Sediment PLFA isotope values from Massachusetts collected from 2012-2015

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Project
» Eutrophication Effects on Sediment Metabolism and Benthic Algal-bacterial Coupling: An Application of Novel Techniques in a LTER Estuary (Benthic_PP_at_TIDE)

Contributors	Affiliation	Role
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Abstract
Sediment PLFA isotope values from Massachusetts collected from 2012-2015

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Coverage

Temporal Extent: 2012-01-01 - 2015-12-31

Dataset Description

Sediment PLFA isotope values.

Methods & Sampling

Methodology from Spivak, AC and J Ossolinski. 2016. Limited effects of nutrient enrichment on bacterial carbon sources in salt marsh tidal creek sediments. Marine Ecology Progress Series. 544:107-130. 10.3354/meps11587

Sediment samples for organic matter composition were collected by placing a hard plastic sleeve around a polyvinyl chloride (PVC) corer (5 cm diameter x 15 cm deep) and then removing the corer. The plastic sleeve remained in place to maintain the integrity of the sediment column and mark the core location. The top 0.5 cm of each core was collected into pre-combusted vials and frozen (-80 deg C) until analysis.

Lipid biomarker compounds were extracted using a modified Bligh and Dyer (1959) method. Sediment samples were extracted with a chloroform : methylene chloride : phosphate buffer saline mixture (2:1:0.8, v:v:v) using a microwave-accelerated reaction system (MARS6); samples were heated to 80deg C for 10 min with continuous stirring. Following extraction, samples were partitioned and the organic phase was removed. The total lipid extract was concentrated under N2 and samples were separated on silica gel columns by eluting with chloroform, acetone (F1/2), and methanol (F3) (Guckert et al. 1985). The F3 (phospholipids) was dried under N2 and saponified with 0.5 M NaOH at 70 deg C for 4 h. Saponified samples were acidified and extracted three times with hexane. The extract was methylated with acidic methanol (95:5 methanol: HCl) and heated overnight at 70deg C to form fatty acid methyl esters (FAME). Samples were analyzed with an Agilent 7890 gas chromatograph with an effluent split ~70:30 between a 5975C mass spectrometer and a flame ionization detector. Peaks were separated on an Agilent DB-5 ms column (60 m, 0.25 mm inner diameter, 0.25 µm film). FAME concentrations were quantified using methyl heneicosanoate as an internal standard. FAs are designated A:BwC, where A is the number of carbon atoms, B is the number of double bonds, and C is the position of the first double bond from the aliphatic ‘w’ end of the molecule. The prefixes ‘i’ and ‘a’ refer to iso and anteiso methyl branched FAs and indicate whether the methyl group is attached to the penultimate or antepenultimate carbon atoms (Bianchi & Canuel 2011).

Stable carbon isotope ratios of FAMEs (F3) were determined by the WHOI Organic Mass Spectrometry Facility with a Hewlett-Packard 6890 GC interfaced to a DeltaPlus IRMS. Excess 13C was calculated per Eqs. 1 – 3, where samples collected prior to 13C label application were controls and PLFA concentrations were in units of moles m-2.

$$R_{\text{sample}} = \frac{^{13}\text{C}}{^{12}\text{C}} = \left(\frac{\delta^{13}\text{C}\ ‰}{1000} + 1\right) \times \frac{^{13}\text{C}}{^{12}\text{C}}\text{VPDB} \qquad (1)$$

$$^{13}\text{C atom\%} = [R_{\text{sample}} / (R_{\text{sample}} + 1)] \times 100 \qquad (2)$$

$$^{13}\text{C}_{\text{excess}}(\text{mmol m}^{-2}) = \qquad (3)$$
$$(^{13}\text{C atom\%}_{\text{sample}} - {}^{13}\text{C atom\%}_{\text{control}}) / 100 \times \text{concentration}_{\text{sample}}$$

PLFA isotopic values were derived from the isotopic composition of FAMEs and corrected for the d13C of the carbon added during methylation using a mass balance approach. We analyzed total PLFA concentrations as well as concentrations and isotopic composition of compounds and subclasses representing algae (polyunsaturated fatty acids C20:4w6, C20:5w3; PUFA), bacteria (iso- and anteiso- branched C15:0, C17:0; BrFA), sulfate reducing bacteria (10-methyl C16:0), and a combination of algae and microbes (short chain fatty acids C12:0, C14:0; SCFA) (Perry et al. 1979, Kaneda 1991, Volkman et al. 1998). The d13C of PLFA subclasses was calculated as concentrated weighted averages. In order to evaluate the sources of carbon supporting sediment bacteria in the tidal creeks, PLFA isotopic values measured in initial sediment samples (i.e., pre-label application) were corrected for a -3 0/00 fractionation during lipid synthesis (Hayes 2001, Bouillon & Boschker 2006).

Data Processing Description

BCO-DMO Data Processing Notes:

-reformatted column names to comply with BCO-DMO standards.
-removed spaces from data
-filled in blank cells with nd

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Data Files

File
sediment_PLFA.csv (Comma Separated Values (.csv), 10.14 KB) MD5:5113ac1506dc54261901082717300 8b5
Primary data file for dataset ID 668443

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Related Publications

Spivak, A., & Ossolinski, J. (2016). Limited effects of nutrient enrichment on bacterial carbon sources in salt marsh tidal creek sediments. Marine Ecology Progress Series, 544, 107–130. doi:10.3354/meps11587
Methods

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Parameters

Parameter	Description	Units
month	Month samples were collected; mm	unitless
core_ID	Core ID	unitless
estuary	Estuary where samples were collected.	unitless
time	Number of hours elapsed since application of the 13C label; 0 represents samples collected immediately before label application.	hours
experiment	Refers to whether the 13 label was added as NaHCO3 (ie BMA) or S. alterniflora (ie S alt) detritus.	unitless
C12	Concentration of a combination of algae and microbes; short chain fatty acid	percentage
C14	Concentration of a combination of algae and microbes; short chain fatty acid	percentage
iso_C15	Concentration of bacteria	percentage
anteiso_C15	Concentration of bacteria	percentage
C16	Concentration of sulfate reducing bacteria	percentage
Methyl_10_C16	Concentration of sulfate reducing bacteria	percentage
iso_C17	Concentration of bacteria	percentage
anteiso_C17	Concentration of bacteria	percentage
C18	Total PLFA concentration	percentage
C20_4w6	Isotopic composition of compounds and subclasses representing algae; polyunsaturated fatty acids	percentage
C20_5w3	Isotopic composition of compounds and subclasses representing algae; polyunsaturated fatty acids	percentage

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Instruments

Dataset-specific Instrument Name	flame ionization detector
Generic Instrument Name	Flame Ionization Detector
Dataset-specific Description	Used to analyze samples
Generic Instrument Description	A flame ionization detector (FID) is a scientific instrument that measures the concentration of organic species in a gas stream. It is frequently used as a detector in gas chromatography. Standalone FIDs can also be used in applications such as landfill gas monitoring, fugitive emissions monitoring and internal combustion engine emissions measurement in stationary or portable instruments.

Dataset-specific Instrument Name	Agilent 7890 gas chromatograph
Generic Instrument Name	Gas Chromatograph
Dataset-specific Description	effluent split ~70:30
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	Hewlett-Packard 6890 GC interfaced to a DeltaPlus IRMS
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	Usted to determine stable isotope ratios
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	5975C mass spectrometer
Generic Instrument Name	Mass Spectrometer
Dataset-specific Description	Used to analyze samples
Generic Instrument Description	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.

Dataset-specific Instrument Name	polyvinyl chloride (PVC) corer
Generic Instrument Name	Push Corer
Dataset-specific Description	5 cm diameter x 15 cm deep
Generic Instrument Description	Capable of being performed in numerous environments, push coring is just as it sounds. Push coring is simply pushing the core barrel (often an aluminum or polycarbonate tube) into the sediment by hand. A push core is useful in that it causes very little disturbance to the more delicate upper layers of a sub-aqueous sediment. Description obtained from: http://web.whoi.edu/coastal-group/about/how-we-work/field-methods/coring/

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Deployments

Spivak_2012

Website	https://www.bco-dmo.org/deployment/668449
Platform	shoreside Massachusetts
Start Date	2012-09-01
End Date	2015-08-15

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Project Information

Eutrophication Effects on Sediment Metabolism and Benthic Algal-bacterial Coupling: An Application of Novel Techniques in a LTER Estuary (Benthic_PP_at_TIDE)

Coverage: Plum Island Estuary, Rowley Massachusetts

Extracted from the NSF award abstract:
This project will address how rates of benthic microalgal production respond to eutrophication and geomorphological changes in human-impacted tidal creeks. Excess nutrient loading increases benthic algal biomass and likely stimulates production rates but the magnitude of nutrient and geomorphological effects on rates of production is unknown. Will changes in benthic algal productivity affect algal-bacterial coupling? Furthermore, how is algal-bacterial coupling affected by geomorphological changes, which may be exacerbated by excess nutrient loading but can also occur in pristine marshes?

This project will take advantage of the infrastructure of the TIDE project, a long-term saltmarsh eutrophication experiment at the Plum Island Ecosystem - Long Term Ecological Research site in Northeastern Massachusetts. Specifically, the PIs will measure benthic metabolism and examine algal- bacterial coupling in fertilized and ambient nutrient tidal creeks in the first field season. The following field season, they will compare sediment metabolism and carbon dynamics on slumped tidal creek walls (i.e. areas where low marsh has collapsed into the tidal creek) to that on the bottom of tidal creeks. In both years, gross and net production will be determined using an innovative triple oxygen isotope technique and traditional dissolved oxygen and inorganic carbon flux measurements. Comparisons between these methods will be useful in informing studies of sediment metabolism. Lipid biomarkers will be used to characterize the sources of organic matter to creek sediments, and stable isotope analysis of bacterial specific biomarkers to identify the sources of organic carbon utilized by sediment bacteria. The biomarkers will reveal whether sediment bacteria use organic matter substrates, such as benthic microalgal carbon, selectively or in proportion to availability. Overall, results from the proposed study will provide important information about how sediment carbon dynamics in shallow tidal creeks respond to long term eutrophication. Furthermore, findings will enhance understanding of the role of tidal creeks in coastal biogeochemistry.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1233678

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