets:

- * [Smith Island N cycle: 2013 Seasonal Fluxes](#)
- * [Smith Island N cycle: 2014 Seasonal Field Data](#)
- * [Smith Island N cycle: 2014 Seasonal Fluxes](#)

Methods & Sampling

Methodology

Sediment samples were collected near Smith Island, VA in Smith Island Bay. Smith Island is one of the southern barrier islands of the Delmarva Peninsula and part of the Virginia Coastal Reserve Long Term Ecological Research site. A restored oyster reef, isolated on a mudflat, clam bed used as part of an aquaculture lease and subtidal sand flat were established as sampling locations. Studies were conducted seasonally in August 2013, April 2014, July 2014, and November 2014. At each event, samples were taken for sediment biogeochemical flux incubations and sediment physico-chemical properties (sediment organic matter, benthic algal biomass, porewater nutrients).

For sediment flux incubations, triplicate sediment cores (9.5cm i.d. X 10 cm sediment depth) were collected by hand at each of the three locations: restored oyster reefs, clam aquaculture beds and subtidal bare sediments located approximately 50m from the reef and aquaculture. Samples from the oyster reef were collected directly adjacent to the reef. For the clam aquaculture samples, the predator exclusion net was taken off prior to sample collection. Associated infauna were not removed from any of the samples (i.e. live clams were included in the clam aquaculture cores). On average there were 4 clams per core with a mean biomass density of 493 ± 42.94 g DW m⁻². However, oyster reef cores did not contain live oysters. Water chemistry was assessed with a YSI and ~170 L of water was collected from Smith Island Bay for use in the continuous flow core incubations. Samples were also collected for dissolved nutrient analysis.

Upon collection, sediment cores and water were transported to an environmental chamber set to *in situ* temperature at The Virginia Institute of Marine Science (VIMS) in Gloucester Point, VA. Once at VIMS, cores were submerged in site water to mimic high tide (saturated) conditions and held in the dark for 12-16 hrs. The following day each core was sealed with gas tight lids equipped with an inflow and outflow port and incubated in a continuous flow system. Cores were acclimated for 24 hours before sampling to allow the system to reach steady state. Samples for dissolved nutrients and gasses were collected from the outflow port of each sediment core three times over the course of 24 hours after an initial pre-incubation period. A bypass line that flowed directly into the sample vial was used to determine the concentration of dissolved constituents entering the cores. This line also accounted for tubing and pump effects on water chemistry.

Isotopic enrichment experiments were conducted to determine rates of denitrification. After the initial sampling period, the reservoir water was enriched with ¹⁵N-NaNO₃ (98atm%) to a final concentration of ~100 μmol L⁻¹. Samples were collected for dissolved gas analysis three times after the initial 24-hour acclimation period after the reservoir was enriched. The concentration of ²⁹N₂ and ³⁰N₂ was measured using a membrane inlet mass spectrometer (MIMS). The details of methods are published in Smyth et al. (2017).

Nutrients and isotopic composition of N₂ and NH₄⁺ were used to calculate the fluxes and rates as reported in Smyth et al. (2017).

Data Processing Description

BCO-DMO Data Manager Processing Notes:

- * added a conventional header with dataset name, PI name, version date
- * modified parameter names to conform with BCO-DMO naming conventions (no spaces, hyphens, names that start with numbers)
- * added site latitude and longitude (Lat,Lon) supplied by the contributor. Values were converted from degrees decimal minutes to decimal degrees and rounded to five decimal places.

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Data Files

File
Smith_Island_2013_Field.csv (Comma Separated Values (.csv), 1.45 KB) MD5:333d6b0a2b0e8ec368d3657872afa2e4
Primary data file for dataset ID 721950

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Related Publications

Smyth, A. R., Murphy, A. E., Anderson, I. C., & Song, B. (2017). Differential Effects of Bivalves on Sediment Nitrogen Cycling in a Shallow Coastal Bay. *Estuaries and Coasts*, 41(4), 1147–1163. doi:[10.1007/s12237-017-0344-9](https://doi.org/10.1007/s12237-017-0344-9)

Results

Methods

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Parameters

Parameter	Description	Units
Site	Site name	unitless
Rep	Replicate	unitless
SOM_Surface_0_to_2	Sediment organic matter (SOM) at 0-2cm depth (surface)	percent (%)
SOM_Depth_2_to_5	Sediment organic matter (SOM) at 2-5cm	percent (%)
C_to_N_Surface_0_to_2	Carbon to nitrogen ratio (C:N) at a 0-2cm depth (surface)	dimensionless
C_to_N_Depth_2_to_5	Carbon to nitrogen ratio (C:N) at a 2-5cm depth	dimensionless
PW_Sulfide	Sulfide (H ₂ S) concentration	micromolar (uM)
PW_NOx	Combined nitrogen and nitrate concentration (Nox) from pore water (PW, 1-5cm)	micromolar (uM)
PW_NO2	Nitrate (NO ₂) concentration from pore water (PW, 1-5cm)	micromolar (uM)
PW_NH3	Ammonia (NH ₃) concentration from pore water (PW, 1-5cm)	micromolar (uM)
PW_PO4	Phosphate from pore water (PW, 1-5cm)	micromolar (uM)
WC_NOx	Combined nitrite and nitrate concentration (Nox) from the water column (WC)	micromolar (uM)
WC_NO2	Nitrate (NO ₂) concentration from the water column (WC)	micromolar (uM)
WC_NH3	Ammonia (NH ₃) concentration from the water column (WC)	micromolar (uM)
WC_PO4	Phosphate from the water column (WC)	micromolar (uM)
Lat	Smith Island latitude	decimal degrees
Lon	Smith Island longitude	decimal degrees

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Deployments

Smith_Island_Song

Website	https://www.bco-dmo.org/deployment/721959
Platform	shoreside Virginia

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Project Information

Microbial Regulation of Greenhouse Gas N₂O Emission from Intertidal Oyster Reefs (Oyster Reef N₂O Emission)

Extracted from the NSF award abstract:

Oyster reefs are biogeochemical hot spots and prominent estuarine habitats that provide disproportionate ecological function. Suspension-feeding eastern oysters, *Crassostrea virginica*, are capable of improving water quality and diminishing eutrophication by filtering nutrients and particles from the water and depositing them in the sediments. Remineralization of these deposits may enhance sedimentary denitrification that facilitates nitrogen removal in tidal estuaries. However, the scientific underpinning of oyster reef function has been challenged in various studies. In addition, recent studies of filter feeding invertebrates reported the production of nitrous oxide (N₂O), a greenhouse gas, as an end product of incomplete denitrification by gut microbes. *C. virginica* could be another source of N₂O flux from intertidal habitats. Preliminary work indicated substantial N₂O production from individual oysters. The estimated N₂O production from high density oyster reefs may exceed the N₂O flux measured from some estuaries. With the new discovery of N₂O emission and uncertainty regarding eutrophication control, the ecological value of oyster reef restoration may become equivocal.

This project will quantify N₂O fluxes to understand the factors controlling N₂O emission from oyster reefs. Sedimentary N processes will be examined to develop an oyster reef N model to estimate N₂O emission from tidal creek estuaries relative to other N cycling processes. The PIs hypothesize that intertidal oyster reefs are a substantial source of N₂O emission from estuarine ecosystems and the magnitude of emission may be linked to water quality. If substantial N₂O flux from oyster reefs is validated, ecological benefits of oyster reef restoration should be reevaluated. This interdisciplinary research team includes a microbial ecologist, a biogeochemist, an ecologist and an ecosystem modeler. They will utilize stable isotope and molecular microbiological techniques to quantify oyster N₂O production, elucidate microbial sources of N₂O emission from oysters and sediments, and estimate seasonal variation of N₂O fluxes from oyster reefs. Measurements from this study will be integrated into a coupled oyster bioenergetics-sediment biogeochemistry model to compare system level rates of N cycling on oyster reefs as a function of oyster density and water quality. Modeling results will be used to assess the relative trade-offs of oyster restoration associated with N cycling. They expect to deliver the following end products: 1) estimation of annual N₂O flux from oyster reefs as an additional source of greenhouse gases from estuaries, 2) a better understanding of the environmental and microbial factors influencing N₂O and N₂ fluxes in tidal estuaries, 3) transformative knowledge for the effect of oyster restoration on water quality enhancement and ecosystem function, 4) direct guidance for oyster restoration projects whose goals include water quality enhancement, and 5) a modeling tool for use in research and restoration planning.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1321373

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