RNA:DNA measurements for field-collected animals from the Gulf of Mexico Estuary near Port Aransas and Mud Island, Texas from 2020 to 2021

Website: https://www.bco-dmo.org/dataset/908180
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
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Abstract
RNA:DNA measurements for field-collected animals from the Gulf of Mexico Estuary near Port Aransas and Mud Island, Texas from 2020 to 2021.

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Coverage

Spatial Extent: **N**:27.9362 **E**:-97.0218 **S**:27.8396 **W**:-97.0827
Temporal Extent: 2020-07-04 - 2021-09-21

Methods & Sampling

Location: 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)).

RNA:DNA ratios, which are indicators of animal condition, were measured for samples of egg consumers collected from the field as well as those used in laboratory experiments. Samples of small fishes were collected with cast nets or seines. Fishes were euthanized with lethal dose of MS-222. The euthanized fish were placed on ice and muscle plugs were collected. All samples were lyophilized and stored at -80°C until being processed for RNA:DNA analysis. The time between collection and analysis ranged from 15 to 444 days. Results of the analysis were reported as the ratio of RNA content to DNA content.

Measurements of RNA:DNA were made on individuals. DNA and RNA were measured using the ethidium

bromide (EB) fluorometric technique (Westerman and Holt 1988) based on aliquots (10 µL) of homogenates. Calculations were based upon comparisons with DNA-EB and RNA-EB calibration curves from calf thymus DNA and yeast RNA (Type 111) standards. RNA:DNA ratios were normalized using a standardization factor based on the common RNA:DNA slope ratio procedure described by Caldarone et al. (2006). Results of the analysis were reported as the ratio of RNA content to DNA content. Measurements of RNA:DNA were unsuccessfully attempted for invertebrates.

Data Processing Description

The microplate fluorometer is operated using SoftMax Pro version 5.4 also by Molecular Devices. Raw data were exported to Microsoft Excel for further processing.

Quality control procedure:

Individual samples for which the means were greater than 3 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 "RNA DNA field data.xlsx" (submitted in our online submission system 2023-06-23) 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]
* Taxon name and associated LSID for names in this dataset as of 2023-06-23 (source: World Register of Marine Species). Added this list to Methods and Sampling section.
* Date formats converted to ISO 8601.
* Site lat and lon added as data columns from values provided in metadata.

After correspondence with the submitter, "Spotfin mojarro, Eucinostomus melanopterus " in this dataset was updated to "Spotfin mojarra, Eucinostomus argenteus"

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Data Files

File
908180_v1_rna-dna-field.csv (Comma Separated Values (.csv), 10.94 KB) MD5:a74ff343f5012257d3bd6de74c0bd6c8
Primary data file for dataset ID 908180, version 1

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Supplemental Files

File

Species List

filename: species_list.csv

(Comma Separated Values (.csv), 1.12 KB)
MD5:ae9bd1f0a8ca222367bd84db24f02a2c

Unique species list for data in RNA DNA field data.xslx. World Register of Marine Species Taxa Match performed 2024-01-16 (all exact matches to accepted names as of this date).

Scientific_name, Genus and species in the "Scientific_name" column of this dataset
Common_name, Common name in the "Common_name" column of this dataset
AphiaID, Taxonomic identifier the for the Scientific_name. AphiaID
(see WoRMS)
LSID, Lifescience identifier for the Scientific_name

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Related Publications

Caldarone, E. M., Clemmesen, C. M., Berdalet, E., Miller, T. J., Folkvord, A., Holt, G. J., Olivar, M. P., & Suthers, I. M. (2006). Intercalibration of four spectrofluorometric protocols for measuring RNA/DNA ratios in larval and juvenile fish. Limnology and Oceanography: Methods, 4(5), 153–163. Portico. https://doi.org/10.4319/lom.2006.4.153
Methods

Molecular Devices, LLC (2012). SoftMax Pro version 5.4. https://www.moleculardevices.com/products/microplate-readers/acquisition-and-analysis-software/softmax-pro-software
Software

Westerman, M., & Holt, G. J. (1994). RNA:DNA ratio during the critical period and early larval growth of the red drum Sciaenops ocellatus. Marine Biology, 121(1), 1–9. https://doi.org/10.1007/bf00349468 https://doi.org/10.1007/BF00349468
Methods

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Parameters

Parameter	Description	Units
Scientific_name	Scientific name of sample	unitless
Common_name	Common name of sample	unitless
Sample_ID	Sample identifier for a taxon on a sampling date	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.; MI: Mud Island in Aransas Bay, TX, United States.)	unitless
lat	Site latitude	decimal degrees
lon	Site longitude	decimal degrees
Date_collected	Date sample was collected. ISO 8601 format.	unitless
Date_analyzed	Date sample was analyzed. ISO 8601 format.	unitless
Tissue	Tissue sampled	unitless
Primary_check	QC check	unitless
RNA_DNA	Ratio of RNA to DNA in sample	unitless

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Instruments

Dataset-specific Instrument Name	Gemini XPS
Generic Instrument Name	Fluorometer
Dataset-specific Description	Microplate fluorometer (Molecular Devices, model Gemini XPS). The microplate fluorometer is operated using SoftMax Pro version 5.4 also by Molecular Devices.
Generic Instrument Description	A fluorometer or fluorimeter is a device used to measure parameters of fluorescence: its intensity and wavelength distribution of emission spectrum after excitation by a certain spectrum of light. The instrument is designed to measure the amount of stimulated electromagnetic radiation produced by pulses of electromagnetic radiation emitted into a water sample or in situ.

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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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