Stable isotope ratios in eye lens tissues of individuals of three species of fish from the Matagorda Bay region of Texas in the northwestern Gulf of Mexico from 2021 to 2023

Website: https://www.bco-dmo.org/dataset/961971
Data Type: Other Field Results
Version: 1
Version Date: 2025-08-11

Project
» Collaborative Research: Shifting the Hypoxia Paradigm – New Directions to Explore the Spread and Impacts of Ocean/Great Lakes Deoxygenation (HypoxiDigm / Project Breathless)

Contributors	Affiliation	Role
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Abstract
This dataset describes the stable isotope ratios in eye lens tissues of individuals of three fish species (Red Drum Sciaenops ocellatus, Southern Flounder Paralichthys lethostigma, and Atlantic Croaker Micropogonias undulatus) in the Matagorda Bay region of Texas in the northwestern Gulf of Mexico.

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Coverage

Location: Matagorda Bay, Texas, USA
Spatial Extent: **N**:29.009 **E**:-91.80883333 **S**:28.4319444 **W**:-96.4330556
Temporal Extent: 2021-07-16 - 2023-06-17

Methods & Sampling

Fish collection locations and associated information are found in an accompanying dataset for this project: https://www.bco-dmo.org/dataset/916418.

Fish eye lenses were dried and then processed for stable isotope analyses. When sufficient eye lens mass was available, lenses were peeled from the outer layer towards the eye lens core, and each layer or core material was analyzed separately. When insufficient material was available for peeling, eye lenses were analyzed whole to obtain a single isotope ratio measurement for that individual fish. Eye lens processing methods were similar to those reported by Bell-Tilcock et al. 2021.

Samples were packed into individual tin capsules for stable isotope analyses. All isotope analyses were

conducted at the University of California, Davis Stable Isotope Facility. Text describing their methods below are from https://stableisotopefacility.ucdavis.edu/

Samples were analyzed for 13C and 15N isotopes using a PDZ Europa ANCA-GSL elemental analyzer interfaced to a PDZ Europa 20-20 isotope ratio mass spectrometer (Sercon Ltd., Cheshire, UK). Samples are combusted at 1000 degrees Celsius (°C) in a reactor packed with chromium oxide and silvered copper oxide. Following combustion, oxides are removed in a reduction reactor (reduced copper at 650°C). The helium carrier then flows through a water trap (magnesium perchlorate and phosphorous pentoxide). N2 and CO2 are separated on a Carbosieve GC column (65°C, 65 milliliters per minute (mL/min)) before entering the IRMS. During analysis, samples are interspersed with several replicates of at least four different laboratory reference materials. The long term standard deviation is 0.2 ‰ for 13C and 0.3 ‰ for 15N. The final delta values, delivered to the customer, are expressed relative to international standards VPDB (Vienna Pee Dee Belemnite) and Air for carbon and nitrogen, respectively.

Stable isotope ratios of 34S in solid samples are measured using an Elementar vario ISOTOPE cube interfaced to an Isoprime PrecisION IRMS (Cheadle Hume, Stockport, UK). Samples are combusted at 1000°C in a reactor packed with tungsten oxide and elemental copper. Immediately following combustion, sample gases are reduced with elemental copper at 900°C and subsequently pass through a buffering reactor filled with quartz chips held at 900°C. SO2 and CO2 are then separated by purge and trap, allowing for full separation and peak focusing. Following separation, the SO2 adsorption trap is heated and the sample SO2 passes directly to the IRMS for measurement.

During analysis, samples are interspersed with replicates of several laboratory reference materials to monitor and allow for correction of any potential variation in drift and linearity. Final 34S delta values are obtained after adjusting the provisional measurements such that correct 34S delta values for laboratory quality assurance materials are obtained. The long-term reproducibility of this method is ± 0.4 ‰.

Data Processing Description

Data are provided as reported by the analytical facility without additional processing. Duplicate samples from some eye lens layers from some fish were analyzed separately to assess within-layer variation. Those results are provided separately and indicated as duplicates within the datasheet.

BCO-DMO Processing Description

- Imported fish collection location data (file "916418_v2_fish_collection_locations.csv").
- Imported original file "Eye Lens SIA UPLOAD.xlsx" into the BCO-DMO system.
- Flagged "NA" and "LOQ" as missing data values (missing data are empty/blank in the final CSV file).
- Added the following columns from the fish collection location data file to this dataset by joining on Fish_ID: Station_Latitude, Station_Longitude, Date_Collected, Species.
- Saved the final file as "961971_v1_fish_eye_lens_stable_isotopes.csv".

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Data Files

File	
961971_v1_fish_eye_lens_stable_isotopes.csv	(Comma Separated Values (.csv), 6.02 KB) MD5:2a70bb664ee49736f801680938ea8d7e
Primary data file for dataset ID 961971, version 1	

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Related Publications

Bell-Tilcock, M., Jeffres, C. A., Rypel, A. L., Sommer, T. R., Katz, J. V. E., Whitman, G., & Johnson, R. C. (2021). Advancing diet reconstruction in fish eye lenses. Methods in Ecology and Evolution, 12(3), 449–457. Portico. https://doi.org/10.1111/2041-210X.13543
Methods

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Related Datasets

IsRelatedTo

Walther, B., Oster, J. (2025) **Collection locations, dates, and weight and length measurements of individuals of three fish species from the Matagorda Bay region of Texas in the northwestern Gulf of Mexico from 2021 to 2023.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 2) Version Date 2025-04-15 doi:10.26008/1912/bco-dmo.916418.2 [view at BCO-DMO]
Relationship Description: The "collection locations" dataset contains information for all Fish ID numbers reported in related datasets.

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Parameters

Parameter	Description	Units
FishID	Unique identifier number for each individual fish included in the project. IDs include a prefix of "MB" (Matagorda Bay) or "PB" (Project Breathless) followed by a unique sequence of digits.	unitless
Subsample	Categorical code indicating subsample according to position within each eye lens. 1 = outermost layer, 2 = second layer inwards, 3 = third layer inwards, 4 = fourth layer inwards, 5 = 5th layer inwards, C = innermost core, W = whole eye lens (unpeeled).	unitless
Duplicate	Number indicating duplicate (1 or 2)	unitless
Species	Latin binomial (Genus species) of each individual collected	unitless
d13C	Stable isotope ratio of carbon (d13C)	permil (‰)
d15N	Stable isotope ratio of nitrogen (d15N)	permil (‰)
d34S	Stable isotope ratio of sulfur (d34S)	permil (‰)
Station_Latitude	Collection location latitude in decimal degrees; positive values = North	decimal degrees
Station_Longitude	Collection location longitude in decimal degrees; negative values = West	decimal degrees
Date_Collected	Date of fish collection	unitless

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Instruments

Dataset-specific Instrument Name	Elementar vario ISOTOPE cube
Generic Instrument Name	Elemental 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	PDZ Europa ANCA-GSL elemental analyzer
Generic Instrument Name	Elemental 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	Isoprime PrecisION IRMS
Generic Instrument Name	Isotope-ratio Mass Spectrometer
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	PDZ Europa 20-20 isotope ratio mass spectrometer
Generic Instrument Name	PDZ Europa 20-20 isotope ratio mass spectrometer
Generic Instrument Description	The PDZ Europa 20-20 is a dedicated continuous flow isotope ratio mass spectrometer for hyphenated stable isotope analyses able to measure 15N, 13C, 18O, and 34S in a host of applications. The analyzer has been purposely designed to measure 2H by continuous flow methodology and is also suitable to analyze the light stable isotopes in all the commonly measured gases: H2, N2, NO, N2O, O2, CO, CO2, SO, and SO2.

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Project Information

Collaborative Research: Shifting the Hypoxia Paradigm – New Directions to Explore the Spread and Impacts of Ocean/Great Lakes Deoxygenation (HypoxiDigm / Project Breathless)

Coverage: Central Baltic Sea; Lake Erie; and Lavaca Bay, Texas

NSF Award Abstract:
Ocean oxygen loss (deoxygenation) is increasing due to climate warming. This warming, together with nutrient loading, is causing many marine and freshwater systems to experience increasing episodes of hypoxia (low oxygen) of greater duration and intensity. Impacts on fish and fisheries have been difficult to quantify; direct observation has been challenged by a lack of long-term exposure indicators. This team has successfully refined the use of fish chemical biomarkers in fish otoliths (earstones) to directly assess lifetime hypoxia exposure in fishes. This project will those findings to look for additional biomarkers and models, to expand our understanding of how hypoxia affects fish and their food webs, contaminant transfers, and ecosystem services including economic impacts. The project includes a unique way of training students in science communication, posing the question: What forms of media and "messaging strategies" about deoxygenation are most effective at raising public awareness and understanding? Students are developing entries for

PlanetForward's Storyfest, which is a contest to tell compelling stories to foster environmental understanding and solutions. Students from historically underrepresented, economically disadvantaged backgrounds are particularly sought out to participate. The investigators will engage with regional, national, and international management agencies and other relevant stakeholder groups to share information.

This project encompasses a novel, linked set of interdisciplinary studies of food webs, and ecosystem services assessment. The thematic questions explored in this project are: 1. How does hypoxia alter habitat use for fishes? 2. How does hypoxia-altered habitat use and habitat productivity change food webs? 3. How does hypoxia affect/enhance trophic transfer of methylmercury? 4. How do hypoxia-induced changes in food webs affect aquatic ecosystem services? The set of linked studies will employ chemical analyses of otoliths and eye lenses, combined with chemical analyses of muscle tissues (Questions 1 and 3), physiologically-structured food web modeling informed by monitoring time-series (Questions 2 and 4), and a scoping workshop to address ecosystem services (Question 4). The investigators are using a "trans-basin" comparative approach to system-specific responses, studying fishes in Lake Erie, the Baltic Sea, and a Gulf of Mexico estuary. They study three species from each system that represent different degrees of benthic reliance, to discern differential responses to the increasingly hypoxic environment. This research provides novel insight about variable biotic responses to oxygen loss and the impacts on ecosystem functioning.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1924011

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