Elemental ratio data from Mass Spec analysis of newly settled oyster spat from Pamlico Sound, North Carolina from June to August of 2012 (EstuarineMetaDyn project)

Website: https://www.bco-dmo.org/dataset/615529
Data Type: experimental
Version:
Version Date: 2015-10-07

Project
» Interacting Effects of Local Demography and Larval Connectivity on Estuarine Metapopulation Dynamics (EstuarineMetaDyn)

Contributors	Affiliation	Role
Fodrie, F. Joel	University of North Carolina at Chapel Hill (UNC-Chapel Hill-IMS)	Principal Investigator
Kroll, Ian R.	University of North Carolina at Chapel Hill (UNC-Chapel Hill-IMS)	Contact
Allison, Dicky	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager
York, Amber D.	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

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Coverage

Spatial Extent: **N**:35.8416 **E**:-75.4818 **S**:34.6562 **W**:-76.7528
Temporal Extent: 2012-06-13 - 2012-08-25

Dataset Description

Elemental ratio data (X:Ca) from laser ablation inductively coupled plasma mass spectrometer (LA ICP-MS) analysis of newly settled oyster spat collected from Pamlico Sound, NC.

Methods & Sampling

Spat settlement collectors were constructed by affixing 2-3 wire strings, each containing 12 adult oyster shells, to private and public docks or stand-alone wooden pilings, throughout BBCPS study system. Settlement collectors were deployed on June 7th and 21st and again on August 1st and 16th of 2012 and retrieved approximately 2 weeks later as part of an ongoing settlement sampling program (Eggleston and Puckett, *unpubl.data*). Recovered settlement collectors were frozen until individual spat could be counted and removed from adult oyster shells with a tungsten probe. Spat were divided by collection site and collection period and refrozen at -23°C.

Spat from the field settlement collections were thawed and placed individually in 2 mL centrifuge tubes filled

with 100 mL of 15% H_2O_2 solution buffered in 0.05 N ultrapure NaOH. Samples were sonicated for 10 min to remove organic material. The H_2O_2 solution was then removed and replaced with a 100 mL solution of 1% ultrapure HNO_3 (OPTIMA grade; Fisher Scientific; Hampton, NJ). Samples were then sonicated for 5 additional min to dissolve any remaining tissue and surface impurities. Spat were then rinsed three times with ultrapure H_2O and dried overnight in a laminar flow hood. After drying, spat were mounted in haphazard order onto a glass microscope slide with double-sided tape and stored until analysis.

Both larval and spat samples were analyzed using a Thermo-Fisher Element2 inductively coupled plasma mass spectrometer with a Teledyne ATLex 300si-x 193nm Excimer laser ablation unit (LA ICP-MS). To correct for mass bias and instrument drift, National Institute of Technology Standards-certified standards (Reference Material 612, 614, and 616) were run at the beginning and end of every 4 slide sequence (~140 burns). Concentrations of the following elements were quantified from laboratory larval samples: ^{48}Ca, ^{55}Mn, ^{88}Sr, ^{138}Ba, and ^{208}Pb; and from field-collected spat: ^{26}Mg, ^{48}Ca, ^{55}Mn, ^{63}Cu, ^{88}Sr, ^{118}Sn, ^{138}Ba, and ^{208}Pb. These elements were all analyzed in low-resolution mode, and were chosen because of their previous use in uptake and tagging studies of fish otoliths and bivalve shells (Bath Martin & Thorrold 2005; Strasser et al. 2008a,b; Fodrie et al. 2011).

To determine elemental signatures of the collection sites, the outermost (most recently formed) section of the settler shell was also ablated with a 150 µm transect with 40 µm spot size and 80% intensity. Elemental variability among the larval portion of settler shells was also examined to broadly explore potential larval sources. Larval shell of each spat sample was identified and sampled in a line transect of 110 µm with 40 µm spot size and 80% intensity. Isotope intensities were converted into elemental ratios (X:Ca) following Becker et al. (2007).

Data Processing Description

Means and standard errors for field-collected larval and settlement shell Sr:Ca and Ba:Ca ratios were calculated and plotted by site to assess spatial variation in geochemical signatures among collection sites. Signatures from larval shells were used to examine possible temperature and salinity gradients present among natal sites. Additionally, contour plots were used to explore how settler shell elemental concentrations of Mn, Sr, Ba, and Pb varied with temperature and salinity. Contour plots were created using the *graphics* package in R (version 3.0.3). Multiple regression models were then used to quantitatively assess the relationship between salinity, temperature and shell signatures in a natural environment. Because some collection sites did not produce any spat over a given collection period, spat were grouped only by site to increase the sample size and statistical power of our results. A logarithmic transformation of elemental ratio was used as the response variable.

Linear Discriminate Function Analysis (DFA) was used to examine spatial variability in settler shell geochemistry and to determine the viability of using geochmical fingerprints to assess connectivity in oyster populations. All 23 sites were used in preliminary DFAs, however the classification success was low, directing us toward independent examination of PS sites from the BBCS sites. Because adjacent sites often experienced similar temperature/salinity gradients, PS sites were then grouped by geographic quadrant within PS: Northwest (NW; WC, EH, StP), Northeast (NE; RD, HT), Southeast (SE; OK, CI, WB), and Southwest (SW; OR, SoP, SQ). BBCS sites were similarly broken up into 5 groups based on geomorphology and site location: Bay (JB, WM), Creek (WH, TC), Newport (NeU, NeM, NeL), North (NoU, NoM, NoL), and Sound (BoS, BaS). Jack-knifed classification matrices, without sample replacement, were compared to expected classification matrices, based on random chance, to assess classification success. Sites were additionally grouped based on similar temperature and salinity profiles, however classification success did not improve significantly over geomorphological quadrants so analysis did not continue with these groupings. Because natal origins are unknown and modeled dispersal pathways for the area (e.g. Haase et al. 2012) have not been empirically validated, no DFA was performed on larval signatures.

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
* rounded LR params to 5 decimal places
* replaced parameter name \s with _
* removed parameter name chars (LR) as data submitter indicated it is irrelevant and part of post-processing.
* removed #DIV/0! values

* removed "Name" column as data submitter indicated it is irrelevant and part of post-processing.
* Added Site Code, Lat, and Lon from site info dataset

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Data Files

File
spatdata.csv (Comma Separated Values (.csv), 174.62 KB) MD5:5579ac99e8c375647a76a917d871ba83 Primary data file for dataset ID 615529

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Parameters

Parameter	Description	Units
Burn_Number	Number corresponding to the order in which the samples were burned (in a given sequence) during LA ICP-MS analysis	unitless
Burn_Date	date the sample was run through the mass spectometer	unitless
Mg26	Elemental ratio (Mg:Ca). Mg26 isotope intensity in counts per second divided by the Ca48 concentration	dimensionless
Mn55	Elemental ratio (Mn:Ca). Mn55 isotope intensity in counts per second divided by the Ca48 concentration	dimensionless
Co59	Elemental ratio (Co:Ca). Co59 isotope intensity in counts per second divided by the Ca48 concentration	dimensionless
Cu63	Elemental ratio (Cu:Ca). Cu63 isotope intensity in counts per second divided by the Ca48 concentration	dimensionless
Sr88	Elemental ratio (Sr:Ca). Sr88 isotope intensity in counts per second divided by the Ca48 concentration	dimensionless
Cd112	Elemental ratio (Cd:Ca). Cd112 isotope intensity in counts per second divided by the Ca48 concentration	dimensionless
Ba138	Elemental ratio (Ba:Ca). Ba138 isotope intensity in counts per second divided by the Ca48 concentration	dimensionless
Sn118	Elemental ratio (Sn:Ca). Sn118 isotope intensity in counts per second divided by the Ca48 concentration	dimensionless
La139	Elemental ratio (La:Ca). La139 isotope intensity in counts per second divided by the Ca48 concentration	dimensionless
Ce140	Elemental ratio (Ce:Ca). Ce140 isotope intensity in counts per second divided by the Ca48 concentration	dimensionless
Pb208	Elemental ratio (Pb:Ca). Pb208 isotope intensity in counts per second divided by the Ca48 concentration	dimensionless
Spat_ID	Idenifier for oyster spat bag the sampled spat came from	unitless
Sample_Site	Geomorphological quadrants the data were grouped into for analysis	unitless
Sample_Site_2	Geomorphological quadrants the data were grouped into for analysis	unitless
Date_Collected	Date of spat collection in format yyyymmdd	unitless
Month_Collected	Month of spat collection	unitless
Sample_Type	Identifier for replicate burn performed on each shell (S1 or S2).	unitless
Sal	Average salinity at sample site during length of experiment (June to August of 2012)	PSU
Temp	Average temperature at sample site during length of experiment (June to August of 2012)	degrees centigrade
Site_Code	Site identifier	untiless
Lat	Latitude of site	decimal degrees
Lon	Longitude of site	decimal degrees

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Instruments

Dataset-specific Instrument Name	Teledyne ATLex 300si-x 193nm Excimer laser ablation unit
Generic Instrument Name	Laser
Dataset-specific Description	http://www.cetac.com/product_dashboard/laser-ablation.htm
Generic Instrument Description	A device that generates an intense beam of coherent monochromatic light (or other electromagnetic radiation) by stimulated emission of photons from excited atoms or molecules.

Dataset-specific Instrument Name	Thermo-Fisher Element2 inductively coupled plasma mass spectrometer
Generic Instrument Name	Mass Spectrometer
Dataset-specific Description	Both larval and spat samples were analyzed using a Thermo-Fisher Element2 inductively coupled plasma mass spectrometer with a Teledyne ATLex 300si-x 193nm Excimer laser ablation unit (LA ICP-MS). To correct for mass bias and instrument drift, National Institute of Technology Standards-certified standards (Reference Material 612, 614, and 616) were run at the beginning and end of every 4 slide sequence (~140 burns).
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.

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Deployments

Fodrie_SpatStrings

Website	https://www.bco-dmo.org/deployment/615538
Platform	shoreside Pamlico-Oysters
Start Date	2012-06-13
End Date	2012-08-25
Description	Pamlico Sound, North Carolina is the largest lagoonal estuary along the U.S. East Coast, approximately 129 km long and 24-48 km wide. Average depth is ~2 m but can reach ~ 10 m, with wind-driven currents dominating circulation patterns. Spat settlement collectors were constructed by affixing 2-3 wire strings, each containing 12 adult oyster shells, to private and public docks or stand-alone wooden pilings, throughout BBCPS study system. Settlement collectors were deployed on June 7th and 21st and again on August 1st and 16th of 2012 and retrieved approximately 2 weeks later as part of an ongoing settlement sampling program (Eggleston and Puckett, unpubl.data).

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Project Information

Interacting Effects of Local Demography and Larval Connectivity on Estuarine Metapopulation Dynamics (EstuarineMetaDyn)

Coverage: North Carolina Estuaries

Description from NSF award abstract:
The PIs will use the eastern oyster (*Crassostrea virginica*) in Pamlico Sound, North Carolina, as a model system and will attempt to optimize the design of networks of no-take reserves as a strategy for maintaining metapopulations of this commercially harvested species. The project specifically recognizes that network persistence depends on (1) the potential for growth, survival, and reproduction within reserves, and (2) the potential to distribute offspring among reserves. Thus, demographic processes within reserves and settling areas play important roles, along with variability of physical transport. The PIs plan to:
(1) test and refine 3D bio-physical models of connectivity due to oyster larval transport in a shallow, wind-dominated system;
(2) test, refine, and apply technology to detect natal origins of larvae using geochemical tags in larval shell; and
(3) integrate regional connectivity and demographic rates to model metapopulation dynamics.

This study will produce new tools and test and refine others used for studying larval connectivity, a fundamentally important process in the maintenance of natural populations, and thus in biological conservation and resource management. The tools include a hydrodynamic modeling tool coupled with an open-source particle tracking model that will be available on-line with computer code and user guide. The project will use integrated modeling approaches to evaluate the design of reserve networks: results will be directly useful to improving oyster and ecosystem-based management in Pamlico Sound, and the methods will inform approaches to network design in other locations.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1155609

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