Total mercury (THg) concentration, fork length, and mass data for bigeye tuna (Thunnus obesus), yellowfin tuna (Thunnus albacares), and longnose lancetfish (Alepisaurus ferox) collected from the central and eastern North Pacific between 1971 and 2023

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Data Type: Other Field Results
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Project
» Scripps Center for Oceans and Human Health: advancing the science of marine contaminants and seafood security (SCOHH)

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Abstract
This dataset contains total mercury (THg) concentration, fork length, and mass data for bigeye tuna (Thunnus obesus), yellowfin tuna (Thunnus albacares), and longnose lancetfish (Alepisaurus ferox) collected from the central and eastern North Pacific between 1971 and 2023. The THg data for tunas were compiled from published literature. We compared the THg bioaccumulation curve for lancetfish from this study to the bioaccumulation curves for two well-studied tuna species to examine how life history and feeding ecology affect THg accumulation with size.

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Coverage

Location: Central and eastern North Pacific Ocean. Tuna specimens were collected in the waters around Hawaii, while lancetfish specimens were collected between 20 – 40° N and 115 – 160° W.
Spatial Extent: **N**:40 **E**:-115 **S**:10 **W**:-170
Temporal Extent: 1971-01 - 2023-09

Dataset Description

This dataset is referred to as "Dataset S2" in the supplementary material of Chen et al. The data were used in Figure 3.

Methods & Sampling

Lancetfish Sample Collection:

Whole lancetfish (n = 69) were collected by fisheries observers of the National Oceanic and Atmospheric Administration (NOAA) Pacific Islands Region and West Coast Region Observer Programs from 2018 to 2023 between 20 – 40° N and 115 – 160° W in the central and eastern North Pacific Ocean. Observers sampled lancetfish from the Hawaii-based shallow- and deep-set pelagic longline fisheries. Lancetfish were frozen whole at sea and capture location was recorded. In the lab, specimens were defrosted, measured to the nearest mm (FL), and weighed whole to the nearest 0.1 g.

Dorsal muscle tissue from each lancetfish was sampled posterior to the operculum at the base of the dorsal fin insertion and anterior to the vent. Only white muscle tissue was sampled, and skin, bones, and cartilage were removed from white muscle tissues before analysis. Following dissection, all tissues were gently rinsed with Milli-Q to avoid contamination between samples, placed in pre-weighed Whirl-Paks, and weighed before and after drying to measure moisture content. Tissues were frozen at -80˚C before being freeze-dried and homogenized within the Whirl-Pak or using an electronic mill (IKA Tube Mill 100 Control). Milling vessels and tools were cleaned with 95% ethanol between samples.

Tuna THg Data:

We used published size and THg data from muscle tissues of bigeye tuna (*Thunnus obesus*) and yellowfin tuna (*Thunnus albacares*) collected in the central North Pacific (Brooks, 2004; Choy et al., 2009; Kaneko and Ralston, 2007; Kraepiel et al., 2003; Rivers et al., 1972; Thieleke, 1973; as compiled in Drevnick and Brooks, 2017), along with data from Choy (2013). Life history, metabolism, and diet information for bigeye and yellowfin tuna are available in the literature and were used to explain changes in THg burden with size.

Data Processing Description

Analytical Methods:

Total mercury (THg) concentrations were determined using a Nippon Instruments MA-3000 Direct Mercury Analyzer (DMA), which uses direct thermal decomposition, gold amalgamation, and cold vapor atomic absorption spectroscopy. For quality assurance and quality control, certified reference materials National Research Council Canada (NRCC) DORM-4 (fish protein) and NRCC TORT-3 (lobster hepatopancreas) were analyzed at the beginning and end of each analysis day. Around 20 mg of dried, homogenized tissues were weighed out for THg analysis, and replicate samples and DORM-4 were analyzed every seven samples. A blank boat was combusted after samples expected to have high THg concentrations to reduce any potential THg carryover to subsequent samples. The average variation of replicate measurements was 4.1%, and analyses of DORM-4 (average measured THg = 417 ± 26 ng Hg/g dry weight, n = 161) and TORT-3 (296 ± 15 ng Hg/g dry weight, n = 40) were within 1.2% and 1.5% of mean certified values, respectively. Only data collected between standard reference materials that were within the range of certified values were included in analyses.

All data processing was performed in R Statistical Software (version 4.3.2; R Core Team, 2023).

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Data Files

File
948928_v1_tuna.csv (Comma Separated Values (.csv), 44.97 KB) MD5:a32023aafb3b5a86e1dbe805ab155588 Primary data file for dataset ID 948928, version 1

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Related Publications

Brooks, B. (2004). Mercury levels in tuna and other major commercial fish species in Hawaii, in: National Forum on Contaminants in Fish. San Diego, CA, USA, pp. 24–24.
Methods

Chen, R. S., Schartup, A. T., Paulson, E. T., & Choy, C. A. (2024). Diet shifts drive mercury bioaccumulation and distribution in tissues of the longnose lancetfish (Alepisaurus ferox). Scripps Institution of Oceanography, University of California San Diego. https://doi.org/10.1016/j.marpolbul.2025.117590
Results

Choy, C. A., Popp, B. N., Kaneko, J. J., & Drazen, J. C. (2009). The influence of depth on mercury levels in pelagic fishes and their prey. Proceedings of the National Academy of Sciences, 106(33), 13865–13869. https://doi.org/10.1073/pnas.0900711106
Methods

Choy, C.A. (2013). Pelagic food web connectivity in the North Pacific Subtropical Gyre: A combined perspective from multiple biochemical tracers and diet. PhD Dissertation. University of Hawai'i at Manoa. https://hdl.handle.net/http://hdl.handle.net/10125/100681
Methods

Drevnick, P. E., & Brooks, B. A. (2017). Mercury in tunas and blue marlin in the North Pacific Ocean. Environmental Toxicology and Chemistry, 36(5), 1365–1374. https://doi.org/10.1002/etc.3757
Methods

Kaneko, J. J., & Ralston, N. V. C. (2007). Selenium and Mercury in Pelagic Fish in the Central North Pacific Near Hawaii. Biological Trace Element Research, 119(3), 242–254. https://doi.org/10.1007/s12011-007-8004-8
Methods

Kraepiel, A. M. L., Keller, K., Chin, H. B., Malcolm, E. G., & Morel, F. M. M. (2003). Sources and Variations of Mercury in Tuna. Environmental Science & Technology, 37(24), 5551–5558. https://doi.org/10.1021/es0340679
Methods

R Core Team (2023). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/
Software

Rivers, J. B., Pearson, J. E., & Shultz, C. D. (1972). Total and organic mercury in marine fish. Bulletin of Environmental Contamination and Toxicology, 8(5), 257–266. https://doi.org/10.1007/bf01684554 https://doi.org/10.1007/BF01684554
Methods

Thieleke, J. (1973). Mercury levels in five species of commercially important pelagic fish taken from the Pacific Ocean near Hawaii. MS Thesis. University of Wisconsin-Madison.
Methods

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Parameters

Parameter	Description	Units
specimen_id	unique identifier assigned to individual fish	unitless
speciesID	scientific name	unitless
date	fish collection date, in the format YYYY-MM	unitless
latitude	fish collection location. Location data are provided in 5x5 degree cells. The coordinate represents the lower left corner of the 5x5 degree cell	degrees
longitude	fish collection location. Location data are provided in 5x5 degree cells. The coordinate represents the lower left corner of the 5x5 degree cell	degrees
length_cm	fork length of whole fish	centimeters (cm)
weight_kg	wet weight of whole fish	kilograms (kg)
wetTHg_ng_g	total mercury (THg) concentration in muscle tissue, reported as ng Hg/g on a wet weight basis (ng/g, ww)	nanograms per gram (ng/g)
reference	abbreviated reference to data source	unitless

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Instruments

Dataset-specific Instrument Name	Nippon Instruments MA-3000 Direct Mercury Analyzer
Generic Instrument Name	Automated Mercury Analysis System
Dataset-specific Description	Nippon Instruments MA-3000 Direct Mercury Analyzer: used to measure total mercury concentrations
Generic Instrument Description	Examples include Tekran Models 2600 and 2700

Dataset-specific Instrument Name	IKA Tube Mill 100 Control
Generic Instrument Name	Homogenizer
Dataset-specific Description	IKA Tube Mill 100 Control: used to homogenize freeze-dried tissues
Generic Instrument Description	A homogenizer is a piece of laboratory equipment used for the homogenization of various types of material, such as tissue, plant, food, soil, and many others.

Dataset-specific Instrument Name	LABCONCO Benchtop Freeze Dryer
Generic Instrument Name	Lyophilizer
Dataset-specific Description	LABCONCO Benchtop Freeze Dryer: used to freeze dry tissues
Generic Instrument Description	A lyophilizer, also known as freeze dryer or liofilizador, is a device that is used to freeze-dry material.

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Project Information

Scripps Center for Oceans and Human Health: advancing the science of marine contaminants and seafood security (SCOHH)

Coverage: Scripps Center for Oceans and Human Health

The Scripps Center for Oceans and Human Health (SCOHH) is a five-year effort to advance the science and community engagement surrounding seafood pollutants, on a rapidly changing planet. The project brings together a multidisciplinary team of biomedical and oceanographic researchers with expertise in fish ecology, microbiology, marine chemistry, climate modeling, technology development, bioaccumulation, genomics, toxicology, and public health. The Center’s scientific goals and focus are guided by the needs of society, established through bidirectional community engagement, and led by a proven community engagement team. The proposed research program of SCOHH spans four main areas:

1. Climate change impacts on the human intake of seafood micronutrients and contaminants.
2. The marine microbiome as a source for the synthesis, transformation, and distribution of seafood contaminants.
3. Mechanisms of bioaccumulation and developmental toxicity of seafood pollutants.
4. Bidirectional public engagement and literacy surrounding seafood risks and benefits.

The outcomes of the SCOHH will inform policies, consumption guidelines, and individual decisions to lower risk and enhance greater benefits associated with seafood consumption. Internally, SCOHH will take deliberate measures to enhance equity, diversity, and inclusion in all aspects of its functioning, from the investigator team and graduate student/postdoctoral trainees to engagement with community partners. The Center is jointly supported by NSF’s Division of Ocean Sciences and by the National Institute for Environmental Health Sciences (NIEHS).

The central scientific theme of SCOHH is to advance knowledge of marine contaminants and seafood security. Natural and anthropogenic contaminants such as mercury, DDT, and PCBs drive seafood consumption advisories. Yet understanding of their sources, microbial transformations, toxicity, and potential for climate driven change remain incomplete. The SCOHH team will study and track the distribution of essential micronutrients and harmful contaminants in marine food webs to the three billion people who consume seafood globally, the roles that the marine microbiome play in their production and transport, and the developmental toxicity of seafood pollutants and their interactions with transporters that determine uptake and bioaccumulation.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-2414798
National Institute of Environmental Health Sciences (NIEHS)	P01ES035541

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