N2O, 15N2, 15N tissue tracer in oyster aquariums (Oyster Reef N2O Emission project)

Website: https://www.bco-dmo.org/dataset/722560
Data Type: experimental
Version: 1
Version Date: 2017-12-31

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

Contributors	Affiliation	Role
Tobias, Craig	University of Connecticut (UConn - Avery Point)	Principal Investigator, Contact
Brush, Mark J.	Virginia Institute of Marine Science (VIMS)	Co-Principal Investigator
Piehler, Michael F.	University of North Carolina at Chapel Hill (UNC-Chapel Hill-IMS)	Co-Principal Investigator
Song, Bongkeun	Virginia Institute of Marine Science (VIMS)	Co-Principal Investigator
Biddle, Mathew	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
N2O, 15N2, 15N tissue tracer in oyster aquariums

Table of Contents

Dataset Description

N2O, 15N2, 15N tissue tracer in oyster aquariums

Methods & Sampling

Three 9.45L aquariums contained twelve 7-cm long oysters pre-exposed to ^{15}N labeled phytoplankton (OA1, OA2, OA3,) and three aquariums had no oysters and served as controls (CA1, CA2, CA3). These aquariums were filled with 0.1micron filtered seawater and a small circulation pump was added. N_2O, ^{15}N, and oxygen were measured initially and then aquariums sealed until oxygen had depleted to $2 mgL^{-1}$. Oysters were then harvested for their gill/mantle tissue (meat) and digestive tissue (digestive) over a period of time.

Oxygen was measured insitu using an oxygen probe. Water samples for N_2O analysis were collected with a peristaltic pump through a syringe needle directly into 12 ml exetainer that had been flushed with N_2 and preserved with KOH to a pH above 12. Approximately six ml sample was collected. N_2O concentrations in the headspace were measured on a GC-ECD. Water samples for 15N2 samples were collected with a peristaltic pump through a syringe needle directly into 30 ml serum bottles that had been flushed with He and preserved

with KOH to a pH above 12. Approximately eight ml sample was collected. $^{15}N_2$ was analyzed by GC - Isotope Ratio Mass Spectrometry (IRMS). Oyster tissue ^{15}N samples were collected from the aquariums from dissections. ^{15}N was analyzed on a elemental analyzer (EA) coupled with an IRMS.

Data Processing Description

Oxygen concentrations were derived from a precalibrated oxygen probe. N_2O concentrations were calculated from N_2O calibration curve and corrected for N_2O solubility in the aqueous phase using the Bunsen coefficient. $^{15}N_2$ was normalized to air and air saturated water standards and reported in the delta notation. Oyster tissue ^{15}N values were normalized to reference materials and reported in the delta notation.

BCO-DMO Processing:

- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions
- empty values were replaced with 'nd' (no data).

[table of contents | back to top]

Data Files

File
aquarium_exper.csv (Comma Separated Values (.csv), 3.52 KB) MD5:4f0ffc22f82f920afd5d24ce96f6fb0f Primary data file for dataset ID 722560

[table of contents | back to top]

Parameters

Parameter	Description	Units
Timepoint	Represents when the experiment began and ended (0 - initial, 1- final). While all aquariums started at the same time, not all ended at the same time. The reason for multiple time points (i.e., 0,0,1,1,1,1) is to accommodate the multiple samples taken during that time point. For example, Timepoint 1, Hour 5, only applies to OA1 and OA2. However, Timepoint 1, Hour 69.50 applies to the remaining aquariums (OA3, CA1, CA2, CA3). Under the "Timepoint" column is "Oyster Harvests*", which marks the second phase of this Oyster Aquarium experiment. The data collected for that section would be Del15N digestive/ meat. "Oyster Harvest" is under that column since the oysters were harvested at time points indicated by the Time_Days / Hours column.	unitless
Time_Days	Time_Days gives a value that represents how much time has passed since the initial sample taken. "Hours" is just a conversion of the "Time_Days" value. An easier way to understand how much time has passed.	days
Hours	Incubation time per incubation	hours

OA1_15N2	Oyster aquarium 1 15N enrichment of dissolved N2	permil
OA1_N2O	Oyster aquarium 1 Aqueous N2O concentration	nM
OA1_O2	Oyster aquarium 1 Aqueous O2 concentration	mg/L
OA1_Del15N_Digestive	Oyster aquarium 1 15N enrichment digestive tissue	permil
OA1_Del15N_Meat	Oyster aquarium 1 15N enrichment other (mantle; gills) tissue	permil
OA2_15N2	Oyster aquarium 2 15N enrichment of dissolved N2	permil
OA2_N2O	Oyster aquarium 2 Aqueous N2O concentration	nM
OA2_O2	Oyster aquarium 2 Aqueous O2 concentration	mg/L
OA2_Del15N_Digestive	Oyster aquarium 2 15N enrichment digestive tissue	permil
OA2_Del15N_Meat	Oyster aquarium 2 15N enrichment other (mantle; gills) tissue	permil
OA3_15N2	Oyster aquarium 3 15N enrichment of dissolved N2	permil
OA3_N2O	Oyster aquarium 3 Aqueous N2O concentration	nM
OA3_O2	Oyster aquarium 3 Aqueous O2 concentration	mg/L
OA3_Del15N_Digestive	Oyster aquarium 3 15N enrichment digestive tissue	permil
OA3_Del15N_Meat	Oyster aquarium 3 15N enrichment other (mantle; gills) tissue	permil
CA1_15N2	Control aquarium 1 15N enrichment of dissolved N2	permil
CA1_N2O	Control aquarium 1 Aqueous N2O concentration	nM
CA1_O2	Control aquarium 1 Aqueous O2 concentration	mg/L
CA2_15N2	Control aquarium 2 15N enrichment of dissolved N2	permil

CA2_N2O	Control aquarium 2 Aqueous N2O concentration	nM
CA2_O2	Control aquarium 2 Aqueous O2 concentration	mg/L
CA3_15N2	Control aquarium 3 15N enrichment of dissolved N2	permil
CA3_N2O	Control aquarium 3 Aqueous N2O concentration	nM
CA3_O2	Control aquarium 3 Aqueous O2 concentration	mg/L

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Costech Elemental Analyzer
Generic Instrument Name	Elemental Analyzer
Dataset-specific Description	Oyster tissue 15N was analyzed via IRMS coupled to a Costech 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	Agilent 7890B GC with a Poropak Column
Generic Instrument Name	Gas Chromatograph
Dataset-specific Description	N2O was measured on a Agilent 7890B GC with a Poropak Column.
Generic Instrument Description	Instrument separating gases, volatile substances, or substances dissolved in a volatile solvent by transporting an inert gas through a column packed with a sorbent to a detector for assay. (from SeaDataNet, BODC)

Dataset-specific Instrument Name	Thermo Delta V IRMS
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	15N2 was measured on a Thermo Delta V IRMS fitted with a Gas Bench II interface following separation from O2 and Ar on a mol sieve 5A column.
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 Orion rugged dissolved oxygen probe
Generic Instrument Name	Oxygen Sensor
Dataset-specific Description	Oxygen was measured using a Thermo Orion rugged dissolved oxygen probe.
Generic Instrument Description	An electronic device that measures the proportion of oxygen (O2) in the gas or liquid being analyzed

[table of contents | back to top]

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.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1233372

[table of contents | back to top]