Geochemical concentrations of elements measured in transects across otoliths of three Gulf of Mexico fish species collected from 2021-2023

Website: https://www.bco-dmo.org/dataset/962569
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 chemical composition of otoliths of three fish species (Red Drum Sciaenops ocellatus, Southern Flounder Paralichthys lethostigma, and Atlantic Croaker Micropogonias undulatus) collected in the Matagorda Bay region of Texas in the northwestern Gulf of Mexico. Otoliths were sectioned and analysed using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) to obtain continuous core-to-edge transects of elemental variation across growth increments.

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Coverage

Location: Matagorda Bay, Texas, USA
Spatial Extent: **N**:28.785556 **E**:-96.009722 **S**:28.4184066 **W**:-96.641667
Temporal Extent: 2021-07-16 - 2023-07-01

Methods & Sampling

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

Otolith element concentrations for each individual fish were measured at the University of Austin, Jackson School of Geosciences using laser ablation inductively coupled mass spectrometry (LA-ICP-MS). Standard reference materials included a National Institute of Standards and Technology glass standard (NIST-612) and a United States Geological Survey microanalytical carbonate standard pressed pellet (MACS-3). Otolith element

concentrations were quantified along the longest dorso-ventral axis spanning the core (i.e., hatch) to the edge (i.e,. death). The distance measurement indicates the distance of the laser spot as it progressed from the beginning of the transect near the otolith core (a distance of zero) and progressively moving outward to the outer edge of the ototlith.

Analytical methods followed the detailed methods provided in Altenritter et al. (2018) and Altenritter and Walther (2019).

Data Processing Description

Data were corrected using certified reference materials and converted to parts per million (ppm) concentrations.

BCO-DMO Processing Description

- Imported fish collection location data (file "916418_v2_fish_collection_locations.csv").
- Imported original file "NSF FishOtolithTransects Combined.xlsx" into the BCO-DMO system.
- Flagged "NAN" as a missing data value (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.
- Renamed fields to comply with BCO-DMO naming conventions.
- Removed rows for FishID numbers PB004, PB247, and PB285 as requested by data submitter.
- Saved the final file as "962569_v1_otolith_transects.csv".

Problem Description

Transects are presented with minimal processing, and some may include data from just before commencement of laser acquisition of otolith material at the beginning of each transect, as well as material ablated at the end of the transect as the laser exited off of the otolith surface. In addition, phosphorus values were acquired, but reported values were frequently negative, indicating they were present below the measured background blank concentrations and these values may be of low confidence.

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Data Files

File
962569_v1_otolith_transects.csv (Comma Separated Values (.csv), 53.01 MB) MD5:506642ca01a1587bdcc89856c9db23d9 Primary data file for dataset ID 962569, version 1

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Related Publications

Altenritter, M. E., & Walther, B. D. (2019). The Legacy of Hypoxia: Tracking Carryover Effects of Low Oxygen Exposure in a Demersal Fish Using Geochemical Tracers. Transactions of the American Fisheries Society, 148(3), 569–583. doi:10.1002/tafs.10159
Methods

Altenritter, M., Cohuo, A., & Walther, B. (2018). Proportions of demersal fish exposed to sublethal hypoxia revealed by otolith chemistry. Marine Ecology Progress Series, 589, 193–208. doi:10.3354/meps12469
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
Species	Latin binomial (Genus species) of each individual collected	unitless
Dist_um	Distance in micrometers of laser traversal across each otolith beginning near the otolith core (distance of zero) out to the exterior edge of each otolith.	micrometers (um)
Mg24_ppm	Concentration of Magnesium isotope 24	parts per million (ppm)
Mg25_ppm	Concentration of Magnesium isotope 25	parts per million (ppm)
P31_ppm	Concentration of Phosphorus isotope 31	parts per million (ppm)
Mn55_ppm	Concentration of Manganese isotope 55	parts per million (ppm)
Sr88_ppm	Concentration of Strontium isotope 88	parts per million (ppm)
Ba138_ppm	Concentration of Barium isotope 138	parts per million (ppm)
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	Agilent 7500ce ICP-Q-MS
Generic Instrument Name	Agilent 7500ce inductively coupled plasma mass spectrometer
Dataset-specific Description	Otolith elemental transects were collected with an Agilent 7500ce ICP-Q-MS coupled with a UP-193 FX laser ablation system.
Generic Instrument Description	The Agilent 7500ce is a laboratory benchtop inductively coupled plasma mass spectrometer (ICP-MS) for metal analysis. The instrument comprises a sample introduction system (micromist glass concentric nebuliser, quartz Scott-type spray chamber, peristaltic pump), an interface of nickel cones and dual on-axis extraction lenses, a vacuum system, mass flow controllers (plasma, auxiliary, makeup, and carrier gas and two Octopole Reaction System (ORS) reaction gas lines), a shieldtorch system (STS), an all-solid state digitally-driven 27 MHz RF generator and an off-axis Omega lens. The octopole cell of the ORS can be used with no gas, operated in collision mode using pure He cell gas or used in H2 reaction mode for ultra-trace Se analysis and semiconductor applications. All three of these modes come as standard in the 7500ce model. The instrument has been discontinued.

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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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