

# Unveiling Mercury Exposure Complexities: Integrating Tools and Charting Future Research Paths

**Mi-Ling Li**

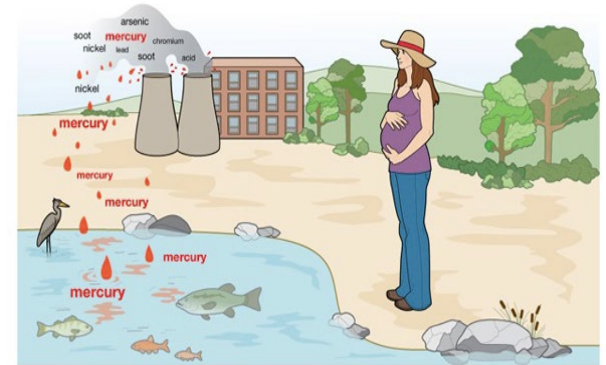
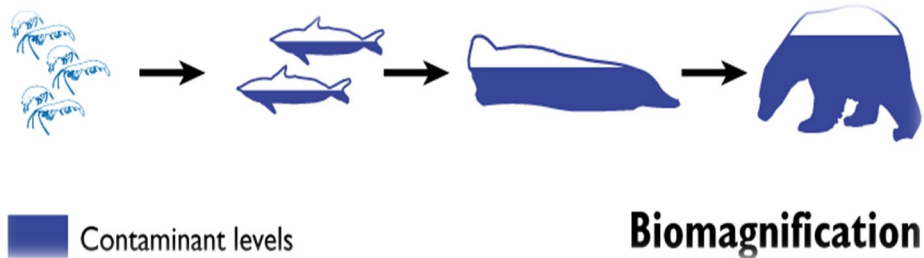
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School of Marine Science and Policy  
University of Delaware  
Present @ ICMGP 2024



# Methylmercury (MeHg) Poses Risks to Ecological and Human Health

- Potent neurotoxicant for humans.
- Biomagnify along food chain.
- Primary exposure route for fish, marine mammals and humans: dietary consumption.



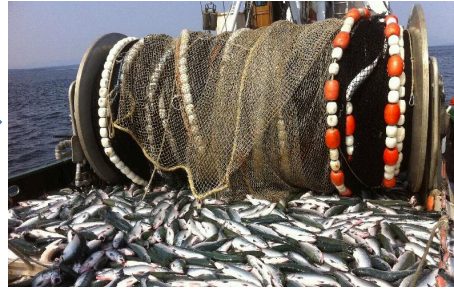
# Central Question

What are the major sources and exposure pathways of MeHg found in wildlife and humans?



# Seafood consumption is a major MeHg exposure pathway

*MeHg flow*



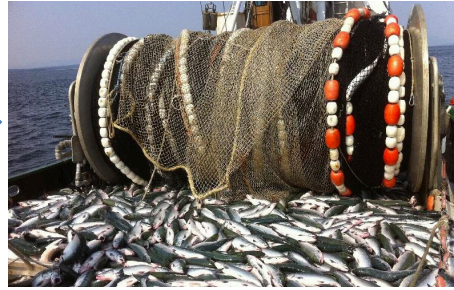
Tools for assessing MeHg exposure sources for humans

- Stable Hg isotopes
- Toxicokinetic model
- Fisheries catch data



# Seafood consumption is a major MeHg exposure pathway

*MeHg flow*

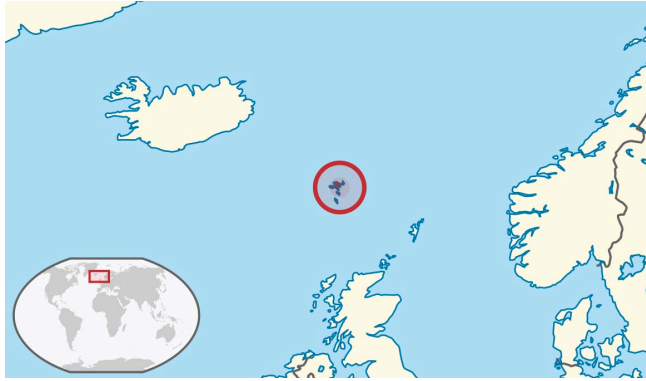


Tools for assessing MeHg exposure sources for humans

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# Faroe Islands



# Simple Diet Scenario (Faroe Islands)

- Faroese whalers: source of exposure to Hg is highly constrained. (i.e., limited isotopic variability).

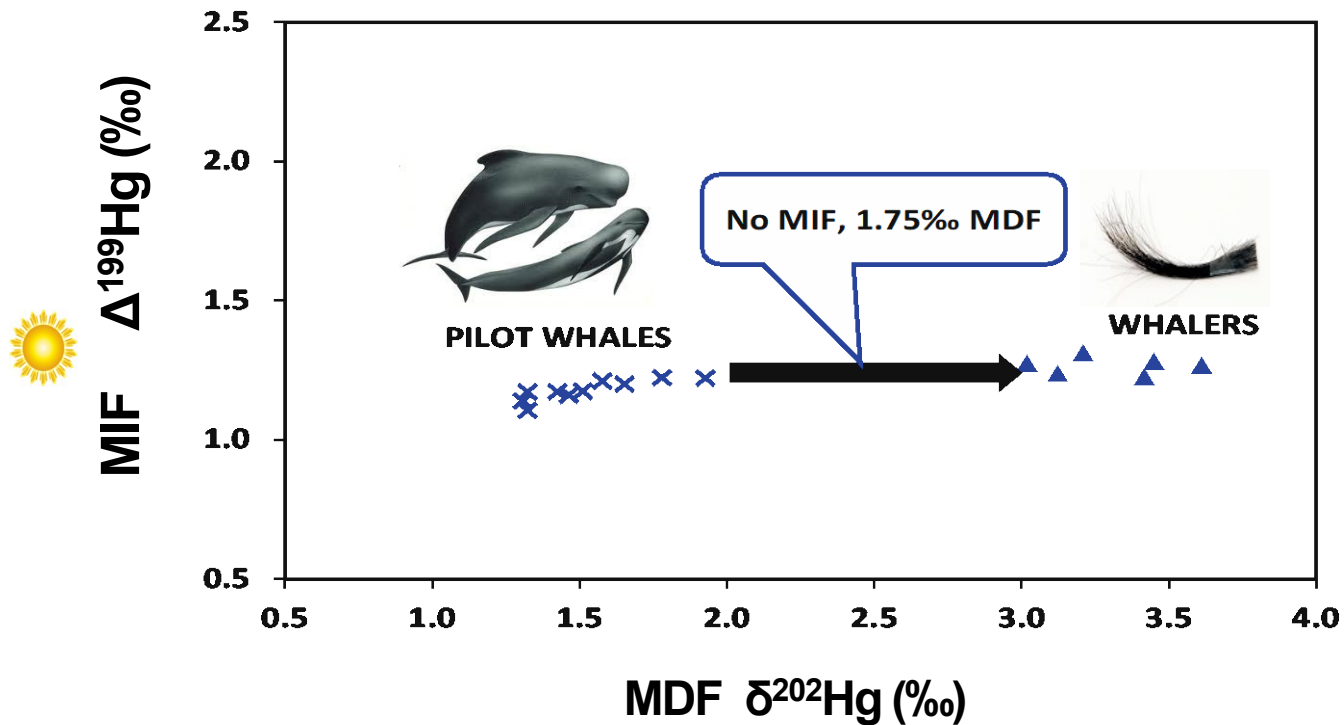
**Faroese whalers**



**Pilot whales**



# Simple Diet Scenario (Faroe Islands)

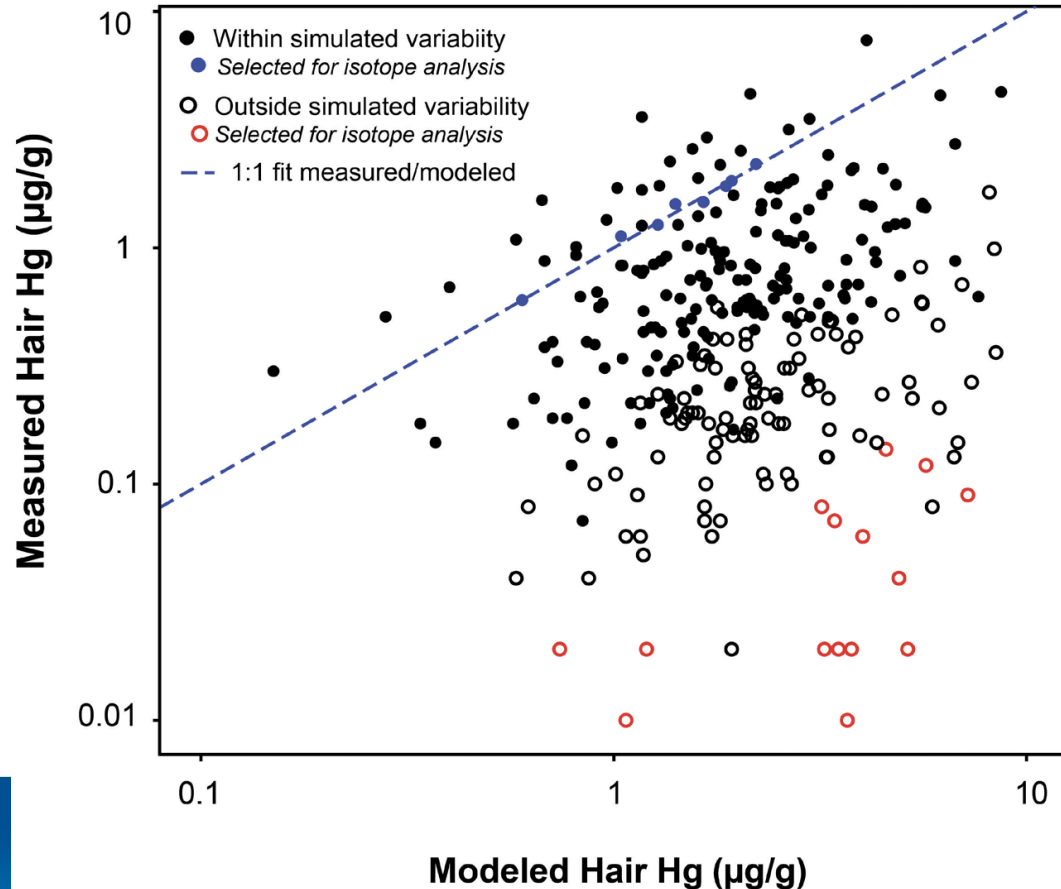


# **U.S. Highly exposed populations**

- High-frequency fish consumers



# Hair Hg of high-frequency fish consumers in U.S.

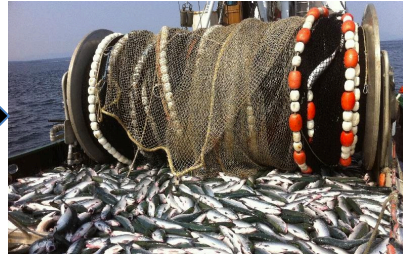


- Modeled  $>$  Measured hair Hg
- Is it because of recall bias or misreporting?
- *Hg isotopes showed NO evidence of serious misreporting.*



# Seafood consumption is a major MeHg exposure pathway

*MeHg flow*



Tools for tracking MeHg exposure sources for humans

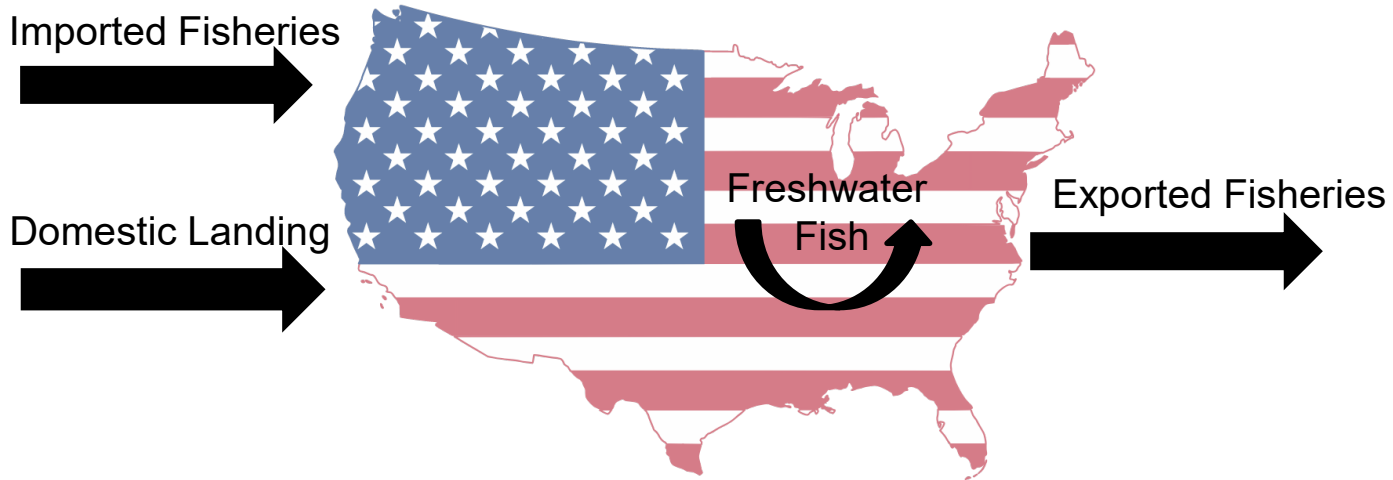
- Stable Hg isotopes
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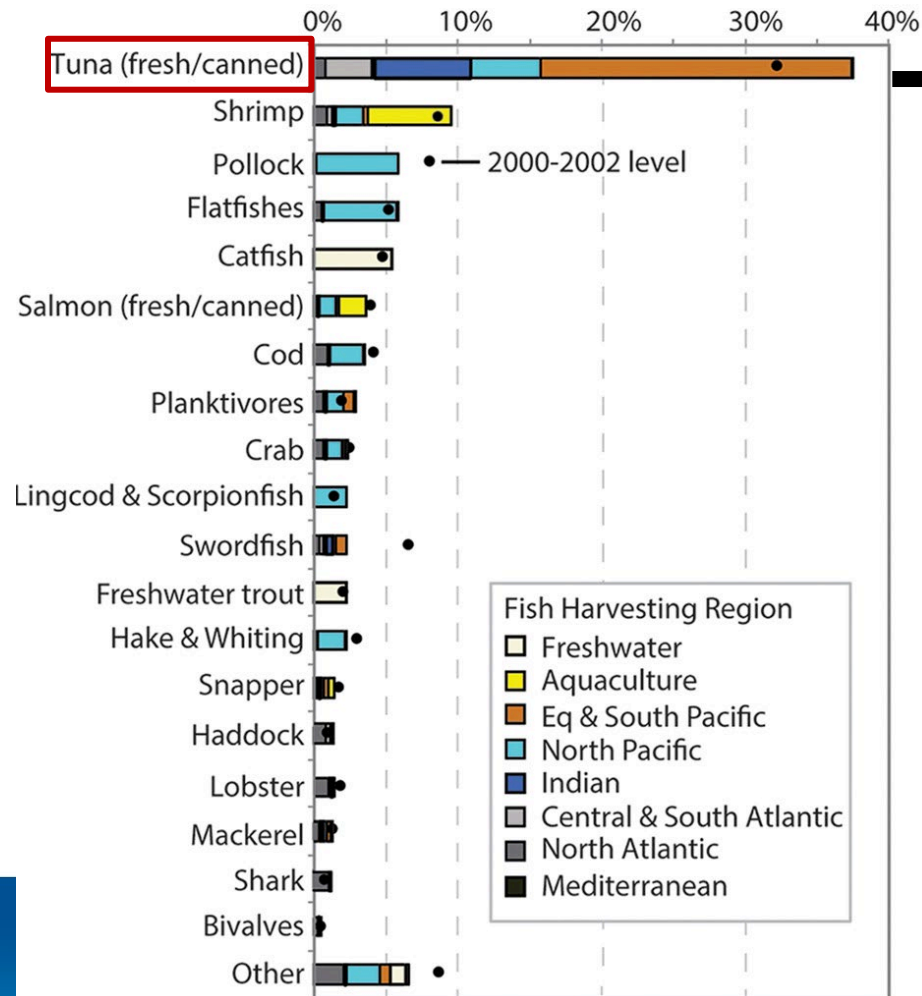
# Where are the Fish in the U.S. Market from?

Catch information (i.e., fisheries volumes, ocean basins) for each fish group

$$\text{Fished MeHg flow} = \text{MeHg concentrations} * \text{Fish mass}$$



## U.S. MeHg Intake (%)



- Tuna contribute largest fraction (38%) of MeHg intake in U.S. between 2010-2012.
- Its MeHg contribution increased compared with a decade ago.



# How About Global Populations?



# Global MeHg exposure from contemporary fisheries

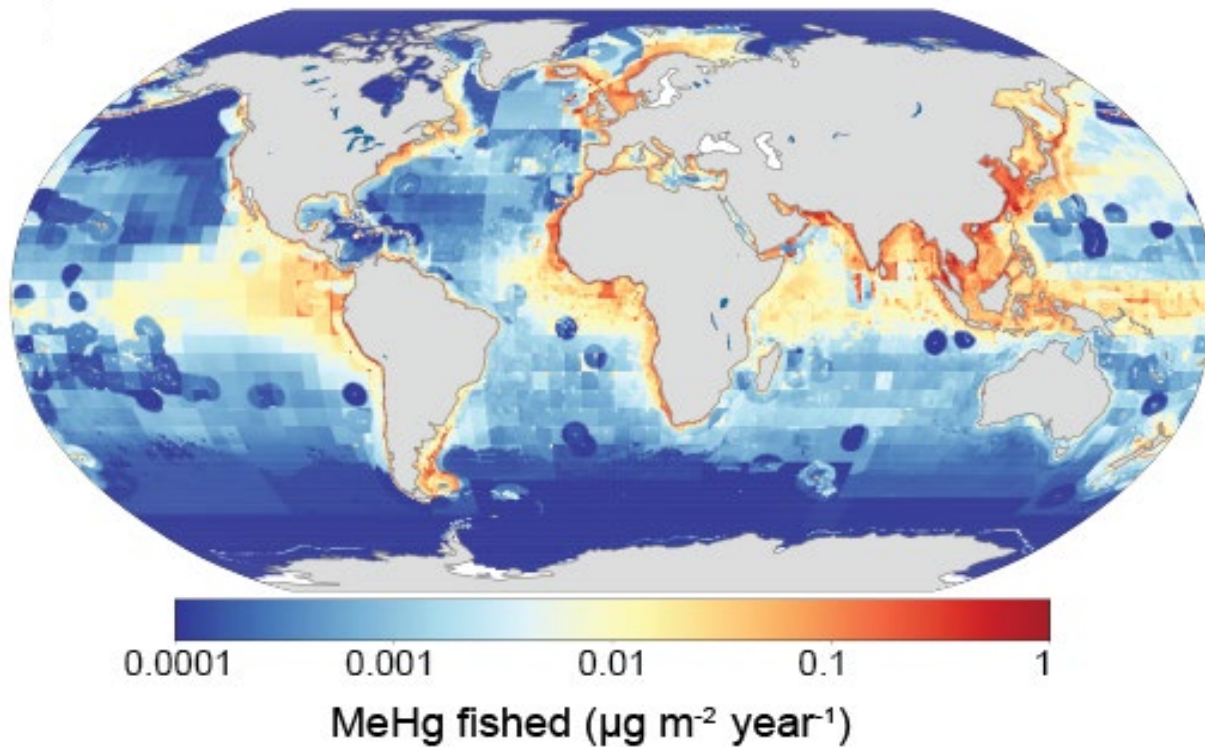


Image credit: Pew Charitable Trusts

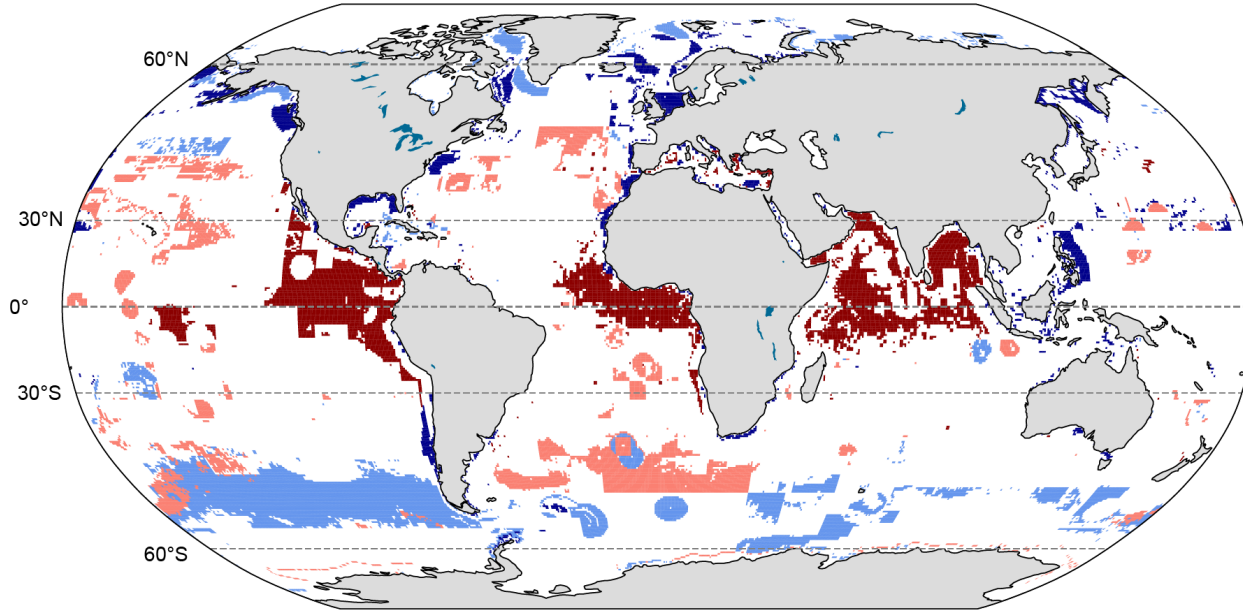


Image credit: Mongabay

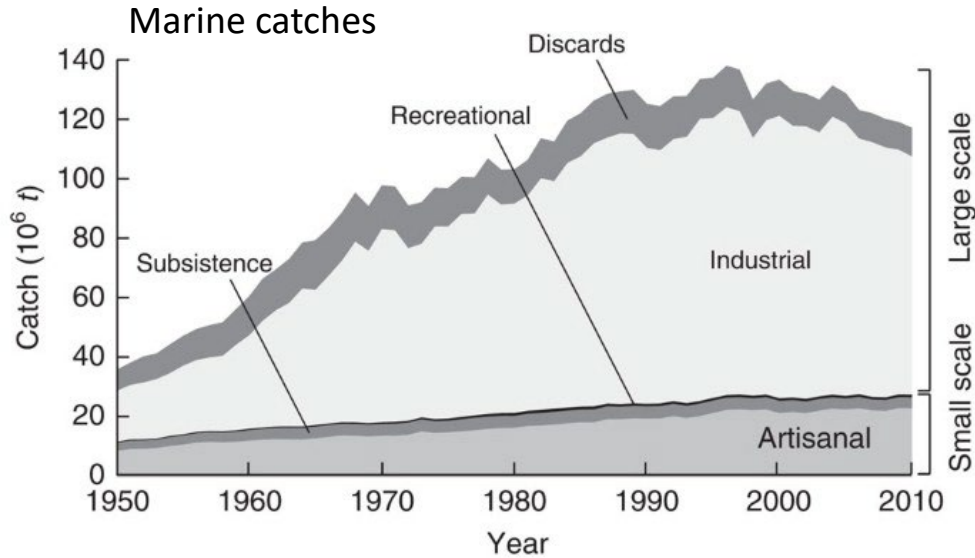
# Global fisheries skew toward high MeHg seafood from low latitudes



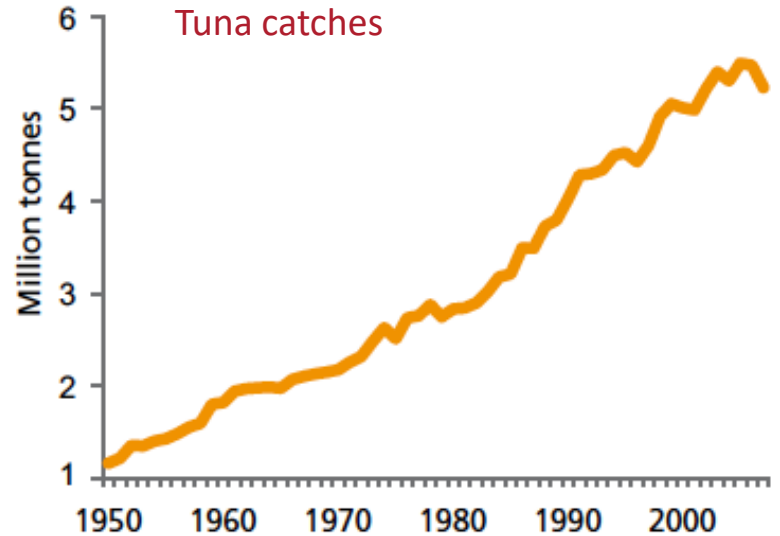
# High MeHg concentrations and high catches in tropical regions



# Global marine fisheries catches declined since 1996 but tuna catches keep increasing



Pauly and Zeller, 2016. *Nature communication*

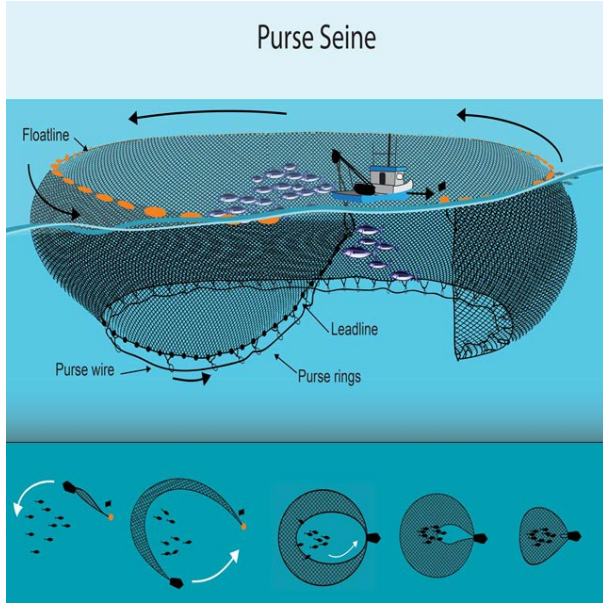


FAO, 2010



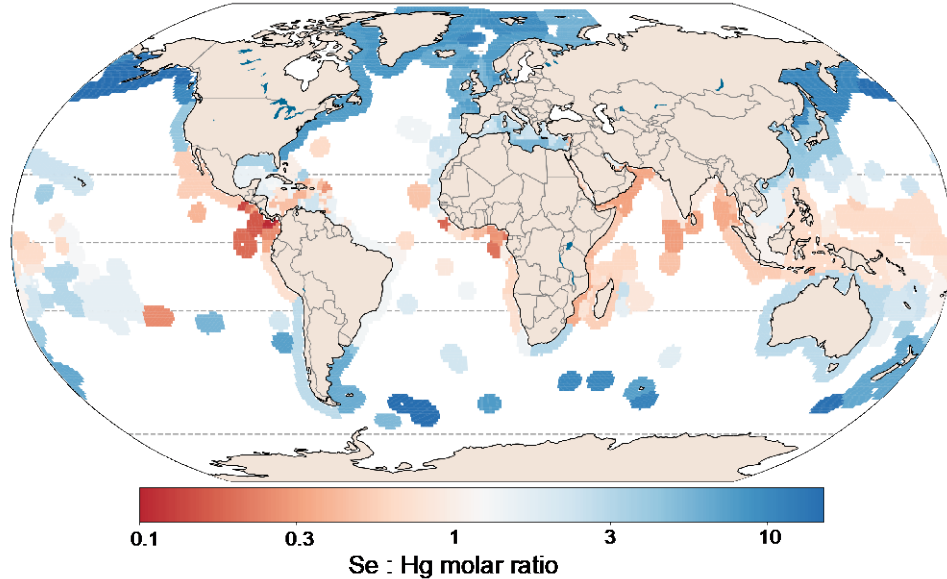
# Advances in fishing techniques allowed greater high-seas harvests and catches of large pelagics

Purse Seine

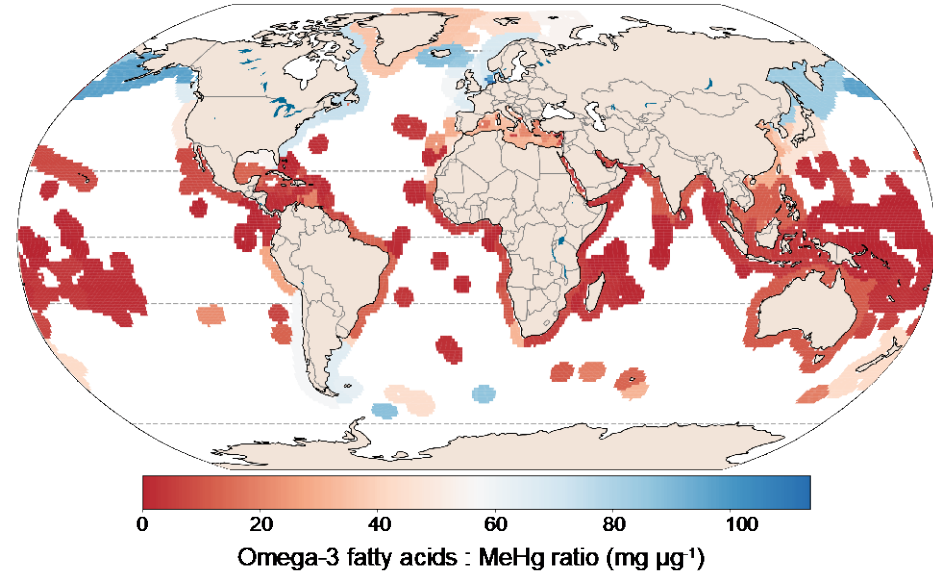


# MeHg vs. nutrients (selenium and fatty acids in marine catches)




Se:Hg molar ratio



Fatty acids:MeHg ratio ( $\text{mg } \mu\text{g}^{-1}$ )



# Key Messages and Future Outlook

1. Hg isotopes, toxicokinetic model, and fisheries data are useful for assessing human MeHg exposure.  Method integration can enhance understanding of MeHg exposure.
2. Absorption/elimination efficiencies for MeHg in seafood may be highly variable among humans.  Diversity in human populations (diet; habit; microbiome).
3. Global Fishing Patterns Amplify Human Exposures to Methylmercury  Alter fishing practices to maximize the benefits of seafood consumption.



# Acknowledgments

## Key research collaborators

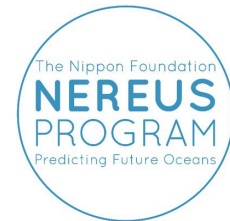
- Elsie Sunderland, Colin Thackray, Prentiss Balcom (Harvard)
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Biogeochemistry of  
Global Contaminants  
HARVARD

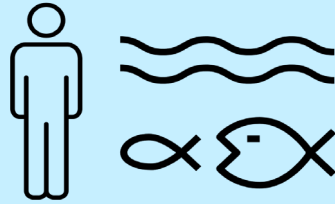


# NextGen Plenary Themes

Understand  
environmental fate  
and transport



Assess human and  
wildlife impact



Develop actionable  
solutions



## Key takeaway

Tackling Hg problems requires collaborative efforts from a range of environmental and social science disciplines



# Thank you!

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