Carbon and Nitrogen stable isotope measurements for various marine samples collected from the Gulf of Mexico as well as eggs, animals, and food sources collected in the laboratory and commercial sources from 2020 to 2022.

Website: https://www.bco-dmo.org/dataset/908171
Data Type: Other Field Results
Version: 1
Version Date: 2023-09-12

Project
» Counter-gradient Flow of Fatty Acids in Marine Food Webs Through Egg Boons (Egg Boon Food Webs)

Contributors	Affiliation	Role
Fuiman, Lee A.	University of Texas - Marine Science Institute (UTMSI)	Principal Investigator, Contact
Nair, Parvathi	University of Texas - Marine Science Institute (UTMSI)	Co-Principal Investigator
York, Amber D.	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Carbon and Nitrogen stable isotope measurements for various marine samples collected from the Gulf of Mexico Estuary near Port Aransas, Texas from 2020 to 2022 as well as eggs, animals, and food sources from the laboratory and commercial sources from 2020 to 2022.

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Coverage

Spatial Extent: **N**:27.9362222 **E**:-97.0217777 **S**:27.8396111 **W**:-97.0827222
Temporal Extent: 2020-07-01 - 2023-07-31

Methods & Sampling

Locations: Gulf of Mexico Estuary near Port Aransas, Texas. FAML: pier at in Corpus Christi Channel, Port Aransas, TX, United States, Fisheries and Mariculture Laboratory of the University of Texas Marine Science Institute (lat. 27.8396111, lon. -97.0827222); MI: Mud Island in Aransas Bay, TX, United States (lat. 27.9362222, lon. -97.0217777)).

Methods and Sampling:
Carbon and Nitrogen stable isotope values were measured for samples of fish eggs, marine animals, and basal resources collected from the field as well as eggs, commercial fish food, Otohime (EP1, Reed Mariculture, Inc. and Artemia sp. nauplii (enriched with Alga-Mac 3050; Aquafauna Bio-Marine, Inc.) used in laboratory experiments.

Plankton net (500-µm mesh) samples were sorted immediately after collection (live material). Samples of jellyfish were collected using dip net. Animals were transferred to holding tanks to evacuate their guts for 4-5 hours. Fish were collected using cast net and seines. Fishes were immediately euthanized with lethal dose of MS-222. The euthanized fish were placed on ice and a fillet of dorsal white muscle tissue and liver were collected. Each sample was rinsed twice in distilled water and frozen at -80°C for subsequent analysis.

Basal resources were collected by pumping seawater from the Aransas Pass Channel adjacent to the University of Texas Marine Science Institute's Fisheries and Mariculture Laboratory and filtering the seawater through sieves of five different mesh sizes to obtain five size fractions of plankton samples (i.e., 38-63 µm, 63-100 µm, 100-150 µm, 150-250 µm and 250-500 µm). Bottom sediment was collected with a dredge sampler. Those samples were passed through sieves of five different mesh sizes to obtain five size fractions mentioned above. The time between collection and analysis ranged from 2 months to a year.

For stable isotope analysis, each sample was lyophilized, homogenized, and weighed. A subsample of the lyophilized and homogenized tissue was analyzed for bulk stable carbon and nitrogen isotope ratios by mass spectrometry. Analyses of size-fractioned plankton samples were run separately for carbon and for nitrogen stable isotopes. The plankton samples and bottom sediments for carbon stable isotope analysis were acidified to remove carbonates. The nitrogen stable isotope analysis values of acidified samples were not significantly different from non-acidified samples of plankton and bottom sediment. Hence, the nitrogen stable isotope values of acidified samples were reported. Samples of eggs, commercial feed, and animals were not acidified. Isotope analysis produced δ13C and δ15N values as well as percent carbon and percent nitrogen in the sample.

Data Processing Description

ISODAT software (version 3.0) was used to collect the isotope trace chromatography and calculate raw isotopic ratios. Isotope results are presented using the conventional δ-notation:

δ13C (or δ15N) = [(Rsample/Rstandard)-1] (in ‰)

where, Rsample and Rstandard = 13C/12C (or 15N/14N). All δ-values are reported relative to VPDB for carbon and AIR for nitrogen, unless otherwise stated (Coplen, 1996). A two-point calibration of δ13C to VPDB and to δ15N to AIR was achieved using USGS-40 (−26.39‰, −4.52‰) and USGS-41a (+36.55‰, +47.55‰), respectively. Internal laboratory standards; casein (protein), was used to evaluate the carbon and nitrogen accuracy and precision during analytical sessions. Overall, carbon and nitrogen isotope results had a standard deviation of less than 0.2‰.

Quality control procedure

Individual samples for which the means were greater than 4 standard deviations from the taxon mean were removed from the data set.
A primary check value was assigned as follows:
1 Perfectly fine
2 Data not evaluated because of too few data points for quality control check

BCO-DMO Processing Description

BCO-DMO Data Manager Processing Notes:
* Sheet 1 of file "Stable isotope 2020-2022.xlsx" from the online submission system was imported into the BCO-DMO data system with values "NA" as missing data values.
** Missing data values are displayed differently based on the file format you download. They are blank in csv files, "NaN" in MatLab files, etc.
* Column names adjusted to conform to BCO-DMO naming conventions designed to support broad re-use by a variety of research tools and scripting languages. [Only numbers, letters, and underscores. Can not start with a number]
* Date format changed to ISO 8601 format
* Taxon name and associated LSID for names in this dataset as of 2023-06-23 (source: World Register of Marine Species). Added supplemental file with taxon ids and match information including if the name used in the dataset was the accepted or unaccepted synonym and if unaccepted also included the currently accepted synonym at time of match.

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Data Files

File
908171_v1_stable_isotopes_field_and_lab.csv (Comma Separated Values (.csv), 133.00 KB) MD5:018c2b951827f33b60766d7123699c89 Primary data table for dataset 908171 version 1.

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Supplemental Files

File
Species List and Taxonomic Identifiers filename: 908171_species_list.csv (Comma Separated Values (.csv), 5.98 KB) MD5:bddfb5389606a548f76888817c0bd680 Unique species list for this dataset with the matched taxonomic identifiers. Match performed using the World Register of Marine Species (WoRMS) taxa match tool on 2023-12-05. All exact matches to known taxonomic names. Taxon_in_dataset "Salpa" for "salps" was matched to family taxon Salpidae. columns: Taxon_in_dataset, Taxon(category) name in the dataset which may contain lifestage terms as well as taxon name (e.g. "Sciaenops ocellatus lab eggs"). ScientificName, Taxon name matched to the "Taxon_in_dataset" which does not include lifestage terms or sp. Common_name_in_dataset, Common name in the dataset for the category AphiaID, Taxonomic identifier (AphiaID) for the taxonomic name used in the dataset (see World Register of Marine Species) LSID, Lifesciences Identifier (LSID) for the taxonomic name used in the dataset. Taxon status, Status of the name used in the dataset (denotes if the currently accepted name or a currently unaccepted synonym as of the date 2023-12-05) ScientificName_accepted, The currently accepted name for the taxonomic name used in the dataset. AphiaID_accepted, The taxonomic identifier (AphiaID) for the currently accepted name (see World Register of Marine Species)

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Related Publications

Thermo Scientific (n.d.). Thermo Scientific™ Isodat™ Software Version 3.0. *Software*

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Parameters

Parameter	Description	Units
Taxon	Taxonomic grouping of sample, or category. May include lifestage or source of sample (examples: "Sciaenops ocellatus lab eggs","Otohime","Bottom sediment")	unitless
Common_name	Common name of sample, or source of sample	unitless
Sample_ID	Sample identifier for a taxon on a sampling date	unitless
Classification	Broader taxonomic group (or category) to which sample belongs (examples: "Benthic","	unitless
Weight	Sample dry weight	milligrams (mg)
Date_collected	Date sample was collected in ISO format	unitless
Site	Location where sample was collected (FAML: pier at in Corpus Christi Channel, Port Aransas, TX, United States, Fisheries and Mariculture Laboratory of the University of Texas Marine Science Institute (lat. 27.8396111, lon. -97.0827222); MI: Mud Island in Aransas Bay, TX, United States (lat. 27.9362222, lon. -97.0217777); TPWD: produced by captive adults at Texas Parks and Wildlife Department, Marine Development Center, Corpus Christi, TX, United States (lat. 27.646877, lon. -97.0217777))	unitless
Length	Bell diameter for cnidarians; total length for fish; carapace length for crabs	centimeters (cm)
Notes	Notes about sample	unitless
Primary_check	Primary QC check (1 = Perfectly fine, 2 = Data not evaluated because of too few data points for quality control check)	unitless
d13C	Stable isotope of carbon; values in permil or parts per thousand	per mil
percent_C	Percent carbon in the sample	percentage
d15N	Stable isotope of nitrogen; values in permil or parts per thousand	per mil
percent_N	Percent nitrogen in the sample	percentage

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Instruments

Dataset-specific Instrument Name	ThermoFisher Scientific EA-Isolink CNSOH element analyzer.
Generic Instrument Name	Elemental Analyzer
Dataset-specific Description	ThermoFisher Scientific Delta V isotope ratio mass spectrometer (IRMS) coupled to a ThermoFisher Scientific EA-Isolink CNSOH element 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	ThermoFisher Scientific Delta V isotope ratio mass spectrometer (IRMS)
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	ThermoFisher Scientific Delta V isotope ratio mass spectrometer (IRMS) coupled to a ThermoFisher Scientific EA-Isolink CNSOH element analyzer.
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).

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Project Information

Counter-gradient Flow of Fatty Acids in Marine Food Webs Through Egg Boons (Egg Boon Food Webs)

Coverage: Gulf of Mexico estuary at Port Aransas, Texas

NSF Award Abstract:
Marine animals release extremely large numbers of eggs when they spawn. Most of these eggs are eaten by animals ranging from microscopic plankton to fish. Many egg consumers are smaller than the animals that released the eggs, representing a reversal of the usual food web. The consumption of eggs provides animals with highly nutritious molecules called essential fatty acids which are very concentrated in eggs. These essential fatty acids are important for the health of animals and the health of the whole ecosystem. When marine fishes form spawning aggregations to coordinate the timing and location of spawning, they release trillions of eggs. This results in an "egg boon" an immense but temporary concentration of highly nutritious fatty acids. This project combines field-based sampling with laboratory experiments to assess how fatty acids in the egg boons affect food webs. The project is determining whether consumption of eggs is beneficial to the condition of the egg consumers. New findings from this project are advancing the understanding of aquatic food webs and contributing to improved management of marine resources. For example, commercial harvest of fish can remove tons of fatty acids from an ecosystem by reducing egg boons and leading to cascading and unforeseen effects on those biological communities. The project is fostering the participation of women in science by substantially advancing the professional training of a female postdoctoral fellow. The project is supporting K-12 STEM education through inquiry-based and place-based programs for teachers and youth. Findings are being communicated to the public locally and nationally through participation in public lectures and contributions to the Science and the SeaTM radio program, podcast, and website.

Super-abundances of eggs released in temporally and spatially discrete patches create pulsed nutritional resources for egg consumers, called "egg boons", which are potentially important components of marine food webs. While various marine animals have been shown to consume eggs, the role of egg boons in energy transfer through food webs has received little attention. Three hypotheses are being tested: 1) egg boons provide a pathway through which essential fatty acids (EFAs) are redistributed counter to the main direction of trophic flow; 2) stores of EFAs in egg consumers increase during egg boons and remain elevated after the spawning season; and 3) egg boons are beneficial to the condition of egg consumers. The proposed research takes advantage of an annual egg boon produced by a spawning aggregation of the marine fish, red drum (Sciaenops ocellatus) near Port Aransas, Texas. In a combination of field sampling and laboratory experiments, fatty acid profiles, lipid content, and bulk stable isotope ratios are measures used to define trophic links between the egg boon and a selection of lower-trophic-level taxa. Egg boons are simulated in laboratory feeding experiments that are designed to enhance interpretation of data collected from field based sampling by comparing taxa that consume fish eggs with those that do not. A nucleic acid biomarker (RNA/DNA ratios) is being used to assess changes in condition that can be attributed to egg consumption in target taxa. In the environment, the importance and persistence of counter-gradient flow of fatty acids in the food web is being gauged through comparisons of samples taken inside and outside the spatial and temporal extent of the egg boon. The effects of egg consumption on consumers is being quantified in controlled experiments to identify

dietary biomarkers of egg consumption in consumer tissues that can be applied to field samples. The proposed research examines how egg consumption redistributes EFAs within food webs and provides a context for considering potential controls and trophic bottlenecks that cannot be explained from the traditional element-limitation models. The integration of fatty acid and stable isotope approaches is expected to provide greater resolution for tracking organic matter through food webs and to advance the application of multi-tracer techniques in trophic investigations. Further, if egg boons are indeed an important nutritional subsidy to select groups of consumers, then subsequent studies investigating the energetic contribution of egg boons to secondary production in marine food webs are warranted. An analysis of how reduction or removal of egg resources through the harvest of fishes in spawning aggregations changes nutrient flow in food webs could have implications for ecosystem-based fisheries management.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-2023618

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