Raw concentrations of individual PLFA compounds from Massachusetts from 2012-2015.

Website: https://www.bco-dmo.org/dataset/669693
Data Type: experimental
Version: 1
Version Date: 2016-12-08

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
Raw concentrations of individual PLFA compounds from Massachusetts from 2012-2015.

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Dataset Description

We conducted two sets of 13C label addition experiments. In one set, we evaluated how nutrient fertilization affected bacterial utilization of BMA carbon over a growing season. In the other set, we used 13C-labelled S. alterniflora to assess bacterial incorporation of recently-produced macrophyte detritus. Data presented are raw concentrations individual PLFA compounds (ng g-1 dry sediment) measured in surface sediments.

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

In June, August, and October 2013, intact sediment cores were collected from the mudflats of the fertilized and reference creeks at low tide (n=3 per creek in June and October, n=6 per creek in August; 31 cm diameter x 15 cm deep). These time periods reflected late spring, late summer, and early fall conditions. Sediment cores were transported to Woods Hole Oceanographic Institution's mesocosm system (Woods Hole, MA). Cores were placed in rectangular fiberglass tanks (2.7 m x 1.2 m x 0.8 m, l x w x d) that served as a water bath to minimize extreme fluctuations in day – night temperatures. The mesocosm system is located outside, so cores experienced ambient weather conditions.

Upon placement in the fiberglass tanks, the overlying water collected with each sediment core was continuously recirculated (~9 cm deep). The cores acclimated to the mesocosm system for 1 – 3 days,

depending on weather, as we applied the 13C label during sunny periods when BMA would be productive. Visible epifauna (e.g., snails, shrimp) were removed to minimize grazing on benthic microbes. At the beginning of each experiment, the overlying water column was removed and replaced with filtered water from the creek where the core was collected. We used 0.2 um filtered creek water to minimize label uptake by water column microbes and recirculated the water column to maintain well-mixed conditions. The isotopic label was added as 13C-sodium bicarbonate (NaHCO3, 99 atom %, Sigma-Aldrich) to the water column of each core in June and October and half of the cores from each creek in August. The other half of the August cores received 13C-labeled S. alterniflora detritus. This material was produced from a separate experiment in which living S. alterniflora plants from PIE-LTER were dosed with 13CO2 for 3 h (Spivak & Reeve 2015). Aboveground leaves were harvested after label exposure, dried (60 deg C), and ground into a coarse powder that was evenly applied across the sediment surface. 13C-S. alterniflora was only applied in August due to availability of the labeled material. From here forward, experiments receiving 13C-NaHCO3 or 13C-S. alterniflora are referred to as BMA or S. alterniflora experiments, respectively, to reflect the autotrophic source of carbon to bacteria. On average (+/- standard error, S.E.), the cores received 11.90 +/- 0.07 mg, 10.90 +/- 0.05, and 10.97 +/- 0.09 mg 13C from NaHCO3 application in June, August, and October, respectively, and 3.17 +/- 0.12 mg 13C from the S. alterniflora detritus in August. The 13C label, as NaHCO3 or S. alterniflora, was applied for four hours between 11:00 – 15:00 h before the overlying water was removed and the cores were rinsed with at least three volumes of filtered creek water to remove unused label. The four hour sampling period was based on results from a preliminary study demonstrating that this timeframe was sufficient for detecting the label in algal and bacterial lipids. After the final rinse, the overlying water column was replaced with filtered creek water and recirculated for the duration of the experiments.

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 (Spivak 2015). The top 0.5 cm of each core was collected into pre-combusted vials and frozen (-80 deg C) until analysis for total organic carbon and nitrogen content and stable isotopes (d13C, d15N) and lipid biomarker composition. Adjacent samples for benthic chlorophyll were collected with smaller cores (1.5 cm diameter x 1 cm deep) into glass vials and frozen (-20 deg C) until analysis. Additional sediment cores for organic matter composition and benthic chlorophyll were collected 4, 8, 24, and 48 h after the 13C-labeled NaHCO3 was applied in June, August, and October and 4, 8, 24, and 144h after the 13C-labeled S. alterniflora was applied in August.

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 80 deg 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 70 deg 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 um 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 antepenulttimate carbon atoms (Bianchi & Canuel 2011).

Data Processing Description

The file includes raw data only.

BCO-DMO Data Processing Notes:

-reformatted column names to comply with BCO-DMO standards.
-displayed months numerically

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Data Files

File
concentrations.csv (Comma Separated Values (.csv), 39.18 KB) MD5:170dc023869f40141ed420ee5bebb056 Primary data file for dataset ID 669693

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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
estuary	The core originiated from Sweeny or West tidal creeks	unitless
timepoint	Timepoint refers to when the sample was collected before (PL) or after the 13C-isotope label was added; HH:MM	unitless
experiment	Experiment refers to whether the 13C label was applied as benthic microalgae (BMA) or Spartina alterniflora (salt) detritus.	unitless
c12	Concentration of a combination of algae and microbes; short chain fatty acid	percentage
i13	iso methyl branced FA; indicates whether the methyl group is attached to the penultimate carbon atom	percentage
a13	anteiso methyl branced FAs; indicates whether methyl group is attached to the antepenultimate carbon atom	percentage
c13	Concentration of a combination of algae and microbes; short chain fatty acid	percentage
i14	iso methyl branced FA; indicates whether the methyl group is attached to the penultimate carbon atom	percentage
c14	Conentration of carbon isotope	percentage
i15	iso methyl branced FA; indicates whether the methyl group is attached to the penultimate carbon atom	percentage
a15	anteiso methyl branced FAs; indicates whether methyl group is attached to the antepenultimate carbon atom	percentage
c15	Concentration of carbon isotope	percentage
i16	iso methyl branced FA; indicates whether the methyl group is attached to the penultimate carbon atom	percentage
c16	Concentration of sulfate reducing bacteria	percentage
me10_16	Concentration of sulfate reducing bacteria	percentage
i17	iso methyl branced FA; indicates whether the methyl group is attached to the penultimate carbon atom	percentage
a17	anteiso methyl branced FAs; indicates whether methyl group is attached to the antepenultimate carbon atom	percentage

c17	Concentration of carbon isotope	percentage
c18	Concentration of carbon isotope	percentage
i19	iso methyl branced FA; indicates whether the methyl group is attached to the penultimate carbon atom	percentage
a19	anteiso methyl branced FAs; indicates whether methyl group is attached to the antepenultimate carbon atom	percentage
c19	Concentration of carbon isotope	percentage
c20_5w3	Isotopic composition of compounds and subclasses representing algae; polyunsaturated fatty acids	percentage
c20_4w6	Isotopic composition of compounds and subclasses representing algae; polyunsaturated fatty acids	percentage
c20	Concentration of carbon isotope	percentage
c21	Concentration of carbon isotope	percentage
unsatC22	Concentration of unsaturated fatty acids	percentage
c22_6w3	Isotopic composition of compounds and subclasses representing algae; polyunsaturated fatty acids	percentage
c22_5	Isotopic composition of compounds and subclasses representing algae; polyunsaturated fatty acids	percentage
c22	Concentration of carbon isotope	percentage
c23	Concentration of carbon isotope	percentage
c24	Concentration of carbon isotope	percentage
c26	Concentration of carbon isotope	percentage
c28	Concentration of carbon isotope	percentage
totalFA	Total fatty acid concentration	percentage

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Instruments

Dataset-specific Instrument Name	Flame ionization detector
Generic Instrument Name	Flame Ionization Detector
Dataset-specific Description	Analyzed 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	Analyzed samples
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	5975C mass spectrometer
Generic Instrument Name	Mass Spectrometer
Dataset-specific Description	Analyzed 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	Core
Generic Instrument Name	Push Corer
Dataset-specific Description	Used to collect core samples
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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