GLOBAL BIOTA MERCURY CONSIDERATIONS

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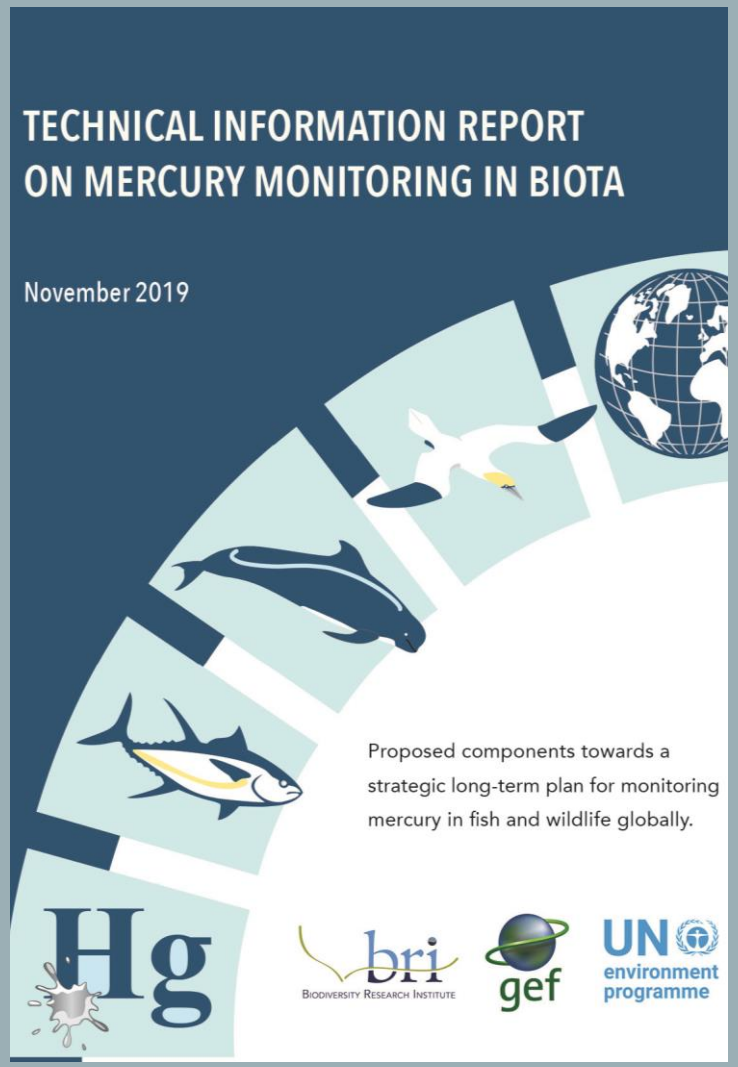
GLOBAL BIOTIC MERCURY SYNTHESIS DATABASE



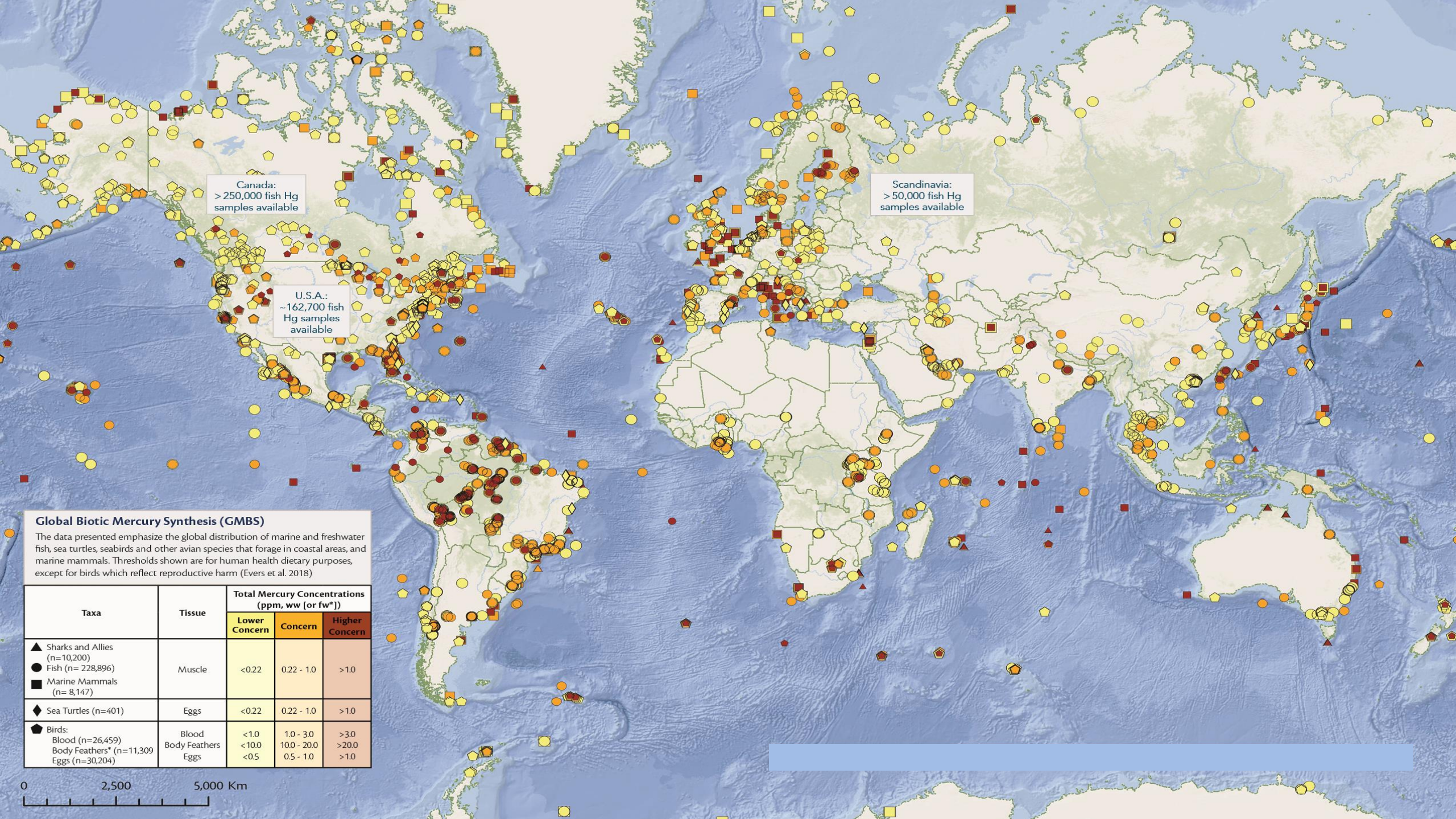
www.unep.org/resources/report/technical-information-mercury-monitoring-biota

GBMS Database (Taxa from Article 19 of the MC)

Peer-reviewed publications: 1,342 (few national data)

Locations: 3,428 with >760,000 Hg data points

	Fish	Sea Turtles	Birds	Marine Mammals	Subtotal
Ocean Basins					
Antarctic	1,228		5,274	2,894	9,396
Arctic	1,811		5,233	7,189	14,233
Gulf of Mexico-Caribbean	8,162	415	222	529	9,328
Indian	5,511	196	2,305	180	8,192
Mediterranean	11,502	476	1,063	1,420	14,461
North Atlantic	25,559	1,122	24,582	5,484	56,747
North Pacific	19,649	611	44,037	4,817	69,114
South Atlantic	11,422	397	1,748	1,011	14,578
South Pacific	5,869	6	2,667	171	8,713
Subtotal	90,713	3,223	87,131	23,695	204,762
Continents					
Africa	5,238	277	1,459	388	7,362
Antarctica			5,062	2,724	7,786
Asia	8,011	326	4,525	2,001	14,863
Australia	95		1,526	117	1,738
Europe	7,945	747	20,887	4,053	33,632
North America	179,205	1,322	89,850	14,466	284,843
South America	32,634	551	2,457	968	36,610
Subtotal	233,128	3,223	125,766	24,717	386,834
Total	461,018	6,169	250,073	49,046	766,306



Global Biotic Mercury Synthesis (GMBS)

The data presented emphasize the global distribution of marine and freshwater fish, sea turtles, seabirds and other avian species that forage in coastal areas, and marine mammals. Thresholds shown are for human health dietary purposes, except for birds which reflect reproductive harm (Evers et al. 2018)

Taxa	Tissue	Total Mercury Concentrations (ppm, ww [or fw*])		
		Lower Concern	Concern	Higher Concern
▲ Sharks and Allies (n=10,200) ● Fish (n= 228,896) ■ Marine Mammals (n= 8,147)	Muscle	<0.22	0.22 - 1.0	>1.0
◆ Sea Turtles (n=401)	Eggs	<0.22	0.22 - 1.0	>1.0
⬟ Birds: Blood (n=26,459) Body Feathers* (n=11,309 Eggs (n=30,204)	Blood Body Feathers Eggs	<1.0 <10.0 <0.5	1.0 - 3.0 10.0 - 20.0 0.5 - 1.0	>3.0 >20.0 >1.0

0 2,500 5,000 Km

Table 3. Examples of trophic level 4 or higher biota that could serve as bioindicators within major biomes and associated nearshore areas (based on Evers et al. 2016, 2018).*

Terrestrial Biomes and Associated Marine Areas	Ecological Health Bioindicators			Human and Ecological Health Bioindicators		
	Freshwater Birds	Marine Birds	Marine Mammals	Freshwater Fish	Marine Fish	Marine Mammals
Arctic Tundra and Arctic Ocean	Loons	Fulmars, Murres	Polar Bears, Seals	Arctic Char	Cod, Halibut	Beluga, Narwhal
Boreal Forest-Taiga and N. Pacific and N. Atlantic Oceans	Eagles, Loons, Osprey, Songbirds	Osprey	Mink, Otter, Seals	Pike, Walleye	Bluefish, Tuna	Pilot Whale
Temperate Mixed Forest and Pacific and Atlantic Oceans	Egrets, Grebes, Herons, Loons, Osprey, Terns, Songbirds	Cormorants, Osprey, Terns	Otter, Seals	Bass, Walleye	Barracuda, Mackerel, Sharks,Tuna	Pilot Whale
Tropical Rainforest and S. Pacific, S. Atlantic, and Indian Oceans	Egrets, Herons, Kingfishers, Songbirds	Albatrosses, Frigatebirds, Shearwaters, Terns, Tropicbirds	Otter, Seals	Catfish	Barracuda, Billfish, Grouper, Mahi mahi, Sharks, Tuna	Pilot Whale

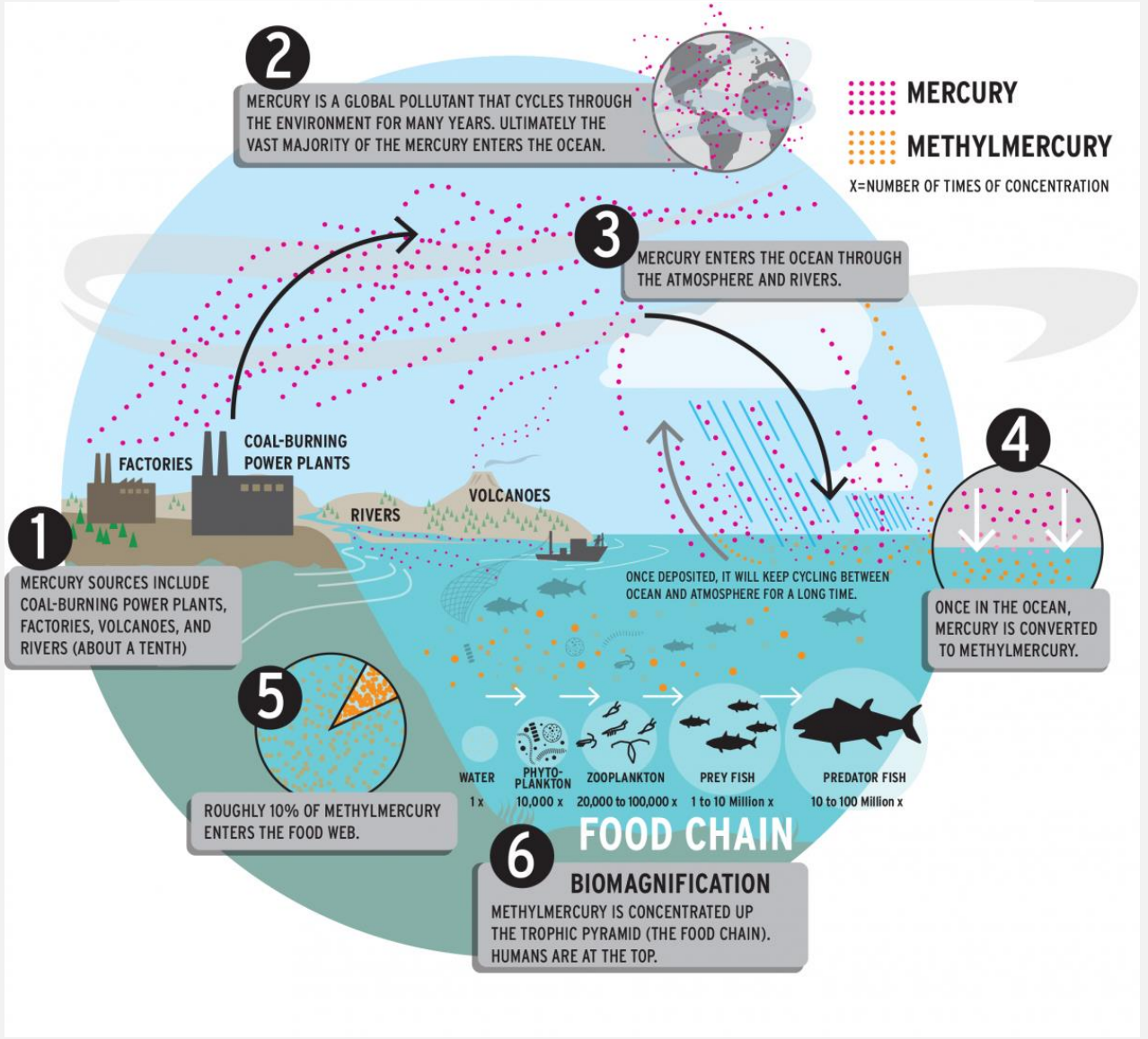
*Trophic level for some taxa may be specific to types of food webs, habitats and locations.

HOW CAN BIOTA MERCURY CONCENTRATIONS BE USED FOR MODELING MINAMATA CONVENTION NEEDS

1. **Model linkages from air to biota Hg** – still very challenging, partly because of the biogeochemical and foodweb factors that vary across the landscape and waterscape

2. **Model ecosystems sensitivity to Hg input** – also quite challenging, especially at large scales, but may be feasible for helping to prioritize locations for Hg monitoring

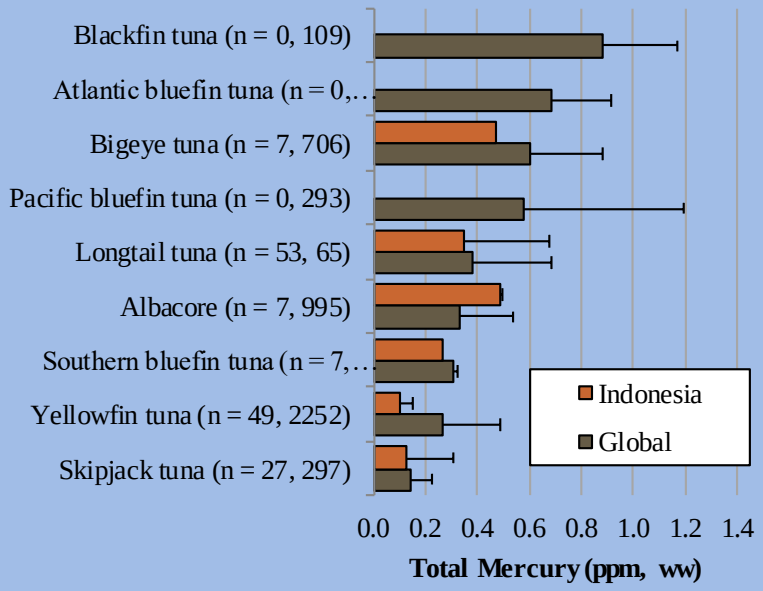
3. **Model Hg in dietary items to humans** – this linkage has been demonstrated and new advisory levels better link MeHg toxicity to adverse impacts to human health. Advisory levels are now linked with consumption levels.



Source: Harvard Magazine

ECOSYSTEM SENSITIVITY GLOBAL MODEL

Indonesia



MODELING FISH-HUMAN MERCURY EXPOSURE

Global Health Trade-off for Mercury and Omega-3 in Seafood

Milligrams of Omega-3 Fatty Acids/4 Ounces of Cooked Fish →

Total Mercury in Muscle Tissue µg/g (ww) ←

Meal Frequency Recommendations (based on 6 oz or 170 g fish portion)	<500 mg	500-1,000 mg	1,000-2,000 mg	> 2,000 mg
3 meals per week (< 0.15 µg/g)	Catfish (temperate waters), Clams, Cockle, Crab* (most species), Croaker, Haddock, Parrotfish, Scallops, Seabream, Shrimp, Tilapia*	Ballyhoo, Blue Mussels,* Fying Fish, Pink Salmon, Sockeye Salmon	Coho Salmon, Oysters	Sardines, Shad
2 meals per week (0.16–0.22 µg/g)	Butterfish, Atlantic and Pacific Cod, Grenadier, Hake, Lionfish, Lobster,* Red Fish, Scad, Snapper, Sole	Atlantic Pollock, Bonito Garfish, Mahi-mahi, Mullet, Octopus, Squid, Skipjack Tuna (light canned tuna), White Marlin	Atlantic Horse Mackerel, Atlantic and Pacific Mackerel, Chinook Salmon,* European Sea Bass, Rays, Skates, Spanish Mackerel, Trout	Anchovies,* Atlantic Salmon, Herring
1 meal per month (0.23–0.46 µg/g)	Bonefish, Catfish (tropical waters) Flounder, Grouper, Orange Roughy, Seabream	Amberjack, Barracuda, Bigeye Tuna, Bluefish, Croaker, Halibut, Jack, Tilefish, Trevally, Yellowfin Tuna (white canned tuna[1]), Wahoo,	Albacore Tuna,* (white canned tuna[1]), Atlantic and Southern Bluefin Tuna, Blackfin Tuna, Chilean Sea Bass, Spanish Mackerel	Mercury concentrations vary widely across shark species. To learn more, visit: www.briloon.org/hgcenter
No consumption (> 0.46 µg/g)	King Mackerel	Blue Marlin, Sailfish	Dogfish, Ground, and Mackerel Sharks; Pacific Bluefin Tuna, Swordfish*	

Healthier Choices

Riskier Choices

*Pictured

Mercury Data Source: BRI's Global Biotic Mercury Synthesis Database; Frequency Recommendations Sources: U.S. Environmental Protection Agency (EPA); U.S. Food and Drug Administration (www.epa.gov/fish-tech/epa-fda-fish-advice-technical-information)

[1] White canned tuna can be albacore or yellowfin.