

**Mercury, food webs and marine mammals:
Implications of diet and climate change for human health**

Supplemental Data

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Modifications to the underlying Ecopath with Ecosim model

We modified the ecosystem model of Zeller and Reinert (2004) by splitting the original group ‘toothed mammals’ into ‘pilot whale’, ‘seals’, and ‘other toothed cetaceans’ (see Supplemental Data Table 1 for model input data). This allowed us to trace methylmercury accumulation specifically in pilot whales (*Globicephala melas*, the main target of the marine mammal hunt in the Faroe Islands). We made other minor changes to the diet compositions of some species (Supplemental Data Table 2), e.g., updated Greenland halibut (*Reinhardtius hippoglossoides*) diet composition with information from Hovde et al. (2002), and supplemented haddock diet composition with data from Albert (1994) and Alderstein et al. (2002). We made minor changes to the Q/B and P/B parameters to better reflect methylmercury bioaccumulation (Supplemental Data Table 1).

We took the regional population estimate for pilot whales of ~ 49,000 individuals from Buckland et al. (1993) and converted it into biomass using Kaschner et al. (2001). We obtained the production to biomass ratio (P/B) from Trites and Heise (1996), and based the diet composition on Zeller and Reinert (2004), Pauly et al. (1998) and information provided by the North Atlantic Marine Mammal Commission (www.nammco.no). We included a biomass immigration of $0.0048 \text{ t} \cdot \text{km}^{-2} \cdot \text{year}^{-1}$ for pilot whales.

The seal group includes the grey seal (*Halichoerus grypus*) and the harbor seal (*Phoca vitulina*). We took biomass estimates for the sub-arctic area and consumption to biomass ratio (Q/B) from the marine mammal database of the *Sea Around Us* project (Kaschner et al. 2001), production to biomass ratio (P/B) from Trites and Heise (1996), and diet composition from Pauly et al. (1998).

Seabird breeding pair data specific for the Faroe Islands was from International Council for the Exploration of the Sea (ICES 2002), and was transformed into weight using Croxall et al. (1984). We took the P/B estimate from Bundy et al. (2000).

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Supplemental Data, Table 1: Mass-balanced input data for the Ecopath model (values in brackets were estimated by Ecopath, see Christensen and Walters 2004).
Data modified from Zeller and Reinert (2004).

Group	TL	Biomass (t·km ⁻²)	P/B (year ⁻¹)	Q/B (year ⁻¹)	EE	P/Q	Catch (t·km ⁻² ·year ⁻¹)	Biomass immigration (t·km ⁻² ·year ⁻¹)
Other toothed cetaceans	(4.59)	0.0250	0.020	11.972	(0.599)	(0.002)	-	-
Pilot whale	(4.63)	0.0514	0.020	9.520	(0.875)	(0.002)	0.0054	0.0048
Seals	(4.40)	0.0070	0.060	14.562	(0.713)	(0.004)	-	-
Baleen whales	(3.65)	0.0590	0.020	5.059	(0.254)	(0.004)	-	-
Seabirds	(3.77)	0.0110	0.250	35.000	(0.420)	(0.007)	-	-
Cod	(3.93)	0.5700	0.653	2.580	(0.813)	(0.253)	0.1993	-
Haddock	(3.72)	0.7230	0.650	2.600	(0.565)	(0.250)	0.0944	-
Saithe	(3.97)	0.6110	0.443	3.000	(0.665)	(0.148)	0.1174	-
Redfish	(3.54)	(1.0637)	0.350	4.500	0.950	(0.078)	0.0389	-
Greenland halibut	(4.26)	(0.1065)	0.446	1.500	0.950	(0.297)	0.0255	-
Other demersal fish	(3.98)	(1.2481)	0.450	3.000	0.950	(0.150)	0.0335	-
Other deepwater fish	(4.08)	(0.8792)	0.350	3.100	0.950	(0.113)	0.1048	-
Herring	(3.29)	(2.3650)	0.296	4.600	0.949	(0.064)	0.0961	-
Blue whiting	(3.35)	(3.4229)	0.355	6.000	0.950	(0.059)	0.5698	-
Mackerel	(3.48)	(0.5386)	0.460	4.400	0.950	(0.105)	0.0588	-
Other pelagic fish	(3.10)	(7.6654)	0.585	4.500	0.947	(0.130)	0.0209	-
Benthos	(2.63)	(1.9466)	3.000	10.000	0.950	(0.300)	0.0200	-
Squids	(3.52)	(6.0255)	0.600	3.500	0.950	(0.171)	-	-
Large zooplankton	(2.48)	16.1930	10.000	30.000	(0.509)	(0.333)	-	-
Small zooplankton	(2.05)	11.6980	40.000	140.000	(0.663)	(0.286)	-	-
Phytoplankton	(1.00)	54.3600	50.000	-	(0.637)	-	-	-
Detritus	(1.00)	-	-	-	(0.065)	-	-	-

Supplemental Data, Table 2: Diet matrix for the Faroe Islands model showing fraction of prey (row) forming portion of diet of predator (column). Data modified from Zeller and Reinert (2004).

Group No.	Prey	Predator											
		1	2	3	4	5	6	7	8	9	10	11	12
1	Other toothed cetaceans	0.001	-	-	-	-	-	-	-	-	-	-	-
2	Pilot whale	0.001	-	-	-	-	-	-	-	-	-	-	-
3	Seals	0.001	-	-	-	-	-	-	-	-	-	-	-
4	Baleen whales	0.001	-	-	-	-	-	-	-	-	-	-	-
5	Seabirds	-	-	-	-	0.003	-	-	-	-	-	-	-
6	Cod	0.080	0.070	0.060	-	-	0.005	-	-	-	0.080	0.005	-
7	Haddock	0.130	0.110	0.120	-	-	0.005	-	0.010	-	0.050	0.005	0.005
8	Saithe	0.005	0.003	0.010	-	-	0.003	-	-	-	-	0.005	0.013
9	Redfish	0.020	-	0.010	-	-	0.050	0.005	0.001	-	0.040	0.020	0.052
10	Greenland halibut	0.020	-	-	-	-	-	-	-	-	-	-	0.005
11	Other demersal fish	0.100	0.050	0.180	-	-	0.020	0.050	0.005	0.005	0.090	0.027	0.057
12	Other deepwater fish	0.050	0.070	0.020	-	-	-	-	-	-	-	-	0.050
13	Herring	0.026	0.005	0.095	0.020	0.005	0.047	0.035	0.001	-	0.150	-	0.005
14	Blue whiting	0.031	0.005	0.020	0.040	0.010	0.060	0.005	0.094	-	0.080	0.030	0.050
15	Mackerel	0.035	0.005	0.010	0.020	0.010	-	-	0.050	-	-	0.010	-
16	Other pelagic fish	0.035	0.005	0.295	0.020	0.400	0.260	0.090	0.090	0.050	0.060	0.037	0.272
17	Benthos	0.062	-	0.130	-	0.397	0.213	0.480	0.180	0.163	0.040	0.221	0.181
18	Squids	0.402	0.677	0.050	0.100	0.040	0.085	0.030	0.240	0.040	0.250	0.480	0.095
19	Large zooplankton	-	-	-	0.746	0.075	0.202	0.235	0.328	0.642	0.110	0.040	0.215
20	Small zooplankton	-	-	-	0.054	-	0.050	0.070	-	0.100	-	-	-
21	Phytoplankton	-	-	-	-	-	-	-	-	-	-	-	-
22	Detritus	-	-	-	-	0.060	-	-	0.001	-	0.050	0.120	-
	SUM	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Supplemental Data, Table 2: (cont'd).

Group No.	Prey	Predator							
		13	14	15	16	17	18	19	20
1	Other toothed cetaceans	-	-	-	-	-	-	-	-
2	Pilot whale	-	-	-	-	-	-	-	-
3	Seals	-	-	-	-	-	-	-	-
4	Baleen whales	-	-	-	-	-	-	-	-
5	Seabirds	-	-	-	-	-	-	-	-
6	Cod	-	-	-	-	-	-	-	-
7	Haddock	-	-	-	-	-	-	-	-
8	Saithe	-	-	-	-	-	-	-	-
9	Redfish	-	-	-	-	-	-	-	-
10	Greenland halibut	-	-	-	-	-	-	-	-
11	Other demersal fish	-	-	-	-	-	-	-	-
12	Other deepwater fish	-	-	-	-	-	-	-	-
13	Herring	-	-	0.021	-	-	0.015	-	-
14	Blue whiting	-	-	0.010	-	-	-	-	-
15	Mackerel	-	-	0.010	-	-	-	-	-
16	Other pelagic fish	-	-	0.020	-	-	0.101	-	-
17	Benthos	-	-	-	-	0.050	0.034	-	-
18	Squids	-	-	0.010	-	-	-	-	-
19	Large zooplankton	0.800	0.700	0.780	0.600	0.300	0.750	0.020	-
20	Small zooplankton	0.100	0.300	0.149	0.200	0.100	0.100	0.430	0.050
21	Phytoplankton	0.100	-	-	0.200	0.400	-	0.500	0.900
22	Detritus	-	-	-	-	0.150	-	0.050	0.050
	SUM	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000