Tracing Methylmercury in the Marine Ecosystem of the Faroe Islands

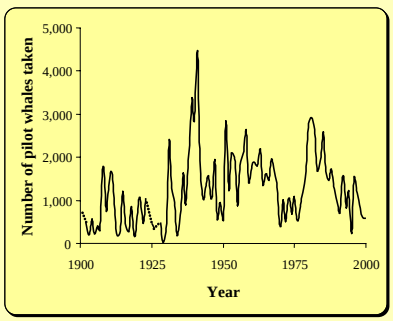
Shawn Booth[a], Dirk Zeller[a] and Jákup Reinert[b]

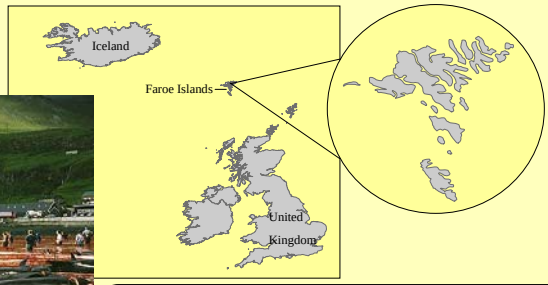
[a] Sea Around Us Project, Fisheries Centre, University of British Columbia, Vancouver, BC, Canada

[b] The Faroese Fisheries Laboratory, Tórshavn, Faroe Islands

Monomethylmercury (MeHg) is a public health concern: toxicity, bioaccumulation and biomagnification at all trophic levels of an ecosystem.[1]

Pilot whales (*Globicephala melas*) and Atlantic cod (*Gadus morhua*):
- Important component of the Faroe traditional diet;[2,3]
- Both are contaminated with MeHg.





Source of MeHg:[4]
- Mostly industrial contamination, some natural sources of mercury;
- Long-range atmospheric transport of mercury;
- Deposition to water column;
- Transformation of mercury to MeHg in water column.

Children of the Faroe Islands were found to have impaired cognitive abilities as a result of being exposed to MeHg prenatally.[5]

Project Aims:
- Trace MeHg in the marine ecosystem using Ecotracer;[6]
- Modify and improve an existing ecosystem model.[7]

Pilot whale (*Globicephala melas*): www.songsofhome.com

Baseline Simulations (t=0 to t=100)**:**
- Group/species MeHg loads were traced to establish stabilized baseline concentrations;
- Baseline (t=100) concentrations were compared to literature values sampled in the 1990s.

Input parameters used in the Faroe Islands methylmercury Ecotracer model.

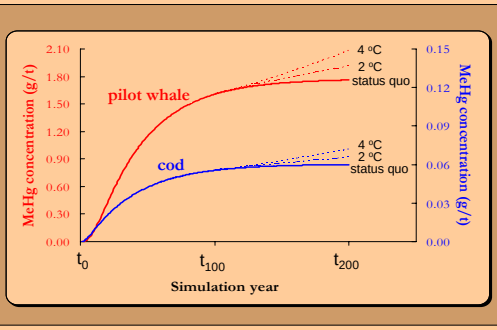
Parameter	Value
Base inflow rate	0.120 g·km^{-2}·year^{-1}
Initial environmental concentration	0.004 g·km^{-2}
Group/species initial concentrations	0.000 (i.e., bottom-up model)
Demethylation rates (year^{-1})	
Pilot whales	0.10
Seals	0.25
Other toothed cetaceans	0.20
Baleen whales	0.20
Direct uptake rates (year^{-1})	
Phytoplankton	0.0030
Large zooplankton	0.0030
Small zooplankton	0.0030
Benthos	0.0093

Concentrations of MeHg (g·t^{-1}) after 100 year baseline simulation vs. literature values.

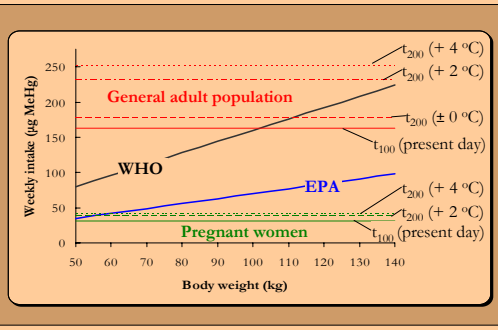
Group/Species Name	Literature Mean	Model Prediction	% Difference (model vs. lit.)	Group/Species Name	Literature Mean	Model Prediction	% Difference (model vs. lit)
Other toothed cetaceans	0.853	2.2721	+ 166.4	Herring	0.058	0.0273	- 52.9
Pilot whale	1.607	1.6053	- 0.1	Blue whiting	-	0.0287	-
Seals	-	1.6431	- 4.6	Mackerel	0.024	0.0286	+ 19.2
Baleen whales	0.114	0.1167	+ 2.4	Other pelagics	0.015	0.0111	- 26.0
Seabirds	1.227	2.0892	+ 70.3	Benthos	0.070	0.0162	- 76.9
Cod	0.056	0.0555	- 0.8	Squids	0.016	0.0193	+ 20.6
Haddock	0.052	0.0530	+ 1.9	Large zooplankton	0.005	0.0026	- 48.0
Saithe	0.065	0.0790	+ 21.5	Small zooplankton	-	0.0010	-
Redfish	0.039	0.0640	+ 64.1	Phytoplankton	-	0.0002	-
Greenland halibut	0.033	0.0441	+ 33.6	Detritus	-	0.0005	-
Other demersal	0.095	0.1038	+ 9.3	Environment	3.612	3.6165	+ 0.1
Other deepwater	0.139	0.2242	+ 61.3				

MeHg food web accumulation and human consumption rates were assessed under present day and future climate change scenarios.

MeHg concentrations in groups/species were modeled with present fishing mortalities and with the effects of climate change on methylation rates.



Weekly MeHg intake derived from pilot whale and cod was compared to the Tolerable Weekly Intake (TWI) levels set by the World Health Organisation (WHO) and the U.S. Environmental Protection Agency (EPA).



Projected sea surface temperature increases result in increased mercury loads in both species

General adult population:
- Weekly MeHg intake exceeds the TWI level for people less than 105 kg;
- Weekly MeHg intake will exceed the TWI under climate change projections.

Pregnant women:
- Lowered their intake of pilot whale due to identified risk and are now below EPA limits.

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Acknowledgements

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